

Stormwater Recharged: Innovating with Electrical Flocculation

by

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ABSTRACT

The construction, operation, and maintenance of public infrastructure systems generate a variety of pollutants such as sediment, heavy metals, and nutrients, which are contaminants the U.S. Environmental Protection Agency (EPA) identifies as the most widespread in affecting the beneficial uses of the Nation's rivers and streams. These contaminants degrade aquatic habitat, impair water quality, and reduce channel capacity, often requiring costly dredging or remediation. Growing urban development and increasingly severe storm events place additional strain on traditional drainage infrastructure, which must contend with both high flow volumes and elevated pollutant concentrations. In response, construction sites located near Waters of the United States, impaired waterbodies, or areas served by municipal separate storm sewer systems are required to implement stormwater pollution prevention plans, incorporating best-management practices to minimize downstream impacts.

Although conventional erosion and sediment control measures, such as sediment basins, check dams, and silt fences effectively capture coarse, gravitationally settleable solids, they are not necessarily designed to reduce turbidity from colloidal particles. Currently, chemical flocculants remain the primary enhancement method for turbidity control in the field of stormwater. However, these chemical flocculants typically require manual dosing, generate large sludge volumes, and require tailored products for specific soils. These challenges highlight the need for additional solutions to address high turbidity environments to improve downstream water quality.

To address these limitations, this dissertation details the design, fabrication, and evaluation of a portable electrical flocculant generator, which employs in situ electrocoagulation to aggregate fine particulates without added chemicals. While electrocoagulation is well established in

municipal and industrial water treatment, its application to construction and post-construction stormwater has been limited. By branding the technology as “electrical flocculation,” this work introduces a familiar concept to stormwater practitioners and provides a foundation for broader field adoption.

Research began with a comprehensive literature review to distinguish between chemical coagulation and electrical flocculation, identify common stormwater contaminants, and the parameters affecting electrical flocculation performance. Leveraging these insights, three prototypes (A, B, and C) were developed and tested in an intermediate-scale system across five evaluation categories, including fundamental performance evaluations, aluminum-coagulant release, mixing, electrode longevity, and pollutant loading. Fundamental performance evaluations that compared series versus parallel electrode wiring (prototypes A and B), showed no significant difference in turbidity removal performance. Subsequently, aluminum release trials demonstrated that under conditions of 54.1 L/min (14.3 GPM), 750 Nephelometric Turbidity unit (NTU) influent, and 37 A/m² (3.4 A/ft²), prototype C released 0.19 mg/L Al³⁺, which is below the EPA’s secondary drinking-water standard of 0.20 mg/L. This indicated preliminary compliance; however, toxicity analysis must be completed to confirm this finding in future testing. Mixing experiments demonstrated that two minutes of mechanical stirring at 360 rotations per minute (RPM) optimizes settlement, and specific passive mixers can offer equal performance. Electrode-longevity trials revealed a 33% performance decline over 100 hours without polarity reversal and showed that a 5-hour reversal interval did not improve current density or performance within a 30-hour test. Pollutant-loading evaluations conducted under testing parameters of 37.9 L/min (10.0 GPM) and 38 A/m² (3.5 A/ft²) achieved removals of 60% of cadmium, below detection limits for copper, 73% for iron, 82% for lead, 68% for phosphorus, and 33% for zinc. Field-scale tests with

prototypes C and D confirmed that performance is strongly influenced by both influent temperature and anodic surface area.

These results establish a baseline performance for the retrofit electrical flocculant generator, demonstrating its lab- and field-scale efficacy in removing turbidity and non-sediment pollutants and quantifying its kinetics, energy use, and optimal current densities. This research provides a new approach to improving stormwater treatment by introducing a chemical-free, portable device that uses electrical flocculation to remove suspended solids and pollutants. By effectively reducing turbidity, heavy metals, and nutrients, the technology can help prevent the degradation of downstream waterbodies and support cleaner, healthier aquatic ecosystems. Its ability to operate without added chemicals also reduces the risk of harmful byproducts and makes it easier to implement at construction sites and other areas with stormwater challenges. Overall, this research offers a practical alternative solution to enhance water quality and advance sustainable stormwater management practices.

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LIST OF ABBREVIATIONS

A	Amperage
AC	Alternating Current
Al	Aluminum
Al(OH) ₃	Aluminum hydroxide
Al ³⁺	Aluminum ions
ALDOT	Alabama Department of Transportation
AL-WRC	Alabama Water Resources Conference
AMD	Acid Mine Drainage
APC	Alternating Pulse Current
As	Arsenic
AU-SRF	Auburn University Stormwater Research Facility
BMP	Best Management Practices
BOD	Biological Oxygen Demand
BP-S	Bipolar Series
C ₀	Initial Turbidity
C-1	colder inflow, single cartridge
C-4	colder inflow, four cartridges
CC	Chemical Coagulation
Cd	Cadmium
CD	Control-Downstream
C _e	Equilibrium Turbidity

CGP	Construction General Permit
Cl-	Chloride
C-M	Control - Mixed
C-NM	Control - Not Mixed
COD	Chemical Oxygen Demand
C _t	Instantaneous Turbidity
Cu	Copper
CU	Control-Upstream
CWA	Clean Water Act
DC	Direct Current
DO	Dissolved Oxygen
DOT	Department of Transportation
DP	Dissolved Phosphorous
EPA	Environmental Protection Agency
Fe	Iron
Fe ²⁺	Ferrous ions
Fe ³⁺	Ferric ions
GPM	Gallons per minute
H ⁺	Hydrogen ions
H ₂	Hydrogen gas
HRT	Hydraulic Retention Time
IBC	Intermediate Bulk Container
IECA	International Erosion Control Association

k	Rate Constant
LCA	Life Cycle Assessment
MFC	Microbial Fuel Cell
mL/s	Milliliter per Second
Mn	Manganese
MP-P	Monopolar Parallel
MP-S	Monopolar Series
MS4	Municipal Separate Storm Sewer System
N	Nickel
NCHRP	National Cooperative Highway Research Program
NO ₃ ⁻	Nitrate
NOM	Natural Organic Removal
NPDES	National Pollutant Discharge Elimination System
N-PR	No Polarity Reversal
NTU	Nephelometric Turbidity unit
OH ⁻	Hydroxide anions
PAM	Polyacrylamide
Pb	Lead
PETG	Polyethylene Terephthalate Glycol
PFAS	Per- and Polyfluoroalkyl Substances
PLA	Polylactic Acid
PO ₄ ³⁻	Phosphate
PR	Polarity Reversal

PVC	Polyvinyl Chloride
R ²	Coefficient of Determination
RPM	Rotations per Minute
SBIR	Small Business Innovation Research
SCM	Stormwater Control Measures
SEC	Specific Energy Consumption
SEM	Scanning Electron Microscope
SL	Sampling Locations
SWPPP	Stormwater Pollution Prevention Plan
TDS	Total Dissolved Solids
T-M	Treated - Mixed
TN	Total Nitrogen
T-NM	Treated - Not Mixed
TP	Total Phosphorous
TRB	Transportation Research Board
TR _x	Turbidity Reduction at time x
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
V	Voltage
V1	Passive Mixer Version 1
V1-10	series of ten V1 mixers
V2	Passive Mixer Version 2

V2-10	series of ten V2 mixers
V3	Passive Mixer Version 3
V4	Passive Mixer Version 4
W-1	warmer inflow, single cartridge
Zn	Zinc

CHAPTER ONE: INTRODUCTION

1.1 Background

Stormwater management is integral to the design and operation of roadways because it includes methods and practices that mitigate the impacts transportation infrastructure has on water quality and ensure compliance with state and federal regulations. State departments of transportation (DOTs) are obligated through regulatory requirements and community expectations to maintain and preserve local environmental systems while delivering and maintaining safe, reliable, and cost-efficient transportation systems. The construction, operation, and maintenance of roadways generates pollutants such as sediment, heavy metals, and nutrients, which are pollutants the U.S. Environmental Protection Agency (USEPA) identifies as the most widespread in impeding the beneficial uses of the Nation's rivers and streams (United States Environmental Protection Agency 1998, 2016). Rainwater can dislodge, suspend, and transport sediments to nearby receiving waters (Duan et al. 2013, 2015). Elevated levels of suspended sediment can have detrimental effects on the physical, biological, and chemical properties of surface waters. Suspended sediment degrades water quality by blocking sunlight, thus decreasing aquatic plant growth, reducing visibility, and destroying the habitat of benthic species. Furthermore, sedimentation can reduce stormwater conveyance capacities, leading to increased risk of flooding and potentially requiring expensive dredging operations (Kerr 1995).

Sediment is also a transporter of pollutants commonly found in highway runoff, such as heavy metals, nutrients, hydrocarbons, and pathogens. These contaminants adhere to sediment particles and are carried to downstream waters. Many negative environmental impacts stem from the deposition of foreign particulate matter in waterbodies. Vehicle-emitted particles, such as hydrocarbons and heavy metals, can be transported and deposited from these conveyances, which increases the risk of acute and chronic toxicity to aquatic organisms (Ellis et al. 1987; Nixon and

Saphores 2007; Pikula et al. 2021). These roadway contaminants are typically sourced from tire wear, brake pad residues, and gasoline emissions. Nutrients, primarily phosphorus and nitrogen, transported from agricultural and urban sources through highway rainwater runoff and storm sewer systems, can lead to eutrophication and harmful algal blooms in receiving waters. These blooms reduce oxygen concentrations in surface waters, impede sunlight from reaching aquatic biota, and produce harmful toxins (Anderson et al. 2002; United States Environmental Protection Agency 2025a; Water Resources Mission Area 2019).

Contaminants of emerging concern, such as Per- and Polyfluoroalkyl Substances (PFAS) (Gasperi et al. 2022; Kali et al. 2025a; Kim and Kannan 2007; Murakami et al. 2009; Xiao et al. 2012), 6PPD-quinone (Brinkmann et al. 2022; Chen et al. 2023; Greer et al. 2023; Halama et al. 2024; Mitchell and Jayakaran 2024), and microplastics (Kali et al. 2025a; Liu et al. 2019; Men et al. 2024; Shruti et al. 2021), are also found in stormwater originating from trafficked urban surfaces. These contaminants contribute to widespread water pollution and increase the risk of bioaccumulation and ingestion by aquatic life.

Stormwater runoff management in roadway environments is increasingly challenging because of the combined effects of urbanization and the changing climate. Urban development changes natural drainage patterns by overlaying impervious surfaces over permeable landscapes. The expansion of impervious surfaces has decreased the land available for infiltration, resulting in peak flows occurring more frequently with heightened magnitude and reduced duration (United States Environmental Protection Agency 2025b). Simultaneously, climate change is exacerbating these challenges because of increased frequency and intensity of precipitation events. Together, these factors place a strain on existing stormwater infrastructure and increase pollutant transport

into receiving waters (Yang et al. 2024). Therefore, existing stormwater infrastructure should be modified to account for the increased runoff load.

Public drinking water systems often rely on local water bodies to provide potable water to the local population. A large amount of contaminants within drinking water sources emanate from nonpoint source runoff and place additional demands on water treatment facilities. In rural areas, these extra strains on smaller, less efficient treatment facilities can create significant challenges that require additional operating costs, treatment duration, and resources. Further, degraded waterbodies may not be able to maintain their intended uses, such as supporting aquatic life or serving recreational uses. To address these impacts, the USEPA, under the authority of the Clean Water Act (CWA) of 1972, established the National Pollutant Discharge Elimination System (NPDES) to regulate stormwater discharges that could impair water quality. Through the NPDES program, the USEPA requires state DOTs and other regulated entities to manage stormwater runoff during construction activities. Construction activities that disturb one acre or more of land are under the Construction General Permit (CGP), which requires the development and implementation of a Stormwater Pollution Prevention Plan (SWPPP) to minimize pollutant discharges.

Today, 80% of the U.S. population lives in areas regulated by municipal separate storm sewer system (MS4) permits. These areas are required to implement measures to address water quality and quantity impacts. Despite decades of regulatory action, over half of our nation's assessed waterways are listed as impaired or threatened from urban non-point source runoff (United States Environmental Protection Agency 2000). Increased urban runoff pollution and aging systems earned a letter grade of "D" for Stormwater infrastructure on the 2021 American Society of Civil Engineers Infrastructure Report Card (American Society of Civil Engineers 2021).

Stormwater regulators and engineers face increasing challenges in managing volume and water quality from both urban and rural stormwater runoff. As a result, innovative solutions are needed. However, widespread adoption of new technologies is often gradual because they challenge the traditional methods. Bridging the gap between innovation and practical application is critical to advancing the next generation of stormwater treatment solutions and ensuring cleaner downstream waterways that will support future water needs.

1.2 Flocculants in Stormwater Management

The linear nature of roadways results in complex state DOT MS4 systems comprised of roads with drainage infrastructure, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, storm drains, and thousands of outfalls into receiving water bodies. Due to the challenges in managing stormwater from roadway MS4s, DOTs primarily rely on passive stormwater best management practices (BMPs) or stormwater control measures (SCMs) to manage stormwater runoff quality and quantity. These practices include erosion or sediment controls such as vegetation establishment, ditch checks, slope interrupters, erosion control blankets, inlet protection, sedimentation basins, and silt fencing. However, current BMPs and SCMs are often not capable of completely removing pollutants from stormwater runoff, especially fine-sized soil particles and dissolved pollutants (Bugg et al. 2017; Perez et al. 2015; Schussler et al. 2021). Most of these practices are designed to prevent the detachment of sediment from the ground or impound, settle, and capture the gravitationally settleable solids.

The construction stormwater industry has turned to the use of chemical flocculants to address turbidity in stormwater runoff. Chemical flocculants, such as the flocculant blocks shown in Figure 2.1(a), typically polyacrylamide (PAM), polish runoff by agglomerating soil particles and increasing the settling velocity of particles (Pillai 2013). While highly effective, these

chemical flocculants are costly and difficult to properly dose. They often require match tests to be performed to select appropriate flocculant chemicals and target dosage rates for the specific soils found on site. Further, these chemicals are often passively dosed with little to no monitoring of performance; therefore, successful utilization of chemical flocculants is not typical and performance is inconsistent (Kazaz et al. 2021). Certain chemical flocculants have also been attributed to adverse environmental impacts on gill-breathing aquatic organisms. Numerous state DOTs and state environmental agencies are reluctant to allow the use of all chemical-based flocculants due to regulatory restrictions, such as effluent monitoring requirements, and a lack of dosage guidance. Additionally, DOTs stated insufficient research results limiting them from using chemical flocculants (Kazaz et al. 2021).

Active treatment systems, shown in Figure 2.1(b), can be used to treat stormwater by using a combination of systems that may involve chemicals, sand filters, and reverse osmosis. However, their use is challenging and requires complicated infrastructure (e.g., pumps, piping, chemicals, frac tanks, sand filters, etc.) and expertise. Thus, their widespread use is cost-prohibitive. A need exists to develop enhanced stormwater management practices that are easy to employ and maintain while minimizing fine suspended solids in runoff from traveling downstream.

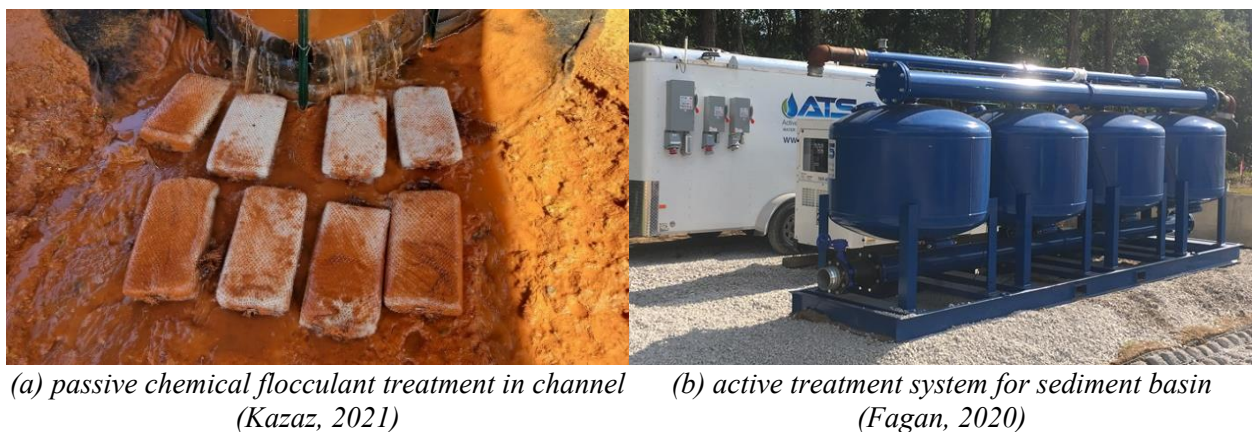


Figure 2.1 Advanced Construction Stormwater Treatment Methods.

For this project, the overall objective was to design, fabricate, and evaluate a portable, self-contained stormwater treatment device that improves water quality. To effectively reduce turbidity in effluent from various BMPs, we recognized the need for an innovative solution. Turbidity is primarily caused by colloidal particles, which remain suspended in the water column due to their small size, low density, and surface charges. These charges cause the particles to repel each other, preventing them from aggregating and settling out by gravity over time.

One treatment mechanism that has been proven to treat turbidity in drinking water, wastewater, and industrial water sectors is electrocoagulation, which is a process that uses electrical current to remove contaminants from water by applying current to sacrificial metal electrodes (Liu and Perez 2022). During electrocoagulation, aluminum (Al) or Iron (Fe) anodes release Al^{3+} , Fe^{2+} , or Fe^{3+} in situ to form $\text{Al}(\text{OH})_3$, $\text{Fe}(\text{OH})_2$, or $\text{Fe}(\text{OH})_3$, which helps capture suspended solids in water. Meanwhile, the applied current creates a potential difference between electrodes, causing ions in the fluid to migrate towards the electrodes. As the ions move, they collide with other particles and form larger aggregates that eventually settle out of the fluid or float to the surface where they can be removed. Electrocoagulation is highly effective in removing various contaminants, including suspended solids, organic compounds, heavy metals, and oils. Based on these findings, electrocoagulation was selected as the treatment technology for the development of the portable stormwater treatment device.

Throughout this dissertation, the term electrical flocculation will be used to refer to electrocoagulation. This terminology is chosen to align with the stormwater community's familiarity with chemical flocculation, leveraging that understanding to introduce the concept of electrical flocculation. This dissertation will outline the methods used to design, fabricate, refine, and evaluate the stormwater treatment prototypes named the floc generator.

1.3 Research Objectives

This dissertation is divided into six specific objectives related to the development of the self-contained, portable stormwater treatment device.

The six objectives of this research are as follows:

- (1) Research the state of the practice of electrical flocculation technology,
 - (2) Design and construct functional prototypes informed by existing literature,
 - (3) Develop a testing methodology and evaluate prototype performance for sediment and non-sediment pollutant removal under controlled laboratory conditions,
 - (4) Develop a testing methodology and evaluate prototype performance under field conditions at varied flows and influent temperatures,
 - (5) Iteratively refine the electrical flocculation prototype using accessible materials to enhance functionality and adaptability across diverse applications,
- and,
- (6) Disseminate knowledge of the developed electrical flocculation technology within the stormwater management community.

Several tasks were identified and completed to achieve the outlined research objectives.

The tasks are as follows:

- (1) Conduct a comprehensive literature review on the principles of electrical flocculation,
- (2) Identify and describe the key differences between electrical flocculation and chemical coagulation,
- (3) Analyze and understand the specific parameters (e.g., current density, electrode material, pH) affecting electrical flocculation efficiency,

- (4) Develop a detailed design for an electrical flocculation prototype,
 - (5) Fabricate the initial functional electrical flocculation prototype,
 - (6) Enhance the design of the prototype based on potential applications and the availability of materials,
 - (7) Conduct lab-scale experiments to determine the prototype's efficiency in sediment removal under varied electrolysis durations, power constraints, and mixing durations,
 - (8) Perform lab-scale evaluations to assess the device's performance in removing non-sediment pollutants,
 - (9) Measure and analyze the electrode degradation rate during the electrical flocculation process,
 - (10) Conduct field-scale evaluations of the prototype's performance with larger flow rate and varied water inflow temperatures,
 - (11) Develop accessible and informative materials (e.g., fact sheets, brochures, and presentations) explaining the principles and benefits of the developed electrical flocculation technology for stormwater treatment,
- and,
- (12) Present the research findings and the prototype's capabilities at relevant stormwater-related conferences, workshops, and seminars.

1.4 Expected Outcomes

This research intends to advance stormwater treatment practices through the development and validation of an innovative, self-contained electrical flocculation technology. Scientific results from controlled laboratory experiments and field-scale evaluations are expected to establish an

adaptable and effective approach for sediment and non-sediment pollutant removal across varied applications. The fabricated prototype will provide the stormwater community with a practical, chemical-alternative turbidity treatment option. Educational materials and outreach efforts developed as part of this research are intended to promote broader understanding and adoption of electrical flocculation within the stormwater management community. The outcomes of this study are expected to equip practitioners with the knowledge and resources necessary to implement this emerging technology while minimizing risks to downstream water quality. Future research efforts will build upon the foundation established, advancing the understanding of electrical flocculation's performance under varied circumstances and its role in sustainable stormwater treatment.

1.5 Organization of Dissertation

This dissertation is divided into seven chapters that organize, illustrate, and describe the steps taken to meet the defined research objectives. Following this chapter, Chapter Two: Literature Review provides an overview of electrical flocculation principles, advantages, limitations, key variables influencing performance, and a comparison to chemical coagulation. Recent advancements and innovations in the field, along with contaminants commonly found in stormwater, are also summarized. Chapter Three: Prototypes Designed and Fabricated details the design, fabrication, and iterative enhancements of four different electrical flocculation prototypes developed. Chapter Four: Lab-Scale Methodology outlines the testing setups, sampling procedures, and evaluation methods used to assess the prototypes' performance in sediment and non-sediment pollutant removal under controlled laboratory conditions. Chapter Five: Field-Scale Methodology describes the adaptation of Prototypes C and D for larger-scale testing, including the design of supporting structures and sampling strategies for real-world applications. Chapter Six: Results and Discussion presents the laboratory and field performance data of each prototype, analyzes parameter

influences such as current, voltage, and electrolysis duration, and evaluates electrode longevity and toxicity concerns. Finally, Chapter Seven: Conclusions and Impact summarizes significant findings, discusses limitations, proposes areas for further research, and highlights the potential impact of electrical flocculation technology on future stormwater management practices.

CHAPTER TWO: LITERATURE REVIEW

2.1 Electrical Flocculation

Electrical flocculation is a water treatment process proven to be effective for treating various components of the urban water cycle, including drinking water, wastewater, and industrial water. This process employs electrical energy to remove contaminants from water by applying current to sacrificial metal electrodes (Liu 2020). Aluminum or iron are the most common metals used for the sacrificial anode material (Lu et al. 2025). In many water processing systems, aluminum is the preferred anode metal because it does not discolor the treated effluent (Ibrahim et al. 2020; Lin et al. 2005). As the most copious metal element within the Earth's crust, aluminum's abundance makes it ideal for electrode applications. In many studies, aluminum is used for the anode and cathode, forming an Al-Al (anode-cathode) system. However, researchers have evaluated the performance of alternative cathode materials, such as iron (Castañeda et al. 2022), stainless steel (Lu et al. 2025; Tanneru et al. 2013), graphite (Chen et al. 2020; Lu et al. 2025), copper (García-Orozco et al. 2022; Lu et al. 2025), and titanium (Lu et al. 2025).

Electrical flocculation involves applying direct current (DC) or alternating current (AC) between a pair of electrodes, anodes and cathodes, immersed in water. Applying an electrical current to the electrodes differentiates this electrolytic cell from a galvanic cell, which is dependent on spontaneous reactions to initiate the flow of electrons. The electrodes are positioned in proximity, without direct contact, forming a gap occupied by water. In an electrolytic cell, simultaneous reactions occur at the positively charged anode and negatively charged cathode. Oxidation occurs at the sacrificial anode, while reduction occurs at the cathode.

Electrical flocculation has a wide range of uses, as it can remove many types of contaminants, such as suspended solids, colloidal substances, nutrients, metals, dissolved solids,

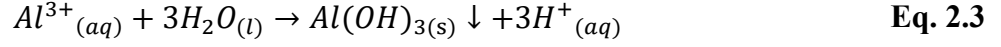
pesticides, and pathogens (Emamjomeh and Sivakumar 2009; Garcia-Segura et al. 2017; Merzouk et al. 2009; Sahu et al. 2014). Electrical flocculation has been widely employed in the treatment of diverse industrial wastewater (Makwana and Ahammed 2016; Mousazadeh et al. 2021; Nawarkar and Salkar 2019; Syam Babu et al. 2020), including textile wastewater (Suhan et al. 2020; Vidal et al. 2016), pharmaceutical wastewater (Ahmad et al. 2022; Alam et al. 2021; Baran et al. 2018; Ensano et al. 2019), pulp and paper industry wastewater (Asaithambi et al. 2016; Sridhar et al. 2011), and dairy wastewater (Akansha et al. 2020). Researchers have found that the electrical flocculation process is efficient in reducing water pollutants such as arsenic (Nidheesh and Singh 2017; Sandoval et al. 2021), fluoride (Castañeda et al. 2021; Sandoval et al. 2021), pesticides (Biswas and Goel 2022), and other emerging contaminants (Bajpai et al. 2022; Nidheesh et al. 2022).

The electrochemical reactions initiated by the applied current result in simultaneous reactions occurring at the anode and cathode. At the anode, oxidation occurs through electro-dissolution of the sacrificial metal, releasing metal cations into the solution, Eq. 2.2. Simultaneously, at the cathode, water molecules undergo reduction, producing hydrogen gas (H_2) and hydroxide anions (OH^-), shown in Figure 2.1(a) and Eq. 2.1. Metal cation and hydroxide anions at the anode and cathode create localized pH variances at the respective electrodes. The resulting metal cations and hydroxide ions interact to form metal hydroxide species. When aluminum is used as the anode material, this process generates coagulant species such as trivalent aluminum ions (Al^{3+}) and aluminum hydroxide ($Al(OH)_3$), Figure 2.1(b), (c), and Eq. 2.3.

Reaction at the cathode:



Reaction at the anode:



The applied current creates a potential difference between the electrodes, causing ions in the fluid to migrate toward the electrodes. As the ions move, they collide with other particles, trapping or destabilizing them by neutralizing charges or enmeshing them within forming flocs (Figure 2.1(b)), which are subsequently removed from the water column by gravitational settlement or electrofloatation (Figure 2.1(c)).

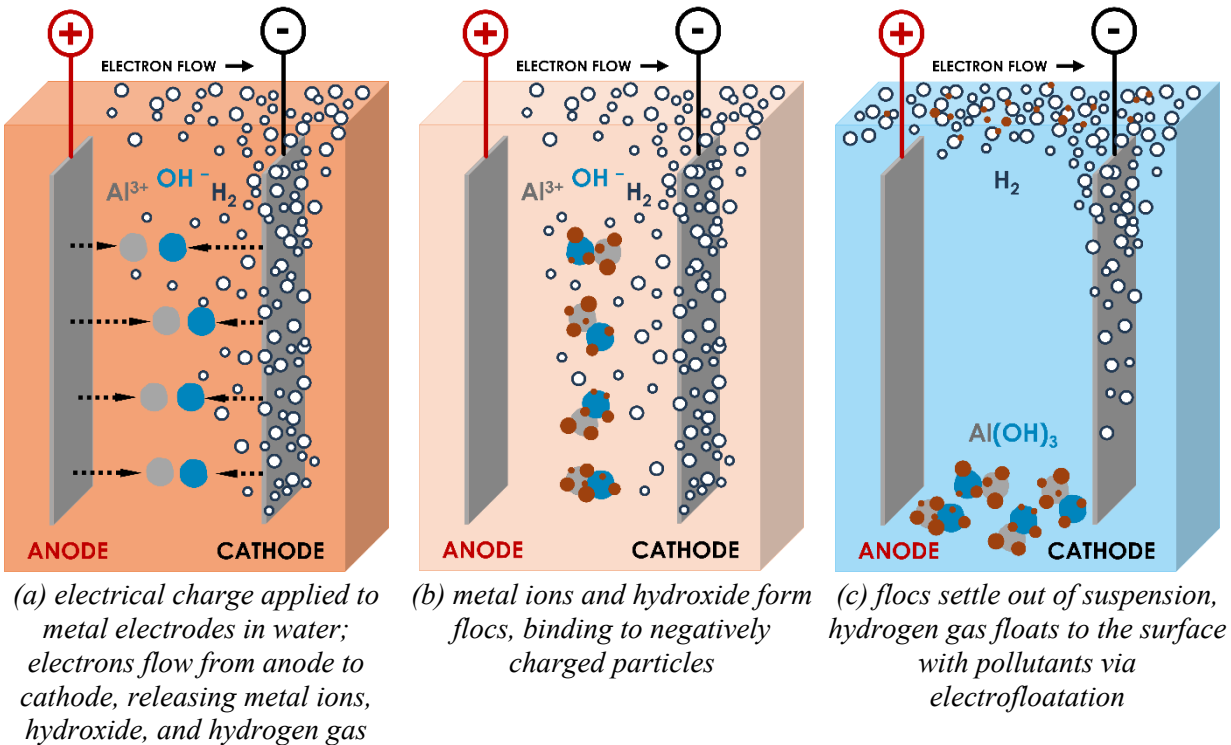


Figure 2.1 Electrical Flocculation Process.

Following the anodic dissolution and cathodic reduction reactions, these electrogenerated coagulant species remove contaminants from the water column through various physical and chemical mechanisms. Pollutant removal via electrical flocculation is typically separated into three overarching categories including: adsorption, coagulation, and floatation. The effectiveness of these mechanisms is significantly influenced by both pH and the coagulant dosage (Duan and Gregory 2003; Mouedhen et al. 2008). Mechanisms that fall into these categories include entrapment, adsorption, electrofloatation, charge neutralization, cathodic electrodeposition, and complexation, as shown in Figure 2.2. Entrapment refers to the physical incorporation of solids and colloids into a growing matrix of metal hydroxide precipitates, such as aluminum hydroxide ($\text{Al}(\text{OH})_3$). As these metal hydroxide compounds agglomerate, they physically enmesh smaller pollutant particles within their porous, gelatinous structure, which grows larger and eventually settles gravitationally.

Adsorption involves the adhesion of dissolved or colloidal contaminants onto the surface of solid precipitates, such as metal hydroxides. This process depends on surface area and surface charge, where pollutants are held in place by van der Waals forces, hydrogen bonding, or electrostatic interactions. Under a suitable initial pH of the bulk solution, these aluminum ions (Al^{3+}) can create a variety of coagulated species and metal hydroxides like aluminum hydroxide ($\text{Al}(\text{OH})_3$). While aluminum hydroxide ($\text{Al}(\text{OH})_3$) is a neutrally charged hydroxide species in its bulk form, its surface typically acquires a charge depending on the surrounding pH. This surface charge allows the metal hydroxide to adsorb dissolved or suspended contaminants effectively. These species precipitate dissolved or suspended contaminants by adsorption and facilitate their precipitation from the bulk solution (Chen 2004; Kobya et al. 2003; Song et al. 2017). Further, during the electrolysis process, microbubbles of hydrogen gas are generated and enhance the floatation properties of transporting small, suspended contaminants. The bubble-floc complexes float to the water surface, forming a froth that can be skimmed off.

Aluminum ions (Al^{3+}), a cationic (i.e., positively charged) monomeric species, are primarily responsible for lessening interparticle repulsive forces or defeating electrostatic attraction barriers. These ions have an affinity for negatively charged pollutants, such as sediment, which effectively neutralizes their charges. This charge neutralization and attraction counteracts the forces keeping the colloids suspended and increases their mass, enabling them to begin gravitationally settling.

A phenomenon within the field of electrical flocculation is the build-up of an impermeable, impeding layer on the surface of the cathode, known as the passivation or fouling layer. This accumulation of unwanted complexes impedes electron transfer and is typically comprised of metal hydroxides and organic matter. The reduction of dissolved metallic ions, such as Al^{3+} , and

other cationic species at the cathode's surface leads to the formation and deposition of insoluble metallic or metal hydroxide films, which is known as cathodic electrodeposition. This mechanism may aid in removing dissolved metals and other ionic species from a solution by converting them into insoluble forms. However, it hinders the efficiency of the electrical flocculation process. Cathodic electrodeposition is an unfavored process due to the reduction in electrolysis efficiency. The passivation or fouling layer and mitigation methods for this unwanted build-up will be discussed later in this chapter.

Additionally, complexation is a chemical process in which metallic ions such as aluminum ions (Al^{3+}) form bonds with ligands, typically organic molecules like humic substances. These metal-ligand complexes can improve the stability of coagulant species, facilitate the precipitation of dissolved contaminants into larger aggregates, and help with the selective removal of specific contaminants. These mechanisms can be found in a schematic form in Figure 2.2.

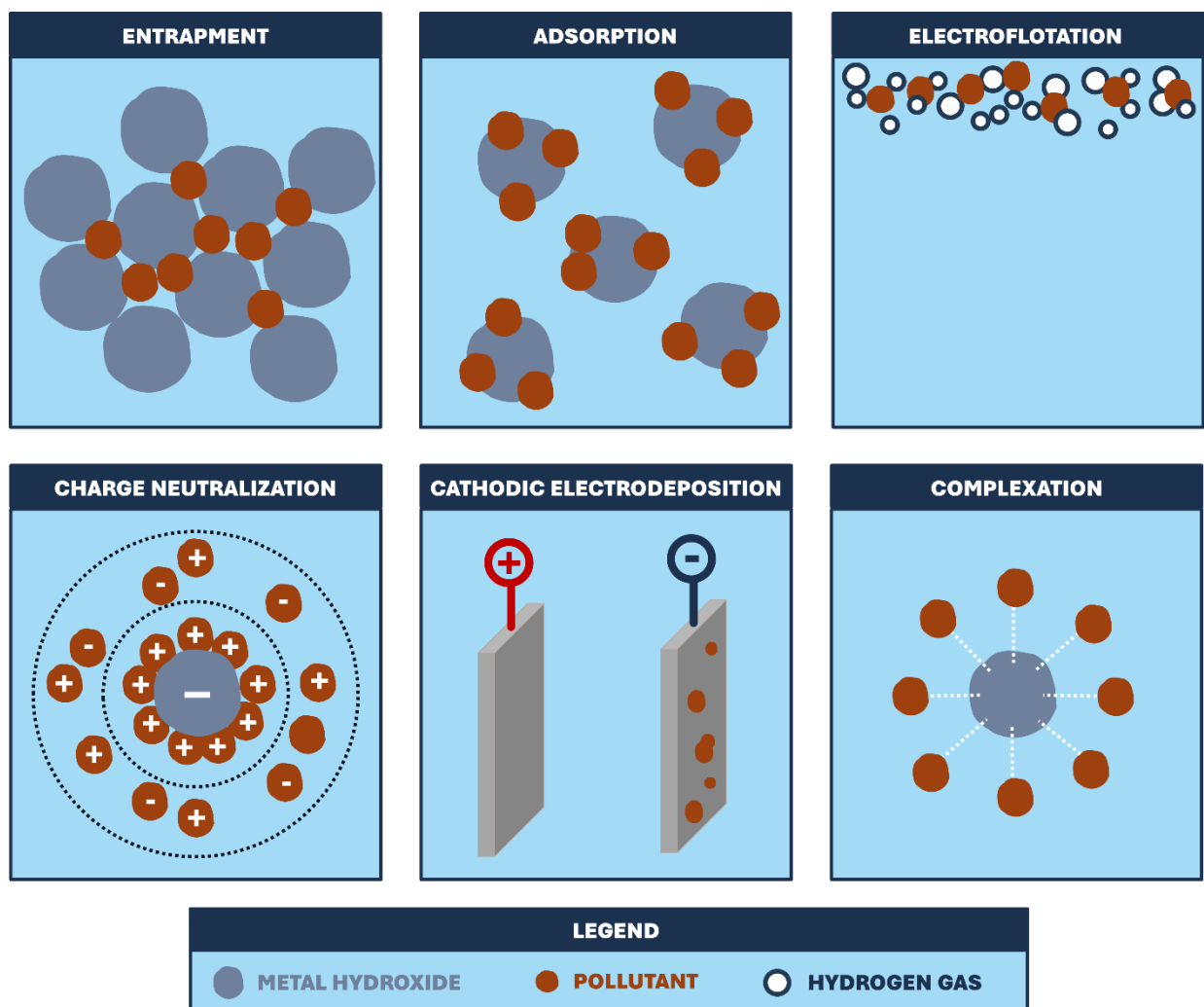


Figure 2.2 Mechanisms of Contaminant Removal via the Electrical Flocculation Process.

Due to the amphoteric nature of aluminum and its hydroxides, the solubility of $\text{Al}(\text{OH})_3$ reaches a minimum near neutral pH, particularly around pH 6. Therefore, a pH of approximately 6 is optimal for electrical flocculation using aluminum anodes (Akansha et al. 2020; Attour et al. 2014). Deviations from this optimal pH in either direction, more acidic or alkaline, lead to increased solubility of aluminum species. Therefore, in acidic or alkaline solutions, aluminum hydroxide ($\text{Al}(\text{OH})_3$) can dissociate into monomeric species or may further polymerize into polyaluminum species like $\text{Al}_n(\text{OH})_{3n}$, as shown in Eq. 2.4. These monomeric and polymeric

species form due to the lack of hydroxides in acidic conditions and abundance of hydroxides in alkaline environments.



Aluminum (Al^{3+}) and hydroxide (OH^-) ions produced from the anodic and cathodic reactions in Eq. 1 and 2 react to form various hydroxo-complexes including monomeric and polymeric species can be found such as $Al(OH)^{2+}$, $Al(OH)_2^+$, $Al(OH)_4^-$, $Al(OH)_5^{2-}$, $Al_2(OH)_2^{4+}$, $Al_6(OH)_{15}^{3+}$, $Al_7(OH)_{17}^{4+}$, $Al_8(OH)_{20}^{4+}$, $Al_{13}O_4(OH)_{24}^{7+}$ and $Al_{13}(OH)_{34}^{5+}$ (Alimohammadi et al. 2017; Drogui et al. 2014a; Elazzouzi et al. 2017; Gurses et al. 2002; Mouedhen et al. 2008; Rebhun and Lurie 1993; Song et al. 2017). Monomeric aluminum hydroxide species can be found in Figure 2.3. Through intricate precipitation kinetics, these species gradually develop into various aluminum hydroxides and oxyhydroxides (i.e., chemical compounds that contain both oxide (O_2^-) and hydroxide (OH^-) ions), such as $Al(OH)_3$ and $AlOOH$, which possess a high surface area that is advantageous for rapid adsorption of soluble organic molecules and capture of colloidal particles. These complexes' high surface area and gelatinous texture are responsible for aggregating or adsorbing dissolved pollutants (Koby et al. 2003; Rebhun and Lurie 1993).

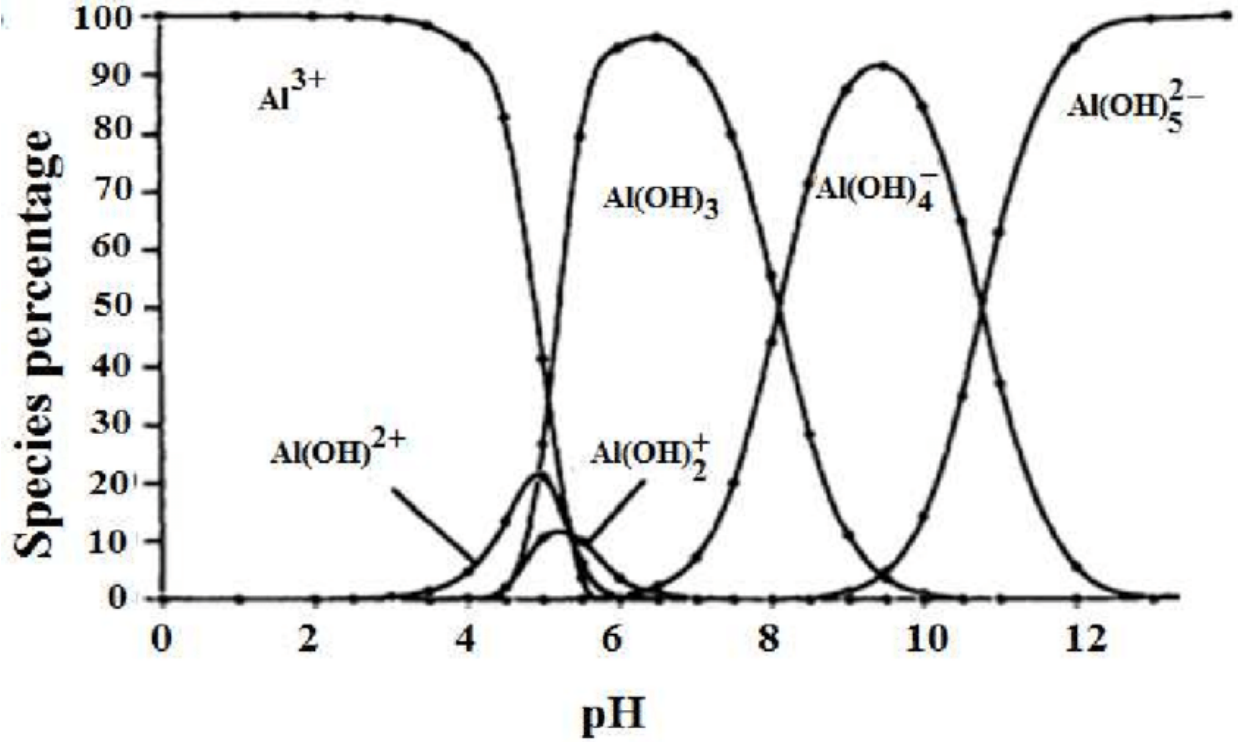


Figure 2.3 Understanding Aluminum Speciation Based on pH (Drogui et al. 2014b).

The quantity of coagulant generated from anodic dissolution can be estimated using Faraday's Law of Electrolysis, Eq. 2.5, which is proportional to the total charge transferred through the cell (Chow and Pham 2021; Ingelsson et al. 2020; Yasri and Gunasekaran 2017).

$$m_{theoretical} = \frac{ItM}{zF} \quad \text{Eq. 2.5}$$

where m represents the theoretical mass of anode dissolved (g), I is the applied current (A), t is the electrolysis duration (s), M is the specific molecular weight of the anode metal ($M = 26.98$ g/mol for Al), z is the electron transfer number ($z = 3$ for Al), and F is Faraday's constant (96,485 C/mol).

Faradaic efficiency can also be calculated as the ratio of the experimentally observed coagulant mass (i.e., the amount of anode material dissolved) to the theoretical mass predicted by Faraday's Law, shown in Eq. 2.6. Faradaic efficiency is an important metric for evaluating the

performance of electrical flocculation systems. Sustaining consistent and high faradaic efficiency throughout extended operation periods is crucial for ensuring reliable performance in electrical flocculation processes (Müller et al. 2019). A faradaic efficiency of 100% indicates optimal current utilization.

$$\text{Faradaic efficiency (\%)} = \frac{m_{\text{observed}}}{m_{\text{theoretical}}} = \frac{zFm}{ItM} \times 100\% \quad \text{Eq. 2.6}$$

2.1.1 Advantages of Electrical Flocculation

Electrical flocculation presents numerous advantages, which make it a highly favorable and effective water treatment method. It requires minimal space, is easy to operate, and supports automation, which allows for rapid activation by flipping a switch (Hakizimana et al. 2017; Khandegar and Saroha 2013; Naje et al. 2016). In contrast to traditional chemical treatments, electrical flocculation treatment removes the need for chemical additives. This ensures minimal secondary chemicals are produced, which enhances its environmental compatibility (Ahmed and Hameed 2019). Compared to chemical coagulation, membrane filtration, and ion exchange, it produces less sludge and avoids generating brine streams, thereby reducing the need for maintenance or downstream treatment efforts (Ben-Sasson et al. 2013; Harif et al. 2006). Further, electrical flocculation is versatile, capable of operating with alternating or direct current, and adaptable to be powered by renewable energy sources, such as photovoltaic systems, enhancing its sustainability. It can also be effective in both batch and continuous flow systems.

2.1.2 Limitations of Electrical Flocculation

Like other treatment methods, electrical flocculation is not without its limitations. Drawbacks to the electrical flocculation process include sacrificial anode consumption, operating costs, and electrode fouling (Yousuf et al. 2001). The sacrificial anodes require replacement or

maintenance to maintain optimal functionality due to their dissolution during the electrical flocculation process. One of the most researched limitations of electrical flocculation is electrode passivation, or fouling layer, as it directly affects performance and operating costs. Passivation occurs when solid materials accumulate on electrode surfaces, forming an insulating surface layer or film (Abdollahi et al. 2023; van Genuchten et al. 2016a). This layer impedes the electro-dissociation of metal ions into the solution by entrapping complexes within its structure. The formation of these non-porous layers increases the resistance of electron transfer at the electrode-electrolyte interface, which elevates cell voltage and operating costs while reducing treatment efficiency (Amrose et al. 2014; Bandaru et al. 2020; Chow and Pham 2021; Ingelsson et al. 2020; Müller et al. 2019; Timmes et al. 2010). Fouling layers result from the accumulation of coagulant metals, hydroxides, contaminants, and insoluble reaction products at the electrode surface, with their rate of formation influenced by the mass transfer rate of dissolved coagulants, the chemical species present, and mixing conditions (Panikulam et al. 2018; Yasri et al. 2022). Slow or stagnant flows can exacerbate this issue by slowing ion diffusion from the electrode surface to the bulk solution (Rodrigo et al. 2014).

2.2 Electrical Flocculation versus Chemical Coagulation

In wastewater treatment, electrical flocculation and chemical flocculants are used to impregnate contaminant-laden water with coagulants. Chemical coagulation (CC) is a water treatment method where chemicals are introduced to modify the physical state of dissolved and suspended solids to promote gravitational sedimentation (Duan and Gregory 2003; Matilainen et al. 2010). Coagulants interact with suspended and colloidal particles in a water matrix, facilitating their aggregation and subsequent removal (Li et al. 2006). The removal of these particles and colloids occurs through mechanisms such as charge neutralization, entrapment, adsorption, and complexation with

coagulant ions, forming insoluble aggregates (Alexander et al. 2012; Duan and Gregory 2003; Matilainen et al. 2010; Metcalfe et al. 1979; Pillai 2013; Verma et al. 2012a). Both electrical flocculation and CC find applications in removing contaminants and commonly involve the using aluminum and iron compounds as coagulants (Al-Malack et al. 1999; Bayramoglu et al. 2007; Cañizares et al. 2007b; a; Canizares et al. 2009; Kobya et al. 2007; Teh et al. 2016; Torres et al. 1997). While they share common objectives, their dosing techniques distinguish them. In CC, the coagulants are chemical substances (i.e., metal salts, polymers, and polyelectrolytes) that are typically passively dosed as powders, emulsions, blocks, or socks (Harif et al. 2012). Therefore, the use of chemical flocculants requires recurrent application. In electrical flocculation, coagulants are introduced in situ through the electrolytic oxidation of the anode material. Additionally, coagulants produced via electrical flocculation are applied without salts like SO_4^{2-} or alum, negating the need for brine management.

Electrical flocculation benefits from the electric field, which induces gas generation at the cathode. Gas generation aids in the migration of charged species and leads to improved collision rates and the formation of denser sludge. CC involves adding chemicals, a practice that can inadvertently elevate the concentrations of certain dissolved constituents and generate substantial sludge (Metcalfe et al. 1979; Valero et al. 2011; Verma et al. 2012b). Therefore, due to its higher volume, CC introduces more challenges in sludge removal.

Chemical flocculants are commonly employed in construction and post-construction settings alongside detention-based measures, such as sediment basins and traps, to enhance their performance (Kazaz et al. 2021; Vasconcelos et al. 2017). Chemical flocculants, when combined with extended detention practices, have been shown to reduce turbidity and total suspended solids (TSS) effectively (Kazaz 2022). As opposed to electrical flocculation, chemical coagulation has

been widely researched in the construction stormwater field using sediment as its contaminant to settle out. Bhardwaj and McLaughlin (2008) evaluated active and passive PAM dosing in sediment basins, finding that active treatment with PAM injection reduced TSS by up to 80%. Passive treatment using a PAM block achieved a 65% turbidity reduction in discharge with an initial turbidity of 260 Nephelometric Turbidity unit (NTU). Further, Kang and McLaughlin (2016) evaluated the use of chitosan and PAM for treating construction stormwater, applying passive (i.e., chitosan) and active (i.e., PAM) methods on geotextile dewatering bags. Their findings indicated a 97% reduction in turbidity. Similarly, Sojka et al. (1996) investigated PAM in field studies, reporting a 57% sediment reduction in irrigation water with its application.

However, the use of flocculants in the stormwater field remains controversial due to limited research on optimizing their application in uncontrolled field conditions. Kazaz et al. (2021) found that 39% of the 51 surveyed state DOTs actively use chemical flocculants, with 54% relying on manufacturer recommendations intended as general starting points rather than site-specific solutions. Additionally, only 23% of DOTs using chemical flocculants require residual monitoring during application, while non-users cited regulatory restrictions, environmental risks, and increased costs as barriers.

A study by Canizares (2009) compared CC and electrical flocculation using aluminum as the coagulant to treat a synthetic oil-in-water emulsion and an effluent from a door-manufacturing factory. The research highlighted the critical role of pH in influencing coagulant species formation, the surface charge of aluminum hydroxide precipitates, and overall treatment efficiency. Results demonstrated that under identical fluid dynamics conditions, aluminum dosage, and pH, both methods achieved similar pollutant removal efficiencies. However, electrical flocculation requires less pH adjustment than CC, potentially making it a more favorable option for certain wastewaters.

Chafi et al. (2011) compared electrical flocculation and CC methods for decolorizing synthetic textile wastewater focused on Orange II, a common mono-azo acid dye. Electrical flocculation was conducted in a batch electrochemical cell using aluminum and iron electrodes. The results demonstrated that electrical flocculation achieved superior decolorization efficiency (up to 98%) compared to CC (53%).

2.3 Reactor Types

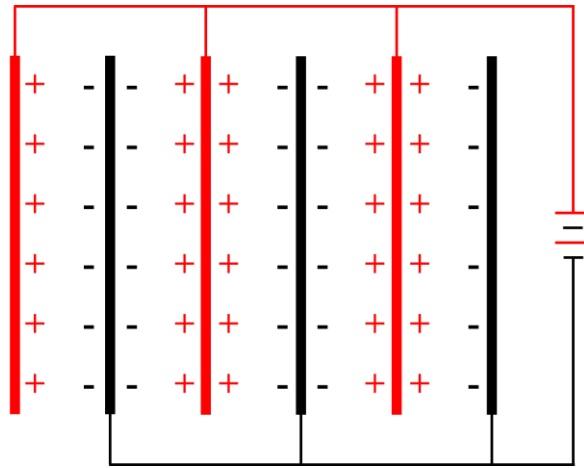
Electrical flocculation reactors are designed in various configurations. The design and configuration of electrical flocculation reactors dictate treatment efficiency, scalability, and operational practicality. Reactor selection often depends on the intended application, flow rate, pollutant characteristics, and maintenance preferences. Many reactor types have been researched and developed to meet these various needs, and they each have their individual advantages and disadvantages. Reactor types can include batch reactors, continuous flow systems, various electrode circuitry configurations (i.e., monopolar and bipolar), electrode geometry and arrangements, and hybrid processes.

The most basic and commonly found electrical flocculation system is the batch reactor. This system is typically used for laboratory research, pilot testing, or small-scale water treatment. Batch systems treat a known volume of contaminated water per cycle by submerging electrodes into the bulk solution and applying electricity to them for a specific duration (Adamović et al. 2025). Once the treatment cycle is completed, the resulting froth and sludge are separated, and the clarified supernatant is decanted. Batch reactors are typically simple and easy to operate. However, they are limited by non-continuous operation, requiring downtime for filling and draining, which makes them inefficient for high-flow or continuous applications.

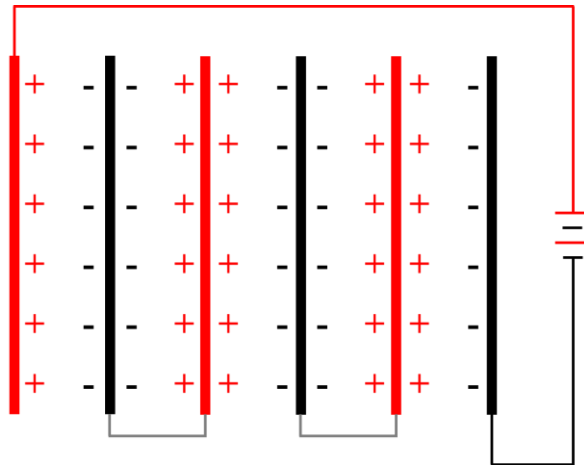
In contrast, for a continuous flow through system, water is channelized into an electrical flocculation reactor, and it steadily flows through the system (Bazrafshan et al. 2015; Holt et al. 2005). The residence time within the reactor, which determines the extent of coagulation, is a function of the reactor volume and the volumetric flow rate. Lower flow rates increase residence time and allow for more coagulant generation per unit volume of water. These systems require downstream separation units such as sedimentation tanks, lamella clarifiers, or dissolved air flotation units to remove the flocculated solids. These designs enable uninterrupted treatment and are more scalable for industrial or field deployment, due to their ability to handle larger volumes effectively (Bazrafshan et al. 2015). However, they are more complex due to several factors including possible increased capital investment, more intricate automation and electrical control systems, and ensuring proper integration with solids separation unit.

In electrical flocculation systems, electrodes can be configured in monopolar or bipolar arrangements. There are two types of monopolar arrangements: parallel and series. In the monopolar-parallel configuration, all anodes are electrically connected to one another and wired to the positive terminal of the power supply, while all cathodes are similarly connected and wired to the negative terminal, Figure 2.4(a). This configuration allows the same voltage to be applied across each electrode pair and is the most widely used due to its straightforward control and uniform electrical distribution. In contrast, a monopolar series is an electrical circuit that entails individual anode-cathode pairs connected in series, such that the electrical current flows from one pair to the next, Figure 2.4(b). A bipolar series connection is where only the peripheral electrodes are directly connected to the power supply, while the intermediate electrodes are not directly connected to the peripheral electrodes or the power supply. When electrical current is applied to the peripheral electrodes, the internal electrodes become polarized by the electric field, which

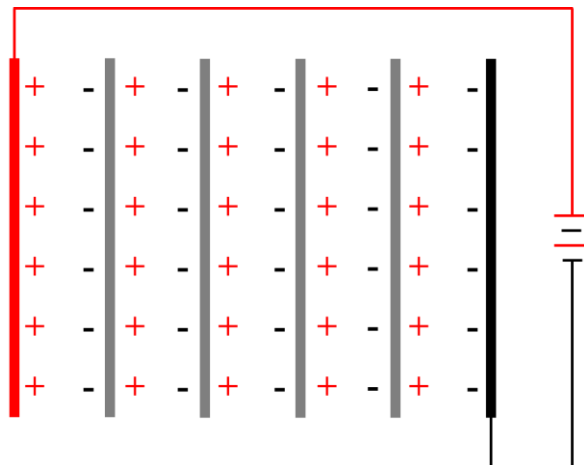
allows them to acquire an opposite charge to the peripheral electrodes (Jasim and Aljaberi 2023; Othmani et al. 2022), Figure 2.4(c). The bipolar-series configuration can simplify system wiring and reduce the number of electrical connections, which may contribute to lower energy requirements. However, achieving effective polarization of the intermediate electrodes often necessitates higher applied voltages. This indirect energization can result in reduced or uneven treatment efficiency across the electrode array. These limitations, combined with potential challenges in scaling and process control, may contribute to the less frequent implementation of bipolar-series systems.



(a) monopolar electrodes in parallel connection (MP-P)



(b) monopolar electrodes in series connection (MP-S)



(c) bipolar electrodes in series connection (BP-S)

Figure 2.4 Electrode Arrangements in Electrical Flocculation Cells.

Beyond electrode circuitry arrangements, various electrode shapes and physical configurations have been developed and evaluated to improve the performance of the electrical flocculation process. These designs aim to enhance mass transfer, increase mass transfer, enlarge effective electrode surface area, reduce energy consumption, minimize system footprint, and improve scalability. Common electrode shapes include rectangular plates, cylindrical rods, fin-shaped designs, and particulate or granular materials. These electrode geometries have been implemented alongside reactor configurations such as serpentine layouts, interdigitated arrays, and unequal cathode-to-anode surface area ratios. Together, these configurations can be applied in batch or continuous flow systems using specific circuitry arrangements, forming various reactor types, including parallel plate reactors, tubular reactors, and packed-bed reactors.

Electrode design is often selected based on reactor geometry, volume, and shape. Multiple studies have explored more efficient electrical flocculation cell configurations. For example, Abbasi (2022) employed iron-iron rod electrodes in a continuous flow system to treat licorice processing effluent. The study found rod-shaped electrodes to be more effective than plate electrodes due to their ability to generate a more uniform electric field, which improves mixing and increases mass transfer rates.

Similarly, AlJaberi (2022) evaluated a novel electrical flocculation reactor which was comprised of multiple fin-shaped anodes concentrically situated within a tubular aluminum cathode. The electrodes were connected in a monopolar-parallel configuration and demonstrated a high anode-to-cathode surface area ratio of 4.8:1. However, other studies suggest that smaller anode-to-cathode ratios, particularly those around 0.36, may enhance the removal of certain contaminants such as chemical oxygen demand (COD) and color (Sanei and Mokhtarani 2022). These effects are attributed to the influence of surface area ratios on current density distribution

across the electrodes. A larger cathode surface area relative to the anode promotes more uniform current dispersion, reducing localized anodic passivation and improving treatment longevity (Sun et al. 2022). In contrast, when the anodic surface area is too large relative to the cathode, it can cause uneven current distribution, reduce treatment efficiency, and increase energy consumption due to elevated voltage requirements and electrical resistance.

To further increase electrode surface area and mass transfer, researchers have evaluated packed-bed electrical flocculation cells. These reactors are filled with conductive media such as metallic granules or beads that serve as electrodes, allowing water to percolate through and contact the reactive surfaces. Kobya (2021) conducted a study that evaluated packed-bed reactors and found that increased bed densities enhance metal cation generation and hydrolysis, likely due to the greater effective surface area of the anode contributing to higher coagulant production.

2.4 Contaminants in Stormwater Runoff

A comprehensive understanding of the pollutants typically present in stormwater runoff from highway construction sites is essential to effectively address the treatment of construction stormwater runoff. Various surfaces in urban areas can accumulate pollutants through dry atmospheric deposition, which are then washed into waterways during precipitation events such as rainfall or snowmelt (Djukić et al. 2016). According to the National Cooperative Highway Research Program (NCHRP) findings, the common constituents encountered in construction stormwater runoff encompass TSS, nutrients (e.g., nitrogen and phosphorous), heavy metals, bacteria (e.g., *E. coli* and fecal coliforms), hydrocarbons (e.g., oil and grease), and deicing agents (e.g., chlorides) (Lantin et al. 2019). The intricate traffic patterns and dynamics on highways play a significant role in the downstream transportation of these contaminants. Table 2.1 describes concentrations of nutrients, bacteria, and organic matter transported by highway runoff,

specifically combined average annual daily traffic, with the corresponding concentrations and number of samples collected.

Table 2.1 Nutrients, Bacteria, and Organic Material Found in Highway Runoff (Lantin et al. 2019a).

Contaminant	Concentration	No. of Sites	No. of Samples
Total Suspended Solids (TSS)	67.5 mg/L	193	4,160
Total Nitrogen (TN)	1.36 mg/L	12	389
Total Phosphorous (TP)	0.18 mg/L	184	3,325
Dissolved Phosphorus (DP)	0.05 mg/L	71	1,361
Biological Oxygen Demand (BOD)	6.83 mg/L	50	602
Dissolved Oxygen (DO)	8.80 mg/L	4	18
Total Dissolved Solids (TDS)	58.0 mg/L	47	918
Chloride (Cl ⁻)	27.9 mg/L	51	2,249
E. Coli	1,250 (MPN/100 mL)	1	22
Fecal Coliform	1,600 (MPN/100 mL)	50	404

Note: MPN = most probable number

This indicates that the concentrations of TSS and TDS are 67.5 and 58.0 mg/L for highway runoff, and 1.36, 0.18, and 0.05 mg/L for nutrients TN, TP, and DP, respectively. For BOD and DO are listed as 6.83 mg/L and 8.80 mg/L, respectively, for highway and vehicle-derived contaminants.

Table 2.2 provides data on heavy metal pollutants transported by highways, specifically combined average annual daily traffic, with the corresponding concentrations and number of samples collected.

Table 2.2 Heavy Metals Found in Highway Runoff.

Contaminant	Concentration (mg/L)	No. of Sites	No. of Samples
Aluminum (Al)	4.8100	1	16
Arsenic (As)	0.0012	100	1,764
Cadmium (Cd)	0.0005	162	2,613
Copper (Cu)	0.0220	196	3,692
Iron (Fe)	1.9000	61	1,028
Lead (Pb)	0.0017	187	3,411
Manganese (Mn)	0.0573	20	185
Zinc (Zn)	0.1300	200	3,722

The table shows that aluminum has the highest reported concentration among the listed contaminants; however, this value is based on data from only one monitoring site with 16 collected samples. This represents the lowest sample count among all the reported highway runoff constituents. In contrast, the other seven heavy metals listed had a significantly higher average sample count of approximately 2,345 samples each, providing a more robust dataset for those contaminants. It is important to understand the quantification of prevalent stormwater contaminants in order to design targeted treatment strategies, support environmental protection goals, inform policy and engineering standards, and guide the direction of future innovations in the stormwater industry.

Stormwater runoff from urban settings provides transportation for micropollutants to make entry into aquatic environments (Beryani et al. 2025). Recent research has identified various emerging contaminants in rainfall and urban stormwater runoff, including 6PPD-quinone, microplastics, and PFAS. These pollutants are increasingly recognized for their persistence and potential ecological and human health impacts. 6PPD-quinone is derived from tire rubber and is the primary toxicant responsible for the urban runoff mortality syndrome affecting Pacific Northwest coho salmon (Tian et al. 2021). This issue is further complicated by the increasing efforts to recycle and repurpose scrap tire materials. In 2009, the U.S. generated over 4.5 billion kg (4,960,400 tons) of scrap tire material, with more than 80% of it finding use within the scrap tire market (USEPA 2005). These applications encompass sporting and playground surfaces, mulch, septic field drainage, and recycled construction materials, including asphalt concrete containing recycled crumb rubber. Often, these uses occur without a comprehensive evaluation of potential environmental impacts (Feraldi et al. 2013; McElvery 2020; Mohajerani et al. 2020; Nanjegowda and Biligiri 2020; United States Environmental Protection Agency 2005).

Additionally, researchers have documented the harmful effects of tire rubber leachate on various organisms, including algae (Capolupo et al. 2020), mollusks (Capolupo et al. 2020), fish (Kolomijeca et al. 2020; LaPlaca and van den Hurk 2020; Stephensen et al. 2005), and arthropods (Halsband et al. 2020).

Microplastics are a very big concern in stormwater runoff because they are widespread pollutants that cause negative environmental and health impacts. Microplastics are commonly described as plastic particulates less than 5mm in length and are small sections of synthetic polymers that are derived from the degradation of larger plastics. (Arthur et al. 2009). Further, stormwater runoff is an important source of microplastic pollutants that originate from urban activities such as tire and road wear, littering, and packaging materials. Stormwater or surface runoff is also recognized as a significant pathway for the movement and transfer of microcontaminants from land-based sources into various aquatic environments, such as ponds, rivers, and oceans. Microplastics have been detected across various parts of the marine (Andrady 2011), freshwater (Li et al. 2020), and estuary (Han et al. 2020) environments. In the marine environment, microplastics have been found within the digestive tracts of fish (Beer et al. 2018), zooplankton (Cole et al. 2013), and organisms that feed through filtering or sediment ingestion, such as deposit and filter feeders (Van Cauwenberghe et al. 2015). Adverse effects have been observed in distinct marine species like copepods (Cole et al. 2015), marine worms (Wesch et al. 2017), and marine mollusks like bivalves (Bour et al. 2018). In addition to ecological impacts, potential risks to human health have been highlighted, particularly through consumption of seafood (Garrido Gamarro et al. 2020; Hantoro et al. 2019; Lusher et al. 2017; Smith et al. 2018).

Among the contaminants of increasing concern are PFAS, a class of synthetic compounds widely used in industrial processes and common consumer products. PFAS can be introduced into

stormwater through many sources such as spills or improper disposal. These chemicals are used to produce many items such as food packaging, Teflon (non-stick cookware), paints and sealants, and firefighting foam (Illinois Environmental Agency 2025). Since they are broadly used chemicals, this makes PFAS particularly difficult to trace, because they originate not only from concentrated industrial point sources but also from widespread domestic sources that contribute to stormwater runoff (Paul et al. 2009). This is particularly concerning because stormwater is typically discharged into nearby surface waters with limited or no treatment, which can provide a direct path for PFAS to infiltrate aquatic environments. PFAS are highly persistent, mobile, and frequently detected in surface waters, therefore it is essential to understand how stormwater runoff facilitates their movement through urban landscapes (Podder et al. 2021). PFAS's chemical stability, resistance to heat, water, and oil, makes them valuable for use in textiles, food packaging, and fire suppression, but these same properties also contribute to their long-term environmental persistence (Buck et al. 2011). A recent study conducted by Kali et al. (2025b) verified the presence of PFAS in both water and sediment in urban streams, which further emphasizes the role of stormwater runoff in transporting these compounds.

2.5 Electrical Flocculation Variables

The performance of electrical flocculation is influenced by a range of operational parameters including the electrode material, electrolysis duration (i.e., contact or reaction time), current density, interelectrode distance, and initial pH of the solution (Akyol 2012; Li et al. 2017; Mahmoud et al. 2013a; Sadik 2019; Sharma 2014; Singh and Mishra 2017a). These parameters affect mass transfer dynamics, energy efficiency, the speciation and release of metal ions, and overall contaminant removal effectiveness. Understanding how these factors impact the electrical flocculation process is important when designing or evaluating these systems. The following

sections summarize key findings from existing studies, focusing on how each variable influences treatment performance and system design. The discussion of pH was excluded from this discussion, as it was detailed in subsection 2.1.

2.5.1 Electrode Material

The electrodes in an electrical flocculation cell can vary in material, shape, size, configuration, and circuit arrangement. Since most of these factors were discussed in Section 2.3, this subsection focuses on electrode materials. The choice of anode and cathode material affects the type of ions produced, the pH of the treated water, the formation and characteristics of coagulants, their interaction with pollutants, and overall performance. Aluminum and iron are the most used anode materials, with zinc gaining interest in recent studies. Aluminum is widely preferred due to its abundance, low cost, and lack of effluent discoloration (Lin et al. 2005). It is commonly used in Al-Al (anode-cathode) systems but has also been paired with alternative cathodes like iron, stainless steel, carbon steel graphite, copper, titanium, and nickel (Castañeda et al. 2022; Chen et al. 2020; Doumbi et al. 2024; García-Orozco et al. 2022; Lu et al. 2025; Medvidović et al. 2023; Tanneru et al. 2013).

Using different materials for anode and cathode can be advantageous for cell performance. Lu et al. (2025) found that an aluminum-graphite (Al-G) system, compared to Al-Al, reduced electrode degradation by 50%, energy usage by 27%, sludge generation by 40%, and residual Al^{3+} by 52% at a current density of 2.5 A/m^2 (0.23 A/ft^2). In this study aluminum was used as the anode material in all trials and five cathode materials were tested including aluminum, titanium, copper, stainless steel, and graphite. This study found that after 10 minutes of applied voltage to the electrode sets, the final pH and Al^{3+} concentrations were 6.7 and 0.39 mg/L for Al-G, compared to 7.6 and 0.82 mg/L for Al-Al. These differences are attributed to aluminum speciation at varying

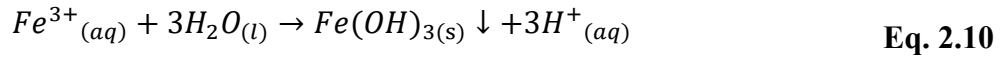
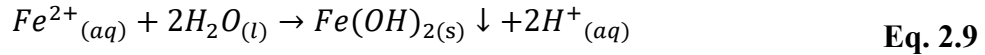
pH levels, which can be found in Figure 2.3. Aluminum hydroxides are amphoteric, with the lowest solubility near pH 6. The closer the solution pH is to this value, the lower the concentration of dissolved Al^{3+} is found in the treated solution. Since the final pH for the Al-G cell was 6.7, aluminum solubility was minimized. The Al-G cell also demonstrated more stable voltage, resulting in lower energy consumption. The electrical flocculation cells operated under galvanostatic mode, where the current is held constant. Among all systems tested, Al-G had the lowest charge transfer resistance, meaning less resistance at the electrode-electrolyte interface. In contrast, Al-Al and Al-Ti exhibited higher resistance, likely due to thicker oxide layers. The anodic mass loss in the Al-G system was 8% lower than Al-Al, indicating reduced coagulant release per volume.

The pH of the treated bulk solution can be affected by the type of metal used as the sacrificial anode in an electrical flocculation cell. The oxidation state of the resulting metal cations directly influences the pH due to the hydrolysis reactions these ions undergo. In hydrolysis, hydrogen ions (H^+) are either consumed or produced, which alters the solution's pH. Electrical flocculation occurs in an aqueous solution, typically water, as used in drinking water, wastewater, or industrial effluents. When metal ions are released into the solution, they are usually hydrated, meaning they are surrounded by water molecules attracted to the charged ions. Eq. 2.2 shows the oxidation of solid aluminum at the anode into aluminum ions (Al^{3+}) cations, which have a fixed oxidation state of +3. In Eq. 2.3, aluminum ions (Al^{3+}) undergoes hydrolysis in a neutral pH environment, reacting with three water molecules to form aluminum hydroxide ($\text{Al}(\text{OH})_3$) and three hydrogen ions (H^+). This release of hydrogen ions (H^+) lowers the pH, making the solution more acidic.

In contrast, iron used as an anode can exist in multiple oxidation states depending on the current density or applied voltage. At lower potentials, iron oxidizes to ferrous ions (Fe^{2+}), while higher potentials lead to ferric ions (Fe^{3+}), as shown in Eq. 2.7 and Eq. 2.8.



These iron ions also undergo hydrolysis but release different amounts of hydrogen ions. Ferric ion hydrolysis produces more H^{+} than ferrous ion hydrolysis, resulting in a more acidic environment near the anode, shown in Eq. 2.9 and Eq. 2.10. When comparing aluminum ions (Al^{3+}) and ferric ions (Fe^{3+}), their hydrolysis reactions result in similar pH reductions due to their shared oxidation state.



Thus, the oxidation state of the released metal ion determines how many hydrogen ions are produced, which directly impacts the pH of the treated solution. This acidification is counterbalanced by the cathodic generation of hydroxide ions (OH^{-}).

Several studies have compared the energy consumption and cost efficiency of different electrode materials. Alimohammadi (2017) evaluated the removal of natural organic matter (NOM) using iron and aluminum electrodes. This study reported nearly 100% NOM removal efficiency and energy consumption values of 0.092 kWh/m³ (0.0026 kWh/ft³) for aluminum and 0.11 kWh/m³ (0.0031 kWh/ft³) for iron electrodes. The higher electrical resistance of iron (Fe) resulted in greater energy consumption compared to aluminum (Al). Specific electrode consumption and operating costs were also calculated for aluminum (Al) and iron (Fe) resulting

in 0.0062 and 0.0382 kg/m³ (0.00039 and 0.00238 lb/ft³), and \$0.057 and \$0.119/ m³ (\$0.0016 and \$0.0033/ft³) respectively. While iron (Fe) is less expensive than aluminum (Al), it experiences a greater mass loss rate than aluminum (Al), resulting in nearly twice the operating costs.

Akyol (2012) investigated the performance of electrical flocculation in treating paint manufacturing wastewater. The cost analysis revealed removal expenses of \$0.140/m³ (0.0040/ft³) for aluminum (Al) electrodes and \$0.200/m³ (0.0057/ft³) for iron (Fe) electrodes, with aluminum (Al) electrodes outperforming iron (Fe) in both efficiency and cost. Similarly, Bouhezila et al. (2011) found favorable results using aluminum (Al) electrodes, although reporting operating expenses of \$0.540/m³ (0.015/ ft³) for aluminum (Al) electrodes, compared to \$0.470/m³ (0.013/ft³) for iron (Fe).

2.5.2 Electrolysis Duration

Electrolysis duration, also referred to as contact time, is the period during which electrical current is applied to the electrodes, enabling reduction-oxidation (i.e., redox) reactions that generate coagulant species. Generally, the longer the electrolysis time, the greater the pollutant removal, as more metal ions and hydroxides are produced to aid in coagulation. However, once an optimal electrolysis duration is reached, additional treatment time does not enhance contaminant removal because sufficient floc formation has already occurred (Abdulrazzaq et al. 2021). Beyond this point, extended operation may lead to unnecessary increased energy use, higher electrode consumption, elevated effluent temperatures, and changes in pH without improving treatment outcomes (Naraghi et al. 2018).

Electrolysis duration varies based on the type of treatment system, such as batch or continuous flow. In batch systems, contact times typically range from 5 to over 120 minutes, though most studies report effective treatment within 20 to 30 minutes, shown in Table 2.3. Factors

such as pollutant load, energy consumption, and electrode configuration also influence the required treatment time. Alimohammadi et al. (2017) found that 20 minutes was the most cost-effective duration for batch electrical flocculation, balancing energy use with removal efficiency. Similar results were observed by Yetilmezsoy et al. (2009), who achieved significant decolorization and COD reduction when treating anaerobically pretreated poultry manure wastewater using electrical flocculation.

Batch systems process a fixed volume of water and generally require longer electrolysis times to ensure effective coagulation and settling. Conversely, continuous flow systems use hydraulic retention time (HRT) to determine how long the water remains in the reactor. HRT is a ratio of volume to volumetric flow rate of the fluid flowing through the cell. Typical electrolysis times for continuous flow reactors range from 5 to 80 minutes, and most systems operate effectively between 5 and 20 minutes, Table 2.3. Despite shorter durations, continuous systems can provide equal or better pollutant removal performance due to enhanced mixing and more efficient use of electrode surface area. Studies have shown that increasing HRT improves treatment performance; for instance, Nguyen et al. (2021) observed enhanced arsenic (As(V)) removal at lower flow rates of 3 and 6 L/hr (0.8 and 1.6 gal/hr), attributing the improvement to extended interaction time with iron hydroxides, which promotes greater adsorption and co-precipitation. Similarly, Zampeta et al. (2022) reported reduced removal efficiencies of COD, color, and TSS at higher flow rates when treating printing ink wastewater. Researchers have noted that extended residence times allowed more thorough contact and mixing of coagulants in the solution, thereby increasing pollutant capture and removal (Hendaoui et al. 2021; Wu et al. 2021). Zodi et al. (2013) further demonstrated the importance of both flow rate and current density, finding that COD removal improved from 52% to 76% when current density increased from 100 to 200 A/m² (9.3 to

18.6 A/ft²) at a flow rate of 10 L/hr (2.6 gal/hr). However, at a higher flow rate of 28 L/hr (7.4 gal/hr), COD removal was less effective, 48% at 100 A/m² (9.3 A/ft²) and 68% at 200 A/m² (18.6 A/ft²), indicating that elevated flow rates can diminish treatment efficiency even when current is increased.

Additionally, studies have been conducted to observe removal efficiencies from electrical flocculation cells employing DC, AC, and alternating pulse current (APC). APC was preferred for its lower cost, faster treatment time, and reduced electrode wear. Tests using Fe-Fe, Fe-Al, and Al-Al electrodes at varying durations of 15 to 60 minutes and current densities of 0.04-0.08, found the Fe-Al combination proved most efficient, using the least current in 15 minutes and showing minimal electrode mass loss, (Chellam and Sari 2016; Moussa et al. 2017). Ultimately, determining the appropriate electrolysis duration depends on a combination of factors, including the type of system, power source, electrode materials, current density, flow configuration, and the specific contaminants targeted for removal.

2.5.3 Current Density

The electrical flocculation process is initiated by applying a controlled electric current to submerged electrodes, initiating electrochemical reactions. The intensity of this current, referred to as current density, is measured in amperes per unit area (e.g., A/m², A/ft², mA/cm², and mA/in.²). Current density governs the pace of the electrical flocculation reaction, thus dictating the rate of anodic dissolution. This, in turn, directly influences coagulant production, bubble formation, electrode lifespan, and passivation, which are all important factors that impacts the effectiveness of electrical flocculation. Higher current densities (i.e., increased power output) accelerate the dissolution of metal electrodes, producing more metal hydroxide flocs, thus enhancing contaminant removal efficiency (Phu et al. 2025; Zampeta et al. 2022). However, this

also leads to faster electrode wear and encourages the formation of passivation layers, which hinder mass transfer and reduce treatment efficiency. As passivation increases, more power is required to generate the same amount of coagulant. Overall, higher current densities raise energy consumption and accelerate electrode degradation, both of which contribute to higher operational costs (Hossain et al. 2013).

Several studies have emphasized the importance of optimizing current density. Al-Ghoul (2017) reported enhanced pollutant removal rates due to higher current densities increasing electrochemical reaction rates. Aouni et al. (2009) observed that current density regulates coagulant generation and influences the formation of gas bubbles, which promotes floc growth. As flocs grow larger, they become heavier and settle from the solution more rapidly. Hafez et al. (2018) quantified the relationship between current density and electrode consumption for aluminum, iron, and zinc, using a constant 60-minute electrolysis time. The study found that increasing the current density from 14.3 to 142.9 A/m² (1.32 to 13.30 A/ft²) resulted in a 10 to 13.5-fold increase in consumption rates for all three metals. Similarly, Nandi and Patel (2013) achieved 98% removal of Red 9 dye from textile wastewater using iron electrodes at a current density of 83.3 A/m² (7.7 A/ft²) over a 30-minute treatment period. Results from the study found no additional performance gains when increasing the current density beyond that point, indicating a threshold beyond which performance plateaus. Additionally, Xie et al. (2022) investigated the removal of COD from rendering wastewater using a combined electrical flocculation and electro-flotation process with aluminum electrodes. Under optimal conditions, specifically, a current density of 20 A/m² (1.9 A/ft²) and an electrolysis time of 15 minutes, the process achieved a COD reduction of 72.2% ± 5.3%. Further, the study also reported that increasing the current density to 30 A/m² (2.8 A/ft²) led to a significant increase in sludge generation.

While current densities from 0.6 to 500 A/m² (0.06 to 46.5 A/ft²) have been explored, most research indicates that effective operation occurs between 20 and 40 A/m² (1.9 and 3.7 A/ft²), which creates a balance between removal efficiency, energy use, and electrode longevity. The identified optimal range can be found at the end of the section in Table 2.3.

2.5.4 Interelectrode Distance

The spacing between electrodes, known as the interelectrode distance, significantly influences the performance of electrical flocculation systems. Finding an optimal distance is important, as it directly affects the electrical and hydrodynamic aspects within the cell, which influence removal efficiency, energy consumption, sludge generation, and electrode passivation. Increasing the interelectrode distance leads to a rise in electrical resistance, also known as ohmic drop, which requires a higher applied voltage to maintain current flow and thereby increases energy consumption (Mouedhen et al. 2008; Singh and Mishra 2017b). Reducing the interelectrode distance improves the electric field, decreases resistance, and improves energy efficiency and pollutant removal. Additionally, a shorter interelectrode distance enhances floc dispersion within the reactor, which can have a more significant impact on cell performance compared to the quantity of flocs (Martínez-Villafañe et al. 2022). However, electrodes placed too closely may risk short-circuiting and may restrict fluid flow between them, emphasizing the need for a balanced design.

Table 2.3 summarizes electrical flocculation studies and outlines interelectrode distances, which range from 1.2 to 50 mm (0.05 to 1.97 in.). The most common range of interelectrode gap is 10 to 20 mm (0.39 to 0.79 in.). Fattah et al. (2024) conducted a study using electrical flocculation to treat carwash greywater and found the optimal interelectrode distance to be 20 mm (0.79 in.), which resulted in removal rates of 93%, 37%, and 24% for turbidity, COD, and TOC (total organic carbon), respectively. Similarly, another study conducted by Kim et al. (2016) evaluated

interelectrode distances of 5 to 15 mm (0.20 to 0.6 in.) for the treatment of fluoride in groundwater and found the optimal interelectrode distance for removing fluorine was 10 mm, resulting in a 99% removal efficiency. Martínez-Villafañe et al. (2022) evaluated various interelectrode distances, 3, 5, and 9 mm (0.12, 0.20, 0.35 in.), in an electrical flocculation cell for the removal of fluoride and silica, and found that shorter spacing (e.g., 3 mm or less) was optimal for treatment.

Further, Mousset (2024) conducted a study looking at millimetric and micrometric gaps ranging from 0.1, 0.5, 3, 5, 10 mm (0.004, 0.02, 0.12, 0.20, and 0.40 in.) to treat TOC (total organic carbon) in laundry wastewater. The best performance was observed at electrode spacings of 0.5 and 3 mm (0.02 and 0.12 in.), with TOC removal rates of up to 58%. Smaller distances, such as 0.5 mm (0.02 in.), led to lower energy consumption compared to 3 mm and 10 mm (0.12 and 0.40 in.) due to reduced cell voltage requirements. However, these micro-distances also caused a significant increase in sludge production, which can create excessive sludge buildup in the reactor. The 3 mm (0.12 in.) spacing was identified as the most practical balance, offering high treatment efficiency, moderate energy use, and manageable sludge generation.

2.6 Passivation Mitigation

Electrode passivation or fouling is a phenomenon in electrical flocculation that occurs when unwanted oxides and organic material adhere to the surface of the electrode. The layer impedes the electrode's ability to perform electrolysis reaction by basically blinding the usable surface area of the electrode. Metal dissolution is hindered as fouling occurs, raising the passivation overpotential and resulting in higher energy consumption during treatment (Chow and Pham 2021; van Genuchten et al. 2016b; Holt et al. 2005; Yang et al. 2015). Passivation layer formation is influenced by several operational factors, including electrode type, electrolyte conductivity and components, current density, and the application of polarity reversal cycles (Abdollahi et al. 2023;

van Genuchten et al. 2016c). To minimize ohmic drop and lower the cell potential, it is typically beneficial to sustain elevated electrolyte conductivity and short interelectrode distances between electrodes during electrical flocculation (Yousuf et al. 2001). Conversely, these same conditions can lead to uneven current distribution across the electrode surface, accelerating irregular anode wear and posing challenges for long-term system stability. Since passivation reduces process efficiency and may require routine electrode cleaning to restore performance, selecting optimal voltage conditions is critical for stable and effective operation (Salinas-Echeverría et al. 2023).

Researchers have found methods of mitigating the effects of this unwanted layer, such as polarity reversal, baffled (or perforated) electrodes, aggressive ion addition (acid cleaning), alternating current, pulsed current, ultrasonication, mechanical cleaning, increasing flow velocity, and chemical cleaning via organic acids (Abdollahi et al. 2023; Chow and Pham 2021; Ibrahim et al. 2020; Ingelsson et al. 2020; Yang et al. 2015). Polarity reversal is one of the most studied mitigation methods. Mohora et al. (2014) investigated how switching the polarity of bipolar aluminum electrodes every 15 or 30 minutes impacted electrode passivation and the concentration of residual aluminum in treated groundwater. This study found that reversing the polarity every 30 minutes effectively prevented electrode passivation and resulted in the highest arsenic removal efficiency, 93%, while also maintaining optimal levels of residual aluminum in the effluent. Similarly, Chow (2021) investigated the effects of electrode passivation under various polarity reversal intervals and water chemistries. The study found that faradaic efficiency decreased with increasing PR intervals, primarily due to enhanced electrode passivation and the occurrence of undesirable side reactions at the electrode to electrolyte junction. Additionally, the study concluded that very short PR intervals (e.g., 0.5 minutes) can negatively impact the performance of electrical

flocculation systems by accelerating the rate of electrode fouling. Further, this study suggests that the faradaic efficiency and electrode passivation are dependent on solution chemistry.

Another approach to mitigating electrode passivation involves the use of perforated electrodes, which can enhance mass transfer and reduce fouling. Ibrahim (2020) investigated this strategy by using tubular perforated electrodes to treat synthetic wastewater contaminated with oil and grease, aiming to evaluate both pollutant removal efficiency and passivation reduction associated with baffled electrode configurations. The study examined four experimental setups (1) non-perforated electrodes (control), (2) perforated electrodes (both anode and cathode), (3) perforated anode with a non-perforated cathode, and (4) non-perforated anode with a perforated cathode. Results showed that the perforated electrode designs improved pollutant removal efficiencies and mitigated cathode fouling. The optimal configuration was found to be a non-perforated anode paired with a perforated cathode, operated at a current density of 170 A/m^2 (15.8 A/ft^2) and a pH of 6. Under these conditions, the system achieved substantial reductions: TOC: 96.8%, TPH: 97.9%, and oil and grease: 94.6%.

Yang (2020) conducted a study comparing traditional direct DC electrical flocculation with positive single-pulse current electrical flocculation for the removal of cadmium from solutions. While DC electrical flocculation demonstrated effective cadmium removal, its performance was limited by the formation of a passivation layer on the electrodes, which reduced treatment efficiency and increased energy consumption. Under optimal operating conditions, positive single-pulse current electrical flocculation achieved a marginally higher cadmium removal efficiency of 99.92% compared to DC electrical flocculation, which achieved 99.74%, but positive single-pulse current electrical flocculation used 44% less energy. Additionally, positive single-pulse current

electrical flocculation generated larger, more adsorptive flocs and formed larger particles, enhancing Cd removal.

2.7 Renewable Energy Sources in Electrical Flocculation

Recent research reveals renewable energy sources such as photovoltaic energy and microbial fuel cells (MFCs) can be used to power electrical flocculation cells. A significant limitation of electrical flocculation is the operational cost associated with supplying power to the electrodes required for inducing electrochemical reactions. Photovoltaic systems convert sunlight into electricity by absorbing photon energy through semiconductor materials in solar panels. MFCs offer another potential solution by generating electricity through the metabolic activity of microorganisms.

Recent studies have investigated the incorporation of photovoltaic power into electrical flocculation systems to improve the sustainability and cost-efficiency of wastewater treatment. Elkacmi et al. (2020) explored the treatment of olive mill wastewater using aluminum electrodes in an electrical flocculation system powered via photovoltaic energy. The study focused on removing COD, polyphenols, and color. Optimal results were achieved at a current density of 321.4 A/m^2 (29.8 A/ft^2) with a 40-minute treatment time, resulting in 79.24% COD removal, 94.82% polyphenol removal, and 97.87% color reduction. The system demonstrated a relatively low specific energy consumption (SEC) of 9.86 kWh/m^3 (0.28 kWh/ft^3) and electrode consumption of 0.1118 kg/m^3 (0.007 lbs/ft^3), showing potential for cost-effective treatment.

Similarly, Tones et al. (2020) demonstrated the application of a photovoltaic-powered electrical flocculation system to treat synthetic dye wastewater containing a mixture of azo dyes. A batch reactor equipped with aluminum electrodes achieved more than 97% color removal for both dyes in under 17 minutes of treatment, operating at high current densities of 1,320 and 1,160

A/m² (122.6 and 107.8 A/ft²). This study underscores the capability of solar-powered systems to provide rapid and efficient treatment without relying on traditional grid electricity, making it particularly suitable for remote or energy-limited areas.

Garcia-Orozco et al. (2022) also researched the use of photovoltaic electrical flocculation for treating real industrial wastewater from a chocolate manufacturing facility. The study evaluated three anodic materials, aluminum, copper, and zinc, under low current density conditions of 3.6 to 17.8 A/m² (0.3 to 1.7 A/ft²) over a 60-minute treatment period. Among the tested materials, aluminum showed the most promising results, removing 50% of COD and 39% of BOD. Copper and zinc electrodes yielded slightly lower removal efficiencies, with zinc achieving the highest total solids removal (67%) compared to aluminum (50%) and copper (42%). The use of solar power eliminated electricity costs, and life cycle assessment (LCA) results showed zinc to have the lowest overall environmental impact, with aluminum in second place.

Numerous studies have evaluated MFCs as alternative treatment technologies to electrical flocculation. Microbial fuel cells (MFCs) are bio-electrochemical systems that use bacteria to oxidize organic compounds in wastewater, generating electricity in the process. Electrons flow through an external circuit, while protons pass through a membrane to the cathode, where they combine with oxygen to form water. This allows MFCs to simultaneously treat wastewater and produce energy. Foudhaili et al. (2019) investigated the use of MFCs to drive electrical flocculation for the treatment of iron-rich acid mine drainage (AMD). In their study, the electrical flocculation process employed iron and aluminum electrodes, with reaction times ranging from 15 to 90 minutes, current densities between 0.38 and 1.9 A/m² (0.035 and 0.18 A/ft²), and an initial pH of approximately 2.5. Optimal electrical flocculation performance was achieved using iron electrodes with a 60-minute reaction time and 1.9 A/m² (0.18 A/ft²) current density, resulting in a final pH of

7.4 and iron removal efficiency exceeding 94%. In contrast, the MFC treatment demonstrated higher iron removal efficiency (>99.9%) and a higher final pH of 7.8. However, the MFC system was found to be approximately 12 times more expensive than the electrical flocculation system. Additionally, the MFC process required significantly more time for treatment, on the order of days, compared to the minutes required for electrical flocculation cell. Therefore, under current technological and economic constraints, MFCs are not yet a viable alternative to EC in terms of cost-effectiveness and treatment duration.

Beyond individual comparisons, a limited number of studies have explored the use of MFCs as power sources for driving electrical flocculation. For example, Safwat (2019) evaluated the performance of an integrated system in which MFCs powered an electrical flocculation cell for wastewater treatment. Two types of wastewaters were used for this study: synthetic wastewater enriched with glucose and starch, and municipal wastewater. The MFCs generated more electrical energy when treating the synthetic wastewater, leading to better electrical flocculation performance. Specifically, the system achieved removal efficiencies of 95% for COD, 88% for TDS, and 93% for TSS in the synthetic wastewater, compared to 83%, 57%, and 85%, respectively, for the real municipal wastewater. Although the capital cost of integrating MFCs into electrical flocculation systems is high, the study concluded that operational costs could be significantly reduced compared to traditional, externally powered electrical flocculation systems.

2.8 Summary

Electrical flocculation is a widely used water treatment technology whose performance depends on a range of environmental and operational parameters. Like any technology, it has both advantages and limitations; however, the benefits generally outweigh the drawbacks. The efficiency of electrical flocculation is influenced not only by reactor type and design, such as batch

or continuous flow systems, different electrode configurations (e.g., monopolar or bipolar), and electrode geometry and arrangement, but also by factors including, the type of contaminants, electrode material, electrolysis duration or HRT, current density, interelectrode distance, and the rate of electrode passivation. Moreover, the process can be powered by conventional electricity (i.e., AC or DC) or by renewable energy sources, such as photovoltaic systems or MFCs. Table 2.3 summarizes key parameters from various studies, including electrode materials, plate spacing, electrolysis duration, current density, initial pH, and reactor type, allowing for quick and direct comparison of experimental setups and findings.

Insights from the literature review have directly informed the research approach by identifying effective electrode circuitry configurations, electrode materials, practical and effective current density ranges and electrode spacing distances, and common challenges, such as electrode passivation, and mitigation methods to prevent this layer buildup. Rather than duplicating existing work, this study builds on past findings by applying optimized parameters in the design of a modular, continuous flow reactor prototype tailored for stormwater applications. From this literature presented, several constants were selected to reduce the number of variables during testing, including the use of aluminum electrodes and a fixed interelectrode distance of 5 mm.

Table 2.3 Optimal Electrical Flocculation Configurations from Research Evaluations.

Study	Wastewater Source	Plate Material (A-C)	Interelectrode Distance, mm (in.)	Electrolysis Time, min.	Current Density, A/m ² (A/ft ²)	Initial pH	Reactor Type	Removal Efficiency
(Abdel-Shafy et al. 2022)	Synthetic	SS-SS	20 (0.79)	30	N/A	9.00	Continuous	Ni: 92.1%, Zn: 87.8%, Cu: 82.9%
(Abdulhadi et al. 2021)	Iron	Al-Al	5 (0.20)	50	30 (2.79)	7.00	Continuous	Iron: 99.9%
(Akansha et al. 2020)	Dairy	Al-Fe	10 (0.39)	120	N/A	5.87	Batch	COD: 86.4%
(Akyol 2012)	Paint	Al-Al	10 (0.39)	15	35 (3.3)	6.95	Batch	COD 94.0%, TOC: 89.0%
(Al-Ghoul 2017)	Oilfield runoff	Al-Al	25 (0.98)	30	300 (27.9)	6.20	Batch	TSS: 94.8%, NTU: 92.5%, Oil and Grease: 98.6%
(Alizadeh et al. 2013)	Textile	Fe-Fe	10 (0.39)	30	200 (18.6)	5.50	Batch	Hardness: 99.3%, COD: 66.0%
(Alimohammadi et al. 2017)	Municipal	Al-Al	5 (0.20)	20	2.5 (0.23)	7.00	Batch	NOM: 99.8%
(Al-Shannag et al. 2015)	Metal Plating	CS-CS	15 (0.60)	45	40 (3.7)	9.56	Continuous	Cr: 100%, Cu: 100%, Ni=99%
(Asaithambi et al. 2016)	Industrial	Fe-Fe	12 (0.47)	130.8	385 (35.8)	7.00	Batch	COD: 83.0%
(Baran et al. 2018)	Municipal	Al-LCS	45 (1.77)	36	18 (1.7)	6.00	Batch	NTU: 78.8%, COD: 58.7%
(Bouhezila et al. 2011)	Landfill leachate	Al-Al	28 (1.10)	30	500 (46.5)	8.69	Batch	COD: 70.0%, TN: 24.0%, Color: 56.0%, TSS: 60.0%
(Ensano et al. 2019)	Municipal	Al-SS	50 (1.96)	360	18 (1.7)	7.24	Batch	COD: 23.0%, DOC: 52.0%, UV ₂₅₄ : 54.0%, NH ₄ -N: 65.0%, PO ₄ -P: 100%
(Gönder et al. 2020)	Carwash	Fe-Fe	20 (0.79)	30	30 (2.8)	8.00	Batch	Oil: 88.0%, grease: 90.0%
(Hafez et al. 2018)	Cooling Tower Blowdown	Al-Al	10 (0.39)	60	143 (13.3)	8.10	Batch	Hardness: 55.4%, Silica ions: 99.5%
(Hashim et al. 2017)	Drinking	Al-Al	5 (0.20)	25	20 (1.9)	6.00	Batch	Fluoride: 98.0%
(Kambuyi et al. 2021)	Surface Waters	Al-Al	14 (0.55)	6.5	N/A	7.41	Continuous	NTU: 72.05%
(Kim et al. 2016)	Groundwater	Al-Al	10 (0.39)	N/A	60 (5.6)	3.00	Batch	Fluoride: 99.0%
(Koby et al. 2016)	Textile	Fe-Fe Al-Al	20 (0.79)	80	65 (6.0)	N/A	Continuous	COD: 85%, TOC: 76%, NTU: 95% COD: 77%, TOC: 72%, NTU: 95%
(Liu 2020)	Synthetic	Al-Al	20 (0.79)	0.75	39 (3.9)	N/A	Continuous	NTU: 91.7%
(Lu et al. 2015)	Nickel	Al-Al	10 (0.39)	20	7.5 (0.70)	6.00	Continuous	Ni: 100%

Study	Wastewater Source	Plate Material (A-C)	Interelectrode Distance, mm (in.)	Electrolysis Time, min.	Current Density, A/m ² (A/ft ²)	Initial pH	Reactor Type (HRT)	Removal Efficiency
(Mahmoud et al. 2013b)	Wastewater	Fe-Fe	20 (0.79)	10-20	80 (7.4)	N/A	Batch	Dye: 80.0%
(Makwana and Ahammed 2016)	Municipal	Al-Al	15 (0.59)	5	20 (1.9)	7.50	Batch	Coliform: 99.8%, Fecal coliform: 99.9%
(Merzouk et al. 2009)	Textile	Al-Al	10 (0.39)	10	115.5 (10.7)	7.60	Batch	BOD: 83.0%, COD: 68.0%, NTU: 86.6%, SS: 86.5%, color: 92.5%
(Mohora et al. 2014)	Groundwater	Al-Al	1.2 (0.05)	N/A	88.6 (8.2)	5	Continuous	As: 93%, NOM: 89%
(Nawarkar and Salkar 2019)	Municipal	Al-Al	10 (0.39)	20	40 (3.7)	7.4-8	Batch	COD: 90.0%, NTU: 94.6%, TDS: 49.8%
(Nguyen et al. 2021)	Arsenate	SS-SS	10 (0.39)	5	4.5 (0.42)	6-8	Continuous	As(V): 92%
(Rincón and La Motta 2014)	Bilge	Al-CS	13 (0.51)	N/A	0.6 (0.06)	2-4	Continuous	Zn: 99%, Cu: 70%, Ni: 70%
(Rodrigues et al. 2020)	Textile	Al-Al	N/A	5	111.1 (10.32)	3.00	Continuous	Color: >95%
(Salinas-Echeverría et al. 2023)	Surface Waters	Al-Al	20 (0.79)	30	N/A	N/A	Continuous	NTU: 74.13%
(Singh and Mishra 2017b)	Synthetic	Al-Al	20-40 (0.79-1.57)	40	53 (4.9)	7.00	Batch	TSS: 76.6%, Cu: 99%, Cr: 59.2%, Zn: 82.1%
(Sridhar et al. 2011)	Pulp / Paper	Al-Al	30 (1.18)	20	115 (10.7)	7.00	Batch	Color: 94.0%, COD: 90.0%, BOD: 87.0%
(Suhan et al. 2020)	Textile	Fe-Fe	8 (0.31)	50	100 (9.3)	3.00	Batch	Color: 91.0%, Dye: 86.5%, NTU: 60.4%
(Vidal et al. 2016)	Textile	Al-Al	20 (0.79)	120	5.0 (0.5)	4.00	Batch	TOC: >90.0%, COD: 60%
(Xie et al. 2022)	Rendering	Al-SS	20 (0.79)	15	20 (1.9)	7.02	Batch	COD: 72.2 ± 5.3%
(Zampeta et al. 2022)	Printing Ink	Al-Al	3 (0.12)	75	210 (19.51)	N/A	Continuous	COD: 82%, Color: 98%, TSS: 85%

Note: A-C: anode-cathode, N/A: not applicable, SS: Stainless Steel, CS: Carbon Steel, NTU: turbidity, BOD: Biochemical Oxygen Demand, COD: Chemical Oxygen Demand, NOM: Natural Organic Material, TDS: Total Dissolved Solids, TOC: Total Organic Carbon, TSS: Total Suspended Solids, TN: Total Nitrogen

CHAPTER THREE: PROTOTYPES DESIGNED AND CONSTRUCTED

3.1 Overview

This section provides a detailed outline of the design, development, and assembly of four prototypes evaluated throughout this research. The first two prototypes, designated as prototype A and prototype B, were fabricated using 3D-printed inserts and electrode housings and tested exclusively within a lab-scale apparatus. Prototype C, the third iteration, was also constructed with 3D-printed inserts and electrode housing but featured a larger anodic surface area compared to prototypes A and B. Prototype C underwent both lab-scale testing and preliminary field-scale evaluation. The fourth prototype, prototype D, was designed with an emphasis on using readily available materials for housing the 3D-printed electrode spacing inserts and electrodes. This prototype incorporated schedule 40 polyvinyl chloride (PVC) for its housing and was specifically engineered for retrofitting into widely used stormwater BMPs, such as floating surface skimmers. All 3D printed parts were designed using Autodesk Inventor® and subsequently printed on either the Prusa MK4S or Prusa XL printers, depending on the size of the parts.

3.2 Prototypes A and B

The electrode housing and electrode spacing insert for prototypes A and B were constructed using specifically designed 3D-printed components using polylactic acid (PLA) filament. The use of 3D printing facilitated iterative design modifications, allowing rapid prototyping and reprinting of updated components, depending on results from evaluations. The primary objective during this phase was to evaluate the feasibility of electrical flocculation for effective sediment removal, leading to the design of compact devices with smaller anodic surface areas.

Prototype A was designed and fabricated in three separate components: the top, the electrode spacing insert, and the housing for the insert. The top component measured 19.3 by 17.0 cm (7.6 by 6.7 in.), while the total length from outlet to outlet was 23.9 cm (9.4 in.), Figure 3.1(a) and Figure 3.1(c). Each outlet featured an outer diameter of 5.1 cm (2.0 in.). The electrode spacing insert measured 14.2 by 11.9 by 9.9 cm (5.6 by 4.7 by 3.9 in.) with a 6.4 cm (2.5 in.) wide opening to hold ten aluminum electrodes, Figure 3.1(b).

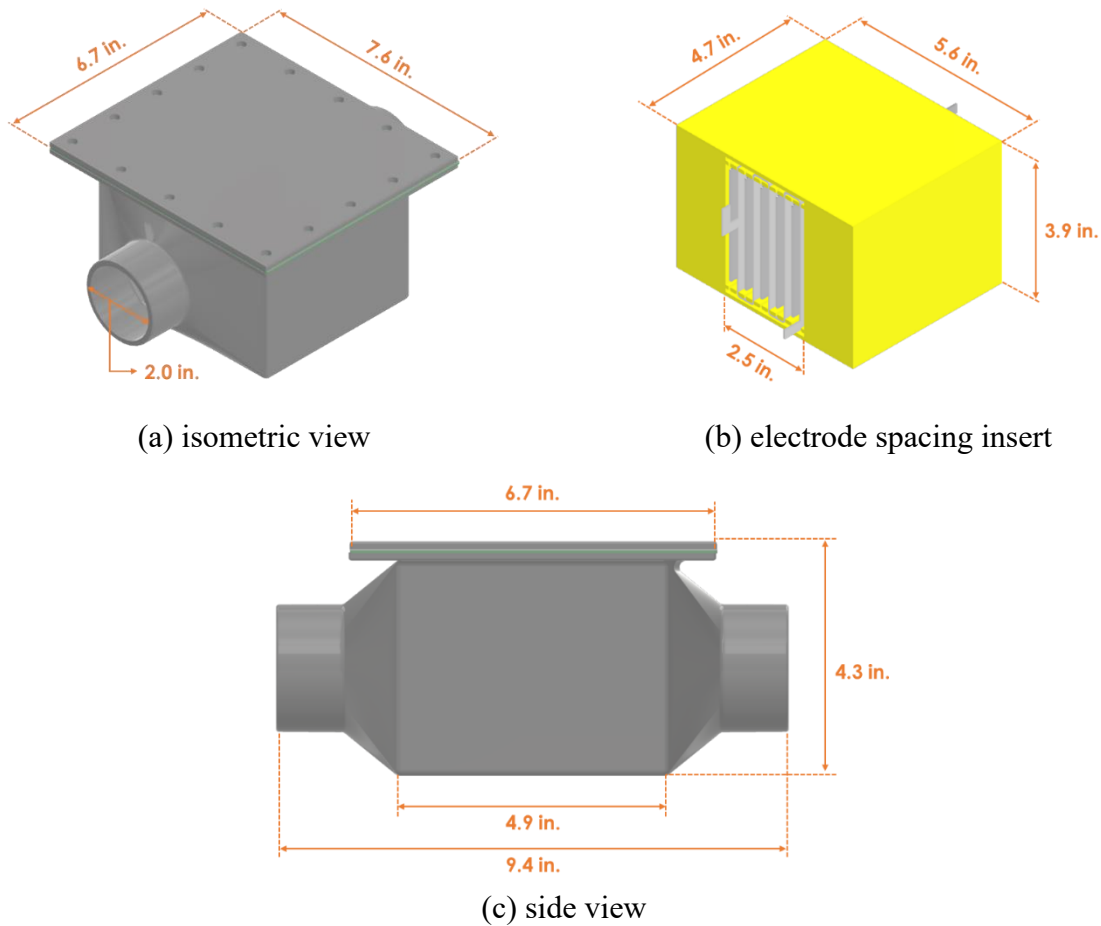


Figure 3.1 Prototypes A and B Components.

Prototype A was assembled using sixteen 3.8 cm (1.5 in.) bolts, thirty-two 0.63 cm (0.25 in.) washers, sixteen lock washers, and sixteen 0.63 cm (0.25 in.) butterfly nuts. A 0.63 cm (0.25 in.) thick rubber gasket was cut and placed between the top and bottom housing components prior

to bolting, ensuring a watertight enclosure and preventing electrical short circuits. The fully constructed prototype is shown in Figure 3.2.

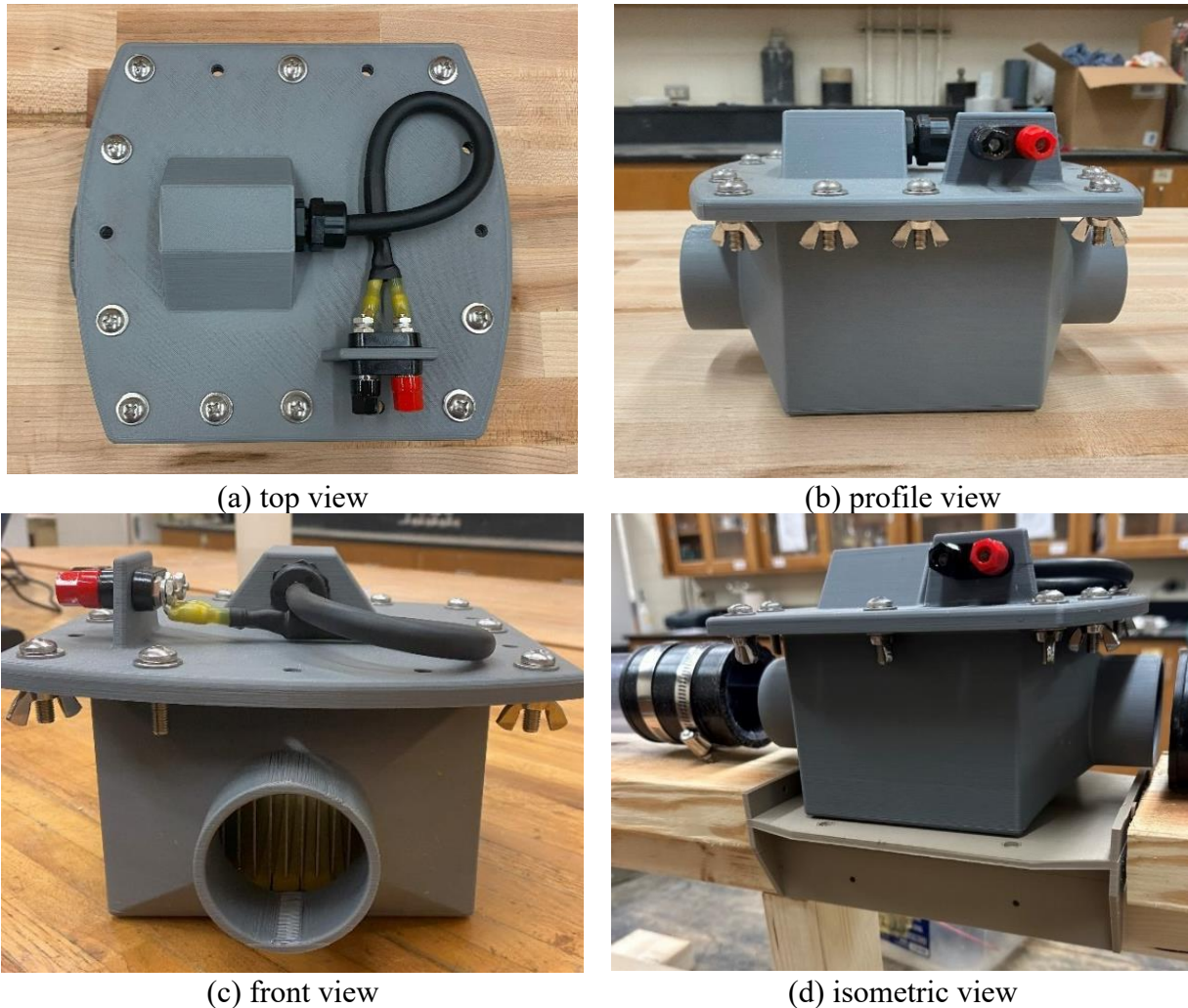


Figure 3.2 Prototype A Floc Generator.

The electrodes used in prototype A were fabricated from 1 mm (0.04 in.) thick grade 6061 aluminum and maintained an interelectrode distance of 1.3 cm (0.5 in.). Precision cutting of the electrodes was performed using a water jet at Auburn University's Brown-Kopal Makerspace. The ability to precisely cut aluminum sheets into electrodes of specific dimensions, guided by AutoCAD drawings, expedited iterative design modifications as electrode housing and inserts were redesigned.

The electrodes for prototype A were wired in a series configuration (i.e., MP-S) for simplicity. To further streamline assembly, the electrodes were designed with integrated aluminum tabs that connected the five anode electrodes and the five cathode electrodes, as shown in Figure 3.3. This eliminated the need for separate wiring of individual electrodes. Each of the ten electrodes used in prototype A had a surface area of 101.9 cm² (15.8 in.²), resulting in a total anodic surface area of 509.0 cm² (78.9 in.²).

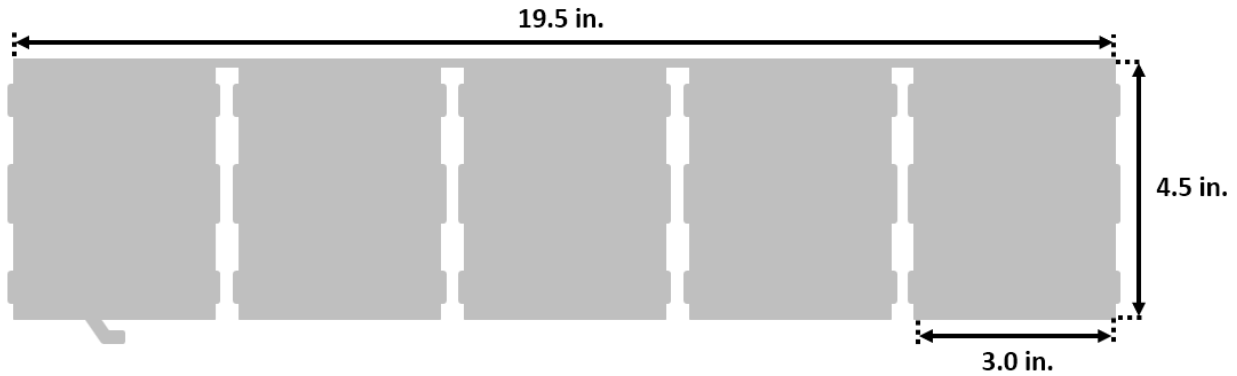


Figure 3.3 Prototype A Electrodes.

After evaluating prototype A, a second floc generator, designated as prototype B, was developed using a parallel circuitry (i.e., MP-P) design to reduce electrode resistance and increase overall electrical current. The use of parallel circuitry aimed to enhance the electrical flocculation process by providing multiple current paths, thereby reducing total circuit resistance compared to a series configuration. In a series circuit, the total resistance is the sum of the resistance values of each component, whereas in a parallel circuit, the total resistance is equal to the reciprocal of the sum of the reciprocals of the individual resistances. These principles are demonstrated by Eq. 3.1 and Eq. 3.2.

$$R_t(\text{series}) = R_1 + R_2 + R_3 + \dots R_n \quad \text{Eq. 3.1}$$

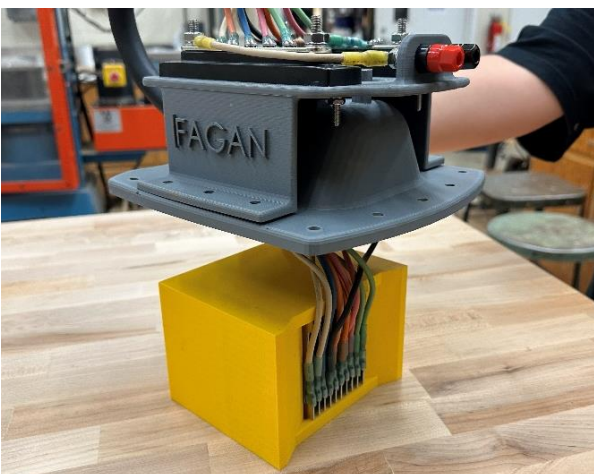
$$\frac{1}{R_t(\text{parallel})} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots + \frac{1}{R_n} \quad \text{Eq. 3.2}$$

Prototypes A and B shared identical electrode housing units, electrode spacing inserts, electrode materials (6061 aluminum), and comparable anodic surface areas. The primary distinction between the two prototypes was the top component design and the electrical wiring configuration. Prototype B's parallel circuitry design required each electrode to be individually wired, which necessitated the inclusion of tabs on the electrodes for wire attachment, shown in Figure 3.4. Each of the ten electrodes in prototype B had an individual surface area of 100.0 cm² (15.5 in.²), resulting in a total anodic surface area of 499.0 cm² (77.3 in.²). The slight reduction in anodic surface area compared to prototype A was due to the space allocated for attaching the wiring connectors and the elimination of the joining aluminum tabs.



Figure 3.4 Prototype B Electrodes.

Prototype B featured a redesigned top component to accommodate the wiring required for its parallel circuitry configuration. The modified top included a raised section designed to house the ten wires connecting each electrode to one of two bus bars. The two bus bars, one for anodes and one for cathodes, were fixed to the platform of the modified top component. An additional cover was designed and 3D-printed to enclose the bus bars. Figure 3.5 depicts prototype B fully constructed with the electrode wiring configuration and implemented into the lab-scale testing apparatus.



(a) electrode wiring



(b) electrode housing



(c) bus bars atop electrode housing



(d) electrode housing

Figure 3.5 Prototype B Floc Generator.

During evaluations of prototype B, the electrical current at the same applied voltage did not increase compared to the series configuration. Despite expectations that parallel circuitry would produce higher current density due to reduced plate resistance, the high electrical resistance of the water limited overall system performance. Therefore, lab-scale testing concluded that the series and parallel devices exhibited similar performance.

3.3 Prototype C

Prototype C incorporated a larger 3D-printed electrode housing to accommodate 20 larger aluminum electrodes. The filament used for printing this prototype was polyethylene terephthalate

glycol (PETG) which is known to be stronger and more durable than PLA. The design consists of four separate components: two end caps, a middle coupling, and an electrode spacing insert. Prototype C measures 47.2 cm (18.6 in.) in length, with a width and height of 14.7 cm (5.8 in.), Figure 3.6. The flanges that connect these components extend outwards by approximately 2.54 cm (1 in.) in all directions. The electrode spacing insert was designed to fit within the middle coupling and has dimensions of 19.8 cm by 14.22 cm by 14.22 cm (7.8 by 5.6 by 5.6 in.). Circular attachment outlets, each with a diameter of 5.1 cm (2 in.), were included to facilitate connections to 5.1 cm (2 in.) PVC pipes. These PVC connections enabled easy integration into both lab-scale and field-scale testing systems.

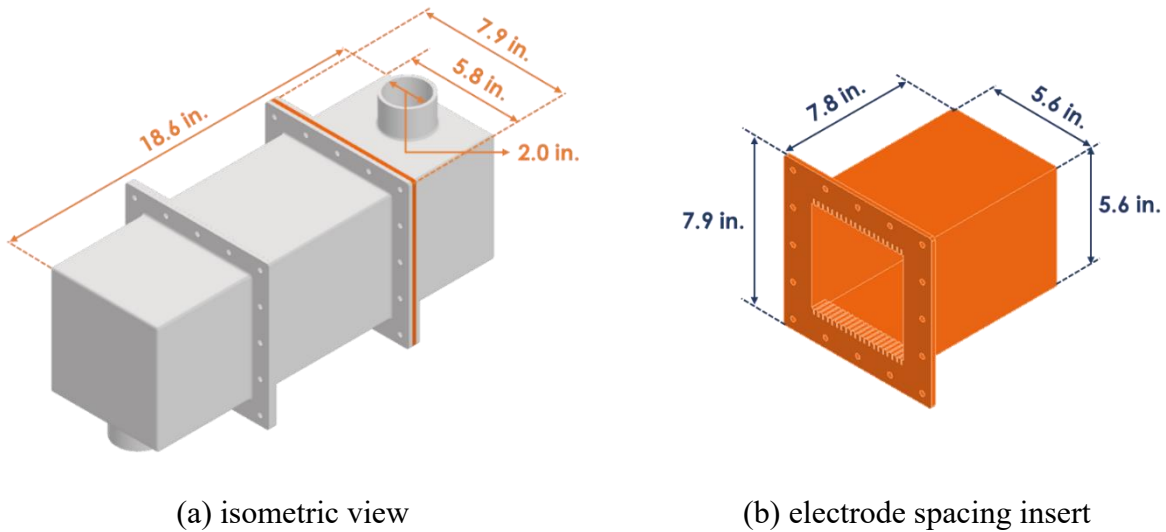


Figure 3.6 Full-Scale Floc Generator Dimensions.

The PVC connection orifices were positioned on opposite sides of the device to allow the electrodes to be fully saturated during evaluations. The inflow path was designed to direct sediment-laden water into the bottom of the floc generator and discharge it through the top, as illustrated in Figure 3.7. To guide the flow into the device while it remained in a horizontal orientation, 5.1 cm (2 in.) PVC elbows were used, as shown in Figure 3.7(c).



(a) wiring for electrodes



(b) electrode housing



(c) EC installed in bench-scale testing system

Figure 3.7 Prototype C Floc Generator.

Similar to prototypes A and B the electrodes were fabricated from 1 mm (0.04 in.) thick grade 6061 aluminum, maintained an interelectrode distance of 1.3 cm (0.5 in.), and were precision

cut using a water jet. In contrast to prototypes A and B, the electrode size in prototype C was increased to reduce plate resistance and enhance electrical flocculation performance. Each electrode had a surface area of 261.9 cm^2 (40.6 in.^2) and an anodic area of $2,619.4 \text{ cm}^2$ (406.0 in.^2), which is 5 times larger than the electrodes used in prototypes A and B. The electrodes, measuring 19.6 cm (7.7 in.) in length and 13.5 cm (5.3 in.) in width, were designed to fit within the electrode spacing insert, as shown in Figure 3.8.

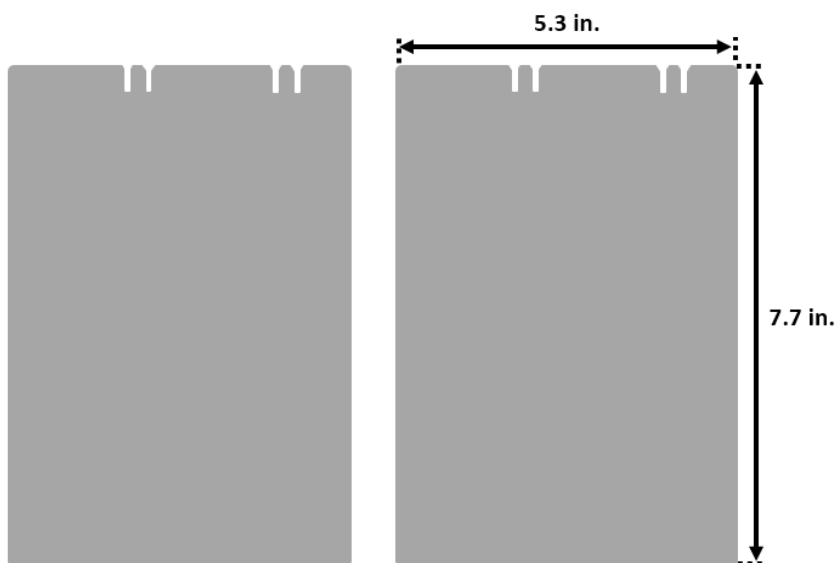


Figure 3.8 Prototype C Electrodes.

Thick rubber gaskets (0.63 cm or 0.25 in.) were positioned on either side of the electrode spacing insert to create a watertight seal. The electrodes were oriented vertically within the device, aligning with the flow path. Based on the comparable performance of series and parallel circuitry observed in prototypes A and B, series circuitry was selected for prototype C, as shown in Figure 3.9. The two end electrodes were connected to a primary wire extending through the device to the power supply. A watertight cord connector was incorporated to allow the wire to pass through the housing without causing leaks or short circuits.

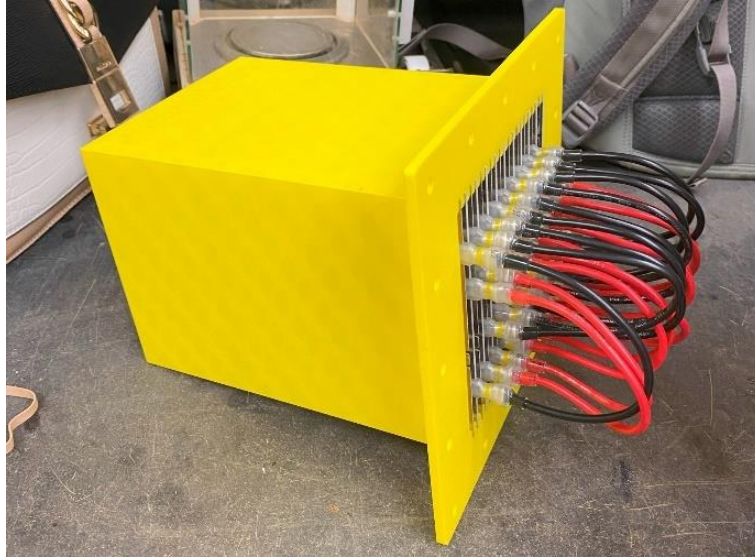


Figure 3.9 Prototype C Electrode Wiring.

On the upstream side of the device, a 3D-printed baffle was employed to prevent the entrapment of debris between the electrodes. The baffle featured orifices with a total open area of 38.0 cm^2 (5.9 in.^2), Figure 3.10. Further, thick rubber gaskets 0.63 cm (0.25 in.) bounded either side of the baffle plate to ensure effective waterproof sealing.

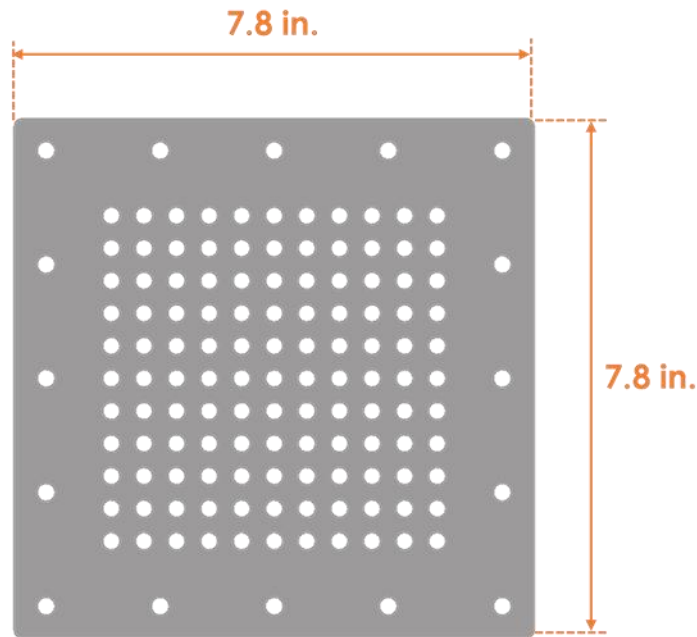


Figure 3.10 Upstream Baffle in Prototype C.

3.4 Prototype D

Prototype D was designed to incorporate an electrode spacing insert housed within readily available materials, making it compatible with commonly used stormwater BMPs and post-construction practices. PVC was selected for the housing due to its durability and widespread availability on construction sites. The floc generator was refined to allow retrofitting into various sizes of PVC piping, with the first version of the prototype designed specifically for integration into a 30.5 cm (12 in.) PVC pipe, as shown in Figure 3.11.

Previous prototypes required over 32 bolts for electrode access, complicating assembly and maintenance. Prototype D addressed this limitation by integrating the device into the PVC pipe with rubber or PVC couplings to attach the device to existing PVC, allowing for easier installation and removal. Further, the printed cartridge was designed with a handle to easily remove the device from the PVC housing.



(a) 12-in. prototype D in PVC



(b) top view



(c) front view

Figure 3.11 Prototype D: 12-in. Model.

Similar to the previously discussed prototypes, the electrode spacing insert for prototype D maintained an interelectrode distance of 0.5 cm (0.2 in.), and the plates were precision cut using

a water jet. In contrast, the grade of aluminum used for the 12- and 6-in. prototype D's electrodes were comprised of grade 1100 aluminum (commercially pure aluminum). For this prototype, 28 electrodes were used in the device, each with a length of 15.2 cm (6.0 in.) and a width of 17.5 cm (6.9 in.). The individual area of each electrode was 261.9 cm² (40.6 in.²) and an anodic surface area of 3,669.7 cm² (568.8 in.²). Further refinements were made to the floc generator to ensure reliable and easy use. To improve accessibility and eliminate the need for wiring to each electrode, the design replaced slip-on wire connections with a more reliable configuration. Prototype D utilizes 0.6 cm (0.25-in.) threaded aluminum rods to connect all cathodes and anodes, significantly reducing the risk of connection detachment. Electrodes are aligned using alternating small and large orifices, ensuring proper contact with the rod, as shown in Figure 3.12.

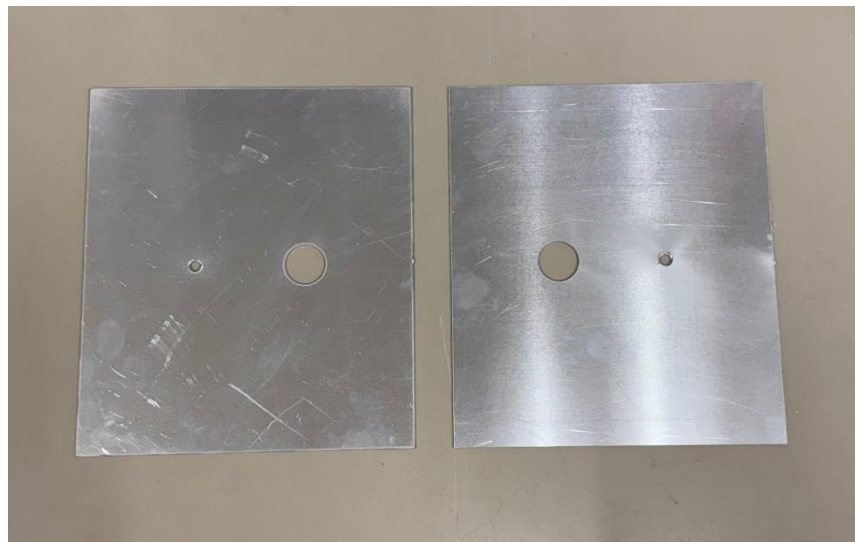


Figure 3.12 Prototype D Electrodes: 30 cm (12 in.) Model.

To build on the 12-in. PVC prototype developments, the focus shifted to optimizing material costs and maintaining design efficiency. Following the construction and evaluation of the 12-inch modular prototype, a cost analysis of various PVC pipe sizes was conducted. The analysis revealed approximate costs of \$47, \$39, \$27, and \$7 per linear foot for 30.5, 25.4, 20.3, 15.2 cm (12, 10, 8, and 6 in.) PVC, respectively. Based on this analysis, a 15.2 cm (6 in.) PVC prototype

was selected for development to reduce material expenses while preserving functional performance. The design includes two sets of identical side components, simplifying the 3D printing process and assembly. The handle components and the electrode spacing insert are separate parts joined together by #8 hex screws, washers, and hex nuts. An exposed middle section was incorporated to facilitate electrode plate length adjustments, shown in Figure 3.13.

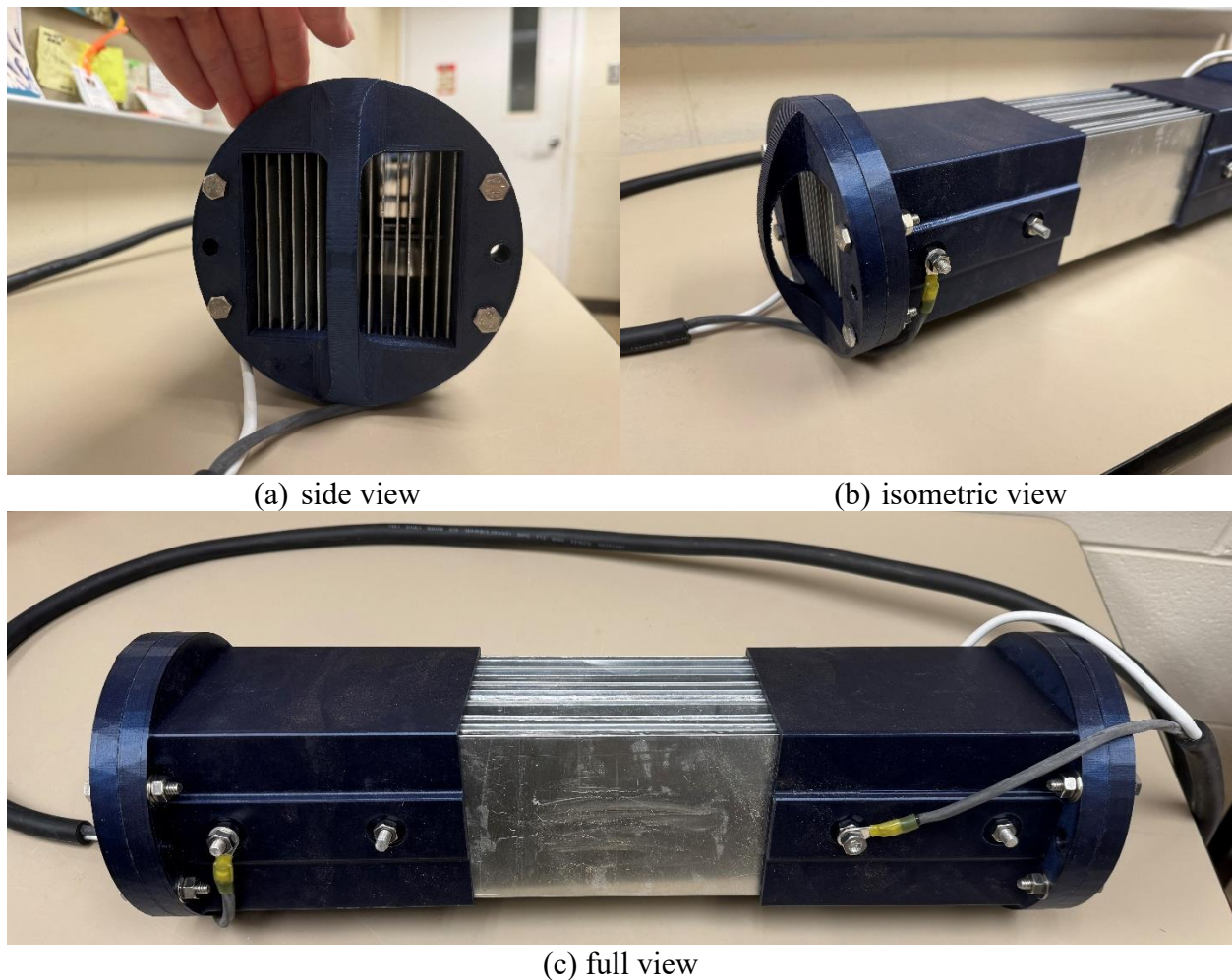


Figure 3.13 Prototype D: 15.2 cm (6 in.) Model.

The 15.2 cm (6 in.) PVC prototype was designed to maintain the electrode surface area equivalent to the 30.5 cm (12 in.) prototype, ensuring consistent efficiency. The 15.2 cm (6 in.) prototype D is 55.9 cm (22.0 in.) in length with electrodes that have dimensions of 42.7 cm by 9.8

cm (18 in. by 3.85 in.), Figure 3.14. Prototype D was designed to accommodate 16 electrodes with an individual area of 440.6 cm^2 (68.3 in.^2) and an anodic area of $3,526.4 \text{ cm}^2$ (546.6 in.^2). Electrodes are connected via a 0.64 cm (0.25 in.) threaded metal rod, with two wires linking the rods to the power source to minimize wiring requirements, identical to the 30.5 cm (12 in.) prototype D configuration. The 15.2 (6 in.) prototype D has two sets of 0.61 cm (0.24 in.) orifices and two sets of 1.91 cm (0.75 in.) orifices to allow for both ends of the electrodes to be connected to the positive and negative wires. A 30.5 cm (12.0 in.) jumper cable was used to connect the two positively charged rods and then the two negatively charged wires.



Figure 3.14 Prototype D: 6-in. Model Electrodes.

3.5 Automation of Device Controls

To support preliminary electrode longevity testing and field evaluations of the floc generator, an automated polarity reversal system was developed. A microcontroller was programmed to alternate electrode polarity every 5 minutes, based on findings from the literature indicating that frequent polarity switching can reduce fouling on the cathode surface. The controller was designed using an Arduino Mega, H-bridge module, relay module, and an OLED display. The Arduino Mega

serves as the central microcontroller, coordinating the timing and logic for polarity switching. The H-bridge is responsible for reversing the current direction through the floc generator's electrodes by toggling the polarity of the 12V power supply. A relay module is integrated to isolate and safely control the high-current flow, providing additional protection and ensuring safe switching during the polarity reversal process. The OLED screen provides real-time visual feedback by displaying which polarity direction is currently active. Indicator lights, red and blue, were also wired to signal the active polarity in real time. These components can be found in Figure 3.15. Together, these components create an automated system that extends electrode life and maintains treatment efficiency by periodically reversing polarity in the electrical flocculation process.

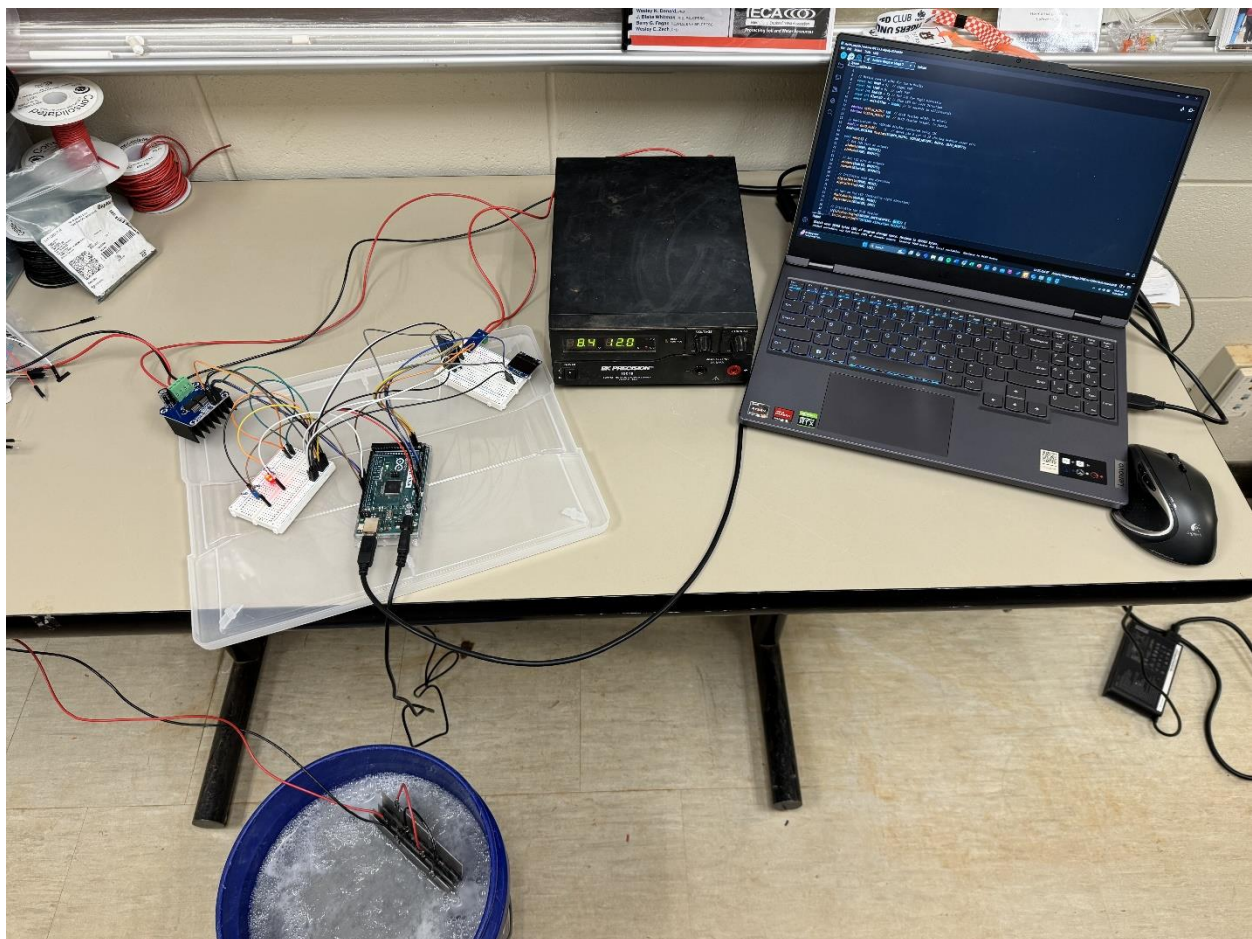


Figure 3.15 Programming a Microcontroller for Polarity Reversal.

3.6 Summary

This chapter detailed the design and development of four flocculation generator prototypes, forming the foundation for scalable and adaptable electrical flocculation devices for stormwater treatment. Each prototype incorporated lessons from earlier designs to improve performance, fabrication, and field applicability. Prototypes A and B were smaller reactors fabricated with 3D-printed PLA components and precision-cut aluminum electrodes. Prototype A used a monopolar-series configuration, while prototype B used a monopolar-parallel design to assess differences in electrical resistance between electrode circuitries. Despite its theoretical advantages, the parallel configuration in prototype B performed similarly to the series configuration in prototype A, likely due to the high electrical resistance of water limiting current flow. As a result, prototype C retained the monopolar-series circuitry but increased the electrode surface area and utilized more durable material, PETG, allowing for both lab and preliminary field testing. The reactor also featured integrated PVC connections and a flow baffle. Prototype D prioritized field practicality and cost-effectiveness. The electrode spacing cartridge for prototype D was housed in standard PVC pipe, simplifying installation and wiring using threaded aluminum rods. A 30.5 cm (12 in.) version was developed first, followed by a 15.2 cm (6 in.) model that maintained the same electrode surface area while reducing material costs and assembly time. These prototypes were designated as 30.5 cm (12 in.) and 15.2 cm (6 in.) based on their compatibility with 30.5 cm (12 in.) and 15.2 cm (6 in.) PVC pipe, respectively. To support extended use and reduce fouling, an automated polarity reversal system was integrated using an Arduino-based controller, extending electrode longevity and improving operational consistency.

CHAPTER FOUR: BENCH-SCALE METHODOLOGY

4.1 Overview

Intermediate-scale testing was conducted at the Auburn University Stormwater Research Lab to evaluate the performance of the first three of the four floc generator prototypes designed and developed through this project. These prototypes were evaluated in a controlled testing system to ensure that the system was designed to produce replicable evaluations and consistent, comparable results across all tests. Testing aimed to assess how operational parameters such as voltage, current, current density, flow rate, specific SEC, mixing conditions, and electrode passivation influence treatment efficiency. Prototypes A and B underwent over 70 evaluations, while prototype C was subjected to extended testing focused on mixing optimization and electrode longevity. Prototype D was not evaluated in this intermediate-scale system for this study. Although the same core apparatus was used throughout, specific tests incorporated static mixers or an intermediate-scale lamella settler to observe how mixing and/or extended detention time affected testing. This section outlines the system, testing procedures, and sampling processes used to evaluate the performance of the prototypes under a range of controlled conditions.

4.2 Experimental Setup

To conduct evaluations, sediment was introduced to water to create a synthetic stormwater mixture. Figure 4.1 illustrates this setup, which was comprised of a garden hose connected to a pressure regulator and directed into a top funnel, where it was mixed with sediment. The pressure regulator was connected to a two-way splitter with two 1.5 m (5 ft) tubes inserted, each leading to ribbed elbows fitted into a 20.3 to 10.1 cm (8 to 4 in.) PVC coupler. The angled design of the elbows created a vortex inside the funnel, effectively mixing the water and sediment. The sediment was continuously fed to the system using a Schenck AccuRate[®], and was equipped with a 1.91 cm

(0.75 in.) diameter helix, a 7.1 L (1.9 gal) hopper, and a potentiometer for consistent auger speed. The auger introduced the sediment mixture into the system at a controlled and replicable rate.

Subsequently, the sediment-laden stormwater mixture was channeled into a 416 L (110 gal) trough and was briefly detained before activating the flotation device on the WAYNE® 1/3 Horsepower Cast Iron Submersible Sump Pump. This pump automatically transferred the synthetic stormwater into the 1040 L (275 gal) intermediate bulk container (IBC) tote, which stored the mixture for subsequent testing. To ensure a homogeneous mixture, the IBC tote was equipped with a Baldor VL3510 1 Horsepower Industrial Motor with a propeller for mixing. This system, for producing and storing synthetic stormwater, allowed for consistent and replicable evaluations.

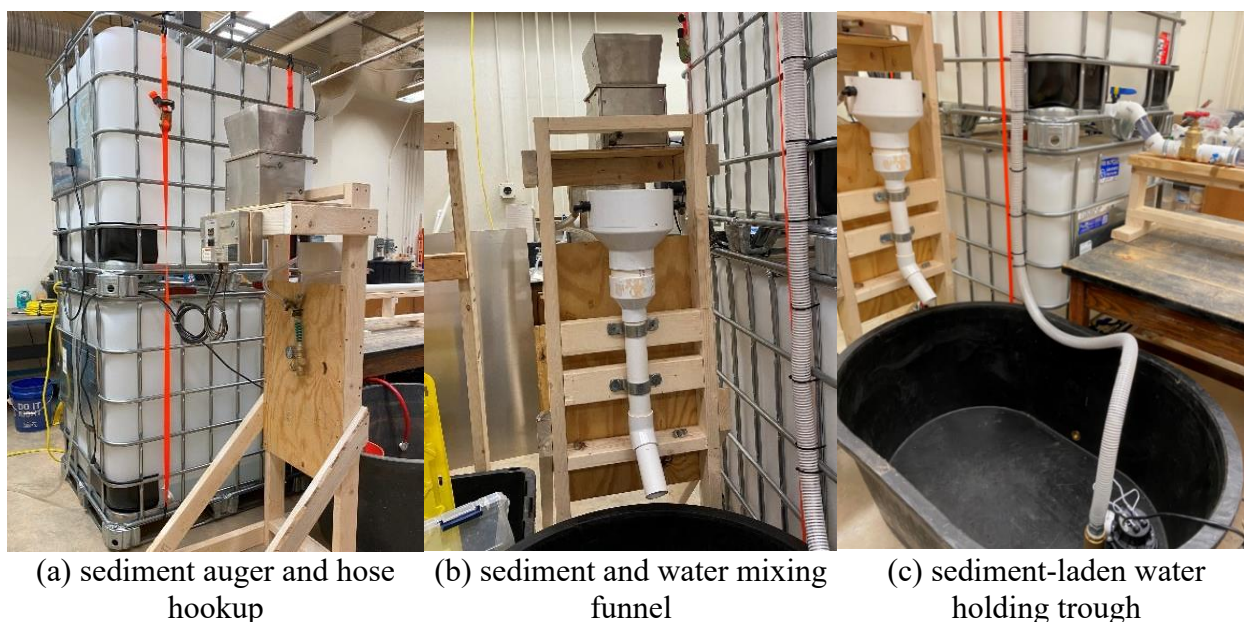


Figure 4.1 Synthetic Stormwater Prep Station.

To deliver synthetic stormwater to the floc generator prototypes, a system of 5 cm (2-in.) PVC piping and valves were assembled to direct sediment-laden water into the devices. The setup consisted of clear PVC piping incorporating an upstream gate valve, a sampling port, connection points for the floc generator prototypes, static mixers, a downstream gate valve, and a sediment

discharge valve, as shown in Figure 4.2. The sampling port was located upstream of the prototype connection to collect control samples of effluent from the stock tank. It included a 3D-printed elbow designed to extract water from the center of the pipe's flow profile. The prototype connection segment was equipped with two rubber couplings, allowing for quick installation and removal of the floc generator units during testing. Downstream of this section, a 0.6 m (2 ft) unobstructed PVC segment was intentionally left to accommodate static mixers. These mixers promote additional interaction between the in-situ generated coagulant and target pollutants. A downstream gate valve was used to regulate flow through prototypes. For prototypes A and B, an inclined section of PVC was incorporated at the effluent end of the system to ensure the electrodes remained fully submerged during operation. Full submersion is critical, as unsaturated portions of the electrodes are unable to perform the redox reactions required for coagulant generation. Prototype C, a more recent design shown in Figure 4.2(a), featured an improved housing that ensured constant electrode saturation without requiring the pipe inclination piece.



(a) intermediate-scale testing system



(b) upstream valve and sampling port

(c) elbow in sampling port

Figure 4.2 Intermediate-Scale Electrical Flocculation Testing System.

Overall, this system provided a consistent and controlled environment for evaluating the floc generator prototypes. It allowed for the regulation of testing parameters, including flow rate, turbidity, mixing intensity, and power consumption. By standardizing these conditions, the setup ensured reliable comparisons between prototypes and replicable test results across trials.

4.3 Testing Procedures

Five groups of evaluations were conducted to assess the performance of the floc generator under varying conditions. These groups are categorized as Fundamental Performance Evaluations, Aluminum Coagulant Release Evaluations, Mixing Evaluations, Electrode Longevity Evaluations, Pollutant Loading Evaluations, and Lamella Settler Evaluations. While all test groups used the same sediment mixture, synthetic stormwater, laboratory equipment, and general sampling methods, they differed in the use of static mixers, mixing durations, lamella settlers, and prototype configurations. Each test group will be described in detail in its respective subsection. This subsection provides an overview of the sediment mixture, laboratory equipment, and sampling procedures common to all intermediate-scale tests.

All experimental tests in this study used soil sourced from the Auburn University Stormwater Research Facility (AU-SRF), located in Opelika, Alabama. The soil's gradation was characterized using a wet sieve analysis, with results presented in Table 4.1. According to the United States Department of Agriculture (USDA) Web Soil Survey, the native AU-SRF soil consists of a mixture of Cecil sandy loam and Toccoa sandy loam. The wet sieve analysis further revealed that the soil composition was composed of approximately 34% clay, 5% silt, and 61% sand. Based on these percentages and referencing the USDA soil texture triangle, the soil was classified as a sandy clay loam.

Table 4.1 AU-SRF Soil Classification.

Type	Size (mm)	Percentage
Clay	<0.002	34%
Silt	0.002-0.05	5%
Sand	0.005-2.00	61%

A uniform mixture of soil passed through the No. 50, 100, and 200 sieves was introduced at a consistent rate of 92.4 g/min to maintain a consistent turbidity. The sieve opening sizes used for the soil mixture are detailed in Table 4.2. This specific gradation was selected to evaluate the prototypes' performance in treating particles that remain suspended in the water column and do not readily settle by gravity (i.e., colloids). The floc generator is designed to operate downstream of a pretreatment practice and targets microscopic colloidal particles that remain suspended for extended periods. These colloidal particles stay suspended primarily due to Brownian motion, which is the random movement caused by collisions with the faster-moving molecules in the surrounding fluid. The perpetual motion resulting from these collisions keeps the particles suspended. Additionally, colloids carry surface charges that create electrostatic repulsion, which prevents them from aggregating or settling out of the water column.

Table 4.2 Sieve Size with Particle Diameter.

Sieve No.	50	100	200
Particle Diameter (mm)	0.30-0.15	0.15-0.07	0.07-0.05

Once the sediment composition was finalized, experimental testing commenced. Testing began by filling a 416 L (110 gal) IBC tote with sediment-laden water, as described in the experimental setup subsection. Upon reaching the desired volume, gravitational discharge from the IBC tote introduced flow into the floc generator. To maintain sufficient hydrostatic pressure for consistent gravitational flow into the floc generator, the IBC tote was kept between 567 and 1,040 L (150 and 275 gal) throughout testing. Maintaining at least a 50% fill level also mitigated the potential for cavitation within the IBC's integrated mixer.

Prior to each experimental run, the turbidity of the stock solution was tested to ensure the synthetic stormwater was within a specific range. This was achieved by initiating flow through the PVC piping and collecting influent samples at the upstream sampling port. The target turbidity range for most evaluations was 650–750 NTU. Three replicate samples were collected, and the resulting turbidity values were averaged to establish the representative inflow condition. If any of the three values deviated from the target range, the sediment concentration in the stock tank was adjusted accordingly by adding either clean water (to dilute) or additional sediment (to concentrate) the solution.

Throughout the experimental testing, the flow rate was evaluated as a parameter to assess its influence on the treatment performance of the floc generator. Flow rate through the floc generator was quantified volumetrically by timing the duration required to fill a 2,000 mL (67.6 oz.) container across three replicates. The mean fill time was then used to compute the flow rate, which was subsequently converted from milliliters per second (mL/s) to gallons per minute (GPM) for consistency with system calibration and power consumption metrics. Once the desired flow and turbidity conditions were established, the BK Precision 1901B power supply (Figure 4.3) was connected to the floc generator and activated. Electrical current was applied across the aluminum electrodes, initiating electrochemical redox reactions. These reactions released aluminum cations (Al^{3+}), which hydrolyzed in situ to form aluminum hydroxide ($\text{Al}(\text{OH})_3$) flocs, serving as the primary coagulant responsible for destabilizing and aggregating colloidal particles in the water column.



Figure 4.3 BK Precision 1901B Power Supply.

After power had been supplied to the electrodes for a minimum of five minutes and the system had stabilized at the target flow rate, sample collection commenced. Upstream samples, representing untreated influent, were designated as “control,” while downstream samples, representing effluent following electrical flocculation treatment, were designated as “treated.” For each test, one control and one treated sample were collected. Each test series consisted of three sampling events, resulting in a total of three control samples and three treated samples per series, shown in Figure 4.4.

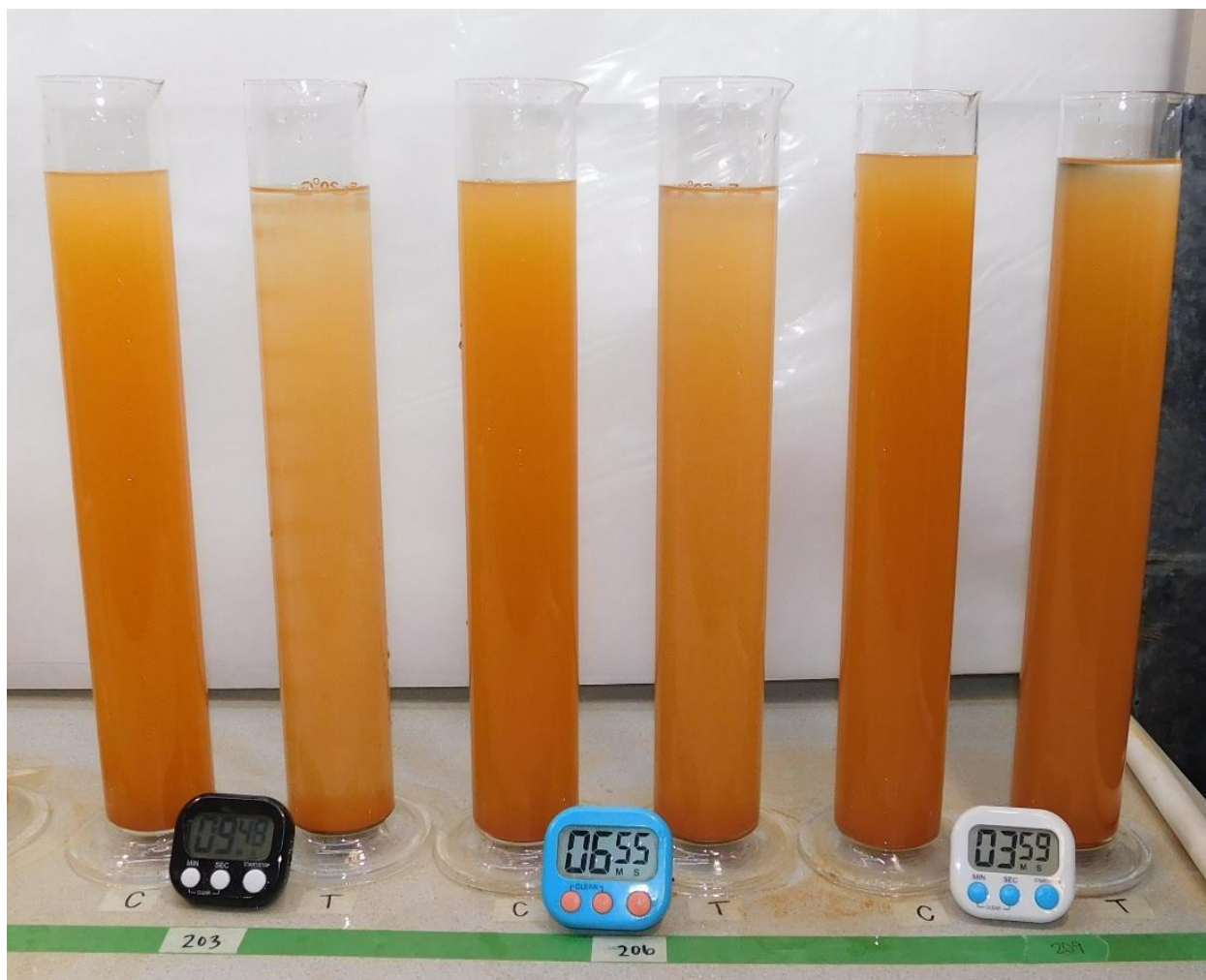


Figure 4.4 Intermediate-Scale Test Series.

Samples were collected using 2,000 mL beakers, with approximately 1,000 mL collected from the control valve and the treated effluent outlet. At the time of each sampling event, the current supplied to the electrodes was recorded. The measured amperage reflected the electrode surface area in the potentiostatic system (i.e., constant applied voltage). Following collection, samples requiring homogenization were immediately placed on a VWR® Advanced and Standard Multi-Position Stirrer with a 5.1 cm (2-in.) magnetic stir bar, as shown in Figure 4.5. To prevent cross-contamination, the left platform of the stirrer was used for control samples, and the right

platform to treated samples. Conductivity and pH measurements were conducted using a VWR® symPHony B40PCID Multimeter.



Figure 4.5 Mechanical Mixing Station.

After homogenization, the samples were transferred into 1,000 mL graduated cylinders for sedimentation analysis. Control and treated samples, collected simultaneously during each test, were poured into their respective graduated cylinders, and timing began immediately following transfer, shown in Figure 4.6(a). This procedure enabled both quantitative analysis and visual comparison of settling rates between the control and treated samples. All electric floc generator prototypes demonstrated effective floc formation, especially at lower flow rates, with the progression of floc development and settling illustrated in Figure 4.6(b).



(a) sample comparison between control and treated sample

(b) close-up of floc formation

Figure 4.6 Sample Set Comparison and Floc Formation.

Surface turbidity measurements of the samples in each graduated cylinder were determined using a Hach® 2300 Turbidimeter and Hach® Lab Turbidimeter sample cells. Turbidity was measured 8.9 cm (3.5 in.) below the surface of the sediment-laden water column in the graduated cylinders, shown in Figure 4.7. Approximately 30 mL (1 oz.) subsamples were collected in the sample cells at roughly 5-minute intervals, with the total sampling duration varying depending on the specific evaluation. Before each turbidity reading, the exterior of the sample cells was cleaned with KimTech® wipes to remove fingerprints or debris that could interfere with the optical reading, and the turbidity was immediately measured and recorded.



Figure 4.7 Intermediate-Scale Testing: Aliquots Extracted for Turbidity Analysis.

4.3.1 Fundamental Performance Evaluations

This experimental group of test series was designed to comprehensively evaluate the performance of three distinct prototypes: A, B, and C. These evaluations were conducted across 64 test series under varying operational conditions with a focus on optimizing the electrical flocculation prototype. Testing was structured to systematically isolate and assess the influence of parameters, including flow rate, electrical circuitry configuration, and applied voltage, on treatment performance. Prototypes A and B were the focus of the initial testing phases, which were subjected to 25 and 21 individual test series, respectively. As described in Chapter 3, these prototypes shared identical electrode surface areas, reactor volumes, and designs but differed in electrical configuration. Prototype A used an MP-S configuration, while prototype B employed a monopolar parallel MP-P configuration to evaluate the effect of electrode wiring on electrical

flocculation performance. After establishing baseline electrical performance with prototypes A and B, prototype C was subjected to 14 additional test series.

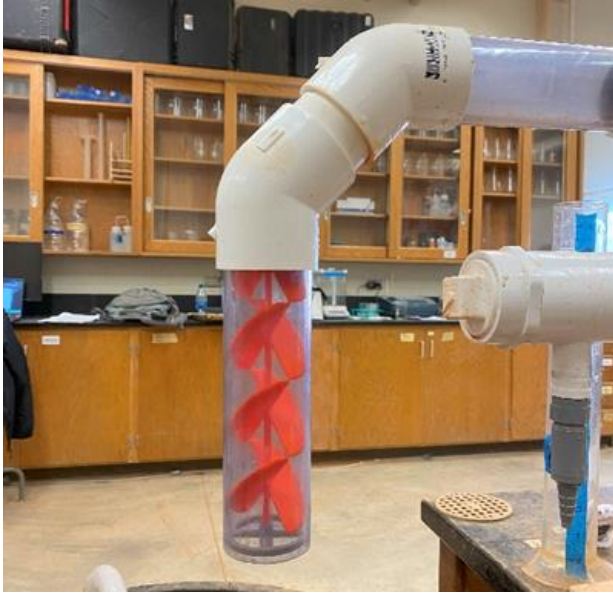
Further, voltages of 6, 12, and 24 volts were applied during tests 1 through 43 using prototypes A and B to determine the optimal voltage for effective electrical flocculation. The results of this testing demonstrated that 12 volts provided the best balance of current delivery and flocculation efficiency. Consequently, 12 volts was selected as the standardized operating voltage for all subsequent testing, including all intermediate-scale testing conducted with prototype C. All 64 tests were conducted within a turbidity range of 214 to 1,452 NTU, with the majority of evaluations occurring between 600 and 800 NTU to reflect typical sediment concentrations expected to emanate from a pretreatment stormwater practice.

Throughout all 64 test series, samples were mixed using a magnetic stirrer to facilitate interaction between the coagulant and suspended sediment. Both control and treated samples underwent identical mixing procedures to maintain consistency and ensure valid comparative results. Although mixing was not required for the control (i.e., untreated) samples, they were stirred alongside the treated samples at a standardized setting of speed 3, approximately 360 rotations per minute (RPM), for 8 minutes. This approach eliminated potential variability due to differences in sample handling. Detailed procedures for surface turbidity sampling are provided in Subsection 4.2.

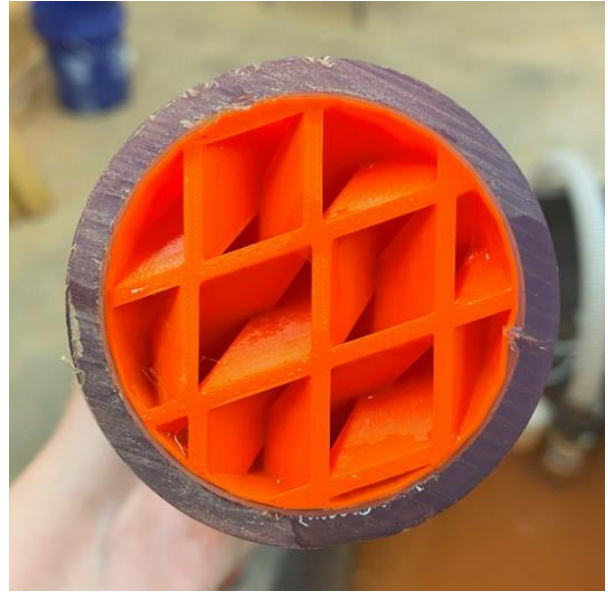
4.3.2 Mixing Evaluations

Mixing is important for the electrical flocculation process to be effective. Without adequate mixing, the interaction required for destabilizing and aggregating suspended solids would remain incomplete, limiting the system's settling performance. To assess mixing, a standardized mixing methodology was used during intermediate-scale testing to evaluate the influence of static and

mechanical mixing on electrical flocculation performance. The first phase of mixer testing, Phase I, evaluated the effectiveness of various in-line passive mixers in promoting floc formation. Four mixer designs were tested by installing them individually within a 5.1 cm (2 in.) PVC pipe downstream of the floc generator sampling apparatus. These designs included two static mixers: version 1 (20.3 cm (8 in.), Figure 4.8(a)) and version 2 (7.6 cm (3 in.), Figure 4.8(b)); a chain mixer consisting of 4.6 m (15 ft) of chain placed inside a PVC pipe (Figure 4.8(c)); and a 30.5 cm (12 in.) dust cyclone (Figure 4.8(d)). Each mixer was tested independently to evaluate its ability to generate turbulence and promote interaction between the coagulant and suspended solids. Static mixers were selected instead of mechanical mixers such as impellers, overhead stirrers, or magnetic stirrers to avoid using additional electrical power; the available 12-volt battery was reserved exclusively for powering the floc generator.



(a) static mixer version 1



(b) static mixer version 2



(c) hardware chain mixer



(d) dust cyclone mixer

Figure 4.8 Passive Mixers Evaluated.

Samples requiring additional mechanical mixing were placed on a magnetic stirrer at speed 3 (approximately 360 RPM) for 8 minutes. After mixing, samples were transferred to graduated cylinders for sedimentation analysis, following the procedures outlined in Section 4.2. Turbidity aliquots were collected at 5-minute intervals over a 30-minute settling period, providing data for direct comparison of turbidity reduction across all four mixing conditions. The primary objective

of Phase I was to evaluate the relative effectiveness of passive in-line mixing compared to controlled mechanical stirring. Each of the four mixer designs underwent this testing, resulting in 12 individual test series.

Further, Phase II of mixer testing expanded the evaluation by testing static mixer versions 1 and 2 in varying quantities, specifically 10, 20, and 30 individual static mixers installed in sequence, to determine how increasing the number of mixers affected treatment performance. Separately, magnetic mixing was assessed across a range of mixing durations, including 15 seconds, 30 seconds, 45 seconds, 1 minute, 2 minutes, 3 minutes, 4 minutes, and 5 minutes, to better define the relationship between mechanical mixing time and turbidity reduction. A constant mixing rate of approximately 360 RPM, corresponding to speed setting 3 on the magnetic stirrer, was used for all evaluations. For Phase II, only treated effluent samples were collected for individual evaluations, with three treated samples comprising each test series. Upstream control samples were collected once during the Phase II testing, consisting of three replicates to provide a baseline comparison for all subsequent mixing evaluations. To further support comparisons, three additional treated effluent samples were taken without any static mixers or mechanical mixing. The intent of this approach was to generate a dataset capable of isolating the effects of both static mixer quantity and magnetic mixing duration on flocculation performance. These results built upon the findings of Phase I, providing a more comprehensive understanding of mixing influences on electrical coagulation treatment outcomes.

4.3.3 Electrode Longevity Evaluations

Electrode longevity evaluations were conducted to assess the operational lifespan and performance stability of the electrodes in Prototype C. This assessment simulated extended operational periods without maintenance to evaluate electrode durability, fouling potential, and the

corresponding impacts on treatment performance. The test was conducted over a cumulative 100-hour duration with Prototype C, using 6061 aluminum electrodes, and operating at a constant applied voltage of 12 volts. Power was supplied in continuous intervals of 2 to 3 hours, with no mechanical cleaning, electrode maintenance, or internal adjustments performed throughout the testing period. This testing approach reflected realistic operational conditions in which system maintenance may be infrequent or delayed. For example, if deployed on the effluent end of a floating surface skimmer within a sediment basin, the floc generator could be continuously operated for 48 to 72 hours, which corresponds to typical dewatering durations.

A constant flow rate of 18.9 L/min (5.0 GPM) was maintained throughout the 100-hour longevity test. This flow rate was selected to balance inflow and outflow, ensuring the stock tank remained at or above 50% full due to the inflow capacity of the garden hose and sediment delivery system. A lower flow rate, such as 3.8 L/min (1.0 GPM), would have been impractically slow and unrepresentative of field conditions, while a higher rate, such as 37.9 L/min (10.0 GPM), would have outpaced the available inflow, leading to inconsistent testing conditions. The sediment-laden influent consistently exhibited turbidity concentrations between 650 and 750 NTU, providing uniform conditions for evaluating both treatment performance and electrode degradation over time.

Throughout the 100-hour testing duration, electrical performance was monitored by recording the amperage delivered to the electrodes at consistent 5-minute intervals. This allowed for tracking changes in current draw over time and provided insight into electrode passivation and degradation that is associated with prolonged use of the electrodes. Water quality evaluations were conducted simultaneously by collecting two to three test sets per hour. To isolate the effects of electrical flocculation on turbidity reduction, no additional mixing with static mixers or magnetic

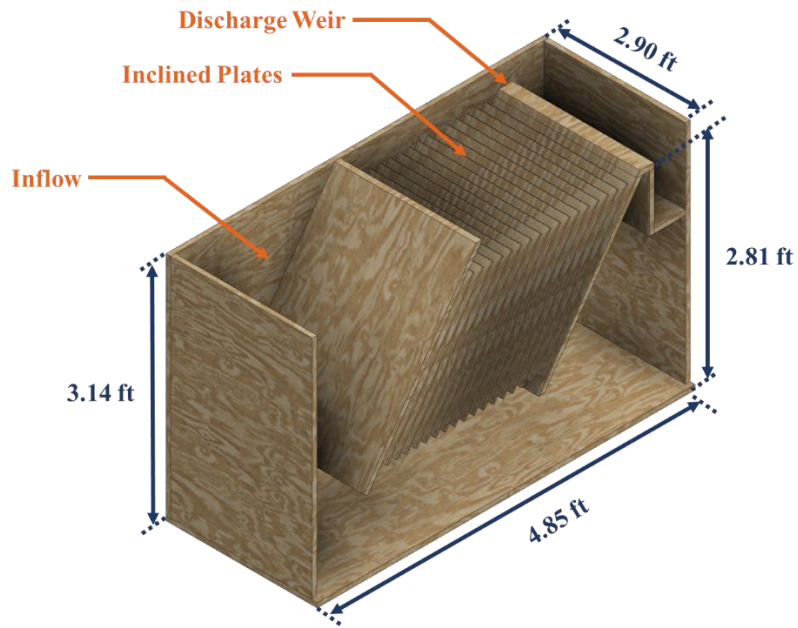
stirring was performed. Following collection, the samples were transferred to 1,000 mL graduated cylinders for sedimentation evaluation. Surface turbidity measurements were recorded at 5-minute intervals over a 30-minute period, following the procedures outlined in Section 4.2.

A common mitigation strategy for electrode passivation and fouling is the use of polarity reversal at set intervals. An additional longevity evaluation was conducted using new electrodes installed in prototype C, with polarity reversal applied every five hours. Current was supplied to the electrodes for a total duration of 32 hours, following the same procedures used in the standard longevity testing series. The results indicated that the 5-hour polarity reversal did not provide any noticeable improvement in treatment performance or electrical current delivery when compared to the 100-hour continuous testing without polarity reversal. Based on these findings, an additional longevity evaluation has been planned to assess the effects of more frequent polarity reversal, using a 5-minute reversal interval. This future testing will follow the same procedures but will be conducted after the completion of this dissertation and is not included in the present analysis.

4.4 Lamella Settler

For evaluations including the intermediate-scale lamella settler (i.e., pollutant loading evaluations), a settling tank was integrated at the effluent end of the PVC channel system to capture and promote gravitational settling of flocs. A lamella settler was chosen as the settling mechanism for the intermediate-scale testing setup. Also known as an inclined plate settler or parallel plate separator, this device is commonly used in wastewater treatment to enhance sedimentation efficiency. It consists of multiple closely spaced, inclined plates that provide a large effective settling area within a compact footprint. The inclination reduces the vertical distance particles must settle, improving the separation of suspended solids.

The intermediate-scale lamella settler includes a separated inflow zone, 19 inclined plates, and a discharge weir, shown in Figure 4.9. The settling box was constructed from 1.9 cm (0.75 in.) pre-treated plywood and reinforced with nominal 2x4 lumber around the top, middle, and bottom edges to enhance structural stability. The inclined plates, made from 6.4 mm (0.25 in.) plywood, were positioned at a 55-degree angle within the settling box. 1.27 cm (0.5 in.) PVC was mounted on the side walls to create channels for secure placement of the inclined plates during operation and easy removal for dredging and maintenance.



(a) lamella settler schematic



(b) side view without plates



(c) back view without plates



(d) side view with plates



(e) back view with plates

Figure 4.9 Intermediate-Scale Lamella Settler.

The overall dimensions of the lamella box were 1.47 m (4.85 ft) in length, 0.88 m (2.90 ft) in width, and 0.96 m (3.14 ft) in height, with the weir set at 0.86 m (2.81 ft). The total volume of the settler was 1,253 L (331 gal), with an operational water volume up to the weir of 1,120 L (296 gal). This configuration effectively enabled floc separation and supported downstream water quality assessments under controlled conditions.

The intermediate-scale lamella settler was used for pollutant loading evaluations. These evaluations operated under a constant applied voltage of 12V, which consistently drew approximately 12A from the electrodes. The flow rate was maintained at 37.9 L/min (10.0 GPM) for all six samples obtained, including three control and three treated. The system filling time for the lamella settler was approximately 45 minutes. Although the expected filling time for the 1,120.5 L (296-gal) volume was 30 minutes, the presence of minor leaks throughout the setup extended the filling duration. For each of the three sample sets, three treated samples and three control samples were collected when the weir at the top of the lamella settler overtopped at the conclusion of the 45-minute filling period. These samples were collected in clean 16-oz. mason jars and refrigerated until sent off for water quality analysis.

4.5 Summary

Intermediate-scale testing at the Auburn University Stormwater Research Lab was conducted to evaluate the performance of the first three floc generator prototypes, A, B, and C, under controlled conditions. The objective was to determine how operational variables such as voltage, current, current density, flow rate, SEC, mixing, and electrode passivation influenced treatment efficiency. Prototypes A and B underwent over 70 tests, while prototype C received additional testing to evaluate mixing strategies and electrode durability. A standardized synthetic stormwater mixture

was created using site-specific soil and a controlled auger system, allowing consistent turbidity levels between 650 and 750 NTU for the majority of evaluations. The mixture was delivered through a PVC system equipped with valves, sampling ports, and optional static mixers. Testing was organized into five categories: Fundamental Performance, Aluminum Release, Mixing, Electrode Longevity, and Pollutant Loading Evaluations. Fundamental performance testing involved 64 test series across prototypes A, B, and C to assess the impact of flow rate, voltage (6, 12, and 24V), and circuit configuration. Mixing tests assessed both passive and mechanical methods to determine their influence on flocculation. Electrode longevity testing included a continuous 100-hour run of prototype C to evaluate long-term performance, with additional polarity reversal evaluations conducted. To allow detention for pollutant loading samples, a lamella settler was integrated downstream of the system. The settler unit included 19 inclined plates and an operational volume of 1,120 L (296 gal), enhancing floc separation through gravitational settling. Standardized procedures and consistent operating conditions throughout all evaluations ensured reliable comparisons of treatment performance across prototypes and testing configurations.

CHAPTER FIVE: FIELD-SCALE METHODOLOGY

5.1 Overview

Field-scale testing was conducted at the AU-SRF to assess prototype performance under various flow rates, including flows exceeding 75.7 L/min (20.0 GPM), which represented the highest flow reached during intermediate-scale testing. Two floc generator prototypes, prototypes C and D, were evaluated in the field-scale testing system. Each prototype was assessed using a distinct testing methodology. Prototype C was tested in December 2023, while Prototype D was evaluated in October and November 2024. Testing approaches differed between the two prototypes. For example, prototype C testing incorporated static mixers and a lamella settler, whereas Prototype D evaluations were conducted without these components. During prototype D evaluations, flow rates were adjusted and monitored using a constructed weir box.

5.2 Prototype C Experimental System

For the field-scale evaluation of prototype C, the floc generator prototype was placed in the discharge outlet of a floating surface skimmer in a sediment basin. The sediment basin used was originally designed and constructed at the AU-SRF in 2014 and has been used for various research testing on large-scale sediment basins (Perez 2016), as shown in Figure 5.1. Alabama Department of Transportation (ALDOT) standard details for sediment basins were used to construct the basin. When the basin was originally constructed, the excavated footprint of the sediment basin measured 17.1 m (56 ft) long by 8.5 m (28 ft) wide at the top and 13.4 m (44 ft) long by 4.9 m (16 ft) wide at its base. The basin had a primary stormwater storage volume of 79 m³ (2,790 ft³) when the water depth reached 1.1 m (3.5 ft). The auxiliary spillway is activated as the stage exceeds 1.1 m (3.5 ft). The primary outlet, a floating surface skimmer, was placed in the basin with the discharge pipe

sitting approximately 0.12 m (0.4 ft) above the basin floor. Before testing commenced, the entire channel and basin were re-lined with a non-woven 8-oz. geotextile.



Figure 5.1 Field-Scale Sediment Basin.

Sediment-laden inflow into the sediment basin is guided through a 27.4 m (90 ft) long geotextile-lined channel, which comprises a longitudinal slope of 5% and a total channel depth of 1.2 m (4 ft). The channel design incorporated a bottom width of 1.2 m (4 ft), side slopes of 2:1 (H:V), and a top width of 1.2 m (20 ft), Figure 5.2 depicts the channel, which beneath the geotextile is armored with Flexamat® tied concrete block mat.



Figure 5.2 Field-Scale Basin Inflow Channel.

Upstream of the inflow channel is a water and sediment introduction system constructed on a 2.4 by 3.0 m (8 by 10 ft) concrete pad. The system includes a pump setup with three semi-trash pumps, two with 10.2 cm (4 in.) outflow ports and one with a 7.62 cm (3 in.) outflow port, along with a 1,136 L (300 gal.) equalizing tank equipped with both inlets and outlets (Figure 5.3), a controlled discharge weir, and a soil-water mixing trough. Water is pumped from the upper storage pond to the equalizing tank positioned upstream of the basin channel. The pump system was used solely for conducting field-scale testing and did not operate or assist the floc generator cartridge(s). Flow entering the test channel is measured using a rectangular weir plate mounted on the face of the equalizing tank. This plate is designed for easy interchangeability to accommodate varying flow ranges.



Figure 5.3 Flow Introduction System for Field-Scale Testing.

5.2.1 Baffle Design

Porous baffles are commonly used in sediment basins to improve the overall efficiency of the basin by spreading flow across the width of the basin. When sediment-laden runoff flows through the baffle, flow is uniformly distributed across the width of the basin which reduces runoff velocity. The combination of spreading flow and reduced velocity enhances sediment retention and reduction in the size of the deposited sediment particles (Rivers and McLaughlin 2015). ALDOT standard details and specifications (Alabama Department of Transportation 2010) details three rows of wire-backed coir baffles. Studies have shown that the first baffle dissipates majority of the runoff's velocity, which typically results in increased sediment deposition (Thaxton et al. 2003). Considering these findings, a single wire-backed coir baffle was installed in the sediment basin at the first baffle location. The first baffle location is defined in Alabama as a fourth of the bottom length of the basin from the mouth of the basin. Since the bottom length is 13.4 m (44 ft), the baffle was placed 3.4 m (11 ft) from the basin entrance, Figure 5.4. The baffle was installed by first

spacing 1.5 m (5 ft) steel studded t-posts 1.2m (4 ft) apart and attaching a wire backing that extended along the entire width of the basin and up the side slopes. Next, the coir netting was placed on both sides of the wire backing and secured using 15 cm (6.0 in.) steel U-shaped sod staples, which were applied every 15 cm (6.0 in.). The single baffle height was set at the primary stormwater storage depth of 1.1 m (3.5 ft).



Figure 5.4 Field-Scale Baffle Design.

5.2.2 Settling System Design

To evaluate the effects of detention downstream of the floc generator prototype in the field-scale apparatus, a lamella settler was used. The field-scale lamella settler comprises a separated inflow region, 38 slanted plates, and a discharge weir, as illustrated in Figure 5.5. The field-scale lamella settler was constructed for a previous project but was refurbished and used for this project. Construction involved the use of 19 cm (0.75 in.) thick plywood and nominal 2x4 lumber, along with 6.4 mm (0.25 in.) thick plywood plates. To ensure stability during testing and facilitate easy removal for dredging, 13 cm (0.5 in.) PVC channels were integrated into the side walls, which

allowed the plates to be easily removed. The PVC channels create a 55-degree plate angle, the standard angle used in lamella settlers. This settling box followed a similar configuration to the intermediate-scale settler; however, the field-scale settling box was constructed with a larger volume and included additional plates.



Figure 5.5 Field-Scale Lamella Settler.

The field-scale lamella settler dimensions include a length of 2.5 m (8.3 ft), a width of 1.2 m (4.0 ft), a total height of 1.2 m (3.8 ft), and a weir height of 1.1 m (3.5 ft), shown in Figure 5.6. The settler's overall volume is 3,585 L (947 gal.), with a water volume up to the weir of 3,339 L (882 gal.).

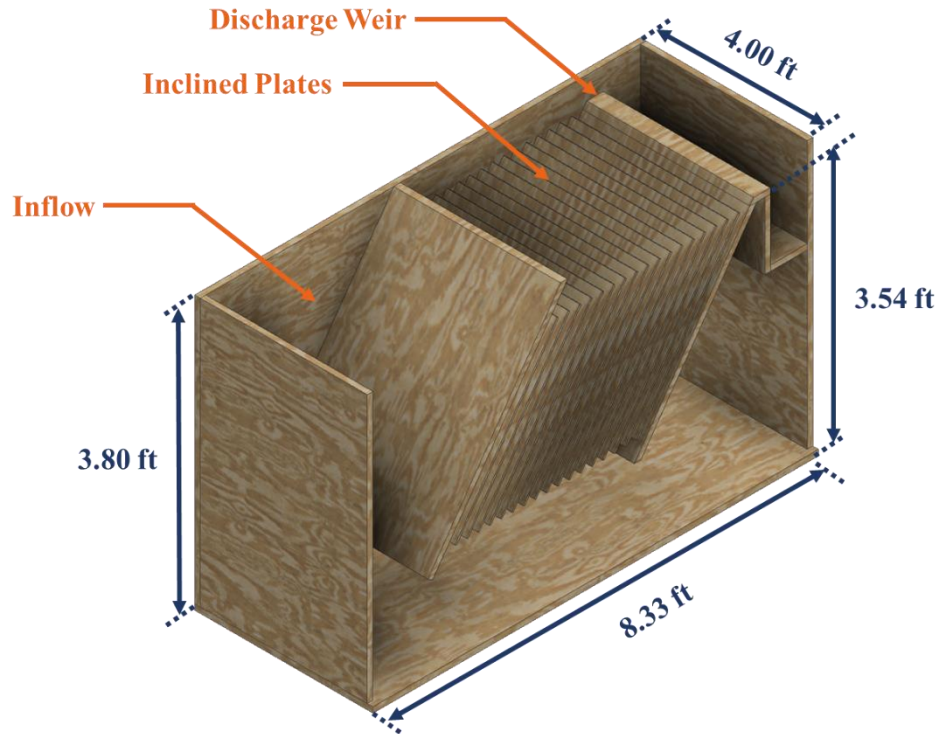


Figure 5.6 Field-Scale Lamella Settler with Dimensions.

5.3 Prototype C Testing Methods

The 79 m³ (2,790 ft³) sediment basin constructed at the AU-SRF was employed to collect and detain the synthetic stormwater runoff during evaluations. The basin design for field-scale testing featured a single coir baffle and a 3.8 cm (1.5 in.) skimmer, as shown in Figure 5.7. The configuration directed flow from the skimmer's discharge outlet to a control sampling port upstream of the device, followed by the floc generator prototype, and then the mixers downstream. Incorporating the 3.8 cm (1.5 in.) skimmer enabled the floc generator to treat discharge rates between 34.0 and 37.8 L/min (9.0 and 10.0 GPM).

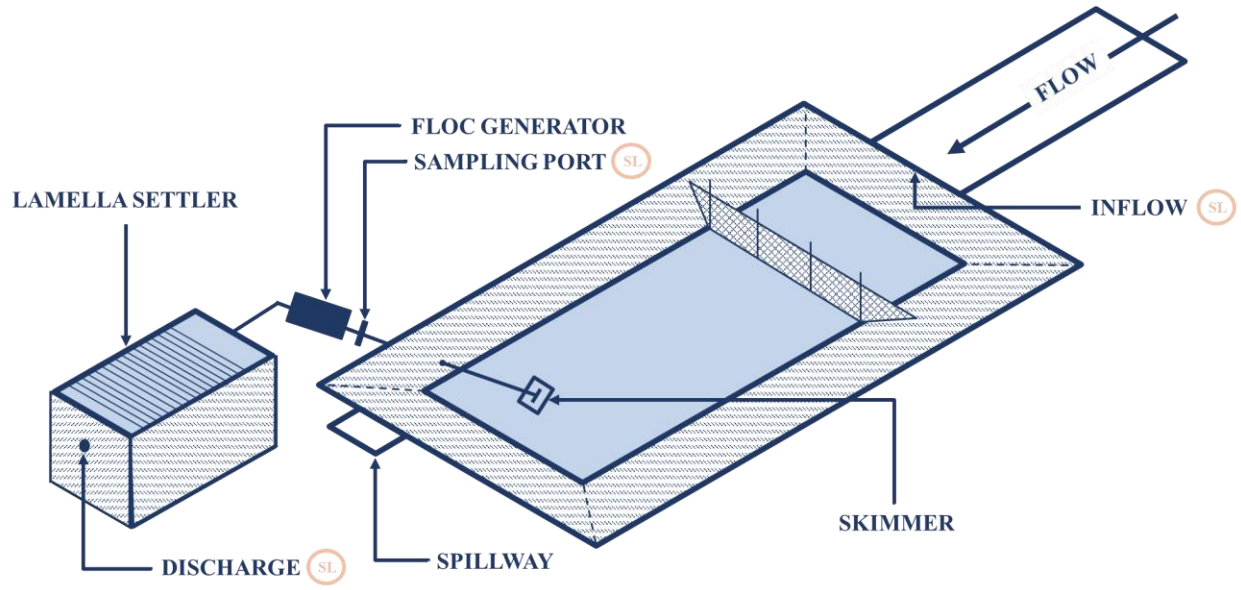


Figure 5.7 Field-Scale Basin Schematic.

5.3.1 Flow and Sediment Introduction

Water was directed into the basin using three semi-trash pumps, which pumped water from the upper storage pond. Based on outcomes from previous tests conducted in this sediment basin, the target inflow rate had been set at 2.5 m³/min (1.5 ft³/s). However, employing three pumps, the maximum flow rate obtained was 1.9 m³/min (1.2 ft³/s). The sediment introduction rate selection was based on applying the MUSLE equation at the peak 30 minutes of the 2-yr, 24-hour design storm, Eq. 5.1, where S is the sediment yield (tons), Q is the 2-yr, 24-hr stormwater runoff volume (acre-ft), and p_p is the peak discharge (ft³/s). The soil erodibility factor (K) was determined to be 0.085. The slope-length and steepness factor (LS) was calculated as 0.83, considering 16% slopes at a length of 20 ft (6.1 m) and conditions characterized by high rill to interrill erosion ratios (Pitt et al. 2007). The soil cover (C) factor was assigned a value of 1.0 to represent bare soil conditions, and the practice factor (P) was set at 1.0.

$$S = 95(Qp_p)^{0.56}KLSCP \quad \text{Eq. 5.1}$$

The total sediment yield was computed as 1,348 lbs (611 kg). To achieve the desired experimental conditions, a sediment load targeted metering rate of 44.9 lbs/min (20.4 kg/min) was established, with a test duration of 30 minutes (Perez 2016). Two 10.2 kg (22.5 lbs) buckets were discharged into the soil-water mixing trough to achieve this rate, shown in Figure 5.8.



Figure 5.8 Sediment Introduction in Field-Scale Testing.

The soil used for all field-scale evaluations was the native AU-SRF soil, as described in the *Intermediate-Scale Methodology* chapter. Unlike the intermediate-scale testing, where the soil was sieved to obtain mainly the fines, the soil for field-scale testing was only screened through a 1.3 cm (0.5 in.) mesh to remove larger clumps and organic material.

5.3.2 Sampling Regime and Processing

Three sampling locations (SL) were selected for field-scale testing: the basin inflow, and sites upstream and downstream of the floc generator, as shown in Figure 5.7. The basin inflow sample was collected downstream of the two rock check dams to capture the turbidity of the

sediment-laden water entering the basin. The upstream floc generator sample was obtained from the designated sampling port prior to the floc generator, while the downstream sample was collected from the lamella settler discharge. At the inflow location, hand-grab samples were collected every 3 minutes during the 30-minute inflow period, resulting in a total of ten samples. Sampling at the upstream floc generator location employed both manual and automated methods. Hand samples were taken every 10 minutes prior to the start of discharge from the lamella settler to document turbidity in the skimmer outflow. Approximately 2.5 hours after testing began, coinciding with the start of lamella settler discharge, two ISCO automatic samplers at the upstream location began sampling every 30 minutes for a 12-hour duration. This approach produced approximately 32 samples from the upstream location and 24 samples from the lamella settler discharge. All collected samples were processed for turbidity analysis at the Auburn University Stormwater Research Lab.

5.4 Prototype D Experimental System

For field-scale evaluations, prototype D was installed at the discharge outlet of the floating surface skimmer within the same sediment basin used for prototype C testing. A custom weir box was designed and constructed to measure varying flow rates through the floc generator cartridges. Depending on the test series, between one and four floc generators were used in the system. Unlike previous evaluations where samples were returned to the lab for analysis, an outdoor sample processing area was established on-site to facilitate immediate sample processing.

5.4.1 Weir Box Design and Calibration

To initiate evaluations of electrode surface area relative to flow rate, a weir box was designed, constructed, and calibrated at the discharge of a 10.2 cm (4 in.) floating surface skimmer. The weir box was fabricated from a 379 L (100 gal.) oval stock tank with a 90-degree V-notch weir

cut into one end, as shown in Figure 5.9. A metal yardstick was securely clamped to a steel support to measure water depth relative to the tank's bottom, providing consistent and repeatable readings across all test conditions.



Figure 5.9 Weir Box for Prototype D Evaluations.

The weir box was placed on a level platform, and the tank was filled to the base of the V-notch to establish the weir crest elevation, which was measured at 41.9 cm (16.5 in.) from the tank bottom. Flow rates were then evaluated at various water depths above the weir using a bucket and a stopwatch. For each flow rate measurement, two team members independently verified the total water depth to ensure accuracy before recording the value. The bucket was consistently filled to the same level for each trial and weighed to calculate the corresponding water volume. To confirm

repeatability, three separate flow rate measurements were collected at each water depth. Figure 5.10 depicts the resulting weir calibration curve, illustrating flow rate (GPM) as a function of water depth above the weir (inches). Flow rates measured during calibration ranged from 9.5 to 632.1 L/min (2.5 to 167.0 GPM) at water depths between 2.8 and 15.2 cm (1.1 and 6 in.) above the invert of the weir.

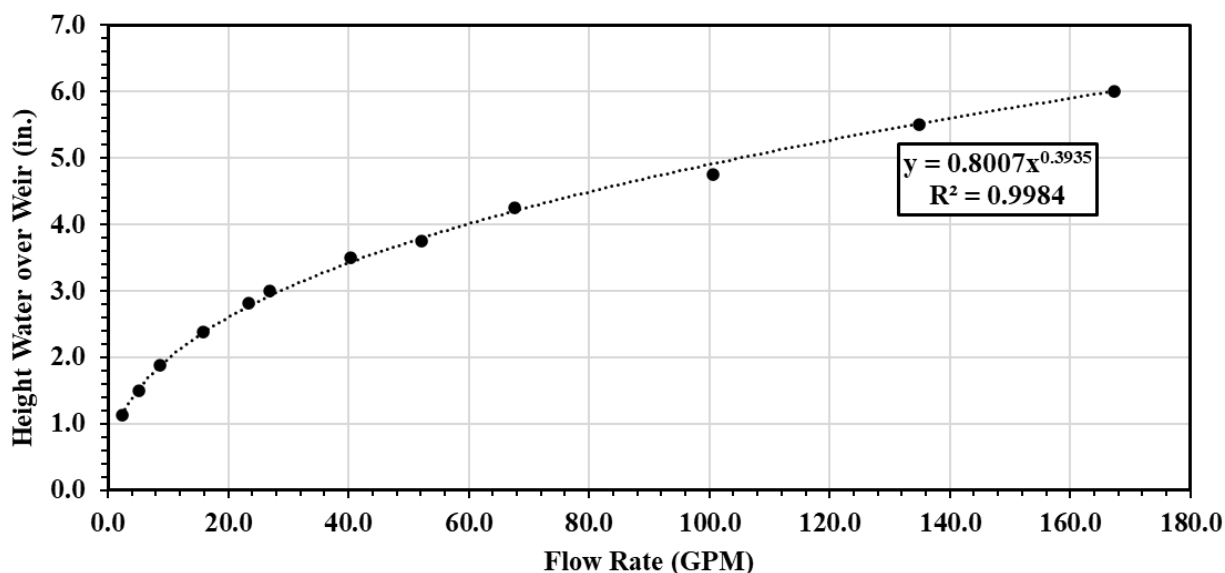


Figure 5.10 Weir Calibration Curve.

As shown in Figure 5.10, the calibration data exhibited a strong correlation between flow rate and water depth, with a best-fit power trendline defined by the equation $y = 0.8007x^{0.3935}$ and a coefficient of determination (R^2) value of 0.9984. This high degree of fit, determined by R^2 , indicates that calibration reliably predicts flow rates based on measured water depths. The resulting equation was subsequently used to calculate flow rates during all field-scale evaluations.

5.5 Prototype D Testing Methods

Two testing groups were devised to evaluate various parameters: (1) electrode surface area relative to flow rate, and (2) temperature test series. For all test evaluations, the floc generator prototype(s)

were positioned upstream of the weir box. A sampling port located downstream of the skimmer, upstream of the prototype, was used to collect control samples for baseline comparison. Treated samples were collected from the skimmer discharge pipe, downstream of the prototype, as shown in Figure 5.11. For each flow rate tested, water depth over the weir was verified by two individuals following the same procedure used during weir calibration. To further validate recorded depths, photographs of the yardstick were taken at each flow rate.



Figure 5.11 Upstream and Downstream Sampling Locations.

On the day of evaluations, a field setup mimicking a laboratory arrangement was set up near the testing site. This setup included a turbidity meter, magnetic mixer, and graduated cylinders, shown in Figure 5.12.



Figure 5.12 Sample Evaluation Setup.

For each evaluated flow rate, a control and treated sample of 1,200 mL each were collected. Both control and treated samples were mixed on a magnetic mixer at a speed of 3, approximately 360 RPM, for 30 seconds, then poured into graduated cylinders to observe settling properties, shown in Figure 5.13. Control samples were obtained at each flow rate to provide a baseline comparison for the treated samples. Each sample set, containing both control and treated samples, was monitored over time, with 30 mL samples taken from each cylinder at 0, 5, 10, 15, and 20 minutes of settling time.

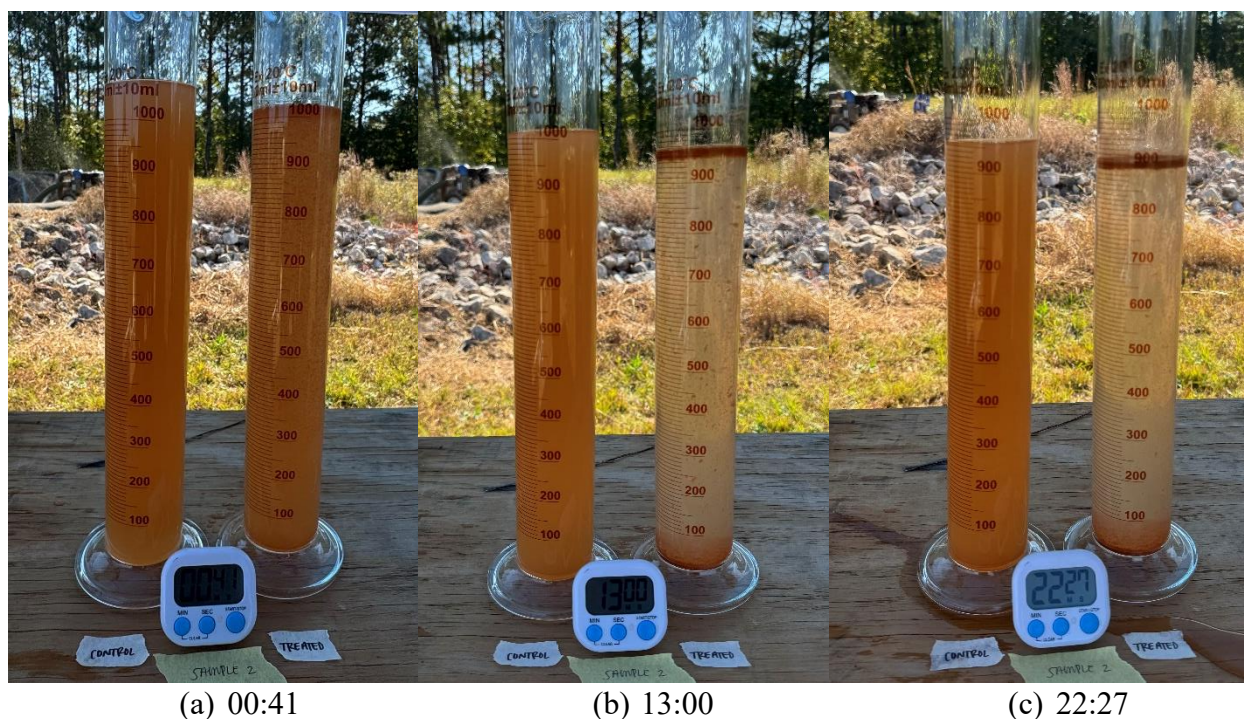


Figure 5.13 Field-Scale Testing: Sample Sets Settling Over Time.

This evaluation included twenty flow rates ranging from 22.7 to 477.0 L/min (6.0 to 126.0 GPM). Testing began at the lowest flow rate, with incremental increases to reach higher flow rates. After sixteen tests, the valve was fully opened to achieve the maximum flow. To verify consistency, four flow rates, representing low, medium, and high ranges, were repeated, resulting in closely spaced flow rates for cross-checking.

To assess the effect of increased electrode surface area on treatment performance, a U-shaped 15.2 cm (6 in.) PVC apparatus was constructed to house multiple floc generator cartridges within the same channel used for single-generator testing, as depicted in Figure 5.14. Tests using multiple floc generators were conducted with configurations of two, three, and four cartridges. Because a single 12-volt power supply could only operate two generators, tests with two floc generators utilized one power source, while tests with three or four generators required two separate power supplies. This second flow rate to surface area evaluation included nineteen flow

rates, ranging from 7.6 to 302.8 L/min (2.0 to 80.0 GPM), with sampling procedures consistent with those used in the previous test series.

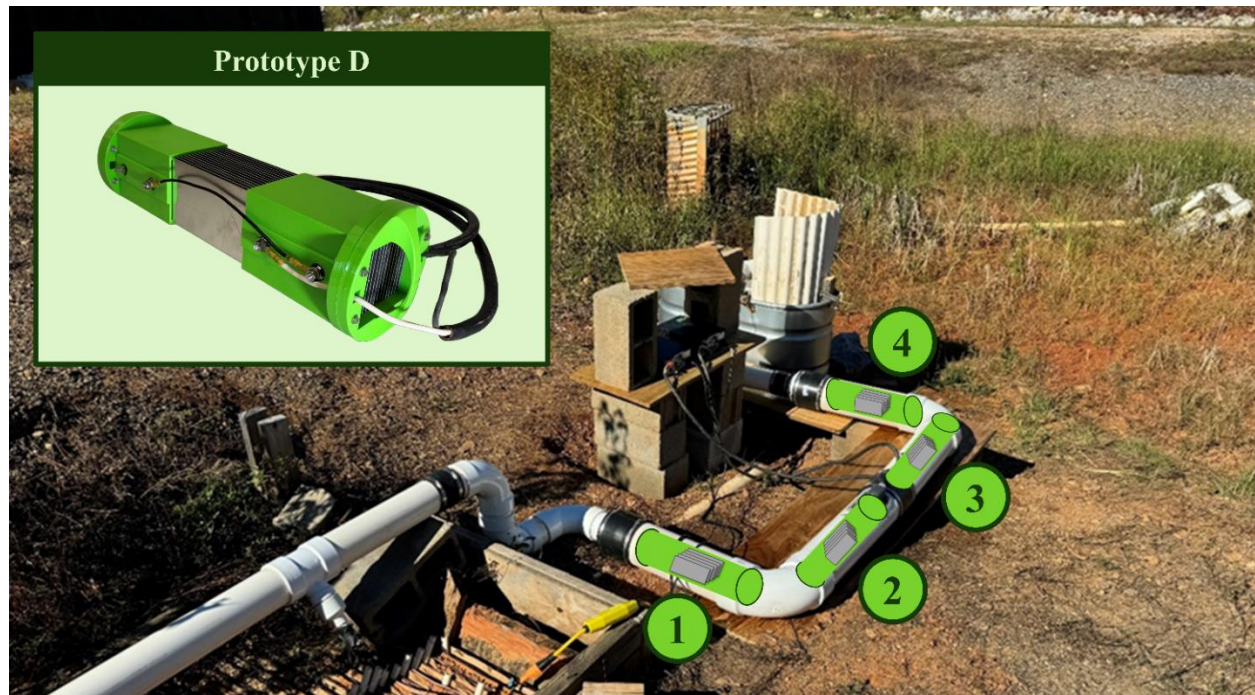


Figure 5.14 Multiple Floc Generator Locations in the Field-Scale Testing Apparatus.

5.6 Summary

Field-scale testing at the AU-SRF was conducted to evaluate the performance of prototypes C and D under high-flow conditions exceeding 75.7 L/min (20.0 GPM), surpassing the flows achieved during intermediate-scale testing. Prototype C was tested in December 2023 using static mixers and a lamella settler, while Prototype D was evaluated in October and November 2024 without these components. Each prototype followed a distinct methodology, with prototype D incorporating a calibrated weir box to measure flow rates through one to four floc generator cartridges. Testing was conducted in a 79 m³ (2,790 ft³) sediment basin constructed to ALDOT standards. Synthetic stormwater was introduced through a 27.4 m (90 ft) geotextile-lined channel using three semi-trash pumps, reaching a maximum inflow rate of 1.9 m³/min (1.2 cfs). Sediment

loading was determined using the MUSLE equation and targeted a total of 611 kg (1,348 lbs) over a 30-minute duration, with sediment introduced via a soil-water mixing trough at a metering rate of 20.4 kg/min (44.9 lbs/min). Native AU-SRF soil was screened through a 1.3 cm (0.5 in.) mesh to remove large clumps and organic debris. To improve sediment retention of readily settleable sediments, a single wire-backed coir baffle was installed one-fourth the bottom length from the basin inlet. Downstream of the floc generator, a field-scale lamella settler with 38 inclined plates set at a 55-degree angle and an operational volume of 3,339 L (882 gal) supported post-treatment settling. Sampling occurred at three locations: basin inflow, upstream of the floc generator, and downstream of the lamella settler. Approximately 66 samples were collected and processed for turbidity analysis. For prototype D, a custom weir box constructed from a 379 L (100 gal) stock tank with a 90-degree V-notch was calibrated to measure flow rates based on water depth. Two test series were conducted: one evaluating electrode surface area relative to flow rate, and the other assessing temperature effects. For each flow rate, 1,200 mL control and treated samples were collected, mixed at 360 RPM for 30 seconds, and transferred to graduated cylinders. Turbidity was measured at 0, 5, 10, 15, and 20 minutes to evaluate settling behavior. To test the effect of increased electrode surface area, a U-shaped 15.2 cm (6 in.) PVC housing was used to hold one to four floc generator cartridges. Due to power supply limitations, configurations with more than two cartridges required multiple 12-volt power sources. Nineteen flow rates ranging from 3.8 to 492 L/min (1.0 to 130.0 GPM) were evaluated using consistent sampling and testing procedures across all configurations. These field-scale evaluations provided critical insight into the floc generator's performance under realistic flow conditions and operational configurations, supporting its continued development for stormwater treatment applications.

CHAPTER SIX: RESULTS

6.1 Parameters Measured and Evaluated

Sediment was the primary pollutant of concern, representing construction site runoff. Consequently, most data from both intermediate- and field-scale evaluations were based on turbidity measurements. To assess the treatment performance of the flocc generator, turbidity reduction was calculated by comparing turbidity values from control (i.e., untreated) and treated samples. Turbidity reduction (%) represents the percentage decrease in turbidity achieved by the electrical flocculation treatment process and is calculated using Eq. 6.1.

$$\text{Turbidity Reduction}(\%) = \frac{\text{Inflow}_{avg.}(NTU) - \text{treated}(NTU)}{\text{Inflow}_{avg.}(NTU)} \quad \text{Eq. 6.1}$$

Where $\text{Inflow}_{avg.}$ is the average turbidity of the three untreated (i.e., control) influent samples obtained directly before testing, and *treated* is the turbidity of the water after treatment. The *treated* turbidity values were measured at various sample settling times. After each sample was transferred to a graduated cylinder, aliquots were extracted at specific intervals for turbidity analysis. Aliquots were also taken from the control samples at the same time to observe and compare settling behavior over time. Turbidity reduction was typically evaluated at intervals of 0, 5, 10, 15, 20, and 30 minutes for most evaluations, with extended intervals of 40, 50, 60, 70, 80, and 90 minutes included in the fundamental performance evaluations. To differentiate turbidity reduction at each specific time, the values were denoted accordingly, such as TR₁₅ for turbidity reduction calculated at 15 minutes of settling, shown as the last sample in Figure 6.1. Following the calculation, the turbidity reduction data was plotted to evaluate trends and relationships in treatment performance across various settling durations.

Visual observations during testing demonstrated effective floc formation and settling of suspended materials in the treated samples. Figure 6.1 presents a side-by-side comparison of a control sample, which did not pass through the floc generator prototypes, and a treated sample subjected to electrical flocculation. This specific test was conducted using prototype C operating at a flow rate of 3.8 L/min. (1.0 GPM).

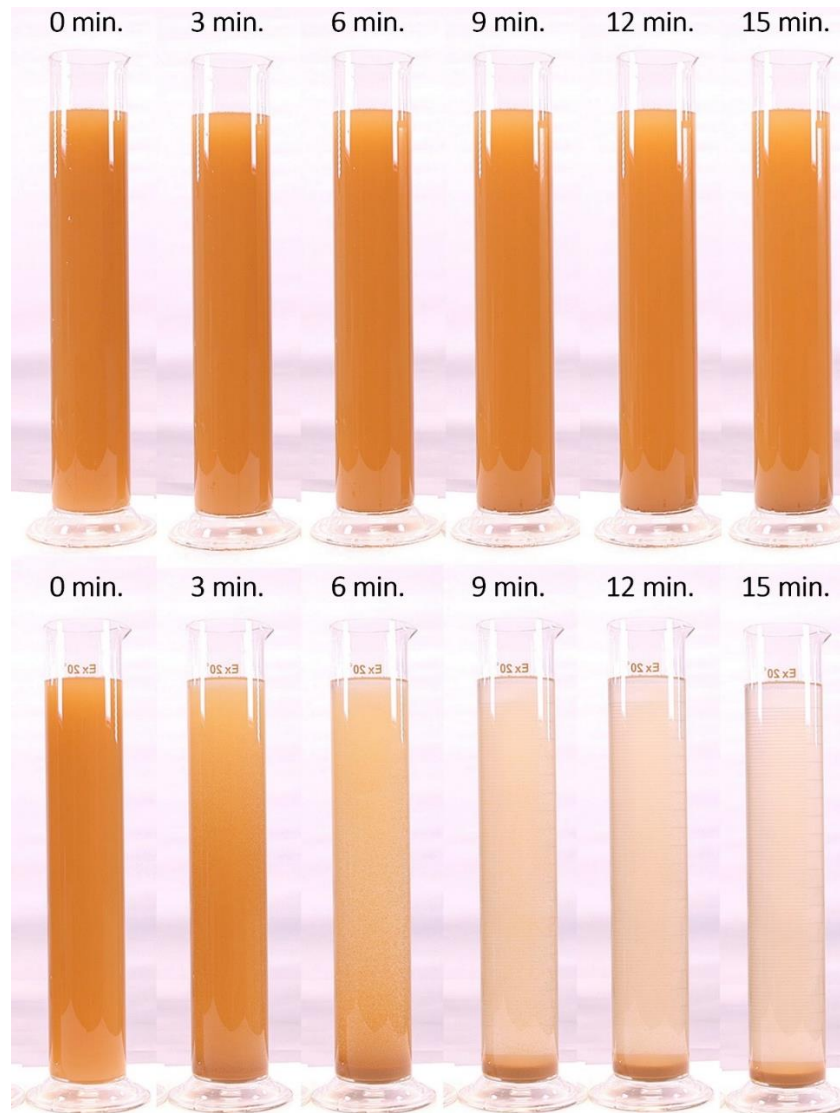


Figure 6.1 Observations Comparing Floc Formation and Settling; Control Samples (top) versus Treated Samples (bottom).

6.2 Intermediate-Scale Testing

This subsection summarizes the results from intermediate-scale evaluations of floc generator prototypes A, B, and C. The test series was organized into five groups: Fundamental Performance Evaluations, Spectrophotometer, Mixing, Electrode Longevity, and Pollutant Loading Evaluations. The primary objective was to assess and compare turbidity reduction across various operational conditions. Key parameters included electrode circuitry configuration, flow rate, amperage, applied voltage, SEC, mixing, electrode longevity, non-sediment removal performance, and the effects of downstream settling combined with mixing. These metrics defined the performance of the three prototypes within this testing group.

6.2.1 Fundamental Performance Evaluations

Fundamental performance evaluations comprised 64 test series, of which 62 included three replicate test sets. The two series with fewer replicates were excluded from this analysis. Each test set consisted of one control and one treated sample, and all reported values are the average of those three runs to ensure consistent device behavior and eliminate anomalies. Inflow turbidity ranged from 214 to 1,452 NTU, but because higher starting turbidity can exaggerate total sediment removal, the analysis focused on 52 series with three replicates and inlet turbidity between 505 and 855 NTU; outliers and incomplete series were omitted. All samples, control and treated, were mixed at a speed setting of three (about 360 RPM) for eight minutes. Turbidity removal performance was evaluated under varying flow rates, voltages, current densities, and SEC, and pseudo-second-order kinetic models were applied to characterize and compare settling rates between control and treated samples.

Prototypes A and B had the same reactor volume, electrode geometry, and nearly identical anode surface areas, but differed in how the electrodes were wired. Prototype A used a series

arrangement, where each electrode's resistance adds together to increase the total circuit resistance. Prototype B used a parallel arrangement, in which each electrode provides its own current path, and the combined resistance is always lower than any single branch. That lower resistance in the parallel configuration was hypothesized to allow higher current at the same applied voltage, thus boosting aluminum dissolution and coagulant production. Figure 6.2 depicts the data as settling time versus turbidity reduction measured at flow rates varying from 7.6 to 37.9 L/min (2.0 to 10.0 GPM). The data confirmed that lower flow rates, in other words, longer HRTs, achieved greater downstream turbidity removal, meaning more coagulant was produced per unit volume of water.

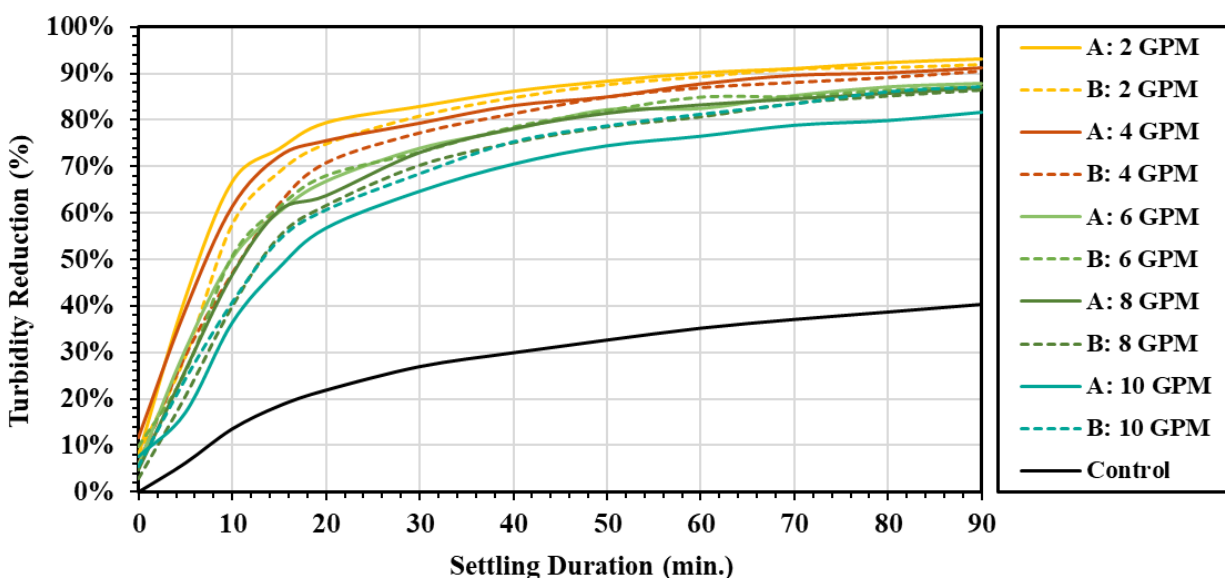


Figure 6.2 Settling Duration versus Turbidity Reduction for Prototypes A and B.

On this plot, solid lines denote prototype A and dashed lines prototype B. Additionally, colored lines represent treated samples, and the black lines signify the untreated control samples. All treated test series achieved a rapid drop in turbidity during the first 20 minutes, then gradually leveled off, reaching at least 82% removal by 90 minutes, whereas the control attained only 40% removal in the same 90-minute settling interval. Both A and B crossed the 80% removal threshold by 30 minutes at 7.6 L/min (2.0 GPM), whereas at 15.1 to 30.3 L/min (4.0 to 8.0 GPM), the TR₃₀

yielded a 70% or greater removal. Performance declined slightly at 37.9 L/min (10.0 GPM), where prototype A and B reached TR₃₀ removal rates of 65% (694 to 246 NTU) and 68% (from 526 to 156 NTU), respectively. Visually, prototypes A and B behaved similarly, with prototype A demonstrating a marginal advantage at lower flows, while prototype B achieved slightly faster sediment removal at 37.9 L/min (10.0 GPM). Table 6.1 outlines the TR₂₀ values and corresponding standard deviations for prototypes A and B across the five flow rates.

Table 6.1 Prototype A and B Flow Rate Groupings with Corresponding TR₂₀ and Standard Deviations.

Flow Rate, GPM	Prototype A		Prototype B	
	Average Treated TR ₂₀ , %	Standard Deviation, %	Average Treated TR ₂₀ , %	Standard Deviation, %
2 GPM	79%	1.0%	75%	0.7%
4 GPM	76%	3.1%	71%	0.5%
6 GPM	67%	0.5%	68%	2.5%
8 GPM	64%	0.8%	62%	0.7%
10 GPM	57%	1.0%	61%	1.1%

Both devices exhibited decreasing TR₂₀ with increasing volumetric flow rates. Prototype A outperformed prototype B at low flows, achieving 79% ± 1.0% and 76% ± 3.1% at 7.6 and 15.1 L/min (2.0 and 4.0 GPM) versus 75% ± 0.7% and 71% ± 0.5%, respectively. At 22.7 and 30.3 L/min (6.0 and 8.0 GPM), both prototypes delivered comparable performance, with prototype A yielding a removal rate of 67% ± 0.5% and 64% ± 0.8% and prototype B exhibiting 68% ± 2.5% and 62% ± 0.7% removal. Under the highest loading of 37.9 L/min (10.0 GPM), prototype B had a slightly higher removal with 61% ± 1.1% compared to prototype A's 57% ± 1.0%. Overall, the two configurations demonstrated similar settling efficacy, with only marginal differences at the extremes of the tested flow range.

To put the removal rates into perspective, Table 6.2 summarizes the influent turbidity and the SEC values for each test series. Both prototypes exhibited nearly identical anodic surface areas

and were operated at a constant 12V, resulting in closely matched SEC values at each flow rate. The minor variations in SEC reflect slight differences in test amperage consumption, which ranged from 2.0A to 2.3A for all ten test series. Additionally, the current densities for prototype A and B ranged from 41.3 to 45.2 A/m² (3.8 to 4.2 A/ft²) and 42.1 to 44.1 A/m² (4.0 to 4.1 A/ft²), respectively.

Table 6.2 Prototype A and B Flow Rate Groupings with Corresponding Inflow Turbidity and SEC values.

Flow Rate, GPM	Prototype A		Prototype B	
	Turbidity, NTU	SEC, kWh/m ³	Turbidity, NTU	SEC, kWh/m ³
2	838	0.059	715	0.058
4	651	0.031	663	0.028
6	571	0.020	597	0.019
8	704	0.015	526	0.014
10	694	0.012	505	0.011

Given the similarity of the performance curves, paired t-tests at a 99% confidence level ($\alpha=0.01$) were applied to the TR₂₀ data for Prototypes A and B at each flow rate. Table 6.3 presents the resulting p-values and indicates whether the differences are statistically significant.

Table 6.3 Prototype A and B Paired T-Test Results.

Comparison	P-value	Significance
A vs. B: 2 GPM	0.009	Significant
A vs. B: 4 GPM	0.155	Not Significant
A vs. B: 6 GPM	0.568	Not Significant
A vs. B: 8 GPM	0.045	Not Significant
A vs. B: 10 GPM	0.018	Not Significant

At the 99% confidence level, only the 7.6 L/min (2.0 GPM) comparison, with a p-value of 0.009, was found to be significantly different. All other flow-rate pairings yielded a p-value greater than 0.01, indicating no statistical significance in the difference between prototypes A and B under those conditions. After testing, it was hypothesized that the parallel circuitry offered no enhanced performance due to the dominant ohmic and interfacial resistances present; therefore, variations in electrode circuitry had a negligible impact on performance. Total system resistance in a

continuous-flow electrical flocculation unit is determined by device design parameters such as inter-electrode distance, available anodic surface area, electrode surface condition (i.e., fouling or passivation), electrode material properties and electrical connection quality, as well as by operational factors including solution composition (i.e., ion species and concentration, supporting electrolyte, temperature, solids loading) and hydrodynamic conditions (i.e., mixing intensity and HRT). These paired t-test results support the conclusion that electrode circuitry variations had minimal impact on the system's overall resistance.

A similar analysis was conducted between prototype A and prototype C. Since the TR_{20} comparisons of prototypes A and B showed no significant differences for the majority of the flow rates evaluated, only one of the two prototypes was used as the reference for prototype C. Prototype C was designed with a larger reactor volume and anodic surface area compared to prototype A and B. Prototype C's anodic surface area was 2,619.4 cm² (406.0 in.²) compared to 509.0 cm² (78.9 in.²) and 499.0 cm² (77.3 in.²) for prototypes A and B, which resulted in over five times the conductive area. It was hypothesized that the increased anodic surface area would enhance performance and enable the device to handle larger flow rates. According to Ohm's law, bulk solution resistance is inversely proportional to conductive cross-sectional areas, so the increased anodic surface reduces ohmic losses. However, increasing the anodic surface area decreases current density, which reduces the interfacial resistance and overpotential losses.

Figure 6.3 compares prototype A and prototype C performance. Solid lines indicate prototype A and dashed lines indicate prototype C. Colored lines show treated samples and the black line shows the untreated control, using the same coloring and solid/dashed convention as the previous plot. The x-axis shows settling time from 0 to 90 minutes, and the y-axis shows percent

turbidity reduction. Each color corresponds to a flow rate from 1.9 to 37.8 L/min (0.5 to 10.0 GPM).

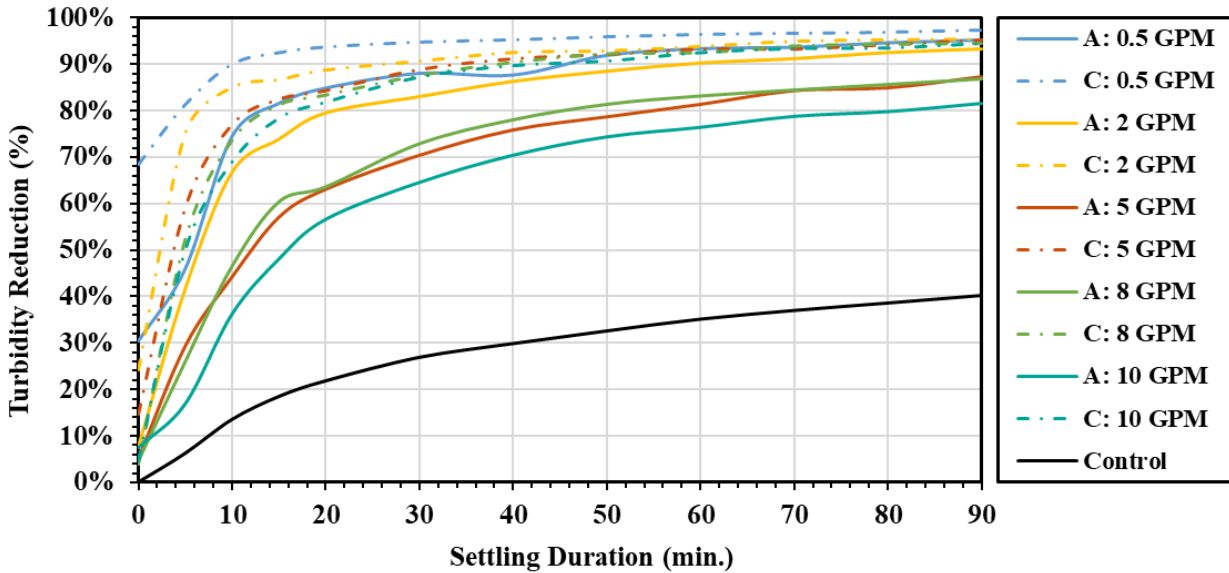


Figure 6.3 Settling Duration versus Turbidity Reduction for Prototypes A and C.

Both sets of settling curves exhibit an initial rapid settling phase followed by a slower polishing phase. For prototypes A and B, the rapid phase extends through the first 20 minutes, whereas prototype C completes its rapid settling within the first 10 minutes before transitioning into gradual sediment removal over the remaining 80 minutes. After 10 minutes of settling, prototype C achieved turbidity reductions (TR_{10}) from $69\% \pm 1.3\%$ at 37.8 L/min up to $90\% \pm 0.8\%$ at 1.9 L/min (0.5 GPM); by comparison, prototype A reached TR_{10} values of $36\% \pm 1.5\%$ to $74\% \pm 1.4\%$ across the same flow range. This yielded increases in treated TR_{10} values from prototype A to prototype C of 92% and 22%, respectively. After 90 minutes of settling, prototype A met or exceeded 82% treated removal across all flows, while prototype C attained 94% or higher. Table 6.4 summarizes the TR_{20} values and their standard deviations for both prototypes across the five flow rates.

Table 6.4 Prototype A and C Flow Rate Groupings with Corresponding TR₂₀ and Standard Deviations.

Flow Rate, GPM	Prototype A		Prototype C	
	Average Treated TR ₂₀ , %	Standard Deviation, %	Average Treated TR ₂₀ , %	Standard Deviation, %
0.5 GPM	85%	0.3%	94%	0.3%
2 GPM	79%	1.0%	89%	1.4%
5 GPM	63%	0.2%	84%	0.2%
8 GPM	64%	0.8%	83%	0.9%
10 GPM	57%	1.0%	82%	0.3%

Similarly to the previous plot, increased flow led to a decrease in TR₂₀. At low flow rates, prototype A achieved 85% ± 0.3% while prototype C reached 94% ± 0.3%, which yielded an 11% improvement. Under the highest loading shown on this plot, 37.9 L/min (10.0 GPM), prototype A recorded 57% ± 1.0% compared with 82% ± 0.3% for prototype C, indicating a 44% performance enhancement. Across every flow condition, prototype C consistently delivered higher turbidity reduction than prototype A. These findings demonstrated that prototype C was more effective in treating larger flow volumes.

Table 6.5 provides influent turbidity and SEC for each test series. All experiments were carried out at a constant 12V. Prototype A drew between 2.1A and 2.3A (average 2.2A), while prototype C drew a higher current of 8.7A to 12.3A (average 11.3A) due to its larger anodic surface area. When expressed as current density, which is current divided by surface area, the two devices remained closely matched. Prototype A exhibited current densities from 41.3 to 45.2 A/m² (3.8 to 4.2 A/ft²) (average 44.0 A/m², 4.1 A/ft²), and prototype C ranged from 33.2 to 47.0 A/m² (3.1 to 4.4 A/ft²) (average 43.3 A/m², 4.0 A/ft²). Since SEC depends on the applied voltage and current in relation to flow rate, these dissimilar current draws led to significantly different SEC values across corresponding flow conditions. The SEC values indicate that prototype C consumed substantially more energy than prototype A, with energy use between 4.3- and 6.3-fold higher.

Table 6.5 Prototype A and C Flow Rate Groupings with Corresponding Inflow Turbidity and SEC Values.

Flow Rate, GPM	Prototype A		Prototype C	
	Turbidity, NTU	SEC, kWh/m ³	Turbidity, NTU	SEC, kWh/m ³
0.5	720	0.222	679	0.958
2	838	0.050	705	0.314
5	519	0.024	713	0.126
8	704	0.015	704	0.078
10	694	0.012	751	0.061

A series of paired t-tests was conducted on the TR₂₀ data for prototypes A and C at flow rates of 1.9, 7.6, 18.9, 30.3, and 37.9 L/min (0.5, 2.0, 5.0, 8.0 and 10.0 GPM), results shown in Table 6.6. Prototype C consistently achieved higher mean TR₂₀ values under every condition. At a 99% confidence interval ($\alpha=0.01$), each comparison yielded a p-value below 0.001, demonstrating that prototype C's early-stage settling performance is statistically superior to prototype A across the entire flow range.

Table 6.6 Prototype A and C Paired T-Test Results.

Comparison	P-value	Significance
A vs. C: 0.5 GPM	1.1×10^{-5}	Significant
A vs. C: 2 GPM	2.4×10^{-3}	Significant
A vs. C: 5 GPM	3.9×10^{-8}	Significant
A vs. C: 8 GPM	3.1×10^{-5}	Significant
A vs. C: 10 GPM	3.6×10^{-4}	Significant

In continuous flow electrical flocculation systems, electrolysis duration is governed by HRT, which decreases as flow rate increases and may limit treatment efficiency by reducing exposure to the electric field. Prototype C was tested in an intermediate-scale system to quantify how flow rate affects turbidity removal. Figure 6.4 compares settling performance over 60 minutes at 3.8, 37.8, and 71.9 L/min (1.0, 10.0, and 19.0 GPM) against an untreated control test series. On the plot, colored lines denote the treated test series, and the black line denotes the control. All treated series exhibited an initial rapid removal phase, which is completed by 10 minutes at 3.8 L/min (1.0 GPM) and by 20 minutes at 71.9 L/min (19.0 GPM), and is followed by a slower

polishing phase. After 20 minutes of settling, turbidity reductions of 89%, 81% and 77% were recorded at 3.8, 37.8, and 71.9 L/min (1.0, 10.0, and 19.0 GPM), respectively, compared with 23% for the control. By 60 minutes, all treated conditions converge at 90 to 92% turbidity removal, whereas the control plateaus below 40%. These findings demonstrate that lower flows accelerate early-stage settling kinetics while sufficient retention time allows high-flow treatments to reach similar clarity.

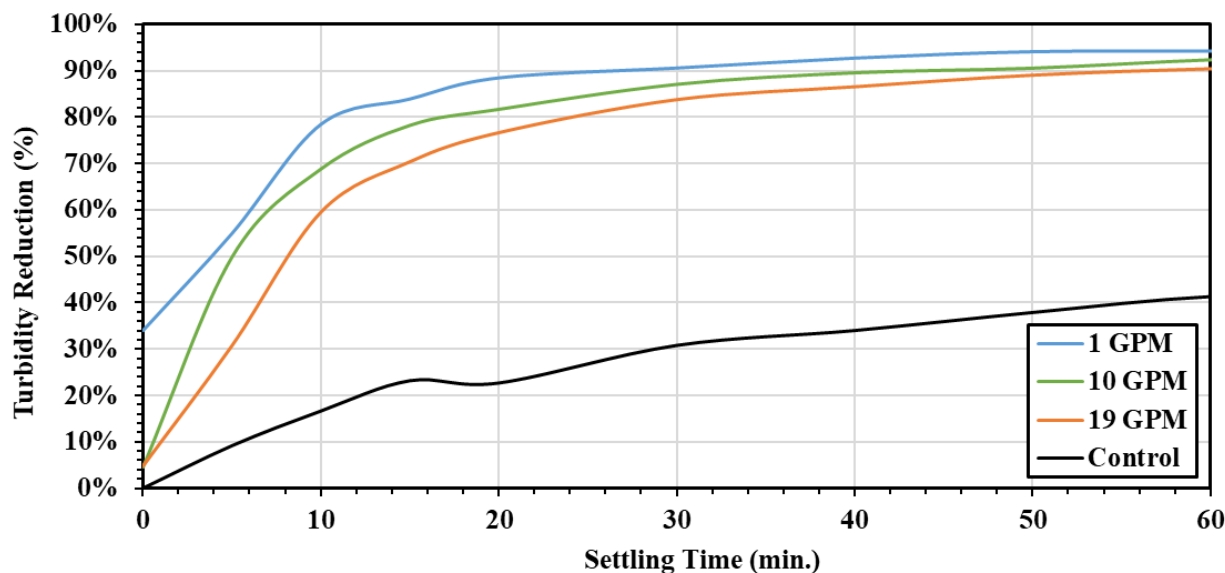


Figure 6.4 Prototype C: Settling Duration versus Turbidity Reduction for Various Flow Rates.

Further, the intermediate-scale evaluations quantified the effects of voltage, current draw, and current density on sediment settling performance. Experiments were conducted at 6V, 12V, and 24V to represent low-power systems, a single car battery, and two batteries in series. Prototypes A and B were tested at all three voltages using flow rates of 1.9 to 37.9 L/min (0.5 to 10.0 GPM), while prototype C was evaluated at 12V across 3.8 to 71.9 L/min (1.0 to 19.0 GPM). In the following three plots (Figure 6.5, Figure 6.6, Figure 6.7), white markers denote data from prototypes A and B and solid markers denote prototype C. For Figure 6.5, the marker's colors indicate voltage: green for 6V, blue for 12V, and yellow for 24V.

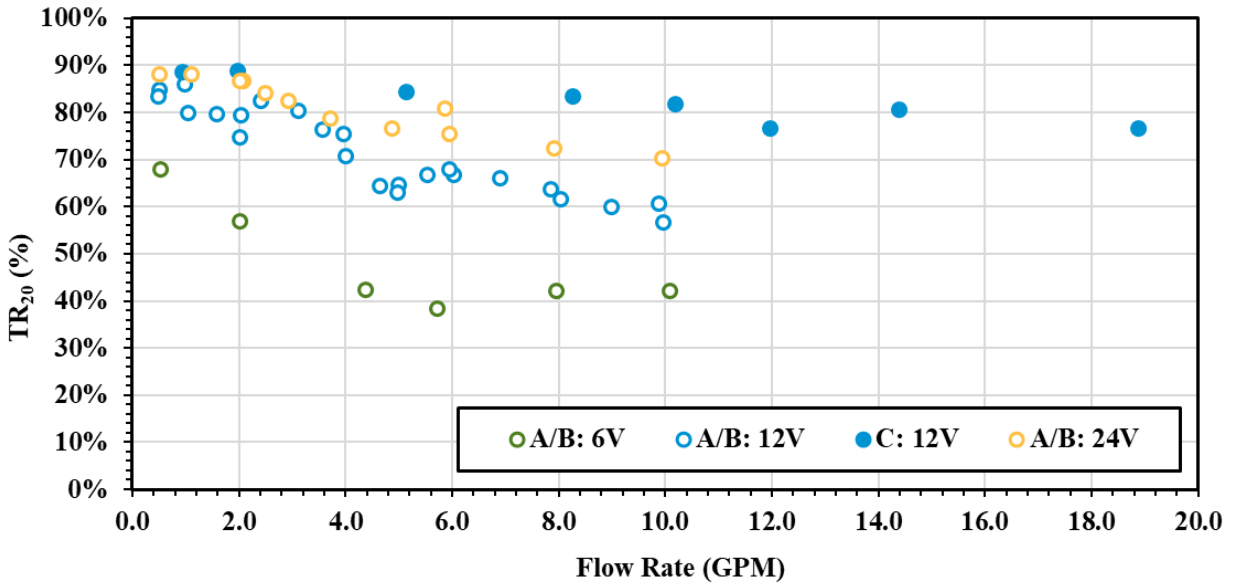


Figure 6.5 Comparison of Applied Voltage versus TR₂₀.

In all four cases, TR₂₀ decreases as flow rate increases, demonstrating the effects of reduced HRT at higher flows. At 6V, prototype A yielded a TR₂₀ below 70% at the lowest flow rate of 1.9 L/min (0.5 GPM) and dropped below 50% for flows above 15.1 L/min (4.0 GPM). At 12V, prototype A's TR₂₀ ranged between 57% and 85% (average 72%), while prototype C delivered even higher values of 77% to 89% (average 86%) under identical flows. Prototype C maintained a stable performance when subjected to higher flows, achieving 81% TR₂₀ at 54.5 L/min (14.4 GPM) and 77% at 71.9 L/min (19.0 GPM). Applying 24V to prototype A increased its TR₂₀ to between 70% and 88%, matching prototype C's 12V performance. Compared to the 12V and 24V results, this demonstrated that 6V is insufficient in reducing turbidity in the desired settling time of 20 minutes. The average amperage draws for these conditions were 1A for prototypes A and B at 6V, 2.3A for the 12V evaluations, and 4.6A for the 24V tests. Prototype C drew a much higher average amperage of 11.9A for the 12V evaluations.

Visual observations indicated that 12V delivers adequate current to generate sufficient aluminum coagulant for effective early-stage sediment removal. At 6V, the lower current draw is

hypothesized to have limited coagulant production, thus providing TR₂₀ below the targeted 75% for all the data points. Increasing the applied voltage to 24V elevated current but produced only a marginal increase in TR₂₀, indicating that current draw and electrode surface area govern performance more directly than raw voltage.

Table 6.7 summarizes mean TR₂₀, standard deviation, and sample count for each voltage condition. Prototypes A and B at 6V achieved only 48% $\pm$ 1% removal (n=6), reflecting limited coagulant release that causes the weak performance. Increasing to 12V improved their performance to 72% $\pm$ 7% (n=24), while prototype C at the same voltage delivered 85% $\pm$ 6% (n=10), demonstrating the benefit of its larger electrode area, yielding enhanced current draw. Further, increasing to 24V raised prototype A and B's TR₂₀ to 82% $\pm$ 5% (n=13). The decreasing standard deviations at higher voltages indicate more consistent initial settling as electrical loading increases.

Table 6.7 Testing Results for Various Voltage Groupings.

Groups	Average Treated TR₂₀	Standard Dev	Sample Count
A/B: 6V	48%	11%	6
A/B: 12V	72%	7%	24
C: 12V	85%	6%	10
A/B: 24V	82%	5%	13

Two statistical analyses, using a confidence level of 99%, were conducted on this data to determine if the observed differences in performance among the prototypes were statistically significant or not. A one-way ANOVA revealed a highly significant effect of prototype condition on performance (p-value=6.5 x 10⁻¹¹), confirming that not all groups performed equivalently. Subsequent paired t-tests were conducted to identify the exact locations of these differences, with the comparisons, p-values, and indicated significance summarized in Table 6.8. The results demonstrated statistically significant differences in performance across most comparisons, notably

identifying prototype A and B at 6V as significantly underperforming compared to all other voltage configurations. Further, prototypes A and B at 12V also showed a significantly lower performance than prototype C at 12V and prototypes A and B at 24V. Additionally, the comparison between prototype C at 12V and prototypes A and B at 24V yielded a non-significant p-value of 0.264, indicating that their performance difference is not statistically discernible. Overall, these analyses demonstrate that operating prototypes A and B at 6V delivers insufficient turbidity removal, while voltages of 12V and above provide improved performance, especially prototype C at 12V and prototypes A and B at 24V.

Table 6.8 Voltage Groupings Post-Hoc Paired T-Tests Results.

Comparison	P-value	Significance
A/B: 6V vs. A/B: 12V	2.9×10^{-3}	Significant
A/B: 6V vs. C: 12V	2.2×10^{-4}	Significant
A/B: 6V vs. A/B: 24V	4.0×10^{-4}	Significant
A/B: 12V vs C: 12V	4.8×10^{-5}	Significant
A/B: 12V vs A/B: 24V	4.6×10^{-4}	Significant
A/B: 24V vs. C: 12V	2.6×10^{-1}	Not Significant

After examining voltage effects on prototypes A and B, the focus shifted to how applied voltage translated into current draw and current density. Using the same dataset from the previous analysis, Figure 6.6 plots average current against TR₂₀. In this plot, white filled green markers denote prototype A and prototype B at 6V drawing 1A, white filled blue markers denote those prototypes at 12V drawing 2.0 to 2.3A (current densities of 40.0 to 46.0 A/m²; 3.7 to 4.3 A/ft²), solid blue markers denote prototype C at 12V drawing 11.7 to 13.2A (current densities of 44.7 to 50.4 A/m²; 4.2 to 4.7 A/ft²), and white filled yellow markers denote prototype A and prototype B at 24V drawing 4.2 to 5A (current density of 84.0 to 100.0 A/m²; 7.8 to 9.3 A/ft²).

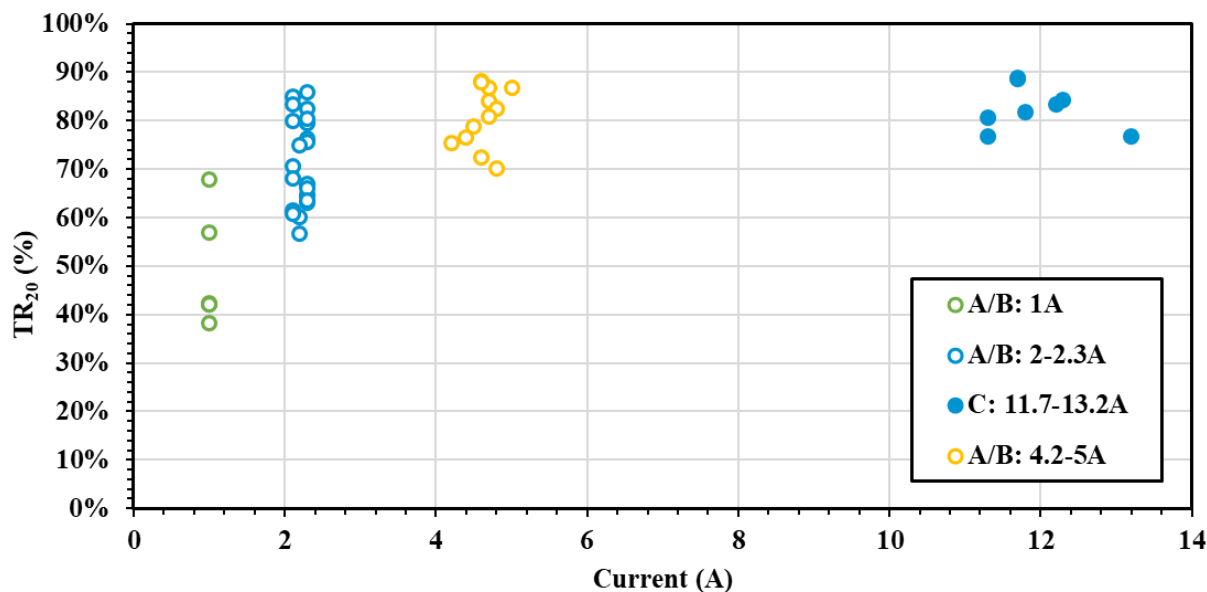


Figure 6.6 Comparison of Current Draw versus TR₂₀.

Visually, this scatter plot indicates that current draw has limited influence on turbidity removal (TR₂₀) when comparing prototype C at 12V (solid blue) with prototypes A and B at 24V (white-filled yellow). At 1A, TR₂₀ ranges from 38% to 68%, with a mean of 48%. Increasing the current to between 2 and 2.3A raises TR₂₀ to between 57% and 86%, with a mean of 72%. At 4.2 to 5A, TR₂₀ spans 70% to 92%, with a mean of 82%, and at 11.7 to 13.2A it reaches 77% to 89%, with a mean of 85%. These two higher current intervals produce nearly identical TR₂₀ ranges and statistical means. Prototype C's TR₂₀ at 11.7 to 13.2A aligns with that of prototypes A and B at 4.2 to 5A, despite its larger anodic surface area. This finding prompted examination of current density as the key performance metric. Figure 6.7 shows that current density has an influence on early-stage turbidity removal.

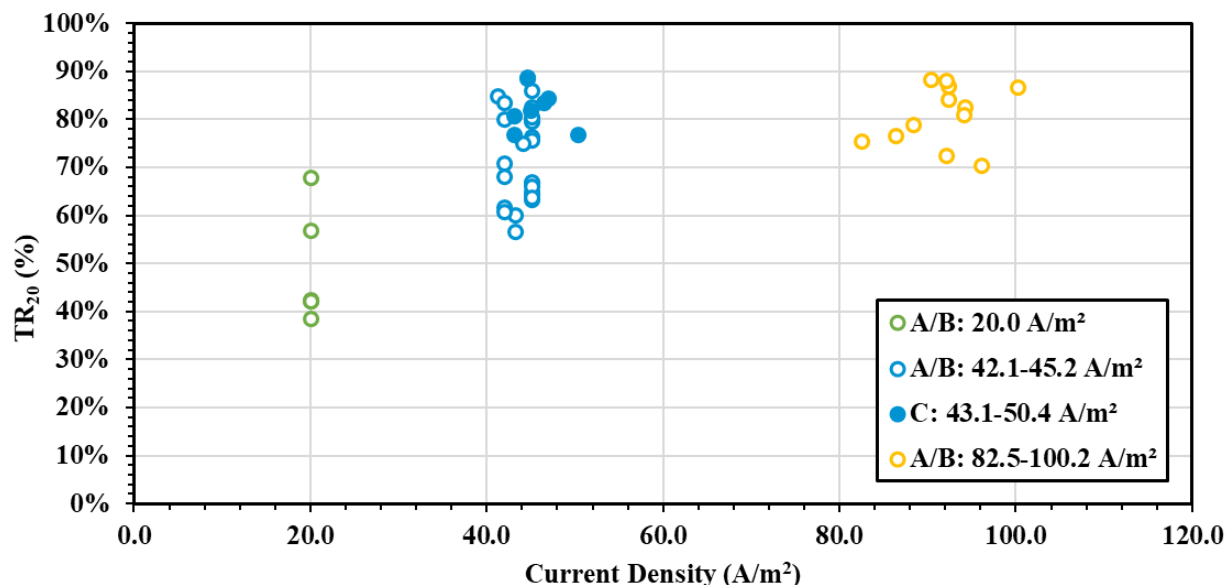


Figure 6.7 Comparison of Current Density versus TR₂₀.

Since prototype C has a larger conductive area, it distributes the 11.7 to 13.2A draw over an anodic area of 2,619.4 cm² (406.0 in.²) and sits in a mid-range density of 43.1 to 50.4 A/m² (4.0 to 4.7 A/ft²). This prototype achieves a TR₂₀ range of 57% to 89%. In contrast, prototypes A and B distribute 4.2 to 5 A across their 499.0 cm² (77.3 in.²) anodic surface area to reach a high density of 82.5 A/m² to 100.2 A/m² (7.7 to 9.3 A/ft²), consistently exceeding 70% removal, but showing diminishing returns. At a low density of 20 A/m² (1.9 A/ft²) from 6V applied to prototypes A and B, the mean TR₂₀ remains below 50%. Both mid-density (43.1 to 50.4 A/m²; 4.0 to 4.7 A/ft²), and high-density (82.5 to 100.2 A/m²; 7.7 to 9.3 A/ft²) conditions exceed the threshold current density for effective aluminum cation (Al³⁺) generation, as evidenced by statistically indistinguishable TR₂₀ means converging on a 77% to 94% removal range. This lack of significant difference in early-stage turbidity reduction indicates that, once the threshold density is surpassed, further increases in current density yield diminishing returns. Combining all four voltage and current combinations onto a current density axis confirms that charge per unit anode area, rather than absolute current or voltage, drives early-stage turbidity removal.

Further, the SEC of each prototype was evaluated to quantify the corresponding treatment efficacy. In electrical flocculation, SEC, expressed in kilowatt-hours per cubic meter (kWh/m^3), defines the electrical energy required to treat a unit volume of water, with lower values signifying greater energy efficiency and reduced operational costs. Achieving a low SEC typically requires high flow rates or reduced applied voltage and current. However, these conditions can hinder floc formation, since metal dissolution at the anode is oxidation-driven and benefits from elevated current density. This is because higher current density increases electron flux per unit electrode area, accelerating the oxidation reaction and thus enhancing metal cation release. Conversely, an unusually low SEC may indicate electrode passivation, which is an accumulation of an oxide or scale layer on the cathode that increases interfacial resistance and, at a constant applied voltage, reduces current density. All electrodes in this study were maintained in a non-passivated state.

To interpret trends in SEC versus TR_{20} , the dataset was divided into two plots, one for prototypes A and B and one for prototype C. Additionally, the SEC values were categorized into three ranges based on consistent breaks in the data. Low SEC was defined as less than 0.026 kWh/m^3 , mid-range as between 0.027 to 0.130 kWh/m^3 , and high as greater than 0.131 kWh/m^3 . In both plots, blue markers denote the low-SEC range, orange markers the mid-SEC range, and yellow markers the high-SEC range; solid symbols represent prototypes A and B (Figure 6.8), while white-filled symbols represent prototype C (Figure 6.9). The following discussion first examines the SEC versus TR_{20} relationship for prototypes A and B (Figure 6.8).

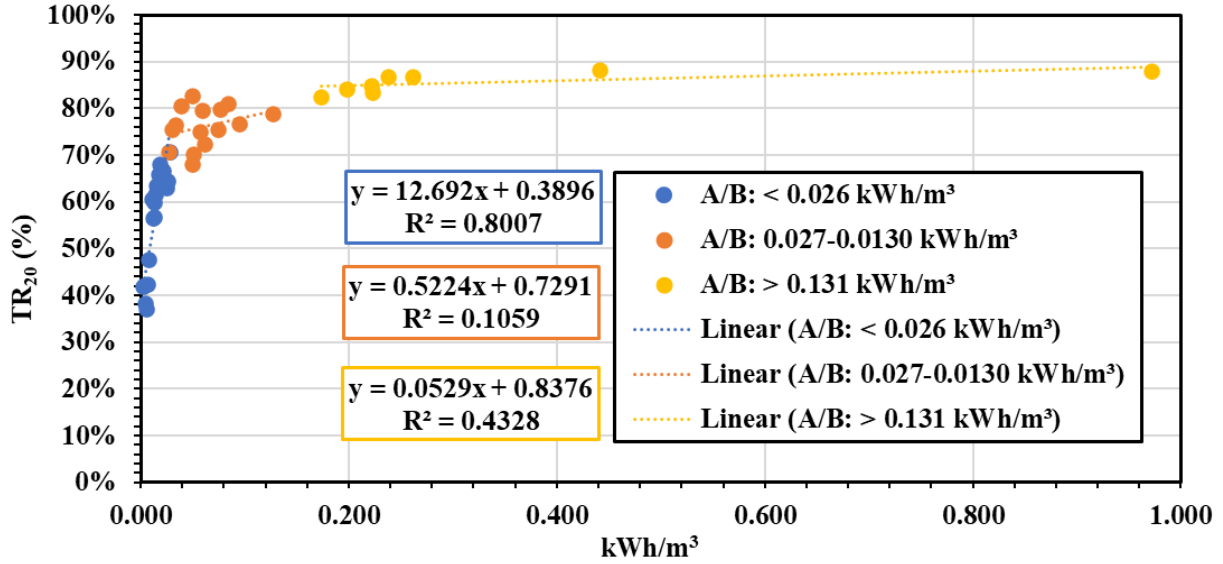


Figure 6.8 SEC Analysis for Prototypes A and B.

The low-SEC condition (<0.026 kWh/m³; average of 0.014 kWh/m³) encompasses all 6V test series, excluding the 1.9 L/min (0.5 GPM) test series, and the higher-flow of 17.0 to 37.9 L/min (4.5 to 10.0 GPM) 12V experiments. Within this range, TR₂₀ values span 38% to 68%, with a mean of 57%. The linear fit for these data has a slope of 12.7 per kWh/m³, indicating that each additional 0.01 kWh/m³ of energy increases TR₂₀ by a factor of 12.7. The coefficient of determination, R², equals 0.80, which means that 80% of the variability in TR₂₀ is explained by SEC. This confirms that performance here is energy-limited; thus, small increases in energy directly drive floc production and subsequent settling.

Additionally, the mid-SEC range (0.027-0.130 kWh/m³; average 0.061 kWh/m³) covers 24V tests at 14.0 to 37.9 L/min (3.7 to 10.0 GPM) and 12V tests below 17.0 L/min (4.5 GPM). In this condition, TR₂₀ narrows to 68% to 83%, with a mean of 77%. The slope falls to 0.5 per kWh/m³, which is over 25 times lower than the low range condition, and R² drops to 0.11. These metrics reveal a saturation plateau, meaning once the SEC exceeds approximately 0.026 kWh/m³, additional energy produces negligible gains in early-stage sediment removal.

Further, the high-SEC condition ($>0.131 \text{ kWh/m}^3$; average 0.341 kWh/m^3) comprises 24V tests at 1.9 to 11.4 L/min (0.5 to 3.0 GPM) and the 12V test at 1.9 L/min (0.5 GPM). Here, TR_{20} is tightly clustered between 82% and 88%, with a mean of 86%. The slope shallows further to 0.05 per kWh/m^3 , and R^2 rises to 0.43. This behavior demonstrates declining incremental gains. Therefore, it is hypothesized that the coagulant dose per unit volume is already sufficient for near-maximum removal, so extra energy yields only marginal improvement. Based on the data, the optimal range appears to fall between 0.150 to 0.250 kWh/m^3 .

A concise comparison of the three SEC groups for prototypes A and B is presented in Table 6.9, which summarizes the mean TR_{20} , its standard deviation, and the number of observations for each SEC-range.

Table 6.9 Prototypes A and B: Testing Results for Various SEC Groupings.

Groups	Average TR_{20} , %	Standard Deviation, %	Sample Count
Low SEC	58%	10%	16
Mid SEC	77%	4%	15
High SEC	86%	2%	8

The low-SEC conditions ($n=16$) achieved an average TR_{20} of $58\% \pm 10\%$, the mid-SEC range ($n=15$) achieved $77\% \pm 4\%$, and the high-SEC condition ($n=8$) achieved $86\% \pm 2\%$. As SEC increases, the mean turbidity removal improves and variability narrows, with a 33% increase from low to mid ranges and a smaller 12% increase from mid to high conditions. This indicates declining benefits at higher energy inputs. Additionally, the coinciding narrowing of standard deviations shows that turbidity removal becomes more consistent as SEC increases.

Two statistical analyses, a one-way ANOVA and subsequent paired t-tests, were performed to assess whether TR_{20} statistically differed across the SEC groups. One-way ANOVA first tested whether mean TR_{20} differed across the three SEC groups using the means, standard deviations,

and sample counts from Table 6.10. The ANOVA returned p-value equal to 6.8×10^{-11} , well below the 0.01 threshold, which indicated that at least two SEC ranges have significantly different mean TR_{20} values. Subsequent paired t-tests were conducted, and the results are shown in Table 6.10.

Table 6.10 Prototypes A and B: SEC Groupings Post Hoc Paired T-Test.

Comparison	P-value	Significance
Low vs. Mid Ranges	1.3×10^{-6}	Significant
Low vs. High Ranges	3.7×10^{-9}	Significant
Mid vs. High Ranges	1.8×10^{-6}	Significant

Paired t-tests then confirmed that all three comparisons are statistically significant, with p-values less than the alpha indicated as 0.01, indicating a 99% confidence level. Together, these results demonstrate that increases in SEC correspond to statistically significant, nonrandom improvements in early-stage turbidity removal.

Additionally, a second SEC versus TR_{20} plot for prototype C, shown in Figure 6.9. The three SEC ranges ($<0.026 \text{ kWh/m}^3$, 0.027 to 0.130 kWh/m^3 , and $>0.131 \text{ kWh/m}^3$) were retained to match the analysis for prototypes A and B since the data consistently separated into these three bands. However, only 12 test series were available for the prototype C plot, which was 27 fewer than the 39 runs plotted for prototypes A and B. As a result, each SEC range exhibits limited data points and large gaps in the data, particularly in the low- and high-SEC ranges. This did limit the ability to resolve clear performance trends or to draw statistically robust conclusions for prototype C's TR_{20} response.

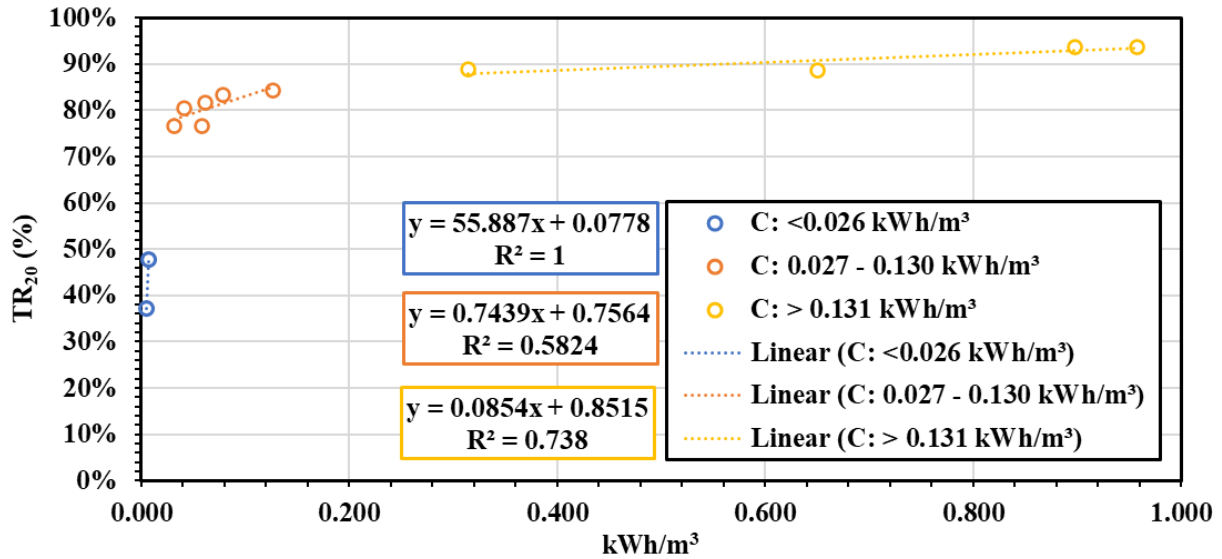


Figure 6.9 SEC Analysis for Prototype C.

Prototype C's low-SEC condition ($<0.026 \text{ kWh/m}^3$; average 0.006 kWh/m^3) is represented by only two data points. Within this narrow range, TR_{20} spans 37% to 48%, with a mean of 42%. This performance is 38% lower than prototypes A and B, which averaged 58% under their low-SEC condition. However, it is important to note that C's average SEC in this condition (0.006 kWh/m^3) was under half that of prototypes A and B's average (0.014 kWh/m^3). Although a linear fit yields a slope of roughly 56 per kWh/m^3 and R^2 of 1.0, these statistics are based on just two observations, so no reliable conclusions can be drawn for prototype C in this range.

In the mid-SEC range ($0.027\text{-}0.130 \text{ kWh/m}^3$; average 0.066 kWh/m^3), five 12V test series at higher flow rates of 18.9 to 71.9 L/min (5.0 to 19.0 GPM) are plotted. Here, TR_{20} ranges from 77% to 84%, with a mean of 81%. Prototype C's average SEC of 0.066 kWh/m^3 closely matches the 0.061 kWh/m^3 measured for prototypes A and B in their mid-range, and prototype C's mean TR_{20} is approximately 5% (4-percentage points) higher than prototypes A and B's. The slope reduced from a factor of 0.74 per kWh/m^3 (mid-range) to 55.9 per kWh/m^3 and R^2 of 0.58, possibly indicating that prototype C is approaching the plateau phase in sediment removal.

The high-SEC condition ($>0.131 \text{ kWh/m}^3$; average 0.705 kWh/m^3) includes four low-flow 12V experiments. In this high range, TR_{20} is tightly clustered between 89% and 94%, with a mean of 91%. Notably, prototype C's average SEC for the high range is more than double that of prototypes A and B ($0.705 \text{ vs. } 0.341 \text{ kWh/m}^3$), and its mean TR_{20} of 94% surpasses the 88% achieved by prototypes A and B. The shallow slope of 0.085 per kWh/m^3 reflects diminishing incremental gains once the coagulant dose is ample.

Table 6.11 summarizes the three SEC categories for prototype C alongside their corresponding average TR_{20} values, standard deviations, and sample counts.

Table 6.11 Prototype C: Testing Results for Various SEC Groupings.

Groups	Average Treated TR_{20} , %	Standard Deviation, %	Sample Count
Low SEC	42%	5%	2
Mid SEC	81%	3%	6
High SEC	91%	3%	4

Prototype C's low-SEC range ($n=2$) averaged a TR_{20} of $42\% \pm 5\%$. In the mid-SEC range ($n=6$), mean removal jumped to $81\% \pm 3\%$, and in the high-SEC condition ($n=4$) it reached $91\% \pm 3\%$. The 93% increase from low to mid SEC contrasts with only a 12% gain from mid to high, illustrating tapering improvements at higher energy inputs. Given the small number of observations, however, these trends should be interpreted with caution.

Two statistical approaches were used to evaluate whether TR_{20} varied significantly among the SEC categories, including a one-way ANOVA followed by paired t-tests. The ANOVA employed the condition-specific means, standard deviations, and sample sizes listed in Table 6.12, yielding a p-value of 4.9×10^{-7} , which was well under the 0.01 significance threshold (i.e., 99% confidence level), demonstrating that not all SEC ranges share the same mean TR_{20} . To determine

which pairs differed, paired t-tests were then carried out, with their outcomes summarized in Table 6.12.

Table 6.12 Prototype C: SEC Groupings Post Hoc Paired T-Tests Results.

Comparison	P-value	Significance
Low vs. Mid Ranges	0.072	Not Significant
Low vs. High Ranges	0.052	Not Significant
Mid vs. High Ranges	9.8×10^{-4}	Significant

The paired t-tests comparing the low-SEC condition to both the mid- and high-SEC ranges did not reach statistical significance, largely because the low-SEC category included only two test series. In contrast, the comparison between the mid- and high-SEC conditions produced a p-value of 9.8×10^{-4} , well below the 0.01 significance threshold. This result indicates, with 99% confidence, that the mean TR_{20} differs between the mid- and high-SEC conditions.

To quantify and compare the settling behavior of both untreated control and electrical flocculation-treated samples, kinetic reaction models were developed. The models describe the rate of turbidity settlement under given conditions. Prototype C data was used to develop these models. The data from control samples (i.e., untreated) were obtained from the upstream sampling area to observe the natural settling of the synthetic stormwater. However, the treated samples were collected at a constant applied voltage of 12V, which yielded SEC values of 0.032 to 0.651 kWh/m³ corresponding to flow rates of 3.8 to 71.9 L/min (1.0 to 19.0 GPM) and current densities of 43.1 to 47.0 A/m² (4.0 to 4.4 A/ft²). The data was first fitted to a first-order kinetic model, which assumes the removal rate is directly proportional to the final turbidity. This model yielded moderate R^2 values of 0.78 to 0.88, indicating the simple exponential decay did not fully capture the settling dynamics. To achieve a stronger correlation, the data was then fitted using a pseudo-second-order kinetic model, which assumes the removal rate is proportional to the square of the

difference between the equilibrium turbidity (C_e) and the instantaneous turbidity (C_t). Applying this model improved the R^2 to above 0.94 for all treated SEC conditions, demonstrating a much closer match to the observed settling behavior. Plots show elapsed time on the x-axis and the ratio of time compared to instantaneous turbidity t/C_t on the y-axis, which is the linearized pseudo-second order kinetic model. Eq. 6.2 shows the linearized form of the pseudo second order kinetic model.

$$\frac{t}{C_t} = \frac{1}{k(C_e^2)} + \frac{t}{C_e} \quad \text{Eq. 6.2}$$

Where, t is the time in minutes, C_t is the instantaneous turbidity in NTU, C_e is the equilibrium turbidity in NTU, and k is the rate constant. C_e , found in Eq. 6.3, is the residual turbidity level that the system approaches as time goes to infinity under fixed conditions (i.e., the plateau value once settling or coagulation has effectively ceased).

$$C_e = \frac{1}{Slope} \quad \text{Eq. 6.3}$$

Further, the pseudo-second order rate constant, k , governs how quickly turbidity is removed and is calculated by Eq. 6.4 Where, b is the intercept of the linear trendline.

$$k = \frac{1}{bC_e^2} \quad \text{Eq. 6.4}$$

Figure 6.10 presents the pseudo-second-order fit for the untreated control samples. These samples were not subjected to electrical flocculation and were not evaluated under a current density but correspond to the treated data at these SEC ranges. The SEC ranges were maintained in this plot to provide a comparison to the treated samples evaluated under these SEC conditions.

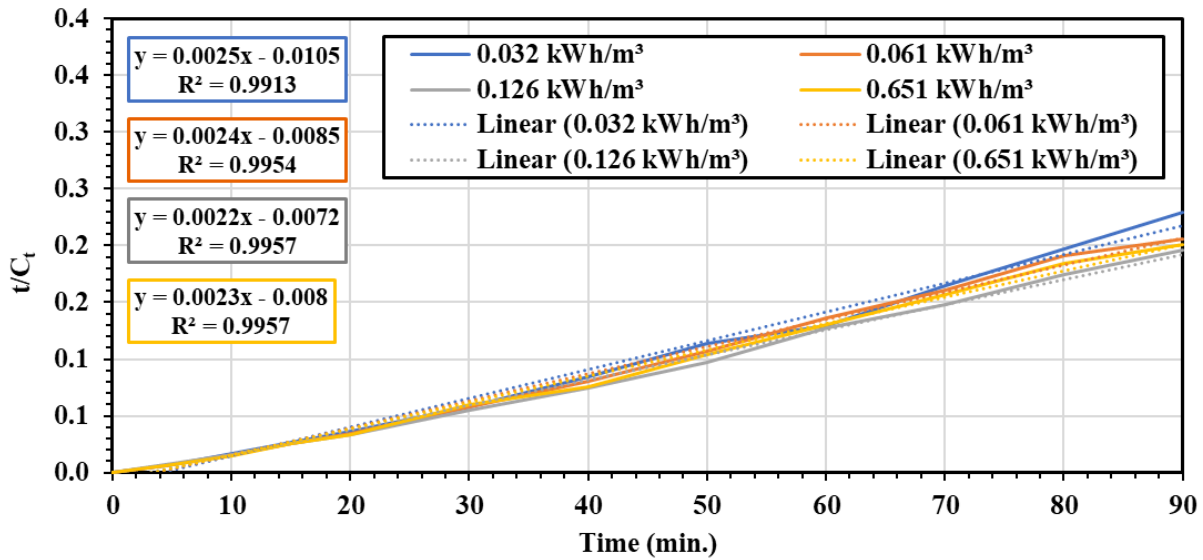


Figure 6.10 Pseudo-Second Order Kinetic Model for Untreated Samples.

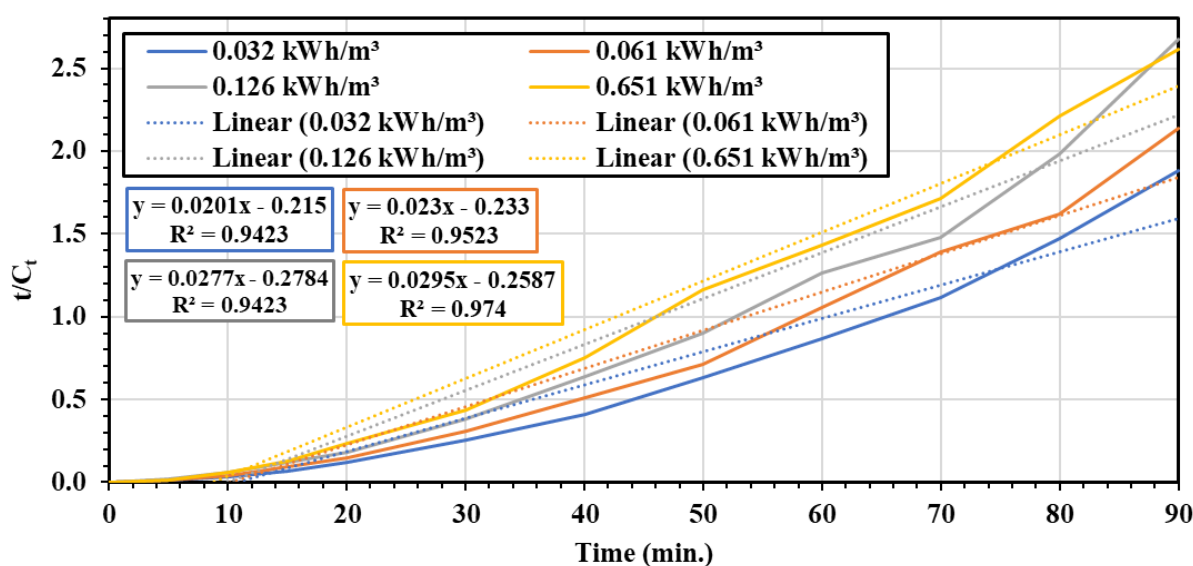
In the absence of electrical flocculation treatment, control samples still settle gravitationally and follow a pseudo-second-order kinetic law with strong linearity. All four control test series yielded a coefficient of determination, R^2 , greater than or equal to 0.991. Plotting the ratio of time over turbidity at time, t , (t/C_t) for four control settling samples yields similar slopes of 0.0022 to 0.0025 min/NTU and intercepts of -0.0105 to -0.0072 min/NTU, reflecting an intrinsic settling rate constant for untreated samples.

Table 6.13 summarizes the electrical and hydraulic conditions at which prototype C was evaluated for this analysis. Across SEC conditions of 0.032, 0.061, 0.126, and 0.651 kWh/m³, associated flow rates were 71.9, 38.6, 19.3, and 3.8 L/min (19.0, 10.2, 5.1, and 1.0 GPM), respectively. For the treated samples, the voltage was held at a constant 12V and yielded a current draw ranging from 11.3 to 12.3A and current densities ranging from 43.1 to 47.0 A/m² (4.0 to 4.4 A/ft²).

Table 6.13 Prototype C: Treated SEC Samples Testing Parameters.

SEC, kWh/m ³	Current, A	Flow Rate, GPM (L/min)	Current Density, A/m ² (A/ft ²)
0.032	11.3	19.0 (71.9)	43.1 (4.0)
0.061	11.8	10.2 (38.6)	45.0 (4.2)
0.126	12.3	5.1 (19.3)	47.0 (4.4)
0.651	11.7	1.0 (3.9)	44.7 (4.2)

Similar to the previous plot, a pseudo-second-order kinetic model was generated for the treated samples, and the corresponding plot is shown in Figure 6.11.

**Figure 6.11 Pseudo-Second Order Kinetic Model for Treated Samples.**

For the treated samples, the same pseudo-second order linearization plot was developed. This plot depicts the same format, plotting time versus the ratio of time compared to instantaneous turbidity, C_e , for all four SEC conditions. The treated data also yielded strong linear relationships across the board with R^2 values ranging from 0.942 to 0.974. Under SEC ranges of 0.032, 0.061, 0.126, and 0.651 kWh/m³, the slopes of those lines increase considerably in comparison to the change in slopes for the untreated control samples. The slopes rise from approximately 0.0201 to 0.0295 min/NTU, respectively, indicating a 47% increase in the rate of reaching equilibrium

turbidity. Table 6.14 summarizes the slope, the intercept, and the coefficient of determination, R^2 , for both control and treated samples.

Table 6.14 Prototype C: Linear Regression Data for Untreated and Treated SEC Conditions.

Condition	SEC, kWh/m ³	Slope, min/NTU	Intercept, min/NTU	R ²
Untreated	0.032	0.0025	0.0105	0.991
	0.061	0.0024	0.0085	0.995
	0.126	0.0022	0.0072	0.996
	0.651	0.0023	0.0080	0.996
Treated	0.032	0.0201	0.2150	0.942
	0.061	0.0230	0.2330	0.952
	0.126	0.0277	0.2784	0.943
	0.651	0.0295	0.2587	0.974

Additionally, the equilibrium turbidity decreases from the range of 400 to 455 NTU in the control test series down to a range of 34 to 50 NTU once electrical flocculation is applied. At the same time, the interceptions of these linear trends, which range from 0.215 to 0.278 min/NTU, are also an order of magnitude larger than in the untreated control samples. When combined with equilibrium turbidity in the relationship found in Eq. 6.4, these larger intercepts translate into rate constants that are approximately 3 to 5 times greater than those of the natural settling process. In practical terms, the electrical flocculation system produces effluent that removes turbidity faster and achieves a much lower long-term turbidity plateau (i.e., equilibrium turbidity). Table 6.15 summarizes the initial turbidity (C_0), equilibrium turbidity (C_e), and rate constant (k).

Table 6.15 Prototype C: Pseudo-Second-Order Kinetic Model Parameters for Untreated and Treated Samples.

Condition	SEC (kWh/m ³)	Initial Turbidity (C ₀), NTU	Equilibrium Turbidity (C _e), NTU	k (min ⁻¹)
Untreated	0.032	728	400	6.6×10^{-4}
	0.061	751	417	6.7×10^{-4}
	0.126	713	455	6.8×10^{-4}
	0.651	736	435	6.0×10^{-4}
Treated	0.032	694	50	3.4×10^{-3}
	0.061	717	43	2.8×10^{-3}
	0.126	609	36	2.3×10^{-3}
	0.651	485	34	1.9×10^{-3}

Comparison of the pseudo-second-order rate constants shows that prototype C's electrical flocculation accelerates settling by factors of 3.2, 3.4, 4.1, and 5.1 at SECs of 0.032, 0.061, 0.126, and 0.651 kWh/m³, respectively, relative to the gravitational settling of the untreated samples.

6.2.2 Aluminum Coagulant Release

To quantify residual dissolved aluminum, a preliminary aluminum coagulant release analysis was performed with a HACH DR3900 Laboratory Spectrophotometer using HACH Aluminum TNTplus vials (measurement range 0.02-0.05 mg/L Al³⁺). Treated effluent was drawn from the intermediate-scale system fitted with the prototype C floc generator device. These evaluations were conducted under two stock-tank conditions: one clean condition, where the tank was drained and thoroughly rinsed to remove sediment, and one sediment-laden condition, in which the tank maintained at approximately 750 NTU influent turbidity.

Trials were conducted across a varying volumetric flow range, with flow rates spanning 3.5 to 54.1 L/min (0.9 to 14.3 GPM) and a constant applied voltage of 12V. Current draw varied between 6.9 and 9.8A (i.e., current density of 26.3 and 37 A/m²; 2.4 and 3.4 A/ft²), reflecting changes in solution conductivity and flow rate. At the lowest flow of approximately 3.8 L/min (1.0 GPM), the reduced conductivity (i.e., clean samples) and choked flow caused the current density

to drop toward the lower bound of this range. For comparison, flows were classified into four conditions, including low (approximately 3.9 L/min; 1.0 GPM), low-mid (approximately 18.9 L/min; 5.0 GPM), mid-high (approximately 36.0 L/min; 9.5 GPM), and high (approximately 53.0 L/min; 14.0 GPM), and samples were collected directly from the device outlet without mixing to simulate a worst-case scenario. Sediment-laden samples were allowed to settle for one hour prior to aluminum analysis. Table 6.16 summarizes influent turbidity, current density, flow rate, and measured dissolved aluminum concentration for each condition.

Table 6.16 Prototype C: Spectrophotometer Evaluations Testing Parameters.

Flow Condition	Sediment Condition	Inflow Turbidity, NTU	Current Density, A/m² (A/ft²)	Flow Rate, GPM (L/min.)	Measured Al³⁺, mg/L
Low Flow	Clean	2.6	26.3 (2.4)	1.0 (3.8)	1.81
	Sediment	735	32.8 (3.1)	0.9 (3.5)	0.79
Low-Mid Flow	Clean	2.6	36.2 (3.3)	4.8 (18.3)	0.81
	Sediment	774	36.2 (3.3)	4.9 (18.4)	0.26
Mid-High Flow	Clean	2.6	37.0 (3.4)	9.3 (35.1)	0.52
	Sediment	751	36.2 (3.3)	9.5 (36.0)	0.22
High Flow	Clean	2.6	37.4 (3.5)	14.3 (54.1)	0.40
	Sediment	746	35.9 (3.3)	13.9 (52.7)	0.19

Aliquots were extracted from the samples and used for the spectrophotometric analysis. Results quantify the fraction of aluminum that remained suspended as cations versus that bound within settled floc sludge. In sediment-laden trials, the low-flow condition bound 56% of generated aluminum ions (Al³⁺), reducing dissolved concentration from 1.81 mg/L to 0.79 mg/L of Al³⁺. Under low-mid flows, 68% of aluminum ions (Al³⁺) were bound in sediment, lowering the dissolved fraction from 0.81 mg/L to 0.26 mg/L of Al³⁺. The mid-high flow condition achieved 57% reduction in aluminum ions (Al³⁺) concentration of the supernatant, converting 0.52 mg/L of dissolved Al³⁺ to 0.22 mg/L, while the high-flow conditions reduced supernatant concentrations by 51%, reducing the dissolved concentration from 0.40 mg/L to 0.19 mg/L of Al³⁺.

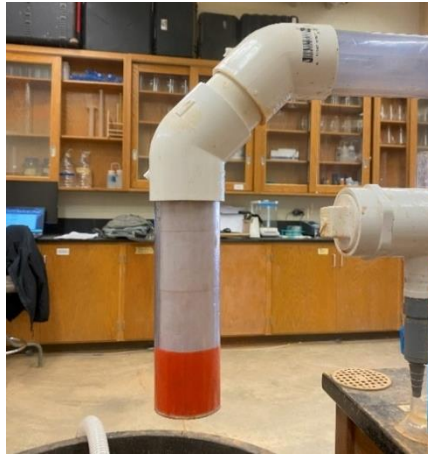
Because the floc generator is intended to operate above the low-flow conditions in field applications, emphasis is placed on the mid-high and high conditions. In the high-flow condition of approximately 53 L/min (14.0 GPM), the measured dissolved aluminum concentration of 0.19 mg/L approaches the U.S. EPA secondary standard for aluminum in drinking water (0.20 mg/L), the closest available regulatory benchmark. These findings demonstrate that optimizing the flow-to-current ratio is critical to generating sufficient aluminum ions (Al^{3+}) coagulant for effective turbidity removal while avoiding excessive residual aluminum in the effluent.

6.2.3 Mixing Evaluations

In this study, the mixing evaluation comprised two distinct phases. Phase I focused on passive mixer-type optimization. Four passive mixers were tested, individually and in series, downstream of prototype C under identical flow of 18.9 L/min (5.0 GPM), current density of 44.0 A/m² (4.1 A/ft²), and inflow turbidity conditions. Mixer versions included two 3D printed static mixers denoted as V1 and V2, a chain section inside (V3), and cyclone insert (V4). Detailed mixer geometries are described in *Chapter 4: Intermediate-Scale Methodology*. For the first evaluation of each mixer type (M-1 through M-4), V1 and V4 were tested as single elements, while V2 was evaluated as a pair, and V3 was tested as a single 4.6 m (15 ft) chain segment. In the second evaluation (M-5 through M-7), the mixing length was increased by stacking elements: three V1 units for M-5, four V2 units for M-6, and a 0.6 (2 ft) PVC section filled with chain for M-7, shown in Figure 6.12. Cyclone mixer (V4) was not enhanced and did not undergo a second test series evaluation.



(a) stacked V1 mixer



(b) stacked V2 mixer



(c) additional hardware V3

Figure 6.12 Enhanced Passive Mixers Evaluated.

For each test, four samples were obtained from the effluent end of the testing system; therefore, all samples were treated with electrical flocculation. The “control” sample indicated samples that were not mixed by the passive mixer configuration, whereas the “treated” sample represented samples that were passively mixed. Two sets of control and treated samples were obtained for each test set, and one of each was subjected to additional mechanical mixing on a magnetic stirrer plate at a speed of 360 RPM for 8 minutes. Therefore, the four samples obtained included: (1) no static or mechanical mixing (C-NM), (2) only mechanical mixing (C-M), (3) only passive mixing (T-NM), and (4) mixed passively and mechanically (T-M). All samples were transferred to graduated cylinders and settled for 60 minutes with aliquots obtained at 0, 5, 10, 15, 20, 30, 40, 50, and 60 minutes and subsequently run for turbidity analysis. Table 6.17 summarizes the inflow turbidity, passive TR₂₀, and mechanical TR₂₀ for each mixing condition.

Table 6.17 Evaluated Mixer Conditions with Corresponding Passive and Treated TR₂₀.

Mixer Condition	Inflow Turbidity, NTU	Passive TR₂₀, %	Mechanical TR₂₀, %
M-1	583	-3%	12%
M-2	379	-3%	9%
M-3	551	-6%	11%
M-4	641	-2%	17%
M-5	597	-4%	18%
M-6	599	3%	9%
M-7	703	-8%	9%

The passive TR₂₀ was calculated by comparing control-not-mixed (C-NM) samples to treated-not-mixed (T-NM) samples, which isolated the effect of passive mixing, while the mechanical TR₂₀ compared C-NM to control-mixed (C-M) samples and isolated the effect of magnetic stirring. As shown in the chart, passive mixing under the configurations tested yielded TR₂₀ values virtually identical or reduced compared to the TR₂₀ of the unmixed samples (C-NM), indicating no improvement in floc formation or subsequent settling. In contrast, mechanical mixing produced an average 12 percentage point increase in TR₂₀ over from C-NM to T-NM, demonstrating that mechanical agitation enhances treatment efficiency. These findings confirm that mixing is important for effective floc development and settling, but that the passive mixer conditions evaluated did not generate sufficient turbulence to improve performance. Due to cost and practical constraints, the chain and cyclone mixers were not evaluated further. Phase II testing employed increased numbers of the V1 and V2 3D-printed static mixers.

Further, Phase II directly compared static mixing to mechanical agitation using prototype C at 37.9 L/min (10.0 GPM), inflow turbidity of 668-721 NTU, and a current density of 31 A/m² (2.9 A/ft²). Downstream samples were either passively mixed via a series of ten V1 (V1-10) or ten V2 (V2-10) static mixers or stirred on a magnetic plate at 360 RPM for 0.5, 1, 2, 3, 4, or 5 min (i.e., mechanically mixed). Control-upstream (CU) samples were obtained upstream of the floc

generator cartridge and used to quantify natural settling. In contrast, T-NM samples were obtained from the discharge of the floc generator prototype, isolating the effect of electrical flocculation without mixing. Each mixing condition was replicated at least three times, and TR₂₀ values were averaged. The resulting turbidity-reduction data are presented in Figure 6.13.

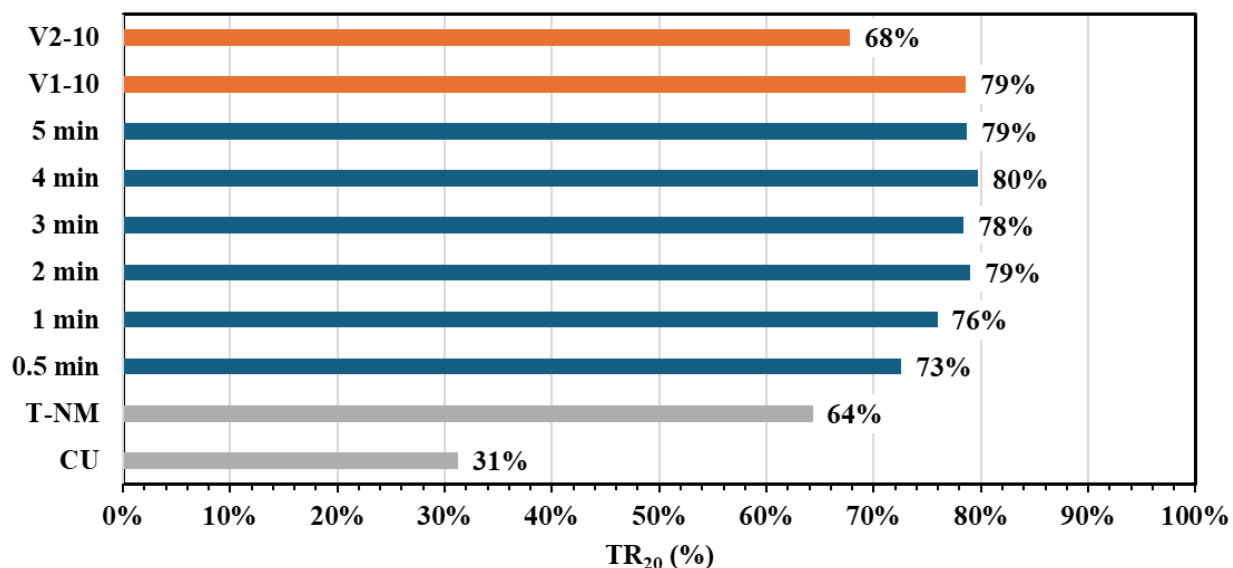


Figure 6.13 Phase II Mixing Evaluation Results: Mechanical versus Passive Mixing.

The chart shows that natural settling (CU) achieved only 31% TR₂₀, reducing turbidity from 714 to 491 NTU, whereas electrical flocculation treatment without mixing (T-NM) improved removal to 64%, by decreasing turbidity from 697 to 249 NTU. This further confirms that electrical flocculation alone enhances sediment removal. Introducing mechanical mixing at 360 RPM further raised TR₂₀ rates. After 30 seconds of stirring, TR₂₀ reached 73%, decreasing turbidity from 705 to 193 NTU, increasing to 80% at 4 minutes, reducing turbidity from 710 to 144 NTU. Negligible gains were observed beyond 2 minutes of mixing. Passive mixing using ten V1 (V1-10) static mixers yielded 79% TR₂₀ (reducing turbidity from 693 to 148 NTU), comparable to 2-5 minutes of mechanical stirring, whereas passive mixing with ten V2 (V2-10) mixers provided only minor benefits compared to electrical flocculation without mixing, achieving a TR₂₀ of 68%, reducing

turbidity from 692 to 223 NTU. These results demonstrate that mechanical and passive mixing promotes floc growth and settling under the tested conditions. After 2 minutes of mechanical stirring or employing a ten-element V1 static mixer series, the optimal performance was achieved.

6.2.4 Electrode Longevity Evaluations

Electrode longevity evaluations were performed to assess the electrodes lifespan with and without polarity reversal. Polarity reversal has been determined to mitigate the effects of electrode passivation, or fouling, under optimal intervals. Both evaluations were conducted using prototype C in the intermediate-scale system, which was operated continuously at 12V for 100 hours without any interim cleanouts. However, the piping feeding the floc generator prototype was flushed to remove as much sediment as possible without removing it and mechanically cleaning the device. Performance assessments were conducted hourly, each consisting of two to three paired control and treated sample sets, to monitor treatment efficacy as the electrodes began to passivate. Simultaneously, the current draw was recorded every five minutes, and the corresponding current density was used for data analysis. This raw data (i.e., 5-minute data) was averaged on an hourly basis to smooth out momentary spikes associated with device start-ups and shutdowns, and the resulting profile is plotted in Figure 6.14.

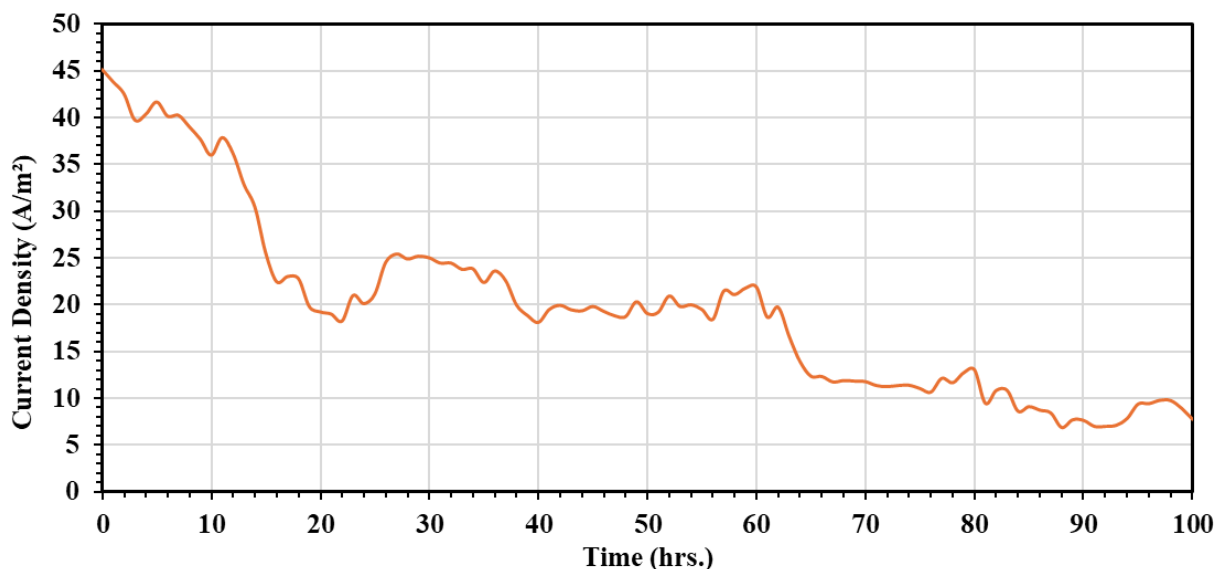


Figure 6.14 Electrode Longevity: Experiment Duration versus Average Current Density.

The plot compares the experiment duration, in hours, to the corresponding current density. At the beginning of testing, the system drew an average current density of 45 A/m² (4.2 A/ft²) during the first hour. Within the first 22 hours, the current dropped substantially to 18.3 A/m² (1.7 A/ft²). From hours 23 through 62, the current density stabilized around an average of 21.2 A/m² (2.0 A/ft²). A second rapid decline occurred in a short period between 62 and 65 hours, when the current density reduced from 19.7 A/m² (1.8 A/ft²) to 12.4 A/m² (1.2 A/ft²). For the remainder of the 100-hour test duration, the current continued to taper gradually, fluctuating between 13.0 A/m² (1.2 A/ft²) and 6.9 A/m² (0.6 A/ft²) and averaging 10.0 A/m² (0.9 A/ft²) overall. These trends reflect the progressive reduction in active electrode surface area due to passivation, which corresponded with diminishing electrical flocculation performance over time.

Hourly turbidity reduction was monitored simultaneously with the electrode longevity amperage evaluation by collecting one to three sample sets each hour. These sample sets were allowed to settle for 30 minutes, and the reduction in turbidity was measured every 0, 5, 10, 15, 20, and 30 minutes. The assessed turbidity reduction for these evaluations used TR₃₀. As shown in

Figure 6.15, the treated samples exhibited a gradual decline in removal efficiency that paralleled, but did not match the sharp drop in current density.

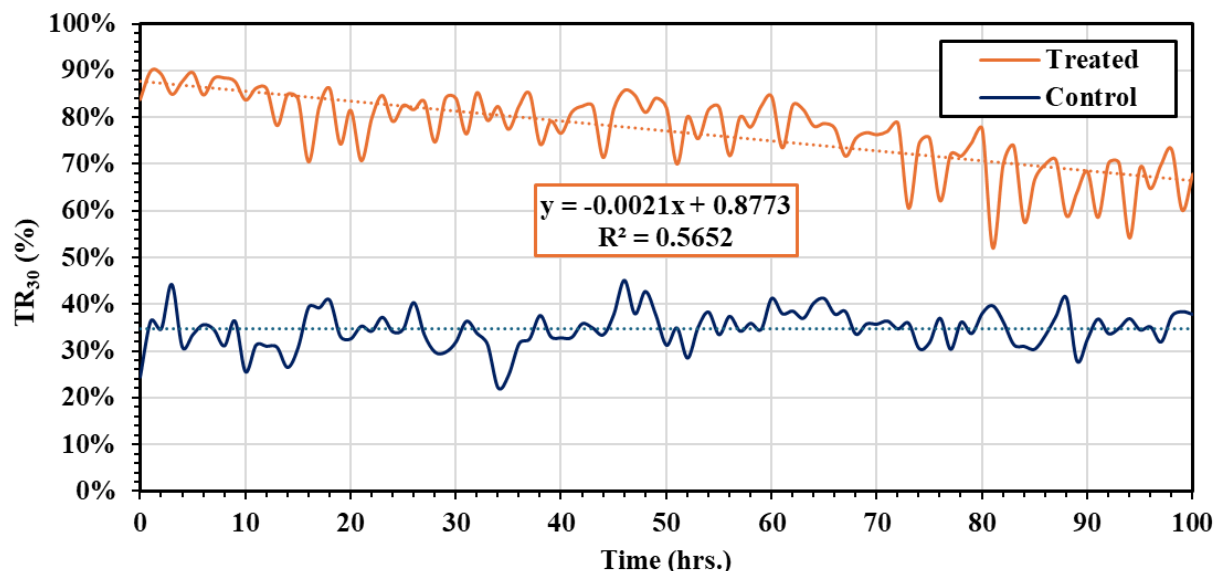
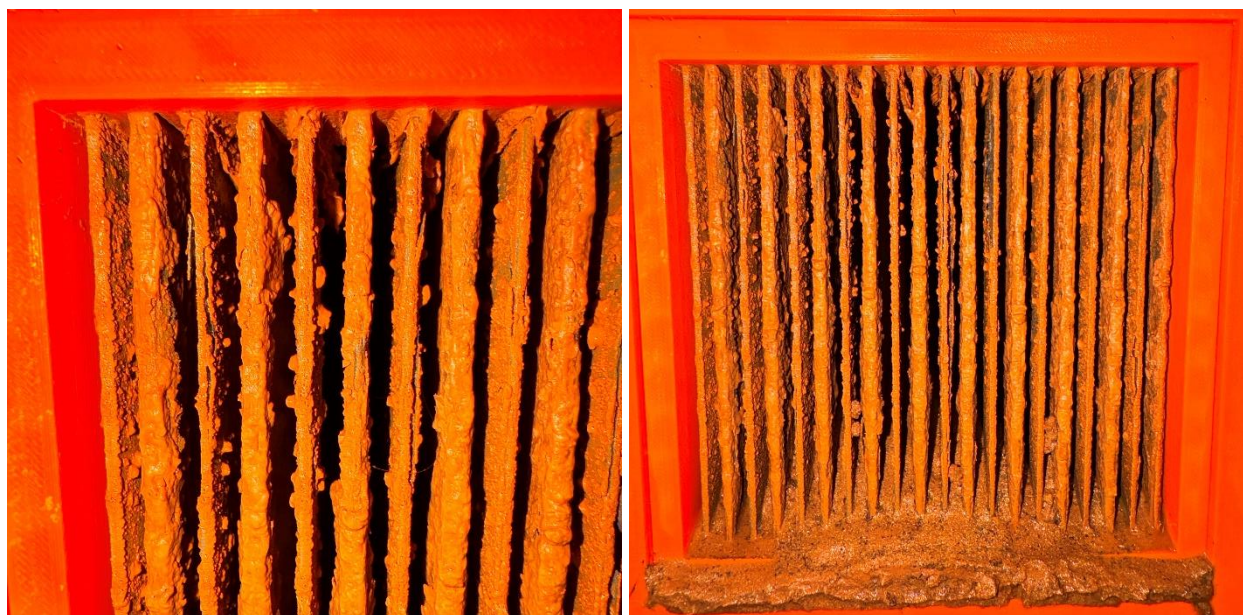


Figure 6.15 Electrode Longevity: Experiment Duration versus Turbidity Reduction.

Treated samples exhibited a negative trend due to the loss of current density over the 100-hour testing duration. However, visually, the decrease in current density had a steeper negative slope compared to the turbidity reduction. This indicates that the device continued to treat the synthetic stormwater effectively, especially considering current density values decreased from 45.2 to 7.8 A/m² (4.2 to 0.72 A/ft²), an 83% reduction, whereas TR₃₀ decreased from 84% to 68%, which yielded a 23.5% reduction. The dataset had a maximum TR₃₀ of 90% and a minimum of 52% over the 30-hour timeframe. Over the full 100 hours, treated samples achieved an average 77% TR₃₀; however, when separated into beginning and ending performance, they resulted in 82% TR₃₀ during the first 50 hours and 72% TR₃₀ during the final 50 hours. In contrast, control samples achieved an average TR₃₀ of 35% with values ranging from 18% to 38%, with no appreciable difference between the first and second half of the test, confirming that the observed decrease in treated-sample performance arose from electrode passivation rather than changes in natural

settling. Linear projections of the treated turbidity removal trend (TR_{30}) indicate that, without any device maintenance, removal efficiency would decline to the control sample average of 35% after roughly 250 hours of continuous operation. To preserve a minimum 50% TR_{30} , electrode replacement would be required at approximately 180 hours.

To visually assess the electrodes and the passivation that occurred over the 100-hour operational duration, the floc generator was removed from the testing apparatus and evaluated, shown in Figure 6.16.



(a) close-up of electrodes before rinsing

(b) sediment accumulation in floc generator



(c) electrodes after rinsing

Figure 6.16 Electrodes and Floc Generator after 100-hour Operation.

When removed from the test configuration, the floc generator remained full of water and contained substantial sediment; some of this material drained before the device was fully opened (Figure B), so the photographed deposit underrepresents the total mass. The retained sediment obstructed the electrodes and reduced the available conductive surface area, impeding electrolysis. A distinct passivating layer of oxide and organic matter adhered to the electrodes, visibly coating

their surfaces and in places peeling away when disturbed, Figure A. Following rinsing to remove excess sediment and the oxide deposits, localized pitting became evident on the electrode surfaces. In addition, several electrodes exhibited brittleness, indicating material degradation. To address this progressive passivation, a second longevity series was conducted, which incorporated periodic polarity reversal.

Polarity reversal trials followed the same protocol as the original electrode-longevity tests, where current density was logged every five minutes, and paired treated-control performance sample sets were collected each hour. During these evaluations, the only addition to the testing methods was adding a polarity reversal in 5-hour intervals. Figure 6.17 compares the resulting average hourly current density profiles for the standard test without polarity reversal (N-PR) and the polarity reversal series (PR) over a 30-hour testing duration.

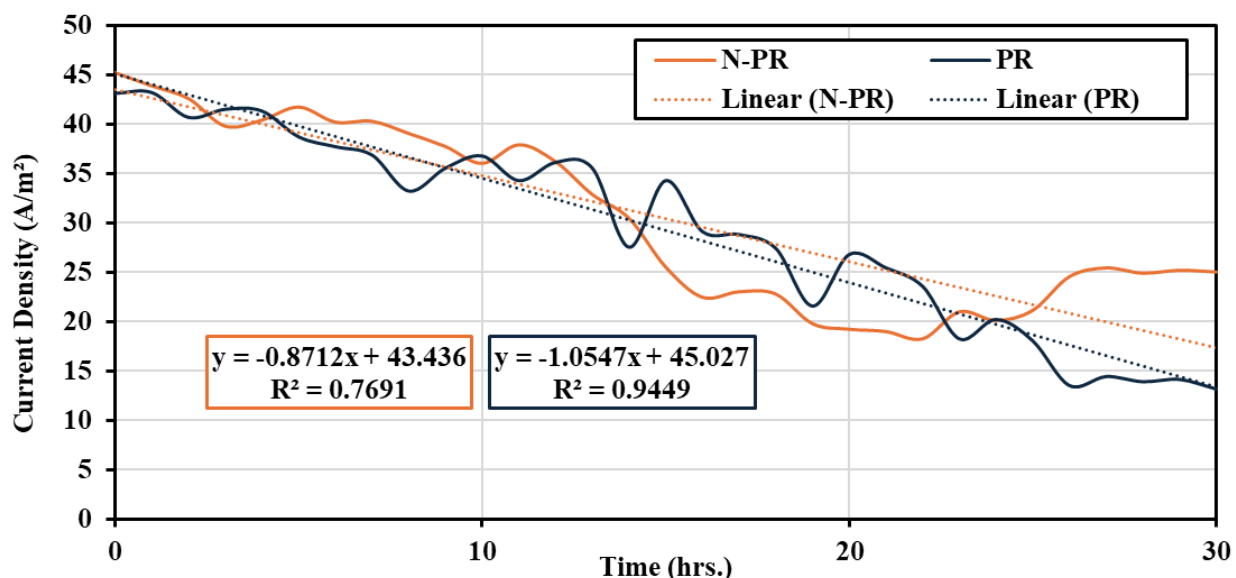


Figure 6.17 Electrode Longevity: Experiment Duration versus Average Current Density for N-PR and PR Conditions.

The plot includes two linear regressions fitted to the average hourly current density datasets for both tests, N-PR and PR. The N-PR regression has a slope of approximately -0.9 A/m^2 (0.08

A/ft²) per hour ($R^2=0.77$), indicating a gradual loss of electrode current density over time. In contrast, the PR regression has a slope of -1.1 A/m² (0.1 A/ft²) per hour ($R^2=0.94$), reflecting a much faster and more uniform decline. Because the N-PR series extends past 22 hours, its current density first declines and then rebounds between the hours of 22 (18.3 A/m²; 1.7 A/ft²) and 30 (25.0 A/m²; 2.3 A/ft²), creating a lower correlation in the N-PR data, reducing its R^2 relative to PR. In contrast, PR exhibits a continuous, gradual decline over the entire 30-hour testing duration. Analysis of the N-PR dataset revealed an average current draw of 30.4 A/m² (2.8 A/ft²) in the first 30 hours, whereas the PR data showed an average amperage of 29.2 A. At the end of the 30-hour test duration, the N-PR current density yielded 25.0 A/m² (2.2 A/ft²), whereas the PR configuration only delivered 13.1 A/m² (1.2 A/ft²). This analysis demonstrates that the five-hour polarity reversal interval may increase net electrode degradation rather than extending the operational life of the electrodes. Additionally, the turbidity removal (TR₃₀) data for the N-PR and PR evaluations were plotted and compared, shown in Figure 6.18.

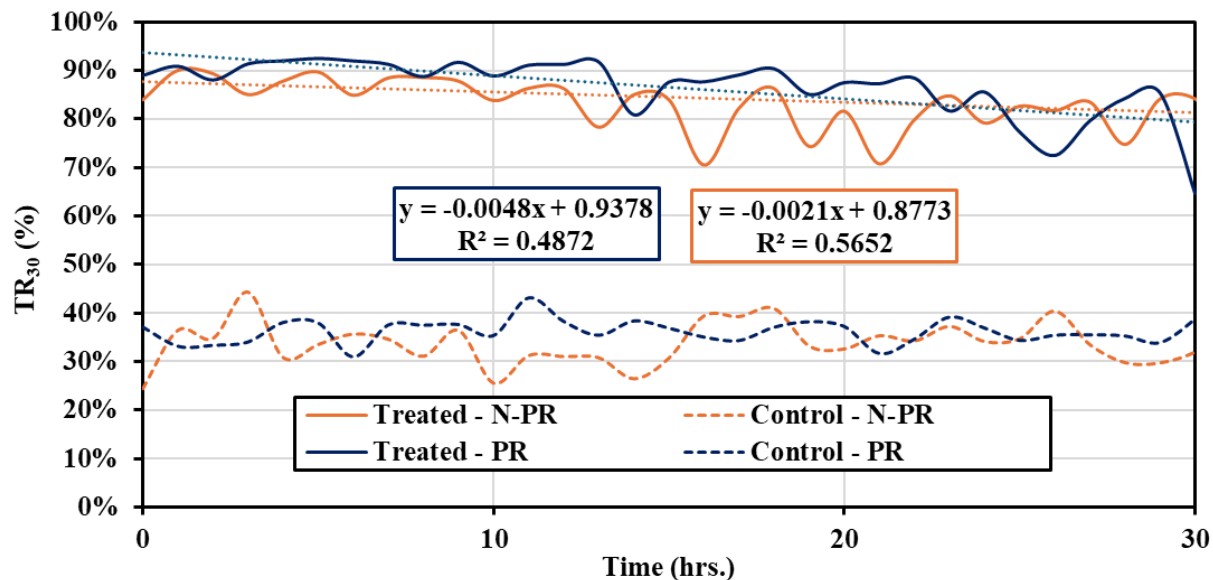


Figure 6.18 Electrode Longevity: Experiment Duration versus Turbidity Reduction for N-PR and PR Conditions.

Over the 30-hour evaluation, the treated samples under PR achieved an average TR₃₀ of 87% compared with 83% for the N-PR dataset. A linear regression of the N-PR data yielded a slope of -0.0021 ($R^2=0.5652$), corresponding to a decay rate of 0.21% per hour. In contrast, the PR regression yielded a slope of -0.0048 ($R^2=0.4872$), corresponding to a decay rate of 0.48% per hour. Although PR correlates to a higher sediment removal efficiency over the 30-hour duration, its steeper decay predicts convergence with the N-PR curve at about 22 hours and subsequent underperformance thereafter. Meanwhile, control samples under both conditions remain stable, averaging 34% removal for N-PR and 36% for PR evaluations, confirming that these trends reflect electrode passivation rather than changes in natural settling.

Further research is needed to optimize the polarity reversal interval and its effect on electrode lifespan. Dedicated longevity trials with shorter reversal intervals will indicate how varying the frequency and duration of polarity swaps impacts oxide-layer mitigation and the net active electrode surface area over time.

6.2.5 Pollutant Loading Evaluations

Prototype C was installed in the intermediate-scale testing system to evaluate its capacity to remove post-construction pollutants, including heavy metals and nutrients. Unlike previous tests that used only sediment-laden flow to simulate construction runoff, these pollutant-loading trials spiked the influent with known concentrations of cadmium (Cd), copper (Cu), iron (Fe), lead (Pb), nickel (Ni), nitrate (NO_3^-), phosphate (PO_4^{3-}) and zinc (Zn), in an effort to replicate typical contaminant profiles found in post-construction stormwater. Target concentrations were chosen in accordance with representative runoff levels reported in NCHRP Report 918 (Lantin et al. 2019a). Table 6.18 summarizes each pollutant's reagents, molecular formulas, and target concentrations.

Table 6.18 Heavy Metals and Nutrients in Synthetic Stormwater.

Target Species	Reagent	Molecular Formula	Target Concentration, mg/L
Cadmium (Cd)	Cadmium nitrate tetrahydrate	$\text{Cd}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$	0.072
Iron (Fe)	Iron (II) sulfate heptahydrate	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$	12.74
Zinc (Zn)	Zinc nitrate hexahydrate	$\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	0.889
Copper (Cu)	Copper sulfate anhydrous	CuSO_4	0.028
Nickel (Ni)	Nickel nitrate hexahydrate	$\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	0.012
Lead (Pb)	Lead (II) nitrate	$\text{Pb}(\text{NO}_3)_2$	0.162
Nitrate (NO_3^-)	Sodium nitrate	NaNO_3	1.841
Phosphate (PO_4^{3-})	Disodium hydrogen phosphate	Na_2HPO_4	0.182

Synthetic stormwater at approximately 750 NTU was dosed with target contaminant concentrations in two separate vessels, including a 1,041 L (275 gal) IBC tote and a 416 L (110 gal) trough. The spiked stormwater was then pumped through prototype C with an applied current density of approximately 38 A/m^2 (3.5 A/ft^2), downstream mixers, and the intermediate-scale lamella settling system at 37.9 L/min (10.0 GPM). To achieve the same final concentrations after dilution, two distinct stock solutions were calculated so that the IBC tote solution was prepared at higher contaminant concentrations to compensate for its larger volume, while the trough solution was proportioned for the 416 L (110 gal) vessel. Table 6.19 summarizes the mass of the spiked pollutants introduced into both vessels.

Table 6.19 Concentrations of Heavy Metals and Nutrients in Synthetic Stormwater.

Target Species	IBC Tote, mg	Trough, mg
Cadmium (Cd)	19.2	7.2
Iron (Fe)	3,503.5	1,274
Zinc (Zn)	244.5	88.9
Copper (Cu)	7.7	2.8
Nickel (Ni)	3.3	1.2
Lead (Pb)	44.6	16.2
Nitrate (NO_3^-)	506.3	184.1
Phosphate (PO_4^{3-})	50	18.2

Three upstream (control) and three downstream (treated) grab samples were submitted to the University of Georgia Agricultural & Environmental Services Laboratories for comprehensive water quality analysis. Results from each triplicate set were averaged to establish baseline (control) and post-treatment (treated) pollutant concentrations. Comparative mean values for all target contaminants and their corresponding percent reduction are presented in Table 6.20.

Table 6.20 Contaminant Concentrations Measured in Pollutant Loading Testing.

Contaminant	Control, mg/L	Treated, mg/L	% Reduction
Cadmium (Cd)	0.064	0.025	60%
Copper (Cu)	0.070	<0.050	>50%
Iron (Fe)	13.01	3.520	73%
Lead (Pb)	0.150	0.028	82%
Nickel (Ni)	0.010	0.030	-200%
Nitrate (NO ₃ ⁻)	0.820	1.100	-34%
Phosphate (PO ₄ ³⁻)	0.340	0.110	68%
Zinc (Zn)	1.320	0.880	33%

This data demonstrates that the floc generator achieved substantial removal for most metal and nutrient targets under the specified pollutant loading conditions. Cadmium concentrations declined from 0.064 mg/L upstream to 0.025 mg/L downstream, corresponding to 60% removal. Copper dropped from 0.070 mg/L to below the detection limit of 0.050 mg/L. Iron exhibited a 73% reduction, reducing in concentration from 13.01 mg/L to 3.520 mg/L, while lead removal reached 82%, decreasing from 0.150 mg/L to 0.028 mg/L. Phosphate was reduced by 68%, from 0.340 mg/L to 0.110 mg/L, and zinc saw a more moderate decline of 33%, from 1.320 mg/L to 0.880 mg/L.

In contrast, nickel and nitrate concentrations increased in the treated effluent. Nickel rose from 0.010 mg/L upstream to 0.030 mg/L downstream, which resulted in a 200% increase, and nitrate increased from 0.820 mg/L to 1.100 mg/L, a 34% increase. Although these initial pollutant-loading trials demonstrate significant removal of cadmium, copper, iron, lead, and phosphate,

further testing is required before definitive conclusions can be drawn regarding the floc generator's capability to treat heavy metals and nutrients. Future evaluations should include replicate trials across a wider range of flow rates, water chemistries, the inclusion of longer-duration trials to assess performance stability, and targeted analyses to determine the mechanisms behind observed nitrate mobilization and nickel release.

6.3 Field-Scale Evaluations

This subsection will cover the field-scale evaluations conducted at AU-SRF using a 79 m³ (2,790 ft³) sediment basin. Separate field-scale evaluations were conducted using prototype C and prototype D. Evaluations employing prototype C aimed at obtaining preliminary performance data on the floc generator in a field-scale testing system. Further, prototype D evaluations aimed at optimizing flow to electrode surface area ratio, employing multiple cartridges to treat larger volumetric flows. Also, prototype D evaluations aimed to assess how variations in inflow water temperature affect sediment removal. In both evaluation series, each floc generator prototype was installed at the discharge end of its respective surface skimmer (i.e., 3.8 cm (1.5-in.) skimmer for prototype C and 10.2 cm (4-in.) skimmer for prototype D) to treat basin outflows directly.

6.3.1 Prototype C

Prototype C, fitted with new 6061-grade aluminum electrodes, was evaluated in three preliminary field-scale test series at the AU-SRF. All test series were conducted using a 3.81 cm (1.5-in.) floating surface skimmer, which supplied the floc generator prototype with approximately 28.0 to 31.4 L/min (7.4 to 9.0 GPM) of flow. Sampling occurred at three locations, including the basin inflow, upstream of the floc generator (i.e., skimmer effluent), and downstream at the lamella settler discharge (i.e., electrical flocculation treated). The location produced ten hand-grab inflow samples (collected every 3 min over 30 min duration), approximately 32 skimmer discharge

samples (hand grabbed every 10 min plus ISCO autosampling every 30 min for 12 hours), and 24 treated autosamples (every 30 min for 12 hours), respectively. Due to an ISCO sampler malfunction during FS3, the upstream control (i.e., skimmer effluent) dataset was incomplete, and its missing turbidity values were estimated from the corresponding FS1 and FS2 measurements. Because this missing data affected only the skimmer effluent dataset, and not the treated-effluent measurements, this estimation preserves the integrity of the treatment performance analysis while ensuring that all treated-sample results remain based on directly measured data.

Figure 6.19 shows a comparative analysis of preliminary turbidity reduction data from the three field-scale test series, with the time axis (x-axis) beginning at the initiation of basin inflow. Because lamella-settler discharge (i.e., treated sampling) did not commence until approximately 2 hours and 45 minutes after inflow began, the plot's data begins at that point. In this plot, turbidity reduction is expressed as the percentage decrease in turbidity between the average skimmer effluent turbidity (i.e., upstream of the prototype) and the treated turbidity at the lamella settler outlet over the subsequent nine-hour period. Basin inflow turbidity was excluded from this comparison to avoid integrating the floc generator treatment performance with the basin's gravitational settling, thereby isolating the removal efficiency attributed only to the floc generator and subsequent settling.

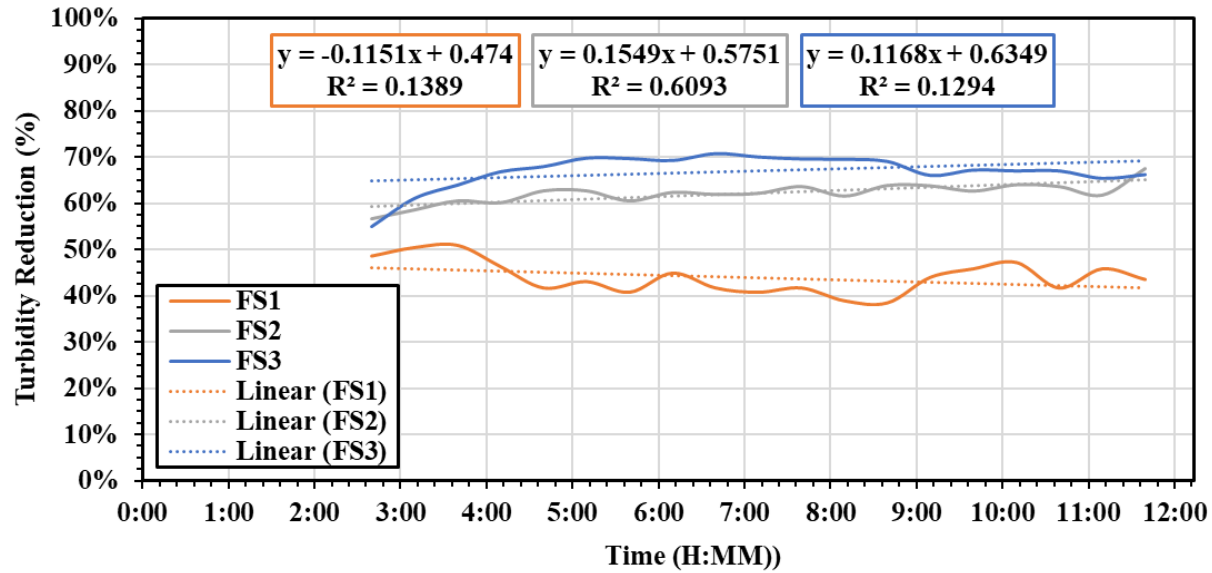


Figure 6.19 Prototype C Field-Scale Testing: Test Duration versus TR.

In the plot, FS1 is represented in orange, FS2 in grey, and FS3 in blue, with average turbidity reduction values of 44%, 62%, and 67%, respectively. Across the three field-scale test series, FS1 began with a 49% turbidity reduction, decreasing the average skimmer inflow turbidity of 216 to 111 NTU after approximately 2 hours and 40 hours of detention. Further, the FS1 dataset declined at a factor of 0.12 per hour, and exhibited an R^2 of 0.14, which indicated a weak downward trend with high variability. Further, FS1 was the only test series to depict a declining trend in turbidity reduction over the sampling period. FS2 started at 57% turbidity removal, from 256 to 111 NTU and improved at a factor of 0.15 per hour, and achieved an R^2 of 0.61, reflecting the most consistent upward trend. This test series increased to a 67% turbidity reduction, reflecting a turbidity reduction from 256 to 85 NTU during the conclusion of sampling. FS3 held the highest starting skimmer effluent turbidity of 275 NTU, and experienced a 55% turbidity removal at the beginning of sampling. FS3 had an increasing trend at a factor of 0.12 per hour but showed an R^2 of 0.13. This suggests that while the data are relatively stable, the weak trend over time reduces the effectiveness of a linear model in capturing meaningful variation. As a result, the low R^2 values

reflect the limited change in turbidity reduction over the testing period rather than high variability or noise in the data. In these test series, FS2 demonstrated the most reliable performance improvement and the greatest early removal. Further, FS1 trended downward with inconsistent results.

The lower field-scale performance, relative to laboratory evaluations, conducted under similar flow rates of 28.0 to 31.4 L/min (7.4 to 9.0 GPM), applied voltage of 12V, and current density range of 28.6 to 34.4 A/m² (2.7 to 3.2 A/ft²) is likely attributable to the substantial temperature differential of the inflow. Field-scale testing has a flow rate through the device of 28.0 to 31.4 L/min (7.4 to 9.0 GPM), and a settler volume of 3,339 L (882 gal) equating to an HRT exceeding 90 minutes. When compared to the intermediate scale test series conducted at a flow of 31.4 L/min (8.3 GPM) and current density of 46.6 A/m² (4.3 A/ft²), prototype C achieved a TR₉₀ of 94%, reducing turbidity from 704 to 39 NTU. In the lab, intermediate-scale synthetic stormwater is typically measured at approximately 20°C (68°F), with only minor seasonal variations. In contrast, field tests were conducted outdoors in winter, when ambient air temperatures fell to as low as -4.4°C (24°F).

Lower water temperatures increase solution viscosity, which creates more resistance for the flocs to settle. Additionally, lower temperatures reduce ion mobility and reaction kinetics, which can decrease the rate of coagulant production at the electrodes. This effect is reflected in the field's peak current of 35.9 A/m² (3.3 A/ft²), which is 14.5 A/m² (1.4 A/ft²) lower than the findings from the intermediate-scale evaluation under similar voltage and flow conditions. Table 6.21 summarizes the dates of each evaluation, corresponding high and low air temperatures, the highest current draw, and the average skimmer-effluent turbidity.

Table 6.21 Prototype C Field-Scale Test Series and Corresponding Testing Parameters.

Test Series	Test Date	Highest Air Temperature, °C (°F)	Lowest Air Temperature, °C (°F)	Highest Current Density, A/m ² (A/ft ²)	Average Upstream Effluent Turbidity, NTU
FS1	12/19/2023	13.3 (56)	-3.9 (25)	35.9 (3.3)	215
FS2	01/02/2024	13.3 (56)	-2.8 (27)	33.6 (3.1)	255
FS3	01/03/2024	10.0 (50)	-4.4 (24)	28.3 (2.6)	275

Further, variability in upstream turbidity possibly influenced removal performance. FS3, which began with the highest influent turbidity, achieved more settling compared to FS2 and FS1. In general, greater sediment loading increases the mass available for coagulation and subsequent removal.

6.3.2 Prototype D

Prototype D, the latest prototype, was employed to investigate how the ratio of flow rate to available anodic surface area and variations in influent temperature affect treatment performance. Unlike prototype C, which provides 2,619.4 cm² (406.0 in²) of anodic surface, prototype D has a conductive surface area of 3,669.7 cm² (568.8 in²) of commercially pure aluminum. Additionally, prototype D employs a redesigned electrode spacer compartment, designed to fit within a 6-in. PVC, see *Chapter 3: Prototypes Constructed and Evaluated* for full details.

Five field-scale test series were conducted to isolate the effects of temperature and the number of cartridges used. Series W-1 evaluated a single prototype D at warmer inflow temperatures, while C-1 repeated the single-cartridge test series under colder conditions. Series C-2, C-3, and C-4 then progressively increased the number of cartridges, two, three, and four units, respectively, under colder, sediment-laden inflow conditions. All tests were conducted at a constant supply of 12V; however, for C-3 and C-4, which powered three and four cartridges simultaneously, two 12V power banks were paralleled to maintain voltage under higher current densities.

Therefore, only two cartridges were powered by a single 12V power bank. The goal for testing was to achieve 75% TR₂₀ at high flow rates, meeting or exceeding 378.5 L/min (100.0 GPM). However, only one sample set was obtained per flow rate, unlike other evaluations that contained three replicate sample sets per test series. Table 6.22 summarizes each series' inflow turbidity, average current, current density, initial inflow water temperature, flow rate range, and number of flows evaluated. Due to the variation in inflow turbidity, inflow water temperatures, and sample sizes of conditions C-2 and C-3, most comparisons were conducted between conditions W-1, C-1, and C-4.

Table 6.22 Prototype D Field-Scale Test Series and Corresponding Testing Parameters.

Test Series	Inflow Turbidity, NTU	Average Current, A	Current Density, A/m², (A/ft²)	Water Temperature, °C (°F)	Flow Rate Range, GPM (L/min)	No. Flow Rates Evaluated
W-1	576	8.9	24.3 (2.3)	22.2 (72)	5.5-126 (20.8-477)	20
C-1	698	10.2	27.8 (2.6)	11.1 (52)	4.0-86.1 (15.1-326)	16
C-2	355	15.4	21.0 (2.0)	7.8 (46)	13.8-80.3 (52.2-304)	7
C-3	382	27.2	24.7 (2.3)	7.8 (46)	1.0-98.4 (3.8-372.5)	11
C-4	769	30.6	20.9 (2.0)	11.7 (53)	1.8-80.3 (6.8-304)	16

All data in this test series was plotted on scatter plots comparing flow rate to TR₂₀, using a 75% line to compare values above or below the specified threshold. Initial evaluations of a single cartridge under warmer inflow conditions (W-1) were evaluated under flow rates of 20.8 to 477 L/min (5.5 to 126.0 GPM) and were plotted in Figure 6.20. This test series contained the largest range in evaluated flow rates compared to the other test series. Test series W-1 was evaluated under the following testing parameters: average inflow turbidity of 576 NTU, current density of 24.3 A/m² (2.3 A/ft²), and an inflow water temperature of 22.2°C (72°F).

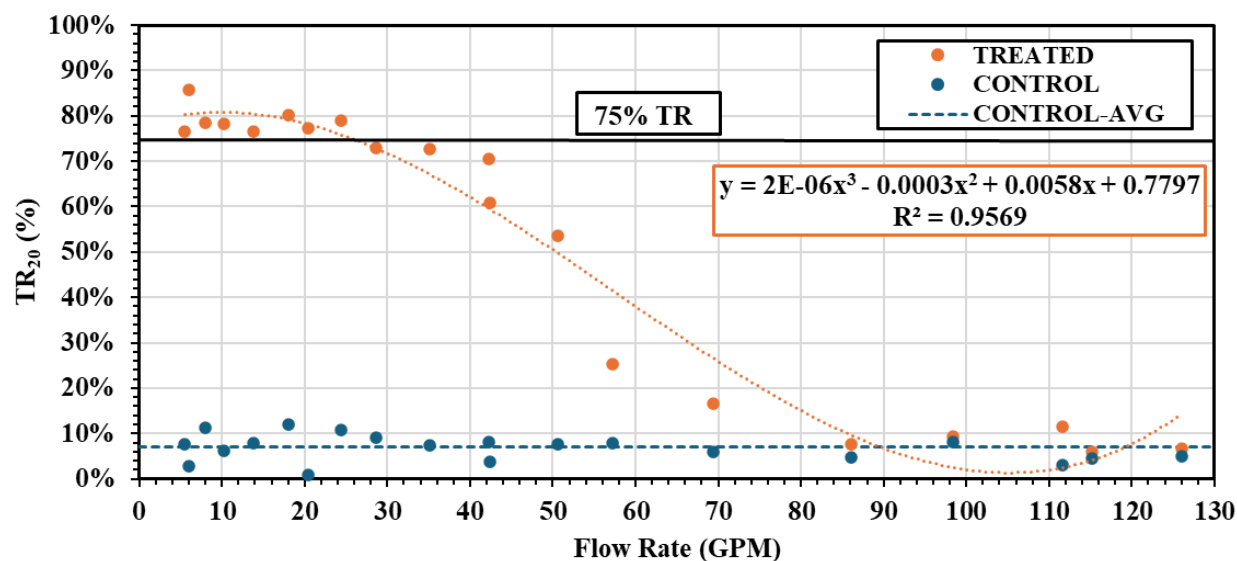


Figure 6.20 Prototype D Field-Scale Testing: Flow Rate versus TR₂₀ for W-1.

In this plot, the control series depicts a consistent trend with values ranging from 1% to 11% and an average control TR₂₀ of 7%. In contrast, treated samples achieved a TR₂₀ of 75% for flow rates less than 94.6 L/min (25.0 GPM). The average treated TR₂₀ for flow rates under 94.6 L/min (25.0 GPM) was 79%, decreasing turbidity, on average, from 530 to 113 NTU. However, TR₂₀ drops off substantially after 151.4 L/min (40.0 GPM). For the first twelve flow rates ranging from 22.7 to 159.0 L/min (6.0 to 42.0 GPM), treated samples obtained an average TR₂₀ of 76%, while during the 8 higher flow rates, the average TR₂₀ decreased to 17%, which is a 78% reduction. Further, treated samples approach control turbidity reduction levels, approximately 10% or below, at roughly 321.7 L/min (85.0 GPM). A third-order polynomial fit ($R^2=0.96$) provides a quantitative description of the treated samples' behavior, capturing both the initial high-performance plateau and the steep TR₂₀ reduction at higher flows.

To assess the performance difference of a single cartridge under warmer and colder conditions, C-1 was evaluated and plotted in Figure 6.21. The C-1 series was evaluated under the following testing parameters: average inflow turbidity of 698 NTU, current density of 27.8 A/m²

(2.6 A/ft²), and an inflow water temperature of 11.1°C (52°F). Therefore, the difference in water temperature between series W-1 and C-1 was 11.1°C (20°F). Further, 16 flow rates ranging from 15.1 to 325.5 L/min (4.0 to 86.0 GPM) were evaluated in C-1, in comparison to the 20 flows ranging from 20.8 to 477.0 L/min (5.5 to 126.0 GPM) assessed in W-1. Conversely, the plot expressing the dataset obtained from C-1 evaluations yielded decreased performance compared to W-1, shown in Figure 6.21.

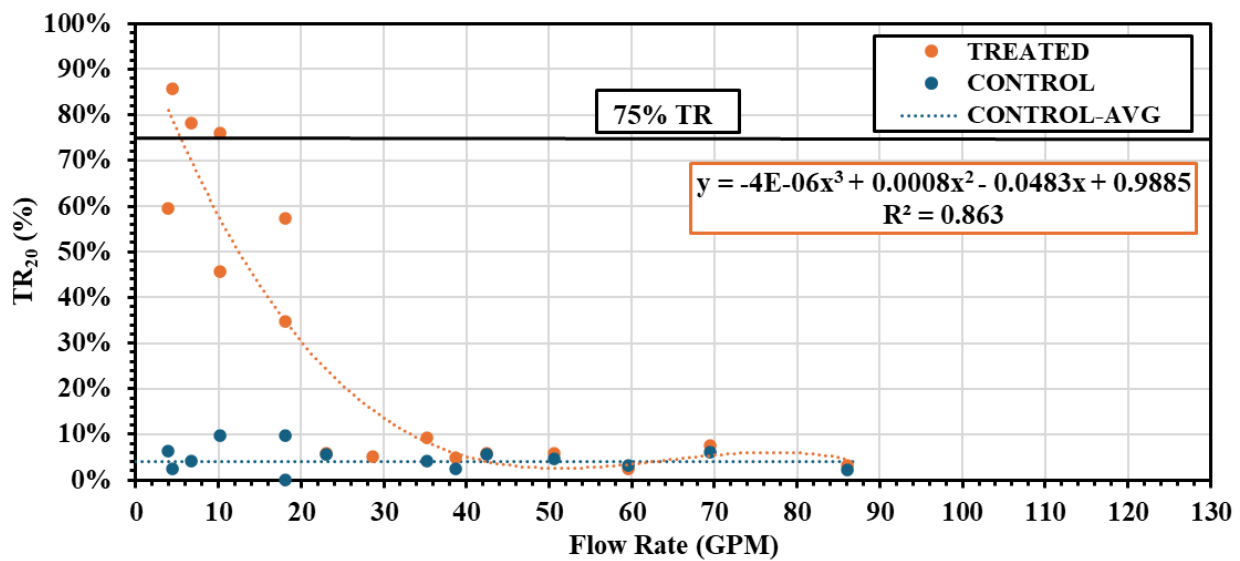


Figure 6.21 Prototype D Field-Scale Testing: Flow Rate versus TR₂₀ for C-1.

Analysis of the C-1 performance plot reveals that TR₂₀ exhibits wide variability for flow rates up to 75.7 L/min (20.0 GPM). A third-order polynomial was fitted to the treated data and produced an R² of 0.86, which was substantially lower than the 0.97 achieved in the W-1 evaluation. Thus, reflecting more variability within C-1 data. The higher variability in TR₂₀ throughout the first 75.7 L/min (20.0 GPM) of flow was attributed to the large range of inflow turbidity values (994 to 542 NTU) found in this flow range. Table 6.23 presents the detailed results for all evaluations containing flow rates less than 75.7 L/min (20.0 GPM), including inflow turbidity, control TR₂₀, and treated TR₂₀.

Table 6.23 Prototype D: Low Flows Evaluated in C-1 and the Corresponding Test Parameters.

Flow Rate (GPM)	Inflow Turbidity, NTU	Control TR₂₀, %	Treated TR₂₀, %
4.0	601	6%	60%
4.4	994	3%	86%
6.7	708	4%	78%
10.3	900	10%	76%
10.3	543	-4%	46%
18.1	774	10%	57%
18.1	588	0%	35%

Certain flow rates were measured multiple times to verify consistency across low, mid, and high flow conditions. Since the device inflow emanated from the floating surface skimmer, samples obtained towards the end of testing exhibited lower influent turbidity. This resulted from gravitational settling, progressively reducing surface-water turbidity in the basin over the course of testing.

As indicated in the Table 6.23, higher sediment concentrations and turbidity accelerate settlement. In control samples, TR₂₀ at 39.0 L/min (10.3 GPM) and 68.5 L/min (18.1 GPM) differed by 14 and 10-percentage points, respectively, while treated samples at approximately 15.1, 39.0, and 68.5 L/min (4.0, 10.3, and 18.1 GPM) showed TR₂₀ differences of 26, 30, and 22-percentage points between high and low inflow turbidities. Since test series W-1 average inflow turbidity was 576 NTU, outliers with inflow turbidities of 994, 900, 774, and 708 NTU were excluded, along with flows of 108.6 L/min (28.7 GPM) and 133.2 L/min (35.2 GPM), which had inflow turbidities of 722 and 728 NTU. The cleaned dataset, containing 10 sample sets, retained only inflow turbidities less than 700 NTU and averaged 633 NTU. Apart from inflow turbidity, testing parameters such as current density and water temperature remained similar to the original dataset. Figure 6.22 presents the revised C-1 dataset, illustrating a single cartridge at colder, more uniform inflow conditions compared to W-1.

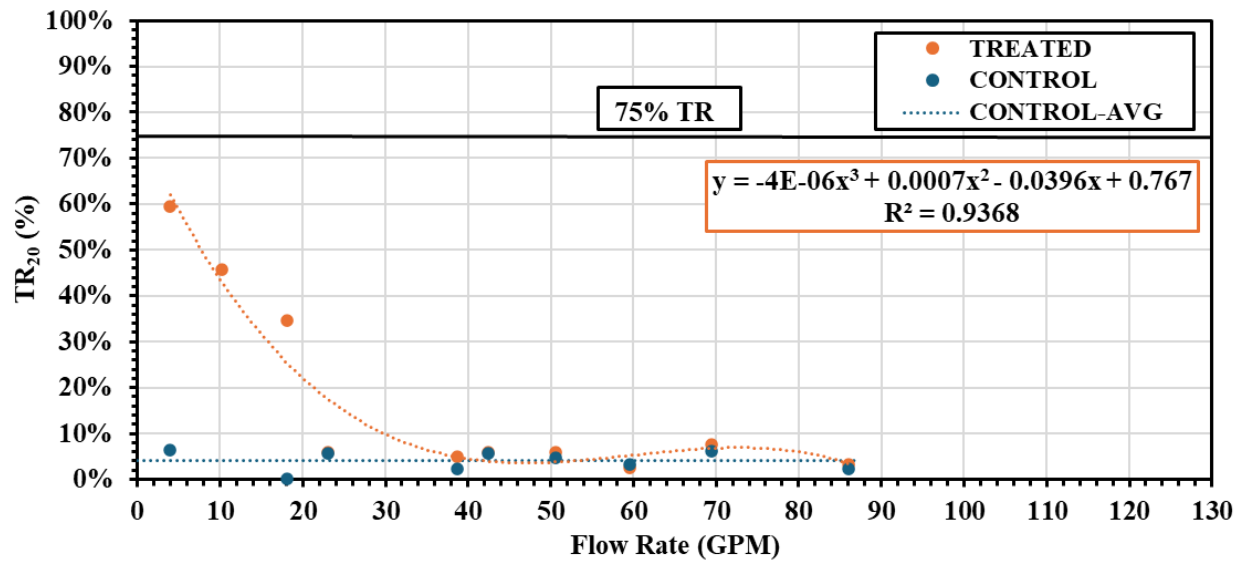


Figure 6.22 Prototype D Field-Scale Testing: Flow Rate versus TR₂₀ for C-1 (Outliers Removed).

Excluding high-turbidity outliers yielded a refined C-1 dataset covering flows from 15.1 to 325.5 L/min (4.0 to 86.0 GPM). Fitting this dataset with a third-order polynomial produced an R^2 of 0.94, an increase of 0.08 over the original dataset. Despite the improved fit, the lowest flow of 15.1 L/min (4.0 GPM) achieved only 60% treated TR₂₀, which was below the 75% target. This performance was substantially lower than W-1, which recorded an average treated TR₂₀ of 76% for flows up to 159.0 L/min (42.0 GPM) versus test series C-1's 26%. Further, treated C-1 samples reach control settling values of 10% or less at around 133.6 L/min (30.0 GPM), while W-1 does not reach this level until approximately 321.8 L/min (85.0 GPM). These results demonstrate impaired coagulation performance under colder inflow temperatures.

To improve electrical flocculation performance, three additional cartridges were added to the single-cartridge test series, yielding a four-cartridge floc generator (C-4). Performance was then compared to C-1 to quantify the effect of increased anodic surface area and to W-1 to assess temperature influence. Test series C-4 ran at an inflow turbidity of 768 NTU, higher than W-1 (576

NTU) and the cleaned C-1 dataset (633 NTU), but the inflow turbidity data range was consistent. The average current density was 20.9 A/m² (2.0 A/ft²), the lowest of all evaluations, but had the highest applied amperage (30.6A) to spread across the 1.46 m² (15.7 ft²) anodic surface area. In comparison, test series W-1 and C-1 each had an anodic surface area of 0.26 m² (2.8 ft²) and amperage draws of 8.9 to 10.2A (24.3 to 27.8 A/m²; 2.3 to 2.6 A/ft²), respectively. C-4 covered flows from 7.1 to 304.0 L/min (1.8 to 80.3 GPM), comparable to C-1, shown in Figure 6.23.

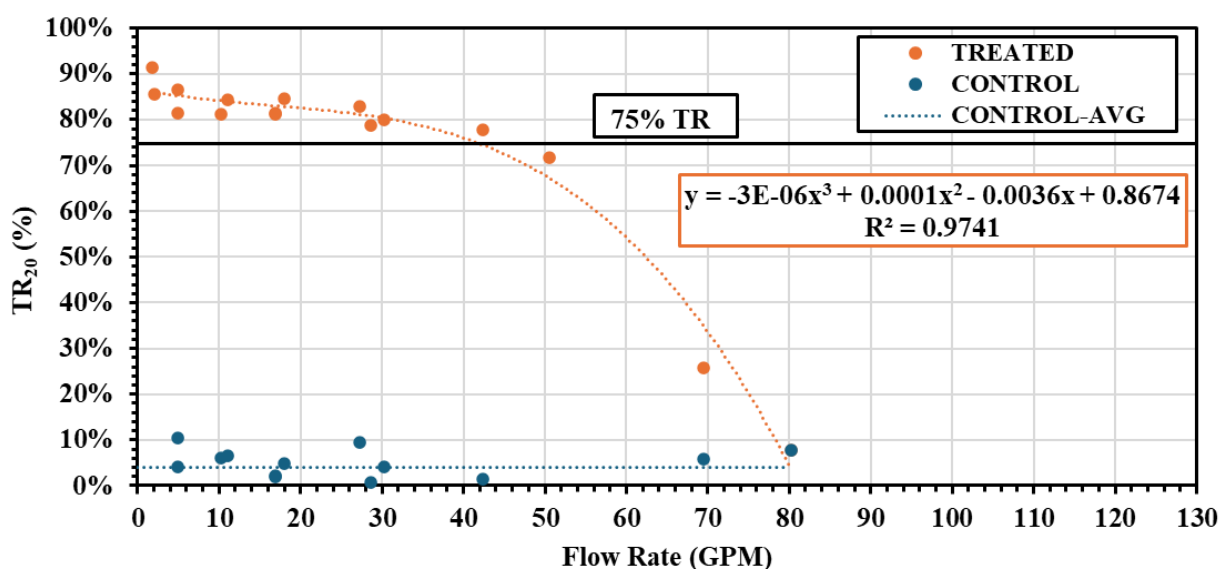


Figure 6.23 Prototype D Field-Scale Testing: Flow Rate versus TR₂₀ for C-4.

C-4, which employed four cartridges, demonstrated substantially higher TR₂₀ performance at colder inflow temperatures than the single-cartridge series, C-1. Treated samples at flow rates up to 159.0 L/min (42.0 GPM) consistently exceeded 75% treated TR₂₀, with an average of 83%, reducing turbidity, on average, from 775 to 134 NTU. Further, at 189.3 L/min (50.0 GPM), the four-cartridge configuration achieved 72% treated TR₂₀, reducing turbidity from 776 to 211 NTU. Fourteen of the sixteen data points fell between 6.43 to 189.3 L/min (1.7 GPM and 50.0 GPM), where the average treated TR₂₀ was 82%. At the two higher flow rates, 261.2 to 302.8 L/min (69 and 80.0 GPM), treated TR₂₀ declined sharply to 26% and 8%, respectively. The control samples

TR₂₀ ranged from -6% to 10%, with an overall mean of 4%. The third-degree polynomial regression of the treated dataset produced an R² of 0.97, indicating that only 3% of the total variance remains unexplained.

To enable a clear comparison of raw performance data from W-1, C-1, and C-4, three flow bands were defined: low, mid, and mid-high, and listed in Table 6.24. Although each test series extends to higher maximum flows (477.0 L/min (126.0 GPM) for W-1, 325.5 L/min (86.0 GPM) for C-1, 302.8 (80.0 GPM) for C-4), the majority of the high flow treated data (above 189.3 L/min (50.0 GPM)) converge with the control data, showing no improved performance by electrical flocculation. Consequently, a “mid-high flow” breakpoint of 191.2 L/min (50.5 GPM), where treated samples still demonstrated significant TR₂₀, was set.

Table 6.24 Prototype D: Testing Parameters and Performance Data Obtained from Evaluations W-1, C-1, and C-4.

Condition	Parameter	W-1	C-1	C-4
Low Flow	Flow Rate, GPM (L/min)	20.8 (5.5)	15.1 (4.0)	18.9 (5.0)
	Inflow Turbidity, NTU	566	601	713
	Current Density, A/m ² , (A/ft ²)	26.4 (2.5)	29.2 (2.7)	21.7 (2.0)
	Water Temperature, °C (°F)	21.7 (71)	10.0 (50)	11.7 (53)
	Treated TR ₂₀ , %	77%	60%	86%
Mid Flow	Flow Rate, GPM (L/min)	108.6 (28.7)	108.6 (28.7)	103.0 (27.2)
	Inflow Turbidity, NTU	603	722	843
	Current Density, A/m ² , (A/ft ²)	24.3 (2.3)	27.5 (2.6)	22.3 (2.1)
	Water Temperature, °C (°F)	22.2 (72)	11.1 (52)	12.2 (54)
	Treated TR ₂₀ , %	73%	5%	83%
Mid-High Flow	Flow Rate, GPM (L/min)	191.2 (50.5)	191.2 (50.5)	191.2 (50.5)
	Inflow Turbidity, NTU	607	695	776
	Current Density, A/m ² , (A/ft ²)	23.9 (2.2)	27.3 (2.5)	22.0 (2.0)
	Water Temperature, °C (°F)	22.8 (73)	12.2 (54)	11.7 (53)
	Treated TR ₂₀ , %	54%	6%	72%

Comparison of C-4 and C-1 at approximately 11.1°C (53°F) inflow temperature indicates that the four-cartridge prototype (C-4) achieved treated TR₂₀ of 86%, 83%, and 72% over the low, mid, and mid-high flow ranges. Test series C-1 only achieved treated TR₂₀ values of 60%, 5%, and

6%, a 16, 78, and 66-percentage point differential compared to C-4. Furthermore, C-1 treated samples reached control-level settling (TR_{20} less than 10%) at approximately 113.6 L/min (30.0 GPM) based on the polynomial regression, whereas C-4 did not reach a TR_{20} less than 10% until near 302.8 L/min (80.0 GPM). These results demonstrate that the increase in anodic area significantly enhances sediment removal efficiency.

When comparing the colder inflow temperatures of C-1 (11.1°C; 52°F) to the warmer conditions of W-1 (22.2°C; 72°F) under the same conductive surface area, W-1 consistently outperformed C-1 despite running at a slightly lower current density (24.3 A/m² (2.3 A/ft²) vs. 27.8 A/m² (2.6 A/ft²)) and lower influent turbidity (576 NTU vs. 698 NTU). W-1 yielded TR_{20} improvements of 22% (17-percentage points) at low flow, 93% (68-percentage points) at mid-range flow, and 89% (48-percentage points) at high flow relative to C-1. These results confirm that colder influent, by increasing viscosity, slowing ion mobility, and reducing Brownian motion, significantly impairs coagulant generation, interaction and floc settlement. Maintaining target removal efficiencies in cold conditions, therefore, requires additional electrode surface area or elevated current densities, implying higher specific energy inputs or expanded cartridge configurations for cold-climate operation.

Despite the substantial performance enhancement between C-1 and C-4, comparison of C-4 (11.1°C; 53°F) with W-1 (22.2°C; 73°F) reveals much narrower differentials. Test series W-1 achieved TR_{20} of 77%, 73%, and 54% over the low, mid, and mid-high flow ranges, which was a 10% (9-percentage points), 12% (10-percentage points), and 25% (18-percentage points) reduction, respectively, compared to C-4. This relatively low differential, compared to C-1 versus C-4, further demonstrates the strong influence of water temperature on electrical flocculation efficacy. Although the difference is relatively small, the improvement from C-4 to W-1 suggests

that less anodic surface area may be sufficient to treat warmer influent with comparable settling performance to W-1. However, because only one sample set was collected for each flow rate tested, statistical analyses could not be performed to compare TR_{20} values across the low, mid, and high flow ranges. This highlights the need for additional testing to evaluate the specific effects of electrode surface area and inflow temperature on settling performance following electrical flocculation treatment.

6.4 Summary

The floc generator was evaluated across a series of intermediate- and field-scale experiments to assess its performance in treating sediment-laden and pollutant-loaded stormwater. Sediment was the primary pollutant targeted, with turbidity used as the primary performance metric. Turbidity reduction was measured by comparing control and treated samples at multiple settling intervals, most commonly at 20 or 30 minutes (TR_{20} and TR_{30}). Intermediate-scale testing was organized into five focus areas: fundamental performance, aluminum release, mixing, electrode longevity, and pollutant loading.

Initial comparisons between series-wired prototype A and parallel-wired prototype B showed no statistically significant differences in turbidity reduction, indicating that wiring configuration did not influence performance. Following this, prototypes A and C were compared since both were wired in series but had different anodic surface areas. Prototype C, with an anodic surface area five times larger than prototype A, consistently achieved higher TR_{20} values, with improvements up to 44%. This demonstrated enhanced coagulant release and improved treatment efficiency, particularly at higher flows. Increasing the flow rate from 3.8 to 71.9 L/min (1.0 to 19.0 GPM) reduced TR_{20} from 94 to 82% for prototype C, confirming that higher flows decrease performance due to reduced HRT. Voltage and current density evaluations showed that TR_{20}

increased with voltage, but for current density, a threshold between 40 and 50 A/m² was identified, beyond which additional current yielded minimal improvement. Turbidity removal also increased with higher SEC, rising from an average TR₂₀ of 57% at low SEC values (less than 0.026 kWh/m³; average of 0.014) to 86% at high SEC values (greater than 0.131 kWh/m³; average of 0.341) for prototypes A and B. However, performance gains diminished beyond approximately 0.150 kWh/m³.

Pseudo-second-order kinetic modeling showed that treated samples settled up to 5.1 times faster than untreated controls, with greater acceleration at lower flow rates for the same energy inputs. Dissolved aluminum testing at 53.0 L/min (14.0 GPM) showed a 51% reduction in aluminum concentration in the sample's supernatant due to sediment binding, lowering levels to 0.19 mg/L. This value is just below the United States Environmental Protection Agency's secondary drinking water standard of 0.20 mg/L, which is the closest regulatory standard for comparison. These results suggest that high flow operation promotes safer aluminum discharge, though additional aluminum release and toxicity evaluations are needed under a wider range of operating conditions to confirm this hypothesis.

Mixing tests demonstrated mechanical mixing improved TR₂₀ by 12%, and passive mixing using a ten-unit V1 series achieved performance similar to 2-5 minutes of mechanical agitation, while the V2 mixers provided negligible benefit. Natural settling reached only 31% TR₂₀, while electrical flocculation improved this to 64%, and mixing enhanced it to 80%. Electrode longevity evaluations revealed current density and performance declines over time, suggesting electrode wear and passivation affected the electrodes' ability to perform electrolysis. PR every 5 hours accelerated performance decay, and at the conclusion of the 30-hour test duration, the N-PR current density yielded 25.0 A/m² (2.2 A/ft²), whereas the PR configuration only delivered 13.1 A/m² (1.2

A/ft²). These findings suggest that 5-hour intervals may worsen degradation, and shorter reversal intervals should be investigated. Pollutant-loading tests showed effective removal of lead (82%), iron (73%), phosphate (68%), cadmium (60%), and copper (BDL), while zinc removal was moderate (33%). However, nickel and nitrate concentrations increased post-treatment, necessitating further investigation.

Field-scale tests of prototype C in a 79 m³ (2,790 ft³) basin using a 3.8 cm (1.5 in.) skimmer at 28.0 to 31.4 L/min (7.4 to 9.0 GPM) achieved TR₂₀ values of 44% to 67%, which were lower than lab values due to cold influent water reducing current density and particle settling efficiency. Prototype D was evaluated under warmer (W-1) and colder (C-1 and C-4) conditions using a single-cartridge system (W-1 and C-1) and a four-cartridge configuration (C-4) to compare the effects of varied influent temperatures and anodic surface areas. Under cold conditions, with one cartridge (C-1), the control sample levels fell to approximately 10% TR₂₀ after 113.6 L/min (30 GPM), while C-4, with four cartridges, maintained over 75% TR₂₀ up to 159 L/min. (42 GPM), dropping to 10% TR₂₀ after nearly 302.8 L/min (80 GPM). Compared to warm-weather (W-4) testing, C-4 performed similarly, indicating that increased surface area can offset temperature-related performance losses. Results suggest that anodic surface area plays an important role in overcoming environmental limitations such as cold-water temperature, and future studies should include replicate testing to better quantify these effects.

CHAPTER SEVEN: CONCLUSIONS AND FUTURE DIRECTION

7.1 Overview

Stormwater runoff from the construction, operation, and maintenance of urban and highway transportation infrastructure carries a complex mixture of suspended sediments, heavy metals, nutrients, hydrocarbons, and emerging contaminants into receiving waters. These pollutants degrade aquatic habitat, impair water quality, and accelerate the loss of conveyance capacity, often necessitating expensive dredging or remediation. With impervious surfaces expanding under rapid urbanization and climate change driving more intense storm events, traditional drainage infrastructure is increasingly challenged to manage both peak flows and pollutant loads.

Traditional BMPs, such as vegetated buffers, inlet protection, ditch checks, sedimentation basins, and silt fences, are effective at intercepting coarse particles but often fail to capture fine colloidal materials and dissolved contaminants. Chemical flocculants have been proven to reduce turbidity, but can be expensive, require match testing, and are hard to dose properly. Fully active treatment systems (combining pumps, filters, and chemical dosing) deliver high turbidity removal efficiencies but require extensive infrastructure and specialized expertise.

To bridge this gap, this study focused on developing a compact, self-contained electrical flocculant device named the “floc generator” that could be retrofitted onto existing BMPs to enhance turbidity reduction performance. By harnessing in situ generation of metal hydroxide coagulants through sacrificial aluminum or iron electrodes, the device offers a chemical-free approach to aggregate and settle fine particulates. Evaluated across intermediate- and field-scale tests, the floc generator is a promising solution that combines the turbidity removal of active systems with the simplicity and footprint of passive practices, addressing a critical need for adaptable, cost-effective stormwater treatment in modern transportation infrastructure.

This dissertation describes the design, fabrication, and evaluation of the flocc generator through six research objectives:

- (1) Research the state of the practice of electrical flocculation technology,
 - (2) Design and construct functional prototypes informed by existing literature,
 - (3) Develop a testing methodology and evaluate prototype performance for sediment and non-sediment pollutant removal under controlled laboratory conditions,
 - (4) Develop a testing methodology and evaluate prototype performance under field conditions at varied flows and influent temperatures,
 - (5) Iteratively refine the electrical flocculation prototype using accessible materials to enhance functionality and adaptability across diverse applications,
- and,
- (6) Disseminate knowledge of the developed electrical flocculation technology within the stormwater management community.

This research addressed each objective and task through a structured, step-by-step process that guided the development and evaluation of the electrical flocculation device. A comprehensive literature review (Task 1) was conducted to establish foundational knowledge of electrical flocculation principles, which informed the identification of key differences between electrical and chemical coagulation (Task 2) and helped isolate important treatment variables like current density, electrode material, and pH (Task 3). This foundational understanding led to the detailed design and fabrication of the initial flocc generator prototype (Tasks 4 and 5), which was then iteratively improved using typical materials found on construction sites and modular design features (Task 6). Laboratory testing under controlled intermediate-scale conditions assessed sediment removal performance across varying electrolysis durations, power inputs, and mixing

conditions (Task 7), and extended to the removal of non-sediment pollutants such as heavy metals and phosphorus in synthetic stormwater (Task 8). Electrode degradation was quantified through extended operation testing, showing a 33% decline in performance over 100 hours without polarity reversal (Task 9). Aluminum release was measured and remained below EPA secondary drinking water limits under standard testing conditions, indicating preliminary compliance and supporting future toxicity assessments (Task 10). Field-scale evaluations were completed using prototypes C and D under increased flow rates and varying inflow temperatures to confirm performance scalability and real-world application potential (Task 11). Outreach materials were developed and distributed through brochures, posters, and presentations to stakeholders and at professional conferences, promoting awareness and adoption of technology in the stormwater community (Tasks 12 and 13). Together, these efforts successfully met the research objectives, demonstrating the feasibility and effectiveness of electrical flocculation as a practical stormwater treatment technology.

This chapter synthesizes the principal findings from both intermediate- and field-scale evaluations. Intermediate-scale assessments covered fundamental performance evaluations, spectrophotometric analysis, mixing efficiency, electrode longevity, and pollutant loading. Further, field-scale evaluations were conducted in two separate phases, assessing the performance of prototypes C and D individually. These experiments explored how electrode circuitry configuration, flow rate, amperage, applied voltage, SEC, mixing regimes, electrode lifespan, removal of non-sediment pollutants, temperature, and conductive surface area influence treatment efficacy. The chapter concludes by outlining the study's limitations, suggesting directions for future research, and outlining outreach efforts.

7.2 Significant Findings

The design, construction, and assessment of the electrical floc generator produced numerous important findings. A comprehensive literature review clarified the mechanisms differentiating chemical coagulation from electrical flocculation, common stormwater contaminants, and the main factors influencing device performance, which were all insights that directly informed the development of four portable prototypes. The following sections summarize the significant results obtained from both intermediate- and field-scale evaluations.

7.2.1 Intermediate-Scale

Intermediate-scale testing was organized into five evaluation categories: fundamental performance evaluations, spectrophotometry, mixing, electrode longevity, and pollutant loading. Key findings are summarized in this subsection.

Fundamental performance evaluations began with prototypes A and B, which were nearly identical in every respect except wiring configuration. Prototype A employed series circuitry, and prototype B used parallel circuitry. These prototypes were evaluated across five flow rates of 7.6, 15.1, 22.7, 30.3, and 37.9 L/min (2.0, 4.0, 6.0, 8.0, and 10.0 GPM). (TR_{20}) values were statistically indistinguishable at four of these five flow rates, where only removal percentages at 7.6 L/min (2.0 GPM) were found statistically significant. Therefore, the results indicated that electrode circuitry does not influence treatment efficiency. Since electrode wiring proved to be non-influential for prototype performance, research focused shifted to how conductive surface area affected electrical flocculation performance. Therefore, prototype C, with an anodic surface area five times larger than prototype A, was directly compared to prototype A. Although both prototypes operated under similar current densities in the range of 41.3 to 45.2 A/m² (3.8 to 4.2 A/ft²), prototype C consistently outperformed prototype A under every flow condition, achieving TR_{20} improvements

of 10% (9-percentage points), 11% (10-percentage points), 33% (21-percentage points), 30% (19-percentage points), and 44% (25-percentage points) at flows of 1.9, 7.6, 18.9, 30.3, and 37.9 L/min (0.5, 2.0, 5.0, 8.0, and 10.0 GPM), respectively. These results demonstrated that increased anodic area accelerated coagulant release and improved electrical flocculation performance, especially at higher flows.

Further, prototype C was evaluated under three flow conditions of 3.8, 37.9, and 71.9 L/min (1.0, 10.0, and 19.0 GPM) to assess how increasing flow rates, thus decreasing HRT, affected device performance. Analysis of this data demonstrated that TR_{20} declined from 89% to 81% and 77%, respectively; therefore, confirming that increased flows provide a reduction in performance. Additionally, evaluations were conducted to assess the effect of applied voltage (6V, 12V, and 24V), current draw (1 to 13.2A), and current density (20 to 100.2 A/m²; 1.9 to 9.3 A/ft²) on the performance of prototypes A, B, and C. At 6V, TR_{20} remained below 50%; raising the voltage to 12V improved TR_{20} to 72% for A/B and 85% for C, while 24V applied to A/B matched the TR_{20} of prototype C's 12V performance. Plotting TR_{20} against current density revealed a threshold of approximately 40 to 50 A/m² (3.7 and 4.7 A/ft²) above which further current density increases yielded diminishing returns.

SEC, a measure of how much energy is required to treat one cubic meter of water, was evaluated separately for prototypes A/B and for prototype C. For prototypes A and B, TR_{20} increased from 58% $\pm$ 10% at low SEC (< 0.026 kWh/m³) to 77% $\pm$ 4% at mid-range SEC (0.027-0.130 kWh/m³), and 86% $\pm$ 2% at high SEC (> 0.131 kWh/m³). This represents a 33% (19-percentage points) treated TR_{20} enhancement from the low to mid-range and a further 12% (9-percentage points) increase from mid to high. Additionally, standard deviations narrowed across each range, indicating that higher energy inputs also yield more consistent performance. Prototype

C exhibited a similar upward trend in treated TR₂₀ with increasing SEC, but its limited number of replicates prevents reliable statistical comparisons. Overall, the data revealed a direct relationship between energy input and turbidity removal, with diminishing returns beyond the mid-SEC range, which suggested an optimal SEC threshold around 0.150 to 0.250 kWh/m³ where additional energy yields marginal benefits.

To assess the settlement rates of control versus treated samples across various SEC conditions, pseudo-second-order kinetic models were developed. The SEC conditions assessed consisted of 0.032, 0.061, 0.126 and 0.651 kWh/m³, which corresponded to flow rates of 71.9, 38.6, 19.3 and 3.8 L/min (19.0, 10.2, 5.1 and 1.0 GPM), respectively. Under these conditions, the models indicated that prototype C's electrical flocculation accelerates settling by factors of 3.2, 3.4, 4.1, and 5.1, respectively, compared to gravitational settling in untreated samples.

Aluminum-ion measurements were conducted at four flow rates, including 3.9, 18.9, 36.0 and 53.0 L/min (1.0, 5.0, 9.5, and 14.0 GPM). In the high-flow regime of 53.0 L/min (14.0 GPM), dissolved aluminum in the supernatant reduced from 0.40 mg/L in the non-turbid sample to 0.19 mg/L in the sediment-laden sample, indicating that approximately 51% was bound in sediment. Since the floc generator targets mid-high to high flow conditions, the 0.19 mg/L dissolved aluminum was evaluated against the U.S. EPA secondary aluminum standard for drinking water (0.20 mg/L). This preliminary result indicated that, at high flows, the device effluent remained below the regulatory benchmark and should be safe for discharge. Nonetheless, comprehensive toxicity testing and systematic studies of effluent aluminum concentrations across a range of flow rates, influent turbidities, water temperatures, and anodic surface areas are needed to confirm device safety and refine operating guidelines.

Mixing evaluations revealed that passive mixing did not improve TR₂₀ compared to unmixed samples, whereas mechanical stirring enhanced TR₂₀ by 12 percentage points relative to treated samples without mixing. In settling tests, natural settling reached only 31% TR₂₀, which increased to 64% (treated TR₂₀) with electrical flocculation alone. Introducing mechanical stirring at 360 RPM further improved treated turbidity removal to 73% after 30 seconds and 80% after 4 minutes of mixing, with negligible increases beyond 2 minutes of mixing. A ten-series passive mixer, V1, achieved 79% TR₂₀, which was comparable to 2 to 5 min of mechanical stirring, while the second passive mixer, V2, offered negligible benefit. These results indicated that moderate mixing, either by brief mechanical agitation or a passive mixer series using the V1 mixer, optimally promotes floc formation and settling.

Electrode longevity was evaluated under two conditions at a constant 12 V input: continuous operation N-PR for 100 h, and periodic 5-h PR over 30 h. Current was logged every 5 minutes, and TR₃₀ was measured hourly to assess performance as electrode current density declined. Linear projection of the N-PR data predicts that TR₃₀ would drop to the control level (35%) by approximately 250 hours, necessitating electrode replacement at approximately 180 hours to maintain at least 50% turbidity removal after 30 minutes of detention. Introducing 5-hour polarity reversals increased the current-density decay rate to -1.1 A/m² (-0.1 A/ft²) per hour versus -0.9 A/m² (-0.08 A/ft²) per hour for N-PR and drove a faster TR₃₀ decay of -0.48x per hour compared to -0.21x per hour. Although PR achieved a higher average TR₃₀ over the 30-hour test period (87% vs. 83%), its increased rate of decline forecasted convergence with N-PR at approximately 22 hours and subsequent underperformance. These findings indicated that a 5-hour reversal interval exacerbates net electrode wear rather than extending service life; therefore, shorter reversal intervals should be explored to optimize longevity.

Pollutant-loading tests demonstrated that the flocc generator delivered substantial removal for specific metals and nutrients that are typically found in roadway stormwater runoff. Cadmium concentrations reduced 60%, from 0.064 to 0.025 mg/L, copper concentrations reduced from 0.070 mg/L to below detectable limits (0.050 mg/L), iron concentrations reduced 73% from 13.01 to 3.52 mg/L, lead concentrations reduced 82% from 0.150 to 0.028 mg/L, phosphate concentrations reduced 68% from 0.340 to 0.110 mg/L, and zinc concentrations reduced 33% from 1.320 to 0.880 mg/L. In contrast, nickel and nitrate concentrations increased by 200% from 0.010 to 0.030 mg/L, and 34% from 0.820 to 1.100 mg/L, respectively. While these preliminary results confirmed considerable removal of several contaminants, further testing is needed to fully assess the device's performance across a broader range of metals, nutrients, and operating conditions.

7.2.2 Field-Scale Evaluations

Prototype C was field-tested on the effluent end of a 3.81 cm (1.5 in.) floating surface skimmer drawing a flow of 28.0 to 31.4 L/min (7.4 to 9.0 GPM). Prototype C was powered at 12V and operated at current densities of 28.6 to 35.9 A/m² (2.7 to 3.3 A/ft²). These results were compared to an intermediate-scale laboratory test series, which was evaluated under 31.4 L/min (8.3 GPM), 46.6 A/m² (4.3 A/ft²), and 20°C (68°F) ambient air temperature. During winter field tests, air temperatures dropped to 4.4°C (40°F) during the sampling period, reducing peak current density by 10.7 A/m² (1.0 A/ft²) compared to the lab evaluation. With an HRT above 90 minutes in the lamella settler, the highest TR₉₀ observed in three field evaluations was 71%, versus 94% under lab conditions. Increased water viscosity and decreased ion mobility at low temperatures hindered floc settlement, which demonstrated the influence of temperature on coagulant generation and settling dynamics. Additional field-scale assessments using prototype D examined how

temperature fluctuations and increased anodic surface area (i.e., extra cartridge modules) influenced device performance.

Prototype D evaluations at lower water inflow temperatures of 11.1°C to 11.7°C (52°F to 53°F) compared to a single-cartridge unit (C-1) to a four-cartridge configuration (C-4) across low, mid, and mid-high flow ranges. This yielded anodic surface areas of 0.367 m² (3.95 ft²) for C-1 and 1.47 m² (15.8 ft²) for C-4, with corresponding average current densities of 28 A/m² (2.6 A/ft²) and 22 A/m² (2.0 A/ft²). Under these cold-water conditions, C-4 achieved TR₂₀ of 86%, 83% and 72%, whereas C-1 achieved only 60%, 5% and 6%, which provided differentials of 16%, 78% and 66%, respectively. Additionally, test series C-1's removal dropped below control TR₂₀ levels of 10% at 113.6 L/min (30.0 GPM), while C-4 maintained a TR₂₀ above 10 % removal until approximately 302.8 L/min (80.0 GPM), demonstrating that increased anodic area substantially enhanced sediment removal and extended the high-flow operating range.

Additionally, when comparing the single-cartridge configurations at colder (11.1°C (51.0°F)) and warmer (22.2°C (72.0°F)) water inflow temperatures, the warmer water inflow tests outperformed the colder tests by 17%, 68% and 48% TR₂₀ at low, mid-range and high inflow rates, respectively, despite running at a lower current density (24.3 vs. 27.8 A/m² (2.3 and 2.6 A/ft²)) and lower influent turbidity (576 vs. 698 NTU). This confirmed at lower water temperatures, which increases viscosity, slows ion mobility, and reduces Brownian motion, coagulant generation, interaction, and floc settlement are substantially impaired. To sustain target removal efficiencies under low water temperature conditions, the device must employ additional anodic surface area or higher current densities, thus implying greater specific energy inputs or expanded cartridge configurations.

7.3 Outreach

For this project, outreach efforts focused on introducing the stormwater management community to electrical flocculation and its potential and gathering feedback. Table 7.1 summarizes these efforts by category (i.e., field demonstrations, oral presentations, poster presentations, and a podcast interview), conference, location and date.

Table 7.1 Electrical Flocculation Outreach.

Category	Conference	Location	Date
Poster Presentation	24 th IECA MS4 Conference	Auburn, AL	05/14/2024
Field Demonstration	AU-SRF Installer Training	Auburn, AL	05/15/2024
Field Demonstration	AU-SRF Field Day	Auburn, AL	05/16/2024
Oral Presentation	Alabama Water Resources Conference	Orange Beach, AL	09/05/2024
Field Demonstration	Clear Water Alabama 2024 Conference	Dothan, AL	09/25/2024
Oral Presentation	TRB 104 th Annual Meeting	Washington, DC	01/07/2025
Oral Presentation	25 th IECA Conference	Richmond, VA	02/27/2025
Poster Presentation	25 th IECA Conference	Richmond, VA	02/25/2025
Field Demonstration	AU-SRF Installer Training	Auburn, AL	05/14/2025
Field Demonstration	AU-SRF Field Day	Auburn, AL	05/15/2024
Podcast	#GINNING Podcast	Auburn, AL	06/22/2025

In 2024, outreach began with a poster presentation at the Annual International Erosion Control Association (IECA) MS4 Conference in Auburn, AL (May 14th). Two field demonstrations at AU-SRF Installer Training and Field Day followed on May 15th and 16th. An oral presentation at the Alabama Water Resources Conference (AL-WRC) in Orange Beach, AL took place on September 5th, and a field demonstration at the Clear Water Alabama Conference in Dothan, AL occurred on September 25th.

Outreach continued in 2025 with an oral presentation at the Transportation Research Board (TRB) 104th Annual Meeting in Washington, DC, on January 7th. At the 25th IECA Conference in Richmond, VA, the project team delivered a poster presentation on February 25th and an oral

presentation on February 27th. Two additional field demonstrations at AU-SRF Installer Training and Field Day were held on May 14th and 15th. Finally, the team appeared on Auburn University College of Engineering's #GINNing podcast on June 22nd to reach audiences beyond the water and stormwater communities.

7.4 Limitations and Future Research

This research program will extend well beyond the completion of this dissertation, with funding secured through August 14th, 2026. Over the coming months, a series of targeted studies will refine the floc generator's design and quantify its performance under a variety of operational conditions. This section will outline the limitations of this research and a framework to guide future research.

7.4.1 Aluminum Coagulant Release and Toxicity

Aluminum-coagulant release results in this study were constrained by the use of unfiltered sediment-laden samples. Although samples were allowed to settle until the supernatant appeared clear, residual colloidal particles could have remained and scattered light during spectrophotometric analysis, possibly artificially elevating measured aluminum concentrations. In other words, any suspended turbidity that went undetected by eye would contribute additional absorbance that the instrument interpreted as aluminum–reagent complex, skewing the results upward. Since these evaluations used only intermediate-scale samples, it remains unclear how those biases translate to the performance of prototype D under more realistic field conditions. To address this, future work must systematically collect effluent directly from field trials and then quantify both dissolved and total aluminum concentrations. Further, running multiple test series across a spectrum of flow rates, influent turbidities, and water temperatures will clarify how these variables influence coagulant release.

Results from the aluminum concentration analyses should be directly compared with aluminum toxicity evaluations to establish a comparison between coagulant release and ecological impact. To achieve this, samples should be collected under varying flow rates to obtain a wide variety of aluminum-coagulant concentrations and subsequently taken to a certified laboratory for toxicity testing in accordance with EPA standard protocols. Toxicity tests will determine lethal and sublethal aluminum concentrations for relevant aquatic species, ensuring that any residual aluminum in the effluent remains below harmful thresholds. By measuring aluminum release across a wide range of operational conditions, and then subjecting similar samples to standardized bioassays, this approach will identify the minimum aluminum-coagulant dose required to achieve target turbidity removal and identify the lowest flow rate at which the floc generator can operate without compromising downstream ecological health.

7.4.2 Electrode Longevity

Electrode longevity evaluations in this dissertation were constrained by their focus on a single alloy (6061 aluminum) and a single, long-interval polarity reversal of 5-hours. Prototype D, by contrast to prototype C evaluated in electrode longevity studies, employed commercially pure 1100 aluminum with a larger anodic surface area, so its operational lifespan must be assessed independently.

Future studies should compare continuous operation with short-interval reversals, such as 30 seconds and 5 minutes, to quantify how reversal frequency and duration affect net active surface area and long-term turbidity removal. Further, scanning electron microscopy (SEM) images of the passivated electrodes may be beneficial to explore in future studies. These images can reveal oxide-layer growth and fouling patterns, providing the microstructural information needed to optimize cleaning protocols and polarity reversal intervals. Collectively, these investigations will

define the electrodes' expected operational life and guide maintenance strategies to maintain treatment efficiency.

7.4.3 Pollutant Loading Evaluations

The pollutant-loading evaluations in this study were conducted at a single flow rate (37.9 L/min; 10.0 GPM) and a single current density (38 A/m^2 ; 3.5 A/ft^2), which limits the ability to draw conclusions about metal and nutrient removal performance beyond these operational parameters. Through outreach, additional interests were identified that were not included in this study. Interests consisted of how effective the floc generator is at removing contaminants of emerging concern, such as arsenic and PFAS. In conjunction with these contaminants of emerging concern, nutrients like phosphate and nitrate, which are major influencers of algal blooms, oxygen depletion, and biodiversity loss, should be evaluated further. This preliminary analysis did result in phosphate removals of 68%, but nitrate was increased by 34%. Further, all heavy metals evaluated showed reduction except nickel, which had a 200% increase. To address these unexpected outcomes, subsequent investigations should evaluate alternative electrode materials (including different aluminum alloys or other metals) and expand the experimental operational parameters to encompass varied flow rates, influent temperatures, sediment types, and loading rates, thereby identifying the optimum operational for non-sediment pollutant removal.

7.4.4 Field-Scale Evaluations

Field-scale evaluations conducted for this dissertation included preliminary tests with prototype C and extended testing of prototype D across varied flow rates, inflow temperatures, and anodic surface areas. To isolate the influence of temperature and increased anodic area on device performance, future studies should incorporate a broader range of influent water temperatures and

expanded anodic surface configurations. These investigations should aim to achieve the original target performance of 75% TR₂₀ at 378.5 L/min (100.0 GPM), under realistic field conditions.

7.4.5 Automation

To enable remote operation, the floc generator should incorporate both automation and off-grid power. Once electrode-longevity trials establish the optimal polarity-reversal interval, integrating a microcontroller would allow the device to manage reversal cycles, monitor real-time power consumption, and trigger a maintenance indicator whenever performance drops below a defined threshold. Additionally, a renewable energy source, such as photovoltaic panels with a connected battery, should be integrated to support deployment in energy-sparse areas. Subsequent studies should evaluate how fluctuations in solar irradiance affect flocculation consistency and determine the battery capacity required for uninterrupted operation during extended low-light periods.

7.5 Summary

This research developed and evaluated a compact, self-contained electrical flocculation device, named the floc generator, designed to remove turbidity and pollutants in stormwater runoff. In response to the limitations of traditional BMPs for turbidity removal such as chemical flocculants, the floc generator provides a chemical-free alternative by generating metal hydroxide coagulants in situ using sacrificial aluminum electrodes. The device was designed to be modular, retrofit to existing BMPs, and scalable for both construction and highway stormwater applications.

Six research objectives were outlined to design, fabricate, evaluate, and share this research with the community. Intermediate-scale evaluations revealed that increased anodic surface area improved treatment performance across a range of flow rates, while increased flow rates led to

decreased treatment efficiency. A current density threshold between 40 to 50 A/m² was identified, beyond which performance gains did not substantially increase. SEC analyses also revealed an optimal SEC range of approximately 0.150 to 0.250 kWh/m³, after which performance gains did not substantially increase. Pseudo-second-order kinetic modeling showed that treated samples settled up to five times faster than controls under certain SEC conditions. Electrode longevity testing revealed that current density and performance declined steadily over time as electrical current was applied to the plates, and that long polarity reversal intervals (i.e., 5 hours) accelerated wear. Aluminum concentrations in treated water remained below U.S. EPA secondary drinking water standards under high-flow conditions, although further toxicity testing is recommended. Mixing studies demonstrated that mechanical agitation or optimized passive mixers significantly enhanced floc formation. Pollutant loading tests showed removal of several metals and nutrients, including cadmium, copper, iron, lead, and phosphate, while some constituents like nickel and nitrate increased, highlighting the need for expanded testing under varied conditions. Field-scale testing demonstrated that colder water temperatures and reduced ion mobility impair treatment efficiency. Additional evaluations confirmed the influence of temperature and surface area on performance, with higher removal rates achieved under warmer inflow conditions and with increased anodic surface area.

Outreach was conducted through oral and poster presentations and field demonstrations to raise awareness and gather stakeholder feedback. The project was presented at several conferences, including IECA, TRB, and AL-WRC, and featured in a podcast to reach broader audiences.

Future research should address limitations identified in this study, including aluminum toxicity assessments, expanded pollutant removal tests (e.g., for PFAS and arsenic), alternative electrode materials, and shorter polarity reversal intervals. Field-scale trials under varying

temperatures and flow rates should aim to achieve target performance at high flows and cooler inflow temperatures. Automation and renewable energy integration are also important areas for development to support remote, off-grid operation. Collectively, these efforts will guide the floc generator toward practical implementation as an adaptable, energy-efficient stormwater treatment solution.

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REFERENCES

- A. K. Bhardwaj, and R. A. McLaughlin. 2008. "Simple Polyacrylamide Dosing Systems for Turbidity Reduction in Stilling Basins." *Trans ASABE*, 51 (5): 1653–1662. American Society of Agricultural and Biological Engineers (ASABE).
<https://doi.org/10.13031/2013.25324>.
- Abbasi, S., A. A. Zinatizadeh, M. Mirghorayshi, S. Zinadini, and T. McKay. 2022. "Electrocoagulation technique for continuous industrial licorice processing wastewater treatment in a single reactor employing Fe-rod electrodes: Process modeling and optimization and operating cost analysis." *J Environ Chem Eng*, 10 (2). Elsevier Ltd.
<https://doi.org/10.1016/j.jece.2021.106686>.
- Abdel-Shafy, H. I., R. M. M. Morsy, M. A. I. Hewehy, T. M. A. Razek, and M. M. A. Hamid. 2022. "Treatment of industrial electroplating wastewater for metals removal via electrocoagulation continous flow reactors." *Water Pract Technol*, 17 (2). IWA Publishing.
<https://doi.org/10.2166/wpt.2022.001>.
- Abdollahi, J., M. R. Alavi Moghaddam, and S. Habibzadeh. 2023. "The role of the current waveform in mitigating passivation and enhancing electrocoagulation performance: A critical review." *Chemosphere*. Elsevier Ltd.
- Abdulhadi, B., P. Kot, K. Hashim, A. Shaw, M. Muradov, and R. Al-Khaddar. 2021. "Continuous-flow electrocoagulation (EC) process for iron removal from water: Experimental, statistical and economic study." *Science of the Total Environment*, 760. Elsevier B.V. <https://doi.org/10.1016/j.scitotenv.2020.143417>.
- Abdulrazzaq, N. N., B. H. Al-Sabbagh, and H. A. Shanshool. 2021. "Coupling of electrocoagulation and microflotation for the removal of textile dyes from aqueous solutions." *Journal of Water Process Engineering*, 40. Elsevier Ltd.
<https://doi.org/10.1016/j.jwpe.2020.101906>.
- Adamović, S., R. Milošević, and M. Prica. 2025. "Optimizing batch electrocoagulation-flotation for emerging industrial wastewaters: A review on the state-of-the-art." *Desalination Water Treat*. Elsevier B.V.
- Ahmad, A., M. Priyadarshini, S. Das, and M. M. Ghangrekar. 2022. "Electrocoagulation as an efficacious technology for the treatment of wastewater containing active pharmaceutical compounds: a review." *Separation Science and Technology (Philadelphia)*. Taylor and Francis Ltd.
- Ahmed, M. J., and B. H. Hameed. 2019. "Insights into the isotherm and kinetic models for the coadsorption of pharmaceuticals in the absence and presence of metal ions: A review." *J Environ Manage*. Academic Press.

- Akansha, J., P. V. Nidheesh, A. Gopinath, K. V. Anupama, and M. Suresh Kumar. 2020. "Treatment of dairy industry wastewater by combined aerated electrocoagulation and phytoremediation process." *Chemosphere*, 253. Elsevier Ltd. <https://doi.org/10.1016/j.chemosphere.2020.126652>.
- Akyol, A. 2012. "Treatment of paint manufacturing wastewater by electrocoagulation." *Desalination*, 285: 91–99. <https://doi.org/10.1016/j.desal.2011.09.039>.
- Alabama Department of Transportation. 2010. *ALDOT Sedimentation Basin Recommendations*. Montgomery, AL.
- Alam, R., M. Sheob, B. Saeed, S. U. Khan, M. Shirinkar, Z. Frontistis, F. Basheer, and I. H. Farooqi. 2021. "Use of electrocoagulation for treatment of pharmaceutical compounds in water/wastewater: A review exploring opportunities and challenges." *Water (Switzerland)*. MDPI AG.
- Alexander, J. T., F. I. Hai, and T. M. Al-aboud. 2012. "Chemical coagulation-based processes for trace organic contaminant removal: Current state and future potential." *J Environ Manage*.
- Al-Ghoul, M. 2017. "TREATMENT OF PRODUCED WATER USING AN ENHANCED ELECTROCOAGULATION PROCESS."
- Alimohammadi, M., M. Askari, M. H. Dehghani, A. Dalvand, R. Saeedi, K. Yetilmezsoy, B. Heibati, and G. McKay. 2017. "Elimination of natural organic matter by electrocoagulation using bipolar and monopolar arrangements of iron and aluminum electrodes." *International Journal of Environmental Science and Technology*, 14 (10): 2125–2134. Center for Environmental and Energy Research and Studies. <https://doi.org/10.1007/s13762-017-1402-3>.
- Alizadeh, M., A. Hossein Mahvi, H. J. Mansoorian, and R. Ardani. 2013. *The survey of electrocoagulation Process for removal dye Reactive Orange 16 from aqueous solutions using sacrificial iron electrodes. Iranian Journal of Health, Safety & Environment*.
- AlJaberi, F. Y. 2022. "Desalination of groundwater by electrocoagulation using a novel design of electrodes." *Chemical Engineering and Processing - Process Intensification*, 174. Elsevier B.V. <https://doi.org/10.1016/j.cep.2022.108864>.
- Al-Malack, M. H., N. S. Abuzaid, and A. H. El-Mubarak. 1999. *COAGULATION OF POLYMERIC WASTEWATER DISCHARGED BY A CHEMICAL FACTORY*.
- Al-Shannag, M., Z. Al-Qodah, K. Bani-Melhem, M. R. Qtaishat, and M. Alkasrawi. 2015. "Heavy metal ions removal from metal plating wastewater using electrocoagulation: Kinetic

- study and process performance.” *Chemical Engineering Journal*, 260: 749–756. Elsevier. <https://doi.org/10.1016/j.cej.2014.09.035>.
- American Society of Civil Engineers. 2021. *Report Card for America's Infrastructure*. Washington, D.C.
- Amrose, S. E., S. R. S. Bandaru, C. Delaire, C. M. van Genuchten, A. Dutta, A. DebSarkar, C. Orr, J. Roy, A. Das, and A. J. Gadgil. 2014. “Electro-chemical arsenic remediation: Field trials in West Bengal.” *Science of the Total Environment*, 488–489 (1): 539–546. Elsevier B.V. <https://doi.org/10.1016/j.scitotenv.2013.11.074>.
- Anderson, D. M., P. M. Glibert, and J. M. Burkholder. 2002. *Harmful Algal Blooms and Eutrophication: Nutrient Sources, Composition, and Consequences*. Estuarine Research Federation Estuaries.
- Andrady, A. L. 2011. “Microplastics in the marine environment.” *Mar Pollut Bull*.
- Aouni, A., C. Fersi, M. Ben Sik Ali, and M. Dhahbi. 2009. “Treatment of textile wastewater by a hybrid electrocoagulation/nanofiltration process.” *J Hazard Mater*, 168 (2–3): 868–874. <https://doi.org/10.1016/j.jhazmat.2009.02.112>.
- Arthur, C., J. Baker, and H. Bamford. 2009. *Proceedings of the International Research Workshop on the Occurrence, Effects, and Fate of Microplastic Marine Debris*. Silver Spring, MD.
- Asaithambi, P., A. R. A. Aziz, and W. M. A. B. W. Daud. 2016. “Integrated ozone—electrocoagulation process for the removal of pollutant from industrial effluent: Optimization through response surface methodology.” *Chemical Engineering and Processing: Process Intensification*, 105: 92–102. Elsevier. <https://doi.org/10.1016/j.cep.2016.03.013>.
- Bajpai, M., S. S. Katoch, A. Kadier, and A. Singh. 2022. “A review on electrocoagulation process for the removal of emerging contaminants: theory, fundamentals, and applications.” *Environmental Science and Pollution Research*. Springer Science and Business Media Deutschland GmbH.
- Bandaru, S. R. S., A. Roy, A. J. Gadgil, and C. M. van Genuchten. 2020. “Long-term electrode behavior during treatment of arsenic contaminated groundwater by a pilot-scale iron electrocoagulation system.” *Water Res*, 175. Elsevier Ltd. <https://doi.org/10.1016/j.watres.2020.115668>.
- Baran, W., E. Adamek, M. Jajko, and A. Sobczak. 2018. “Removal of veterinary antibiotics from wastewater by electrocoagulation.” *Chemosphere*, 194: 381–389. Elsevier Ltd. <https://doi.org/10.1016/j.chemosphere.2017.11.165>.

- Bayramoglu, M., M. Eyvaz, and M. Kobya. 2007. "Treatment of the textile wastewater by electrocoagulation. Economical evaluation." *Chemical Engineering Journal*, 128 (2–3): 155–161. <https://doi.org/10.1016/j.cej.2006.10.008>.
- Bazrafshan, E., L. Mohammadi, A. Ansari-Moghaddam, and A. H. Mahvi. 2015. "Heavy metals removal from aqueous environments by electrocoagulation process - A systematic review." *J Environ Health Sci Eng*. BioMed Central Ltd.
- Beer, S., A. Garm, B. Huwer, J. Dierking, and T. G. Nielsen. 2018. "No increase in marine microplastic concentration over the last three decades – A case study from the Baltic Sea." *Science of the Total Environment*, 621: 1272–1279. Elsevier B.V. <https://doi.org/10.1016/j.scitotenv.2017.10.101>.
- Ben-Sasson, M., Y. Zidon, R. Calvo, and A. Adin. 2013. "Enhanced removal of natural organic matter by hybrid process of electrocoagulation and dead-end microfiltration." *Chemical Engineering Journal*, 232: 338–3345. Elsevier B.V. <https://doi.org/10.1016/j.cej.2013.07.101>.
- Beryani, A., K. Flanagan, S. You, F. Forsberg, M. Viklander, and G. T. Blecken. 2025. "Critical field evaluations of biochar-amended stormwater biofilters for PFAS and other organic micropollutant removals." *Water Res*, 281. Elsevier Ltd. <https://doi.org/10.1016/j.watres.2025.123547>.
- Biswas, B., and S. Goel. 2022. "Electrocoagulation and electrooxidation technologies for pesticide removal from water or wastewater: A review." *Chemosphere*, 302. Elsevier Ltd. <https://doi.org/10.1016/j.chemosphere.2022.134709>.
- Bouhezila, F., M. Hariti, H. Lounici, and N. Mameri. 2011. "Treatment of the OUED SMAR town landfill leachate by an electrochemical reactor." *Desalination*, 280 (1–3): 347–353. <https://doi.org/10.1016/j.desal.2011.07.032>.
- Bour, A., A. Haarr, S. Keiter, and K. Hylland. 2018. "Environmentally relevant microplastic exposure affects sediment-dwelling bivalves." *Environmental Pollution*, 236: 652–660. Elsevier Ltd. <https://doi.org/10.1016/j.envpol.2018.02.006>.
- Brinkmann, M., D. Montgomery, S. Selinger, J. G. P. Miller, E. Stock, A. J. Alcaraz, J. K. Challis, L. Weber, D. Janz, M. Hecker, and S. Wiseman. 2022. "Acute Toxicity of the Tire Rubber-Derived Chemical 6PPD-quinone to Four Fishes of Commercial, Cultural, and Ecological Importance." *Environ Sci Technol Lett*, 9 (4): 333–338. American Chemical Society. <https://doi.org/10.1021/acs.estlett.2c00050>.
- Buck, R. C., J. Franklin, U. Berger, J. M. Conder, I. T. Cousins, P. De Voogt, A. A. Jensen, K. Kannan, S. A. Mabury, and S. P. J. van Leeuwen. 2011. "Perfluoroalkyl and polyfluoroalkyl

- substances in the environment: Terminology, classification, and origins.” *Integr Environ Assess Manag*, 7 (4): 513–541. <https://doi.org/10.1002/ieam.258>.
- Bugg, R. A., W. Donald, W. Zech, and M. Perez. 2017. “Performance evaluations of three silt fence practices using a full-scale testing apparatus.” *Water (Switzerland)*, 9 (7). <https://doi.org/10.3390/w9070502>.
- Cañizares, P., C. Jiménez, F. Martínez, M. A. Rodrigo, and C. Sáez. 2009. “The pH as a key parameter in the choice between coagulation and electrocoagulation for the treatment of wastewaters.” *J Hazard Mater*, 163 (1): 158–164. <https://doi.org/10.1016/j.jhazmat.2008.06.073>.
- Cañizares, P., C. Jiménez, F. Martínez, C. Sáez, and M. A. Rodrigo. 2007a. “Study of the electrocoagulation process using aluminum and iron electrodes.” *Ind Eng Chem Res*, 46 (19): 6189–6195. <https://doi.org/10.1021/ie070059f>.
- Cañizares, P., F. Martínez, C. Jiménez, J. Lobato, and M. A. Rodrigo. 2007b. “Coagulation and electrocoagulation of wastes polluted with colloids.” *Sep Sci Technol*, 42 (10): 2157–2175. <https://doi.org/10.1080/01496390701446530>.
- Canizares, P., F. Martinez, C. Saez, and M. Rodrigo. 2009. “Treatment of Actual Metalworking Wastewaters by Coagulation Combined with Electrochemical Oxidation.” *International Journal of Environmental Engineering*, 1 (3): 238–255.
- Capolupo, M., L. Sørensen, K. D. R. Jayasena, A. M. Booth, and E. Fabbri. 2020. “Chemical composition and ecotoxicity of plastic and car tire rubber leachates to aquatic organisms.” *Water Res*, 169. Elsevier Ltd. <https://doi.org/10.1016/j.watres.2019.115270>.
- Castañeda, L. F., O. Coreño, and J. L. Nava. 2022. “Simultaneous removal of arsenic, fluoride, and hydrated silica from deep well water by electrocoagulation using hybrid Al-Fe electrodes.” *Process Safety and Environmental Protection*, 166: 290–298. Institution of Chemical Engineers. <https://doi.org/10.1016/j.psep.2022.08.025>.
- Castañeda, L. F., J. F. Rodríguez, and J. L. Nava. 2021. “Electrocoagulation as an affordable technology for decontamination of drinking water containing fluoride: A critical review.” *Chemical Engineering Journal*. Elsevier B.V.
- Van Cauwenberghe, L., M. Claessens, M. B. Vandegehuchte, and C. R. Janssen. 2015. “Microplastics are taken up by mussels (*Mytilus edulis*) and lugworms (*Arenicola marina*) living in natural habitats.” *Environmental Pollution*, 199: 10–17. Elsevier Ltd. <https://doi.org/10.1016/j.envpol.2015.01.008>.

- Chafi, M., B. Gourich, A. H. Essadki, C. Vial, and A. Fabregat. 2011. "Comparison of electrocoagulation using iron and aluminium electrodes with chemical coagulation for the removal of a highly soluble acid dye." *Desalination*, 281: 285–292. Elsevier.
- Chellam, S., and M. A. Sari. 2016. "Aluminum electrocoagulation as pretreatment during microfiltration of surface water containing NOM: A review of fouling, NOM, DBP, and virus control." *J Hazard Mater*. Elsevier.
- Chen, G. 2004. "Electrochemical technologies in wastewater treatment." *Sep Purif Technol*, 38 (1): 11–41. <https://doi.org/10.1016/j.seppur.2003.10.006>.
- Chen, M., O. Dollar, K. Shafer-Peltier, S. Randtke, S. Waseem, and E. Peltier. 2020. "Boron removal by electrocoagulation: Removal mechanism, adsorption models and factors influencing removal." *Water Res*, 170. Elsevier Ltd. <https://doi.org/10.1016/j.watres.2019.115362>.
- Chen, X., T. He, X. Yang, Y. Gan, X. Qing, J. Wang, and Y. Huang. 2023. "Analysis, environmental occurrence, fate and potential toxicity of tire wear compounds 6PPD and 6PPD-quinone." *J Hazard Mater*. Elsevier B.V.
- Chow, H., M. Ingelsson, E. P. L. Roberts, and A. L. T. Pham. 2021. "How does periodic polarity reversal affect the faradaic efficiency and electrode fouling during iron electrocoagulation?" *Water Res*, 203. Elsevier Ltd. <https://doi.org/10.1016/j.watres.2021.117497>.
- Chow, H., and A. L. T. Pham. 2021. "Mitigating Electrode Fouling in Electrocoagulation by Means of Polarity Reversal: The Effects of Electrode Type, Current Density, and Polarity Reversal Frequency." *Water Res*, 197. Elsevier Ltd. <https://doi.org/10.1016/j.watres.2021.117074>.
- Cole, M., P. Lindeque, E. Fileman, C. Halsband, and T. S. Galloway. 2015. "The impact of polystyrene microplastics on feeding, function and fecundity in the marine copepod *Calanus helgolandicus*." *Environ Sci Technol*, 49 (2): 1130–1137. American Chemical Society. <https://doi.org/10.1021/es504525u>.
- Cole, M., P. Lindeque, E. Fileman, C. Halsband, R. Goodhead, J. Moger, and T. S. Galloway. 2013. "Microplastic ingestion by zooplankton." *Environ Sci Technol*, 47 (12): 6646–6655. <https://doi.org/10.1021/es400663f>.
- Djukić, A., B. Lekić, V. Rajaković-Ognjanović, D. Veljović, T. Vulić, M. Djolić, Z. Naunovic, J. Despotović, and D. Prodanović. 2016. "Further insight into the mechanism of heavy metals partitioning in stormwater runoff." *J Environ Manage*, 168: 104–110. Academic Press. <https://doi.org/10.1016/j.jenvman.2015.11.035>.

- Doumbi, R. T., J. O. Kowe, Domga, D. weldi Gnowe, and G. B. Noumi. 2024. "The influence of cathodic materials and optimization of the removal of the chromium (VI) from tannery wastewater by electrocoagulation." *Cleaner Water*, 2: 100032. Elsevier BV. <https://doi.org/10.1016/j.clwat.2024.100032>.
- Drogui, P., J.-F. Blais, B. Lekhlif, L. Oudrhiri, F. Zidane, P. Drogui, and J. F. Blais. 2014a. "Study of the electrocoagulation of electroplating industry wastewaters charged by nickel (II) and chromium (VI)." *Article in Journal of Materials and Environmental Sciences*, 5 (1): 111–120.
- Drogui, P., J.-F. Blais, B. Lekhlif, L. Oudrhiri, F. Zidane, P. Drogui, and J. F. Blais. 2014b. "Study of the electrocoagulation of electroplating industry wastewaters charged by nickel (II) and chromium (VI)." *Article in Journal of Materials and Environmental Sciences*, 5 (1): 111–120.
- Duan, J., and J. Gregory. 2003. *Coagulation by hydrolysing metal salts*. *Adv Colloid Interface Sci*.
- Duan, W. L., B. He, K. Takara, P. P. Luo, D. Nover, and M. C. Hu. 2015. "Modeling suspended sediment sources and transport in the Ishikari River basin, Japan, using SPARROW." *Hydrol. Earth Syst. Sci.*, 19 (3): 1293–1306. Copernicus Publications. <https://doi.org/10.5194/hess-19-1293-2015>.
- Duan, W., K. Takara, B. He, P. Luo, D. Nover, and Y. Yamashiki. 2013. "Spatial and temporal trends in estimates of nutrient and suspended sediment loads in the Ishikari River, Japan, 1985 to 2010." *Science of The Total Environment*, 461–462: 499–508. Elsevier. <https://doi.org/10.1016/J.SCITOTENV.2013.05.022>.
- Elazzouzi, M., K. Haboubi, and M. S. Elyoubi. 2017. "Electrocoagulation flocculation as a low-cost process for pollutants removal from urban wastewater." *Chemical Engineering Research and Design*, 117: 614–626. Institution of Chemical Engineers. <https://doi.org/10.1016/j.cherd.2016.11.011>.
- Elkacmi, R., O. Boudouch, A. Hasib, M. Bouzaid, and M. Bennajah. 2020. "Photovoltaic electrocoagulation treatment of olive mill wastewater using an external-loop airlift reactor." *Sustain Chem Pharm*, 17. Elsevier B.V. <https://doi.org/10.1016/j.scp.2020.100274>.
- Ellis, J. B., D. M. Revitt, D.-O Harrop, and P. R. Beckwith. 1987. *The Contribution of Highway Surfaces to Urban Stormwater Sediments and Metal Loadings*. *Science of the Total Environment*.
- Emamjomeh, M. M., and M. Sivakumar. 2009. "Review of pollutants removed by electrocoagulation and electrocoagulation/flotation processes." *J Environ Manage*.

- Ensano, B. M. B., L. Borea, V. Naddeo, V. Belgiorno, M. D. G. de Luna, M. Balakrishnan, and F. C. Ballesteros. 2019. "Applicability of the electrocoagulation process in treating real municipal wastewater containing pharmaceutical active compounds." *J Hazard Mater*, 361: 367–373. Elsevier B.V. <https://doi.org/10.1016/j.jhazmat.2018.07.093>.
- Fattah, K., Z. Al-Dawood, and N. Younes. 2024. "Treatment of Carwash Greywater Through Electrocoagulation: Effect of Time of Treatment and Inter-electrode Distance." *Recent Advances in Environmental Science from the Euro-Mediterranean and Surrounding Regions (4th Edition)*, M. Ksibi, ed., 19–22. Cham: Springer.
- Feraldi, R., S. Cashman, M. Huff, and L. Raahauge. 2013. "Comparative LCA of treatment options for US scrap tires: Material recycling and tire-derived fuel combustion." *International Journal of Life Cycle Assessment*, 18 (3): 613–625. Springer Verlag. <https://doi.org/10.1007/s11367-012-0514-8>.
- Foudhaili, T., T. V. Rakotonimaro, C. M. Neculita, L. Coudert, and O. Lefebvre. 2019. "Comparative efficiency of microbial fuel cells and electrocoagulation for the treatment of iron-rich acid mine drainage." *J Environ Chem Eng*, 7 (3). Elsevier Ltd. <https://doi.org/10.1016/j.jece.2019.103149>.
- García-Orozco, V. M., I. Linares-Hernández, R. Natividad, P. Balderas-Hernández, C. Alanis-Ramírez, C. E. Barrera-Díaz, and G. Roa-Morales. 2022. "Solar-photovoltaic electrocoagulation of wastewater from a chocolate manufacturing industry: Anodic material effect (aluminium, copper and zinc) and life cycle assessment." *J Environ Chem Eng*, 10 (3). Elsevier Ltd. <https://doi.org/10.1016/j.jece.2022.107969>.
- Garcia-Segura, S., M. M. S. Eiband, J. V. de Melo, and C. A. Martínez-Huitle. 2017. "Electrocoagulation and Advanced Electrocoagulation Processes: a General Review About the Fundamentals, Emerging Applications and its Association with Other Technologies." *Journal of Electroanalytical Chemistry*, 267–299.
- Garrido Gamarro, E., J. Ryder, E. O. Elvevoll, and R. L. Olsen. 2020. "Microplastics in Fish and Shellfish—A Threat to Seafood Safety?" *Journal of Aquatic Food Product Technology*. Taylor and Francis Inc.
- Gasperi, J., J. Le Roux, S. Deshayes, S. Ayrault, L. Bordier, L. Boudahmane, H. Budzinski, E. Caupos, N. Caubrière, K. Flanagan, M. Guillon, N. Huynh, P. Labadie, L. Meffray, P. Neveu, C. Partibane, J. Paupardin, M. Saad, L. Varnede, and M. C. Gromaire. 2022. "Micropollutants in Urban Runoff from Traffic Areas: Target and Non-Target Screening on Four Contrasted Sites." *Water (Switzerland)*, 14 (3). MDPI. <https://doi.org/10.3390/w14030394>.
- van Genuchten, C. M., S. R. S. Bandaru, E. Surorova, S. E. Amrose, A. J. Gadgil, and J. Peña. 2016a. "Formation of macroscopic surface layers on Fe(0) electrocoagulation electrodes

- during an extended field trial of arsenic treatment.” *Chemosphere*, 153: 270–279. Elsevier Ltd. <https://doi.org/10.1016/j.chemosphere.2016.03.027>.
- van Genuchten, C. M., S. R. S. Bandaru, E. Surorova, S. E. Amrose, A. J. Gadgil, and J. Peña. 2016b. “Formation of macroscopic surface layers on Fe(0) electrocoagulation electrodes during an extended field trial of arsenic treatment.” *Chemosphere*, 153: 270–279. Elsevier Ltd. <https://doi.org/10.1016/j.chemosphere.2016.03.027>.
- van Genuchten, C. M., S. R. S. Bandaru, E. Surorova, S. E. Amrose, A. J. Gadgil, and J. Peña. 2016c. “Formation of macroscopic surface layers on Fe(0) electrocoagulation electrodes during an extended field trial of arsenic treatment.” *Chemosphere*, 153: 270–279. Elsevier Ltd. <https://doi.org/10.1016/j.chemosphere.2016.03.027>.
- Gönder, Z. B., G. Balcıoğlu, I. Vergili, and Y. Kaya. 2020. “An integrated electrocoagulation–nanofiltration process for carwash wastewater reuse.” *Chemosphere*, 253. Elsevier Ltd. <https://doi.org/10.1016/j.chemosphere.2020.126713>.
- Greer, J. B., E. M. Dalsky, R. F. Lane, and J. D. Hansen. 2023. “Tire-Derived Transformation Product 6PPD-Quinone Induces Mortality and Transcriptionally Disrupts Vascular Permeability Pathways in Developing Coho Salmon.” *Environ Sci Technol*, 57 (30): 10940–10950. American Chemical Society. <https://doi.org/10.1021/acs.est.3c01040>.
- Gurses, A., M. Yalcin, and C. Dogar. 2002. *Electrocoagulation of some reactive dyes: a statistical investigation of some electrochemical variables*.
- Hafez, O. M., M. A. Shoeib, M. A. El-Khateeb, H. I. Abdel-Shafy, and A. O. Youssef. 2018. “Removal of scale forming species from cooling tower blowdown water by electrocoagulation using different electrodes.” *Chemical Engineering Research and Design*, 136: 347–357. Institution of Chemical Engineers. <https://doi.org/10.1016/j.cherd.2018.05.043>.
- Hakizimana, J. N., B. Gourich, M. Chafi, Y. Stiriba, C. Vial, P. Drogui, and J. Naja. 2017. “Electrocoagulation process in water treatment: A review of electrocoagulation modeling approaches.” *Desalination*. Elsevier B.V.
- Halama, J. J., R. B. McKane, B. L. Barnhart, P. P. Pettus, A. F. Brookes, A. K. Adams, C. K. Gockel, K. S. Djang, V. Phan, S. M. Chokshi, J. J. Graham, Z. Tian, K. T. Peter, and E. P. Kolodziej. 2024. “Watershed analysis of urban stormwater contaminant 6PPD-Quinone hotspots and stream concentrations using a process-based ecohydrological model.” *Front Environ Sci*, 12. Frontiers Media SA. <https://doi.org/10.3389/fenvs.2024.1364673>.
- Halsband, C., L. Sørensen, A. M. Booth, and D. Herzke. 2020. “Car Tire Crumb Rubber: Does Leaching Produce a Toxic Chemical Cocktail in Coastal Marine Systems?” *Front Environ Sci*, 8. Frontiers Media S.A. <https://doi.org/10.3389/fenvs.2020.00125>.

- Han, M., X. Niu, M. Tang, B. T. Zhang, G. Wang, W. Yue, X. Kong, and J. Zhu. 2020. "Distribution of microplastics in surface water of the lower Yellow River near estuary." *Science of the Total Environment*, 707. Elsevier B.V. <https://doi.org/10.1016/j.scitotenv.2019.135601>.
- Hantoro, I., A. J. Löhr, F. G. A. J. Van Belleghem, B. Widianarko, and A. M. J. Ragas. 2019. "Microplastics in coastal areas and seafood: implications for food safety." *Food Addit Contam Part A Chem Anal Control Expo Risk Assess*. Taylor and Francis Ltd.
- Harif, T., M. Hai, and A. Adin. 2006. "Electrofloculation as Potential Pre-Treatment in Colloid Ultrafiltration." *Water Supply*, 6 (1): 69–78.
- Harif, T., M. Khai, and A. Adin. 2012. "Electrocoagulation versus chemical coagulation: Coagulation/floculation mechanisms and resulting floc characteristics." *Water Res*, 46 (10): 3177–3188. Elsevier Ltd. <https://doi.org/10.1016/j.watres.2012.03.034>.
- Hashim, K. S., A. Shaw, R. Al Khaddar, M. Ortoneda Pedrola, and D. Phipps. 2017. "Defluoridation of drinking water using a new flow column-electrocoagulation reactor (FCER) - Experimental, statistical, and economic approach." *J Environ Manage*, 197: 80–88. Academic Press. <https://doi.org/10.1016/j.jenvman.2017.03.048>.
- Hendaoui, K., M. Trabelsi-Ayadi, and F. Ayari. 2021. "Optimization and mechanisms analysis of indigo dye removal using continuous electrocoagulation." *Chin J Chem Eng*, 29: 242–252. Materials China. <https://doi.org/10.1016/j.cjche.2020.07.065>.
- Holt, P. K., G. W. Barton, and C. A. Mitchell. 2005. "The future for electrocoagulation as a localised water treatment technology." *Chemosphere*, 59 (3): 355–367. Elsevier Ltd. <https://doi.org/10.1016/j.chemosphere.2004.10.023>.
- Hossain, M. M., M. I. Mahmud, M. S. Parvez, and H. M. Cho. 2013. "Impact of current density, operating time and pH of textile wastewater treatment by electrocoagulation process." *Environmental Engineering Research*, 18 (3): 157–161. <https://doi.org/10.4491/eer.2013.18.3.157>.
- Ibrahim, M. H., D. T. Moussa, M. H. El-Naas, and M. S. Nasser. 2020. "A perforated electrode design for passivation reduction during the electrochemical treatment of produced water." *Journal of Water Process Engineering*, 33. Elsevier Ltd. <https://doi.org/10.1016/j.jwpe.2019.101091>.
- Illinois Environmental Agency. 2025. "Per- and Polyfluoroalkyl Substances (PFAS)."

- Ingelsson, M., N. Yasri, and E. P. L. Roberts. 2020. "Electrode passivation, faradaic efficiency, and performance enhancement strategies in electrocoagulation—a review." *Water Res.* Elsevier Ltd.
- Jasim, M. A., and F. Y. Aljaberi. 2023. "Treatment of oily wastewater by electrocoagulation technology: A general review (2018-2022)." *Journal of Electrochemical Science and Engineering*. International Association of Physical Chemists.
- Kali, S. E., H. Österlund, M. Viklander, and G. T. Blecken. 2025a. "Stormwater discharges affect PFAS occurrence, concentrations, and spatial distribution in water and bottom sediment of urban streams." *Water Res*, 271. Elsevier Ltd. <https://doi.org/10.1016/j.watres.2024.122973>.
- Kali, S. E., H. Österlund, M. Viklander, and G. T. Blecken. 2025b. "Stormwater discharges affect PFAS occurrence, concentrations, and spatial distribution in water and bottom sediment of urban streams." *Water Res*, 271. Elsevier Ltd. <https://doi.org/10.1016/j.watres.2024.122973>.
- Kambuyi, T. N., B. Bejjany, B. Lekhlif, H. Mellouk, K. Digua, and A. Dani. 2021. "Design of a continuous-flow single-channel reactor using optimal experimental data from batch reactor for turbidity removal by electrocoagulation." *J Environ Chem Eng*, 9 (1). Elsevier Ltd. <https://doi.org/10.1016/j.jece.2020.104651>.
- Kang, J., and R. A. McLaughlin. 2016. "Simple systems for treating pumped, turbid water with flocculants and a geotextile dewatering bag." *J Environ Manage*, 182: 208–213. Academic Press. <https://doi.org/10.1016/j.jenvman.2016.07.071>.
- Kazaz, B. 2022. *Improvements in Construction Stormwater Treatment using Flocculants*.
- Kazaz, B., M. A. Perez, and W. N. Donald. 2021. "State-of-the-practice review on the use of flocculants for construction stormwater management in the united states." *Transp Res Rec*, 248–258. SAGE Publications Ltd.
- Kerr, S. J. 1995. *Silt, Turbidity and Suspended Sediments in the Aquatic Environment: An Annotated Bibliography and Literature Review*. Ontario, Canada: Ontario Ministry of Natural Resources, Souther Region Science and Techonology Transfer unit.
- Khandegar, V., and A. K. Saroha. 2013. "Electrocoagulation for the treatment of textile industry effluent - A review." *J Environ Manage*.
- Kim, K. J., K. Baek, S. Ji, Y. Cheong, G. Yim, and A. Jang. 2016. "Study on electrocoagulation parameters (current density, pH, and electrode distance) for removal of fluoride from groundwater." *Environ Earth Sci*, 75 (1): 1–8. Springer Verlag. <https://doi.org/10.1007/s12665-015-4832-6>.

- Kim, S. K., and K. Kannan. 2007. "Perfluorinated acids in air, rain, snow, surface runoff, and lakes: Relative importance of pathways to contamination of urban lakes." *Environ Sci Technol*, 41 (24): 8328–8334. <https://doi.org/10.1021/es072107t>.
- Kobyas, M., M. Bayramoglu, and M. Eyvaz. 2007. "Techno-economical evaluation of electrocoagulation for the textile wastewater using different electrode connections." *J Hazard Mater*, 148 (1–2): 311–318. <https://doi.org/10.1016/j.jhazmat.2007.02.036>.
- Kobyas, M., O. T. Can, and M. Bayramoglu. 2003. "Treatment of textile wastewaters by electrocoagulation using iron and aluminum electrodes." *J Hazard Mater*, 100 (1–3): 163–178. Elsevier. [https://doi.org/10.1016/S0304-3894\(03\)00102-X](https://doi.org/10.1016/S0304-3894(03)00102-X).
- Kobyas, M., E. Gengec, and E. Demirbas. 2016. "Operating parameters and costs assessments of a real dyehouse wastewater effluent treated by a continuous electrocoagulation process." *Chemical Engineering and Processing - Process Intensification*, 101: 87–100. Elsevier B.V. <https://doi.org/10.1016/j.cep.2015.11.012>.
- Kobyas, M., P. I. Omwene, S. M. Sarabi, S. Yildirim, and Z. Ukundimana. 2021. "Phosphorous removal from anaerobically digested municipal sludge centrate by an electrocoagulation reactor using metal (Al, Fe and Al-Fe) scrap anodes." *Process Safety and Environmental Protection*, 152: 188–200. Institution of Chemical Engineers. <https://doi.org/10.1016/j.psep.2021.06.003>.
- Kolomijeca, A., J. Parrott, H. Khan, K. Shires, S. Clarence, C. Sullivan, L. Chibwe, D. Sinton, and C. M. Rochman. 2020. "Increased Temperature and Turbulence Alter the Effects of Leachates from Tire Particles on Fathead Minnow (*Pimephales promelas*)." *Environ Sci Technol*, 54 (3): 1750–1759. American Chemical Society. <https://doi.org/10.1021/acs.est.9b05994>.
- Lantin, A., L. Larsen, A. Vyas, M. Barrett, M. Leisenring, K. Koryto, and L. Pechacek. 2019a. "Approaches for Determining and Complying with TMDL Requirements Related to Roadway Stormwater Runoff." *National Academies*.
- Lantin, A., L. Larsen, A. Vyas, M. Barrett, M. Leisenring, K. Koryto, and L. Pechacek. 2019b. *Approaches for Determining and Complying with TMDL Requirements Related to Roadway Stormwater Runoff*. Washington, D.C.: Transportation Research Board.
- LaPlaca, S. B., and P. van den Hurk. 2020. "Toxicological effects of micronized tire crumb rubber on mummichog (*Fundulus heteroclitus*) and fathead minnow (*Pimephales promelas*)." *Ecotoxicology*, 29 (5): 524–534. Springer. <https://doi.org/10.1007/s10646-020-02210-7>.
- Li, C., R. Busquets, and L. C. Campos. 2020. "Assessment of microplastics in freshwater systems: A review." *Science of the Total Environment*. Elsevier B.V.

- Li, R., B. Wang, O. Owete, J. Dertien, C. Lin, H. Ahmad, and G. Chen. 2017. "Landfill Leachate Treatment by Electrocoagulation and Fiber Filtration." *Water Environment Research*, 89 (11): 2015–2020.
- Li, T., Z. Zhu, D. Wang, C. Yao, and H. Tang. 2006. "Characterization of floc size, strength and structure under various coagulation mechanisms." *Powder Technol*, 168 (2): 104–110. <https://doi.org/10.1016/j.powtec.2006.07.003>.
- Lin, C.-J., S.-L. Lo, C.-Y. Kuo, and C.-H. Wu. 2005. "Pilot-Scale Electrocoagulation with Bipolar Aluminum Electrodes for On-Site Domestic Greywater Reuse." *Journal of Environmental Engineering, ASCE*, 131 (3).
- Liu, F., K. B. Olesen, A. R. Borregaard, and J. Vollertsen. 2019. "Microplastics in urban and highway stormwater retention ponds." *Science of the Total Environment*, 671: 992–1000. Elsevier B.V. <https://doi.org/10.1016/j.scitotenv.2019.03.416>.
- Liu, L. 2020. *Design Guidance and Development of Construction Stormwater Technologies*.
- Liu, L., and M. A. Perez. 2022. "Development and Evaluation of Lamella Settlers Combined with Electrocoagulation for Treating Suspended Sediment." *Journal of Irrigation and Drainage Engineering*, 148 (6). American Society of Civil Engineers (ASCE). [https://doi.org/10.1061/\(asce\)ir.1943-4774.0001680](https://doi.org/10.1061/(asce)ir.1943-4774.0001680).
- Lu, J., Y. Li, M. Yin, X. Ma, and S. Lin. 2015. "Removing heavy metal ions with continuous aluminum electrocoagulation: A study on back mixing and utilization rate of electro-generated Al ions." *Chemical Engineering Journal*, 267: 86–92. Elsevier. <https://doi.org/10.1016/j.cej.2015.01.011>.
- Lu, J., Y. Wang, Y. Cao, Y. Liu, B. Lu, J. Xu, W. Wang, and Z. Ni. 2025. "Arsenate removal from water by Al electrocoagulation with graphite as cathodes: Efficiency, cost, and potential reasons superior to aluminum cathodes." *J Environ Chem Eng*, 13 (3). Elsevier Ltd. <https://doi.org/10.1016/j.jece.2025.116244>.
- Lusher, Amy., P. C. H. . Hollman, and Jeremy. Mendoza-Hill. 2017. *Microplastics in fisheries and aquaculture : status of knowledge on their occurrence and implications for aquatic organisms and food safety*. Food and Agriculture Organization of the United Nations.
- Mahmoud, M. S., J. Y. Farah, and T. E. Farrag. 2013a. "Enhanced removal of Methylene Blue by electrocoagulation using iron electrodes." *Egyptian Journal of Petroleum*, 22 (1): 211–216. Egyptian Petroleum Research Institute. <https://doi.org/10.1016/j.ejpe.2012.09.013>.

- Mahmoud, M. S., J. Y. Farah, and T. E. Farrag. 2013b. “Enhanced removal of Methylene Blue by electrocoagulation using iron electrodes.” *Egyptian Journal of Petroleum*, 22 (1): 211–216. Egyptian Petroleum Research Institute. <https://doi.org/10.1016/j.ejpe.2012.09.013>.
- Makwana, A. R., and M. M. Ahammed. 2016. “Continuous electrocoagulation process for the post-treatment of anaerobically treated municipal wastewater.” *Process Safety and Environmental Protection*, 102: 724–733. Institution of Chemical Engineers. <https://doi.org/10.1016/j.psep.2016.06.005>.
- Martínez-Villafañe, J. F., J. C. Ortiz-Cuellar, J. S. Galindo-Valdés, F. Cepeda-Rodríguez, J. Gómez-Casas, N. A. Rodríguez-Rosales, O. Gómez-Casas, and C. R. Muñoz-Valdez. 2022. “Interelectrode Distance Analysis in the Water Defluoridation by Electrocoagulation Reactor.” *Sustainability (Switzerland)*, 14 (19). MDPI. <https://doi.org/10.3390/su141912096>.
- Matilainen, A., M. Vepsäläinen, and M. Sillanpää. 2010. “Natural organic matter removal by coagulation during drinking water treatment: A review.” *Adv Colloid Interface Sci.* Elsevier B.V.
- McElvery, R. 2020. “Is the Road to Sustainable Asphalt Paved with Tires?” *ACS Cent Sci*, 6 (12): 2120–2122. American Chemical Society. <https://doi.org/10.1021/acscentsci.0c01612>.
- Medvidović, N. V., L. Vrsalović, S. Svilović, A. Bilušić, and D. Jozić. 2023. “Electrocoagulation treatment of compost leachate using aluminium alloy, carbon steel and zinc anode.” *Applied Surface Science Advances*, 15. Elsevier B.V. <https://doi.org/10.1016/j.apsadv.2023.100404>.
- Men, C., Y. Ma, J. Liu, Y. Zhang, Z. Li, and J. Zuo. 2024. “The difference between tire wear particles and polyethylene microplastics in stormwater filtration systems: Perspectives from aging process, conventional pollutants removal and microbial communities.” *Environmental Pollution*, 361. Elsevier Ltd. <https://doi.org/10.1016/j.envpol.2024.124736>.
- Merzouk, B., B. Gourich, A. Sekki, K. Madani, and M. Chibane. 2009. “Removal turbidity and separation of heavy metals using electrocoagulation-electroflotation technique. A case study.” *J Hazard Mater*, 164 (1): 215–222. Elsevier. <https://doi.org/10.1016/j.jhazmat.2008.07.144>.
- Metcalfe, D. D., R. A. Lewis, J. E. Silbert, R. D. Rosenberg, S. I. Wasserman, and K. F. Austen. 1979. “Isolation and characterization of heparin from human lung.” *Journal of Clinical Investigation*, 64 (6): 1537–1543. <https://doi.org/10.1172/JCI109613>.
- Mitchell, C. J., and A. D. Jayakaran. 2024. “Mitigating tire wear particles and tire additive chemicals in stormwater with permeable pavements.” *Science of the Total Environment*, 908. Elsevier B.V. <https://doi.org/10.1016/j.scitotenv.2023.168236>.

- Mohajerani, A., L. Burnett, J. V. Smith, S. Markovski, G. Rodwell, M. T. Rahman, H. Kurmus, M. Mirzababaei, A. Arulrajah, S. Horpibulsuk, and F. Maghool. 2020. "Recycling waste rubber tyres in construction materials and associated environmental considerations: A review." *Resour Conserv Recycl.* Elsevier B.V.
- Mohora, E., S. Rončević, J. Agbaba, A. Tubić, M. Mitić, M. Klašnja, and B. Dalmacija. 2014. "Removal of arsenic from groundwater rich in natural organic matter (NOM) by continuous electrocoagulation/flocculation (ECF)." *Sep Purif Technol*, 136: 150–156. Elsevier. <https://doi.org/10.1016/j.seppur.2014.09.006>.
- Mouedhen, G., M. Feki, M. D. P. Wery, and H. F. Ayedi. 2008. "Behavior of aluminum electrodes in electrocoagulation process." *J Hazard Mater*, 150 (1): 124–135. <https://doi.org/10.1016/j.jhazmat.2007.04.090>.
- Mousazadeh, M., E. Karamati Niaragh, M. Usman, S. Ullah Khan, M. Angel Sandoval, Z. Al-Qodah, Z. Bin Khalid, V. Gilhotra, and M. Mahdi Emamjomeh. 2021. "A critical review of state-of-the-art electrocoagulation technique applied to COD-rich industrial wastewaters." <https://doi.org/10.1007/s11356-021-14631-w>/Published.
- Moussa, D. T., M. H. El-Naas, M. Nasser, and M. J. Al-Marri. 2017. "A comprehensive review of electrocoagulation for water treatment: Potentials and challenges." *J Environ Manage.* Academic Press.
- Mousset, E., F. H. Adnan, A. Ruffet, P. Moretti, and B. Cédât. 2024. "Influence of interelectrode distances in electrocoagulation: is there any possibility and advantages to operate at micro-distances with low-conductivity effluents?" *Chemosphere*, 368. Elsevier Ltd. <https://doi.org/10.1016/j.chemosphere.2024.143794>.
- Müller, S., T. Behrends, and C. M. van Genuchten. 2019. "Sustaining efficient production of aqueous iron during repeated operation of Fe(0)-electrocoagulation." *Water Res*, 155: 455–464. Elsevier Ltd. <https://doi.org/10.1016/j.watres.2018.11.060>.
- Murakami, M., H. Shinohara, and H. Takada. 2009. "Evaluation of wastewater and street runoff as sources of perfluorinated surfactants (PFSs)." *Chemosphere*, 74 (4): 487–493. Elsevier Ltd. <https://doi.org/10.1016/j.chemosphere.2008.10.018>.
- Naje, A. S., S. Chelliapan, Z. Zakaria, M. Ajeel, and P. A. Alaba. 2016. "A Review of Electrocoagulation Technology for the Treatment of Textile Wastewater." *Reviews in Chemical Engineering*.
- Nandi, B. K., and S. Patel. 2013. "Removal of Pararosaniline Hydrochloride Dye (Basic Red 9) from Aqueous Solution by Electrocoagulation: Experimental, Kinetics, and Modeling." *J Dispers Sci Technol*, 34 (12): 1713–1724. <https://doi.org/10.1080/01932691.2013.767203>.

- Nanjegowda, V. H., and K. P. Biligiri. 2020. "Recyclability of rubber in asphalt roadway systems: A review of applied research and advancement in technology." *Resour Conserv Recycl*. Elsevier B.V.
- Naraghi, B., M. M. Baneshi, R. Amiri, A. Dorost, and H. Biglari. 2018. "Removal of Reactive Black 5 dye from aqueous solutions by coupled electrocoagulation and bio-adsorbent process." *Electron Physician*, 10 (7): 7086–7094.
- Nawarkar, C. J., and V. D. Salkar. 2019. "Solar powered Electrocoagulation system for municipal wastewater treatment." *Fuel*, 237: 222–226. Elsevier Ltd. <https://doi.org/10.1016/j.fuel.2018.09.140>.
- Nguyen, T. T. Q., P. Loganathan, B. K. Dinh, T. V. Nguyen, S. Vigneswaran, and H. H. Ngo. 2021. "Removing arsenate from water using batch and continuous-flow electrocoagulation with diverse power sources." *Journal of Water Process Engineering*, 41. Elsevier Ltd. <https://doi.org/10.1016/j.jwpe.2021.102028>.
- Nidheesh, P. V., A. A. Oladipo, N. G. Yasri, A. R. Laiju, V. R. S. Cheela, A. Thiam, Y. G. Asfaha, S. Kanmani, and E. (Ted) P. L. Roberts. 2022. "Emerging applications, reactor design and recent advances of electrocoagulation process." *Process Safety and Environmental Protection*. Institution of Chemical Engineers.
- Nidheesh, P. V., and T. S. A. Singh. 2017. "Arsenic removal by electrocoagulation process: Recent trends and removal mechanism." *Chemosphere*. Elsevier Ltd.
- Nixon, H., and J. D. Saphores. 2007. "Impacts of motor vehicle operation on water quality in the US - Cleanup costs and policies." *Transp Res D Transp Environ*, 12 (8): 564–576. Elsevier Ltd. <https://doi.org/10.1016/j.trd.2007.08.002>.
- Othmani, A., A. Kadier, R. Singh, C. A. Igwegbe, M. Bouzid, M. O. Aquatar, W. A. Khanday, M. E. Bote, F. Damiri, Ö. Gökkuş, and F. Sher. 2022. "A comprehensive review on green perspectives of electrocoagulation integrated with advanced processes for effective pollutants removal from water environment." *Environ Res*, 215. Academic Press Inc. <https://doi.org/10.1016/j.envres.2022.114294>.
- Panikulam, P. J., N. Yasri, and E. P. L. Roberts. 2018. "Electrocoagulation using an oscillating anode for kaolin removal." *J Environ Chem Eng*, 6 (2): 2785–2793. Elsevier Ltd. <https://doi.org/10.1016/j.jece.2018.04.020>.
- Paul, A. G., K. C. Jones, and A. J. Sweetman. 2009. "A first global production, emission, and environmental inventory for perfluorooctane sulfonate." *Environ Sci Technol*, 43 (2): 386–392. <https://doi.org/10.1021/es802216n>.

- Perez, M. A. 2016. “Improvements in the Design and Application of Erosion and Sediment Control Technologies for the Construction Industry.” Auburn, AL: Auburn University.
- Perez, M. A., W. C. Zech, W. N. Donald, and X. Fang. 2015. “Enhancement of inlet protection practice (IPP) installations using large-scale testing techniques.” *Environmental Connection Conference 2015*.
- Phu, T. K. C., P. L. Nguyen, and T. V. B. Phung. 2025. “Recent progress in highly effective electrocoagulation-coupled systems for advanced wastewater treatment.” *iScience*. Elsevier Inc.
- Pikula, K., M. Tretyakova, A. Zakharenko, S. A. Johari, S. Ugay, V. Chernyshev, V. Chaika, T. Kalenik, and K. Golokhvast. 2021. “Environmental risk assessment of vehicle exhaust particles on aquatic organisms of different trophic levels.” *Toxics*, 9 (10). MDPI. <https://doi.org/10.3390/toxics9100261>.
- Pillai, J. 2013. *Flocculants and Coagulants: The Key to Water and Waste Management in Aggregate Production*. Naperville, IL.
- Pitt, R., S. Clark, and D. Lake. 2007. *Construction Site Erosion and Sediment Controls: Planning, Design, and Performance*. Lancaster, PA: DEStech Publications.
- Podder, A., A. H. M. A. Sadmani, D. Reinhart, N. Bin Chang, and R. Goel. 2021. “Per and poly-fluoroalkyl substances (PFAS) as a contaminant of emerging concern in surface water: A transboundary review of their occurrences and toxicity effects.” *J Hazard Mater*. Elsevier B.V.
- Rebhun, M., and M. Lurie. 1993. *Control of Organic Matter by Coagulation and Floc Separation*. *Wat. Sci. Tech*.
- Rincón, G. J., and E. J. La Motta. 2014. “Simultaneous removal of oil and grease, and heavy metals from artificial bilge water using electro-coagulation/flotation.” *J Environ Manage*, 144: 42–50. Academic Press. <https://doi.org/10.1016/j.jenvman.2014.05.004>.
- Rivers, E., and R. McLaughlin. 2015. “Using Baffles to Improve Sediment Basins.” *NC State Extension*.
- Rodrigo, M. A., M. A. Oturan, and N. Oturan. 2014. “Electrochemically assisted remediation of pesticides in soils and water: A review.” *Chem Rev*. American Chemical Society.
- Rodrigues, A. R., C. C. Seki, L. S. Ramalho, A. Argondizo, and A. P. Silva. 2020. “Electrocoagulation in a fixed bed reactor – Color removal in batch and continuous mode.” *Sep Purif Technol*, 253. Elsevier B.V. <https://doi.org/10.1016/j.seppur.2020.117481>.

- Sadik, M. A. 2019. “A Review of Promising Electrocoagulation Technology for the Treatment of Wastewater.” *Advances in Chemical Engineering and Science*, 09 (01): 109–126. Scientific Research Publishing, Inc., <https://doi.org/10.4236/aces.2019.91009>.
- Safwat, S. M. 2019. “Coupling microbial fuel cells with electrocoagulation cells to form an integrated system for wastewater treatment.” *Pol J Environ Stud*, 28 (3): 1909–1915. HARD Publishing Company. <https://doi.org/10.15244/pjoes/89543>.
- Sahu, O., B. Mazumdar, and P. K. Chaudhari. 2014. “Treatment of wastewater by electrocoagulation: A review.” *Environmental Science and Pollution Research*.
- Salinas-Echeverría, D. D., L. C. Sánchez-De La Cruz, L. A. Zambrano-Intriago, J. M. Rodríguez-Díaz, K. A. Sanoja-Lopez, R. Luque, K. J. Fernández-Andrade, Y. Gómez-Salcedo, and R. J. Baquerizo-Crespo. 2023. “Evaluation of a continuous flow electrocoagulation reactor for turbidity removal from surface water.” *Chemical Engineering Research and Design*, 198: 478–488. Institution of Chemical Engineers. <https://doi.org/10.1016/j.cherd.2023.08.049>.
- Sandoval, M. A., R. Fuentes, A. Thiam, and R. Salazar. 2021. “Arsenic and fluoride removal by electrocoagulation process: A general review.” *Science of the Total Environment*, 753. Elsevier B.V. <https://doi.org/10.1016/j.scitotenv.2020.142108>.
- Sanei, E., and N. Mokhtarani. 2022. “Leachate post-treatment by electrocoagulation process: Effect of polarity switching and anode-to-cathode surface area.” *J Environ Manage*, 319. Academic Press. <https://doi.org/10.1016/j.jenvman.2022.115733>.
- Schussler, J. C., B. Kazaz, M. A. Perez, J. Blake Whitman, and B. Cetin. 2021. “Field Evaluation of Wattle and Silt Fence Ditch Checks.” *Transportation Research Record: Journal of the Transportation Research Board*, 036119812199207. <https://doi.org/10.1177/0361198121992073>.
- Sharma, D. 2014. “Treatment of Dairy Waste Water by Electrocoagulation using Aluminum Electrodes and Settling, Filtration Studies.” *Int J Chemtech Res*, 6 (1): 591–599.
- Shruti, V. C., F. Pérez-Guevara, I. Elizalde-Martínez, and G. Kuttralam-Muniasamy. 2021. “Current trends and analytical methods for evaluation of microplastics in stormwater.” *Trends in Environmental Analytical Chemistry*. Elsevier B.V.
- Singh, H., and B. K. Mishra. 2017a. “Assessment of kinetics behavior of electrocoagulation process for the removal of suspended solids and metals from synthetic water.” *Environmental Engineering Research*, 22 (2): 141–148. Korean Society of Environmental Engineers. <https://doi.org/10.4491/eer.2016.029>.

- Singh, H., and B. K. Mishra. 2017b. "Assessment of kinetics behavior of electrocoagulation process for the removal of suspended solids and metals from synthetic water." *Environmental Engineering Research*, 22 (2): 141–148. Korean Society of Environmental Engineers. <https://doi.org/10.4491/eer.2016.029>.
- Smith, M., D. C. Love, C. M. Rochman, and R. A. Neff. 2018. "Microplastics in Seafood and the Implications for Human Health." *Curr Environ Health Rep*. Springer.
- Sojka, R. E., R. D. Lentz, C. W. Ross, and T. J. Trout. 1996. *Net And Tension Infiltration Effects of Pam in Furrow Irrigation*.
- Song, P., Z. Yang, G. Zeng, X. Yang, H. Xu, L. Wang, R. Xu, W. Xiong, and K. Ahmad. 2017. "Electrocoagulation treatment of arsenic in wastewaters: A comprehensive review." *Chemical Engineering Journal*. Elsevier B.V.
- Sridhar, R., V. Sivakumar, V. Prince Immanuel, and J. Prakash Maran. 2011. "Treatment of pulp and paper industry bleaching effluent by electrocoagulant process." *J Hazard Mater*, 186 (2–3): 1495–1502. <https://doi.org/10.1016/j.jhazmat.2010.12.028>.
- Stephensen, E., M. Adolfsson-Erici, M. Hulander, J. Parkkonen, and L. Förlin. 2005. "Rubber additives induce oxidative stress in rainbow trout." *Aquatic Toxicology*, 75 (2): 136–143. <https://doi.org/10.1016/j.aquatox.2005.07.008>.
- Suhan, M. B. K., S. B. Shuchi, A. Anis, Z. Haque, and M. S. Islam. 2020. "Comparative degradation study of remazol black B dye using electro-coagulation and electro-Fenton process: Kinetics and cost analysis." *Environ Nanotechnol Monit Manag*, 14. Elsevier B.V. <https://doi.org/10.1016/j.enmm.2020.100335>.
- Sun, J., J. Huo, B. Li, Z. Gu, C. Hu, and J. Qu. 2022. "Anode passivation mitigation by homogenizing current density distribution in electrocoagulation." *Water Res*, 223. Elsevier Ltd. <https://doi.org/10.1016/j.watres.2022.118966>.
- Syam Babu, D., T. S. Anantha Singh, P. V. Nidheesh, and M. Suresh Kumar. 2020. "Industrial wastewater treatment by electrocoagulation process." *Separation Science and Technology (Philadelphia)*. Bellwether Publishing, Ltd.
- Tanneru, C. T., J. D. Rimer, and S. Chellam. 2013. "Sweep flocculation and adsorption of viruses on aluminum flocs during electrochemical treatment prior to surface water microfiltration." *Environ Sci Technol*, 47 (9): 4612–4618. <https://doi.org/10.1021/es400291e>.
- Teh, C. Y., P. M. Budiman, K. P. Y. Shak, and T. Y. Wu. 2016. "Recent Advancement of Coagulation-Flocculation and Its Application in Wastewater Treatment." *Ind Eng Chem Res*. American Chemical Society.

- Thaxton, C. S., J. Calantoni, and R. A. McLaughlin. 2003. "Hydrodynamic Assessment of Various Types of Baffles in a Sediment Detention Pond." 557. Albuquerque, NM.
- Tian, Z., H. Zhao, K. T. Peter, M. Gonzalez, J. Wetzel, C. Wu, X. Hu, J. Prat, E. Mudrock, R. Hettinger, A. E. Cortina, R. G. Biswas, F. Vinicius, C. Kock, R. Soong, A. Jenne, B. Du, F. Hou, H. He, R. Lundeen, A. Gilbreath, R. Sutton, N. L. Scholz, J. W. Davis, M. C. Dodd, A. Simpson, J. K. McIntyre, and E. P. Kolodziej. 2021. *A ubiquitous tire rubber-derived chemical induces acute mortality in coho salmon*.
- Timmes, T. C., H. C. Kim, and B. A. Dempsey. 2010. "Electrocoagulation pretreatment of seawater prior to ultrafiltration: Pilot-scale applications for military water purification systems." *Desalination*, 250 (1): 6–13. <https://doi.org/10.1016/j.desal.2009.03.021>.
- Tones, A. R. M., E. Eyng, C. L. Zeferino, S. de O. Ferreira, A. A. de A. Alves, M. R. Fagundes-Klen, and E. Sehn. 2020. "Spectral deconvolution associated to the Gaussian fit as a tool for the optimization of photovoltaic electrocoagulation applied in the treatment of textile dyes." *Science of the Total Environment*, 713. Elsevier B.V. <https://doi.org/10.1016/j.scitotenv.2019.136301>.
- Torres, L. G., J. Jaimes, P. Mijaylova, E. Ramirez, and B. Jimenez. 1997. "Coagulation-flocculation pretreatment of high-load chemical-pharmaceutical industry wastewater: mixing aspects." *Water Science and Technology*, 36 (2–3): 255–262.
- United States Environmental Protection Agency. 1998. *Federal Register. Reissuance of NPDES General Permits for Storm Water Discharges from Construction Activities; Notice*. Washington, D.C.
- United States Environmental Protection Agency. 2000. *Water Quality Conditions in the United States*. Water, Office of.
- United States Environmental Protection Agency. 2005. "Wastes, Resource Conservation, Common Wastes & Materials, Scrap Tires."
- United States Environmental Protection Agency. 2016. *National Nonpoint Source Program - A Catalyst for Water Quality Improvements*. Washington, D.C.
- United States Environmental Protection Agency. 2025a. "The Effects: Dead Zones and Harmful Algal Blooms." *Nutrient Pollution*.
- United States Environmental Protection Agency. 2025b. "Urbanization - Stormwater Runoff."

- Valero, D., J. M. Ortiz, V. García, E. Expósito, V. Montiel, and A. Aldaz. 2011. "Electrocoagulation of wastewater from almond industry." *Chemosphere*, 84 (9): 1290–1295. Elsevier Ltd. <https://doi.org/10.1016/j.chemosphere.2011.05.032>.
- Vasconcelos, J. G., M. Perez, J. Wang, W. C. Zech, and X. Fang. 2017. *Evaluation of high-rate settling technology for sediment control in roadway construction sites FINAL REPORT Prepared by*.
- Verma, A. K., R. R. Dash, and P. Bhunia. 2012a. "A review on chemical coagulation/flocculation technologies for removal of colour from textile wastewaters." *J Environ Manage*. Academic Press.
- Verma, A. K., R. R. Dash, and P. Bhunia. 2012b. "A review on chemical coagulation/flocculation technologies for removal of colour from textile wastewaters." *J Environ Manage*.
- Vidal, J., L. Villegas, J. M. Peralta-Hernández, and R. Salazar González. 2016. "Removal of Acid Black 194 dye from water by electrocoagulation with aluminum anode." *J Environ Sci Health A Tox Hazard Subst Environ Eng*, 51 (4): 289–296. Taylor and Francis Inc. <https://doi.org/10.1080/10934529.2015.1109385>.
- Water Resources Mission Area. 2019. "Nutrients and Eutrophication." *USGS*.
- Wesch, C., A. M. Elert, M. Wörner, U. Braun, R. Klein, and M. Paulus. 2017. "Assuring quality in microplastic monitoring: About the value of clean-air devices as essentials for verified data." *Sci Rep*, 7 (1). Nature Publishing Group. <https://doi.org/10.1038/s41598-017-05838-4>.
- Wu, Z., J. Dong, Y. Yao, Y. Yang, and F. Wei. 2021. "Continuous flowing electrocoagulation reactor for efficient removal of azo dyes: Kinetic and isotherm studies of adsorption." *Environ Technol Innov*, 22. Elsevier B.V. <https://doi.org/10.1016/j.eti.2021.101448>.
- Xiao, F., M. F. Simcik, and J. S. Gulliver. 2012. "Perfluoroalkyl acids in urban stormwater runoff: Influence of land use." *Water Res*, 46 (20): 6601–6608. Elsevier Ltd. <https://doi.org/10.1016/j.watres.2011.11.029>.
- Xie, A., D. A. Ladner, and S. C. Papat. 2022. "Electrocoagulation-electroflotation for primary treatment of animal rendering wastewater to enable recovery of fats." *Chemical Engineering Journal*, 431. Elsevier B.V. <https://doi.org/10.1016/j.cej.2021.133910>.
- Yang, J., F. Liu, Y. Bu, N. Wei, S. Liu, J. Chang, X. Chen, W. Zhang, R. Zhou, and C. Zhang. 2020. "Cd removal by direct and positive single pulse current electrocoagulation: Operating conditions and energy consumption." *Environ Technol Innov*, 20. Elsevier B.V. <https://doi.org/10.1016/j.eti.2020.101123>.

- Yang, Y., D. Z. Zhu, M. R. Loewen, W. Zhang, B. van Duin, and K. Mahmood. 2024. "Impacts of climate change on urban stormwater runoff quantity and quality in a cold region." *Science of the Total Environment*, 954. Elsevier B.V. <https://doi.org/10.1016/j.scitotenv.2024.176439>.
- Yang, Z. H., H. Y. Xu, G. M. Zeng, Y. L. Luo, X. Yang, J. Huang, L. K. Wang, and P. P. Song. 2015. "The behavior of dissolution/passivation and the transformation of passive films during electrocoagulation: Influences of initial pH, Cr(VI) concentration, and alternating pulsed current." *Electrochim Acta*, 153: 149–158. Elsevier Ltd. <https://doi.org/10.1016/j.electacta.2014.11.183>.
- Yasri, N. G., and S. Gunasekaran. 2017. "Electrochemical technologies for environmental remediation." *Enhancing Cleanup of Environmental Pollutants*, 5–73. Springer International Publishing.
- Yasri, N., M. Nightingale, K. J. Cleland, and E. P. L. Roberts. 2022. "The impact of a magnetic field on electrode fouling during electrocoagulation." *Chemosphere*, 303. Elsevier Ltd. <https://doi.org/10.1016/j.chemosphere.2022.135207>.
- Yetilmezsoy, K., F. Ilhan, Z. Sapci-Zengin, S. Sakar, and M. T. Gonullu. 2009. "Decolorization and COD reduction of UASB pretreated poultry manure wastewater by electrocoagulation process: A post-treatment study." *J Hazard Mater*, 162 (1): 120–132. <https://doi.org/10.1016/j.jhazmat.2008.05.015>.
- Yousuf, M., A. Mollah, R. Schennach, J. R. Parga, and D. L. Cocke. 2001. *Electrocoagulation (EC)-science and applications*. *J Hazard Mater*.
- Zampeta, C., M. Mastrantonaki, N. Katsaouni, Z. Frontistis, P. G. Koutsoukos, and D. V. Vayenas. 2022. "Treatment of printing ink wastewater using a continuous flow electrocoagulation reactor." *J Environ Manage*, 314. Academic Press. <https://doi.org/10.1016/j.jenvman.2022.115033>.
- Zodi, S., B. Merzouk, O. Potier, F. Lapique, and J. P. Leclerc. 2013. "Direct red 81 dye removal by a continuous flow electrocoagulation/flotation reactor." *Sep Purif Technol*, 108: 215–222. <https://doi.org/10.1016/j.seppur.2013.01.052>.

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Appendix A: Fundamental Performance Evaluations

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-3	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	9/25/2023	0	364	306	0.16			
Test Duration (min.)	9	5	366	307	0.16			
Interelectrode Distance (cm)	0.5	10	377	179	0.53			
Flow Rate (gpm)	0.53	15	339	115	0.66			
Flow Rate (m ³ /hr)	0.120	20	361	81	0.78			
Voltage (V)	12	30	319	69	0.78			
Current (A)	2.3	40	322	63	0.80			
Kwh/m ³	0.230	50	307	53.6	0.83			
		60	298	45.6	0.85			
		70	284	44	0.84			
		80	280	31	0.89			
		90	280	28	0.90			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]	2.3	0	353	312	0.12			
pH	6.9	5	410	313	0.24			
Conductivity (µs/cm)	46	10	389	213	0.45			
		15	352	116	0.67			
		20	369	110	0.70			
		30	319	62.9	0.80			
		40	310	57.9	0.81			
		50	305	47.8	0.84			
		60	293	47.1	0.84			
		70	281	37.9	0.87			
		80	282	30.9	0.89			
		90	282	29.4	0.90			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
	3 Pos. = 2.9, Neg = 1.6	0	341	314	0.08			
	6 Pos. = 1.4, Neg. = 1.4	5						
	9	10	359	192	0.47			
		15	354	125	0.65			
		20	344	99.8	0.71			
		30	325	74.2	0.77			
		40	322	66.7	0.79			
		50	311	50.1	0.84			
		60	301	42.5	0.86			
		70	292	41.2	0.86			
		80	271	35.5	0.87			
		90	276	31.4	0.89			
Avg Inflow Turbidity (NTU)	352.7	Average			Turbidity Reduction			
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	353	311	0.12	0%	12%	12%
		5	388	310	0.20	-10%	12%	22%
		10	375	195	0.48	-6%	45%	51%
		15	348	119	0.66	1%	66%	65%
		20	358	97	0.73	-2%	73%	74%
		30	321	69	0.79	9%	81%	72%
		40	318	63	0.80	10%	82%	72%
		50	308	51	0.84	13%	86%	73%
		60	297	45	0.85	16%	87%	72%
		70	286	41	0.86	19%	88%	69%
		80	278	33	0.88	21%	91%	69%
		90	279	30	0.89	21%	92%	71%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-3.2	Time (min.)	A - Control	A - Treated	Treatment Ratio	TR- Treated		
Date	9/29/2023	0	710	491	0.31	32%		
Test Duration (min.)	9	5	637	413	0.35	43%		
Interelectrode Distance (cm)	0.5	10	563	198	0.65	73%		
Flow Rate (gpm)	0.50	15	557	144	0.74	80%		
Flow Rate (m ³ /hr)	0.114	20	535	112	0.79	84.44%		
Voltage (V)	12	30	478	90	0.81	87%		
Current (A)	2.1	40	487	66	0.86	91%		
Kwh/m ³	0.222	50	425	55	0.87	92%		
		60	426	49.7	0.88	93%		
		70	427	51	0.88	93%		
		80	396	40	0.90	94%		
		90	388	35	0.91	95%		
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]	2.1	Time (min.)	B - Control	B - Treated	Treatment Ratio	TR- Treated		
Current (A) [Dial]		0	678	502	0.26	30%		
pH		5	646	367	0.43	49%		
Conductivity (µs/cm)		10	579	179	0.69	75%		
		15	532	134	0.75	81%		
		20	504	107	0.79	85.14%		
		30	497	85	0.83	88%		
		40	493	65.9	0.87	91%		
		50	447	66.1	0.85	91%		
		60	432	47.2	0.89	93%		
		70	425	41.6	0.90	94%		
		80	406	39.2	0.90	95%		
		90	376	32.6	0.91	95%		
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio	TR- Treated		
3		0	772	510	0.34	29%		
6		5	647	387	0.40	46%		
9		10	603	174	0.71	76%		
		15	531	120	0.77	83%		
		20	541	108	0.80	85.00%		
		30	513	83	0.84	88%		
		40	655	134	0.80	81%		
		50	443	53.8	0.88	93%		
		60	441	47	0.89	93%		
		70	418	44.4	0.89	94%		
		80	420	37	0.91	95%		
		90	409	36	0.91	95%		
Avg Inflow Turbidity (NTU)	720.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	720	501	0.30	0%	30%	30%
		5	643	389	0.40	11%	46%	35%
		10	582	184	0.68	19%	74%	55%
		15	540	133	0.75	25%	82%	57%
		20	527	109	0.79	27%	85%	58%
		30	496	86	0.83	31%	88%	57%
		40	545	89	0.84	24%	88%	63%
		50	438	58	0.87	39%	92%	53%
		60	433	48	0.89	40%	93%	53%
		70	423	46	0.89	41%	94%	52%
		80	407	39	0.90	43%	95%	51%
		90	391	35	0.91	46%	95%	49%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-4	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	9/25/2023	0	311	292	0.06			
Test Duration (min.)	9	5	395	297	0.25			
Interelectrode Distance (cm)	0.5	10						
Flow Rate (gpm)	1.06	15						
Flow Rate (m ³ /hr)	0.240	20	301	145	0.52			
Voltage (V)	12	30	299	108	0.64			
Current (A)	2.3	40	286	92	0.68			
Kwh/m ³	0.115	50	282	83.1	0.71			
		60	285	78.7	0.72			
		70	293	64	0.78			
		80	266	54	0.80			
		90	263	49	0.81			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]	2.3	0	282	281	0.00			
pH	7.39	5	295	272	0.08			
Conductivity (µs/cm)	45	10	297	236	0.20			
		15	298	200	0.33			
		20	293	145	0.51			
		30	298	103	0.65			
		40	293	99	0.66			
		50	298	82.7	0.72			
		60	262	72.6	0.72			
		70	286	63.8	0.78			
		80	276	57.4	0.79			
		90	263	51.6	0.80			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
	3 Pos.+2.9, Neg.=1.8	0	296	292	0.01			
	6	5	291	280	0.04			
	9	10	291	265	0.09			
		15	296	224	0.24			
		20	286	167	0.42			
		30	291	100	0.66			
		40	290	85.4	0.71			
		50	265	70.3	0.73			
		60	267	58.8	0.78			
		70	249	49.7	0.80			
		80	264	45.2	0.83			
		90	246	39.1	0.84			
Avg Inflow Turbidity (NTU)	296.3	Average				Turbidity Reduction		
** all samples taken from MIDDLE of water column**		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	296	288	0.03	0%	3%	3%
		5	327	283	0.13	-10%	4%	15%
		10	294	251	0.15	1%	15%	15%
		15	297	212	0.29	0%	28%	29%
		20	293	152	0.48	1%	49%	48%
		30	296	104	0.65	0%	65%	65%
		40	290	92	0.68	2%	69%	67%
		50	282	79	0.72	5%	73%	68%
		60	271	70	0.74	8%	76%	68%
		70	276	59	0.79	7%	80%	73%
		80	269	52	0.81	9%	82%	73%
		90	257	47	0.82	13%	84%	71%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-4.2	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	9/29/2023	0	858	682	0.21			
Test Duration (min.)	9	5	773	470	0.39			
Interelectrode Distance (cm)	0.5	10	696	247	0.65			
Flow Rate (gpm)	0.99	15	683	179	0.74			
Flow Rate (m ³ /hr)	0.225	20	649	148	0.77			
Voltage (V)	12	30	583	124	0.79			
Current (A)	2.3	40	579	98	0.83			
Kwh/m ³	0.123	50	526	84.3	0.84			
		60	528	69.6	0.87			
		70	493	59	0.88			
		80	486	52	0.89			
		90	445	46	0.90			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	816	696	0.15			
pH		5	750	479	0.36			
Conductivity (µs/cm)		10	734	238	0.68			
		15	657	171	0.74			
		20	647	143	0.78			
		30	604	112	0.81			
		40	555	89.8	0.84			
		50	541	80.2	0.85			
		60			#DIV/0!			
		70	530	58	0.89			
		80	494	48.6	0.90			
		90	489	45.5	0.91			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	860	682	0.21			
6		5	818	438	0.46			
9		10	743	221	0.70			
		15	687	147	0.79			
		20	475	66.4	0.86			
		30	582	99.4	0.83			
		40	577	94.4	0.84			
		50	552	73.1	0.87			
		60	514	66.4	0.87			
		70	524	56.9	0.89			
		80	519	50.5	0.90			
		90	482	44.3	0.91			
Avg Inflow Turbidity (NTU)	844.7	Average				Turbidity Reduction		
		Time (min.)	Avg. - Control	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	845	687	0.19	0%	19%	19%
		5	780	462	0.41	8%	45%	38%
		10	724	235	0.68	14%	72%	58%
		15	676	166	0.75	20%	80%	60%
		20	590	119	0.80	30%	86%	56%
		30	590	112	0.81	30%	87%	57%
		40	570	94	0.84	32%	89%	56%
		50	540	79	0.85	36%	91%	55%
		60	521	68	0.87	38%	92%	54%
		70	516	58	0.89	39%	93%	54%
		80	500	51	0.90	41%	94%	53%
		90	472	45	0.90	44%	95%	51%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-5	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	9/26/2023	0	199	196	0.02			
Test Duration (min.)	9	5	191	191	0.00			
Interelectrode Distance (cm)	0.5	10	201	193	0.04			
Flow Rate (gpm)	1.59	15	206	169	0.18			
Flow Rate (m ³ /hr)	0.360	20	196	134	0.32			
Voltage (V)	12	30	194	98.2	0.49			
Current (A)	2.3	40	183	78.5	0.57			
Kwh/m ³	0.077	50	184	64.1	0.65			
		60	186	51.8	0.72			
		70	188	40.9	0.78			
		80	174	36.8	0.79			
		90	178	33.2	0.81			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	238	198	0.17			
pH	6.74	5	241	222	0.08			
Conductivity (µs/cm)	38.6	10	201	192	0.04			
		15	197	160	0.19			
		20	200	145	0.28			
		30	189	101	0.47			
		40	193	78.5	0.59			
		50	191	58	0.70			
		60	189	52.4	0.72			
		70	180	42.2	0.77			
		80	186	36.4	0.80			
		90	169	33.7	0.80			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	204	193	0.05			
6		5	202	191	0.05			
9		10	211	196	0.07			
		15	196	178	0.09			
		20	242	158	0.35			
		30	202	103	0.49			
		40	194	65.3	0.66			
		50	183	50.5	0.72			
		60	179	43.8	0.75			
		70	174	37	0.79			
		80	171	39.2	0.77			
		90	177	32.4	0.82			
Avg Inflow Turbidity (NTU)	213.7	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	214	196	0.08	0%	8%	8%
		5	211	201	0.05	1%	6%	5%
		10	204	194	0.05	4%	9%	5%
		15	200	169	0.15	7%	21%	14%
		20	213	146	0.32	0%	32%	31%
		30	195	101	0.48	9%	53%	44%
		40	190	74	0.61	11%	65%	54%
		50	186	58	0.69	13%	73%	60%
		60	185	49	0.73	14%	77%	63%
		70	181	40	0.78	15%	81%	66%
		80	177	37	0.79	17%	82%	65%
		90	175	33	0.81	18%	85%	66%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-5.2	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	9/29/2023	0	867	754	0.13			
Test Duration (min.)	9	5	800	592	0.26			
Interelectrode Distance (cm)	0.5	10	772	317	0.59			
Flow Rate (gpm)	1.58	15	741	211	0.72			
Flow Rate (m ³ /hr)	0.359	20	685	183	0.73			
Voltage (V)	12	30	607	140	0.77			
Current (A)	2.3	40	570	118	0.79			
Kwh/m ³	0.077	50	565	106	0.81			
		60	557	92.2	0.83			
		70	535	81	0.85			
		80	539	72	0.87			
		90	487	63	0.87			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	845	764	0.10			
pH		5	802	474	0.41			
Conductivity (µs/cm)		10	751	300	0.60			
		15	701	206	0.71			
		20	693	167	0.76			
		30	629	135	0.79			
		40	606	104	0.83			
		50	545	96.1	0.82			
		60	555	87.7	0.84			
		70	530	80.6	0.85			
		80	503	70.2	0.86			
		90	500	67	0.87			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	827	746	0.10			
6		5	825	463	0.44			
9		10	746	273	0.63			
		15	696	193	0.72			
		20	676	165	0.76			
		30	576	127	0.78			
		40	635	99.9	0.84			
		50	580	86.7	0.85			
		60	526	82.3	0.84			
		70	522	74.1	0.86			
		80	518	62	0.88			
		90	497	60.6	0.88			
Avg Inflow Turbidity (NTU)	846.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	846	755	0.11	0%	11%	11%
		5	809	510	0.37	4%	40%	35%
		10	756	297	0.61	11%	65%	54%
		15	713	203	0.71	16%	76%	60%
		20	685	172	0.75	19%	80%	61%
		30	604	134	0.78	29%	84%	56%
		40	604	107	0.82	29%	87%	59%
		50	563	96	0.83	33%	89%	55%
		60	546	87	0.84	35%	90%	54%
		70	529	79	0.85	37%	91%	53%
		80	520	68	0.87	39%	92%	53%
		90	495	64	0.87	42%	92%	51%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-6	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	9/26/2023	0	326	290	0.11			
Test Duration (min.)	9	5	322	302	0.06			
Interelectrode Distance (cm)	0.5	10	316	216	0.32			
Flow Rate (gpm)	2.11	15	284	158	0.44			
Flow Rate (m ³ /hr)	0.479	20	289	115	0.60			
Voltage (V)	12	30	269	98.7	0.63			
Current (A)	2.3	40	260	70.9	0.73			
Kwh/m ³	0.058	50	236	55.4	0.77			
		60	243	46.0	0.81			
		70	236	38.8	0.84			
		80	232	40.5	0.83			
		90	197	34	0.83			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	310	287	0.07			
pH		5	326	290	0.11			
Conductivity (µs/cm)		10	294	214	0.27			
		15	291	164	0.44			
		20	275	125	0.55			
		30	256	90.2	0.65			
		40	249	65.9	0.74			
		50	238	54.4	0.77			
		60	238	44.2	0.81			
		70	233	43.8	0.81			
		80	223	38.4	0.83			
		90	205	33	0.84			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	314	324	-0.03			
6		5	311	297	0.05			
9		10	296	226	0.24			
		15	266	167	0.37			
		20	282	135	0.52			
		30	261	94.1	0.64			
		40	253	68.1	0.73			
		50	242	55.4	0.77			
		60	233	52.1	0.78			
		70	220	42.2	0.81			
		80	217	41.3	0.81			
		90	205	33.1	0.84			
Avg Inflow Turbidity (NTU)	316.7	Average				Turbidity Reduction		
		Time (min.)	Avg. - Control	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	317	300	0.05	0%	5%	5%
		5	320	296	0.07	-1%	6%	7%
		10	302	219	0.28	5%	31%	26%
		15	280	163	0.42	11%	49%	37%
		20	282	125	0.56	11%	61%	50%
		30	262	94	0.64	17%	70%	53%
		40	254	68	0.73	20%	78%	59%
		50	239	55	0.77	25%	83%	58%
		60	238	47	0.80	25%	85%	60%
		70	230	42	0.82	27%	87%	59%
		80	224	40	0.82	29%	87%	58%
		90	202	33	0.83	36%	89%	53%

Table 1a: Test Information		Sample A (3 min.)					
Test ID	Prototype A-6.2	Time (min.)	A - Control	A - Treated	Treatment Ratio	TR- Treated	
Date	9/29/2023	0	824	786	0.05	6%	
Test Duration (min.)	9	5	821	506	0.38	40%	
Interelectrode Distance (cm)	0.5	10	764	260	0.66	69%	
Flow Rate (gpm)	2.05	15	740	229	0.69	73%	
Flow Rate (m ³ /hr)	0.464	20	648	182	0.72	78.27%	
Voltage (V)	12	30	640	146	0.77	83%	
Current (A)	2.3	40	610	119	0.80	86%	
Kwh/m ³	0.059	50	581	95.9	0.83	89%	
		60	570	80.4	0.86	90%	
		70	596	73	0.88	91%	
		80	520	62	0.88	93%	
		90	516	53	0.90	94%	
Table 1b: Initial Measurements		Sample B (6 min.)					
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio	TR- Treated	
Current (A) [Dial]		0	848	743	0.12	11%	
pH		5	844	471	0.44	44%	
Conductivity (µs/cm)		10	747	275	0.63	67%	
		15	690	201	0.71	76%	
		20	684	161	0.76	80.78%	
		30	658	130	0.80	84%	
		40	615	109	0.82	87%	
		50	588	97	0.84	88%	
		60	577	76.6	0.87	91%	
		70	553	73.3	0.87	91%	
		80	540	64.8	0.88	92%	
		90	527	56.7	0.89	93%	
Table 1c: Current vs Time		Sample C (9 min.)					
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio	TR- Treated	
3		0	841	787	0.06	6%	
6		5	839	488	0.42	42%	
9		10	737	301	0.59	64%	
		15	735	228	0.69	73%	
		20	693	173	0.75	79.35%	
		30	671	152	0.77	82%	
		40	647	118	0.82	86%	
		50	610	98.3	0.84	88%	
		60	544	89.7	0.84	89%	
		70	556	77.5	0.86	91%	
		80	536	63.8	0.88	92%	
		90	535	61.5	0.89	93%	
Avg Inflow Turbidity (NTU)	837.7	Average				Turbidity Reduction	
		Time (min.)	Avg. - Control	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated TR Difference
		0	838	772	0.08	0%	8% 8%
		5	835	488	0.41	0%	42% 41%
		10	749	279	0.63	11%	67% 56%
		15	722	219	0.70	14%	74% 60%
		20	675	172	0.75	19%	79% 60%
		30	656	143	0.78	22%	83% 61%
		40	624	115	0.82	26%	86% 61%
		50	593	97	0.84	29%	88% 59%
		60	564	82	0.85	33%	90% 57%
		70	568	74	0.87	32%	91% 59%
		80	532	64	0.88	36%	92% 56%
		90	526	57	0.89	37%	93% 56%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-7	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	9/27/2023	0	808	784	0.03			
Test Duration (min.)	9	5			#DIV/0!			
Interelectrode Distance (cm)	0.5	10	643	269	0.58			
Flow Rate (gpm)	2.41	15	613	175	0.71			
Flow Rate (m ³ /hr)	0.548	20	579	148	0.74			
Voltage (V)	12	30	490	127	0.74			
Current (A)	2.3	40	465	96	0.79			
Kwh/m ³	0.050	50	450	80.8	0.82			
		60	405	58	0.86			
		70	399	61	0.85			
		80	373	49	0.87			
		90	388	49	0.87			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	854	753	0.12			
pH	6.92	5	699	292	0.58			
Conductivity (µs/cm)	44	10	644	218	0.66			
		15			#DIV/0!			
		20	561	139	0.75			
		30	539	103	0.81			
		40	449	64.4	0.86			
		50	440	63.1	0.86			
		60	443	48.4	0.89			
		70	388	50.3	0.87			
		80	385	42	0.89			
		90	347	44.6	0.87			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	852	720	0.15			
6		5	702	394	0.44			
9		10	665	237	0.64			
		15	539	171	0.68			
		20	534	151	0.72			
		30	484	120	0.75			
		40	456	91.4	0.80			
		50	466	75.4	0.84			
		60	451	63.5	0.86			
		70	442	54.5	0.88			
		80			#DIV/0!			
		90	381	41.1	0.89			
Avg Inflow Turbidity (NTU)	838.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	838	752	0.10	0%	10%	10%
		5	701	343	0.51	16%	59%	43%
		10	651	241	0.63	22%	71%	49%
		15	576	173	0.70	31%	79%	48%
		20	558	146	0.74	33%	83%	49%
		30	504	117	0.77	40%	86%	46%
		40	457	84	0.82	46%	90%	44%
		50	452	73	0.84	46%	91%	45%
		60	433	57	0.87	48%	93%	45%
		70	410	55	0.87	51%	93%	42%
		80	379	46	0.88	55%	95%	40%
		90	372	45	0.88	56%	95%	39%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-8	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	9/27/2023	0	826	766	0.07			
Test Duration (min.)	9	5	753	519	0.31			
Interelectrode Distance (cm)	0.5	10	674	301	0.55			
Flow Rate (gpm)	3.11	15	620	215	0.65			
Flow Rate (m ³ /hr)	0.706	20	578	166	0.71			
Voltage (V)	12	30	560	136	0.76			
Current (A)	2.3	40	472	105	0.78			
Kwh/m ³	0.039	50	448	94.4	0.79			
		60	449	85.5	0.81			
		70	412	72	0.82			
		80	398	62	0.84			
		90	399	59	0.85			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	806	731	0.09			
pH	7.01	5	765	487	0.36			
Conductivity (µs/cm)	49.9	10	668	272	0.59			
		15	593	207	0.65			
		20	557	155	0.72			
		30	532	140	0.74			
		40	468	107	0.77			
		50	483	92.6	0.81			
		60	443	79.6	0.82			
		70	451	68.7	0.85			
		80	364	61.7	0.83			
		90	403	56.7	0.86			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	745	724	0.03			
6		5	736	464	0.37			
9		10	676	259	0.62			
		15	608	182	0.70			
		20	536	143	0.73			
		30	479	81.1	0.83			
		40	376	50.1	0.87			
		50	460	81.5	0.82			
		60	423	66.1	0.84			
		70	422	67.9	0.84			
		80	416	60	0.86			
		90	381	57.6	0.85			
Avg Inflow Turbidity (NTU)	792.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	792	740	0.07	0%	7%	7%
		5	751	490	0.35	5%	38%	33%
		10	673	277	0.59	15%	65%	50%
		15	607	201	0.67	23%	75%	51%
		20	557	155	0.72	30%	80%	51%
		30	524	119	0.77	34%	85%	51%
		40	439	87	0.80	45%	89%	44%
		50	464	90	0.81	41%	89%	47%
		60	438	77	0.82	45%	90%	46%
		70	428	70	0.84	46%	91%	45%
		80	393	61	0.84	50%	92%	42%
		90	394	58	0.85	50%	93%	42%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-9	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	9/27/2023	0	769	647	0.16			
Test Duration (min.)	9	5	656	435	0.34			
Interelectrode Distance (cm)	0.5	10	565	345	0.39			
Flow Rate (gpm)	3.57	15	558	194	0.65			
Flow Rate (m ³ /hr)	0.811	20	510	167	0.67			
Voltage (V)	12	30	459	141	0.69			
Current (A)	2.3	40	450	109	0.76			
Kwh/m ³	0.034	50	451	87.6	0.81			
		60	373	81.2	0.78			
		70	366	72	0.80			
		80	388	64	0.83			
		90	356	52	0.86			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	608	545	0.10			
pH	6.72	5	665	410	0.38			
Conductivity (µs/cm)	34	10	573	261	0.54			
		15	541	197	0.64			
		20	533	173	0.68			
		30	439	134	0.69			
		40	438	124	0.72			
		50	405	98.9	0.76			
		60	481	75.2	0.84			
		70	389	71.8	0.82			
		80	380	70.5	0.81			
		90			#DIV/0!			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	728	670	0.08			
6		5	573	455	0.21			
9		10	612	290	0.53			
		15	524	224	0.57			
		20	513	158	0.69			
		30	453	131	0.71			
		40	472	105	0.78			
		50	419	95.3	0.77			
		60	392	90.9	0.77			
		70	406	81.7	0.80			
		80	378	74.6	0.80			
		90	347	57	0.84			
Avg Inflow Turbidity (NTU)	701.7	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	702	621	0.12	0%	12%	12%
		5	631	433	0.31	10%	38%	28%
		10	583	299	0.49	17%	57%	41%
		15	541	205	0.62	23%	71%	48%
		20	519	166	0.68	26%	76%	50%
		30	450	135	0.70	36%	81%	45%
		40	453	113	0.75	35%	84%	49%
		50	425	94	0.78	39%	87%	47%
		60	415	82	0.80	41%	88%	47%
		70	387	75	0.81	45%	89%	44%
		80	382	70	0.82	46%	90%	45%
		90	352	54	0.85	50%	92%	42%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-10	Time (min.)	A - Control	A - Treated	Treatment Ratio	TR- Treated		
Date	9/27/2023	0	654	574	0.12	12%		
Test Duration (min.)	9	5	559	400	0.28	39%		
Interelectrode Distance (cm)	0.5	10	512	263	0.49	60%		
Flow Rate (gpm)	3.96	15	447	168	0.62	74%		
Flow Rate (m ³ /hr)	0.900	20	427	137	0.68	78.96%		
Voltage (V)	12	30	390	110	0.72	83%		
Current (A)	2.3	40	390	92	0.76	86%		
Kwh/m ³	0.031	50	370	80	0.78	88%		
		60	352	74.9	0.79	88%		
		70	350	70	0.80	89%		
		80	357	68	0.81	90%		
		90	349	57	0.84	91%		
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio	TR- Treated		
Current (A) [Dial]		0	644	585	0.09	10%		
pH	6.8	5	573	391	0.32	40%		
Conductivity (µs/cm)	33.3	10	563	251	0.55	61%		
		15	457	188	0.59	71%		
		20	461	186	0.60	71.43%		
		30	461	166	0.64	75%		
		40	445	132	0.70	80%		
		50	380	101	0.73	84%		
		60	361	66	0.82	90%		
		70	357	66.2	0.81	90%		
		80	365	64	0.82	90%		
		90	341	60.2	0.82	91%		
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio	TR- Treated		
3		0	655	565	0.14	13%		
6		5	572	398	0.30	39%		
9		10	536	241	0.55	63%		
		15	510	188	0.63	71%		
		20	480	155	0.68	76.19%		
		30	420	128	0.70	80%		
		40	419	106	0.75	84%		
		50	421	95	0.77	85%		
		60	373	98.3	0.74	85%		
		70	378	69.5	0.82	89%		
		80	335	61.1	0.82	91%		
		90	332	55	0.83	92%		
Avg Inflow Turbidity (NTU)	651.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Control	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	651	575	0.12	0%	12%	12%
		5	568	396	0.30	13%	39%	26%
		10	537	252	0.53	18%	61%	44%
		15	471	181	0.62	28%	72%	45%
		20	456	159	0.65	30%	76%	46%
		30	424	135	0.68	35%	79%	44%
		40	418	110	0.74	36%	83%	47%
		50	390	92	0.76	40%	86%	46%
		60	362	80	0.78	44%	88%	43%
		70	362	69	0.81	44%	89%	45%
		80	352	64	0.82	46%	90%	44%
		90	341	57	0.83	48%	91%	44%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-11	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	9/7/2023	0	476	472	0.01			
Test Duration (min.)	9	5	433	316	0.27			
Interelectrode Distance (cm)	0.5	10	404	234	0.42			
Flow Rate (gpm)	4.64	15	330	184	0.44			
Rate (m ³ /hr)	1.055	20	380	172	0.55			
Voltage (V)	12	30	354	146	0.59			
Current (A)	2.3	40	323	110	0.66			
/m ³	0.026	50	314	95.2	0.70			
		60	291	82.8	0.72			
		70	287	71	0.75			
		80	273	59	0.78			
		90	283	65	0.77			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	520	479	0.08			
pH	7.05	5	467	366	0.22			
luctivity (µs/cm)		10	440	265	0.40			
		15	393	238	0.39			
		20	398	205	0.48			
		30	369	159	0.57			
		40	365	133	0.64			
		50	333	95.2	0.71			
		60	298	76.1	0.74			
		70	300	67.1	0.78			
		80	278	61.4	0.78			
		90	270	57	0.79			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	531	500	0.06			
6		5	429	287	0.33			
9		10	430	260	0.40			
		15	405	189	0.53			
		20	379	166	0.56			
		30	342	130	0.62			
		40	352	93.5	0.73			
		50	335	89.6	0.73			
		60	318	79.9	0.75			
		70	318	71.2	0.78			
		80	280	55.8	0.80			
		90	277	58.9	0.79			
Avg Inflow Turbidity (NTU)	509.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	509	484	0.05	0%	5%	5%
		5	443	323	0.27	13%	37%	24%
		10	425	253	0.40	17%	50%	34%
		15	376	204	0.46	26%	60%	34%
		20	386	181	0.53	24%	64%	40%
		30	355	145	0.59	30%	72%	41%
		40	347	112	0.68	32%	78%	46%
		50	327	93	0.71	36%	82%	46%
		60	302	80	0.74	41%	84%	44%
		70	302	70	0.77	41%	86%	46%
		80	277	59	0.79	46%	88%	43%
		90	277	60	0.78	46%	88%	43%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-13	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	9/28/2023	0	537	523	0.03			
Test Duration (min.)	9	5	526	435	0.17			
Interelectrode Distance (cm)	0.5	10	468	304	0.35			
Flow Rate (gpm)	5.54	15	404	230	0.43			
Flow Rate (m ³ /hr)	1.257	20	400	181	0.55			
Voltage (V)	12	30	401	153	0.62			
Current (A)	2.3	40	366	127	0.65			
Kwh/m ³	0.022	50	362	104	0.71			
		60	326	90.6	0.72			
		70	324	79	0.76			
		80	326	73	0.77			
		90	301	63	0.79			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	555	534	0.04			
pH		5	531	443	0.17			
Conductivity (µs/cm)		10	427	312	0.27			
		15	427	242	0.43			
		20	417	194	0.53			
		30	386	160	0.59			
		40	381	115	0.70			
		50	337	108	0.68			
		60	333	98.6	0.70			
		70	324	91.4	0.72			
		80	323	72.7	0.77			
		90	304	68.8	0.77			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	549	536	0.02			
6		5	542	444	0.18			
9		10	439	290	0.34			
		15	469	199	0.58			
		20	412	171	0.58			
		30	404	138	0.66			
		40	373	113	0.70			
		50	349	107	0.69			
		60	344	80.3	0.77			
		70	321	81.5	0.75			
		80	321	68	0.79			
		90	309	63.6	0.79			
Avg Inflow Turbidity (NTU)	547.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	547	531	0.03	0%	3%	3%
		5	533	441	0.17	3%	19%	17%
		10	445	302	0.32	19%	45%	26%
		15	433	224	0.48	21%	59%	38%
		20	410	182	0.56	25%	67%	42%
		30	397	150	0.62	27%	73%	45%
		40	373	118	0.68	32%	78%	47%
		50	349	106	0.70	36%	81%	44%
		60	334	90	0.73	39%	84%	45%
		70	323	84	0.74	41%	85%	44%
		80	323	71	0.78	41%	87%	46%
		90	305	65	0.79	44%	88%	44%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-14	Time (min.)	A - Control	A - Treated	Treatment Ratio	TR- Treated		
Date	9/28/2023	0	560	537	0.04	6%		
Test Duration (min.)	9	5	522	425	0.19	26%		
Interelectrode Distance (cm)	0.5	10	484	293	0.39	49%		
Flow Rate (gpm)	6.03	15	428	212	0.50	63%		
Flow Rate (m ³ /hr)	1.369	20	442	189	0.57	66.92%		
Voltage (V)	12	30	393	141	0.64	75%		
Current (A)	2.3	40	380	134	0.65	77%		
Kwh/m ³	0.020	50	370	105	0.72	82%		
		60	344	104	0.70	82%		
		70	331	92	0.72	84%		
		80	331	77	0.77	87%		
		90			#DIV/0!	100%		
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio	TR- Treated		
Current (A) [Dial]		0	583	532	0.09	7%		
pH		5	555	328	0.41	43%		
Conductivity (µs/cm)		10	445	307	0.31	46%		
		15	458	226	0.51	60%		
		20	416	193	0.54	66.22%		
		30	385	157	0.59	73%		
		40	380	125	0.67	78%		
		50	354	102	0.71	82%		
		60	338	98.6	0.71	83%		
		70	328	82.2	0.75	86%		
		80	328	74.7	0.77	87%		
		90	322	68.1	0.79	88%		
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio	TR- Treated		
3		0	571	549	0.04	4%		
6		5	545	438	0.20	23%		
9		10	439	252	0.43	56%		
		15	453	244	0.46	57%		
		20	435	186	0.57	67.44%		
		30	410	148	0.64	74%		
		40	358	117	0.67	80%		
		50	372	96.1	0.74	83%		
		60	347	96.3	0.72	83%		
		70	349	76.7	0.78	87%		
		80	324	67.4	0.79	88%		
		90	350	69.3	0.80	88%		
Avg Inflow Turbidity (NTU)	571.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	571	539	0.06	0%	6%	6%
		5	541	397	0.27	5%	31%	25%
		10	456	284	0.38	20%	50%	30%
		15	446	227	0.49	22%	60%	38%
		20	431	189	0.56	25%	67%	42%
		30	396	149	0.62	31%	74%	43%
		40	373	125	0.66	35%	78%	43%
		50	365	101	0.72	36%	82%	46%
		60	343	100	0.71	40%	83%	43%
		70	336	84	0.75	41%	85%	44%
		80	328	73	0.78	43%	87%	45%
		90	336	69	0.80	41%	88%	47%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-15	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	9/29/2023	0	736	741	-0.01			
Test Duration (min.)	9	5	701	604	0.14			
Interelectrode Distance (cm)	0.5	10	682	390	0.43			
Flow Rate (gpm)	6.91	15	650	292	0.55			
Flow Rate (m ³ /hr)	1.569	20	549	245	0.55			
Voltage (V)	12	30	549	194	0.65			
Current (A)	2.3	40	513	153	0.70			
Kwh/m ³	0.018	50	521	135	0.74			
		60	498	116	0.77			
		70	482	103	0.79			
		80	460	94	0.80			
		90	437	84	0.81			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	696	689	0.01			
pH		5	677	580	0.14			
Conductivity (µs/cm)		10	660	394	0.40			
		15	575	323	0.44			
		20	571	251	0.56			
		30	534	190	0.64			
		40	557	158	0.72			
		50	496	135	0.73			
		60	471	107	0.77			
		70	470	98.9	0.79			
		80	444	93.5	0.79			
		90	434	84.5	0.81			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	680	674	0.01			
6		5	689	583	0.15			
9		10	634	394	0.38			
		15	609	296	0.51			
		20	592	223	0.62			
		30	546	176	0.68			
		40	518	140	0.73			
		50	514	124	0.76			
		60	494	100	0.80			
		70	473	96.8	0.80			
		80	440	87.9	0.80			
		90	413	78.8	0.81			
Avg Inflow Turbidity (NTU)	704.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Control	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	704	701	0.00	0%	0%	0%
		5	689	589	0.15	2%	16%	14%
		10	659	393	0.40	6%	44%	38%
		15	611	304	0.50	13%	57%	44%
		20	571	240	0.58	19%	66%	47%
		30	543	187	0.66	23%	73%	51%
		40	529	150	0.72	25%	79%	54%
		50	510	131	0.74	28%	81%	54%
		60	488	108	0.78	31%	85%	54%
		70	475	100	0.79	33%	86%	53%
		80	448	92	0.80	36%	87%	51%
		90	428	83	0.81	39%	88%	49%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-16	Time (min.)	A - Control	A - Treated	Treatment Ratio	TR- Treated		
Date	9/29/2023	0	780	705	0.10	0%		
Test Duration (min.)	9	5	707	545	0.23	23%		
Interelectrode Distance (cm)	0.5	10	603	380	0.37	46%		
Flow Rate (gpm)	7.85	15	571	296	0.48	58%		
Flow Rate (m ³ /hr)	1.782	20	535	255	0.52	63.80%		
Voltage (V)	12	30	538	188	0.65	73%		
Current (A)	2.3	40	517	158	0.69	78%		
Kwh/m ³	0.015	50	491	131	0.73	81%		
		60	463	124	0.73	82%		
		70	431	112	0.74	84%		
		80	449	103	0.77	85%		
		90	410	94	0.77	87%		
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio	TR- Treated		
Current (A) [Dial]		0	700	679	0.03	4%		
pH		5	635	528	0.17	25%		
Conductivity (µs/cm)		10	600	375	0.38	47%		
		15	571	267	0.53	62%		
		20	535	263	0.51	62.66%		
		30	473	189	0.60	73%		
		40	489	160	0.67	77%		
		50	461	130	0.72	82%		
		60	438	111	0.75	84%		
		70	450	110	0.76	84%		
		80	434	102	0.76	86%		
		90	409	92	0.78	87%		
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio	TR- Treated		
3		0	633	629	0.01	11%		
6		5	597	489	0.18	31%		
9		10	647	373	0.42	47%		
		15	513	273	0.47	61%		
		20	507	250	0.51	64.51%		
		30	470	195	0.59	72%		
		40	449	145	0.68	79%		
		50	441	132	0.70	81%		
		60	415	120	0.71	83%		
		70	404	106	0.74	85%		
		80	395	97.7	0.75	86%		
		90	378	92.3	0.76	87%		
Avg Inflow Turbidity (NTU)	704.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	704	671	0.05	0%	5%	5%
		5	646	521	0.19	8%	26%	18%
		10	617	376	0.39	12%	47%	34%
		15	552	279	0.49	22%	60%	39%
		20	526	256	0.51	25%	64%	38%
		30	494	191	0.61	30%	73%	43%
		40	485	154	0.68	31%	78%	47%
		50	464	131	0.72	34%	81%	47%
		60	439	118	0.73	38%	83%	45%
		70	428	109	0.74	39%	84%	45%
		80	426	101	0.76	40%	86%	46%
		90	399	93	0.77	43%	87%	43%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-17	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	9/29/2023	0	584	566	0.03			
Test Duration (min.)	9	5	575	492	0.14			
Interelectrode Distance (cm)	0.5	10	504	349	0.31			
Flow Rate (gpm)	9.00	15	479	284	0.41			
Flow Rate (m ³ /hr)	2.044	20	446	249	0.44			
Voltage (V)	12	30	440	182	0.59			
Current (A)	2.2	40	419	168	0.60			
Kwh/m ³	0.013	50	411	149	0.64			
		60	392	147	0.63			
		70	368	118	0.68			
		80	368	108	0.71			
		90	375	106	0.72			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	616	575	0.07			
pH		5	551	492	0.11			
Conductivity (µs/cm)		10	528	361	0.32			
		15	471	281	0.40			
		20	461	242	0.48			
		30	436	172	0.61			
		40	428	159	0.63			
		50	400	145	0.64			
		60	396	125	0.68			
		70	406	125	0.69			
		80	369	109	0.70			
		90	384	100	0.74			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	651	665	-0.02			
6		5	579	495	0.15			
9		10	553	388	0.30			
		15	536	303	0.43			
		20	494	249	0.50			
		30	476	201	0.58			
		40	461	179	0.61			
		50	421	149	0.65			
		60	422	147	0.65			
		70	424	123	0.71			
		80	400	115	0.71			
		90	394	105	0.73			
Avg Inflow Turbidity (NTU)	617.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	617	602	0.02	0%	2%	2%
		5	568	493	0.13	8%	20%	12%
		10	528	366	0.31	14%	41%	26%
		15	495	289	0.42	20%	53%	33%
		20	467	247	0.47	24%	60%	36%
		30	451	185	0.59	27%	70%	43%
		40	436	169	0.61	29%	73%	43%
		50	411	148	0.64	33%	76%	43%
		60	403	140	0.65	35%	77%	43%
		70	399	122	0.69	35%	80%	45%
		80	379	111	0.71	39%	82%	43%
		90	384	104	0.73	38%	83%	45%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-18	Time (min.)	A - Control	A - Treated	Treatment Ratio	TR- Treated		
Date	9/29/2023	0	674	651	0.03	6%		
Test Duration (min.)	9	5	648	579	0.11	17%		
Interelectrode Distance (cm)	0.5	10	595	452	0.24	35%		
Flow Rate (gpm)	9.97	15	570	367	0.36	47%		
Flow Rate (m ³ /hr)	2.264	20	522	311	0.40	55.19%		
Voltage (V)	12	30	498	252	0.49	64%		
Current (A)	2.2	40	480	221	0.54	68%		
Kwh/m ³	0.012	50	411	180	0.56	74%		
		60	439	172	0.61	75%		
		70	413	166	0.60	76%		
		80	424	147	0.65	79%		
		90	390	136	0.65	80%		
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio	TR- Treated		
Current (A) [Dial]		0	704	611	0.13	12%		
pH		5	603	586	0.03	16%		
Conductivity (µs/cm)		10	591	447	0.24	36%		
		15	548	349	0.36	50%		
		20	513	296	0.42	57.35%		
		30	488	244	0.50	65%		
		40	492	207	0.58	70%		
		50	464	181	0.61	74%		
		60	451	158	0.65	77%		
		70	407	145	0.64	79%		
		80	408	139	0.66	80%		
		90	401	128	0.68	82%		
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio	TR- Treated		
3		0	704	664	0.06	4%		
6		5	653	565	0.13	19%		
9		10	620	428	0.31	38%		
		15	525	365	0.30	47%		
		20	515	296	0.43	57.35%		
		30	497	242	0.51	65%		
		40	450	188	0.58	73%		
		50	468	173	0.63	75%		
		60	441	161	0.63	77%		
		70	407	131	0.68	81%		
		80	405	135	0.67	81%		
		90	439	120	0.73	83%		
Avg Inflow Turbidity (NTU)	694.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	694	642	0.07	0%	7%	7%
		5	635	577	0.09	9%	17%	8%
		10	602	442	0.27	13%	36%	23%
		15	548	360	0.34	21%	48%	27%
		20	517	301	0.42	26%	57%	31%
		30	494	246	0.50	29%	65%	36%
		40	474	205	0.57	32%	70%	39%
		50	448	178	0.60	35%	74%	39%
		60	444	164	0.63	36%	76%	40%
		70	409	147	0.64	41%	79%	38%
		80	412	140	0.66	41%	80%	39%
		90	410	128	0.69	41%	82%	41%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-19	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/10/2023	0	948	520	0.45			
Test Duration (min.)	9	5	841	240	0.71			
Interelectrode Distance (cm)	0.5	10	770	133	0.83			
Flow Rate (gpm)	0.50	15	734	100	0.86			
Flow Rate (m ³ /hr)	0.114	20	656	83	0.87			
Voltage (V)	24	30	612	63	0.90			
Current (A)	4.2	40	587	58	0.90			
Kwh/m ³	0.888	50	542	54.9	0.90			
		60	550	41.8	0.92			
		70	479	34	0.93			
		80	455	33	0.93			
		90	439	31	0.93			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	914	496	0.46			
pH		5	847	212	0.75			
Conductivity (µs/cm)		10	797	123	0.85			
		15	666	83.8	0.87			
		20	681	80.2	0.88			
		30	622	66.4	0.89			
		40	614	54.6	0.91			
		50	572	46.4	0.92			
		60	536	40.2	0.93			
		70	542	34.1	0.94			
		80	520	35.3	0.93			
		90	507	30.9	0.94			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	966	484	0.50			
6		5	836	232	0.72			
9		10	755	130	0.83			
Avg Inflow Turbidity (NTU)	942.7	15	732	97.3	0.87			
		20	653	70.1	0.89			
		30	643	62.7	0.90			
		40	567	57.2	0.90			
		50	582	38.7	0.93			
		60	597	35.3	0.94			
		70	549	38.4	0.93			
		80	512	31.8	0.94			
		90	493	26.1	0.95			
		Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	943	500	0.47	0%	47%	47%
		5	841	228	0.73	11%	76%	65%
		10	774	129	0.83	18%	86%	68%
		15	711	94	0.87	25%	90%	65%
		20	663	78	0.88	30%	92%	62%
		30	626	64	0.90	34%	93%	60%
		40	589	57	0.90	37%	94%	57%
		50	565	47	0.92	40%	95%	55%
		60	561	39	0.93	40%	96%	55%
		70	523	35	0.93	44%	96%	52%
		80	496	33	0.93	47%	96%	49%
		90	480	29	0.94	49%	97%	48%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-20	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/10/2023	0	805	610	0.24			
Test Duration (min.)	9	5	731	294	0.60			
Interelectrode Distance (cm)	0.5	10	655	150	0.77			
Flow Rate (gpm)	1.10	15	647	118	0.82			
Flow Rate (m ³ /hr)	0.250	20	645	100	0.84			
Voltage (V)	24	30	572	72	0.87			
Current (A)	4.6	40	573	62	0.89			
Kwh/m ³	0.442	50	534	54.9	0.90			
		60	515	49	0.90			
		70	497	42	0.92			
		80	493	36	0.93			
		90	516	32	0.94			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	834	624	0.25			
pH		5	697	247	0.65			
Conductivity (µs/cm)		10	691	144	0.79			
		15	660	110	0.83			
		20	658	97.3	0.85			
		30	570	81.7	0.86			
		40	560	63	0.89			
		50	492	48.7	0.90			
		60	514	43.9	0.91			
		70	510	39.8	0.92			
		80	478	35.8	0.93			
		90	462	27.2	0.94			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	804	620	0.23			
6		5	719	240	0.67			
9		10	673	139	0.79			
		15	635	109	0.83			
		20	610	92.1	0.85			
		30	562	73.3	0.87			
		40	556	62.3	0.89			
		50	545	53	0.90			
		60	496	44.7	0.91			
		70	498	34.8	0.93			
		80	477	31.4	0.93			
		90	445	25.3	0.94			
Avg Inflow Turbidity (NTU)	814.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	814	618	0.24	0%	24%	24%
		5	716	260	0.64	12%	68%	56%
		10	673	144	0.79	17%	82%	65%
		15	647	112	0.83	21%	86%	66%
		20	638	96	0.85	22%	88%	66%
		30	568	76	0.87	30%	91%	60%
		40	563	62	0.89	31%	92%	61%
		50	524	52	0.90	36%	94%	58%
		60	508	46	0.91	38%	94%	57%
		70	502	39	0.92	38%	95%	57%
		80	483	34	0.93	41%	96%	55%
		90	474	28	0.94	42%	97%	55%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-21	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/10/2023	0	806	716	0.11			
Test Duration (min.)	9	5	749	350	0.53			
Interelectrode Distance (cm)	0.5	10	692	191	0.72			
Flow Rate (gpm)	2.08	15	667	154	0.77			
Flow Rate (m ³ /hr)	0.472	20	602	114	0.81			
Voltage (V)	24	30	579	104	0.82			
Current (A)	4.7	40	531	62	0.88			
Kwh/m ³	0.239	50	511	59	0.88			
		60	519	46.4	0.91			
		70	510	50	0.90			
		80	495	42	0.92			
		90	476	36	0.93			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	797	704	0.12			
pH		5	761	365	0.52			
Conductivity (µs/cm)		10	645	182	0.72			
		15	654	135	0.79			
		20	630	101	0.84			
		30	586	87.5	0.85			
		40	558	82.7	0.85			
		50	553	72.5	0.87			
		60	555	61.7	0.89			
		70	517	47.1	0.91			
		80	483	43.8	0.91			
		90	476	37.4	0.92			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	821	704	0.14			
6		5	774	323	0.58			
9		10	654	170	0.74			
		15	632	132	0.79			
		20	591	105	0.82			
		30	586	90.9	0.84			
		40	547	69.9	0.87			
		50	540	60	0.89			
		60	514	47.3	0.91			
		70	505	43.7	0.91			
		80	503	39.1	0.92			
		90	477	34.2	0.93			
Avg Inflow Turbidity (NTU)	808.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	808	708	0.12	0%	12%	12%
		5	761	346	0.55	6%	57%	51%
		10	664	181	0.73	18%	78%	60%
		15	651	140	0.78	19%	83%	63%
		20	608	107	0.82	25%	87%	62%
		30	584	94	0.84	28%	88%	61%
		40	545	72	0.87	33%	91%	59%
		50	535	64	0.88	34%	92%	58%
		60	529	52	0.90	34%	94%	59%
		70	511	47	0.91	37%	94%	57%
		80	494	42	0.92	39%	95%	56%
		90	476	36	0.93	41%	96%	55%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-22	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/10/2023	0	699	650	0.07			
Test Duration (min.)	9	5	582	172	0.70			
Interelectrode Distance (cm)	0.5	10	662	353	0.47			
Flow Rate (gpm)	2.92	15	577	134	0.77			
Flow Rate (m ³ /hr)	0.663	20	541	108	0.80			
Voltage (V)	24	30	500	92	0.82			
Current (A)	4.8	40	470	73	0.85			
Kwh/m ³	0.174	50	456	58.1	0.87			
		60	463	52.9	0.89			
		70	434	48	0.89			
		80	441	41	0.91			
		90	414	36	0.91			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	655	639	0.02			
pH		5	665	298	0.55			
Conductivity (µs/cm)		10	570	185	0.68			
		15	565	145	0.74			
		20	539	120	0.78			
		30	473	98.6	0.79			
		40	465	74.9	0.84			
		50	493	62.5	0.87			
		60	452	49.2	0.89			
		70	418	43	0.90			
		80	416	39.6	0.90			
		90	402	38	0.91			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	670	620	0.07			
6		5	617	338	0.45			
9		10	577	183	0.68			
		15	533	146	0.73			
		20	495	128	0.74			
		30	494	88.3	0.82			
		40	463	72.6	0.84			
		50	442	56.8	0.87			
		60	429	52.9	0.88			
		70	427	46.6	0.89			
		80	399	39.9	0.90			
		90	397	34.6	0.91			
Avg Inflow Turbidity (NTU)	674.7	Average				Turbidity Reduction		
		Time (min.)	Avg. - Control	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	675	636	0.06	0%	6%	6%
		5	621	269	0.57	8%	60%	52%
		10	603	240	0.60	11%	64%	54%
		15	558	142	0.75	17%	79%	62%
		20	525	119	0.77	22%	82%	60%
		30	489	93	0.81	28%	86%	59%
		40	466	73	0.84	31%	89%	58%
		50	464	59	0.87	31%	91%	60%
		60	448	52	0.88	34%	92%	59%
		70	426	46	0.89	37%	93%	56%
		80	419	40	0.90	38%	94%	56%
		90	404	36	0.91	40%	95%	55%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-23	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/11/2023	0	584	533	0.09			
Test Duration (min.)	9	5	532	344	0.35			
Interelectrode Distance (cm)	0.5	10	499	188	0.62			
Flow Rate (gpm)	3.72	15	469	137	0.71			
Flow Rate (m ³ /hr)	0.845	20	454	116	0.74			
Voltage (V)	24	30	405	85	0.79			
Current (A)	4.5	40	423	74	0.83			
Kwh/m ³	0.128	50	388	57.1	0.85			
		60	383	56.4	0.85			
		70	340	40	0.88			
		80	358	40	0.89			
		90	336	31	0.91			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	547	529	0.03			
pH		5	551	346	0.37			
Conductivity (µs/cm)		10	573	210	0.63			
		15	468	141	0.70			
		20	429	115	0.73			
		30	431	83.6	0.81			
		40	404	68.4	0.83			
		50	365	56.5	0.85			
		60	349	50.6	0.86			
		70	361	44.3	0.88			
		80	318	35.2	0.89			
		90	320	33	0.90			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	547	527	0.04			
6		5	526	332	0.37			
9		10	503	201	0.60			
		15	475	156	0.67			
		20	442	124	0.72			
		30	430	95.6	0.78			
		40	390	74.1	0.81			
		50	378	59.1	0.84			
		60	362	48.2	0.87			
		70	357	45.6	0.87			
		80	325	40	0.88			
		90	315	32.9	0.90			
Avg Inflow Turbidity (NTU)	559.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Control	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	559	530	0.05	0%	5%	5%
		5	536	341	0.36	4%	39%	35%
		10	525	200	0.62	6%	64%	58%
		15	471	145	0.69	16%	74%	58%
		20	442	118	0.73	21%	79%	58%
		30	422	88	0.79	25%	84%	60%
		40	406	72	0.82	27%	87%	60%
		50	377	58	0.85	33%	90%	57%
		60	365	52	0.86	35%	91%	56%
		70	353	43	0.88	37%	92%	55%
		80	334	38	0.89	40%	93%	53%
		90	324	32	0.90	42%	94%	52%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-24	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/11/2023	0	528	518	0.02			
Test Duration (min.)	9	5	502	383	0.24			
Interelectrode Distance (cm)	0.5	10	466	208	0.55			
Flow Rate (gpm)	4.87	15	434	159	0.63			
Flow Rate (m ³ /hr)	1.106	20	412	127	0.69			
Voltage (V)	24	30	357	113	0.68			
Current (A)	4.4	40	362	71	0.80			
Kwh/m ³	0.095	50	352	62.6	0.82			
		60	367	52.9	0.86			
		70	342	49	0.86			
		80	335	38	0.89			
		90	306	34	0.89			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	529	520	0.02			
pH		5	487	350	0.28			
Conductivity (µs/cm)		10	476	205	0.57			
		15	456	158	0.65			
		20	395	125	0.68			
		30	395	92.9	0.76			
		40	365	78.7	0.78			
		50	344	54.8	0.84			
		60	348	52.1	0.85			
		70	362	47.5	0.87			
		80	310	40.5	0.87			
		90	312	35.3	0.89			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	544	503	0.08			
6		5	471	320	0.32			
9		10	375	207	0.45			
		15	423	152	0.64			
		20	417	123	0.71			
		30	367	92.8	0.75			
		40	340	81.9	0.76			
		50	347	64.4	0.81			
		60	351	55.9	0.84			
		70	350	48.8	0.86			
		80	317	39.9	0.87			
		90	303	36.9	0.88			
Avg Inflow Turbidity (NTU)	533.7	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	534	514	0.04	0%	4%	4%
		5	487	351	0.28	9%	34%	25%
		10	439	207	0.53	18%	61%	44%
		15	438	156	0.64	18%	71%	53%
		20	408	125	0.69	24%	77%	53%
		30	373	100	0.73	30%	81%	51%
		40	356	77	0.78	33%	86%	52%
		50	348	61	0.83	35%	89%	54%
		60	355	54	0.85	33%	90%	57%
		70	351	48	0.86	34%	91%	57%
		80	321	40	0.88	40%	93%	53%
		90	307	35	0.89	42%	93%	51%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype A-25	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/11/2023	0	634	620	0.02			
Test Duration (min.)	9	5	599	411	0.31			
Interelectrode Distance (cm)	0.5	10	592	225	0.62			
Flow Rate (gpm)	5.95	15	501	175	0.65			
Flow Rate (m ³ /hr)	1.351	20	468	154	0.67			
Voltage (V)	24	30	438	125	0.71			
Current (A)	4.2	40	403	96	0.76			
Kwh/m ³	0.075	50	425	71.8	0.83			
		60	382	67.6	0.82			
		70	402	55	0.86			
		80	347	50	0.86			
		90	356	49	0.86			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	645	643	0.00			
pH		5	591	368	0.38			
Conductivity (µs/cm)		10	502	230	0.54			
		15	537	180	0.66			
		20	466	145	0.69			
		30	442	121	0.73			
		40	408	96.4	0.76			
		50	406	78.7	0.81			
		60	379	70.9	0.81			
		70	390	57.8	0.85			
		80	385	49	0.87			
		90	364	50.7	0.86			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	584	607	-0.04			
6		5	572	373	0.35			
9		10	562	261	0.54			
		15	482	190	0.61			
		20	453	160	0.65			
		30	464	125	0.73			
		40	425	100	0.76			
		50	419	78.8	0.81			
		60	425	73.1	0.83			
		70	402	66.5	0.83			
		80	384	52.3	0.86			
		90	369	48.9	0.87			
Avg Inflow Turbidity (NTU)	621.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	621	623	0.00	0%	0%	0%
		5	587	384	0.35	5%	38%	33%
		10	552	239	0.57	11%	62%	50%
		15	507	182	0.64	18%	71%	52%
		20	462	153	0.67	26%	75%	50%
		30	448	124	0.72	28%	80%	52%
		40	412	98	0.76	34%	84%	51%
		50	417	76	0.82	33%	88%	55%
		60	395	71	0.82	36%	89%	52%
		70	398	60	0.85	36%	90%	54%
		80	372	50	0.86	40%	92%	52%
		90	363	49	0.86	42%	92%	50%

Table 1a: Test Information		Sample A (3 min.)					
Test ID	Prototype B-27	Time (min.)	A - Control	A - Treated	Treatment Ratio	TR- Treated	
Date	10/16/2023	0	638	616	0.03	7%	
Test Duration (min.)	9	5	575	484	0.16	27%	
Interelectrode Distance (cm)	0.5	10	529	334	0.37	50%	
Flow Rate (gpm)	4.00	15	529	254	0.52	62%	
Flow Rate (m ³ /hr)	0.908	20	497	190	0.62	71.33%	
Voltage (V)	12	30	503	156	0.69	76%	
Current (A)	2.1	40	448	124	0.72	81%	
Kwh/m ³	0.028	50	431	90.4	0.79	86%	
		60	435	81.9	0.81	88%	
		70	416	80	0.81	88%	
		80	375	70	0.81	89%	
		90	394	64	0.84	90%	
Table 1b: Initial Measurements		Sample B (6 min.)					
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio	TR- Treated	
Current (A) [Dial]		0	682	618	0.09	7%	
pH		5	603	429	0.29	35%	
Conductivity (µs/cm)		10	542	330	0.39	50%	
		15	514	264	0.49	60%	
		20	502	195	0.61	70.57%	
		30	472	150	0.68	77%	
		40	477	120	0.75	82%	
		50	391	104	0.73	84%	
		60	409	94.2	0.77	86%	
		70	414	75.3	0.82	89%	
		80	393	74.4	0.81	89%	
		90	401	63.4	0.84	90%	
Table 1c: Current vs Time		Sample C (9 min.)					
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio	TR- Treated	
3		0	668	637	0.05	4%	
6		5	613	495	0.19	25%	
9		10	530	392	0.26	41%	
		15	565	242	0.57	63%	
		20	512	198	0.61	70.12%	
		30	501	149	0.70	78%	
		40	501	129	0.74	81%	
		50	461	108	0.77	84%	
		60	459	85.4	0.81	87%	
		70	417	83.7	0.80	87%	
		80	388	74.1	0.81	89%	
		90	409	63.8	0.84	90%	
Avg Inflow Turbidity (NTU)	662.7	Average				Turbidity Reduction	
		Time (min.)	Avg. - Control	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated
		0	663	624	0.06	0%	6%
		5	597	469	0.21	10%	29%
		10	534	352	0.34	19%	47%
		15	536	253	0.53	19%	62%
		20	504	194	0.61	24%	71%
		30	492	152	0.69	26%	77%
		40	475	124	0.74	28%	81%
		50	428	101	0.76	35%	85%
		60	434	87	0.80	34%	87%
		70	416	80	0.81	37%	88%
		80	385	73	0.81	42%	89%
		90	401	64	0.84	39%	90%
						TR Difference	
							6%
							19%
							27%
							43%
							47%
							51%
							53%
							49%
							52%
							51%
							47%
							51%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-28	Time (min.)	A - Control	A - Treated	Treatment Ratio	TR- Treated		
Date	10/16/2023	0	610	548	0.10	8%		
Test Duration (min.)	9	5	538	457	0.15	23%		
Interelectrode Distance (cm)	0.5	10	541	319	0.41	47%		
Flow Rate (gpm)	5.96	15	489	256	0.48	57%		
Flow Rate (m ³ /hr)	1.354	20	516	200	0.61	66.48%		
Voltage (V)	12	30	417	161	0.61	73%		
Current (A)	2.1	40	394	135	0.66	77%		
Kwh/m ³	0.019	50	387	100	0.74	83%		
		60	372	94.5	0.75	84%		
		70	351	90	0.74	85%		
		80	347	79	0.77	87%		
		90	338	80	0.76	87%		
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio	TR- Treated		
Current (A) [Dial]		0	590	540	0.08	9%		
pH		5	532	441	0.17	26%		
Conductivity (µs/cm)		10	481	254	0.47	57%		
		15	438	185	0.58	69%		
		20	466	170	0.64	71.51%		
		30	436	162	0.63	73%		
		40	399	118	0.70	80%		
		50	395	108	0.73	82%		
		60	365	82.7	0.77	86%		
		70	364	84.8	0.77	86%		
		80	352	76.5	0.78	87%		
		90	362	72.9	0.80	88%		
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio	TR- Treated		
3		0	590	529	0.10	11%		
6		5	495	433	0.13	27%		
9		10	483	310	0.36	48%		
		15	458	253	0.45	58%		
		20	440	202	0.54	66.15%		
		30	416	158	0.62	74%		
		40	361	131	0.64	78%		
		50	358	113	0.68	81%		
		60	346	91.5	0.74	85%		
		70	348	92	0.74	85%		
		80	326	86.4	0.73	86%		
		90	330	75.8	0.77	87%		
Avg Inflow Turbidity (NTU)	596.7	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	597	539	0.10	0%	10%	10%
		5	522	444	0.15	13%	26%	13%
		10	502	294	0.41	16%	51%	35%
		15	462	231	0.50	23%	61%	39%
		20	474	191	0.60	21%	68%	47%
		30	423	160	0.62	29%	73%	44%
		40	385	128	0.67	36%	79%	43%
		50	380	107	0.72	36%	82%	46%
		60	361	90	0.75	39%	85%	45%
		70	354	89	0.75	41%	85%	44%
		80	342	81	0.76	43%	87%	44%
		90	343	76	0.78	42%	87%	45%

Table 1a: Test Information		Sample A (3 min.)					
Test ID	Prototype B-29	Time (min.)	A - Control	A - Treated	Treatment Ratio	TR- Treated	
Date	10/16/2023	0	546	505	0.08	4%	
Test Duration (min.)	9	5	515	435	0.16	17%	
Interelectrode Distance (cm)	0.5	10	499	337	0.32	36%	
Flow Rate (gpm)	8.03	15	453	234	0.48	55%	
Flow Rate (m ³ /hr)	1.824	20	397	205	0.48	61.00%	
Voltage (V)	12	30	373	153	0.59	71%	
Current (A)	2.1	40	377	131	0.65	75%	
Kwh/m ³	0.014	50	360	115	0.68	78%	
		60	340	100	0.71	81%	
		70	324	89	0.73	83%	
		80	309	79	0.74	85%	
		90	316	77	0.76	85%	
Table 1b: Initial Measurements		Sample B (6 min.)					
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio	TR- Treated	
Current (A) [Dial]		0	531	526	0.01	0%	
pH		5	505	406	0.20	23%	
Conductivity (µs/cm)		10	416	301	0.28	43%	
		15	436	247	0.43	53%	
		20	385	204	0.47	61.19%	
		30	380	160	0.58	70%	
		40	373	124	0.67	76%	
		50	366	110	0.70	79%	
		60	337	99.4	0.71	81%	
		70	331	83.3	0.75	84%	
		80	299	78.3	0.74	85%	
		90	289	65.7	0.77	88%	
Table 1c: Current vs Time		Sample C (9 min.)					
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio	TR- Treated	
3		0	500	503	-0.01	4%	
6		5	489	414	0.15	21%	
9		10	441	311	0.29	41%	
		15	408	231	0.43	56%	
		20	374	197	0.47	62.52%	
		30	357	156	0.56	70%	
		40	333	137	0.59	74%	
		50	353	113	0.68	79%	
		60	321	105	0.67	80%	
		70	282	86.1	0.69	84%	
		80	291	75.8	0.74	86%	
		90	291	70.6	0.76	87%	
Avg Inflow Turbidity (NTU)	525.7	Average				Turbidity Reduction	
		Time (min.)	Avg. - Control	Avg. - Treated	Treatment Ratio	TR- Control	TR Difference
		0	526	511	0.03	0%	3%
		5	503	418	0.17	4%	16%
		10	452	316	0.30	14%	26%
		15	432	237	0.45	18%	37%
		20	385	202	0.48	27%	35%
		30	370	156	0.58	30%	41%
		40	361	131	0.64	31%	44%
		50	360	113	0.69	32%	47%
		60	333	101	0.69	37%	44%
		70	312	86	0.72	41%	43%
		80	300	78	0.74	43%	42%
		90	299	71	0.76	43%	43%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-30	Time (min.)	A - Control	A - Treated	Treatment Ratio	TR- Treated		
Date	10/16/2023	0	482	457	0.05	9%		
Test Duration (min.)	9	5	439	375	0.15	26%		
Interelectrode Distance (cm)	0.5	10	432	313	0.28	38%		
Flow Rate (gpm)	9.89	15	378	238	0.37	53%		
Flow Rate (m ³ /hr)	2.246	20	378	206	0.46	59.18%		
Voltage (V)	12	30	344	161	0.53	68%		
Current (A)	2.1	40	338	122	0.64	76%		
Kwh/m ³	0.011	50	309	110	0.64	78%		
		60	287	95.8	0.67	81%		
		70	286	83	0.71	84%		
		80	276	75	0.73	85%		
		90	269	68	0.75	87%		
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio	TR- Treated		
Current (A) [Dial]		0	513	483	0.06	4%		
pH		5	457	390	0.15	23%		
Conductivity (µs/cm)		10	402	299	0.26	41%		
		15	398	234	0.41	54%		
		20	350	195	0.44	61.36%		
		30	363	157	0.57	69%		
		40	333	125	0.62	75%		
		50	316	110	0.65	78%		
		60	318	100	0.69	80%		
		70	305	83.3	0.73	83%		
		80	271	68.2	0.75	86%		
		90	265	63.7	0.76	87%		
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio	TR- Treated		
3		0	519	490	0.06	3%		
6		5	453	381	0.16	25%		
9		10	429	284	0.34	44%		
		15	372	221	0.41	56%		
		20	372	194	0.48	61.56%		
		30	376	159	0.58	68%		
		40	339	126	0.63	75%		
		50	317	101	0.68	80%		
		60	279	87.4	0.69	83%		
		70	283	83.3	0.71	83%		
		80	273	66.6	0.76	87%		
		90	271	62.4	0.77	88%		
Avg Inflow Turbidity (NTU)	504.7	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	505	477	0.06	0%	6%	6%
		5	450	382	0.15	11%	24%	13%
		10	421	299	0.29	17%	41%	24%
		15	383	231	0.40	24%	54%	30%
		20	367	198	0.46	27%	61%	33%
		30	361	159	0.56	28%	68%	40%
		40	337	124	0.63	33%	75%	42%
		50	314	107	0.66	38%	79%	41%
		60	295	94	0.68	42%	81%	40%
		70	291	83	0.71	42%	84%	41%
		80	273	70	0.74	46%	86%	40%
		90	268	65	0.76	47%	87%	40%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-31	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/17/2023	0	764	551	0.28			
Test Duration (min.)	9	5	749	492	0.34			
Interelectrode Distance (cm)	0.5	10	674	254	0.62			
Flow Rate (gpm)	0.50	15	637	180	0.72			
Flow Rate (m ³ /hr)	0.113	20	582	134	0.77			
Voltage (V)	12	30	566	108	0.81			
Current (A)	2.1	40	548	82	0.85			
Kwh/m ³	0.223	50	490	67.7	0.86			
		60	493	59.7	0.88			
		70	485	53	0.89			
		80	848	44	0.95			
		90	459	43	0.91			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	825	574	0.30			
pH		5	707	536	0.24			
Conductivity (µs/cm)		10	667	256	0.62			
		15	623	161	0.74			
		20	616	129	0.79			
		30	572	107	0.81			
		40	591	87.8	0.85			
		50	546	68.3	0.87			
		60	495	57	0.88			
		70	498	50.9	0.90			
		80	470	45	0.90			
		90	457	41.9	0.91			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	794	568	0.28			
6		5	705	529	0.25			
9		10	663	273	0.59			
		15	638	167	0.74			
		20	607	131	0.78			
		30	599	106	0.82			
		40	580	87	0.85			
		50	519	64	0.88			
		60	512	54.4	0.89			
		70	473	50	0.89			
		80	459	45.2	0.90			
		90	463	43.7	0.91			
Avg Inflow Turbidity (NTU)	794.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Control	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	794	564	0.29	0%	29%	29%
		5	720	519	0.28	9%	35%	25%
		10	668	261	0.61	16%	67%	51%
		15	633	169	0.73	20%	79%	58%
		20	602	131	0.78	24%	83%	59%
		30	579	107	0.82	27%	87%	59%
		40	573	86	0.85	28%	89%	61%
		50	518	67	0.87	35%	92%	57%
		60	500	57	0.89	37%	93%	56%
		70	485	51	0.89	39%	94%	55%
		80	592	45	0.92	25%	94%	69%
		90	460	43	0.91	42%	95%	52%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-32	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/17/2023	0	744	647	0.13			
Test Duration (min.)	9	5	749	513	0.32			
Interelectrode Distance (cm)	0.5	10	708	259	0.63			
Flow Rate (gpm)	1.04	15	676	186	0.72			
Flow Rate (m ³ /hr)	0.236	20	648	150	0.77			
Voltage (V)	12	30	580	121	0.79			
Current (A)	2.1	40	589	95	0.84			
Kwh/m ³	0.107	50	529	87.1	0.84			
		60	535	76.4	0.86			
		70	489	68	0.86			
		80	514	64	0.88			
		90	478	51	0.89			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	792	639	0.19			
pH		5	754	539	0.29			
Conductivity (µs/cm)		10	696	280	0.60			
		15	678	213	0.69			
		20	583	161	0.72			
		30	623	123	0.80			
		40	556	93.6	0.83			
		50	583	81.2	0.86			
		60	521	69.7	0.87			
		70	480	63	0.87			
		80	493	61	0.88			
		90	473	55.2	0.88			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	790	650	0.18			
6		5	712	479	0.33			
9		10	664	240	0.64			
		15	638	180	0.72			
		20	642	154	0.76			
		30	623	117	0.81			
		40	519	92.1	0.82			
		50	543	76.2	0.86			
		60	528	69.6	0.87			
		70	490	64.6	0.87			
		80	470	56	0.88			
		90	498	51.3	0.90			
Avg Inflow Turbidity (NTU)	775.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	775	645	0.17	0%	17%	17%
		5	738	510	0.31	5%	34%	29%
		10	689	260	0.62	11%	67%	55%
		15	664	193	0.71	14%	75%	61%
		20	624	155	0.75	19%	80%	61%
		30	609	120	0.80	21%	84%	63%
		40	555	93	0.83	28%	88%	59%
		50	552	82	0.85	29%	89%	61%
		60	528	72	0.86	32%	91%	59%
		70	486	65	0.87	37%	92%	54%
		80	492	60	0.88	37%	92%	56%
		90	483	53	0.89	38%	93%	56%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-33	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/18/2023	0	1383	1062	0.23			
Test Duration (min.)	9	5	1503	1013	0.33			
Interelectrode Distance (cm)	0.5	10	1253	518	0.59			
Flow Rate (gpm)	0.50	15	1240	363	0.71			
Flow Rate (m ³ /hr)	0.114	20	1158	279	0.76			
Voltage (V)	6	30	1153	206	0.82			
Current (A)	1	40	1073	169	0.84			
Kwh/m ³	0.053	50	1015	153	0.85			
		60	985	136	0.86			
		70	943	115	0.88			
		80	933	109	0.88			
		90	907	106	0.88			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	1489	1053	0.29			
pH		5	1320	975	0.26			
Conductivity (µs/cm)		10	1347	476	0.65			
		15	1248	354	0.72			
		20	1248	264	0.79			
		30	1146	205	0.82			
		40	1128	183	0.84			
		50	998	153	0.85			
		60	1017	130	0.87			
		70	949	119	0.87			
		80	913	110	0.88			
		90	925	102	0.89			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	1483	1111	0.25			
6		5	1423	914	0.36			
9		10	1225	504	0.59			
		15	1227	332	0.73			
		20	1239	272	0.78			
		30	1042	196	0.81			
		40	1029	162	0.84			
		50	1083	138	0.87			
		60	959	125	0.87			
		70	1028	116	0.89			
		80	957	107	0.89			
		90	942	96.9	0.90			
Avg Inflow Turbidity (NTU)	1451.7	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	1452	1075	0.26	0%	26%	26%
		5	1415	967	0.32	3%	33%	31%
		10	1275	499	0.61	12%	66%	53%
		15	1238	350	0.72	15%	76%	61%
		20	1215	272	0.78	16%	81%	65%
		30	1114	202	0.82	23%	86%	63%
		40	1077	171	0.84	26%	88%	62%
		50	1032	148	0.86	29%	90%	61%
		60	987	130	0.87	32%	91%	59%
		70	973	117	0.88	33%	92%	59%
		80	934	109	0.88	36%	93%	57%
		90	925	102	0.89	36%	93%	57%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-33.2	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/18/2023	0	716	545	0.24			
Test Duration (min.)	9	5	688	523	0.24			
Interelectrode Distance (cm)	0.5	10	647	369	0.43			
Flow Rate (gpm)	0.53	15	625	258	0.59			
Flow Rate (m ³ /hr)	0.120	20	571	199	0.65			
Voltage (V)	6	30	580	153	0.74			
Current (A)	1	40	545	136	0.75			
Kwh/m ³	0.050	50	532	115	0.78			
		60	513	96.4	0.81			
		70	483	85	0.82			
		80	518	78	0.85			
		90	505	70	0.86			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	657	581	0.12			
pH		5	603	537	0.11			
Conductivity (µs/cm)		10	633	404	0.36			
		15	575	283	0.51			
		20	593	211	0.64			
		30	583	166	0.72			
		40	559	137	0.75			
		50	508	124	0.76			
		60	521	179	0.66			
		70	495	91	0.82			
		80	499	90.6	0.82			
		90	496	77.9	0.84			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	591	566	0.04			
6		5	625	542	0.13			
9		10	607	408	0.33			
		15	574	298	0.48			
		20	604	221	0.63			
		30	546	173	0.68			
		40	527	144	0.73			
		50	548	112	0.80			
		60	503	97.6	0.81			
		70	514	88.6	0.83			
		80	494	79.1	0.84			
		90	509	73.8	0.86			
Avg Inflow Turbidity (NTU)	654.7	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	655	564	0.14	0%	14%	14%
		5	639	534	0.16	2%	18%	16%
		10	629	394	0.37	4%	40%	36%
		15	591	280	0.53	10%	57%	48%
		20	589	210	0.64	10%	68%	58%
		30	570	164	0.71	13%	75%	62%
		40	544	139	0.74	17%	79%	62%
		50	529	117	0.78	19%	82%	63%
		60	512	124	0.76	22%	81%	59%
		70	497	88	0.82	24%	87%	63%
		80	504	83	0.84	23%	87%	64%
		90	503	74	0.85	23%	89%	66%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-34	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/18/2023	0	706	610	0.14			
Test Duration (min.)	9	5	688	611	0.11			
Interelectrode Distance (cm)	0.5	10	629	492	0.22			
Flow Rate (gpm)	2.02	15	625	363	0.42			
Flow Rate (m ³ /hr)	0.459	20	583	312	0.46			
Voltage (V)	6	30	537	249	0.54			
Current (A)	1	40	552	175	0.68			
Kwh/m ³	0.013	50	532	167	0.69			
		60	511	145	0.72			
		70	530	129	0.76			
		80	507	121	0.76			
		90	501	117	0.77			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	693	621	0.10			
pH		5	650	590	0.09			
Conductivity (µs/cm)		10	567	471	0.17			
		15	637	364	0.43			
		20	575	290	0.50			
		30	570	226	0.60			
		40	555	101	0.82			
		50	519	157	0.70			
		60	520	133	0.74			
		70	506	122	0.76			
		80	469	115	0.75			
		90	516	101	0.80			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	694	669	0.04			
6		5	669	591	0.12			
9		10	646	471	0.27			
		15	593	332	0.44			
		20	574	300	0.48			
		30	530	218	0.59			
		40	520	171	0.67			
		50	526	151	0.71			
		60	527	132	0.75			
		70	472	119	0.75			
		80	499	108	0.78			
		90	460	100	0.78			
Avg Inflow Turbidity (NTU)	697.7	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	698	633	0.09	0%	9%	9%
		5	669	597	0.11	4%	14%	10%
		10	614	478	0.22	12%	31%	19%
		15	618	353	0.43	11%	49%	38%
		20	577	301	0.48	17%	57%	40%
		30	546	231	0.58	22%	67%	45%
		40	542	149	0.73	22%	79%	56%
		50	526	158	0.70	25%	77%	53%
		60	519	137	0.74	26%	80%	55%
		70	503	123	0.75	28%	82%	54%
		80	492	115	0.77	30%	84%	54%
		90	492	106	0.78	29%	85%	55%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-35	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/18/2023	0	626	629	0.00			
Test Duration (min.)	9	5	614	551	0.10			
Interelectrode Distance (cm)	0.5	10	563	507	0.10			
Flow Rate (gpm)	4.37	15	573	444	0.23			
Flow Rate (m ³ /hr)	0.993	20	509	379	0.26			
Voltage (V)	6	30	488	324	0.34			
Current (A)	1	40	486	275	0.43			
Kwh/m ³	0.006	50	457	240	0.47			
		60	438	210	0.52			
		70	449	201	0.55			
		80	428	171	0.60			
		90	421	165	0.61			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	629	601	0.04			
pH		5	603	560	0.07			
Conductivity (µs/cm)		10	584	455	0.22			
		15	593	380	0.36			
		20	504	363	0.28			
		30	506	278	0.45			
		40	508	227	0.55			
		50	493	200	0.59			
		60	455	177	0.61			
		70	427	168	0.61			
		80	450	163	0.64			
		90	428	147	0.66			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	633	600	0.05			
6		5	609	559	0.08			
9		10	574	465	0.19			
		15	537	386	0.28			
		20	538	345	0.36			
		30	496	217	0.56			
		40	454	186	0.59			
		50	480	180	0.63			
		60	475	177	0.63			
		70	471	151	0.68			
		80	448	140	0.69			
		90	411	131	0.68			
Avg Inflow Turbidity (NTU)	629.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	629	610	0.03	0%	3%	3%
		5	609	557	0.09	3%	12%	8%
		10	574	476	0.17	9%	24%	16%
		15	568	403	0.29	10%	36%	26%
		20	517	362	0.30	18%	42%	25%
		30	497	273	0.45	21%	57%	36%
		40	483	229	0.52	23%	64%	40%
		50	477	207	0.57	24%	67%	43%
		60	456	188	0.59	28%	70%	43%
		70	449	173	0.61	29%	72%	44%
		80	442	158	0.64	30%	75%	45%
		90	420	148	0.65	33%	77%	43%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-36	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/18/2023	0	631	553	0.12			
Test Duration (min.)	9	5	568	540	0.05			
Interelectrode Distance (cm)	0.5	10	538	526	0.02			
Flow Rate (gpm)	5.72	15	522	443	0.15			
Flow Rate (m ³ /hr)	1.299	20	502	394	0.22			
Voltage (V)	6	30	505	314	0.38			
Current (A)	1	40	479	272	0.43			
Kwh/m ³	0.005	50	476	237	0.50			
		60	436	212	0.51			
		70	408	205	0.50			
		80	432	176	0.59			
		90	398	168	0.58			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	602	577	0.04			
pH		5	546	535	0.02			
Conductivity (µs/cm)		10	537	494	0.08			
		15	523	403	0.23			
		20	514	374	0.27			
		30	441	305	0.31			
		40	468	264	0.44			
		50	469	230	0.51			
		60	426	203	0.52			
		70	424	180	0.58			
		80	394	172	0.56			
		90	373	155	0.58			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	585	540	0.08			
6		5	579	523	0.10			
9		10	529	472	0.11			
		15	504	371	0.26			
		20	472	353	0.25			
		30	464	290	0.38			
		40	469	246	0.48			
		50	409	213	0.48			
		60	403	183	0.55			
		70	395	163	0.59			
		80	400	160	0.60			
		90	379	145	0.62			
Avg Inflow Turbidity (NTU)	606.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	606	557	0.08	0%	8%	8%
		5	564	533	0.06	7%	12%	5%
		10	535	497	0.07	12%	18%	6%
		15	516	406	0.21	15%	33%	18%
		20	496	374	0.25	18%	38%	20%
		30	470	303	0.36	22%	50%	28%
		40	472	261	0.45	22%	57%	35%
		50	451	227	0.50	26%	63%	37%
		60	422	199	0.53	30%	67%	37%
		70	409	183	0.55	33%	70%	37%
		80	409	169	0.59	33%	72%	39%
		90	383	156	0.59	37%	74%	38%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-37	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/18/2023	0	551	542	0.02			
Test Duration (min.)	9	5	535	503	0.06			
Interelectrode Distance (cm)	0.5	10	497	435	0.12			
Flow Rate (gpm)	7.96	15	488	375	0.23			
Flow Rate (m ³ /hr)	1.808	20	476	357	0.25			
Voltage (V)	6	30	457	301	0.34			
Current (A)	1	40	414	257	0.38			
Kwh/m ³	0.003	50	408	207	0.49			
		60	392	198	0.49			
		70	377	172	0.54			
		80	374	168	0.55			
		90	389	153	0.61			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	600	534	0.11			
pH		5	546	518	0.05			
Conductivity (µs/cm)		10	497	435	0.12			
		15	483	360	0.25			
		20	440	317	0.28			
		30	447	272	0.39			
		40	408	224	0.45			
		50	387	193	0.50			
		60	381	171	0.55			
		70	370	168	0.55			
		80	366	155	0.58			
		90	342	142	0.58			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	549	551	0.00			
6		5	544	497	0.09			
9		10	476	405	0.15			
		15	477	342	0.28			
		20	460	310	0.33			
		30	425	273	0.36			
		40	413	217	0.47			
		50	390	174	0.55			
		60	362	179	0.51			
		70	376	168	0.55			
		80	357	153	0.57			
		90	360	138	0.62			
Avg Inflow Turbidity (NTU)	566.7	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	567	542	0.04	0%	4%	4%
		5	542	506	0.07	4%	11%	6%
		10	490	425	0.13	14%	25%	11%
		15	483	359	0.26	15%	37%	22%
		20	459	328	0.28	19%	42%	23%
		30	443	282	0.36	22%	50%	28%
		40	412	233	0.43	27%	59%	32%
		50	395	191	0.52	30%	66%	36%
		60	378	183	0.52	33%	68%	35%
		70	374	169	0.55	34%	70%	36%
		80	366	159	0.57	35%	72%	37%
		90	364	144	0.60	36%	75%	39%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-38	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/18/2023	0	661	600	0.09			
Test Duration (min.)	9	5	553	512	0.07			
Interelectrode Distance (cm)	0.5	10	502	454	0.10			
Flow Rate (gpm)	10.09	15	493	406	0.18			
Flow Rate (m ³ /hr)	2.292	20	433	377	0.13			
Voltage (V)	6	30	446	323	0.28			
Current (A)	1	40	432	286	0.34			
Kwh/m ³	0.003	50	407	252	0.38			
		60	405	226	0.44			
		70	367	212	0.42			
		80	363	195	0.46			
		90	357	189	0.47			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	658	634	0.04			
pH		5	596	571	0.04			
Conductivity (µs/cm)		10	546	492	0.10			
		15	500	399	0.20			
		20	491	358	0.27			
		30	440	309	0.30			
		40	430	288	0.33			
		50	435	256	0.41			
		60	400	245	0.39			
		70	391	199	0.49			
		80	409	194	0.53			
		90	384	178	0.54			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	679	477	0.30			
6		5	600	469	0.22			
9		10	586	471	0.20			
		15	511	453	0.11			
		20	508	423	0.17			
		30	446	352	0.21			
		40	466	291	0.38			
		50	449	269	0.40			
		60	434	245	0.44			
		70	414	194	0.53			
		80	396	196	0.51			
		90	408	183	0.55			
Avg Inflow Turbidity (NTU)	666.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	666	570	0.14	0%	14%	14%
		5	583	517	0.11	12%	22%	10%
		10	545	472	0.13	18%	29%	11%
		15	501	419	0.16	25%	37%	12%
		20	477	386	0.19	28%	42%	14%
		30	444	328	0.26	33%	51%	17%
		40	443	288	0.35	34%	57%	23%
		50	430	259	0.40	35%	61%	26%
		60	413	239	0.42	38%	64%	26%
		70	391	202	0.48	41%	70%	28%
		80	389	195	0.50	42%	71%	29%
		90	383	183	0.52	42%	72%	30%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-39	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/18/2023	0	636	388	0.39			
Test Duration (min.)	9	5	623	261	0.58			
Interelectrode Distance (cm)	0.5	10	580	126	0.78			
Flow Rate (gpm)	0.50	15	570	93	0.84			
Flow Rate (m ³ /hr)	0.114	20	530	85	0.84			
Voltage (V)	24	30	473	65	0.86			
Current (A)	4.6	40	424	50	0.88			
Kwh/m ³	0.972	50	435	44.6	0.90			
		60	407	34.2	0.92			
		70	390	31	0.92			
		80	361	24	0.93			
		90	360	22	0.94			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	683	368	0.46			
pH		5	652	238	0.63			
Conductivity (µs/cm)		10	597	130	0.78			
		15	546	94.4	0.83			
		20	505	79.6	0.84			
		30	477	63.7	0.87			
		40	481	51.8	0.89			
		50	428	43.2	0.90			
		60	408	37.1	0.91			
		70	414	31	0.93			
		80	400	25.8	0.94			
		90	375	23.7	0.94			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	665	348	0.48			
6		5	649	260	0.60			
9		10	609	125	0.79			
		15	566	86	0.85			
		20	570	73.5	0.87			
		30	481	62.9	0.87			
		40	446	51	0.89			
		50	443	37	0.92			
		60	445	37.9	0.91			
		70	436	30.1	0.93			
		80	386	27.5	0.93			
		90	380	23.5	0.94			
Avg Inflow Turbidity (NTU)	661.3	Average			Turbidity Reduction			
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	661	368	0.44	0%	44%	44%
		5	641	253	0.61	3%	62%	59%
		10	595	127	0.79	10%	81%	71%
		15	561	91	0.84	15%	86%	71%
		20	535	79	0.85	19%	88%	69%
		30	477	64	0.87	28%	90%	62%
		40	450	51	0.89	32%	92%	60%
		50	435	42	0.90	34%	94%	60%
		60	420	36	0.91	36%	94%	58%
		70	413	31	0.93	38%	95%	58%
		80	382	26	0.93	42%	96%	54%
		90	372	23	0.94	44%	97%	53%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-40	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/18/2023	0	689	614	0.11			
Test Duration (min.)	9	5	635	325	0.49			
Interelectrode Distance (cm)	0.5	10	584	171	0.71			
Flow Rate (gpm)	2.02	15	536	120	0.78			
Flow Rate (m ³ /hr)	0.459	20	515	100	0.81			
Voltage (V)	24	30	514	75	0.85			
Current (A)	5	40	419	44	0.89			
Kwh/m ³	0.262	50	462	50.8	0.89			
		60	442	50.9	0.88			
		70	413	36	0.91			
		80	403	34	0.92			
		90	379	30	0.92			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	717	629	0.12			
pH		5	650	355	0.45			
Conductivity (µs/cm)		10	572	159	0.72			
		15	554	129	0.77			
		20	529	103	0.81			
		30	502	94.7	0.81			
		40	487	86.1	0.82			
		50	462	68.2	0.85			
		60	442	53	0.88			
		70	400	39.1	0.90			
		80	396	36.9	0.91			
		90	408	32	0.92			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	607	635	-0.05			
6		5	569	117	0.79			
9		10	540	91.2	0.83			
		15	466	81	0.83			
		20	469	64.8	0.86			
		30	450	53	0.88			
		40	445	44.3	0.90			
		50	442	50.9	0.88			
		60	435	45	0.90			
		70	427	40.1	0.91			
		80	402	36.8	0.91			
		90	400	31.7	0.92			
Avg Inflow Turbidity (NTU)	671.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	671	626	0.07	0%	7%	7%
		5	618	266	0.57	8%	60%	53%
		10	565	140	0.75	16%	79%	63%
		15	519	110	0.79	23%	84%	61%
		20	504	89	0.82	25%	87%	62%
		30	489	74	0.85	27%	89%	62%
		40	450	58	0.87	33%	91%	58%
		50	455	57	0.88	32%	92%	59%
		60	440	50	0.89	34%	93%	58%
		70	413	38	0.91	38%	94%	56%
		80	400	36	0.91	40%	95%	54%
		90	396	31	0.92	41%	95%	54%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-41	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/18/2023	0	646	643	0.00			
Test Duration (min.)	9	5	618	391	0.37			
Interelectrode Distance (cm)	0.5	10	601	209	0.65			
Flow Rate (gpm)	5.86	15	531	163	0.69			
Flow Rate (m ³ /hr)	1.331	20	513	128	0.75			
Voltage (V)	24	30	498	97	0.81			
Current (A)	4.7	40	475	80	0.83			
Kwh/m ³	0.085	50	452	66.7	0.85			
		60	431	56.1	0.87			
		70	409	53	0.87			
		80	417	45	0.89			
		90	402	40	0.90			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	658	626	0.05			
pH		5	616	353	0.43			
Conductivity (µs/cm)		10	588	242	0.59			
		15	529	155	0.71			
		20	538	147	0.73			
		30	468	109	0.77			
		40	462	92.6	0.80			
		50	428	76.2	0.82			
		60	423	64.7	0.85			
		70	414	58.6	0.86			
		80	393	47.9	0.88			
		90	392	44.3	0.89			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	686	630	0.08			
6		5	610	386	0.37			
9		10	520	189	0.64			
		15	524	146	0.72			
		20	476	106	0.78			
		30	465	95	0.80			
		40	498	81.1	0.84			
		50	450	69.7	0.85			
		60	434	62.4	0.86			
		70	432	52.5	0.88			
		80	404	46	0.89			
		90	360	41.9	0.88			
Avg Inflow Turbidity (NTU)	663.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	663	633	0.05	0%	5%	5%
		5	615	377	0.39	7%	43%	36%
		10	570	213	0.63	14%	68%	54%
		15	528	155	0.71	20%	77%	56%
		20	509	127	0.75	23%	81%	58%
		30	477	100	0.79	28%	85%	57%
		40	478	85	0.82	28%	87%	59%
		50	443	71	0.84	33%	89%	56%
		60	429	61	0.86	35%	91%	56%
		70	418	55	0.87	37%	92%	55%
		80	405	46	0.89	39%	93%	54%
		90	385	42	0.89	42%	94%	52%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-42	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/20/2023	0	602	579	0.04			
Test Duration (min.)	9	5	499	386	0.23			
Interelectrode Distance (cm)	0.5	10	535	283	0.47			
Flow Rate (gpm)	7.91	15	483	207	0.57			
Flow Rate (m ³ /hr)	1.797	20	469	166	0.65			
Voltage (V)	24	30	417	130	0.69			
Current (A)	4.6	40	410	105	0.74			
Kwh/m ³	0.061	50	417	87.6	0.79			
		60	404	72.8	0.82			
		70	354	68	0.81			
		80	378	57	0.85			
		90	365	55	0.85			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	605	564	0.07			
pH		5	511	441	0.14			
Conductivity (µs/cm)		10	499	301	0.40			
		15	482	223	0.54			
		20	446	167	0.63			
		30	429	126	0.71			
		40	399	101	0.75			
		50	379	90	0.76			
		60	381	78.4	0.79			
		70	366	63.7	0.83			
		80	345	62.8	0.82			
		90	350	57.3	0.84			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	585	576	0.02			
6		5	547	448	0.18			
9		10	481	281	0.42			
		15	451	183	0.59			
		20	425	162	0.62			
		30	411	121	0.71			
		40	392	95.2	0.76			
		50	367	75	0.80			
		60	362	71.2	0.80			
		70	350	65.7	0.81			
		80	365	55.4	0.85			
		90	336	49.1	0.85			
Avg Inflow Turbidity (NTU)	597.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	597	573	0.04	0%	4%	4%
		5	519	425	0.18	13%	29%	16%
		10	505	288	0.43	15%	52%	36%
		15	472	204	0.57	21%	66%	45%
		20	447	165	0.63	25%	72%	47%
		30	419	126	0.70	30%	79%	49%
		40	400	100	0.75	33%	83%	50%
		50	388	84	0.78	35%	86%	51%
		60	382	74	0.81	36%	88%	52%
		70	357	66	0.82	40%	89%	49%
		80	363	58	0.84	39%	90%	51%
		90	350	54	0.85	41%	91%	50%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype B-43	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	10/20/2023	0	553	565	-0.02			
Test Duration (min.)	9	5	538	429	0.20			
Interelectrode Distance (cm)	0.5	10	475	305	0.36			
Flow Rate (gpm)	9.94	15	465	210	0.55			
Flow Rate (m ³ /hr)	2.258	20	432	181	0.58			
Voltage (V)	24	30	403	127	0.68			
Current (A)	4.8	40	389	104	0.73			
Kwh/m ³	0.051	50	359	79.7	0.78			
		60	372	80	0.78			
		70	349	68	0.80			
		80	337	63	0.81			
		90	324	55	0.83			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	572	547	0.04			
pH		5	536	397	0.26			
Conductivity (µs/cm)		10	497	272	0.45			
		15	470	206	0.56			
		20	435	171	0.61			
		30	412	120	0.71			
		40	410	98.1	0.76			
		50	385	89.1	0.77			
		60	363	76.6	0.79			
		70	339	66.2	0.80			
		80	344	60.9	0.82			
		90	302	58.7	0.81			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	592	575	0.03			
6		5	529	422	0.20			
9		10	480	271	0.44			
		15	462	185	0.60			
		20	398	159	0.60			
		30	392	116	0.70			
		40	372	85.8	0.77			
		50	343	80.4	0.77			
		60	361	72.4	0.80			
		70	340	60	0.82			
		80	326	56.4	0.83			
		90	318	49.5	0.84			
Avg Inflow Turbidity (NTU)	572.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	572	562	0.02	0%	2%	2%
		5	534	416	0.22	7%	27%	21%
		10	484	283	0.42	15%	51%	35%
		15	466	200	0.57	19%	65%	46%
		20	422	170	0.60	26%	70%	44%
		30	402	121	0.70	30%	79%	49%
		40	390	96	0.75	32%	83%	51%
		50	362	83	0.77	37%	85%	49%
		60	365	76	0.79	36%	87%	50%
		70	343	65	0.81	40%	89%	49%
		80	336	60	0.82	41%	90%	48%
		90	315	54	0.83	45%	91%	45%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype C-44	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	11/2/2023	0	736	485	0.34			
Test Duration (min.)	N/A	5	744	331	0.56			
Interelectrode Distance (cm)	0.5	10	676	158	0.77			
Flow Rate (gpm)	0.95	15	582	118	0.80			
Flow Rate (m ³ /hr)	0.216	20	593	85	0.86			
Voltage (V)	12	30	501	69	0.86			
Current (A)	11.7	40	528	53	0.90			
Kwh/m ³	0.651	50	480	43	0.91			
		60	460	42	0.91			
		70	447	41	0.91			
		80	435	36	0.92			
		90	449	34	0.92			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0			#DIV/0!			
pH		5			#DIV/0!			
Conductivity (µs/cm)		10			#DIV/0!			
		15			#DIV/0!			
		20			#DIV/0!			
		30			#DIV/0!			
		40			#DIV/0!			
		50			#DIV/0!			
		60			#DIV/0!			
		70			#DIV/0!			
		80			#DIV/0!			
		90			#DIV/0!			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0			#DIV/0!			
6		5			#DIV/0!			
9		10			#DIV/0!			
		15			#DIV/0!			
		20			#DIV/0!			
		30			#DIV/0!			
		40			#DIV/0!			
		50			#DIV/0!			
		60			#DIV/0!			
		70			#DIV/0!			
		80			#DIV/0!			
		90			#DIV/0!			
Avg Inflow Turbidity (NTU)	736.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	736	485	0.34	0%	34%	34%
		5	744	331	0.56	-1%	55%	56%
		10	676	158	0.77	8%	79%	70%
		15	582	118	0.80	21%	84%	63%
		20	593	85	0.86	19%	89%	69%
		30	501	69	0.86	32%	91%	59%
		40	528	53	0.90	28%	93%	65%
		50	480	43	0.91	35%	94%	59%
		60	460	42	0.91	38%	94%	57%
		70	447	41	0.91	39%	94%	55%
		80	435	36	0.92	41%	95%	54%
		90	449	34	0.92	39%	95%	56%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype C-45	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	11/2/2023	0	763	721	0.06			
Test Duration (min.)	N/A	5	753	567	0.25			
Interelectrode Distance (cm)	0.5	10	653	308	0.53			
Flow Rate (gpm)	11.96	15	640	229	0.64			
Flow Rate (m ³ /hr)	2.716	20	615	178	0.71			
Voltage (V)	12	30	532	123	0.77			
Current (A)	13.2	40	520	123	0.76			
Kwh/m ³	0.058	50	506	102	0.80			
		60	502	79.8	0.84			
		70	457	74	0.84			
		80	448	66	0.85			
		90	438	63	0.86			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0			#DIV/0!			
pH		5			#DIV/0!			
Conductivity (µs/cm)		10			#DIV/0!			
		15			#DIV/0!			
		20			#DIV/0!			
		30			#DIV/0!			
		40			#DIV/0!			
		50			#DIV/0!			
		60			#DIV/0!			
		70			#DIV/0!			
		80			#DIV/0!			
		90			#DIV/0!			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0			#DIV/0!			
6		5			#DIV/0!			
9		10			#DIV/0!			
		15			#DIV/0!			
		20			#DIV/0!			
		30			#DIV/0!			
		40			#DIV/0!			
		50			#DIV/0!			
		60			#DIV/0!			
		70			#DIV/0!			
		80			#DIV/0!			
		90			#DIV/0!			
Avg Inflow Turbidity (NTU)	763.0	Average		Turbidity Reduction				
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	763	721	0.06	0%	6%	6%
		5	753	567	0.25	1%	26%	24%
		10	653	308	0.53	14%	60%	45%
		15	640	229	0.64	16%	70%	54%
		20	615	178	0.71	19%	77%	57%
		30	532	123	0.77	30%	84%	54%
		40	520	123	0.76	32%	84%	52%
		50	506	102	0.80	34%	87%	53%
		60	502	80	0.84	34%	90%	55%
		70	457	74	0.84	40%	90%	50%
		80	448	66	0.85	41%	91%	50%
		90	438	63	0.86	43%	92%	49%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype C-46	Time (min.)	A - Control	A - Treated	Treatment Ratio	TR- Treated		
Date	11/2/2023	0	649	152	0.77	78%		
Test Duration (min.)	N/a	5	651	139	0.79	80%		
Interelectrode Distance (cm)	0.5	10	613	72	0.88	89%		
Flow Rate (gpm)	0.48	15	563	56	0.90	92%		
Flow Rate (m ³ /hr)	0.109	20	547	47	0.91	93.14%		
Voltage (V)	12	30	527	37	0.93	95%		
Current (A)	8.7	40	471	33	0.93	95%		
Kwh/m ³	0.958	50	497	26.7	0.95	96%		
		60	496	26	0.95	96%		
		70	429	26	0.94	96%		
		80			#DIV/0!	100%		
		90	422	21	0.95	97%		
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio	TR- Treated		
Current (A) [Dial]		0	692	184	0.73	73%		
pH		5	675	148	0.78	78%		
Conductivity (µs/cm)		10	622	72.8	0.88	89%		
		15	603	51.6	0.91	92%		
		20	574	41.9	0.93	93.83%		
		30	538	34.3	0.94	95%		
		40	500	32.6	0.93	95%		
		50	514	25.4	0.95	96%		
		60	464	21.5	0.95	97%		
		70	435	20.6	0.95	97%		
		80	443	18.5	0.96	97%		
		90	432	16.9	0.96	98%		
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio	TR- Treated		
3		0	697	309	0.56	55%		
6		5	691	95.6	0.86	86%		
9		10	651	60.5	0.91	91%		
		15	592	47.6	0.92	93%		
		20	564	41.7	0.93	93.86%		
		30	561	37.7	0.93	94%		
		40	475	33.1	0.93	95%		
		50	549	33.2	0.94	95%		
		60	474	27.3	0.94	96%		
		70	456	23.8	0.95	96%		
		80	464	25.1	0.95	96%		
		90	456	18.6	0.96	97%		
Avg Inflow Turbidity (NTU)	679.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	679	215	0.68	0%	68%	68%
		5	672	128	0.81	1%	81%	80%
		10	629	69	0.89	7%	90%	82%
		15	586	52	0.91	14%	92%	79%
		20	562	43	0.92	17%	94%	76%
		30	542	36	0.93	20%	95%	74%
		40	482	33	0.93	29%	95%	66%
		50	520	28	0.95	23%	96%	72%
		60	478	25	0.95	30%	96%	67%
		70	440	23	0.95	35%	97%	61%
		80	454	22	0.95	33%	97%	64%
		90	437	19	0.96	36%	97%	62%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype C-47	Time (min.)	A - Control	A - Treated	Treatment Ratio	TR- Treated		
Date	11/2/2023	0	701	627	0.11	11%		
Test Duration (min.)	N/A	5	680	223	0.67	68%		
Interelectrode Distance (cm)	0.5	10	650	103	0.84	85%		
Flow Rate (gpm)	1.97	15	602	93	0.85	87%		
Flow Rate (m ³ /hr)	0.447	20	568	80	0.86	88.60%		
Voltage (V)	12	30	577	73	0.87	90%		
Current (A)	11.7	40	488	63	0.87	91%		
Kwh/m ³	0.314	50	506	56.9	0.89	92%		
		60	495	49.6	0.90	93%		
		70	493	38	0.92	95%		
		80	454	31	0.93	96%		
		90	483	35	0.93	95%		
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio	TR- Treated		
Current (A) [Dial]		0	630	192	0.70	73%		
pH		5	594	133	0.78	81%		
Conductivity (µs/cm)		10	582	95.9	0.84	86%		
		15	556	85.7	0.85	88%		
		20	534	66.2	0.88	90.61%		
		30	513	53.2	0.90	92%		
		40	520	47.3	0.91	93%		
		50	488	49	0.90	93%		
		60	466	37.3	0.92	95%		
		70	465	36.7	0.92	95%		
		80	438	34.5	0.92	95%		
		90	439	26.3	0.94	96%		
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio	TR- Treated		
3		0	785	785	0.00	-11%		
6		5	722	170	0.76	76%		
9		10	610	118	0.81	83%		
		15	615	103	0.83	85%		
		20	598	90.8	0.85	87.13%		
		30	540	70.8	0.87	90%		
		40	459	46.8	0.90	93%		
		50	439	44	0.90	94%		
		60	443	43.3	0.90	94%		
		70	465	31.7	0.93	96%		
		80	443	34.3	0.92	95%		
		90	442	34.6	0.92	95%		
Avg Inflow Turbidity (NTU)	705.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	705	535	0.24	0%	24%	24%
		5	665	175	0.74	6%	75%	69%
		10	614	106	0.83	13%	85%	72%
		15	591	94	0.84	16%	87%	70%
		20	567	79	0.86	20%	89%	69%
		30	543	66	0.88	23%	91%	68%
		40	489	52	0.89	31%	93%	62%
		50	478	50	0.90	32%	93%	61%
		60	468	43	0.91	34%	94%	60%
		70	474	35	0.93	33%	95%	62%
		80	445	33	0.93	37%	95%	58%
		90	455	32	0.93	36%	95%	60%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype C-48	Time (min.)	A - Control	A - Treated	Treatment Ratio	TR- Treated		
Date	11/2/2023	0	713	591	0.17	17%		
Test Duration (min.)	N/A	5	673	329	0.51	54%		
Interelectrode Distance (cm)	0.5	10	641	171	0.73	76%		
Flow Rate (gpm)	5.14	15	612	127	0.79	82%		
Flow Rate (m ³ /hr)	1.167	20	616	111	0.82	84.42%		
Voltage (V)	12	30	551	82	0.85	88%		
Current (A)	12.3	40	512	65	0.87	91%		
Kwh/m ³	0.126	50	483	52.4	0.89	93%		
		60	457	46.6	0.90	93%		
		70	475	49	0.90	93%		
		80	442	39	0.91	95%		
		90	453	34	0.92	95%		
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio	TR- Treated		
Current (A) [Dial]		0	734	583	0.21	18%		
pH		5	643	274	0.57	62%		
Conductivity (µs/cm)		10	615	152	0.75	79%		
		15	566	119	0.79	83%		
		20	576	110	0.81	84.57%		
		30	560	77.6	0.86	89%		
		40	542	63.4	0.88	91%		
		50	532	58	0.89	92%		
		60	495	45.6	0.91	94%		
		70	467	46.9	0.90	93%		
		80	476	43.1	0.91	94%		
		90	457	36.3	0.92	95%		
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio	TR- Treated		
3		0	691	652	0.06	9%		
6		5	652	272	0.58	62%		
9		10	598	168	0.72	76%		
		15	599	128	0.79	82%		
		20	599	113	0.81	84.14%		
		30	529	76.8	0.85	89%		
		40	549	59.4	0.89	92%		
		50	524	56.7	0.89	92%		
		60	465	50	0.89	93%		
		70	480	46.6	0.90	93%		
		80	455	39.5	0.91	94%		
		90	469	30.3	0.94	96%		
Avg Inflow Turbidity (NTU)	712.7	Average				Turbidity Reduction		
		Time (min.)	Avg. - Control	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	713	609	0.15	0%	15%	15%
		5	656	292	0.56	8%	59%	51%
		10	618	164	0.74	13%	77%	64%
		15	592	125	0.79	17%	83%	66%
		20	597	111	0.81	16%	84%	68%
		30	547	79	0.86	23%	89%	66%
		40	534	62	0.88	25%	91%	66%
		50	513	56	0.89	28%	92%	64%
		60	472	47	0.90	34%	93%	60%
		70	474	47	0.90	33%	93%	60%
		80	458	40	0.91	36%	94%	59%
		90	460	34	0.93	36%	95%	60%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype C-49	Time (min.)	A - Control	A - Treated	Treatment Ratio	TR- Treated		
Date	11/2/2023	0	704	663	0.06	6%		
Test Duration (min.)	N/A	5	610	332	0.46	53%		
Interelectrode Distance (cm)	0.5	10	566	194	0.66	72%		
Flow Rate (gpm)	8.26	15	547	131	0.76	81%		
Flow Rate (m ³ /hr)	1.876	20	488	108	0.78	84.67%		
Voltage (V)	12	30	503	95	0.81	86%		
Current (A)	12.2	40	479	68	0.86	90%		
Kwh/m ³	0.078	50	472	61.3	0.87	91%		
		60	460	61.2	0.87	91%		
		70	433	47	0.89	93%		
		80	442	42	0.91	94%		
		90	418	39	0.91	94%		
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio	TR- Treated		
Current (A) [Dial]		0	701	688	0.02	2%		
pH		5	626	326	0.48	54%		
Conductivity (µs/cm)		10	598	181	0.70	74%		
		15	527	128	0.76	82%		
		20	542	121	0.78	82.82%		
		30	542	90.7	0.83	87%		
		40	521	66.8	0.87	91%		
		50	460	50.7	0.89	93%		
		60	513	55	0.89	92%		
		70	432	44.7	0.90	94%		
		80	455	41.8	0.91	94%		
		90	414	40.6	0.90	94%		
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio	TR- Treated		
3		0	708	679	0.04	4%		
6		5	701	351	0.50	50%		
9		10	555	183	0.67	74%		
		15	538	138	0.74	80%		
		20	550	123	0.78	82.54%		
		30	511	76.8	0.85	89%		
		40	482	68.5	0.86	90%		
		50	458	52.5	0.89	93%		
		60	425	43.5	0.90	94%		
		70	409	36.8	0.91	95%		
		80	405	37	0.91	95%		
		90	403	37.9	0.91	95%		
Avg Inflow Turbidity (NTU)	704.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	704	677	0.04	0%	4%	4%
		5	646	336	0.48	8%	52%	44%
		10	573	186	0.68	19%	74%	55%
		15	537	132	0.75	24%	81%	58%
		20	527	117	0.78	25%	83%	58%
		30	519	88	0.83	26%	88%	61%
		40	494	68	0.86	30%	90%	61%
		50	463	55	0.88	34%	92%	58%
		60	466	53	0.89	34%	92%	59%
		70	425	43	0.90	40%	94%	54%
		80	434	40	0.91	38%	94%	56%
		90	412	39	0.90	42%	94%	53%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype C-50	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	11/2/2023	0	615	381	0.38			
Test Duration (min.)	N/A	5	682	110	0.84			
Interelectrode Distance (cm)	0.5	10	566	61	0.89			
Flow Rate (gpm)	0.50	15	585	52	0.91			
Flow Rate (m ³ /hr)	0.114	20	584	43	0.93			
Voltage (V)	12	30	501	38	0.92			
Current (A)	8.5	40	518	32	0.94			
Kwh/m ³	0.898	50	461	30.9	0.93			
		60	446	23.8	0.95			
		70	432	21	0.95			
		80	399	20	0.95			
		90	395	15	0.96			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	785	544	0.31			
pH		5	747	91.7	0.88			
Conductivity (µs/cm)		10	623	50.6	0.92			
		15	579	45.7	0.92			
		20	555	44.8	0.92			
		30	520	39.3	0.92			
		40	470	36.6	0.92			
		50	487	28.7	0.94			
		60	450	25.8	0.94			
		70	440	21.1	0.95			
		80	422	19	0.95			
		90	451	16.4	0.96			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	750	484	0.35			
6		5	648	111	0.83			
9		10	644	67	0.90			
		15	563	55.2	0.90			
		20	573	46.5	0.92			
		30	558	43.2	0.92			
		40	498	41	0.92			
		50	471	30.5	0.94			
		60	466	27.8	0.94			
		70	464	27.1	0.94			
		80	449	21.6	0.95			
		90	404	18.1	0.96			
Avg Inflow Turbidity (NTU)	716.7	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	717	470	0.34	0%	34%	34%
		5	692	104	0.85	3%	85%	82%
		10	611	60	0.90	15%	92%	77%
		15	576	51	0.91	20%	93%	73%
		20	571	45	0.92	20%	94%	73%
		30	526	40	0.92	27%	94%	68%
		40	495	36	0.93	31%	95%	64%
		50	473	30	0.94	34%	96%	62%
		60	454	26	0.94	37%	96%	60%
		70	445	23	0.95	38%	97%	59%
		80	423	20	0.95	41%	97%	56%
		90	417	17	0.96	42%	98%	56%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype C-51	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	11/2/2023	0	754	728	0.03			
Test Duration (min.)	N/A	5	642	399	0.38			
Interelectrode Distance (cm)	0.5	10	630	191	0.70			
Flow Rate (gpm)	3.98	15	621	155	0.75			
Flow Rate (m ³ /hr)	0.904	20	592	116	0.80			
Voltage (V)	9.6	30	561	92	0.84			
Current (A)	9	40	511	69	0.86			
Kwh/m ³	0.096	50	517	60	0.88			
		60	482	55.7	0.88			
		70	502	40	0.92			
		80	472	37	0.92			
		90	433	31	0.93			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	755	724	0.04			
pH		5	710	354	0.50			
Conductivity (µs/cm)		10	636	169	0.73			
		15	617	134	0.78			
		20	590	121	0.79			
		30	530	96.3	0.82			
		40	514	80.7	0.84			
		50	514	65.2	0.87			
		60	480	50	0.90			
		70	479	40.9	0.91			
		80	464	37.4	0.92			
		90	454	34.4	0.92			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	778	837	-0.08			
6		5	665	321	0.52			
9		10	655	166	0.75			
		15	617	113	0.82			
		20	563	101	0.82			
		30	532	86.7	0.84			
		40	556	68.2	0.88			
		50	499	54	0.89			
		60	520	40.3	0.92			
		70	450	39.2	0.91			
		80	460	37.3	0.92			
		90	422	37.7	0.91			
Avg Inflow Turbidity (NTU)	762.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	762	763	0.00	0%	0%	0%
		5	672	358	0.47	12%	53%	41%
		10	640	175	0.73	16%	77%	61%
		15	618	134	0.78	19%	82%	64%
		20	582	113	0.81	24%	85%	62%
		30	541	92	0.83	29%	88%	59%
		40	527	73	0.86	31%	90%	60%
		50	510	60	0.88	33%	92%	59%
		60	494	49	0.90	35%	94%	58%
		70	477	40	0.92	37%	95%	57%
		80	465	37	0.92	39%	95%	56%
		90	436	34	0.92	43%	95%	53%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype C-52	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	11/2/2023	0	668	674	-0.01			
Test Duration (min.)	N/A	5	680	430	0.37			
Inter-electrode Distance (cm)	0.5	10	643	233	0.64			
Flow Rate (gpm)	5.98	15	591	189	0.68			
Flow Rate (m ³ /hr)	1.358	20	540	141	0.74			
Voltage (V)	9.2	30	535	115	0.79			
Current (A)	9	40	509	85	0.83			
Kwh/m ³	0.061	50	499	70.8	0.86			
		60	449	52.3	0.88			
		70	454	55	0.88			
		80	435	52	0.88			
		90	438	42	0.91			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	714	681	0.05			
pH		5	678	421	0.38			
Conductivity (µs/cm)		10	638	223	0.65			
		15	584	161	0.72			
		20	562	129	0.77			
		30	529	108	0.80			
		40	513	84.5	0.84			
		50	510	66.5	0.87			
		60	453	54.8	0.88			
		70	429	49	0.89			
		80	435	43.2	0.90			
		90	415	40	0.90			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	727	667	0.08			
6		5	637	365	0.43			
9		10	579	142	0.75			
		15	569	110	0.81			
		20	545	114	0.79			
		30	491	93.3	0.81			
		40	488	70.4	0.86			
		50	465	64.5	0.86			
		60	449	55.6	0.88			
		70	450	50.9	0.89			
		80	427	42.5	0.90			
		90	422	36	0.91			
Avg Inflow Turbidity (NTU)	703.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Control	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	703	674	0.04	0%	4%	4%
		5	665	405	0.39	5%	42%	37%
		10	620	199	0.68	12%	72%	60%
		15	581	153	0.74	17%	78%	61%
		20	549	128	0.77	22%	82%	60%
		30	518	105	0.80	26%	85%	59%
		40	503	80	0.84	28%	89%	60%
		50	491	67	0.86	30%	90%	60%
		60	450	54	0.88	36%	92%	56%
		70	444	52	0.88	37%	93%	56%
		80	432	46	0.89	39%	93%	55%
		90	425	39	0.91	40%	94%	55%

Table 1a: Test Information		Sample A (3 min.)					
Test ID	Prototype C-53	Time (min.)	A - Control	A - Treated	Treatment Ratio	TR- Treated	
Date	11/3/2023	0	759	718	0.05	4%	
Test Duration (min.)	N/A	5	684	403	0.41	46%	
Interelectrode Distance (cm)	0.5	10	594	247	0.58	67%	
Flow Rate (gpm)	10.20	15	593	160	0.73	79%	
Flow Rate (m ³ /hr)	2.317	20	589	139	0.76	81.49%	
Voltage (V)	12	30	506	103	0.80	86%	
Current (A)	11.8	40	500	80	0.84	89%	
Kwh/m ³	0.061	50	466	74.6	0.84	90%	
		60	448	61.7	0.86	92%	
		70	455	54	0.88	93%	
		80	407	56	0.86	93%	
		90	448	47	0.89	94%	
Table 1b: Initial Measurements		Sample B (6 min.)					
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio	TR- Treated	
Current (A) [Dial]		0	743	710	0.04	5%	
pH		5	703	371	0.47	51%	
Conductivity (µs/cm)		10	651	231	0.65	69%	
		15	581	159	0.73	79%	
		20	565	134	0.76	82.16%	
		30	536	94.7	0.82	87%	
		40	465	75.5	0.84	90%	
		50	471	73.6	0.84	90%	
		60	441	52.8	0.88	93%	
		70	462	50.2	0.89	93%	
		80	416	40	0.90	95%	
		90	422	38.7	0.91	95%	
Table 1c: Current vs Time		Sample C (9 min.)					
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio	TR- Treated	
3		0		722	#DIV/0!	4%	
6		5	659	355	0.46	53%	
9		10	632	223	0.65	70%	
		15	556	170	0.69	77%	
		20	587	138	0.76	81.62%	
		30	516	92	0.82	88%	
		40	521	78.5	0.85	90%	
		50	461	63.3	0.86	92%	
		60	432	56.3	0.87	93%	
		70	393	46.8	0.88	94%	
		80	431	52.4	0.88	93%	
		90	441	40.4	0.91	95%	
Avg Inflow Turbidity (NTU)	751.0	Average				Turbidity Reduction	
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated
		0	751	717	0.05	0%	5%
		5	682	376	0.45	9%	50%
		10	626	234	0.63	17%	69%
		15	577	163	0.72	23%	78%
		20	580	137	0.76	23%	82%
		30	519	97	0.81	31%	87%
		40	495	78	0.84	34%	90%
		50	466	71	0.85	38%	91%
		60	440	57	0.87	41%	92%
		70	437	50	0.88	42%	93%
		80	418	49	0.88	44%	93%
		90	437	42	0.90	42%	94%
						TR Difference	
							5%
							41%
							52%
							55%
							59%
							56%
							56%
							53%
							51%
							51%
							49%
							53%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype C-54	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	11/3/2023	0	710	697	0.02			
Test Duration (min.)	N/A	5	687	440	0.36			
Interelectrode Distance (cm)	0.5	10	632	278	0.56			
Flow Rate (gpm)	14.40	15	551	185	0.66			
Flow Rate (m ³ /hr)	3.271	20	530	143	0.73			
Voltage (V)	12	30	513	103	0.80			
Current (A)	11.3	40	442	87	0.80			
Kwh/m ³	0.041	50	406	83	0.80			
		60	407	71.9	0.82			
		70	404	55	0.86			
		80	396	46	0.88			
		90	385	45	0.88			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	694	710	-0.02			
pH		5	653	391	0.40			
Conductivity (µs/cm)		10	582	233	0.60			
		15	545	170	0.69			
		20	535	143	0.73			
		30	494	97	0.80			
		40	454	85.9	0.81			
		50	410	85.9	0.79			
		60	418	72.5	0.83			
		70	435	55.6	0.87			
		80	399	47.9	0.88			
		90	361	39.7	0.89			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	730	698	0.04			
6		5	682	371	0.46			
9		10	603	235	0.61			
		15	560	161	0.71			
		20	569	129	0.77			
		30	489	98.8	0.80			
		40	443	78.8	0.82			
		50	447	64.1	0.86			
		60	409	47.7	0.88			
		70	390	43.1	0.89			
		80	423	35.9	0.92			
		90	394	36.1	0.91			
Avg Inflow Turbidity (NTU)	711.3	Average				Turbidity Reduction		
		Time (min.)	Avg. - Control	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	711	702	0.01	0%	1%	1%
		5	674	401	0.41	5%	44%	38%
		10	606	249	0.59	15%	65%	50%
		15	552	172	0.69	22%	76%	53%
		20	545	138	0.75	23%	81%	57%
		30	499	100	0.80	30%	86%	56%
		40	446	84	0.81	37%	88%	51%
		50	421	78	0.82	41%	89%	48%
		60	411	64	0.84	42%	91%	49%
		70	410	51	0.88	42%	93%	50%
		80	406	43	0.89	43%	94%	51%
		90	380	40	0.89	47%	94%	48%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype C-55	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	11/3/2023	0	738	729	0.01			
Test Duration (min.)	N/A	5	719	498	0.31			
Interelectrode Distance (cm)	0.5	10	597	320	0.46			
Flow Rate (gpm)	18.88	15	549	237	0.57			
Flow Rate (m ³ /hr)	4.288	20	571	185	0.68			
Voltage (V)	12	30	518	129	0.75			
Current (A)	11.3	40	483	103	0.79			
Kwh/m ³	0.032	50	429	90	0.79			
		60	466	72.5	0.84			
		70	429	71	0.83			
		80	409	64	0.84			
		90	398	53	0.87			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	676	658	0.03			
pH		5	686	520	0.24			
Conductivity (µs/cm)		10	614	278	0.55			
		15	569	204	0.64			
		20	538	159	0.70			
		30	528	113	0.79			
		40	476	96.8	0.80			
		50	446	76.5	0.83			
		60	444	64.4	0.85			
		70	422	60.1	0.86			
		80	413	50.5	0.88			
		90	385	46	0.88			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	770	694	0.10			
6		5	675	495	0.27			
9		10	601	285	0.53			
		15	561	205	0.63			
		20	519	165	0.68			
		30	500	111	0.78			
		40	470	92.8	0.80			
		50	443	71.3	0.84			
		60	482	70.7	0.85			
		70	422	57.6	0.86			
		80	399	48.7	0.88			
		90	392	44	0.89			
Avg Inflow Turbidity (NTU)	728.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	728	694	0.05	0%	5%	5%
		5	693	504	0.27	5%	31%	26%
		10	604	294	0.51	17%	60%	43%
		15	560	215	0.62	23%	70%	47%
		20	543	170	0.69	25%	77%	51%
		30	515	118	0.77	29%	84%	55%
		40	476	98	0.80	35%	87%	52%
		50	439	79	0.82	40%	89%	49%
		60	464	69	0.85	36%	90%	54%
		70	424	63	0.85	42%	91%	50%
		80	407	54	0.87	44%	93%	48%
		90	392	48	0.88	46%	93%	47%

Table 1a: Test Information		Sample A (3 min.)						
Test ID	Prototype C-56	Time (min.)	A - Control	A - Treated	Treatment Ratio			
Date	11/3/2023	0	856	879	-0.03			
Test Duration (min.)	N/A	5	842	754	0.10			
Interelectrode Distance (cm)	0.5	10	736	703	0.04			
Flow Rate (gpm)	19.10	15	661	648	0.02			
Flow Rate (m ³ /hr)	4.338	20	643	599	0.07			
Voltage (V)	12	30	609	498	0.18			
Current (A)	1.9	40	528	468	0.11			
Kwh/m ³	0.005	50	544	478	0.12			
		60	483	401	0.17			
		70	486	403	0.17			
		80	485	374	0.23			
		90	461	393	0.15			
Table 1b: Initial Measurements		Sample B (6 min.)						
Current (A) [Measured]		Time (min.)	B - Control	B - Treated	Treatment Ratio			
Current (A) [Dial]		0	833	873	-0.05			
pH		5	786	753	0.04			
Conductivity (µs/cm)		10	741	662	0.11			
		15	714	580	0.19			
		20	674	529	0.22			
		30	549	480	0.13			
		40	531	401	0.24			
		50	520	396	0.24			
		60	506	361	0.29			
		70	481	354	0.26			
		80	498	322	0.35			
		90	478	325	0.32			
Table 1c: Current vs Time		Sample C (9 min.)						
Time (min.)	Current (A)	Time (min.)	C - Control	C - Treated	Treatment Ratio			
3		0	876	847	0.03			
6		5	798	782	0.02			
9		10	711	634	0.11			
		15	692	516	0.25			
		20	652	484	0.26			
		30	608	413	0.32			
		40	539	327	0.39			
		50	572	327	0.43			
		60	514	291	0.43			
		70	504	280	0.44			
		80	488	268	0.45			
		90	564	269	0.52			
Avg Inflow Turbidity (NTU)	855.0	Average				Turbidity Reduction		
		Time (min.)	Avg. - Contol	Avg. - Treated	Treatment Ratio	TR- Control	TR- Treated	TR Difference
		0	855	866	-0.01	0%	-1%	-1%
		5	809	763	0.06	5%	11%	5%
		10	729	666	0.09	15%	22%	7%
		15	689	581	0.16	19%	32%	13%
		20	656	537	0.18	23%	37%	14%
		30	589	464	0.21	31%	46%	15%
		40	533	399	0.25	38%	53%	16%
		50	545	400	0.27	36%	53%	17%
		60	501	351	0.30	41%	59%	18%
		70	490	346	0.30	43%	60%	17%
		80	490	321	0.34	43%	62%	20%
		90	501	329	0.34	41%	62%	20%

Appendix B: Aluminum Coagulant Release Data

Sample ID		
1-SED		
Measured Al ³⁺	0.79 mg/L	
Inflow Turbidity		
	734	NTU
	745	NTU
	727	NTU
AVG	735.3	NTU
Amps		
	8.6	A
Flow Rate		
	Volume	
	2000	mL
	2000	mL
	2000	mL
AVG	2000	mL
	Time	
	33.22	s
	35.17	s
	34.84	s
AVG	34.4	
Flow	58.1	mL/s
Flow	3.5	L/min
Flow	0.9	GPM

Sample ID		
2-SED		
Measured Al ³⁺	0.261 mg/L	
Inflow Turbidity		
	780	NTU
	762	NTU
	781	NTU
AVG	774.3	NTU
Amps		
	9.5	A
Flow Rate		
	Volume	
	21.65	lbs
	21.15	lbs
	20	lbs
AVG	2.509992	gal
	Time	
	31.3	s
	31.4	s
	30	s
AVG	30.9	
Flow	0.1	gps
Flow	18.4	L/min
Flow	4.9	GPM

Sample ID		
3-SED		
Measured Al ³⁺	0.224 mg/L	
Inflow Turbidity		
	746	NTU
	755	NTU
	752	NTU
AVG	751.0	NTU
Amps		
	9.5	A
Flow Rate		
	Volume	
	20.9	lbs
	20.85	lbs
	21.05	lbs
AVG	2.509992	gal
	Time	
	15.6	s
	15.68	s
	16.27	s
AVG	15.9	
Flow	0.2	gps
Flow	36.0	L/min
Flow	9.5	GPM

Sample ID		
4-SED		
Measured Al ³⁺	0.193 mg/L	
Inflow Turbidity		
	785	NTU
	734	NTU
	720	NTU
AVG	746.3	NTU
Amps		
	9.4	A
Flow Rate		
	Volume	
	20.8	lbs
	20.7	lbs
	20.1	lbs
AVG	2.46203	gal
	Time	
	10.6	s
	10.5	s
	10.76	s
AVG	10.6	
Flow	0.2	gps
Flow	52.7	L/min
Flow	13.9	GPM

Sample ID		
1-CLEAN		
Measured Al ³⁺	1.81 mg/L	
Inflow Turbidity		
	2.84	NTU
	2.56	NTU
	2.5	NTU
AVG	2.6	NTU
Amps		
	6.9	A
Flow Rate		
	Volume	
	2000	mL
	2000	mL
	2000	mL
AVG	2000	mL
	Time	
	31.17	s
	31.92	s
	31.77	s
AVG	31.6	
Flow	63.3	mL/s
Flow	3.8	L/min
Flow	1.0	GPM

Sample ID		
2-CLEAN		
Measured Al ³⁺	0.807 mg/L	
Inflow Turbidity		
	2.84	NTU
	2.56	NTU
	2.5	NTU
AVG	2.6	NTU
Amps		
	9.5	A
Flow Rate		
	Volume	
	20.7	lbs
	20.6	lbs
	20.4	lbs
AVG	2.466027	gal
	Time	
	30.5	s
	30.7	s
	30.4	s
AVG	30.5	
Flow	0.1	gps
Flow	18.3	L/min
Flow	4.8	GPM

Sample ID		
3-CLEAN		
Measured Al ³⁺	0.516 mg/L	
Inflow Turbidity		
	2.84	NTU
	2.56	NTU
	2.5	NTU
AVG	2.6	NTU
Amps		
	9.7	A
Flow Rate		
	Volume	
	20.95	lbs
	20.1	lbs
	18.4	lbs
AVG	2.376099	gal
	Time	
	15.53	s
	15.38	s
	15.2	s
AVG	15.4	
Flow	0.2	gps
Flow	35.1	L/min
Flow	9.3	GPM

Sample ID		
4-CLEAN		
Measured Al ³⁺	0.396 mg/L	
Inflow Turbidity		
	2.84	NTU
	2.56	NTU
	2.5	NTU
AVG	2.6	NTU
Amps		
	9.8	A
Flow Rate		
	Volume	
	20.75	lbs
		lbs
		lbs
AVG	2.48801	gal
	Time	
	10.45	s
		s
		s
AVG	10.5	
Flow	0.2	gps
Flow	54.1	L/min
Flow	14.3	GPM

Appendix C: Mixing Evaluations Data

Avg Inflow Turbidity (NTU)	583.0

M1.2						
	Control			Treated		
Time (min.)	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio
0	459	625	-0.31	416	410	0.01
5	381	270	0.34	325	325	0.00
10	206	184	0.11	210	184	0.13
15	169	138	0.20	175	158	0.10
20	137	121	0.12	140	124	0.12
30	119	95	0.22	116	94	0.21
40	92	67	0.32	104	75	0.32
50	76	62.1	0.20	85	62	0.32
60	67	55.5	0.19	74.2	53	0.33

M1.3						
	Control			Treated		
Time (min.)	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio
0	714	503	0.35	508	466	0.09
5	376	390	-0.04	365	329	0.10
10	294	212	0.32	251	208	0.19
15	171	134	0.24	192	161	0.18
20	159	135	0.16	163	114	0.35
30	131	103	0.24	138	107	0.25
40	107	82	0.27	104	80	0.26
50	93	70.1	0.28	95	74	0.24
60	81.8	59.8	0.31	84	58.7	0.35

Average									
	Control			Treated			Turbidity Reduction		
Time (min.)	C-Not Mixed	C-Mixed	Difference Ratio	T-Not Mixed	T-Mixed	Difference Ratio	Passive TR	Mechanical TR	
0	583	557	0.05	492	475	0.04	16%	4%	
5	381	335	0.13	349	338	0.03	8%	12%	
10	251	204	0.21	235	198	0.17	6%	19%	
15	180	149	0.19	190	164	0.15	-6%	17%	
20	148	131	0.12	152	123	0.21	-3%	12%	
30	124	98	0.23	124	102	0.19	-1%	20%	
40	101	80	0.24	104	77	0.30	-3%	21%	
50	86	67	0.24	90	67	0.29	-5%	22%	
60	76	59	0.25	80	57	0.33	-6%	22%	



Table 1a: Test Information	
Test ID	V1-3
Date	
Test Duration (min.)	9
Interelectrode Distance (cm)	0.5
Flow Rate (gpm)	5.00
Flow Rate (m ³ /hr)	1.136
Voltage (V)	12
Current (A)	2.2
Kwh/m ³	0.023

Table 1b: Initial Measurements	
Current (A) [Measured]	
Current (A) [Dial]	
pH	
Conductivity (µs/cm)	

Table 1c: Current vs Time	
Time (min.)	Current (A)
3	
6	
9	

Avg Inflow Turbidity (NTU) 597.0

M1.1						
Time (min.)	Control			Treated		
	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio
0	597	602	-0.01	551	540	0.02
5	462	447	0.03	443	395	0.11
10	354	341	0.04	361	303	0.17
15	280	244	0.14	269	219	0.20
20	222	202	0.09	228	190	0.18
30	192	153	0.23	184	157	0.16
40	148	123	0.18	151	131	0.14
50	137	110	0.22	141	107	0.27
60	121	90.6	0.29	112	95.4	0.16

M1.2						
Time (min.)	Control			Treated		
	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio
0			#DIV/0!			#DIV/0!
5			#DIV/0!			#DIV/0!
10			#DIV/0!			#DIV/0!
15			#DIV/0!			#DIV/0!
20			#DIV/0!			#DIV/0!
30			#DIV/0!			#DIV/0!
40			#DIV/0!			#DIV/0!
50			#DIV/0!			#DIV/0!
60			#DIV/0!			#DIV/0!

M1.3						
Time (min.)	Control			Treated		
	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio
0			#DIV/0!			#DIV/0!
5			#DIV/0!			#DIV/0!
10			#DIV/0!			#DIV/0!
15			#DIV/0!			#DIV/0!
20			#DIV/0!			#DIV/0!
30			#DIV/0!			#DIV/0!
40			#DIV/0!			#DIV/0!
50			#DIV/0!			#DIV/0!
60			#DIV/0!			#DIV/0!

Average								
Time (min.)	Control			Treated			Turbidity Reduction	
	C-Not Mixed	C-Mixed	Difference Ratio	T-Not Mixed	T-Mixed	Difference Ratio	Passive TR	Mechanical TR
0	597	602	-0.01	551	540	0.02	8%	-1%
5	462	447	0.03	443	395	0.11	4%	3%
10	354	341	0.04	361	303	0.17	-2%	4%
15	280	244	0.14	269	219	0.20	4%	13%
20	222	202	0.09	228	190	0.18	-3%	9%
30	192	153	0.23	184	157	0.16	4%	20%
40	148	123	0.18	151	131	0.14	-2%	17%
50	137	110	0.22	141	107	0.27	-3%	20%
60	121	91	0.29	112	95	0.16	7%	25%

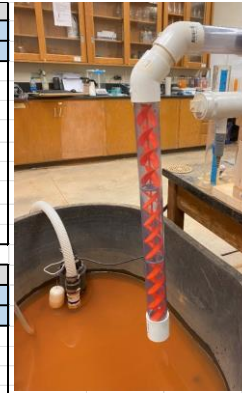




Table 1a: Test Information		M1.1								
Test ID	V2-4	Control			Treated					
Date		Time (min.)	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio		
Test Duration (min.)	9	0	559	557	0.00	565	542	0.04		
Interelectrode Distance (cm)	0.5	5	470	414	0.13	443	413	0.07		
Flow Rate (gpm)	5.00	10	338	280	0.19	316	302	0.05		
Flow Rate (m ³ /hr)	1.136	15	245	214	0.14	268	228	0.16		
Voltage (V)	12	20	202	167	0.19	206	175	0.16		
Current (A)	2.2	30	155	126	0.21	159	132	0.19		
Kwh/m ³	0.023	40	136	102	0.29	139	103	0.30		
		50	110	81.2	0.30	106	97	0.08		
		60	100	65.7	0.41	106	79.9	0.28		
Table 1b: Initial Measurements		M1.2								
Current (A) [Measured]		Time (min.)	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio		
Current (A) [Dial]		0			#DIV/0!			#DIV/0!		
pH		5			#DIV/0!			#DIV/0!		
Conductivity (µs/cm)		10			#DIV/0!			#DIV/0!		
		15			#DIV/0!			#DIV/0!		
		20			#DIV/0!			#DIV/0!		
		30			#DIV/0!			#DIV/0!		
		40			#DIV/0!			#DIV/0!		
		50			#DIV/0!			#DIV/0!		
		60			#DIV/0!			#DIV/0!		
Table 1c: Current vs Time		M1.3								
Time (min.)	Current (A)	Time (min.)	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio		
3		0			#DIV/0!			#DIV/0!		
6		5			#DIV/0!			#DIV/0!		
9		10			#DIV/0!			#DIV/0!		
		15			#DIV/0!			#DIV/0!		
		20			#DIV/0!			#DIV/0!		
		30			#DIV/0!			#DIV/0!		
		40			#DIV/0!			#DIV/0!		
		50			#DIV/0!			#DIV/0!		
		60			#DIV/0!			#DIV/0!		
Avg Inflow Turbidity (NTU)	559.0	Average								
		Time (min.)	C-Not Mixed	C-Mixed	Difference Ratio	T-Not Mixed	T-Mixed	Difference Ratio	Passive TR	Mechanical TR
		0	559	557	0.00	565	542	0.04	-1%	0%
		5	470	414	0.13	443	413	0.07	6%	12%
		10	338	280	0.19	316	302	0.05	7%	17%
		15	245	214	0.14	268	228	0.16	-9%	13%
		20	202	167	0.19	206	175	0.16	-2%	17%
		30	155	126	0.21	159	132	0.19	-3%	19%
		40	136	102	0.29	139	103	0.30	-2%	25%
		50	110	81	0.30	106	97	0.08	4%	26%
		60	100	66	0.41	106	80	0.28	-6%	34%



Table 1a: Test Information	
Test ID	chain mixer
Date	
Test Duration (min.)	9
Inter-electrode Distance (cm)	0.5
Flow Rate (gpm)	5.00
Flow Rate (m ³ /hr)	1.136
Voltage (V)	12
Current (A)	2.2
Kwh/m ³	0.023

Table 1b: Initial Measurements	
Current (A) [Measured]	
Current (A) [Dial]	
pH	
Conductivity (µs/cm)	

Table 1c: Current vs Time	
Time (min.)	Current (A)
3	
6	
9	

Avg Inflow Turbidity (NTU) 551.0

M1.1						
Time (min.)	Control			Treated		
	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio
0	553	539	0.03	544	545	0.00
5	480	413	0.15	461	411	0.11
10	376	357	0.05	414	362	0.13
15	296	257	0.14	279	227	0.21
20	239	193	0.21	241	208	0.15
30	182	168	0.08	181	150	0.19
40	154	124	0.22	150	116	0.26
50	133	105	0.24	132	96	0.32
60	120	91.7	0.27	115	84	0.31

M1.2						
Time (min.)	Control			Treated		
	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio
0	542	547	-0.01	550	555	-0.01
5	449	419	0.07	450	422	0.06
10	354	312	0.13	366	318	0.14
15	286	248	0.14	292	239	0.20
20	237	195	0.19	260	193	0.30
30	175	141	0.22	194	142	0.31
40	156	117	0.29	163	113	0.36
50	125	99	0.23	142	91.8	0.43
60	118	83.4	0.34	115	76	0.41

M1.3						
Time (min.)	Control			Treated		
	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio
0	558	551	0.01	543	545	0.00
5	478	451	0.06	484	425	0.13
10	387	246	0.45	377	315	0.18
15	307	274	0.11	300	233	0.25
20	252	209	0.19	253	192	0.27
30	185	161	0.14	186	147	0.23
40	150	122	0.21	156	117	0.29
50	131	93.2	0.34	135	98.6	0.31
60	115	91.7	0.23	124	85.6	0.37

Average							
Time (min.)	Control			Treated			Passive TR
	C-Not Mixed	C-Mixed	Difference Ratio	T-Not Mixed	T-Mixed	Difference Ratio	
0	551	546	0.01	546	548	0.00	1%
5	469	428	0.09	465	419	0.10	1%
10	372	305	0.20	386	332	0.15	-4%
15	296	260	0.13	290	233	0.22	2%
20	243	199	0.20	251	198	0.24	-4%
30	181	157	0.14	187	146	0.24	-4%
40	153	121	0.24	156	115	0.30	-2%
50	130	99	0.27	136	95	0.35	-5%
60	118	89	0.28	118	82	0.36	0%

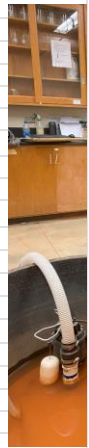


Table 1a: Test Information			M1.1								
Test ID	chain 2		Control				Treated				
Date			Time (min.)	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio		
Test Duration (min.)	9		0	679	653	0.04	678	633	0.07		
Interelectrode Distance (cm)	0.5		5	554	497	0.11	522	488	0.07		
Flow Rate (gpm)	5.00		10	389	356	0.09	399	344	0.15		
Flow Rate (m³/hr)	1.136		15	277	255	0.08	283	233	0.19		
Voltage (V)	12		20	240	203	0.17	233	194	0.18		
Current (A)	2.2		30	181	145	0.22	173	192	-0.10		
Kwh/m³	0.023		40			#DIV/0!			#DIV/0!		
			50	124	87.7	0.34	116	92	0.23		
			60	114	81.6	0.33	120	76.7	0.44		
Table 1b: Initial Measurements			M1.2								
Current (A) [Measured]			Control				Treated				
Current (A) [Dial]			Time (min.)	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio		
pH			0	695	700	-0.01	689	654	0.05		
Conductivity (µs/cm)			5	580	551	0.05	578	549	0.05		
			10	411	382	0.07	387	354	0.09		
			15	311	278	0.11	280	265	0.06		
			20	245	236	0.04	233	209	0.11		
			30	196	162	0.19	181	158	0.14		
			40	151	127	0.17	166	137	0.19		
			50	140	114	0.20	134	108	0.21		
			60	129	107	0.19	125	90.9	0.32		
Table 1c: Current vs Time			M1.3								
Time (min.)	Current (A)		Control				Treated				
3			Time (min.)	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio		
6			0	736	707	0.04	727	730	0.00		
9			5	602	596	0.01	607	585	0.04		
			10	401	383	0.05	399	388	0.03		
			15	314	272	0.14	289	262	0.10		
			20	252	231	0.09	246	217	0.13		
			30	178	183	-0.03	198	182	0.08		
			40	158	140	0.12	166	147	0.12		
			50	128	110	0.15	139	112	0.22		
			60	118	103	0.14	111	106	0.05		
Average			Average								
			Control				Treated				
			Time (min.)	C-Not Mixed	C-Mixed	Difference Ratio	T-Not Mixed	T-Mixed	Difference Ratio	Passive TR	Mechanical TR
			0	703	687	0.02	698	672	0.04	1%	2%
			5	579	548	0.05	569	541	0.05	2%	5%
			10	400	374	0.07	395	362	0.09	1%	7%
			15	301	268	0.11	284	253	0.11	6%	11%
			20	246	223	0.10	237	207	0.14	3%	9%
			30	185	163	0.12	184	177	0.04	1%	12%
			40	155	134	0.15	166	142	0.16	-7%	14%
			50	131	104	0.23	130	104	0.22	1%	20%
			60	120	97	0.21	119	91	0.26	1%	19%

Table 1a: Test Information		M1.1						
Test ID	cyclone (V4)	Control				Treated		
Date		Time (min.)	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio
Test Duration (min.)	9	0	657	640	0.03	657	655	0.00
Interelectrode Distance (cm)	0.5	5	525	507	0.03	525	501	0.05
Flow Rate (gpm)	5.00	10	370	356	0.04	383	346	0.10
Flow Rate (m³/hr)	1.136	15	296	248	0.18	280	269	0.04
Voltage (V)	12	20	221	199	0.10	244	192	0.24
Current (A)	2.2	30	166	153	0.08	186	159	0.16
Kwh/m³	0.023	40	147	119	0.21	151	123	0.20
		50	120	93.2	0.25	129	99	0.26
		60	111	84.5	0.27	111	98.4	0.12
Table 1b: Initial Measurements		M1.2						
Current (A) [Measured]		Control				Treated		
Current (A) [Dial]		Time (min.)	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio
pH		0	592	509	0.15	551	523	0.05
Conductivity (µs/cm)		5	385	381	0.01	382	341	0.11
		10	305	258	0.17	291	250	0.15
		15	241	220	0.09	243	188	0.26
		20			#DIV/0!			#DIV/0!
		30	175	144	0.19	166	139	0.18
		40	151	123	0.20	165	119	0.32
		50	133	114	0.15	130	112	0.15
		60	117	96.6	0.19	119	94.6	0.23
Table 1c: Current vs Time		M1.3						
Time (min.)	Current (A)	Control				Treated		
3		Time (min.)	Not Mixed	Mixed	Difference Ratio	Not Mixed	Mixed	Difference Ratio
6		0	675	724	-0.07	694	730	-0.05
9		5	587	566	0.04	578	552	0.05
		10	433	400	0.08	438	387	0.12
		15	312	286	0.09	345	277	0.22
		20	244	226	0.08	258	223	0.15
		30	202	171	0.17	189	148	0.24
		40	171	138	0.21	173	146	0.17
		50	140	119	0.16	141	117	0.19
		60	121	106	0.13	129	101	0.24
Avg Inflow Turbidity (NTU)	641.3	Average						
		Control				Treated		
		Time (min.)	C-Not Mixed	C-Mixed	Difference Ratio	T-Not Mixed	T-Mixed	Difference Ratio
		0	641	624	0.03	634	636	0.00
		5	499	485	0.03	495	465	0.06
		10	369	338	0.09	371	328	0.12
		15	283	251	0.12	289	245	0.17
		20	233	213	0.09	251	208	0.19
		30	181	156	0.15	180	149	0.19
		40	156	127	0.21	163	129	0.23
		50	131	109	0.19	133	109	0.20
		60	116	96	0.19	120	98	0.20
								Passive TR
								Mechanical TR
								1%
								3%
								8%
								11%
								9%
								14%
								19%
								17%
								18%

Sample ID:	Control - UPSTREAM
Mixed for (min):	0

Run 1	Turbidity #1	657
	Turbidity #2	707
	Turbidity #3	663
	Average Turbidity (NTU)	676
	Volume #1	
	Volume #2	
	Volume #3	
	Average Volume (mL)	N/A
	Time #1	
	Time #2	
	Time #3	
	Average Time (s)	N/A
	Flow Rate (gpm)	#VALUE!
	Amperage	

pH	Control	Treated
Conductivity (µS/cm)	Control	Treated

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	737	693	694	708	5%
5	681	624	667	657	3%
10	633	592	616	614	9%
15	575	547	597	573	15%
20	538	523	543	535	21%
25	519	557	551	542	20%
30	524	490	533	516	24%

Run 2	Turbidity #1	706
	Turbidity #2	735
	Turbidity #3	756
	Average Turbidity (NTU)	732
	Volume #1	
	Volume #2	
	Volume #3	
	Average Volume (mL)	N/A
	Time #1	
	Time #2	
	Time #3	
	Average Time (s)	N/A
	Flow Rate (gpm)	#VALUE!
	Amperage	

pH	Control	Treated
	6.97	
Conductivity (µS/cm)	Control	Treated
	200	

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	690	709	706	702	4%
5	633	598	594	608	17%
10	568	562	573	568	22%
15	511	488	547	515	30%
20	489	487	511	496	32%
25	452	485	498	478	35%
30	491	301	476	423	42%

Run 3	Turbidity #1	703
	Turbidity #2	687
	Turbidity #3	697
	Average Turbidity (NTU)	696
	Volume #1	
	Volume #2	
	Volume #3	
	Average Volume (mL)	N/A
	Time #1	
	Time #2	
	Time #3	
	Average Time (s)	N/A
	Flow Rate (gpm)	#VALUE!
	Amperage	

pH	Control	Treated
Conductivity (µS/cm)	Control	Treated

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	630	638	675	648	7%
5	543	539	566	549	21%
10	508	497	521	509	27%
15	488	481	467	479	31%
20	461	468	471	467	33%
25	455	439	436	443	36%
30	415	438	455	436	37%

Run 4	Turbidity #1	706
	Turbidity #2	735
	Turbidity #3	756
	Average Turbidity (NTU)	732
	Volume #1	
	Volume #2	
	Volume #3	
	Average Volume (mL)	N/A
	Time #1	
	Time #2	
	Time #3	
	Average Time (s)	N/A
	Flow Rate (gpm)	#VALUE!
	Amperage	

pH	Control	Treated
Conductivity (µS/cm)	Control	Treated

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	743	747	703	731	3%
5	614	632	603	616	9%
10	544	535	537	539	20%
15	522	528	531	527	22%
20	478	483	464	475	30%
25	457	479	467	468	31%
30	436	466	436	446	34%

Run 5	Turbidity #1	732
	Turbidity #2	741
	Turbidity #3	732
	Average Turbidity (NTU)	735
	Volume #1	
	Volume #2	
	Volume #3	
	Average Volume (mL)	N/A
	Time #1	
	Time #2	
	Time #3	
	Average Time (s)	N/A
	Flow Rate (gpm)	#VALUE!
	Amperage	

pH	Control	Treated
Conductivity (µS/cm)	Control	Treated

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	688	708	683	693	5%
5	609	590	592	597	18%
10	521	568	536	542	26%
15	515	531	531	526	28%
20	487	488	474	483	34%
25	485	470	455	470	36%
30	482	473	472	476	36%

Run 6	Turbidity #1	
	Turbidity #2	
	Turbidity #3	
	Average Turbidity (NTU)	N/A
	Volume #1	
	Volume #2	
	Volume #3	
	Average Volume (mL)	N/A
	Time #1	
	Time #2	
	Time #3	
	Average Time (s)	N/A
	Flow Rate (gpm)	#VALUE!
	Amperage	

pH	Control	Treated
Conductivity (µS/cm)	Control	Treated

Time (min)	1	2	3	Average	Turbidity Red. (%)
0				#DIV/0!	#DIV/0!
5				#DIV/0!	#DIV/0!
10				#DIV/0!	#DIV/0!
15				#DIV/0!	#DIV/0!
20				#DIV/0!	#DIV/0!
25				#DIV/0!	#DIV/0!
30				#DIV/0!	#DIV/0!

AVERAGE	Turbidity #1	701
	Turbidity #2	721
	Turbidity #3	721
	Average Turbidity (NTU)	714
	Volume #1	#DIV/0!
	Volume #2	#DIV/0!
	Volume #3	#DIV/0!
	Average Volume (mL)	N/A
	Time #1	#DIV/0!
	Time #2	#DIV/0!
	Time #3	#DIV/0!
	Average Time (s)	N/A
	Flow Rate (gpm)	#VALUE!
	Amperage	#DIV/0!

pH	Control	Treated
	6.97	#DIV/0!
Conductivity	Control	Treated
	200.00	#DIV/0!

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	698	699	692	696	3%
5	616	597	604	606	15%
10	555	551	557	554	22%
15	522	515	535	524	27%
20	491	490	493	491	31%
25	474	486	481	480	33%
30	470	434	474	459	36%

Sample ID: control downstream (treated, unmixed)
Mixed for (min): 0

Run 1	Turbidity #1	711
	Turbidity #2	702
	Turbidity #3	705
	Average Turbidity (NTU)	706
	Volume #1	2.54
	Volume #2	2.49
	Volume #3	2.45
	Average Volume (mL)	2
	Time #1	15.0
	Time #2	15.0
	Time #3	15.0
	Average Time (s)	15.0
	Flow Rate (gpm)	10.0
	Amperage	8.4

pH	Control	Treated
	6.94	7.32
Conductivity (µS/cm)	182.1	134.4

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	659	670	695	675	4%
5	510	474	519	501	29%
10	344	313	338	332	53%
15	282	252	258	264	63%
20	233	212	214	220	69%
25	200	180	183	188	73%
30	182	162	175	173	75%

Run 2	Turbidity #1	711
	Turbidity #2	702
	Turbidity #3	705
	Average Turbidity (NTU)	706
	Volume #1	2.54
	Volume #2	2.49
	Volume #3	2.45
	Average Volume (mL)	2
	Time #1	15.0
	Time #2	15.0
	Time #3	15.0
	Average Time (s)	15.0
	Flow Rate (gpm)	10.0
	Amperage	8.4

pH	Control	Treated
	6.94	7.32
Conductivity (µS/cm)	182.1	134.4

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	680	681	697	686	3%
5	537	492	497	509	28%
10	424	374	377	392	45%
15	354	315	297	322	54%
20	306	270	268	281	60%
25	269	238	228	245	65%
30	245	199	202	215	69%

Run 3	Turbidity #1	693
	Turbidity #2	639
	Turbidity #3	633
	Average Turbidity (NTU)	655
	Volume #1	2
	Volume #2	2
	Volume #3	2
	Average Volume (mL)	2
	Time #1	15.0
	Time #2	15.0
	Time #3	15.0
	Average Time (s)	15.0
	Flow Rate (gpm)	9.9
	Amperage	8.0

pH	Control	Treated
	6.9	7.34
Conductivity (µS/cm)	132.6	131.8

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	611	627	603	614	6%
5	446	482	464	464	29%
10	335	320	341	332	49%
15	261	267	274	267	59%
20	225	235	214	225	66%
25	189	200	192	194	70%
30	179	164	174	179	73%

Run 4	Turbidity #1	693
	Turbidity #2	639
	Turbidity #3	633
	Average Turbidity (NTU)	655
	Volume #1	2
	Volume #2	2
	Volume #3	2
	Average Volume (mL)	2
	Time #1	15.0
	Time #2	15.0
	Time #3	15.0
	Average Time (s)	15.0
	Flow Rate (gpm)	9.9
	Amperage	8.0

pH	Control	Treated
	6.9	7.34
Conductivity (µS/cm)	132.6	131.8

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	620	596	575	597	15%
5	485	491	466	481	32%
10	381	384	378	381	46%
15	312	323	322	319	55%
20	265	267	265	266	62%
25	232	238	236	235	67%
30	213	208	211	211	70%

Run 5	Turbidity #1	729
	Turbidity #2	723
	Turbidity #3	737
	Average Turbidity (NTU)	730
	Volume #1	2
	Volume #2	2
	Volume #3	2
	Average Volume (mL)	2
	Time #1	15.0
	Time #2	15.0
	Time #3	15.0
	Average Time (s)	15.0
	Flow Rate (gpm)	9.8
	Amperage	8.5

pH	Control	Treated
	6.96	7.29
Conductivity (µS/cm)	217	124

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	611	615	595	607	14%
5	451	444	444	446	37%
10	349	346	343	346	51%
15	311	295	276	294	58%
20	257	255	240	251	64%
25	216	198	194	203	71%
30	165	190	168	181	74%

Run 6	Turbidity #1	729
	Turbidity #2	723
	Turbidity #3	737
	Average Turbidity (NTU)	730
	Volume #1	2
	Volume #2	2
	Volume #3	2
	Average Volume (mL)	2
	Time #1	15.0
	Time #2	15.0
	Time #3	15.0
	Average Time (s)	15.0
	Flow Rate (gpm)	9.8
	Amperage	8.5

pH	Control	Treated
	6.96	7.29
Conductivity (µS/cm)	217	124

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	644	635	607	629	4%
5	458	443	446	449	31%
10	368	351	348	356	46%
15	316	289	294	300	54%
20	270	247	233	250	62%
25	236	220	200	219	67%
30	207	195	190	197	70%

AVERAGE	Turbidity #1	711
	Turbidity #2	688
	Turbidity #3	692
	Average Turbidity (NTU)	697
	Volume #1	2.48
	Volume #2	2.47
	Volume #3	2.46
	Average Volume (mL)	2.47
	Time #1	15.0
	Time #2	15.0
	Time #3	15.0
	Average Time (s)	15.0
	Flow Rate (gpm)	9.9
	Flow Rate (m ³ /hr)	2.243
	Voltage (V)	12
	Amperage	8.3
	Kwh/m ³	0.045

pH	Control	Treated
	6.93	7.32
Conductivity	177.23	130.07

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	638	637	629	635	9%
5	481	471	473	475	32%
10	367	348	354	356	49%
15	306	290	287	294	58%
20	259	248	239	249	64%
25	224	212	206	214	69%
30	202	190	187	193	72%

Sample ID:	30 seconds
Mixed for (min):	0.5

Run 1	Turbidity #1	676
	Turbidity #2	686
	Turbidity #3	709
	Average Turbidity (NTU)	690
	Volume #1	2.5
	Volume #2	2.5
	Volume #3	2.4
	Average Volume (gal)	2
	Time #1	15.2
	Time #2	15.2
	Time #3	15.3
	Average Time (s)	15.2
	Flow Rate (gpm)	9.7
	Amperage	8.0

	Control	Treated
pH	7.12	7.12
Conductivity (µS/cm)	131.2	135.6

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	554	664	680	633	8%
5	436	434	404	425	38%
10	291	284	273	283	59%
15	228	225	227	227	67%
20	200	184	181	188	73%
25	163	162	154	160	77%
30	142	141	141	141	80%

Run 2	Turbidity #1	702
	Turbidity #2	656
	Turbidity #3	693
	Average Turbidity (NTU)	684
	Volume #1	2.6
	Volume #2	2.4
	Volume #3	2.4
	Average Volume (mL)	2.5
	Time #1	15.6
	Time #2	15.5
	Time #3	15.7
	Average Time (s)	15.6
	Flow Rate (gpm)	9.4
	Amperage	8.3

	Control	Treated
pH	6.88	6.99
Conductivity (µS/cm)	205	129.4

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	619	638	647	635	7%
5	445	430	418	431	37%
10	325	289	309	308	55%
15	260	259	231	250	63%
20	224	204	188	205	70%
25	193	183	168	181	73%
30	162	172	148	161	76%

Run 3	Turbidity #1	732
	Turbidity #2	741
	Turbidity #3	732
	Average Turbidity (NTU)	735
	Volume #1	2.49
	Volume #2	2.74
	Volume #3	2.43
	Average Volume (mL)	2.55
	Time #1	15.0
	Time #2	15.0
	Time #3	15.0
	Average Time (s)	15.0
	Flow Rate (gpm)	10.2
	Amperage	8.0

	Control	Treated
pH	7.06	6.92
Conductivity (µS/cm)	122.4	211

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	681	650	667	666	9%
5	453	436	452	447	39%
10	323	298	290	304	59%
15	247	234	218	233	68%
20	201	194	185	193	74%
25	182	169	168	173	76%
30	167	157	155	160	78%

Run 4	Turbidity #1	737
	Turbidity #2	655
	Turbidity #3	740
	Average Turbidity (NTU)	711
	Volume #1	2.55
	Volume #2	2.52
	Volume #3	2.42
	Average Volume (mL)	2.50
	Time #1	15.0
	Time #2	15.0
	Time #3	15.0
	Average Time (s)	15.0
	Flow Rate (gpm)	10.0
	Amperage	8.0

	Control	Treated
pH	7.02	7.02
Conductivity (µS/cm)	117.6	116

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	687	672	680	680	4%
5	457	452	432	447	37%
10	289	301	294	295	59%
15	218	221	208	216	70%
20	191	182	186	186	74%
25	158	161	152	157	78%
30	136	141	141	139	80%

AVERAGE	Turbidity #1	712
	Turbidity #2	685
	Turbidity #3	719
	Average Turbidity (NTU)	705
	Volume #1	2.53
	Volume #2	2.54
	Volume #3	2.41
	Average Volume (mL)	2.49
	Time #1	15.2
	Time #2	15.2
	Time #3	15.3
	Average Time (s)	15.2
	Flow Rate (gpm)	9.8
	Flow Rate (m ³ /hr)	2.233
	Voltage (V)	12
	Amperage	8.1
	Kwh/m ³	0.044

	Control	Treated
pH	7.02	7.01
Conductivity	144.1	148.0

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	635	656	669	653	7%
5	448	438	427	437	38%
10	307	293	292	297	58%
15	238	235	221	231	67%
20	204	191	185	193	73%
25	174	169	161	168	76%
30	152	153	146	150	79%

Sample ID:	1 minute
Mixed for (min):	1

Run 1	Turbidity #1	670
	Turbidity #2	639
	Turbidity #3	623
	Average Turbidity (NTU)	644
	Volume #1	2.5
	Volume #2	2.4
	Volume #3	2.4
	Average Volume (mL)	2
	Time #1	15.1
	Time #2	15.4
	Time #3	15.3
	Average Time (s)	15.3
	Flow Rate (gpm)	9.5
	Amperage	8.1

	Control	Treated
pH		
Conductivity (µS/cm)		

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	623	614	588	608	6%
5	355	331	346	344	47%
10	213	205	209	209	68%
15	154	158	147	153	76%
20	133	125	131	130	80%
25	119	122	113	118	82%
30	111	113	114	113	83%

Run 2	Turbidity #1	710
	Turbidity #2	677
	Turbidity #3	687
	Average Turbidity (NTU)	691
	Volume #1	2.5
	Volume #2	2.4
	Volume #3	2.4
	Average Volume (mL)	2.4
	Time #1	15.5
	Time #2	15.4
	Time #3	15.5
	Average Time (s)	15.5
	Flow Rate (gpm)	9.4
	Amperage	8.1

	Control	Treated
pH	6.88	6.88
Conductivity (µS/cm)	270	121.7

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	642	655	637	645	7%
5	422	464	442	443	36%
10	344	329	310	328	53%
15	256	239	246	247	64%
20	201	189	190	193	72%
25	174	157	166	166	76%
30	179	157	147	161	77%

Run 3	Turbidity #1	647
	Turbidity #2	666
	Turbidity #3	690
	Average Turbidity (NTU)	668
	Volume #1	2.52
	Volume #2	2.49
	Volume #3	2.45
	Average Volume (mL)	2.49
	Time #1	15.0
	Time #2	15.6
	Time #3	15.0
	Average Time (s)	15.2
	Flow Rate (gpm)	9.8
	Amperage	7.9

	Control	Treated
pH	6.84	6.9
Conductivity (µS/cm)	235	135.2

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	659	654	611	641	4%
5	408	367	404	393	41%
10	252	217	268	246	63%
15	183	179	193	185	72%
20	161	153	162	159	76%
25	146	138	142	142	79%
30	130	113	120	121	82%

Run 4	Turbidity #1	
	Turbidity #2	
	Turbidity #3	
	Average Turbidity (NTU)	N/A
	Volume #1	
	Volume #2	
	Volume #3	
	Average Volume (mL)	N/A
	Time #1	
	Time #2	
	Time #3	
	Average Time (s)	N/A
	Flow Rate (gpm)	#VALUE!
	Amperage	

	Control	Treated
pH		
Conductivity (µS/cm)		

Time (min)	1	2	3	Average	Turbidity Red. (%)
0				#DIV/0!	#VALUE!
5				#DIV/0!	#VALUE!
10				#DIV/0!	#VALUE!
15				#DIV/0!	#VALUE!
20				#DIV/0!	#VALUE!
25				#DIV/0!	#VALUE!
30				#DIV/0!	#VALUE!

AVERAGE	Turbidity #1	676
	Turbidity #2	661
	Turbidity #3	667
	Average Turbidity (NTU)	668
	Volume #1	2.49
	Volume #2	2.44
	Volume #3	2.41
	Average Volume (mL)	2.45
	Time #1	15.2
	Time #2	15.5
	Time #3	15.3
	Average Time (s)	15.3
	Flow Rate (gpm)	9.6
	Flow Rate (m ³ /hr)	2.177
	Voltage (V)	12
	Amperage	8.0
	Kwh/m ³	0.044

	Control	Treated
pH	6.86	6.89
Conductivity	252.5	128.5

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	641	641	612	631	5%
5	395	387	397	393	41%
10	270	250	262	261	61%
15	198	192	195	195	71%
20	165	156	161	161	76%
25	146	139	140	142	79%
30	140	128	127	132	80%

Sample ID:	2 minutes
Mixed for (min):	2

Run 1	Turbidity #1	691
	Turbidity #2	726
	Turbidity #3	772
	Average Turbidity (NTU)	730
	Volume #1	2.4
	Volume #2	2.4
	Volume #3	2.4
	Average Volume (mL)	2
	Time #1	15.1
	Time #2	15.3
	Time #3	15.4
	Average Time (s)	15.3
	Flow Rate (gpm)	9.3
	Amperage	8.0

	Control	Treated
pH		
Conductivity (µS/cm)		

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	684	666	630	660	10%
5	369	386	358	371	49%
10	231	237	228	232	68%
15	161	174	171	169	77%
20	134	150	134	139	81%
25	116	123	116	118	84%
30	103	105	100	103	86%

Run 2	Turbidity #1	677
	Turbidity #2	710
	Turbidity #3	687
	Average Turbidity (NTU)	691
	Volume #1	2
	Volume #2	2
	Volume #3	2
	Average Volume (mL)	2
	Time #1	15.5
	Time #2	15.4
	Time #3	15.5
	Average Time (s)	15.5
	Flow Rate (gpm)	9.4
	Amperage	8.1

	Control	Treated
pH	6.88	6.88
Conductivity (µS/cm)	270	121.7

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	626	621	638	628	9%
5	405	400	444	416	40%
10	287	271	295	284	59%
15	208	208	214	210	70%
20	86	177	164	142	79%
25	150	146	159	152	78%
30	124	141	121	129	81%

Run 3	Turbidity #1	737
	Turbidity #2	655
	Turbidity #3	740
	Average Turbidity (NTU)	711
	Volume #1	2.55
	Volume #2	2.52
	Volume #3	2.42
	Average Volume (mL)	2.50
	Time #1	15.0
	Time #2	15.0
	Time #3	15.0
	Average Time (s)	15.0
	Flow Rate (gpm)	10.0
	Amperage	8.0

	Control	Treated
pH		
Conductivity (µS/cm)		

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	678	701	705	695	2%
5	395	387	384	389	45%
10	260	269	234	254	64%
15	184	186	182	184	74%
20	161	154	169	161	77%
25	136	135	130	134	81%
30	136	115	118	123	83%

Run 4	Turbidity #1	647
	Turbidity #2	666
	Turbidity #3	668
	Average Turbidity (NTU)	660
	Volume #1	2.52
	Volume #2	2.49
	Volume #3	2.44
	Average Volume (mL)	2.48
	Time #1	15.0
	Time #2	15.7
	Time #3	15.0
	Average Time (s)	15.2
	Flow Rate (gpm)	9.8
	Amperage	7.9

	Control	Treated
pH	6.84	6.9
Conductivity (µS/cm)	235	135.2

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	637	623	635	632	4%
5	388	360	386	378	43%
10	235	218	232	228	65%
15	174	166	177	172	74%
20	154	137	136	142	78%
25	126	115	117	119	82%
30	110	105	104	106	84%

AVERAGE	Turbidity #1	688
	Turbidity #2	689
	Turbidity #3	717
	Average Turbidity (NTU)	698
	Volume #1	2.49
	Volume #2	2.46
	Volume #3	2.39
	Average Volume (mL)	2.45
	Time #1	15.2
	Time #2	15.3
	Time #3	15.2
	Average Time (s)	15.2
	Flow Rate (gpm)	9.6
	Flow Rate (m ³ /hr)	2.187
	Voltage (V)	12
	Amperage	8.0
	Kwh/m ³	0.044

	Control	Treated
pH	6.86	6.89
Conductivity	252.5	128.5

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	656	653	652	654	6%
5	389	383	393	389	44%
10	253	249	247	250	64%
15	182	184	186	184	74%
20	134	155	151	146	79%
25	132	130	131	131	81%
30	118	117	111	115	84%

Sample ID:	3 minus
Mixed for (min):	3

Run 1	Turbidity #1	670
	Turbidity #2	639
	Turbidity #3	623
	Average Turbidity (NTU)	644
	Volume #1	2.5
	Volume #2	2.4
	Volume #3	2.4
	Average Volume (mL)	2.4
	Time #1	15.1
	Time #2	15.4
	Time #3	15.3
	Average Time (s)	15.3
	Flow Rate (gpm)	9.5
	Amperage	8.1

	Control	Treated
pH		
Conductivity (µS/cm)		

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	618	603	593	605	6%
5	318	310	344	324	50%
10	200	199	196	198	69%
15	174	169	166	170	74%
20	142	147	136	142	78%
25	126	127	124	126	80%
30	103	98	100	100	84%

Run 2	Turbidity #1	702
	Turbidity #2	656
	Turbidity #3	693
	Average Turbidity (NTU)	684
	Volume #1	3
	Volume #2	2
	Volume #3	2
	Average Volume (mL)	2
	Time #1	15.6
	Time #2	15.6
	Time #3	15.7
	Average Time (s)	15.6
	Flow Rate (gpm)	9.4
	Amperage	8.3

	Control	Treated
pH	6.88	6.99
Conductivity (µS/cm)	205	129.4

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	623	636	660	640	6%
5	352	507	369	409	40%
10	203	204	213	207	70%
15	161	157	166	161	76%
20	139	130	133	134	80%
25	111	118	111	113	83%
30	98	92	102	98	86%

Run 3	Turbidity #1	677
	Turbidity #2	710
	Turbidity #3	687
	Average Turbidity (NTU)	691
	Volume #1	2.48
	Volume #2	2.44
	Volume #3	2.36
	Average Volume (mL)	2.43
	Time #1	15.5
	Time #2	15.4
	Time #3	15.5
	Average Time (s)	15.5
	Flow Rate (gpm)	9.4
	Amperage	8.1

	Control	Treated
pH	6.88	6.88
Conductivity (µS/cm)	270	121.7

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	628	654	627	636	8%
5	429	395	403	409	41%
10	280	270	246	265	62%
15	199	183	187	190	73%
20	165	158	155	159	77%
25	138	135	129	134	81%
30	129	116	115	120	83%

Run 4	Turbidity #1	718
	Turbidity #2	718
	Turbidity #3	711
	Average Turbidity (NTU)	716
	Volume #1	2.63
	Volume #2	2.64
	Volume #3	2.55
	Average Volume (mL)	2.61
	Time #1	14.9
	Time #2	16.2
	Time #3	15.7
	Average Time (s)	15.6
	Flow Rate (gpm)	10.0
	Amperage	8.1

	Control	Treated
pH	6.97	7.15
Conductivity (µS/cm)	141.4	120.3

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	671	688	667	675	6%
5	368	374	362	368	49%
10	253	243	246	247	65%
15	188	187	196	190	73%
20	161	153	156	157	78%
25	148	137	136	140	80%
30	142	116	121	126	82%

AVERAGE	Turbidity #1	692
	Turbidity #2	681
	Turbidity #3	679
	Average Turbidity (NTU)	684
	Volume #1	2.54
	Volume #2	2.47
	Volume #3	2.42
	Average Volume (mL)	2.47
	Time #1	15.3
	Time #2	15.6
	Time #3	15.5
	Average Time (s)	15.5
	Flow Rate (gpm)	9.6
	Flow Rate (m ³ /hr)	2.177
	Voltage (V)	12
	Amperage	8.2
	Kwh/m ³	0.045

	Control	Treated
pH	6.91	7.01
Conductivity	205.5	123.8

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	635	645	637	639	7%
5	367	397	370	378	45%
10	234	229	225	229	66%
15	181	174	179	178	74%
20	152	147	145	148	78%
25	131	129	125	128	81%
30	118	106	109	111	84%

Sample ID:	4 minues
Mixed for (min):	4

Run 1	Turbidity #1	691
	Turbidity #2	726
	Turbidity #3	772
	Average Turbidity (NTU)	730
	Volume #1	2.39
	Volume #2	2.39
	Volume #3	2.35
	Average Volume (mL)	2.38
	Time #1	15.1
	Time #2	15.3
	Time #3	15.4
	Average Time (s)	15.3
	Flow Rate (gpm)	9.3
	Amperage	8.0

	Control	Treated
pH		
Conductivity (µS/cm)		

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	679	652	645	659	10%
5	353	368	365	362	50%
10	205	220	222	216	70%
15	164	166	161	164	78%
20	133	122	131	129	82%
25	110	110	104	108	85%
30	97	115	90	101	86%

Run 2	Turbidity #1	702
	Turbidity #2	656
	Turbidity #3	693
	Average Turbidity (NTU)	684
	Volume #1	2.56
	Volume #2	2.41
	Volume #3	2.38
	Average Volume (mL)	2.45
	Time #1	15.6
	Time #2	15.5
	Time #3	15.2
	Average Time (s)	15.4
	Flow Rate (gpm)	9.5
	Amperage	8.3

	Control	Treated
pH	6.88	6.99
Conductivity (µS/cm)	205	129.4

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	661	633	653	649	5%
5	361	338	362	354	48%
10	211	221	228	220	68%
15	170	155	153	159	77%
20	136	139	134	136	80%
25	120	110	114	115	83%
30	108	104	95	102	85%

Run 3	Turbidity #1	677
	Turbidity #2	710
	Turbidity #3	687
	Average Turbidity (NTU)	691
	Volume #1	2.48
	Volume #2	2.44
	Volume #3	2.36
	Average Volume (mL)	2.43
	Time #1	15.5
	Time #2	15.4
	Time #3	15.5
	Average Time (s)	15.5
	Flow Rate (gpm)	9.4
	Amperage	8.1

	Control	Treated
pH	6.88	6.88
Conductivity (µS/cm)	270	121.7

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	659	642	625	642	7%
5	411	388	408	402	42%
10	255	236	247	246	64%
15	189	186	192	189	73%
20	162	148	157	156	77%
25	146	128	136	137	80%
30	105	113	125	114	83%

Run 4	Turbidity #1	732
	Turbidity #2	741
	Turbidity #3	732
	Average Turbidity (NTU)	735
	Volume #1	2.49
	Volume #2	2.74
	Volume #3	2.43
	Average Volume (mL)	2.55
	Time #1	15.1
	Time #2	15.5
	Time #3	15.0
	Average Time (s)	15.2
	Flow Rate (gpm)	10.1
	Amperage	8.0

	Control	Treated
pH	7.06	6.92
Conductivity (µS/cm)	122.4	211

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	662	678	668	669	9%
5	400	383	393	392	47%
10	238	243	239	240	67%
15	188	185	191	188	74%
20	155	157	154	155	79%
25	139	130	143	137	81%
30	125	120	120	122	83%

AVERAGE	Turbidity #1	701
	Turbidity #2	708
	Turbidity #3	721
	Average Turbidity (NTU)	710
	Volume #1	2.48
	Volume #2	2.50
	Volume #3	2.38
	Average Volume (mL)	2.45
	Time #1	15.3
	Time #2	15.4
	Time #3	15.3
	Average Time (s)	15.3
	Flow Rate (gpm)	9.6
	Flow Rate (m ³ /hr)	2.178
	Voltage (V)	12
	Amperage	8.1
	Kwh/m ³	0.045

	Control	Treated
pH	6.94	6.93
Conductivity	199.1	154.0

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	665	651	648	655	8%
5	381	369	382	378	47%
10	227	230	234	230	68%
15	178	173	174	175	75%
20	147	142	144	144	80%
25	129	120	124	124	83%
30	109	113	108	110	85%

Sample ID:	5 minutes
Mixed for (min):	5

Run 1	Turbidity #1	676
	Turbidity #2	686
	Turbidity #3	709
	Average Turbidity (NTU)	690
	Volume #1	2.5
	Volume #2	2.5
	Volume #3	2.4
	Average Volume (mL)	2.5
	Time #1	15.2
	Time #2	15.2
	Time #3	15.3
	Average Time (s)	15.2
	Flow Rate (gpm)	9.7
	Amperage	8.0

	Control	Treated
pH	7.12	7.12
Conductivity (µS/cm)	131.2	135.6

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	689	649	615	651	6%
5	378	397	377	384	44%
10	228	235	229	231	67%
15	189	172	176	179	74%
20	145	147	146	146	79%
25	121	115	122	119	83%
30	102	109	106	106	85%

Run 2	Turbidity #1	702
	Turbidity #2	656
	Turbidity #3	693
	Average Turbidity (NTU)	684
	Volume #1	2.56
	Volume #2	2.41
	Volume #3	2.38
	Average Volume (mL)	2.45
	Time #1	15.6
	Time #2	15.5
	Time #3	15.2
	Average Time (s)	15.4
	Flow Rate (gpm)	9.5
	Amperage	8.3

	Control	Treated
pH	6.88	6.99
Conductivity (µS/cm)	205	129.4

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	647	613	640	633	7%
5	380	381	357	373	45%
10	244	253	239	245	64%
15	177	190	179	182	73%
20	149	150	146	148	78%
25	127	135	129	130	81%
30	113	102	103	106	84%

Run 3	Turbidity #1	718
	Turbidity #2	718
	Turbidity #3	711
	Average Turbidity (NTU)	716
	Volume #1	2.63
	Volume #2	2.64
	Volume #3	2.56
	Average Volume (mL)	2.61
	Time #1	14.9
	Time #2	16.2
	Time #3	15.7
	Average Time (s)	15.6
	Flow Rate (gpm)	10.0
	Amperage	8.1

	Control	Treated
pH	6.97	7.15
Conductivity (µS/cm)	141.4	120.3

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	684	659	676	673	6%
5	375	364	368	369	48%
10	240	227	228	232	68%
15	186	174	178	179	75%
20	146	154	152	151	79%
25	130	141	127	133	81%
30	116	127	117	120	83%

Run 4	Turbidity #1	
	Turbidity #2	
	Turbidity #3	
	Average Turbidity (NTU)	N/A
	Volume #1	
	Volume #2	
	Volume #3	
	Average Volume (mL)	N/A
	Time #1	
	Time #2	
	Time #3	
	Average Time (s)	N/A
	Flow Rate (gpm)	#VALUE!
	Amperage	

	Control	Treated
pH		
Conductivity (µS/cm)		

Time (min)	1	2	3	Average	Turbidity Red. (%)
0				#DIV/0!	#VALUE!
5				#DIV/0!	#VALUE!
10				#DIV/0!	#VALUE!
15				#DIV/0!	#VALUE!
20				#DIV/0!	#VALUE!
25				#DIV/0!	#VALUE!
30				#DIV/0!	#VALUE!

AVERAGE	Turbidity #1	699
	Turbidity #2	687
	Turbidity #3	704
	Average Turbidity (NTU)	697
	Volume #1	2.57
	Volume #2	2.51
	Volume #3	2.45
	Average Volume (mL)	2.51
	Time #1	15.2
	Time #2	15.7
	Time #3	15.4
	Average Time (s)	15.4
	Flow Rate (gpm)	9.8
	Flow Rate (m ³ /hr)	2.216
	Voltage (V)	12
	Amperage	8.1
	Kwh/m ³	0.044

	Control	Treated
pH	6.99	7.09
Conductivity	159.2	128.4

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	673	640	644	652	6%
5	378	381	367	375	46%
10	237	238	232	236	66%
15	184	179	178	180	74%
20	147	150	148	148	79%
25	126	130	126	127	82%
30	110	113	109	111	84%

Sample ID: V1-10		
Mixed for (min):		

Run 1	Turbidity #1	695
	Turbidity #2	697
	Turbidity #3	682
	Average Turbidity (NTU)	691
	Volume #1	2.49
	Volume #2	2.52
	Volume #3	2.49
	Average Volume (mL)	2
	Time #1	15.0
	Time #2	15.0
	Time #3	15.0
	Average Time (s)	15.0
	Flow Rate (gpm)	10.0
	Amperage	8.0

pH	Control	Treated
Conductivity (µS/cm)	6.95	7.08
	179.8	144.1

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	626	607	630	621	10%
5	406	441	425	424	39%
10	279	285	278	281	59%
15	215	224	223	221	68%
20	185	184	187	185	73%
25	157	160	174	164	76%
30	156	154	140	150	78%

Run 2	Turbidity #1	695
	Turbidity #2	697
	Turbidity #3	682
	Average Turbidity (NTU)	691
	Volume #1	2.49
	Volume #2	2.52
	Volume #3	2.49
	Average Volume (mL)	2
	Time #1	15.0
	Time #2	15.0
	Time #3	15.0
	Average Time (s)	15.0
	Flow Rate (gpm)	10.0
	Amperage	8.0

pH	Control	Treated
Conductivity (µS/cm)	6.95	7.08
	179.8	144.1

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	615	581	621	606	12%
5	428	429	402	420	39%
10	295	266	278	280	60%
15	208	226	220	218	68%
20	177	166	169	171	75%
25	164	166	148	159	77%
30	147	133	140	140	80%

Run 3	Turbidity #1	695
	Turbidity #2	697
	Turbidity #3	682
	Average Turbidity (NTU)	691
	Volume #1	2.49
	Volume #2	2.52
	Volume #3	2.49
	Average Volume (mL)	2
	Time #1	15.0
	Time #2	15.0
	Time #3	15.0
	Average Time (s)	15.0
	Flow Rate (gpm)	10.0
	Amperage	8.0

pH	Control	Treated
Conductivity (µS/cm)	6.95	7.08
	179.8	144.1

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	642	612	597	617	11%
5	440	449	411	433	37%
10	269	290	269	276	60%
15	212	229	220	220	68%
20	194	199	180	191	72%
25	159	171	162	164	76%
30	144	157	138	146	79%

Run 4	Turbidity #1	711
	Turbidity #2	706
	Turbidity #3	677
	Average Turbidity (NTU)	698
	Volume #1	2
	Volume #2	2
	Volume #3	2
	Average Volume (mL)	2
	Time #1	15.2
	Time #2	15.6
	Time #3	15.2
	Average Time (s)	15.3
	Flow Rate (gpm)	9.6
	Amperage	8.3

pH	Control	Treated
Conductivity (µS/cm)	6.9	7.56
	128.1	175.3

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	648	547	441	545	21%
5	86	105	98	96	86%
10	63	68	69	67	90%
15	49	50	51	50	93%
20	44	48	46	46	93%
25	38	43	40	41	94%
30	37	44	36	39	94%

Run 5	Turbidity #1	
	Turbidity #2	
	Turbidity #3	
	Average Turbidity (NTU)	N/A
	Volume #1	
	Volume #2	
	Volume #3	
	Average Volume (mL)	N/A
	Time #1	
	Time #2	
	Time #3	
	Average Time (s)	N/A
	Flow Rate (gpm)	#VALUE!
	Amperage	

pH	Control	Treated
Conductivity (µS/cm)		

Time (min)	1	2	3	Average	Turbidity Red. (%)
0				#DN/0!	#DN/0!
5				#DN/0!	#DN/0!
10				#DN/0!	#DN/0!
15				#DN/0!	#DN/0!
20				#DN/0!	#DN/0!
25				#DN/0!	#DN/0!
30				#DN/0!	#DN/0!

Run 6	Turbidity #1	
	Turbidity #2	
	Turbidity #3	
	Average Turbidity (NTU)	N/A
	Volume #1	
	Volume #2	
	Volume #3	
	Average Volume (mL)	N/A
	Time #1	
	Time #2	
	Time #3	
	Average Time (s)	N/A
	Flow Rate (gpm)	#VALUE!
	Amperage	

pH	Control	Treated
Conductivity (µS/cm)		

Time (min)	1	2	3	Average	Turbidity Red. (%)
0				#DN/0!	#DN/0!
5				#DN/0!	#DN/0!
10				#DN/0!	#DN/0!
15				#DN/0!	#DN/0!
20				#DN/0!	#DN/0!
25				#DN/0!	#DN/0!
30				#DN/0!	#DN/0!

AVERAGE	Turbidity #1	699
	Turbidity #2	699
	Turbidity #3	681
	Average Turbidity (NTU)	693
	Volume #1	2.48
	Volume #2	2.50
	Volume #3	2.48
	Average Volume (mL)	2.49
	Time #1	15.0
	Time #2	15.1
	Time #3	15.1
	Average Time (s)	15.1
	Flow Rate (gpm)	9.9
	Flow Rate (m³/hr)	2.247
	Voltage (V)	12
	Amperage	8.1
	Kwh/m³	0.043

pH	Control	Treated
Conductivity	6.94	7.20
	166.88	151.90

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	633	587	572	597	14%
5	340	356	334	343	50%
10	227	227	223	226	67%
15	171	182	178	177	74%
20	150	149	145	148	79%
25	130	135	131	132	81%
30	121	122	113	119	83%

Sample ID:	V2-10
Mixed for (min):	

Run 1	Turbidity #1	688
	Turbidity #2	692
	Turbidity #3	696
	Average Turbidity (NTU)	692
	Volume #1	2.5
	Volume #2	2.4
	Volume #3	2.4
	Average Volume (mL)	2.5
	Time #1	15.4
	Time #2	14.9
	Time #3	15.7
	Average Time (s)	15.3
	Flow Rate (gpm)	9.6
	Amperage	8.2

	Control	Treated
pH	7.06	7.23
Conductivity (µS/cm)	159.2	129.1

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	620	602	619	614	11%
5	480	478	461	473	32%
10	359	347	361	356	49%
15	324	295	278	299	57%
20	272	246	241	253	63%
25	252	208	200	220	68%
30	219	189	185	198	71%

Run 2	Turbidity #1	688
	Turbidity #2	692
	Turbidity #3	696
	Average Turbidity (NTU)	692
	Volume #1	2.5
	Volume #2	2.4
	Volume #3	2.4
	Average Volume (mL)	2.5
	Time #1	15.4
	Time #2	14.9
	Time #3	15.7
	Average Time (s)	15.3
	Flow Rate (gpm)	9.6
	Amperage	8.2

	Control	Treated
pH	7.06	7.23
Conductivity (µS/cm)	159.2	129.1

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	666	652	661	660	5%
5	393	359	364	372	46%
10	271	257	268	265	62%
15	224	205	223	217	69%
20	195	179	204	193	72%
25	184	163	182	176	75%
30	165	139	178	161	77%

Run 3	Turbidity #1	
	Turbidity #2	
	Turbidity #3	
	Average Turbidity (NTU)	N/A
	Volume #1	
	Volume #2	
	Volume #3	
	Average Volume (mL)	N/A
	Time #1	
	Time #2	
	Time #3	
	Average Time (s)	N/A
	Flow Rate (gpm)	#VALUE!
	Amperage	

	Control	Treated
pH		
Conductivity (µS/cm)		

Time (min)	1	2	3	Average	Turbidity Red. (%)
0				#DIV/0!	#VALUE!
5				#DIV/0!	#VALUE!
10				#DIV/0!	#VALUE!
15				#DIV/0!	#VALUE!
20				#DIV/0!	#VALUE!
25				#DIV/0!	#VALUE!
30				#DIV/0!	#VALUE!

Run 4	Turbidity #1	
	Turbidity #2	
	Turbidity #3	
	Average Turbidity (NTU)	N/A
	Volume #1	
	Volume #2	
	Volume #3	
	Average Volume (mL)	N/A
	Time #1	
	Time #2	
	Time #3	
	Average Time (s)	N/A
	Flow Rate (gpm)	#VALUE!
	Amperage	

	Control	Treated
pH		
Conductivity (µS/cm)		

Time (min)	1	2	3	Average	Turbidity Red. (%)
0				#DIV/0!	#VALUE!
5				#DIV/0!	#VALUE!
10				#DIV/0!	#VALUE!
15				#DIV/0!	#VALUE!
20				#DIV/0!	#VALUE!
25				#DIV/0!	#VALUE!
30				#DIV/0!	#VALUE!

AVERAGE	Turbidity #1	688
	Turbidity #2	692
	Turbidity #3	696
	Average Turbidity (NTU)	692
	Volume #1	2.52
	Volume #2	2.39
	Volume #3	2.44
	Average Volume (mL)	2.45
	Time #1	15.4
	Time #2	14.9
	Time #3	15.7
	Average Time (s)	15.3
	Flow Rate (gpm)	9.6
	Flow Rate (m ³ /hr)	2.181
	Voltage (V)	12
	Amperage	8.2
	Kwh/m ³	0.045

	Control	Treated
pH	7.06	7.23
Conductivity	159.2	129.1

Time (min)	1	2	3	Average	Turbidity Red. (%)
0	643	627	640	637	8%
5	437	419	413	423	39%
10	315	302	315	311	55%
15	274	250	251	258	63%
20	234	213	223	223	68%
25	218	186	191	198	71%
30	192	164	182	179	74%

		Sheet Label	Time (min.)	A	Flow Rate	NTU	0	5	10	15	20	25	30
Control- UPSTREAM		CU	CU	#DM/OI	#VALUE!	714	3%	15%	22%	27%	31%	33%	36%
DOWNSTREAM - UNMIXED		CD	CD	8.3	9.9	697	9%	32%	49%	58%	64%	69%	72%
1	30 sec	30s	0.50	8.0	10	690	8%	38%	59%	67%	73%	77%	80%
2		30s	0.50	8.3	9.4	684	7%	37%	55%	63%	70%	73%	76%
3		30s	0.50	8.0	10.2	735	9%	39%	59%	68%	74%	76%	78%
4		30s	0.50	8.0	10.0	711	4%	37%	59%	70%	74%	78%	80%
avg		30s	0.50	8.1	9.8	705	7%	38%	58%	67%	73%	76%	79%
1	1 min	1	1	8.1	10	644	6%	47%	68%	76%	80%	82%	83%
2		1	1	8.1	9.4	691	7%	36%	53%	64%	72%	76%	77%
3		1	1	7.9	9.8	668	4%	41%	63%	72%	76%	79%	82%
4		1	1	0.0									
avg		1	1	8.0	9.6	668	5%	41%	61%	71%	76%	79%	80%
1	2 min	2	2	8.0	9	730	10%	49%	68%	77%	81%	84%	86%
2		2	2	8.1	9.4	691	9%	40%	59%	70%	79%	78%	81%
3		2	2	8.0	10.0	711	2%	45%	64%	74%	77%	81%	83%
4		2	2	7.9	9.8	660	4%	43%	65%	74%	78%	82%	84%
avg		2	2	8.0	9.6	698	6%	44%	64%	74%	79%	81%	84%
1	3 min	3	3	8.1	10	644	6%	50%	69%	74%	78%	80%	84%
2		3	3	8.3	9.4	684	6%	40%	70%	76%	80%	83%	86%
3		3	3	8.1	9.4	691	8%	41%	62%	73%	77%	81%	83%
4		3	3	8.1	10.0	716	6%	49%	65%	73%	78%	80%	82%
avg		3	3	8.2	9.6	684	7%	45%	66%	74%	78%	81%	84%
1	4 min	4	4	8.0	9	730	10%	50%	70%	78%	82%	85%	86%
2		4	4	8.3	9.5	684	5%	48%	68%	77%	80%	83%	85%
3		4	4	8.1	9.4	691	7%	42%	64%	73%	77%	80%	83%
4		4	4	8.0	10.1	735	9%	47%	67%	74%	79%	81%	83%
avg		4	4	8.1	9.6	710	8%	47%	68%	75%	80%	83%	85%
1	5 min	5	5	8.0	10	690	6%	44%	67%	74%	79%	83%	85%
2		5	5	8.3	9.5	684	7%	45%	64%	73%	78%	81%	84%
3		5	5	8.1	10.0	716	6%	48%	68%	75%	79%	81%	83%
4		5	5	0.0									
avg		5	5	8.1	9.8	697	6%	46%	66%	74%	79%	82%	84%
1	V1-10	V1-10	V1-10	8.0	10	691	10%	39%	59%	68%	73%	76%	78%
2		V1-10	V1-10	8.0	10.0	691	12%	39%	60%	68%	75%	77%	80%
3		V1-10	V1-10	8.0	10.0	691	11%	37%	60%	68%	72%	76%	79%
avg		V1-10	V1-10	8.1	9.9	693	14%	50%	67%	74%	79%	81%	83%
1	V2-10	V2-10	V2-10	8.2	10	692	11%	32%	49%	57%	63%	68%	71%
2		V2-10	V2-10	8.2	9.6	692	5%	46%	62%	69%	72%	75%	77%
3		V2-10	V2-10	0.0									
4		V2-10	V2-10	0.0									
avg		V2-10	V2-10	8.2	9.6	692	8%	39%	55%	63%	68%	71%	74%

Version 1 Passive Mixer (V1)



Version 2 Passive Mixer (V2)



Appendix D: Electrode Longevity Data

Testing Parameters	
Date	6/13/2024
Time Start	1:26PM
Time Interval (mins)	0-60
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	12
Turbidity 1	648
Turbidity 2	636
Turbidity 3	650
Turbidity AVG (NTU)	645
	GPM
Flow Rate 1	4.7
Flow Rate 2	4.7
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.133

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
0	0.00	11.5
5	0.08	11.9
10	0.17	12
15	0.25	12
20	0.33	12
25	0.42	11.9
30	0.50	11.9
35	0.58	11.8
40	0.67	11.9
45	0.75	11.8
50	0.83	11.7
55	0.92	11.7
60	1.00	11.7

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	671	609	-4%	6%	9%
5	616	266	4%	59%	57%
10	525	168	19%	74%	68%
15	512	148	21%	77%	71%
20	519	131	19%	80%	75%
25	511	118	21%	82%	77%
30	493	109	24%	83%	78%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	638	589	1%	9%	8%
5	632	234	2%	64%	63%
10	585	169	9%	74%	71%
15	539	130	16%	80%	76%
20	528	122	18%	81%	77%
25	506	118	22%	82%	77%
30	482	98.8	25%	85%	80%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Contol	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	655	599	-2%	7%	8%
5	624	250	3%	61%	60%
10	555	169	14%	74%	70%
15	526	139	18%	78%	74%
20	524	127	19%	80%	76%
25	509	118	21%	82%	77%
30	488	104	24%	84%	79%

Testing Parameters	
Date	6/13/2024
Time Start	2:26PM
Time Interval (mins)	60-120
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	11.6
Turbidity 1	719
Turbidity 2	663
Turbidity 3	659
Turbidity AVG (NTU)	680
	GPM
Flow Rate 1	4.7
Flow Rate 2	5.0
Flow Rate 3	4.6
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.128

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
60	1.00	11.7
65	1.08	11.7
70	1.17	11.6
75	1.25	11.6
80	1.33	11.5
85	1.42	11.5
90	1.50	11.4
95	1.58	11.5
100	1.67	11.4
105	1.75	11.4
110	1.83	11.4
115	1.92	11.3
120	2.00	11.3

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	662	572	3%	16%	14%
5	571	169	16%	75%	70%
10	539	140	21%	79%	74%
15	466	94.7	32%	86%	80%
20	462	85	32%	88%	82%
25	454	79	33%	88%	83%
30	433	68	36%	90%	84%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Contol	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	662	572	3%	16%	14%
5	571	169	16%	75%	70%
10	539	140	21%	79%	74%
15	466	95	32%	86%	80%
20	462	85	32%	88%	82%
25	454	79	33%	88%	83%
30	433	68	36%	90%	84%

Testing Parameters	
Date	6/13/2024
Time Start	3:26PM
Time Interval (mins)	120-180
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	11.3
Turbidity 1	707
Turbidity 2	730
Turbidity 3	722
Turbidity AVG (NTU)	720
Flow Rate 1	GPM 4.9
Flow Rate 2	4.9
Flow Rate 3	4.7
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [KWh/m ³]	0.124

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
120	2.00	11.3
125	2.08	11.2
130	2.17	11.3
135	2.25	11.2
140	2.33	11.2
145	2.42	11.2
150	2.50	11.2
155	2.58	11.2
160	2.67	11.1
165	2.75	11.1
170	2.83	11
175	2.92	11
180	3.00	10.9
	Max	11.3
	Mean	11.1
	Min	10.9

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	712	623	1%	13%	13%
5	587	195	18%	73%	67%
10	548	149	24%	79%	73%
15	508	114	29%	84%	78%
20	487	97	32%	87%	80%
25	451	89	37%	88%	80%
30	470	77	35%	89%	84%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	712	623	1%	13%	13%
5	587	195	18%	73%	67%
10	548	149	24%	79%	73%
15	508	114	29%	84%	78%
20	487	97	32%	87%	80%
25	451	89	37%	88%	80%
30	470	77	35%	89%	84%

Testing Parameters	
Date	6/20/2024
Time Start	8:20AM
Time Interval (mins)	180-240
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	10.2
Turbidity 1	708
Turbidity 2	714
Turbidity 3	734
Turbidity AVG (NTU)	719
Flow Rate 1	GPM 4.9
Flow Rate 2	4.9
Flow Rate 3	4.8
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [KWh/m ³]	0.111

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
180	3.00	9.5
185	3.08	10
190	3.17	10.2
195	3.25	10.2
200	3.33	10.4
205	3.42	10.6
210	3.50	10.7
215	3.58	10.7
220	3.67	10.7
225	3.75	10.7
230	3.83	10.6
235	3.92	10.6
240	4.00	10.5
	Max	10.7
	Mean	10.4
	Min	9.5

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	624	589	13%	18%	6%
5	571	324	21%	55%	43%
10	530	209	26%	71%	61%
15	479	165	33%	77%	66%
20	472	137	34%	81%	71%
25	451	119	37%	83%	74%
30	401	108	44%	85%	73%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	624	589	13%	18%	6%
5	571	324	21%	55%	43%
10	530	209	26%	71%	61%
15	479	165	33%	77%	66%
20	472	137	34%	81%	71%
25	451	119	37%	83%	74%
30	401	108	44%	85%	73%

Testing Parameters	
Date	6/20/2024
Time Start	9:20AM
Time Interval (mins)	240-300
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	10.6
Turbidity 1	714
Turbidity 2	729
Turbidity 3	707
Turbidity AVG (NTU)	717
Flow Rate 1	5.0
Flow Rate 2	4.9
Flow Rate 3	5.1
Flow Rate AVG (GPM)	5.0
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.112

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
240	4.00	10.6
245	4.08	10.6
250	4.17	10.5
255	4.25	10.5
260	4.33	10.5
265	4.42	10.6
270	4.50	10.5
275	4.58	10.5
280	4.67	10.5
285	4.75	10.5
290	4.83	10.6
295	4.92	10.8
300	5.00	10.8

Max	10.8
Mean	10.6
Min	10.5

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	726	672	-1%	6%	7%
5	631	184	12%	74%	71%
10	582	145	19%	80%	75%
15	554	119	23%	83%	79%
20	523	105	27%	85%	80%
25	502	97	30%	87%	81%
30	496	88	31%	88%	82%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	726	672	-1%	6%	7%
5	631	184	12%	74%	71%
10	582	145	19%	80%	75%
15	554	119	23%	83%	79%
20	523	105	27%	85%	80%
25	502	97	30%	87%	81%
30	496	88	31%	88%	82%

Testing Parameters	
Date	6/20/2024
Time Start	10:20AM
Time Interval (mins)	300-360
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	10.8
Turbidity 1	675
Turbidity 2	672
Turbidity 3	695
Turbidity AVG (NTU)	681
Flow Rate 1	4.7
Flow Rate 2	4.9
Flow Rate 3	5.0
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.118

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
300	5.00	10.8
305	5.08	10.8
310	5.17	10.8
315	5.25	10.8
320	5.33	10.9
325	5.42	10.9
330	5.50	10.9
335	5.58	11
340	5.67	11
345	5.75	11
350	5.83	11.1
355	5.92	11
360	6.00	11

Max	11.1
Mean	10.9
Min	10.8

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	669	618	2%	9%	8%
5	586	163	14%	76%	72%
10	506	119	26%	83%	76%
15	531	93.5	22%	86%	82%
20	501	87	26%	87%	83%
25	459	76	33%	89%	84%
30	453	71	33%	90%	84%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	669	618	2%	9%	8%
5	586	163	14%	76%	72%
10	506	119	26%	83%	76%
15	531	94	22%	86%	82%
20	501	87	26%	87%	83%
25	459	76	33%	89%	84%
30	453	71	33%	90%	84%

Testing Parameters		Time VS Current Reading			Sample A					
Date	6/20/2024	Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	12:20PM	360	6.00	9.8	0	710	653	1%	9%	8%
Time Interval (mins)	360-420	365	6.08	10.4	5	636	243	12%	66%	62%
Inter-electrode Distance (cm)	0.5	370	6.17	10.6	10	576	179	20%	75%	69%
Voltage (Volts)	12	375	6.25	10.6	15	542	148	25%	79%	73%
Current (Amps)	10.4	380	6.33	10.6	20	496	125	31%	83%	75%
Turbidity 1	718	385	6.42	10.6	25	486	120	32%	83%	75%
Turbidity 2	712	390	6.50	10.6	30	463	109	36%	85%	76%
Turbidity 3	726	395	6.58	10.6	Sample B					
Turbidity AVG (NTU)	719	400	6.67	10.6	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Flow Rate 1	4.9	410	6.83	10.6	0			100%	100%	#DIV/0!
Flow Rate 2	4.9	415	6.92	10.6	5			100%	100%	#DIV/0!
Flow Rate 3	4.7	420	7.00	10.6	10			100%	100%	#DIV/0!
Flow Rate AVG (GPM)	4.8		Max	10.6	15			100%	100%	#DIV/0!
Flow Rate AVG (m ³ /hr)	1.1		Mean	10.5	20			100%	100%	#DIV/0!
Specific Energy Consumption (SEC) [kWh/m ³]	0.114		Min	9.8	25			100%	100%	#DIV/0!
					30			100%	100%	#DIV/0!
					Sample C					
					Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
					0			100%	100%	#DIV/0!
					5			100%	100%	#DIV/0!
					10			100%	100%	#DIV/0!
					15			100%	100%	#DIV/0!
					20			100%	100%	#DIV/0!
					25			100%	100%	#DIV/0!
					30			100%	100%	#DIV/0!
					Average					
					Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
					0	710	653	1%	9%	8%
					5	636	243	12%	66%	62%
					10	576	179	20%	75%	69%
					15	542	148	25%	79%	73%
					20	496	125	31%	83%	75%
					25	486	120	32%	83%	75%
					30	463	109	36%	85%	76%

Testing Parameters		Time VS Current Reading			Sample A					
Date	6/20/2024	Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	1:05PM	420	7.00	10.6	0	698	644	3%	10%	8%
Time Interval (mins)	420-480	425	7.08	10.7	5	645	185	10%	74%	71%
Inter-electrode Distance (cm)	0.5	430	7.17	10.6	10	563	136	21%	81%	76%
Voltage (Volts)	12	435	7.25	10.6	15	503	128	30%	82%	75%
Current (Amps)	10.6	440	7.33	10.6	20	488	103	32%	86%	79%
Turbidity 1	729	445	7.42	10.6	25	450	99	37%	86%	78%
Turbidity 2	721	450	7.50	10.6	30	469	83	35%	88%	82%
Turbidity 3	699	455	7.58	10.5	Sample B					
Turbidity AVG (NTU)	716	460	7.67	10.5	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Flow Rate 1	4.9	465	7.75	10.5	0			100%	100%	#DIV/0!
Flow Rate 2	5.0	470	7.83	10.5	5			100%	100%	#DIV/0!
Flow Rate 3	4.9	475	7.92	10.4	10			100%	100%	#DIV/0!
Flow Rate AVG (GPM)	5.0	480	8.00	10.4	15			100%	100%	#DIV/0!
Flow Rate AVG (m ³ /hr)	1.1		Max	10.7	20			100%	100%	#DIV/0!
Specific Energy Consumption (SEC) [kWh/m ³]	0.113		Mean	10.5	25			100%	100%	#DIV/0!
			Min	10.4	30			100%	100%	#DIV/0!
					Sample C					
					Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
					0			100%	100%	#DIV/0!
					5			100%	100%	#DIV/0!
					10			100%	100%	#DIV/0!
					15			100%	100%	#DIV/0!
					20			100%	100%	#DIV/0!
					25			100%	100%	#DIV/0!
					30			100%	100%	#DIV/0!
					Average					
					Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
					0	698	644	3%	10%	8%
					5	645	185	10%	74%	71%
					10	563	136	21%	81%	76%
					15	503	128	30%	82%	75%
					20	488	103	32%	86%	79%
					25	450	99	37%	86%	78%
					30	469	83	35%	88%	82%

Testing Parameters	
Date	6/20/2024
Time Start	2:05PM
Time Interval (mins)	480-540
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	10.4
Turbidity 1	706
Turbidity 2	723
Turbidity 3	698
Turbidity AVG (NTU)	709
Flow Rate 1	GPM
Flow Rate 2	4.7
Flow Rate 3	4.7
Flow Rate AVG (GPM)	4.7
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.116

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
480	8.00	10.4
485	8.08	10.3
490	8.17	10.3
495	8.25	10.3
500	8.33	10.3
505	8.42	10.3
510	8.50	10.3
515	8.58	10.2
520	8.67	10.2
525	8.75	10.1
530	8.83	10.1
535	8.92	10.1
540	9.00	10

Max	10.4
Mean	10.2
Min	10.0

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	678	605	4%	15%	11%
5	631	195	11%	72%	69%
10	572	152	19%	79%	73%
15	525	113	26%	84%	78%
20	536	101	24%	86%	81%
25	497	91	30%	87%	82%
30	489	82	31%	88%	83%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	678	605	4%	15%	11%
5	631	195	11%	72%	69%
10	572	152	19%	79%	73%
15	525	113	26%	84%	78%
20	536	101	24%	86%	81%
25	497	91	30%	87%	82%
30	489	82	31%	88%	83%

Testing Parameters	
Date	6/20/2024
Time Start	3:05
Time Interval (mins)	540-600
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	10
Turbidity 1	677
Turbidity 2	706
Turbidity 3	724
Turbidity AVG (NTU)	702
Flow Rate 1	GPM
Flow Rate 2	4.9
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.7
Flow Rate AVG (m ³ /hr)	4.8
Specific Energy Consumption (SEC) [kWh/m ³]	1.1

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
540	9.00	10
545	9.08	10
550	9.17	9.9
555	9.25	9.9
560	9.33	9.9
565	9.42	9.9
570	9.50	9.9
575	9.58	9.8
580	9.67	9.9
585	9.75	9.8
590	9.83	9.8
595	9.92	9.8
600	10.00	9.8

Max	10.0
Mean	9.9
Min	9.8

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	643	594	8%	15%	8%
5	536	198	24%	72%	63%
10	495	150	30%	79%	70%
15	500	120	29%	83%	76%
20	470	108	33%	85%	77%
25	483	95	31%	86%	80%
30	447	86	36%	88%	81%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	643	594	8%	15%	8%
5	536	198	24%	72%	63%
10	495	150	30%	79%	70%
15	500	120	29%	83%	76%
20	470	108	33%	85%	77%
25	483	95	31%	86%	80%
30	447	86	36%	88%	81%

Testing Parameters	
Date	6/21/2024
Time Start	8:15AM
Time Interval (mins)	600-660
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	9
Turbidity 1	687
Turbidity 2	857
Turbidity 3	671
Turbidity AVG (NTU)	738
Flow Rate 1	GPM 4.9
Flow Rate 2	4.7
Flow Rate 3	4.8
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.099

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
600	10.00	8
605	10.08	8.6
610	10.17	8.8
615	10.25	9.1
620	10.33	9.3
625	10.42	9.5
630	10.50	9.7
635	10.58	9.8
640	10.67	9.9
645	10.75	9.9
650	10.83	10
655	10.92	10
660	11.00	10
	Max	10.0
	Mean	9.4
	Min	8.0

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	857	671	-16%	9%	22%
5	704	297	5%	60%	58%
10	665	204	10%	72%	69%
15	605	170	18%	77%	72%
20	603	144	18%	80%	76%
25	594	130	20%	82%	78%
30	550	120	26%	84%	78%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	857	671	-16%	9%	22%
5	704	297	5%	60%	58%
10	665	204	10%	72%	69%
15	605	170	18%	77%	72%
20	603	144	18%	80%	76%
25	594	130	20%	82%	78%
30	550	120	26%	84%	78%

Testing Parameters	
Date	6/21/2024
Time Start	9:15AM
Time Interval (mins)	660-720
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	10
Turbidity 1	674
Turbidity 2	680
Turbidity 3	662
Turbidity AVG (NTU)	672
Flow Rate 1	GPM 4.9
Flow Rate 2	4.7
Flow Rate 3	4.5
Flow Rate AVG (GPM)	4.7
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.112

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
660	11.00	10
665	11.08	10
670	11.17	10
675	11.25	10
680	11.33	10
685	11.42	10
690	11.50	9.9
695	11.58	9.9
700	11.67	9.9
705	11.75	9.9
710	11.83	9.9
715	11.92	9.8
720	12.00	9.7
	Max	10.0
	Mean	9.9
	Min	9.7

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	662	593	1%	12%	10%
5	563	208	16%	69%	63%
10	529	147	21%	76%	72%
15	513	123	24%	82%	76%
20	512	113	24%	83%	78%
25	476	102	29%	85%	79%
30	474	96	29%	86%	80%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	613	563	9%	16%	8%
5	553	207	18%	69%	63%
10	511	153	24%	77%	70%
15	484	121	28%	82%	75%
20	462	111	31%	83%	76%
25	449	101	33%	85%	78%
30	451	88.3	33%	87%	80%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	638	578	5%	14%	9%
5	558	208	17%	69%	63%
10	520	150	23%	76%	71%
15	499	122	26%	82%	76%
20	487	112	28%	83%	77%
25	463	102	31%	85%	78%
30	463	92	31%	86%	80%

Testing Parameters	
Date	6/21/2024
Time Start	10:15AM
Time Interval (mins)	720-780
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	9.6
Turbidity 1	734
Turbidity 2	723
Turbidity 3	
Turbidity AVG (NTU)	729
Flow Rate 1	4.7
Flow Rate 2	4.9
Flow Rate 3	4.8
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.106

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
720	12.00	9.9
725	12.08	9.7
730	12.17	9.6
735	12.25	9.6
740	12.33	9.5
745	12.42	9.5
750	12.50	9.5
755	12.58	9.4
760	12.67	9.4
765	12.75	9.4
770	12.83	9.3
775	12.92	9.2
780	13.00	9.2

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	723	613	1%	16%	15%
5	646	234	11%	68%	64%
10	590	166	19%	77%	72%
15	581	139	20%	81%	76%
20	540	118	26%	84%	78%
25	546	109	25%	85%	80%
30	525	104	28%	86%	80%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	655	593	10%	19%	9%
5	561	200	23%	73%	64%
10	515	134	29%	82%	74%
15	502	129	31%	82%	74%
20	507	103	30%	86%	80%
25	491	95.1	33%	87%	81%
30	481	96.9	34%	87%	80%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	689	603	5%	17%	12%
5	604	217	17%	70%	64%
10	553	150	24%	79%	73%
15	542	134	26%	82%	75%
20	524	111	28%	85%	79%
25	519	102	29%	86%	80%
30	503	100	31%	86%	80%

Testing Parameters	
Date	6/21/2024
Time Start	12:27PM
Time Interval (mins)	780-840
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	8.6
Turbidity 1	666
Turbidity 2	702
Turbidity 3	674
Turbidity AVG (NTU)	681
Flow Rate 1	4.9
Flow Rate 2	4.8
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.093

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
780	13.00	7.3
785	13.08	8
790	13.17	8.5
795	13.25	8.8
800	13.33	8.9
805	13.42	9
810	13.50	9
815	13.58	8.9
820	13.67	8.9
825	13.75	8.8
830	13.83	8.7
835	13.92	8.6
840	14.00	8.5

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	614	602	10%	12%	2%
5	529	325	22%	52%	39%
10	504	237	26%	65%	53%
15	495	198	27%	71%	60%
20	474	175	30%	74%	63%
25	470	165	31%	76%	65%
30	485	150	29%	78%	69%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	588	568	14%	17%	3%
5	475	306	30%	55%	36%
10	477	226	30%	67%	53%
15	455	182	33%	73%	60%
20	478	163	30%	76%	66%
25	461	150	32%	78%	67%
30	458	146	33%	79%	68%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	601	585	12%	14%	3%
5	502	316	26%	54%	37%
10	491	232	28%	66%	53%
15	475	190	30%	72%	60%
20	476	169	30%	75%	64%
25	466	158	32%	77%	66%
30	472	148	31%	78%	69%

Testing Parameters	
Date	6/21/2024
Time Start	1:35PM
Time Interval (mins)	840-900
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	8.25
Turbidity 1	668
Turbidity 2	691
Turbidity 3	647
Turbidity AVG (NTU)	669
Flow Rate 1	GPM 5.0
Flow Rate 2	4.9
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.088

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
840	14.00	9.1
845	14.08	8.4
850	14.17	8.3
855	14.25	8.3
860	14.33	8.2
865	14.42	8.1
870	14.50	8
875	14.58	8
880	14.67	7.8
885	14.75	7.6
890	14.83	7.5
895	14.92	7.3
900	15.00	7.1

Max 9.1
Mean 8.0
Min 7.1

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	641	521	4%	22%	19%
5	528	199	21%	70%	62%
10	508	158	24%	76%	69%
15	507	136	24%	80%	73%
20	492	119	26%	82%	76%
25	470	132	30%	80%	72%
30	471	94	30%	86%	80%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	684	613	-2%	8%	10%
5	564	212	16%	68%	62%
10	506	154	24%	77%	70%
15	521	107	22%	84%	79%
20	498	114	26%	83%	77%
25	482	109	28%	84%	77%
30	513	107	23%	84%	79%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	663	567	1%	15%	14%
5	546	206	18%	69%	62%
10	507	156	24%	77%	69%
15	514	122	23%	82%	76%
20	495	117	26%	83%	76%
25	476	121	29%	82%	75%
30	492	101	26%	85%	80%

Testing Parameters	
Date	6/21/2024
Time Start	2:35PM
Time Interval (mins)	900-960
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	7
Turbidity 1	719
Turbidity 2	706
Turbidity 3	671
Turbidity AVG (NTU)	699
Flow Rate 1	GPM 5.1
Flow Rate 2	5.2
Flow Rate 3	5.1
Flow Rate AVG (GPM)	5.1
Flow Rate AVG (m ³ /hr)	1.2
Specific Energy Consumption (SEC) [kWh/m ³]	0.072

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
900	15.00	7.4
905	15.08	7
910	15.17	7
915	15.25	6.9
920	15.33	6.8
925	15.42	6.8
930	15.50	6.7
935	15.58	6.7
940	15.67	6.6
945	15.75	6.4
950	15.83	6.3
955	15.92	6.3
960	16.00	6

Max 7.4
Mean 6.7
Min 6.0

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	732	645	-5%	8%	12%
5	650	265	7%	62%	59%
10	567	178	19%	75%	69%
15	566	155	19%	78%	73%
20	564	136	19%	81%	76%
25	511	120	27%	83%	77%
30	500	114	28%	84%	77%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	669	612	4%	12%	9%
5	573	245	18%	65%	57%
10	554	173	21%	75%	69%
15	522	136	25%	81%	74%
20	541	123	23%	82%	77%
25	498	113	29%	84%	77%
30	469	111	33%	84%	76%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	701	629	0%	10%	10%
5	612	255	12%	64%	58%
10	561	176	20%	75%	69%
15	544	146	22%	79%	73%
20	553	130	21%	81%	77%
25	505	117	28%	83%	77%
30	485	113	31%	84%	77%

Testing Parameters	
Date	6/24/2024
Time Start	8:33AM
Time Interval (mins)	960-1020
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.65
Turbidity 1	720
Turbidity 2	738
Turbidity 3	740
Turbidity AVG (NTU)	733
Flow Rate 1	GPM 4.9
Flow Rate 2	4.8
Flow Rate 3	4.7
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.062

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
960	16.00	8
965	16.08	5.9
970	16.17	5.6
975	16.25	5.6
980	16.33	5.6
985	16.42	5.7
990	16.50	5.7
995	16.58	5.8
1000	16.67	5.8
1005	16.75	5.8
1010	16.83	5.7
1015	16.92	5.7
1020	17.00	5.6

Max	8.0
Mean	5.9
Min	5.6

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	712	618	3%	16%	13%
5	583	495	20%	32%	15%
10	528	392	28%	46%	26%
15	483	318	34%	57%	34%
20	460	280	37%	62%	39%
25	438	238	40%	68%	46%
30	455	225	38%	69%	51%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	729	610	1%	17%	16%
5	538	473	27%	35%	12%
10	478	351	35%	52%	27%
15	473	302	35%	59%	36%
20	445	259	39%	65%	42%
25	444	226	39%	69%	49%
30	434	208	41%	72%	52%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	721	614	2%	16%	15%
5	561	484	23%	34%	14%
10	503	372	31%	49%	26%
15	478	310	35%	58%	35%
20	453	270	38%	63%	40%
25	441	232	40%	68%	47%
30	445	217	39%	70%	51%

Testing Parameters	
Date	6/24/2024
Time Start	9:34AM
Time Interval (mins)	1020-1080
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	6.05
Turbidity 1	680
Turbidity 2	651
Turbidity 3	684
Turbidity AVG (NTU)	672
Flow Rate 1	GPM 4.9
Flow Rate 2	4.8
Flow Rate 3	4.7
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.067

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1020	17.00	6.3
1025	17.08	6
1030	17.17	6
1035	17.25	6.1
1040	17.33	6.1
1045	17.42	6.1
1050	17.50	6.1
1055	17.58	6.1
1060	17.67	6
1065	17.75	6
1070	17.83	5.9
1075	17.92	5.9
1080	18.00	5.8

Max	6.3
Mean	6.0
Min	5.8

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	605	586	10%	13%	3%
5	521	306	22%	54%	41%
10	478	222	29%	67%	54%
15	425	168	37%	75%	60%
20	428	155	36%	77%	64%
25	395	141	41%	79%	64%
30	399	123	41%	82%	69%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	681	613	-1%	9%	10%
5	556	305	17%	55%	45%
10	489	203	27%	70%	58%
15	437	161	35%	76%	63%
20	443	132	34%	80%	70%
25	422	121	37%	82%	71%
30	418	116	38%	83%	72%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	643	600	4%	11%	7%
5	539	306	20%	55%	43%
10	484	213	28%	68%	56%
15	431	165	36%	76%	62%
20	436	144	35%	79%	67%
25	409	131	39%	80%	68%
30	409	120	39%	82%	71%

Testing Parameters	
Date	6/24/2024
Time Start	10:35AM
Time Interval (mins)	1080-1140
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.95
Turbidity 1	736
Turbidity 2	733
Turbidity 3	734
Turbidity AVG (NTU)	734
Flow Rate 1	GPM 5.0
Flow Rate 2	4.7
Flow Rate 3	4.7
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) (kWh/m ³)	0.066

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1080	18.00	6.2
1085	18.08	6.1
1090	18.17	6.1
1095	18.25	6.1
1100	18.33	6.1
1105	18.42	6
1110	18.50	5.9
1115	18.58	5.9
1120	18.67	5.9
1125	18.75	5.9
1130	18.83	5.8
1135	18.92	5.8
1140	19.00	5.8
	Max	6.2
	Mean	6.0
	Min	5.8

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	729	633	1%	14%	13%
5	519	248	29%	66%	52%
10	501	189	32%	74%	62%
15	510	167	31%	77%	67%
20	482	133	34%	82%	72%
25	438	121	40%	84%	72%
30	437	105	40%	86%	76%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	666	612	9%	17%	8%
5	487	230	34%	69%	53%
10	476	190	35%	74%	60%
15	455	155	38%	79%	66%
20	469	118	36%	84%	75%
25	447	104	39%	86%	77%
30	432	97.7	41%	87%	77%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	698	623	5%	15%	11%
5	503	239	32%	67%	52%
10	489	190	33%	74%	61%
15	483	161	34%	78%	67%
20	476	126	35%	83%	74%
25	443	113	40%	85%	75%
30	435	101	41%	86%	77%

Testing Parameters	
Date	6/24/2024
Time Start	12:54PM
Time Interval (mins)	1140-1200
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.1
Turbidity 1	676
Turbidity 2	684
Turbidity 3	690
Turbidity AVG (NTU)	GPM 683
Flow Rate 1	4.9
Flow Rate 2	5.0
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) (kWh/m ³)	0.055

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1140	19.00	6.6
1145	19.08	4.8
1150	19.17	5.1
1155	19.25	5.2
1160	19.33	5.3
1165	19.42	5.3
1170	19.50	5.3
1175	19.58	5.2
1180	19.67	5.1
1185	19.75	5
1190	19.83	4.9
1195	19.92	4.8
1200	20.00	4.8
	Max	6.6
	Mean	5.2
	Min	4.8

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	735	591	-8%	14%	20%
5	605	456	11%	33%	25%
10	568	337	17%	51%	41%
15	489	291	28%	57%	40%
20	479	247	30%	64%	48%
25	467	217	32%	68%	54%
30	478	203	30%	70%	58%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	708	610	-4%	14%	14%
5	582	456	15%	33%	22%
10	535	310	22%	55%	42%
15	510	273	25%	60%	46%
20	478	229	30%	66%	52%
25	475	201	30%	71%	58%
30	451	177	34%	74%	61%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	654	629	4%	8%	4%
5	545	371	20%	46%	32%
10	498	263	27%	62%	47%
15	486	218	29%	68%	55%
20	447	177	35%	74%	60%
25	413	166	40%	76%	60%
30	442	147	35%	78%	67%

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	699	610	-2%	11%	13%
5	577	428	16%	37%	26%
10	534	303	22%	56%	43%
15	495	261	28%	62%	47%
20	468	218	32%	68%	53%
25	452	195	34%	72%	57%
30	457	176	33%	74%	62%

Testing Parameters	
Date	6/24/2024
Time Start	1:56PM
Time Interval (mins)	1200-1260
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5
Turbidity 1	667
Turbidity 2	696
Turbidity 3	684
Turbidity AVG (NTU)	682
Flow Rate 1	GPM 4.9
Flow Rate 2	5.0
Flow Rate 3	5.1
Flow Rate AVG (GPM)	5.0
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.053

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1200	20.00	5.2
1205	20.08	5.1
1210	20.17	5.1
1215	20.25	5.1
1220	20.33	5.1
1225	20.42	5
1230	20.50	5.1
1235	20.58	5
1240	20.67	5
1245	20.75	5
1250	20.83	5
1255	20.92	4.9
1260	21.00	4.9

Max 5.2
Mean 5.0
Min 4.9

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	706	658	-3%	4%	7%
5	581	338	15%	50%	42%
10	533	221	22%	68%	59%
15	514	183	25%	73%	64%
20	478	151	30%	78%	68%
25	472	148	31%	78%	69%
30	415	133	39%	81%	68%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	749	678	-10%	1%	9%
5	665	329	3%	52%	51%
10	598	226	12%	67%	62%
15	526	176	23%	74%	67%
20	538	157	21%	77%	71%
25	499	142	27%	79%	72%
30	503	131	26%	81%	74%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	673	669	1%	2%	1%
5	597	329	13%	52%	45%
10	548	220	20%	68%	60%
15	486	178	29%	74%	63%
20	499	146	27%	79%	71%
25	477	135	30%	80%	72%
30	463	114	32%	83%	75%

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	709	668	-4%	2%	6%
5	614	332	10%	51%	46%
10	560	222	18%	67%	60%
15	509	179	25%	74%	65%
20	505	151	26%	78%	70%
25	483	142	29%	79%	71%
30	460	126	33%	82%	73%

Testing Parameters	
Date	6/25/2024
Time Start	8:06AM
Time Interval (mins)	1260-1320
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	4.5
Turbidity 1	722
Turbidity 2	729
Turbidity 3	673
Turbidity AVG (NTU)	708
Flow Rate 1	GPM 4.8
Flow Rate 2	5.0
Flow Rate 3	5.0
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.049

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1260	21.00	8.5
1265	21.08	4.3
1270	21.17	4.5
1275	21.25	4.7
1280	21.33	4.7
1285	21.42	4.7
1290	21.50	4.8
1295	21.58	4.8
1300	21.67	4.8
1305	21.75	4.8
1310	21.83	4.7
1315	21.92	4.7
1320	22.00	4.7

Max 8.5
Mean 5.0
Min 4.3

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	712	636	-1%	10%	11%
5	580	529	18%	25%	9%
10	527	407	26%	43%	23%
15	493	348	30%	51%	29%
20	481	296	32%	58%	38%
25	458	248	35%	65%	46%
30	468	234	34%	67%	50%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	669	667	6%	6%	0%
5	567	452	20%	36%	20%
10	500	345	29%	51%	31%
15	506	273	29%	61%	46%
20	465	243	34%	66%	48%
25	450	205	36%	71%	54%
30	449	181	37%	74%	60%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	691	652	2%	8%	6%
5	574	491	19%	31%	14%
10	514	376	27%	47%	27%
15	500	311	29%	56%	38%
20	473	270	33%	62%	43%
25	454	227	36%	68%	50%
30	459	208	35%	71%	55%

Testing Parameters	
Date	6/25/2024
Time Start	9:08AM
Time Interval (mins)	1320-1380
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	4.8
Turbidity 1	666
Turbidity 2	667
Turbidity 3	652
Turbidity AVG (NTU)	662
Flow Rate 1	GPM 4.8
Flow Rate 2	4.8
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) (kWh/m ³)	0.053

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1320	22.00	5.2
1325	22.08	4.7
1330	22.17	4.8
1335	22.25	4.8
1340	22.33	4.7
1345	22.42	4.8
1350	22.50	4.8
1355	22.58	4.8
1360	22.67	4.8
1365	22.75	4.7
1370	22.83	4.7
1375	22.92	4.7
1380	23.00	4.7

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	684	615	-3%	7%	10%
5	572	359	14%	46%	37%
10	535	242	19%	63%	55%
15	463	185	30%	72%	60%
20	452	158	32%	76%	65%
25	459	142	31%	79%	69%
30	437	136	34%	79%	69%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	754	642	-14%	3%	15%
5	545	311	18%	53%	43%
10	503	231	24%	65%	54%
15	494	183	25%	72%	63%
20	466	161	30%	76%	65%
25	446	135	33%	80%	70%
30	434	131	34%	80%	70%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	719	629	-9%	5%	13%
5	559	335	16%	49%	40%
10	519	237	22%	64%	54%
15	479	184	28%	72%	62%
20	459	160	31%	76%	65%
25	453	139	32%	79%	69%
30	436	134	34%	80%	69%

Testing Parameters	
Date	6/25/2024
Time Start	10:10AM
Time Interval (mins)	1380-1440
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.5
Turbidity 1	676
Turbidity 2	658
Turbidity 3	683
Turbidity AVG (NTU)	672
Flow Rate 1	GPM 4.8
Flow Rate 2	4.9
Flow Rate 3	4.8
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) (kWh/m ³)	0.060

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1380	23.00	5.6
1385	23.08	5.5
1390	23.17	5.5
1395	23.25	5.5
1400	23.33	5.5
1405	23.42	5.5
1410	23.50	5.5
1415	23.58	5.5
1420	23.67	5.5
1425	23.75	5.5
1430	23.83	5.5
1435	23.92	5.5
1440	24.00	5.4

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	680	607	-1%	10%	11%
5	516	238	23%	65%	54%
10	509	189	24%	72%	63%
15	472	152	30%	77%	68%
20	463	118	31%	82%	75%
25	430	110	36%	84%	74%
30	432	106	36%	84%	75%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	664	638	1%	5%	4%
5	564	276	16%	59%	51%
10	512	175	24%	74%	66%
15	457	137	32%	80%	70%
20	464	123	31%	82%	73%
25	430	110	36%	84%	74%
30	413	99.5	39%	85%	76%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	672	623	0%	7%	7%
5	540	257	20%	62%	52%
10	511	182	24%	73%	64%
15	465	145	31%	79%	69%
20	464	121	31%	82%	74%
25	430	110	36%	84%	74%
30	423	103	37%	85%	76%

Testing Parameters	
Date	6/25/2024
Time Start	12:22PM
Time Interval (mins)	1440-1500
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.25
Turbidity 1	680
Turbidity 2	653
Turbidity 3	664
Turbidity AVG (NTU)	666
Flow Rate 1	GPM 4.7
Flow Rate 2	5.0
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.057

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1440	24.00	5.8
1445	24.08	4.7
1450	24.17	5.1
1455	24.25	5.3
1460	24.33	5.3
1465	24.42	5.4
1470	24.50	5.4
1475	24.58	5.4
1480	24.67	5.3
1485	24.75	5.3
1490	24.83	5.3
1495	24.92	5.1
1500	25.00	5.1

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	678	621	-2%	7%	8%
5	571	406	14%	39%	29%
10	501	312	25%	53%	38%
15	488	232	27%	65%	52%
20	458	202	31%	70%	56%
25	438	174	34%	74%	60%
30	419	149	37%	78%	64%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	701	664	-5%	0%	5%
5	579	336	13%	50%	42%
10	553	242	17%	64%	56%
15	520	187	22%	72%	64%
20	485	162	27%	76%	67%
25	490	141	26%	79%	71%
30	459	129	31%	81%	72%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	690	643	-4%	3%	7%
5	575	371	14%	44%	35%
10	527	277	21%	58%	47%
15	504	210	24%	69%	58%
20	472	182	29%	73%	61%
25	464	158	30%	76%	66%
30	439	139	34%	79%	68%

Testing Parameters	
Date	6/25/2024
Time Start	1:25PM
Time Interval (mins)	1500-1560
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.6
Turbidity 1	663
Turbidity 2	693
Turbidity 3	677
Turbidity AVG (NTU)	678
Flow Rate 1	GPM 5.2
Flow Rate 2	5.1
Flow Rate 3	5.2
Flow Rate AVG (GPM)	5.1
Flow Rate AVG (m ³ /hr)	1.2
Specific Energy Consumption (SEC) [kWh/m ³]	0.058

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1500	25.00	5.9
1505	25.08	5.6
1510	25.17	5.6
1515	25.25	5.6
1520	25.33	5.6
1525	25.42	5.5
1530	25.50	5.5
1535	25.58	5.5
1540	25.67	5.5
1545	25.75	5.5
1550	25.83	5.4
1555	25.92	5.4
1560	26.00	5.4

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	747	666	-10%	2%	11%
5	610	317	10%	53%	48%
10	544	207	20%	69%	62%
15	493	169	27%	75%	66%
20	462	146	32%	78%	68%
25	457	135	33%	80%	70%
30	458	120	32%	82%	74%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	697	635	-9%	9%	9%
5	567	333	16%	51%	41%
10	504	228	26%	66%	55%
15	464	174	32%	74%	63%
20	460	141	32%	79%	69%
25	427	129	37%	81%	70%
30	428	116	37%	83%	73%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	722	651	-7%	4%	10%
5	589	325	13%	52%	45%
10	524	218	23%	68%	58%
15	479	172	29%	75%	64%
20	461	144	32%	79%	69%
25	442	132	35%	81%	70%
30	443	118	35%	83%	73%

Testing Parameters	
Date	6/26/2024
Time Start	1:58PM
Time Interval (mins)	1560-1620
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	6.5
Turbidity 1	685
Turbidity 2	678
Turbidity 3	667
Turbidity AVG (NTU)	677
Flow Rate 1	GPM 4.9
Flow Rate 2	4.9
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.070

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1560	26.00	7
1565	26.08	6.2
1570	26.17	6.2
1575	26.25	6.2
1580	26.33	6.2
1585	26.42	6.4
1590	26.50	6.4
1595	26.58	6.5
1600	26.67	6.5
1605	26.75	6.5
1610	26.83	6.5
1615	26.92	6.5
1620	27.00	6.5

Max	7.0
Mean	6.4
Min	6.2

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	653	589	3%	13%	10%
5	565	316	17%	53%	44%
10	510	223	25%	67%	56%
15	480	171	29%	75%	64%
20	462	156	32%	77%	66%
25	434	132	36%	80%	70%
30	404	124	40%	82%	69%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	653	589	3%	13%	10%
5	565	316	17%	53%	44%
10	510	223	25%	67%	56%
15	480	171	29%	75%	64%
20	462	156	32%	77%	66%
25	434	132	36%	80%	70%
30	404	124	40%	82%	69%

Testing Parameters	
Date	6/26/2024
Time Start	2:58PM
Time Interval (mins)	1620-1680
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	6.5
Turbidity 1	687
Turbidity 2	698
Turbidity 3	660
Turbidity AVG (NTU)	682
Flow Rate 1	GPM 4.8
Flow Rate 2	4.8
Flow Rate 3	5.0
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.070

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1620	27.00	6.5
1625	27.08	6.7
1630	27.17	6.7
1635	27.25	6.7
1640	27.33	6.7
1645	27.42	6.7
1650	27.50	6.7
1655	27.58	6.7
1660	27.67	6.7
1665	27.75	6.7
1670	27.83	6.6
1675	27.92	6.6
1680	28.00	6.6

Max	6.7
Mean	6.7
Min	6.5

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	659	606	3%	11%	8%
5	606	281	11%	59%	54%
10	510	194	25%	72%	62%
15	500	161	27%	76%	68%
20	474	141	30%	79%	70%
25	461	124	32%	82%	73%
30	454	113	33%	83%	75%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	659	606	3%	11%	8%
5	606	281	11%	59%	54%
10	510	194	25%	72%	62%
15	500	161	27%	76%	68%
20	474	141	30%	79%	70%
25	461	124	32%	82%	73%
30	454	113	33%	83%	75%

Testing Parameters	
Date	6/27/2024
Time Start	9:25AM
Time Interval (mins)	1680-1740
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	6.1
Turbidity 1	715
Turbidity 2	708
Turbidity 3	724
Turbidity AVG (NTU)	716
Flow Rate 1	GPM 4.9
Flow Rate 2	4.9
Flow Rate 3	5.0
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.065

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1680	28.00	8
1685	28.08	6.4
1690	28.17	5.9
1695	28.25	6.2
1700	28.33	6.3
1705	28.42	6.3
1710	28.50	6.4
1715	28.58	6.5
1720	28.67	6.5
1725	28.75	6.6
1730	28.83	6.5
1735	28.92	6.6
1740	29.00	6.6

Max 8.0
Mean 6.5
Min 5.9

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	759	722	-6%	-1%	5%
5	723	481	-1%	33%	33%
10	628	341	12%	52%	46%
15	572	275	20%	62%	52%
20	555	233	22%	67%	58%
25	531	198	26%	72%	63%
30	503	181	30%	75%	64%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	759	722	-6%	-1%	5%
5	723	481	-1%	33%	33%
10	628	341	12%	52%	46%
15	572	275	20%	62%	52%
20	555	233	22%	67%	58%
25	531	198	26%	72%	63%
30	503	181	30%	75%	64%

Testing Parameters	
Date	6/27/2024
Time Start	10:25AM
Time Interval (mins)	1740-1800
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	6.6
Turbidity 1	735
Turbidity 2	724
Turbidity 3	708
Turbidity AVG (NTU)	722
Flow Rate 1	GPM 5.0
Flow Rate 2	5.0
Flow Rate 3	5.0
Flow Rate AVG (GPM)	5.0
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.070

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1740	29.00	6.6
1745	29.08	6.6
1750	29.17	6.6
1755	29.25	6.6
1760	29.33	6.6
1765	29.42	6.6
1770	29.50	6.6
1775	29.58	6.6
1780	29.67	6.6
1785	29.75	6.6
1790	29.83	6.6
1795	29.92	6.6
1800	30.00	6.6

Max 6.6
Mean 6.6
Min 6.6

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	681	644	6%	11%	5%
5	648	330	10%	54%	49%
10	604	207	16%	71%	66%
15	516	168	29%	77%	67%
20	494	149	32%	79%	70%
25	481	132	33%	82%	73%
30	508	115	30%	84%	77%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	681	644	6%	11%	5%
5	648	330	10%	54%	49%
10	604	207	16%	71%	66%
15	516	168	29%	77%	67%
20	494	149	32%	79%	70%
25	481	132	33%	82%	73%
30	508	115	30%	84%	77%

Testing Parameters	
Date	6/27/2024
Time Start	11:25AM
Time Interval (mins)	1800-1860
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	6.6
Turbidity 1	683
Turbidity 2	672
Turbidity 3	680
Turbidity AVG (NTU)	678
Flow Rate 1	GPM 4.9
Flow Rate 2	4.9
Flow Rate 3	5.0
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.071

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1800	30.00	6.6
1805	30.08	6.6
1810	30.17	6.6
1815	30.25	6.6
1820	30.33	6.6
1825	30.42	6.6
1830	30.50	6.6
1835	30.58	6.6
1840	30.67	6.6
1845	30.75	6.6
1850	30.83	6.6
1855	30.92	6.2
1860	31.00	6.4

Max 6.6
Mean 6.6
Min 6.2

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	675	617	0%	9%	9%
5	644	286	5%	58%	56%
10	536	183	21%	73%	66%
15	515	157	24%	77%	70%
20	493	132	27%	81%	73%
25	512	125	25%	82%	76%
30	462	108	32%	84%	77%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	675	617	0%	9%	9%
5	644	286	5%	58%	56%
10	536	183	21%	73%	66%
15	515	157	24%	77%	70%
20	493	132	27%	81%	73%
25	512	125	25%	82%	76%
30	462	108	32%	84%	77%

Testing Parameters	
Date	6/27/2024
Time Start	1:50PM
Time Interval (mins)	1860-1920
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.9
Turbidity 1	673
Turbidity 2	665
Turbidity 3	650
Turbidity AVG (NTU)	663
Flow Rate 1	GPM 4.8
Flow Rate 2	4.8
Flow Rate 3	4.8
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.065

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1860	31.00	6.2
1865	31.08	5.6
1870	31.17	6.2
1875	31.25	6.3
1880	31.33	6.5
1885	31.42	6.5
1890	31.50	6.5
1895	31.58	6.6
1900	31.67	6.6
1905	31.75	6.6
1910	31.83	6.6
1915	31.92	6.6
1920	32.00	6.5

Max 6.6
Mean 6.4
Min 5.6

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	641	608	3%	8%	5%
5	556	424	16%	36%	24%
10	559	272	16%	59%	51%
15	518	240	22%	64%	54%
20	483	187	27%	72%	61%
25	472	169	29%	74%	64%
30	422	156	36%	76%	63%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	641	608	3%	8%	5%
5	556	424	16%	36%	24%
10	559	272	16%	59%	51%
15	518	240	22%	64%	54%
20	483	187	27%	72%	61%
25	472	169	29%	74%	64%
30	422	156	36%	76%	63%

Testing Parameters	
Date	6/27/2024
Time Start	2:50PM
Time Interval (mins)	1920-1980
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	6.5
Turbidity 1	715
Turbidity 2	730
Turbidity 3	741
Turbidity AVG (NTU)	729
	GPM
Flow Rate 1	4.9
Flow Rate 2	4.9
Flow Rate 3	4.8
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.070

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1920	32.00	6.6
1925	32.08	6.5
1930	32.17	6.5
1935	32.25	6.4
1940	32.33	6.4
1945	32.42	6.4
1950	32.50	6.4
1955	32.58	6.4
1960	32.67	6.4
1965	32.75	6.4
1970	32.83	6.3
1975	32.92	6.3
1980	33.00	6.3

Max	6.6
Mean	6.4
Min	6.3

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	714	660	2%	9%	8%
5	684	307	6%	58%	55%
10	578	191	21%	74%	67%
15	562	156	23%	79%	72%
20	511	134	30%	82%	74%
25	497	125	32%	83%	75%
30	483	107	34%	85%	78%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	714	660	2%	9%	8%
5	684	307	6%	58%	55%
10	578	191	21%	74%	67%
15	562	156	23%	79%	72%
20	511	134	30%	82%	74%
25	497	125	32%	83%	75%
30	483	107	34%	85%	78%

Testing Parameters	
Date	6/28/2024
Time Start	9:28AM
Time Interval (mins)	1980-2040
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	6.2
Turbidity 1	738
Turbidity 2	768
Turbidity 3	748
Turbidity AVG (NTU)	751
	GPM
Flow Rate 1	4.8
Flow Rate 2	4.9
Flow Rate 3	5.0
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.067

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1980	33.00	6.7
1985	33.08	5.8
1990	33.17	6
1995	33.25	6.2
2000	33.33	6.2
2005	33.42	6.2
2010	33.50	6.2
2015	33.58	6.3
2020	33.67	6.3
2025	33.75	6.3
2030	33.83	6.3
2035	33.92	6.2
2040	34.00	6.3

Max	6.7
Mean	6.2
Min	5.8

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	733	677	2%	10%	8%
5	630	390	16%	48%	38%
10	591	268	21%	64%	55%
15	561	209	25%	72%	63%
20	537	180	29%	76%	66%
25	543	166	28%	78%	69%
30	516	155	31%	79%	70%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	733	677	2%	10%	8%
5	630	390	16%	48%	38%
10	591	268	21%	64%	55%
15	561	209	25%	72%	63%
20	537	180	29%	76%	66%
25	543	166	28%	78%	69%
30	516	155	31%	79%	70%

[illegible]

	Max	6.6
	Mean	6.2
	Min	6.2

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	697	657	7%	12%	6%
5	659	257	12%	66%	61%
10	610	238	18%	68%	61%
15	595	199	20%	73%	67%
20	570	172	24%	77%	70%
25	563	150	25%	80%	73%
30	557	126	25%	83%	77%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	710	673	5%	10%	5%
5	653	274	13%	63%	58%
10	657	225	12%	70%	66%
15	612	194	18%	74%	68%
20	581	171	22%	77%	71%
25	574	146	23%	80%	75%
30	583	132	22%	82%	77%

Sample A						
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)	
0	628	606	6%	9%	4%	
5	603	440	10%	34%	27%	
10	562	307	16%	54%	45%	
15	524	227	22%	66%	57%	
20	515	195	23%	71%	62%	
25	499	178	25%	73%	64%	
30	482	161	28%	76%	67%	

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C / T - TR (%)
0	701	694	-5%	-4%	1%
5	628	337	6%	50%	46%
10	599	228	11%	66%	62%
15	517	185	23%	72%	64%
20	526	174	21%	74%	67%
25	516	152	23%	77%	71%
30	502	140	25%	79%	72%

Average					
Time (min.)	Avg. - Contol	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	671	650	0%	3%	3%
5	624	392	7%	41%	37%
10	577	269	14%	60%	53%
15	531	208	21%	69%	61%
20	519	184	22%	72%	64%
25	506	162	24%	76%	68%
30	504	151	25%	77%	70%

[illegible]

	Max	6.6
	Mean	5.9
	Min	5.3

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	683	649	-2%	3%	5%
5	642	399	4%	40%	38%
10	571	273	15%	59%	52%
15	553	211	17%	68%	62%
20	516	184	23%	73%	64%
25	504	155	25%	77%	69%
30	527	152	21%	77%	71%

Average					
Time (min.)	Avg. - Contol	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	671	650	0%	3%	3%
5	624	392	7%	41%	37%
10	577	269	14%	60%	53%
15	531	208	21%	69%	61%
20	519	184	22%	72%	64%
25	506	162	24%	76%	68%
30	504	151	25%	77%	70%

Testing Parameters	
Date	6/28/2024
Time Start	2:34PM
Time Interval (mins)	2160-2220
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	6.2
Turbidity 1	741
Turbidity 2	717
Turbidity 3	679
Turbidity AVG (NTU)	712
Flow Rate 1	GPM
Flow Rate 2	5.1
Flow Rate 3	4.7
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.067

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
2160	36.00	6.4
2165	36.08	6.1
2170	36.17	6.2
2175	36.25	6.2
2180	36.33	6.2
2185	36.42	6.3
2190	36.50	6.2
2195	36.58	6.2
2200	36.67	6.2
2205	36.75	6.2
2210	36.83	6.1
2215	36.92	6.1
2220	37.00	6

Max 6.4
Mean 6.2
Min 6.0

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	708	649	1%	9%	8%
5	626	337	12%	53%	46%
10	569	227	20%	68%	60%
15	560	174	21%	76%	69%
20	545	164	23%	77%	70%
25	493	135	31%	81%	73%
30	508	128	29%	82%	75%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	678	626	5%	12%	8%
5	575	328	19%	54%	43%
10	571	204	20%	71%	64%
15	514	178	28%	75%	65%
20	507	158	29%	78%	69%
25	508	140	29%	80%	72%
30	499	122	30%	83%	76%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	690	587	3%	18%	15%
5	566	319	21%	55%	44%
10	539	202	24%	72%	63%
15	506	169	29%	76%	67%
20	478	152	33%	79%	68%
25	464	134	35%	81%	71%
30	456	124	36%	83%	73%

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	692	621	3%	13%	10%
5	589	328	17%	54%	44%
10	560	211	21%	70%	62%
15	527	174	26%	76%	67%
20	510	158	28%	78%	69%
25	488	136	31%	81%	72%
30	488	125	32%	82%	74%

Testing Parameters	
Date	6/28/2024
Time Start	3:36PM
Time Interval (mins)	2220-2280
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.9
Turbidity 1	702
Turbidity 2	750
Turbidity 3	729
Turbidity AVG (NTU)	727
Flow Rate 1	GPM
Flow Rate 2	4.9
Flow Rate 3	4.8
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	4.8
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.064

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
2220	37.00	6.4
2225	37.08	6
2230	37.17	6
2235	37.25	6
2240	37.33	6
2245	37.42	5.9
2250	37.50	5.9
2255	37.58	5.9
2260	37.67	5.9
2265	37.75	5.8
2270	37.83	5.8
2275	37.92	5.7
2280	38.00	5.6

Max 6.4
Mean 5.9
Min 5.6

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	726	655	0%	10%	10%
5	567	259	22%	64%	54%
10	539	173	26%	76%	68%
15	528	150	27%	79%	72%
20	526	129	28%	82%	75%
25	473	121	35%	83%	74%
30	502	108	31%	85%	78%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	707	596	3%	18%	16%
5	568	231	22%	68%	59%
10	541	170	26%	77%	69%
15	512	138	30%	81%	73%
20	512	129	30%	82%	75%
25	481	120	34%	83%	75%
30	479	109	34%	85%	77%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	717	626	1%	14%	13%
5	568	245	22%	66%	57%
10	540	172	26%	76%	68%
15	520	144	28%	80%	72%
20	519	129	29%	82%	75%
25	477	121	34%	83%	75%
30	491	109	33%	85%	78%

Testing Parameters	
Date	7/1/2024
Time Start	9:19AM
Time Interval (mins)	2280-2340
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5
Turbidity 1	675
Turbidity 2	743
Turbidity 3	772
Turbidity AVG (NTU)	730
Flow Rate 1	GPM 4.9
Flow Rate 2	4.9
Flow Rate 3	5.0
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.054

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
2280	38.00	7.8
2285	38.08	4.8
2290	38.17	4.8
2295	38.25	5
2300	38.33	5
2305	38.42	5.1
2310	38.50	5.1
2315	38.58	5.1
2320	38.67	5.1
2325	38.75	5.1
2330	38.83	5.1
2335	38.92	5
2340	39.00	5
	Max	7.8
	Mean	5.2
	Min	4.8

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	789	689	-8%	6%	13%
5	594	461	19%	37%	22%
10	555	344	24%	53%	38%
15	486	280	33%	62%	42%
20	528	237	28%	68%	55%
25	452	213	38%	71%	53%
30	480	200	34%	73%	58%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	820	628	-12%	14%	23%
5	605	424	17%	42%	30%
10	534	304	27%	58%	43%
15	457	257	37%	65%	44%
20	487	213	33%	71%	56%
25	438	198	40%	73%	55%
30	432	176	41%	76%	59%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	805	659	-10%	10%	18%
5	600	443	18%	39%	26%
10	545	324	25%	56%	40%
15	472	269	35%	63%	43%
20	508	225	30%	69%	56%
25	445	206	39%	72%	54%
30	456	188	38%	74%	59%

Testing Parameters	
Date	7/1/2024
Time Start	10:20AM
Time Interval (mins)	2340-2400
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5
Turbidity 1	671
Turbidity 2	682
Turbidity 3	679
Turbidity AVG (NTU)	677
Flow Rate 1	GPM 4.8
Flow Rate 2	4.8
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.055

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
2340	39.00	5.3
2345	39.08	5
2350	39.17	5
2355	39.25	5
2360	39.33	5
2365	39.42	5
2370	39.50	5
2375	39.58	4.9
2380	39.67	4.9
2385	39.75	4.8
2390	39.83	4.8
2395	39.92	4.8
2400	40.00	4.7
	Max	5.3
	Mean	4.9
	Min	4.7

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	677	576	0%	15%	15%
5	564	353	17%	48%	37%
10	517	229	24%	66%	56%
15	461	190	32%	72%	59%
20	469	167	31%	75%	64%
25	464	149	31%	78%	68%
30	457	138	33%	80%	70%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	755	622	-11%	8%	18%
5	588	333	13%	51%	43%
10	547	249	19%	63%	54%
15	541	198	20%	71%	63%
20	473	168	30%	75%	64%
25	485	150	28%	78%	69%
30	450	144	34%	79%	68%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	716	599	-6%	12%	16%
5	576	343	15%	49%	40%
10	532	239	21%	65%	55%
15	501	194	26%	71%	61%
20	471	168	30%	75%	64%
25	475	150	30%	78%	68%
30	454	141	33%	79%	69%

Testing Parameters	
Date	7/1/2024
Time Start	12:34PM
Time Interval (mins)	2400-2460
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	4.75
Turbidity 1	690
Turbidity 2	688
Turbidity 3	730
Turbidity AVG (NTU)	703
	GPM
Flow Rate 1	4.9
Flow Rate 2	5.0
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.051

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
2400	40.00	4.8
2405	40.08	4.5
2410	40.17	4.7
2415	40.25	4.7
2420	40.33	4.8
2425	40.42	4.8
2430	40.50	4.8
2435	40.58	4.8
2440	40.67	4.8
2445	40.75	4.8
2450	40.83	4.8
2455	40.92	4.7
2460	41.00	4.7

Max 4.8
Mean 4.7
Min 4.5

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	724	641	-3%	9%	11%
5	614	450	13%	36%	27%
10	544	293	23%	58%	46%
15	539	258	23%	63%	52%
20	504	215	28%	69%	57%
25	450	183	36%	74%	59%
30	466	171	34%	76%	63%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	770	629	-10%	10%	18%
5	600	409	15%	42%	32%
10	569	285	19%	59%	50%
15	537	231	24%	67%	57%
20	490	199	30%	72%	59%
25	467	169	34%	76%	64%
30	479	158	32%	78%	67%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	747	635	-6%	10%	15%
5	607	430	14%	39%	29%
10	557	289	21%	59%	48%
15	538	245	23%	65%	55%
20	497	207	29%	71%	58%
25	459	176	35%	75%	62%
30	473	165	33%	77%	65%

Testing Parameters	
Date	7/1/2024
Time Start	1:35PM
Time Interval (mins)	2460-2520
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.15
Turbidity 1	669
Turbidity 2	682
Turbidity 3	666
Turbidity AVG (NTU)	672
	GPM
Flow Rate 1	4.9
Flow Rate 2	4.8
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.056

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
2460	41.00	5.3
2465	41.08	5.2
2470	41.17	5.2
2475	41.25	5.1
2480	41.33	5.1
2485	41.42	5.1
2490	41.50	5.1
2495	41.58	5.1
2500	41.67	5.1
2505	41.75	5.1
2510	41.83	5
2515	41.92	5
2520	42.00	5

Max 5.3
Mean 5.1
Min 5.0

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	710	611	-6%	9%	14%
5	568	371	16%	45%	35%
10	556	251	17%	63%	55%
15	523	200	22%	70%	62%
20	493	173	27%	74%	65%
25	473	154	30%	77%	67%
30	454	130	32%	81%	71%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	773	631	-15%	6%	18%
5	595	334	12%	50%	44%
10	564	231	16%	66%	59%
15	511	185	24%	72%	64%
20	513	164	24%	76%	68%
25	480	149	29%	78%	69%
30	449	124	33%	82%	72%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	742	621	-10%	8%	16%
5	582	353	14%	48%	39%
10	560	241	17%	64%	57%
15	517	193	23%	71%	63%
20	503	169	25%	75%	67%
25	477	152	29%	77%	68%
30	452	127	33%	81%	72%

Testing Parameters	
Date	7/1/2024
Time Start	2:36PM
Time Interval (mins)	2520-2580
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.39
Turbidity 1	707
Turbidity 2	689
Turbidity 3	704
Turbidity AVG (NTU)	700
	GPM
Flow Rate 1	5.0
Flow Rate 2	4.8
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.058

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
2520	42.00	5.5
2525	42.08	5.4
2530	42.17	5.3
2535	42.25	5.3
2540	42.33	5.3
2545	42.42	5.3
2550	42.50	5.2
2555	42.58	5.2
2560	42.67	5.1
2565	42.75	5.1
2570	42.83	5.1
2575	42.92	5.1
2580	43.00	5

Max 5.5
Mean 5.2
Min 5.0

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	686	613	2%	12%	11%
5	584	330	17%	53%	43%
10	540	219	23%	69%	59%
15	514	173	27%	75%	66%
20	478	167	32%	76%	65%
25	474	141	32%	80%	70%
30	450	120	36%	83%	73%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	742	632	-6%	10%	15%
5	620	306	11%	56%	51%
10	556	196	21%	72%	65%
15	529	173	24%	75%	67%
20	507	150	28%	79%	70%
25	463	137	34%	80%	70%
30	449	126	36%	82%	72%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	714	623	-2%	11%	13%
5	602	318	14%	55%	47%
10	548	208	22%	70%	62%
15	522	173	26%	75%	67%
20	493	159	30%	77%	68%
25	469	139	33%	80%	70%
30	450	123	36%	82%	73%

Testing Parameters	
Date	7/1/2024
Time Start	3:37PM
Time Interval (mins)	2580-2640
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.15
Turbidity 1	676
Turbidity 2	684
Turbidity 3	696
Turbidity AVG (NTU)	685
	GPM
Flow Rate 1	4.9
Flow Rate 2	5.0
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.055

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
2580	43.00	5.5
2585	43.08	5.2
2590	43.17	5.2
2595	43.25	5.1
2600	43.33	5.1
2605	43.42	5.1
2610	43.50	5.1
2615	43.58	5.1
2620	43.67	5
2625	43.75	5
2630	43.83	5
2635	43.92	5
2640	44.00	4.9

Max 5.5
Mean 5.1
Min 4.9

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	705	627	-3%	9%	11%
5	587	304	14%	56%	48%
10	511	206	25%	70%	60%
15	497	168	27%	75%	66%
20	493	146	28%	79%	70%
25	461	130	33%	81%	72%
30	437	120	36%	82%	73%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	637	598	7%	13%	6%
5	577	303	16%	56%	47%
10	522	202	24%	71%	61%
15	473	172	31%	75%	64%
20	435	142	37%	79%	67%
25	436	128	36%	81%	71%
30	456	121	33%	82%	73%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	671	613	2%	11%	9%
5	582	304	15%	56%	48%
10	517	204	25%	70%	61%
15	485	170	29%	75%	65%
20	464	144	32%	79%	69%
25	449	129	35%	81%	71%
30	447	121	35%	82%	73%

Testing Parameters	
Date	7/2/2024
Time Start	8:01AM
Time Interval (mins)	2640-2700
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	4.7
Turbidity 1	669
Turbidity 2	704
Turbidity 3	666
Turbidity AVG (NTU)	680
Flow Rate 1	GPM 5.0
Flow Rate 2	4.9
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.050

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
2640	44.00	6.8
2645	44.08	4.3
2650	44.17	4.6
2655	44.25	4.8
2660	44.33	4.9
2665	44.42	4.9
2670	44.50	5
2675	44.58	5.1
2680	44.67	5.1
2685	44.75	5.1
2690	44.83	5.1
2695	44.92	5.1
2700	45.00	5.1

Max 6.8
Mean 5.1
Min 4.3

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	729	645	-7%	5%	12%
5	597	501	12%	26%	16%
10	580	389	15%	43%	33%
15	554	318	18%	53%	43%
20	510	273	25%	60%	46%
25	485	240	29%	65%	51%
30	462	217	32%	68%	53%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	694	638	-2%	6%	8%
5	632	435	7%	36%	31%
10	562	332	17%	51%	41%
15	529	261	22%	62%	51%
20	496	217	27%	68%	56%
25	459	199	32%	71%	57%
30	443	172	35%	75%	61%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	712	642	-5%	6%	10%
5	615	468	10%	31%	24%
10	571	361	16%	47%	37%
15	542	290	20%	57%	47%
20	503	245	26%	64%	51%
25	472	220	31%	68%	53%
30	453	195	33%	71%	57%

Testing Parameters	
Date	7/2/2024
Time Start	9:01AM
Time Interval (mins)	2700-2760
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.25
Turbidity 1	713
Turbidity 2	722
Turbidity 3	733
Turbidity AVG (NTU)	723
Flow Rate 1	GPM 4.9
Flow Rate 2	4.9
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.056

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
2700	45.00	5.3
2705	45.08	5.1
2710	45.17	5.2
2715	45.25	5.2
2720	45.33	5.2
2725	45.42	5.3
2730	45.50	5.2
2735	45.58	5.2
2740	45.67	5.2
2745	45.75	5.2
2750	45.83	5.2
2755	45.92	5.1
2760	46.00	5.1

Max 5.3
Mean 5.2
Min 5.1

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	698	645	3%	11%	8%
5	596	366	18%	49%	39%
10	560	222	23%	69%	60%
15	510	192	29%	73%	62%
20	486	163	33%	77%	66%
25	460	148	36%	80%	68%
30	449	135	38%	81%	70%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	742	589	-3%	18%	21%
5	594	319	18%	56%	46%
10	503	220	30%	70%	56%
15	485	184	33%	75%	62%
20	533	153	26%	79%	71%
25	474	135	34%	81%	72%
30	450	127	38%	82%	72%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	720	617	0%	15%	14%
5	595	343	18%	53%	42%
10	532	221	26%	69%	58%
15	498	188	31%	74%	62%
20	510	158	29%	78%	69%
25	467	142	35%	80%	70%
30	450	131	38%	82%	71%

Testing Parameters	
Date	7/2/2024
Time Start	10:01AM
Time Interval (mins)	2760-2820
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.1
Turbidity 1	734
Turbidity 2	746
Turbidity 3	771
Turbidity AVG (NTU)	750
Flow Rate 1	GPM 4.8
Flow Rate 2	4.9
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) (kWh/m ³)	0.055

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
2760	46.00	5.5
2765	46.08	5.1
2770	46.17	5.1
2775	46.25	5.1
2780	46.33	5.1
2785	46.42	5.1
2790	46.50	5
2795	46.58	5
2800	46.67	5
2805	46.75	5
2810	46.83	4.9
2815	46.92	4.9
2820	47.00	4.9

Max 5.5
Mean 5.1
Min 4.9

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	750	612	0%	18%	18%
5	652	288	13%	62%	56%
10	529	197	29%	74%	63%
15	506	163	33%	78%	68%
20	482	145	36%	81%	70%
25	444	123	41%	84%	72%
30	416	106	45%	86%	75%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	744	601	1%	20%	19%
5	580	278	23%	63%	52%
10	526	183	30%	76%	65%
15	489	154	35%	79%	69%
20	454	133	39%	82%	71%
25	442	120	41%	84%	73%
30	408	107	46%	86%	74%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	747	607	0%	19%	19%
5	616	283	18%	62%	54%
10	528	190	30%	75%	64%
15	498	159	34%	79%	68%
20	468	139	38%	81%	70%
25	443	122	41%	84%	73%
30	412	107	45%	86%	74%

Testing Parameters	
Date	7/2/2024
Time Start	11:01AM
Time Interval (mins)	2820-2880
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5
Turbidity 1	709
Turbidity 2	696
Turbidity 3	709
Turbidity AVG (NTU)	705
Flow Rate 1	GPM 5.0
Flow Rate 2	5.0
Flow Rate 3	5.0
Flow Rate AVG (GPM)	5.0
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) (kWh/m ³)	0.053

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
2820	47.00	5.3
2825	47.08	5
2830	47.17	5
2835	47.25	5
2840	47.33	5
2845	47.42	4.9
2850	47.50	4.9
2855	47.58	4.9
2860	47.67	4.9
2865	47.75	4.8
2870	47.83	4.8
2875	47.92	4.8
2880	48.00	4.8

Max 5.3
Mean 4.9
Min 4.8

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	676	619	4%	12%	8%
5	575	280	18%	60%	51%
10	503	183	29%	74%	64%
15	504	156	28%	78%	69%
20	455	132	35%	81%	71%
25	446	124	37%	82%	72%
30	419	103	41%	85%	75%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	667	604	5%	14%	9%
5	597	291	15%	59%	51%
10	542	194	23%	72%	64%
15	505	158	28%	78%	69%
20	474	134	33%	81%	72%
25	439	117	38%	83%	73%
30	456	112	35%	84%	75%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	672	612	5%	13%	9%
5	586	286	17%	59%	51%
10	523	189	26%	73%	64%
15	505	157	28%	78%	69%
20	465	133	34%	81%	71%
25	443	121	37%	83%	73%
30	438	108	38%	85%	75%

Testing Parameters	
Date	7/2/2024
Time Start	1:04PM
Time Interval (mins)	2880-2940
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	4.8
Turbidity 1	749
Turbidity 2	729
Turbidity 3	742
Turbidity AVG (NTU)	740
Flow Rate 1	GPM
Flow Rate 2	4.8
Flow Rate 3	5.0
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.051

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
2880	48.00	4.8
2885	48.08	3.9
2890	48.17	4.6
2895	48.25	4.8
2900	48.33	5
2905	48.42	5
2910	48.50	5.1
2915	48.58	5.1
2920	48.67	5.1
2925	48.75	5.1
2930	48.83	5.1
2935	48.92	5.1
2940	49.00	5.1

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	733	643	1%	13%	12%
5	580	374	22%	49%	36%
10	556	267	25%	64%	52%
15	533	203	28%	73%	62%
20	501	184	32%	75%	63%
25	505	163	32%	78%	68%
30	486	145	34%	80%	70%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	701	602	5%	19%	14%
5	552	352	25%	52%	36%
10	530	250	28%	66%	53%
15	485	196	34%	74%	60%
20	457	171	38%	77%	63%
25	454	151	39%	80%	67%
30	362	135	51%	82%	63%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	717	623	3%	16%	13%
5	566	363	24%	51%	36%
10	543	259	27%	65%	52%
15	509	200	31%	73%	61%
20	479	178	35%	76%	63%
25	480	157	35%	79%	67%
30	424	140	43%	81%	67%

Testing Parameters	
Date	7/2/2024
Time Start	2:04PM
Time Interval (mins)	2940-3000
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.45
Turbidity 1	768
Turbidity 2	752
Turbidity 3	763
Turbidity AVG (NTU)	761
Flow Rate 1	GPM
Flow Rate 2	4.9
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.059

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
2940	49.00	5.2
2945	49.08	5.6
2950	49.17	5.6
2955	49.25	5.5
2960	49.33	5.5
2965	49.42	5.4
2970	49.50	5.4
2975	49.58	5.3
2980	49.67	5.3
2985	49.75	5.2
2990	49.83	5.1
2995	49.92	5.1
3000	50.00	5

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	757	710	1%	7%	6%
5	628	307	17%	60%	51%
10	548	215	28%	72%	61%
15	493	171	35%	78%	65%
20	495	147	35%	81%	70%
25	489	133	36%	83%	73%
30	471	119	38%	84%	75%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	677	651	11%	14%	4%
5	589	300	23%	61%	49%
10	538	206	29%	73%	62%
15	505	162	34%	79%	68%
20	483	144	37%	81%	70%
25	436	134	43%	82%	69%
30	479	122	37%	84%	75%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	717	681	6%	11%	5%
5	609	304	20%	60%	50%
10	543	211	29%	72%	61%
15	499	167	34%	78%	67%
20	489	146	36%	81%	70%
25	463	134	39%	82%	71%
30	475	121	38%	84%	75%

	Max	5.2
	Mean	5.0
	Min	4.8

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	678	672	0%	1%	1%
5	640	309	5%	54%	52%
10	504	205	26%	70%	59%
15	504	172	26%	75%	66%
20	526	151	22%	78%	71%
25	479	142	29%	79%	70%
30	490	121	28%	82%	75%

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	703	634	-4%	6%	10%
5	618	321	9%	53%	48%
10	527	206	22%	70%	61%
15	521	171	23%	75%	67%
20	508	149	25%	78%	71%
25	463	137	32%	80%	70%
30	466	121	31%	82%	74%

	Max	6.7
	Mean	5.0
	Min	4.0

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	714	637	-6%	6%	11%
5	599	468	11%	31%	22%
10	529	333	22%	51%	37%
15	484	292	28%	57%	40%
20	476	243	30%	64%	49%
25	469	205	31%	70%	56%
30	450	189	33%	72%	58%

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	695	604	-3%	11%	13%
5	569	468	16%	31%	18%
10	519	355	23%	48%	32%
15	475	293	30%	57%	38%
20	463	254	32%	63%	45%
25	443	224	35%	67%	49%
30	441	203	35%	70%	54%

Testing Parameters	
Date	7/3/2024
Time Start	10:24AM
Time Interval (mins)	3120-3180
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.5
Turbidity 1	686
Turbidity 2	687
Turbidity 3	653
Turbidity AVG (NTU)	675
Flow Rate 1	GPM 4.9
Flow Rate 2	4.8
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.060

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
3120	52.00	5.5
3125	52.08	5.5
3130	52.17	5.5
3135	52.25	5.5
3140	52.33	5.5
3145	52.42	5.5
3150	52.50	5.5
3155	52.58	5.5
3160	52.67	5.5
3165	52.75	5.5
3170	52.83	5.5
3175	52.92	5.4
3180	53.00	5.4

Max 5.5
Mean 5.5
Min 5.4

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	650	591	4%	12%	9%
5	598	381	11%	44%	36%
10	548	256	19%	62%	53%
15	498	204	26%	70%	59%
20	502	173	26%	74%	66%
25	494	154	27%	77%	69%
30	464	139	31%	79%	70%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	673	636	0%	6%	5%
5	621	346	8%	49%	44%
10	573	226	15%	67%	61%
15	512	186	24%	72%	64%
20	482	166	29%	75%	66%
25	465	144	31%	79%	69%
30	462	132	32%	80%	71%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	679	661	-1%	2%	3%
5	643	330	5%	51%	49%
10	566	229	18%	66%	59%
15	558	183	17%	73%	67%
20	516	158	24%	77%	69%
25	516	145	24%	79%	72%
30	524	131	22%	81%	75%

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	667	629	1%	7%	6%
5	621	352	8%	48%	43%
10	559	237	17%	65%	58%
15	523	191	23%	72%	63%
20	500	166	26%	75%	67%
25	492	148	27%	78%	70%
30	483	134	28%	80%	72%

Testing Parameters	
Date	7/3/2024
Time Start	1:05PM
Time Interval (mins)	3180-3240
Interelectrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	4.8
Turbidity 1	738
Turbidity 2	686
Turbidity 3	731
Turbidity AVG (NTU)	718
Flow Rate 1	GPM 4.9
Flow Rate 2	5.0
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.052

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
3180	53.00	5
3185	53.08	4.3
3190	53.17	4.8
3195	53.25	5.1
3200	53.33	5.3
3205	53.42	5.4
3210	53.50	5.4
3215	53.58	5.4
3220	53.67	5.4
3225	53.75	5.4
3230	53.83	5.4
3235	53.92	5.3
3240	54.00	5.3

Max 5.4
Mean 5.2
Min 4.3

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	697	621	3%	14%	11%
5	607	454	15%	37%	25%
10	519	348	28%	52%	33%
15	497	272	31%	62%	45%
20	496	231	31%	68%	53%
25	494	210	31%	71%	57%
30	458	189	36%	74%	59%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	672	615	6%	14%	8%
5	612	426	15%	41%	30%
10	537	290	25%	60%	46%
15	485	222	32%	69%	54%
20	509	195	29%	73%	62%
25	477	176	34%	75%	63%
30	476	164	34%	77%	66%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	685	618	5%	14%	10%
5	610	440	15%	39%	28%
10	528	319	26%	56%	40%
15	491	247	32%	66%	50%
20	503	213	30%	70%	58%
25	486	193	32%	73%	60%
30	467	177	35%	75%	62%

Testing Parameters	
Date	7/3/2024
Time Start	2:05PM
Time Interval (mins)	3240-3300
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.4
Turbidity 1	684
Turbidity 2	707
Turbidity 3	718
Turbidity AVG (NTU)	703
Flow Rate 1	GPM 4.9
Flow Rate 2	4.9
Flow Rate 3	4.8
Flow Rate AVG (GPM)	4.8
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.059

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
3240	54.00	5.4
3245	54.08	5.5
3250	54.17	5.5
3255	54.25	5.4
3260	54.33	5.4
3265	54.42	5.3
3270	54.50	5.3
3275	54.58	5.2
3280	54.67	5.1
3285	54.75	5.1
3290	54.83	5
3295	54.92	5
3300	55.00	4.9

Max 5.5
Mean 5.2
Min 4.9

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	658	620	6%	12%	6%
5	614	329	13%	53%	46%
10	536	223	24%	68%	58%
15	512	185	27%	74%	64%
20	483	161	31%	77%	67%
25	472	141	33%	80%	70%
30	417	128	41%	82%	69%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	662	640	6%	9%	3%
5	600	311	15%	56%	48%
10	526	215	25%	69%	59%
15	506	175	28%	75%	65%
20	493	142	30%	80%	71%
25	467	141	34%	80%	70%
30	451	130	36%	82%	71%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	660	630	6%	10%	5%
5	607	320	14%	54%	47%
10	531	219	24%	69%	59%
15	509	180	28%	74%	65%
20	488	152	31%	78%	69%
25	470	141	33%	80%	70%
30	434	129	38%	82%	70%

Testing Parameters	
Date	7/3/2024
Time Start	3:05PM
Time Interval (mins)	3300-3360
Inter-electrode Distance (cm)	0.5
Voltage (Volts)	12
Current (Amps)	5.2
Turbidity 1	670
Turbidity 2	705
Turbidity 3	673
Turbidity AVG (NTU)	683
Flow Rate 1	GPM 4.9
Flow Rate 2	5.0
Flow Rate 3	4.9
Flow Rate AVG (GPM)	4.9
Flow Rate AVG (m ³ /hr)	1.1
Specific Energy Consumption (SEC) [kWh/m ³]	0.056

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
3300	55.00	5.1
3305	55.08	5.3
3310	55.17	5.3
3315	55.25	5.2
3320	55.33	5.2
3325	55.42	5.1
3330	55.50	5.1
3335	55.58	5.1
3340	55.67	5.1
3345	55.75	5
3350	55.83	5
3355	55.92	5
3360	56.00	4.9

Max 5.3
Mean 5.1
Min 4.9

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	668	625	2%	8%	6%
5	592	368	13%	46%	38%
10	252	233	63%	66%	8%
15	505	182	26%	73%	64%
20	489	163	28%	76%	67%
25	466	138	32%	80%	70%
30	454	122	33%	82%	73%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	735	647	-8%	5%	12%
5	592	312	13%	54%	47%
10	542	217	21%	68%	60%
15	520	174	24%	75%	67%
20	484	147	29%	78%	70%
25	429	131	37%	81%	69%
30	457	122	33%	82%	73%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	731	707	-7%	-4%	3%
5	647	320	5%	53%	51%
10	555	214	19%	69%	61%
15	556	185	19%	73%	67%
20	516	149	24%	78%	71%
25	464	133	32%	81%	71%
30	452	121	34%	82%	73%

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	711	660	-4%	3%	7%
5	610	333	11%	51%	45%
10	450	221	34%	68%	51%
15	527	180	23%	74%	66%
20	496	153	27%	78%	69%
25	453	134	34%	80%	70%
30	454	122	33%	82%	73%

Testing Parameters					Time VS Current Reading			Sample A					
Date	7/8/2024				Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	9:35				3360	56.00	5.8	0	687	603	0%	12%	12%
Time Interval (mins)	3360-3420				3365	56.08	3.8	5	592	506	14%	26%	15%
Interelectrode Distance (cm)	0.5				3370	56.17	4	10	560	377	18%	45%	33%
Voltage (Volts)	12				3375	56.25	4.3	15	507	317	26%	54%	37%
Current (Amps)	4.6				3380	56.33	4.5	20	486	254	29%	63%	48%
Turbidity 1	689				3385	56.42	4.7	25	474	234	31%	66%	51%
Turbidity 2	691				3390	56.50	4.8	30	449	209	35%	70%	53%
Turbidity 3	677				3395	56.58	5						
Turbidity AVG (NTU)	686				3400	56.67	5	Sample B					
	GPM	volume	time	mL/s	3405	56.75	5.1	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Flow Rate 1	5.0	2000	6.38	313.4796	3410	56.83	5.2	0	607	586	11%	15%	3%
Flow Rate 2	4.9	2000	6.46	309.5975	3415	56.92	5.3	5	586	441	15%	36%	25%
Flow Rate 3	5.0	2000	6.36	314.4654	3420	57.00	5.3	10	506	332	26%	52%	34%
Flow Rate AVG (GPM)	5.0							15	493	268	28%	61%	46%
Flow Rate AVG (m³/hr)	1.1							20	459	226	33%	67%	51%
Specific Energy Consumption (SEC) [kWh/m³]	0.049							25	442	197	36%	71%	55%
								30	410	178	40%	74%	57%
								Sample C					
								Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
								0			100%	100%	#DIV/0!
								5			100%	100%	#DIV/0!
								10			100%	100%	#DIV/0!
								15			100%	100%	#DIV/0!
								20			100%	100%	#DIV/0!
								25			100%	100%	#DIV/0!
								30			100%	100%	#DIV/0!
								Average					
								Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
								0	647	595	6%	13%	8%
								5	589	474	14%	31%	20%
								10	533	355	22%	48%	33%
								15	500	293	27%	57%	42%
								20	473	240	31%	65%	49%
								25	458	216	33%	69%	53%
								30	430	194	37%	72%	55%

Testing Parameters					Time VS Current Reading			Sample A					
Date	8/24/2024				Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	10:35				3420	57.00	5.3	0	707	657	0%	7%	7%
Time Interval (mins)	3420-3480				3425	57.08	5.5	5	635	403	10%	43%	37%
Interelectrode Distance (cm)	0.5				3430	57.17	5.6	10	557	257	21%	64%	54%
Voltage (Volts)	12				3435	57.25	5.6	15	534	162	25%	77%	70%
Current (Amps)	5.6				3440	57.33	5.6	20	506	180	29%	75%	64%
Turbidity 1	695				3445	57.42	5.6	25	488	157	31%	78%	68%
Turbidity 2	707				3450	57.50	5.7	30	471	150	33%	79%	68%
Turbidity 3	722				3455	57.58	5.7						
Turbidity AVG (NTU)	708				3460	57.67	5.7	Sample B					
	GPM	volume	time	mL/s	3465	57.75	5.7	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Flow Rate 1	5.0	2000	6.34	315.4574	3470	57.83	5.7	0	705	672	0%	5%	5%
Flow Rate 2	5.0	2000	6.33	315.9558	3475	57.92	5.7	5	616	359	13%	49%	42%
Flow Rate 3	4.9	2000	6.44	310.559	3480	58.00	5.7	10	579	238	18%	66%	59%
Flow Rate AVG (GPM)	5.0							15	519	192	27%	73%	63%
Flow Rate AVG (m³/hr)	1.1							20	520	164	27%	77%	68%
Specific Energy Consumption (SEC) [kWh/m³]	0.059							25	490	152	31%	79%	69%
								30	481	143	32%	80%	70%
								Sample C					
								Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
								0	696	631	2%	11%	9%
								5	648	340	8%	52%	48%
								10	576	230	19%	68%	60%
								15	510	186	28%	74%	64%
								20	481	155	32%	78%	68%
								25	428	144	40%	80%	66%
								30	446	130	37%	82%	71%
								Average					
								Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
								0	703	653	1%	8%	7%
								5	633	367	11%	48%	42%
								10	571	242	19%	66%	58%
								15	521	180	26%	75%	65%
								20	502	166	29%	77%	67%
								25	469	151	34%	79%	68%
								30	466	141	34%	80%	70%

	Max	5.8
	Mean	5.5
	Min	4.7

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	647	645	12%	12%	0%
5	576	393	21%	46%	32%
10	521	269	29%	63%	48%
15	489	211	33%	71%	57%
20	467	188	36%	74%	60%
25	477	165	35%	78%	65%
30	461	152	37%	79%	67%

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	694	664	5%	9%	4%
5	633	424	14%	42%	33%
10	533	294	27%	60%	45%
15	512	230	30%	69%	55%
20	490	202	33%	72%	59%
25	486	180	34%	75%	63%
30	471	162	36%	78%	66%

	Max	5.9
	Mean	5.7
	Min	5.6

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	741	654	-5%	8%	12%
5	639	330	10%	53%	48%
10	487	211	31%	70%	57%
15	516	174	27%	75%	66%
20	505	147	29%	79%	71%
25	490	133	31%	81%	73%
30	461	119	35%	83%	74%

Average Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	702	640	1%	10%	9%
5	626	328	12%	54%	48%
10	515	221	27%	69%	57%
15	519	175	27%	75%	66%
20	487	152	31%	79%	69%
25	481	137	32%	81%	71%
30	463	125	35%	82%	73%

[illegible]

Testing Parameters					
Date	7/9/2024				
Time Start	10:18				
Time Interval (mins)	3780-3840				
Interelectrode Distance (cm)	0.5				
Voltage (Volts)	12				
Current (Amps)	4.7				
Turbidity 1	694				
Turbidity 2	708				
Turbidity 3	731				
Turbidity AVG (NTU)	711				
GPM	volume	time	mL/s		
Flow Rate 1	4.9	2000	6.45	310.0775	
Flow Rate 2	4.8	2000	6.58	303.9514	
Flow Rate 3	4.9	2000	6.45	310.0775	
Flow Rate AVG (GPM)	4.9				
Flow Rate AVG (m³/hr)	1.1				
Specific Energy Consumption (SEC) [kWh/m³]	0.051				

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
3780	63.00	4.8
3785	63.08	4.7
3790	63.17	4.7
3795	63.25	4.7
3800	63.33	4.5
3805	63.42	4.5
3810	63.50	4.4
3815	63.58	4.3
3820	63.67	4.2
3825	63.75	4.1
3830	63.83	4
3835	63.92	3.9
3840	64.00	3.8

	Max	4.8
	Mean	4.4
	Min	3.8

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	673	570	5%	20%	15%
5	565	340	21%	52%	40%
10	516	233	27%	67%	55%
15	506	182	29%	74%	64%
20	482	162	32%	77%	66%
25	465	162	35%	77%	65%
30	448	132	37%	81%	71%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	636	572	11%	20%	10%
5	480	305	32%	57%	36%
10	504	231	29%	68%	54%
15	473	192	33%	73%	59%
20	466	164	34%	77%	65%
25	437	148	39%	79%	66%
30	447	129	37%	82%	71%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	634	571	11%	20%	10%
5	512	313	28%	56%	39%
10	512	234	28%	67%	54%
15	474	187	33%	74%	61%
20	472	167	34%	77%	65%
25	436	149	39%	79%	66%
30	450	130	37%	82%	71%

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	648	571	9%	20%	12%
5	519	319	27%	55%	38%
10	511	233	28%	67%	54%
15	484	187	32%	74%	61%
20	473	164	33%	77%	65%
25	446	153	37%	78%	66%
30	448	130	37%	82%	71%

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/9/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	1:15			3840	64.00	3.4	0	581	548	12%	17%	6%
Time Interval (mins)	3840-3900			3845	64.08	3	5	513	329	23%	50%	36%
Interelectrode Distance (cm)	0.5			3850	64.17	3.3	10	439	257	34%	61%	41%
Voltage (Volts)	12			3855	64.25	3.7	15	460	203	31%	69%	56%
Current (Amps)	3.9			3860	64.33	3.8	20	446	174	33%	74%	61%
Turbidity 1	679			3865	64.42	3.9	25	414	160	38%	76%	61%
Turbidity 2	662			3870	64.50	3.9	30	387	150	42%	77%	61%
Turbidity 3	648			3875	64.58	3.9						
Turbidity AVG (NTU)	663			3880	64.67	3.8						
	GPM	volume	time	mL/s	3885	64.75	3.7					
Flow Rate 1	4.8	2000	6.63	301.6591	3890	64.83	3.7					
Flow Rate 2	5.1	2000	6.22	321.5434	3895	64.92	3.7					
Flow Rate 3	4.8	2000	6.63	301.6591	3900	65.00	3.6					
Flow Rate AVG (GPM)	4.9						Max					
Flow Rate AVG (m ³ /hr)	1.1						Mean					
							Min					
Specific Energy Consumption (SEC) [kWh/m ³]	0.042											

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/9/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	2:22			3900	65.00	3.7	0	746	634	22%	13%	15%
Time Interval (mins)	3900-3960			3905	65.08	3.4	5	630	426	14%	42%	32%
Interelectrode Distance (cm)	0.5			3910	65.17	3.4	10	525	313	28%	57%	40%
Voltage (Volts)	12			3915	65.25	3.3	15	486	239	33%	67%	51%
Current (Amps)	3.3667			3920	65.33	3.2	20	493	204	32%	72%	59%
Turbidity 1	719			3925	65.42	3.2	25	467	173	36%	76%	63%
Turbidity 2	737			3930	65.50	3.2	30	441	152	39%	79%	66%
Turbidity 3	730			3935	65.58	3.2						
Turbidity AVG (NTU)	729			3940	65.67	3.1						
	GPM	volume	time	mL/s	3945	65.75	3.1					
Flow Rate 1	4.8	2000	6.6	303.0303	3950	65.83	3.1					
Flow Rate 2	5.1	2000	6.27	318.9793	3955	65.92	3.1					
Flow Rate 3	5.0	2000	6.31	316.9572	3960	66.00	3.1					
Flow Rate AVG (GPM)	5.0						Max					
Flow Rate AVG (m ³ /hr)	1.1						Mean					
							Min					
Specific Energy Consumption (SEC) [kWh/m ³]	0.036											

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/9/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	3:20			3960	66.00	3.4	0	648	573	4%	15%	12%
Time Interval (mins)	3960-4020			3965	66.08	3.2	5	569	404	15%	40%	29%
Inter-electrode Distance (cm)	0.5			3970	66.17	3.1	10	530	266	21%	60%	50%
Voltage (Volts)	12			3975	66.25	3.1	15	467	228	31%	66%	51%
Current (Amps)	3.1			3980	66.33	3.1	20	480	196	29%	71%	59%
Turbidity 1	658			3985	66.42	3.1	25	442	167	34%	75%	62%
Turbidity 2	682			3990	66.50	3.1	30	395	152	41%	77%	62%
Turbidity 3	680			3995	66.58	3.8						
Turbidity AVG (NTU)	673			4000	66.67	3.1						
Flow Rate 1	GPM	volume	time	4005	66.75	4						
Flow Rate 1	4.9	2000	6.5	4010	66.83	3						
Flow Rate 2	4.9	2000	6.48	4015	66.92	3						
Flow Rate 3	4.9	2000	6.42	4020	67.00	3						
Flow Rate AVG (GPM)	4.9											
Flow Rate AVG (m ³ /hr)	1.1											
Specific Energy Consumption (SEC) (kWh/m ³)	0.033											

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/10/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	9:40			4020	67.00	5.6	0	664	652	1%	3%	2%
Time Interval (mins)	4020-4080			4025	67.08	2.4	5	585	467	13%	30%	20%
Inter-electrode Distance (cm)	0.5			4030	67.17	2.3	10	531	376	21%	44%	29%
Voltage (Volts)	12			4035	67.25	2.7	15	479	291	29%	57%	39%
Current (Amps)	2.8			4040	67.33	2.8	20	434	250	35%	63%	42%
Turbidity 1	681			4045	67.42	2.8	25	442	243	34%	64%	45%
Turbidity 2	664			4050	67.50	3	30	405	193	40%	71%	52%
Turbidity 3	667			4055	67.58	3						
Turbidity AVG (NTU)	671			4060	67.67	3						
Flow Rate 1	GPM	volume	time	4065	67.75	3.1						
Flow Rate 1	5.0	2000	6.4	4070	67.83	3.1						
Flow Rate 2	5.0	2000	6.35	4075	67.92	3.1						
Flow Rate 3	4.9	2000	6.42	4080	68.00	3.1						
Flow Rate AVG (GPM)	5.0											
Flow Rate AVG (m ³ /hr)	1.1											
Specific Energy Consumption (SEC) (kWh/m ³)	0.030											

Testing Parameters			
Date	7/10/2024		
Time Start	11:40		
Time Interval (mins)	4140-4200		
Interelectrode Distance (cm)	0.5		
Voltage (Volts)	12		
Current (Amps)	3.1		
Turbidity 1	689		
Turbidity 2	702		
Turbidity 3	677		
Turbidity AVG (NTU)	689		
GPM	volume	time	mL/s
Flow Rate 1	4.9	2000	6.43 311.042
Flow Rate 2	4.9	2000	6.43 311.042
Flow Rate 3	5.0	2000	6.4 312.5
Flow Rate AVG (GPM)	4.9		
Flow Rate AVG (m³/hr)	1.1		
Specific Energy Consumption (SEC) [kWh/m³]	0.033		

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
4140	69.00	3.1
4145	69.08	3.1
4150	69.17	3.1
4155	69.25	3.1
4160	69.33	3.1
4165	69.42	3.1
4170	69.50	3.1
4175	69.58	3.1
4180	69.67	3.1
4185	69.75	3.1
4190	69.83	3.1
4195	69.92	3.1
4200	70.00	3.1

Sample A						
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)	
0	670	621	3%	10%	7%	
5	592	428	14%	38%	28%	
10	567	335	18%	51%	41%	
15	508	256	26%	63%	50%	
20	500	204	27%	70%	59%	
25	477	181	31%	74%	62%	
30	458	159	34%	77%	65%	

Sample B						
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)	
0	704	635	-2%	8%	10%	
5	601	464	13%	33%	23%	
10	543	311	21%	55%	43%	
15	499	250	28%	64%	50%	
20	481	213	30%	69%	56%	
25	449	185	35%	73%	59%	
30	428	162	38%	76%	62%	

Sample C						
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)	
0			100%	100%	#DIV/0!	
5			100%	100%	#DIV/0!	
10			100%	100%	#DIV/0!	
15			100%	100%	#DIV/0!	
20			100%	100%	#DIV/0!	
25			100%	100%	#DIV/0!	
30			100%	100%	#DIV/0!	

Average						
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)	
0	687	628	0%	9%	9%	
5	597	446	13%	35%	25%	
10	555	323	19%	53%	42%	
15	504	253	27%	63%	50%	
20	491	209	29%	70%	57%	
25	463	183	33%	73%	60%	
30	443	161	36%	77%	64%	

Testing Parameters					Time VS Current Reading			Sample A					
Date	7/10/2024				Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	12:40				4200	70.00	3.4	0	640	584	3%	12%	9%
Time Interval (mins)	4200-4260				4205	70.08	3.1	5	568	415	14%	37%	27%
Interelectrode Distance (cm)	0.5				4210	70.17	3.1	10	435	306	34%	54%	30%
Voltage (Volts)	12				4215	70.25	3.1	15	512	231	23%	65%	55%
Current (Amps)	3.1				4220	70.33	3.1	20	468	194	29%	71%	59%
Turbidity 1	650				4225	70.42	3.1	25	455	169	31%	74%	63%
Turbidity 2	663				4230	70.50	3.1	30	421	165	36%	75%	61%
Turbidity 3	672				4235	70.58	3.1						
Turbidity AVG (NTU)	662				4240	70.67	3	Sample B					
	GPM	volume	time	mL/s	4245	70.75	3	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Flow Rate 1	4.9	2000	6.42	311.5265	4250	70.83	3	0	656	594	1%	10%	9%
Flow Rate 2	4.9	2000	6.49	308.1664	4255	70.92	3	5	570	451	14%	32%	21%
Flow Rate 3	4.9	2000	6.41	312.0125	4260	71.00	3	10	546	300	17%	55%	45%
Flow Rate AVG (GPM)	4.9							15	482	228	27%	66%	53%
Flow Rate AVG (m³/hr)	1.1						Max	20	472	196	29%	70%	58%
							Mean	25	452	165	32%	75%	63%
							Min	30	430	149	35%	77%	65%
Specific Energy Consumption (SEC) [kWh/m³]	0.033												
								Sample C					
								Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
								0			100%	100%	#DIV/0!
								5			100%	100%	#DIV/0!
								10			100%	100%	#DIV/0!
								15			100%	100%	#DIV/0!
								20			100%	100%	#DIV/0!
								25			100%	100%	#DIV/0!
								30			100%	100%	#DIV/0!
								Average					
								Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
								0	648	589	2%	11%	9%
								5	569	433	14%	35%	24%
								10	491	303	26%	54%	38%
								15	497	230	25%	65%	54%
								20	470	195	29%	71%	59%
								25	454	167	31%	75%	63%
								30	426	157	36%	76%	63%

Testing Parameters				Time VS Current Reading			Sample A						
Date	7/10/2024				Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	1:40				4260	71.00	3.2	0	721	662	1%	7%	8%
Time Interval (mins)	4260-4320				4265	71.08	3.1	5	631	442	12%	38%	30%
Interelectrode Distance (cm)	0.5				4270	71.17	3	10	570	310	20%	57%	46%
Voltage (Volts)	12				4275	71.25	3	15	525	245	26%	66%	53%
Current (Amps)	3.1				4280	71.33	3	20	504	211	29%	70%	58%
Turbidity 1	719				4285	71.42	3	25	483	189	32%	74%	61%
Turbidity 2	694				4290	71.50	3	30	436	163	39%	77%	63%
Turbidity 3	727				4295	71.58	2.9						
Turbidity AVG (NTU)	713				4300	71.67	2.9						
	GPM	volume	time	mL/s	4305	71.75	2.9						
Flow Rate 1	4.9	2000	6.45	310.0775	4310	71.83	2.9						
Flow Rate 2	4.9	2000	6.51	307.2197	4315	71.92	2.9						
Flow Rate 3	4.9	2000	6.49	308.1664	4320	72.00	2.9						
Flow Rate AVG (GPM)	4.9						Max						
Flow Rate AVG (m³/hr)	1.1						Mean						
							Min						
Specific Energy Consumption (SEC) [kWh/m³]	0.033												
							</						

Testing Parameters								Time VS Current Reading			Sample A						
Date	7/10/2024								Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	2:40								4320	72.00	3.4	0	674	623	3%	10%	8%
Time Interval (mins)	4320-4380								4325	72.08	3	5	633	417	9%	40%	34%
									4330	72.17	3	10	552	272	20%	61%	51%
Interelectrode Distance (cm)	0.5								4335	72.25	2.9	15	517	227	26%	67%	56%
Voltage (Volts)	12								4340	72.33	2.9	20	446	184	36%	73%	59%
Current (Amps)	3								4345	72.42	2.9	25	467	165	33%	76%	65%
									4350	72.50	2.9	30	456	151	34%	78%	67%
Turbidity 1	698								4355	72.58	2.9						
Turbidity 2	706								4360	72.67	2.9						
Turbidity 3	679								4365	72.75	2.9						
Turbidity AVG (NTU)	694								4370	72.83	2.9						
	GPM	volume	time	mL/s					4375	72.92	2.9						
Flow Rate 1	4.9	2000	6.43	311.042					4380	73.00	2.8						
Flow Rate 2	4.8	2000	6.55	305.3435													
Flow Rate 3	4.8	2000	6.55	305.3435													
Flow Rate AVG (GPM)	4.9									Max	3.4						
Flow Rate AVG (m³/hr)	1.1									Mean	2.9						
										Min	2.8						
Specific Energy Consumption (SEC) [kWh/m³]	0.033																

Testing Parameters				Time VS Current Reading			Sample A						
Date	7/11/2024				Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	8:20				4380	73.00	6	0	682	657	1%	6%	5%
Time Interval (mins)	4380-4440				4385	73.08	2.3	5	640	561	9%	20%	12%
					4390	73.17	2.3	10	544	462	22%	34%	15%
Interelectrode Distance (cm)	0.5				4395	73.25	2.4	15	521	376	26%	46%	28%
Voltage (Volts)	12				4400	73.33	2.6	20	478	347	32%	50%	27%
Current (Amps)	2.3				4405	73.42	2.7	25	467	323	33%	54%	31%
					4410	73.50	2.8	30	447	294	36%	58%	34%
Turbidity 1	708				4415	73.58	2.8						
Turbidity 2	696				4420	73.67	2.9						
Turbidity 3	695				4425	73.75	2.9						
Turbidity AVG (NTU)	700				4430	73.83	3						
	GPM	volume	time	mL/s	4435	73.92	3						
Flow Rate 1	4.9	2000	6.48	308.642	4440	74.00	3						
Flow Rate 2	5.0	2000	6.4	312.5									
Flow Rate 3	4.9	2000	6.43	311.042									
Flow Rate AVG (GPM)	4.9					Max	6.0						
Flow Rate AVG (m³/hr)	1.1					Mean	3.0						
						Min	2.3						
Specific Energy Consumption (SEC) [kWh/m³]	0.025												

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/15/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	9:34			4560	76.00	5	0	698	637	-4%	5%	9%
Time Interval (mins)	4560-4620			4565	76.08	2.6	5	593	494	11%	26%	17%
				4570	76.17	2.3	10	515	390	23%	42%	24%
Interelectrode Distance (cm)	0.5			4575	76.25	2.3	15	459	329	31%	51%	28%
Voltage (Volts)	12			4580	76.33	2.4	20	455	295	32%	56%	35%
Current (Amps)	2.35			4585	76.42	2.5	25	431	271	36%	60%	37%
				4590	76.50	2.6	30	410	258	39%	61%	37%
Turbidity 1	707			4595	76.58	2.6	Sample B					
Turbidity 2	629			4600	76.67	2.7	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Turbidity 3	672			4605	76.75	2.8	0	703	676	-5%	-1%	4%
Turbidity AVG (NTU)	669			4610	76.83	2.8	5	625	494	7%	26%	21%
	GPM	volume	time	mL/s			10	506	411	24%	39%	19%
Flow Rate 1	4.9	2000	6.43	311.042			15	470	347	30%	48%	26%
Flow Rate 2	4.9	2000	6.5	307.6923			20	447	301	33%	55%	33%
Flow Rate 3	4.8	2000	6.63	301.6591			25	434	278	35%	58%	36%
Flow Rate AVG (GPM)	4.9				Max	5.0	30	434	250	35%	63%	42%
Flow Rate AVG (m ³ /hr)	1.1				Mean	2.8	Sample C					
					Min	2.3	Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Specific Energy Consumption (SEC) [kWh/m ³]	0.028						0			100%	100%	#DIV/0!
							5			100%	100%	#DIV/0!
							10			100%	100%	#DIV/0!
							15			100%	100%	#DIV/0!
							20			100%	100%	#DIV/0!
							25			100%	100%	#DIV/0!
							30			100%	100%	#DIV/0!
							Average					
							Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	701	657	-5%	2%	6%
							5	609	494	9%	26%	19%
							10	511	401	24%	40%	22%
							15	465	338	31%	50%	27%
							20	451	298	33%	55%	34%
							25	433	275	35%	59%	37%
							30	422	254	37%	62%	40%

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/15/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	10:34			4620	77.00	2.9	0	759	673	-15%	-2%	11%
Time Interval (mins)	4620-4680			4625	77.08	3.2	5	645	468	2%	29%	27%
				4630	77.17	3.2	10	582	370	12%	44%	36%
Interelectrode Distance (cm)	0.5			4635	77.25	3.2	15	549	304	17%	54%	45%
Voltage (Volts)	12			4640	77.33	3.2	20	508	246	23%	63%	52%
Current (Amps)	3.2			4645	77.42	3.2	25	502	209	24%	68%	58%
				4650	77.50	3.2	30	451	195	32%	70%	57%
Turbidity 1	654			4655	77.58	3.2	Sample B					
Turbidity 2	676			4660	77.67	3.2	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Turbidity 3	652			4665	77.75	3.2	0	708	647	-7%	2%	9%
Turbidity AVG (NTU)	661			4670	77.83	3.2	5	618	459	6%	31%	26%
	GPM	volume	time	mL/s			10	535	388	19%	41%	27%
Flow Rate 1	4.8	2000	6.64	301.2048			15	481	272	27%	59%	43%
Flow Rate 2	4.8	2000	6.64	301.2048			20	461	249	30%	62%	46%
Flow Rate 3	5.0	2000	6.28	318.4713			25	458	201	31%	70%	56%
Flow Rate AVG (GPM)	4.9				Max	3.2	30	470	174	29%	74%	63%
Flow Rate AVG (m ³ /hr)	1.1				Mean	3.2	Sample C					
					Min	2.9	Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Specific Energy Consumption (SEC) [kWh/m ³]	0.035						0			100%	100%	#DIV/0!
							5			100%	100%	#DIV/0!
							10			100%	100%	#DIV/0!
							15			100%	100%	#DIV/0!
							20			100%	100%	#DIV/0!
							25			100%	100%	#DIV/0!
							30			100%	100%	#DIV/0!
							Average					
							Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	734	660	-11%	0%	10%
							5	632	464	4%	30%	27%
							10	559	379	15%	43%	32%
							15	515	288	22%	56%	44%
							20	485	248	27%	63%	49%
							25	480	205	27%	69%	57%
							30	461	185	30%	72%	60%

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/15/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	1:34			4680	78.00	3	0	677	621	6%	14%	8%
Time Interval (mins)	4680-4740			4685	78.08	2.6	5	593	492	18%	32%	17%
				4690	78.17	2.8	10	509	398	29%	45%	22%
Interelectrode Distance (cm)	0.5			4695	78.25	2.9	15	499	316	31%	56%	37%
Voltage (Volts)	12			4700	78.33	3	20	498	271	31%	62%	46%
Current (Amps)	3			4705	78.42	3.1	25	437	243	39%	66%	44%
				4710	78.50	3.1	30	452	216	37%	70%	52%
Turbidity 1	746			4715	78.58	3.2	Sample B					
Turbidity 2	695			4720	78.67	3.2	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Turbidity 3	721			4725	78.75	3.2	0	667	652	7%	10%	2%
Turbidity AVG (NTU)	721			4730	78.83	3.2	5	625	475	13%	34%	24%
	GPM	volume	time	4735	78.92	3.2	10	494	361	31%	50%	27%
Flow Rate 1	5.0	2000	6.36	4740	79.00	3.2	15	471	294	35%	59%	38%
Flow Rate 2	5.0	2000	6.34				20	484	256	33%	64%	47%
Flow Rate 3	5.0	2000	6.29				25	458	229	36%	68%	50%
Flow Rate AVG (GPM)	5.0				Max	3.2	30	469	192	35%	73%	59%
Flow Rate AVG (m ³ /hr)	1.1				Mean	3.1	Sample C					
					Min	2.6	Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Specific Energy Consumption (SEC) [kWh/m ³]	0.032						0			100%	100%	#DIV/0!
							5			100%	100%	#DIV/0!
							10			100%	100%	#DIV/0!
							15			100%	100%	#DIV/0!
							20			100%	100%	#DIV/0!
							25			100%	100%	#DIV/0!
							30			100%	100%	#DIV/0!
							Average					
							Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	672	637	7%	12%	5%
							5	609	484	15%	33%	21%
							10	502	380	30%	47%	24%
							15	485	305	33%	58%	37%
							20	491	264	32%	63%	46%
							25	448	236	38%	67%	47%
							30	461	204	36%	72%	56%

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/15/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	2:34			4740	79.00	3.2	0	680	639	3%	9%	6%
Time Interval (mins)	4740-4800			4745	79.08	3.4	5	601	476	14%	32%	21%
				4750	79.17	3.4	10	598	350	15%	50%	41%
Interelectrode Distance (cm)	0.5			4755	79.25	3.4	15	512	275	27%	61%	46%
Voltage (Volts)	12			4760	79.33	3.4	20	492	235	30%	66%	52%
Current (Amps)	3.4			4765	79.42	3.4	25	559	187	20%	73%	67%
				4770	79.50	3.4	30	480	170	31%	76%	65%
Turbidity 1	702			4775	79.58	3.3	Sample B					
Turbidity 2	717			4780	79.67	3.3	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Turbidity 3	680			4785	79.75	3.3	0	648	644	7%	8%	1%
Turbidity AVG (NTU)	700			4790	79.83	3.3	5	638	482	9%	31%	24%
	GPM	volume	time	4795	79.92	3.3	10	570	339	19%	52%	41%
Flow Rate 1	4.9	2000	6.49	4800	80.00	3.2	15	524	272	25%	61%	48%
Flow Rate 2	5.0	2000	6.38				20	515	227	26%	68%	56%
Flow Rate 3	5.1	2000	6.23				25	490	192	30%	73%	61%
Flow Rate AVG (GPM)	5.0				Max	3.4	30	448	186	36%	73%	58%
Flow Rate AVG (m ³ /hr)	1.1				Mean	3.3	Sample C					
					Min	3.2	Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Specific Energy Consumption (SEC) [kWh/m ³]	0.036						0			100%	100%	#DIV/0!
							5			100%	100%	#DIV/0!
							10			100%	100%	#DIV/0!
							15			100%	100%	#DIV/0!
							20			100%	100%	#DIV/0!
							25			100%	100%	#DIV/0!
							30			100%	100%	#DIV/0!
							Average					
							Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	664	642	5%	8%	3%
							5	620	479	11%	32%	23%
							10	584	345	17%	51%	41%
							15	518	274	26%	61%	47%
							20	504	231	28%	67%	54%
							25	525	190	25%	73%	64%
							30	464	178	34%	75%	62%

Testing Parameters			
Date	7/17/2024		
Time Start	8:40		
Time Interval (mins)	4860-4920		
Interelectrode Distance (cm)	0.5		
Voltage (Volts)	12		
Current (Amps)	2		
Turbidity 1	667		
Turbidity 2	689		
Turbidity 3	674		
Turbidity AVG (NTU)	677		
GPM	volume	time	mL/s
Flow Rate 1	4.9	2000	6.44 310.559
Flow Rate 2	4.9	2000	6.5 307.6923
Flow Rate 3	4.9	2000	6.5 307.6923
Flow Rate AVG (GPM)	4.9		
Flow Rate AVG (m³/hr)	1.1		
Specific Energy Consumption (SEC) [kWh/m³]	0.022		

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
4860	81.00	4
4865	81.08	2.2
4870	81.17	2
4875	81.25	2.1
4880	81.33	2.2
4885	81.42	2.2
4890	81.50	2.3
4895	81.58	2.4
4900	81.67	2.5
4905	81.75	2.5
4910	81.83	2.6
4915	81.92	2.6
4920	82.00	2.6

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	661	626	2%	7%	5%
5	590	550	13%	19%	7%
10	567	494	16%	27%	13%
15	500	430	26%	36%	14%
20	461	403	32%	40%	13%
25	445	333	34%	51%	25%
30	409	318	40%	53%	22%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	640	633	5%	6%	1%
5	618	601	9%	11%	3%
10	582	482	14%	29%	17%
15	568	438	16%	35%	23%
20	484	379	28%	44%	22%
25	458	364	32%	46%	21%
30	408	332	40%	51%	19%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	651	630	4%	7%	3%
5	604	576	11%	15%	5%
10	575	488	15%	28%	15%
15	534	434	21%	36%	19%
20	473	391	30%	42%	17%
25	452	349	33%	48%	23%
30	409	325	40%	52%	20%

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/17/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	9:40			4920	82.00	2.8	0	700	650	1%	8%	7%
Time Interval (mins)	4920-4980			4925	82.08	2.7	5	602	493	15%	30%	18%
				4930	82.17	2.8	10	541	392	24%	45%	28%
Interelectrode Distance (cm)	0.5			4935	82.25	2.8	15	538	319	24%	55%	41%
Voltage (Volts)	12			4940	82.33	2.8	20	496	272	30%	62%	45%
Current (Amps)	2.8			4945	82.42	2.8	25	470	234	34%	67%	50%
				4950	82.50	2.8	30	442	208	38%	71%	53%
				4955	82.58	2.9						
Turbidity 1	715			4960	82.67	2.9	Sample B					
Turbidity 2	698			4965	82.75	2.9	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Turbidity 3	712			4970	82.83	2.9	0	698	649	1%	8%	7%
Turbidity AVG (NTU)	708			4975	82.92	2.9	5	611	520	14%	27%	15%
				4980	83.00	2.9	10	566	401	20%	43%	29%
Flow Rate 1	4.9	2000	6.48	308.642			15	543	305	23%	57%	44%
Flow Rate 2	4.9	2000	6.5	307.6923			20	475	278	33%	61%	41%
Flow Rate 3	5.0	2000	6.35	314.9606			25	537	238	24%	66%	56%
Flow Rate AVG (GPM)	4.9				Max	2.9	30	462	217	35%	69%	53%
Flow Rate AVG (m ³ /hr)	1.1				Mean	2.8						
					Min	2.7						
Specific Energy Consumption (SEC) [kWh/m ³]	0.030						Sample C					
							Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0			100%	100%	#DIV/0!
							5			100%	100%	#DIV/0!
							10			100%	100%	#DIV/0!
							15			100%	100%	#DIV/0!
							20			100%	100%	#DIV/0!
							25			100%	100%	#DIV/0!
							30			100%	100%	#DIV/0!
							Average					
							Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	699	650	1%	8%	7%
							5	607	507	14%	28%	16%
							10	554	397	22%	44%	28%
							15	541	312	24%	56%	42%
							20	486	275	31%	61%	43%
							25	504	236	29%	67%	53%
							30	452	213	36%	70%	53%

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/17/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	10:40			4980	83.00	2.9	0	695	627	0%	10%	10%
Time Interval (mins)	4980-5040			4985	83.08	2.9	5	616	447	11%	35%	27%
				4990	83.17	2.9	10	578	345	17%	50%	40%
Interelectrode Distance (cm)	0.5			4995	83.25	2.9	15	533	276	23%	60%	48%
Voltage (Volts)	12			5000	83.33	2.9	20	510	226	26%	67%	56%
Current (Amps)	2.9			5005	83.42	2.8	25	514	196	26%	72%	62%
				5010	83.50	2.8	30	473	170	32%	75%	64%
				5015	83.58	2.8						
Turbidity 1	700			5020	83.67	2.8	Sample B					
Turbidity 2	692			5025	83.75	2.8	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Turbidity 3	687			5030	83.83	2.8	0	718	637	-4%	8%	11%
Turbidity AVG (NTU)	693			5035	83.92	2.8	5	624	497	10%	28%	20%
				5040	84.00	2.8	10	560	345	19%	50%	38%
Flow Rate 1	4.9	2000	6.49	308.1664			15	532	274	23%	60%	48%
Flow Rate 2	5.0	2000	6.36	314.4654			20	526	240	24%	65%	54%
Flow Rate 3	4.9	2000	6.41	312.0125			25	487	197	30%	72%	60%
Flow Rate AVG (GPM)	4.9				Max	2.9	30	479	193	31%	72%	60%
Flow Rate AVG (m ³ /hr)	1.1				Mean	2.8						
					Min	2.8						
Specific Energy Consumption (SEC) [kWh/m ³]	0.031						Sample C					
							Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0			100%	100%	#DIV/0!
							5			100%	100%	#DIV/0!
							10			100%	100%	#DIV/0!
							15			100%	100%	#DIV/0!
							20			100%	100%	#DIV/0!
							25			100%	100%	#DIV/0!
							30			100%	100%	#DIV/0!
							Average					
							Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	707	632	-2%	9%	11%
							5	620	472	11%	32%	24%
							10	569	345	18%	50%	39%
							15	533	275	23%	60%	48%
							20	518	233	25%	66%	55%
							25	501	197	28%	72%	61%
							30	476	182	31%	74%	62%

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/18/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	8:30			5040	84.00	4.3	0	650	582	5%	15%	10%
Time Interval (mins)	5040-5100			5045	84.08	1.9	5	606	539	11%	21%	11%
				5050	84.17	1.9	10	536	470	21%	31%	12%
Interelectrode Distance (cm)	0.5			5055	84.25	1.8	15	475	417	30%	39%	12%
Voltage (Volts)	12			5060	84.33	1.9	20	473	374	31%	45%	21%
Current (Amps)	1.8			5065	84.42	2	25	468	303	31%	56%	35%
				5070	84.50	2.1	30	473	297	31%	56%	37%
Turbidity 1	675			5075	84.58	2.2						
Turbidity 2	693			5080	84.67	2.2						
Turbidity 3	675			5085	84.75	2.2						
Turbidity AVG (NTU)	681			5090	84.83	2.2						
	GPM	volume	time	5095	84.92	2.3						
Flow Rate 1	4.9	2000	6.46	5100	85.00	2.3						
Flow Rate 2	4.8	2000	6.55									
Flow Rate 3	4.9	2000	6.51									
Flow Rate AVG (GPM)	4.9				Max	4.3						
Flow Rate AVG (m ³ /hr)	1.1				Mean	2.3						
					Min	1.8						
Specific Energy Consumption (SEC) [kWh/m ³]	0.020											

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/18/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	9:30			5100	85.00	2.3	0	658	650	4%	5%	1%
Time Interval (mins)	5100-5160			5105	85.08	2.3	5	606	516	12%	25%	15%
				5110	85.17	2.4	10	531	417	23%	39%	21%
Interelectrode Distance (cm)	0.5			5115	85.25	2.4	15	520	325	24%	53%	38%
Voltage (Volts)	12			5120	85.33	2.4	20	490	290	29%	58%	41%
Current (Amps)	2.3			5125	85.42	2.4	25	479	261	30%	62%	46%
				5130	85.50	2.4	30	473	221	31%	68%	53%
Turbidity 1	659			5135	85.58	2.4						
Turbidity 2	693			5140	85.67	2.4						
Turbidity 3	707			5145	85.75	2.4						
Turbidity AVG (NTU)	686			5150	85.83	2.4						
	GPM	volume	time	5155	85.92	2.4						
Flow Rate 1	5.0	2000	6.39	5160	86.00	2.4						
Flow Rate 2	4.9	2000	6.5									
Flow Rate 3	5.0	2000	6.35									
Flow Rate AVG (GPM)	4.9				Max	2.4						
Flow Rate AVG (m ³ /hr)	1.1				Mean	2.4						
					Min	2.3						
Specific Energy Consumption (SEC) [kWh/m ³]	0.025											

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/18/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	5160-5220			5160	86.00	2.4	0	677	615	-1%	8%	9%
Time Interval (mins)	10:30			5165	86.08	2.3	5	593	484	11%	28%	18%
				5170	86.17	2.3	10	514	363	23%	46%	29%
Interelectrode Distance (cm)	0.5			5175	86.25	2.3	15	498	304	26%	55%	39%
Voltage (Volts)	12			5180	86.33	2.3	20	491	249	27%	63%	49%
Current (Amps)	2.3			5185	86.42	2.3	25	459	221	31%	67%	52%
				5190	86.50	2.3	30	445	199	33%	70%	55%
Turbidity 1	653			5195	86.58	2.3	Sample B					
Turbidity 2	670			5200	86.67	2.3	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Turbidity 3	683			5205	86.75	2.3	0	673	607	-1%	9%	10%
Turbidity AVG (NTU)	669			5210	86.83	2.2	5	588	469	12%	30%	20%
	GPM	volume	time	5215	86.92	2.2	10	543	370	19%	45%	32%
Flow Rate 1	4.9	2000	6.41	5220	87.00	2.2	15	510	294	24%	56%	42%
Flow Rate 2	5.0	2000	6.36				20	488	261	27%	61%	47%
Flow Rate 3	4.9	2000	6.46				25	473	218	29%	67%	54%
Flow Rate AVG (GPM)	4.9				Max	2.4	30	447	203	33%	70%	55%
Flow Rate AVG (m ³ /hr)	1.1				Mean	2.3	Sample C					
Specific Energy Consumption (SEC) [kWh/m ³]	0.025				Min	2.2	Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0			100%	100%	#DIV/0!
							5			100%	100%	#DIV/0!
							10			100%	100%	#DIV/0!
							15			100%	100%	#DIV/0!
							20			100%	100%	#DIV/0!
							25			100%	100%	#DIV/0!
							30			100%	100%	#DIV/0!
							Average					
							Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	675	611	-1%	9%	9%
							5	591	477	12%	29%	19%
							10	529	367	21%	45%	31%
							15	504	299	25%	55%	41%
							20	490	255	27%	62%	48%
							25	466	220	30%	67%	53%
							30	446	201	33%	70%	55%

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/18/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	11:30			5220	87.00	2.3	0	684	631	4%	12%	8%
Time Interval (mins)	5220-5280			5225	87.08	2.2	5	629	507	12%	29%	19%
				5230	87.17	2.2	10	577	375	19%	48%	35%
Interelectrode Distance (cm)	0.5			5235	87.25	2.2	15	558	297	22%	58%	47%
Voltage (Volts)	12			5240	87.33	2.2	20	502	249	30%	65%	50%
Current (Amps)	2.2			5245	87.42	2.2	25	469	224	34%	69%	52%
				5250	87.50	2.2	30	467	207	35%	71%	56%
Turbidity 1	719			5255	87.58	2.2	Sample B					
Turbidity 2	738			5260	87.67	2.2	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Turbidity 3	689			5265	87.75	2.2	0	669	637	6%	11%	5%
Turbidity AVG (NTU)	715			5270	87.83	2.2	5	616	458	14%	36%	26%
	GPM	volume	time	5275	87.92	2.2	10	507	632	29%	12%	-25%
Flow Rate 1	4.9	2000	6.48	5280	88.00	2.2	15	532	305	26%	57%	43%
Flow Rate 2	5.0	2000	6.38				20	476	257	33%	64%	46%
Flow Rate 3	4.9	2000	6.36				25	487	225	32%	69%	54%
Flow Rate AVG (GPM)	4.9				Max	2.3	30	430	210	40%	71%	51%
Flow Rate AVG (m ³ /hr)	1.1				Mean	2.2	Sample C					
Specific Energy Consumption (SEC) [kWh/m ³]	0.023				Min	2.2	Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0			100%	100%	#DIV/0!
							5			100%	100%	#DIV/0!
							10			100%	100%	#DIV/0!
							15			100%	100%	#DIV/0!
							20			100%	100%	#DIV/0!
							25			100%	100%	#DIV/0!
							30			100%	100%	#DIV/0!
							Average					
							Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	677	634	5%	11%	6%
							5	623	483	13%	33%	22%
							10	542	504	24%	30%	7%
							15	545	301	24%	58%	45%
							20	489	253	32%	65%	48%
							25	478	225	33%	69%	53%
							30	449	209	37%	71%	54%

Testing Parameters					
Date	7/19/2024				
Time Start	12:46				
Time Interval (mins)	5460-5520				
Interelectrode Distance (cm)	0.5				
Voltage (Volts)	12				
Current (Amps)	1.7				
Turbidity 1	709				
Turbidity 2	704				
Turbidity 3	742				
Turbidity AVG (NTU)	718				
GPM	volume	time	mL/s		
Flow Rate 1	5.0	2000	6.34	315.4574	
Flow Rate 2	5.1	2000	6.26	319.4888	
Flow Rate 3	4.9	2000	6.43	311.042	
Flow Rate AVG (GPM)	5.0				
Flow Rate AVG (m³/hr)	1.1				
Specific Energy Consumption (SEC) [kWh/m³]	0.018				

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
5460	91.00	2.7
5465	91.08	1.7
5470	91.17	1.6
5475	91.25	1.7
5480	91.33	1.7
5485	91.42	1.8
5490	91.50	1.8
5495	91.58	1.8
5500	91.67	1.8
5505	91.75	1.8
5510	91.83	1.8
5515	91.92	1.8
5520	92.00	1.8

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	658	621	6%	14%	6%
5	607	562	15%	22%	7%
10	585	482	19%	33%	18%
15	516	411	28%	43%	20%
20	533	396	26%	45%	26%
25	500	356	30%	50%	29%
30	469	308	35%	57%	34%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	689	622	4%	13%	10%
5	607	521	15%	27%	14%
10	522	473	27%	34%	9%
15	516	391	28%	46%	24%
20	463	353	36%	51%	24%
25	461	316	36%	56%	31%
30	439	288	39%	60%	34%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	674	622	6%	13%	8%
5	607	542	15%	25%	11%
10	554	478	23%	34%	14%
15	516	401	28%	44%	22%
20	498	375	31%	48%	25%
25	481	336	33%	53%	30%
30	454	298	37%	59%	34%

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/19/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	1:46			5520	92.00	2.1	0	730	632	-3%	11%	13%
Time Interval (mins)	5520-5580			5525	92.08	1.9	5	625	522	12%	26%	16%
				5530	92.17	1.8	10	534	432	25%	39%	19%
Interelectrode Distance (cm)	0.5			5535	92.25	1.8	15	499	314	30%	56%	37%
Voltage (Volts)	12			5540	92.33	1.8	20	529	277	25%	61%	48%
Current (Amps)	1.85			5545	92.42	1.8	25	440	257	38%	64%	42%
				5550	92.50	1.8	30	464	196	34%	72%	58%
Turbidity 1	708			5555	92.58	1.8	Sample B					
Turbidity 2	690			5560	92.67	1.8	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Turbidity 3	727			5565	92.75	1.8	0	702	622	1%	12%	11%
Turbidity AVG (NTU)	708			5570	92.83	1.8	5	608	536	14%	24%	12%
	GPM	volume	time	mL/s			10	532	396	25%	44%	26%
Flow Rate 1	4.9	2000	6.43	311.042			15	511	334	28%	53%	35%
Flow Rate 2	4.8	2000	6.63	301.6591			20	491	279	31%	61%	43%
Flow Rate 3	5.0	2000	6.35	314.9606			25	478	242	33%	66%	49%
Flow Rate AVG (GPM)	4.9				Max	2.1	30	476	227	33%	68%	52%
Flow Rate AVG (m ³ /hr)	1.1				Mean	1.8	Sample C					
Specific Energy Consumption (SEC) [kWh/m ³]	0.020				Min	1.8	Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0			100%	100%	#DIV/0!
							5			100%	100%	#DIV/0!
							10			100%	100%	#DIV/0!
							15			100%	100%	#DIV/0!
							20			100%	100%	#DIV/0!
							25			100%	100%	#DIV/0!
							30			100%	100%	#DIV/0!
							Average					
							Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	716	627	-1%	11%	12%
							5	617	529	13%	25%	14%
							10	533	414	25%	42%	22%
							15	505	324	29%	54%	36%
							20	510	278	28%	61%	45%
							25	459	250	35%	65%	46%
							30	470	212	34%	70%	55%

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/19/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	2:48			5580	93.00	2.2	0	671	623	7%	13%	7%
Time Interval (mins)	5580-5640			5585	93.08	1.9	5	589	479	18%	33%	19%
				5590	93.17	1.9	10	507	382	29%	47%	25%
Interelectrode Distance (cm)	0.5			5595	93.25	1.9	15	507	329	29%	54%	35%
Voltage (Volts)	12			5600	93.33	1.9	20	476	288	34%	60%	39%
Current (Amps)	1.83			5605	93.42	1.8	25	443	256	38%	64%	42%
				5610	93.50	1.8	30	468	210	35%	71%	55%
Turbidity 1	720			5615	93.58	1.8	Sample B					
Turbidity 2	736			5620	93.67	1.8	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Turbidity 3	698			5625	93.75	1.8	0	722	649	-1%	10%	10%
Turbidity AVG (NTU)	718			5630	93.83	1.8	5	624	503	13%	30%	19%
	GPM	volume	time	mL/s			10	515	424	28%	41%	18%
Flow Rate 1	5.1	2000	6.25	320			15	500	317	30%	56%	37%
Flow Rate 2	5.2	2000	6.1	327.8689			20	493	252	31%	65%	49%
Flow Rate 3	5.0	2000	6.33	315.9558			25	466	252	35%	65%	46%
Flow Rate AVG (GPM)	5.1				Max	2.2	30	443	210	38%	71%	53%
Flow Rate AVG (m ³ /hr)	1.2				Mean	1.9	Sample C					
Specific Energy Consumption (SEC) [kWh/m ³]	0.019				Min	1.8	Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	694	648	3%	10%	7%
							5	655	535	9%	25%	18%
							10	592	405	18%	44%	32%
							15	505	312	30%	57%	38%
							20	515	281	28%	61%	45%
							25	445	265	38%	63%	40%
							30	493	223	31%	69%	55%
							Average					
							Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	696	640	3%	11%	8%
							5	623	506	13%	30%	19%
							10	538	404	25%	44%	25%
							15	504	319	30%	56%	37%
							20	495	274	31%	62%	45%
							25	451	258	37%	64%	43%
							30	468	214	35%	70%	54%

Testing Parameters			
Date	7/22/2024		
Time Start	10:35		
Time Interval (mins)	5700-5780		
Interelectrode Distance (cm)	0.5		
Voltage (Volts)	12		
Current (Amps)	2.5		
Turbidity 1	748		
Turbidity 2	750		
Turbidity 3	722		
Turbidity AVG (NTU)	740		
GPM	volume	time	mL/s
Flow Rate 1	4.9	2000	6.44 310.559
Flow Rate 2	5.0	2000	6.31 316.9572
Flow Rate 3	4.8	2000	6.61 302.5719
Flow Rate AVG (GPM)	4.9		
Flow Rate AVG (m³/hr)	1.1		
Specific Energy Consumption (SEC) [kWh/m³]	0.027		

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
5700	95.00	2
5705	95.08	2.5
5710	95.17	2.4
5715	95.25	2.5
5720	95.33	2.5
5725	95.42	2.5
5730	95.50	2.5
5735	95.58	2.5
5740	95.67	2.5
5745	95.75	2.5
5750	95.83	2.5
5755	95.92	2.5
5760	96.00	2.5

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	730	658	1%	11%	10%
5	638	549	14%	26%	14%
10	569	397	23%	46%	30%
15	536	330	28%	55%	38%
20	492	303	34%	59%	38%
25	486	254	34%	66%	48%
30	483	234	35%	68%	52%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	714	666	4%	10%	7%
5	665	546	10%	26%	18%
10	555	402	25%	46%	28%
15	535	308	28%	58%	42%
20	489	258	34%	65%	47%
25	496	244	33%	67%	51%
30	487	222	34%	70%	54%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	722	662	2%	11%	8%
5	652	548	12%	26%	16%
10	562	400	24%	46%	29%
15	536	319	28%	57%	40%
20	491	281	34%	62%	43%
25	491	249	34%	66%	49%
30	485	228	34%	69%	53%

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/22/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	12:52			5760	96.00	3.6	0	719	661	1%	9%	8%
Time Interval (mins)	5760-5820			5765	96.08	2.3	5	610	541	16%	26%	11%
				5770	96.17	2.3	10	547	421	25%	42%	23%
Interelectrode Distance (cm)	0.5			5775	96.25	2.3	15	538	364	26%	50%	32%
Voltage (Volts)	12			5780	96.33	2.4	20	498	334	31%	54%	33%
Current (Amps)	2.3			5785	96.42	2.4	25	510	301	30%	59%	41%
				5790	96.50	2.4	30	462	262	36%	64%	43%
Turbidity 1	703			5795	96.58	2.4	Sample B					
Turbidity 2	741			5800	96.67	2.4	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Turbidity 3	735			5805	96.75	2.4	0	701	653	3%	10%	7%
Turbidity AVG (NTU)	726			5810	96.83	2.4	5	626	531	14%	27%	15%
	GPM	volume	time	mL/s	5815	96.92	10	540	423	26%	42%	22%
Flow Rate 1	4.9	2000	6.48	308.642	5820	97.00	15	525	341	28%	53%	35%
Flow Rate 2	4.8	2000	6.66	300.3003			20	514	304	29%	58%	41%
Flow Rate 3	5.0	2000	6.38	313.4796			25	479	271	34%	63%	43%
Flow Rate AVG (GPM)	4.9				Max	3.6	30	481	251	34%	65%	48%
Flow Rate AVG (m ³ /hr)	1.1				Mean	2.5	Sample C					
Specific Energy Consumption (SEC) [kWh/m ³]	0.025				Min	2.3	Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0			100%	100%	#DIV/0!
							5			100%	100%	#DIV/0!
							10			100%	100%	#DIV/0!
							15			100%	100%	#DIV/0!
							20			100%	100%	#DIV/0!
							25			100%	100%	#DIV/0!
							30			100%	100%	#DIV/0!
							Average					
							Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	710	657	2%	10%	7%
							5	618	536	15%	26%	13%
							10	544	422	25%	42%	22%
							15	532	353	27%	51%	34%
							20	506	319	30%	56%	37%
							25	495	286	32%	61%	42%
							30	472	257	35%	65%	46%

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/22/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	1:52			5820	97.00	2.4	0	672	628	2%	8%	7%
Time Interval (mins)	5820-5880			5825	97.08	2.6	5	597	492	13%	28%	18%
				5830	97.17	2.6	10	533	389	22%	43%	27%
Interelectrode Distance (cm)	0.5			5835	97.25	2.6	15	507	305	26%	55%	40%
Voltage (Volts)	12			5840	97.33	2.6	20	493	274	28%	60%	44%
Current (Amps)	2.6			5845	97.42	2.6	25	501	233	27%	66%	53%
				5850	97.50	2.6	30	471	208	31%	70%	56%
Turbidity 1	681			5855	97.58	2.6	Sample B					
Turbidity 2	692			5860	97.67	2.6	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Turbidity 3	674			5865	97.75	2.6	0	701	586	-3%	14%	16%
Turbidity AVG (NTU)	682			5870	97.83	2.5	5	612	509	10%	25%	17%
	GPM	volume	time	mL/s	5875	97.92	10	553	381	19%	44%	31%
Flow Rate 1	4.8	2000	6.55	305.3435	5880	98.00	15	549	326	20%	52%	41%
Flow Rate 2	4.9	2000	6.51	307.2197			20	497	268	27%	61%	46%
Flow Rate 3	5.0	2000	6.36	314.4654			25	469	232	31%	66%	51%
Flow Rate AVG (GPM)	4.9				Max	2.6	30	459	203	33%	70%	56%
Flow Rate AVG (m ³ /hr)	1.1				Mean	2.4	Sample C					
Specific Energy Consumption (SEC) [kWh/m ³]	0.028				Min	2.4	Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0			100%	100%	#DIV/0!
							5			100%	100%	#DIV/0!
							10			100%	100%	#DIV/0!
							15			100%	100%	#DIV/0!
							20			100%	100%	#DIV/0!
							25			100%	100%	#DIV/0!
							30			100%	100%	#DIV/0!
							Average					
							Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	687	607	-1%	11%	12%
							5	605	501	11%	27%	17%
							10	543	385	20%	44%	29%
							15	528	316	23%	54%	40%
							20	495	271	27%	60%	45%
							25	485	233	29%	66%	52%
							30	465	206	32%	70%	56%

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/22/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	2:52			5880	98.00	2.5	0	752	641	-3%	12%	15%
Time Interval (mins)	5880-5940			5885	98.08	2.7	5	675	493	8%	33%	27%
				5890	98.17	2.7	10	568	334	22%	54%	41%
Interelectrode Distance (cm)	0.5			5895	98.25	2.6	15	553	285	24%	61%	48%
Voltage (Volts)	12			5900	98.33	2.6	20	468	228	36%	69%	51%
Current (Amps)	2.6			5905	98.42	2.6	25	476	203	35%	72%	57%
				5910	98.50	2.6	30	446	191	39%	74%	57%
Turbidity 1	739			5915	98.58	2.6	Sample B					
Turbidity 2	734			5920	98.67	2.5	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Turbidity 3	721			5925	98.75	2.5	0	743	671	-2%	8%	10%
Turbidity AVG (NTU)	731			5930	98.83	2.5	5	619	459	15%	37%	26%
	GPM	volume	time	5935	98.92	2.4	10	585	337	20%	54%	42%
Flow Rate 1	5.0	2000	6.3	5940	99.00	2.4	15	544	292	26%	60%	46%
Flow Rate 2	5.1	2000	6.25				20	515	239	30%	67%	54%
Flow Rate 3	5.1	2000	6.21				25	513	205	30%	72%	60%
Flow Rate AVG (GPM)	5.1				Max	2.7	30	470	203	36%	72%	57%
Flow Rate AVG (m ³ /hr)	1.2				Mean	2.6	Sample C					
Specific Energy Consumption (SEC) [kWh/m ³]	0.027				Min	2.4	Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0			100%	100%	#DIV/0!
							5			100%	100%	#DIV/0!
							10			100%	100%	#DIV/0!
							15			100%	100%	#DIV/0!
							20			100%	100%	#DIV/0!
							25			100%	100%	#DIV/0!
							30			100%	100%	#DIV/0!
							Average					
							Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	748	656	-2%	10%	12%
							5	647	476	12%	35%	26%
							10	577	336	21%	54%	42%
							15	549	289	25%	61%	47%
							20	492	234	33%	68%	52%
							25	495	204	32%	72%	59%
							30	458	197	37%	73%	57%

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/23/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	1:11			5940	99.00	4.5	0	671	608	5%	14%	9%
Time Interval (mins)	5940-6000			5945	99.08	2.4	5	572	570	19%	19%	0%
				5950	99.17	2	10	509	451	28%	36%	11%
Interelectrode Distance (cm)	0.5			5955	99.25	2	15	488	365	31%	48%	25%
Voltage (Volts)	12			5960	99.33	2.1	20	469	384	33%	46%	18%
Current (Amps)	2.1			5965	99.42	2.1	25	453	339	36%	52%	25%
				5970	99.50	2.1	30	444	307	37%	56%	31%
Turbidity 1	707			5975	99.58	2.2	Sample B					
Turbidity 2	686			5980	99.67	2.2	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Turbidity 3	722			5985	99.75	2.2	0	640	564	9%	20%	12%
Turbidity AVG (NTU)	705			5990	99.83	2.2	5	547	529	22%	25%	3%
	GPM	volume	time	5995	99.92	2.2	10	508	414	28%	41%	19%
Flow Rate 1	4.9	2000	6.45	6000	100.00	2.2	15	484	378	31%	46%	22%
Flow Rate 2	4.8	2000	6.57				20	475	320	33%	55%	33%
Flow Rate 3	5.0	2000	6.37				25	443	302	37%	57%	32%
Flow Rate AVG (GPM)	4.9				Max	4.5	30	425	256	40%	64%	40%
Flow Rate AVG (m ³ /hr)	1.1				Mean	2.3	Sample C					
Specific Energy Consumption (SEC) [kWh/m ³]	0.023				Min	2.0	Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0			100%	100%	#DIV/0!
							5			100%	100%	#DIV/0!
							10			100%	100%	#DIV/0!
							15			100%	100%	#DIV/0!
							20			100%	100%	#DIV/0!
							25			100%	100%	#DIV/0!
							30			100%	100%	#DIV/0!
							Average					
							Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	656	586	7%	17%	11%
							5	560	550	21%	22%	2%
							10	509	433	28%	39%	15%
							15	486	372	31%	47%	24%
							20	472	352	33%	50%	25%
							25	448	321	36%	55%	28%
							30	435	282	38%	60%	35%

AMPS					CURRENT DENSITY (A/m ²)	Inflow Turbidity vs. Treated					Inflow Turbidity vs. Control				
Time (hrs)	MAX	MEAN	MIN	SEC		Time (hrs)	TR10	TR20	TR30		Time (hrs)	TR10	TR20	TR30	
0	12.0	11.8	11.5	0.133	45.166	0	74%	80%	84%		0	14%	19%	24%	
1	11.7	11.5	11.3	0.128	43.844	1	79%	88%	90%		1	21%	32%	36%	
2	11.3	11.1	10.9	0.124	42.552	2	79%	87%	89%		2	24%	32%	35%	
3	10.7	10.4	9.5	0.111	39.762	3	71%	81%	85%		3	26%	34%	44%	
4	10.8	10.6	10.5	0.112	40.379	4	80%	85%	88%		4	19%	27%	31%	
5	11.1	10.9	10.8	0.118	41.701	5	83%	87%	90%		5	26%	26%	33%	
6	10.6	10.5	9.8	0.114	40.174	6	75%	83%	85%		6	20%	31%	36%	
7	10.7	10.5	10.4	0.113	40.262	7	81%	86%	88%		7	21%	32%	35%	
8	10.4	10.2	10.0	0.116	39.028	8	79%	86%	88%		8	19%	24%	31%	
9	10.0	9.9	9.8	0.109	37.707	9	79%	85%	88%		9	30%	33%	36%	
10	10.0	9.4	8.0	0.099	36.004	10	72%	80%	84%		10	10%	18%	26%	
11	10.0	9.9	9.7	0.112	37.883	11	78%	83%	86%		11	23%	28%	31%	
12	9.9	9.5	9.2	0.106	36.180	12	79%	85%	86%		12	24%	28%	31%	
13	9.0	8.6	7.3	0.093	32.861	13	66%	75%	78%		13	28%	30%	31%	
14	9.1	8.0	7.1	0.088	30.453	14	77%	83%	85%		14	24%	26%	26%	
15	7.4	6.7	6.0	0.072	25.520	15	75%	81%	84%		15	20%	21%	31%	
16	8.0	5.9	5.6	0.062	22.466	16	49%	63%	70%		16	31%	38%	39%	
17	6.3	6.0	5.8	0.067	23.023	17	68%	79%	82%		17	28%	35%	39%	
18	6.2	6.0	5.8	0.066	22.789	18	74%	83%	86%		18	33%	35%	41%	
19	6.6	5.2	4.8	0.055	19.793	19	56%	68%	74%		19	22%	32%	33%	
20	5.2	5.0	4.9	0.053	19.235	20	67%	78%	82%		20	18%	26%	33%	
21	8.5	5.0	4.3	0.049	19.000	21	47%	62%	71%		21	27%	33%	35%	
22	5.2	4.8	4.7	0.053	18.266	22	64%	76%	80%		22	22%	31%	34%	
23	5.6	5.5	5.4	0.060	20.997	23	73%	82%	85%		23	24%	31%	37%	
24	5.8	5.3	4.7	0.057	20.116	24	58%	73%	79%		24	21%	29%	34%	
25	5.9	5.5	5.4	0.058	21.144	25	68%	79%	83%		25	23%	32%	35%	
26	7.0	6.4	6.2	0.070	24.551	26	67%	77%	82%		26	25%	32%	40%	
27	6.7	6.7	6.5	0.070	25.432	27	72%	79%	83%		27	25%	30%	33%	
28	8.0	6.5	5.9	0.065	24.903	28	52%	67%	75%		28	12%	22%	30%	
29	6.6	6.6	6.6	0.070	25.197	29	71%	79%	84%		29	16%	32%	30%	
30	6.6	6.6	6.2	0.071	25.020	30	73%	81%	84%		30	21%	27%	32%	
31	6.6	6.4	5.6	0.065	24.462	31	59%	72%	76%		31	16%	27%	36%	
32	6.6	6.4	6.3	0.070	24.462	32	74%	82%	85%		32	21%	30%	34%	
33	6.7	6.2	5.8	0.067	23.787	33	64%	76%	79%		33	21%	29%	31%	
34	6.6	6.2	6.2	0.066	23.846	34	70%	77%	82%		34	12%	22%	22%	
35	6.6	5.9	5.3	0.061	22.377	35	60%	72%	77%		35	14%	22%	25%	
36	6.4	6.2	6.0	0.067	23.611	36	70%	78%	82%		36	21%	28%	32%	
37	6.4	5.9	5.6	0.064	22.583	37	76%	82%	85%		37	26%	29%	33%	
38	7.8	5.2	4.8	0.054	19.969	38	56%	69%	74%		38	25%	30%	38%	
39	5.3	4.9	4.7	0.055	18.853	39	65%	75%	79%		39	21%	30%	33%	
40	4.8	4.7	4.5	0.051	18.119	40	59%	71%	77%		40	21%	29%	33%	
41	5.3	5.1	5.0	0.056	19.499	41	64%	75%	81%		41	17%	25%	33%	
42	5.5	5.2	5.0	0.058	19.940	42	70%	77%	82%		42	22%	30%	36%	
43	5.5	5.1	4.9	0.055	19.470	43	70%	79%	82%		43	25%	32%	35%	
44	6.8	5.1	4.3	0.050	19.353	44	47%	64%	71%		44	16%	26%	33%	
45	5.3	5.2	5.1	0.056	19.823	45	69%	78%	82%		45	26%	29%	38%	
46	5.5	5.1	4.9	0.055	19.294	46	75%	81%	86%		46	30%	38%	45%	
47	5.3	4.9	4.8	0.053	18.824	47	73%	81%	85%		47	26%	34%	38%	
48	5.1	4.9	3.9	0.051	18.736	48	65%	76%	81%		48	27%	35%	43%	
49	5.6	5.3	5.0	0.059	20.322	49	72%	81%	84%		49	29%	36%	38%	
50	5.2	5.0	4.8	0.056	19.059	50	70%	78%	82%		50	22%	25%	31%	
51	6.7	5.0	4.0	0.049	19.206	51	48%	63%	70%		51	23%	32%	35%	
52	5.5	5.5	5.4	0.060	20.938	52	65%	75%	80%		52	17%	26%	28%	
53	5.4	5.2	4.3	0.052	19.823	53	56%	70%	75%		53	26%	30%	35%	
54	5.5	5.2	4.9	0.059	19.999	54	69%	78%	82%		54	24%	31%	38%	
55	5.3	5.1	4.9	0.056	19.499	55	68%	78%	82%		55	34%	27%	33%	
56	5.8	4.8	3.8	0.049	18.442	56	48%	65%	72%		56	22%	31%	37%	
57	5.7	5.6	5.3	0.059	21.467	57	66%	77%	80%		57	19%	29%	34%	
58	5.8	5.5	4.7	0.059	21.085	58	60%	72%	78%		58	27%	33%	36%	
59	5.9	5.7	5.6	0.062	21.790	59	69%	79%	82%		59	27%	31%	35%	
60	5.8	5.7	5.6	0.062	21.908	60	74%	80%	84%		60	30%	35%	41%	
61	5.3	4.9	3.9	0.049	18.677	61	50%	66%	73%		61	24%	32%	38%	
62	5.3	5.2	4.9	0.057	19.734	62	71%	79%	83%		62	33%	38%	38%	
63	4.8	4.4	3.8	0.051	16.622	63	67%	77%	82%		63	28%	33%	37%	
64	3.9	3.6	3.0	0.042	13.920	64	62%	73%	78%		64	30%	34%	40%	
65	3.7	3.2	3.1	0.036	12.363	65	58%	73%	79%		65	27%	35%	41%	
66	4.0	3.2	3.0	0.033	12.334	66	58%	71%	78%		66	25%	30%	38%	
67	5.6	3.1	2.3	0.030	11.747	67	46%	63%	72%		67	20%	34%	38%	
68	3.3	3.1	3.1	0.033	11.894	68	53%	69%	76%		68	22%	30%	34%	
69	3.1	3.1	3.1	0.033	11.835	69	53%	70%	77%		69	19%	29%	36%	
70	3.4	3.1	3.0	0.033	11.776	70	54%	71%	76%		70	26%	29%	36%	
71	3.2	3.0	2.9	0.033	11.365	71	57%	70%	77%		71	22%	29%	36%	
72	3.4	2.9	2.8	0.033	11.247	72	61%	73%	79%		72	18%	33%	35%	
73	6.0	3.0	2.3	0.025	11.365	73	36%	52%	60%		73	24%	36%	36%	
74	3.2	3.0	2.9	0.034	11.394	74	47%	66%	74%		74	20%	27%	30%	
75	3.0	2.9	2.8	0.031	11.042	75	51%	69%	76%		75	17%	26%	32%	
76	5.0	2.8	2.3	0.026	10.660	76	40%	55%	62%		76	24%	33%	37%	
77	3.2	3.2	2.9	0.035	12.128	77	43%	63%	72%		77	15%	27%	30%	
78	3.2	3.1	2.6	0.032	11.659	78	47%	63%	72%		78	30%	32%	36%	
79	3.4	3.3	3.2	0.036	12.716	79	51%	67%	75%		79	17%	28%	34%	
80	3.6	3.4	3.2	0.036	13.039	80	59%	72%	78%		80	26%	35%	38%	
81	4.0	2.5	2.0	0.022	9.456	81	28%	42%	52%		81	15%	30%	40%	
82	2.9	2.8	2.7	0.030	10.836	82	44%	61%	70%		82	22%	31%	36%	
83	2.9	2.8	2.8	0.031	10.836	83	50%	66%	74%		83	18%	25%	31%	
84	4.3	2.3	1.8	0.020	8.604	84	32%	46%	57%		84	21%	30%	31%	
85	2.4	2.4	2.3	0.025	9.104	85	39%	57%	67%		85	20%	29%	30%	
86	2.4	2.3	2.2	0.025	8.722	86	45%	62%	70%		86	21%	27%	33%	
87	2.3	2.2	2.2	0.023	8.428	87	30%	65%	71%		87	24%	32%	37%	
88	2.9	1.8	1.5	0.017	6.872	88	38%	50%	59%		88	29%	37%	41%	
89	2.2	2.0	2.0	0.021	7.694	89	36%	55%	64%		89	14%	27%	28%	
90	2.3	2.0	1.9	0.023	7.635	90	46%	60%	68%		90	22%	25%	33%	
91	2.7	1.8	1.6	0.018	6.989	91	34%	48%	59%		91	23%	31%	37%	
92	2.1	1.8	1.8	0.020	6.989	92	42%	61%	70%		92	25%	28%	34%	
93	2.2	1.9	1.8	0.019	7.107	93	44%	62%	70%		93	25%	31%	35%	
94	4.3	2.1	1.7	0.019	7.841	94	31%	47%	54%		94	22%	31%	37%	
95	2.5	2.5	2.0	0.027	9.368	95	46%	62%	69%		95	24%	34%	34%	
96	3.6	2.5	2.3	0.025	9.427	96	42%	56%	65%		96	25%	30%	35%	
97	2.6	2.6	2.4	0.028	9.779	97	44%	60%	70%		97	20%	27%	32%	
98	2.7	2.6	2.4	0.027	9.750	98	54%	68%	73%		98	21%	33%	37%	
99	4.5	2.3	2.0	0.023	8.927	99	39%	50%	60%						

Appendix E: Electrode Longevity: Polarity Reversal

Testing Parameters				Time VS Current Reading			Sample A					
Date	7/29/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	3:20PM			60	1.00	11.5	0	656	560	3%	17%	15%
Time Interval (mins)	60-120			65	1.08	11.5	5	578	129	15%	81%	78%
Interelectrode Distance (cm)	0.5			70	1.17	11.4	10	529	106	22%	84%	80%
Voltage (Volts)	12			75	1.25	11.4	15	445	89.1	34%	87%	80%
Current (Amps)	11.45			80	1.33	11.4	20	459	79	32%	88%	83%
Turbidity 1	667			85	1.42	11.3	25	452	79	33%	88%	82%
Turbidity 2	697			90	1.50	11.4	30	443	65	35%	90%	85%
Turbidity 3	667			95	1.58	11.4						
Turbidity AVG (NTU)	677			100	1.67	11.2	Sample B					
				105	1.75	11.2	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
				110	1.83	11.2	0	629	417	7%	38%	34%
				115	1.92	11.2	5	565	135	17%	80%	76%
				120	2.00	11.2	10	525	103	22%	85%	80%
Flow Rate 1	4.9	2000	6.52	306.7485			15	508	87.2	25%	87%	83%
Flow Rate 2	5.1	2000	6.18	323.6246			20	448	71.8	34%	89%	84%
Flow Rate 3	4.8	2000	6.57	304.414		Max	25	439	66.7	35%	90%	85%
Flow Rate AVG (GPM)	4.9					Mean	30	463	59.5	32%	91%	87%
Flow Rate AVG (m³/hr)	1.1					Min						
Specific Energy Consumption (SEC) [kWh/m³]	0.122						Sample C					
							Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0			100%	100%	#DIV/0!
							5			100%	100%	#DIV/0!
							10			100%	100%	#DIV/0!
							15			100%	100%	#DIV/0!
							20			100%	100%	#DIV/0!
							25			100%	100%	#DIV/0!
							30			100%	100%	#DIV/0!
							Average					
							Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
							0	643	489	5%	28%	24%
							5	572	132	16%	81%	77%
							10	527	105	22%	85%	80%
							15	477	88	30%	87%	82%
							20	454	75	33%	89%	83%
							25	446	73	34%	89%	84%
							30	453	62	33%	91%	86%

volume	time	ml/s
2000	6.49	308.1664
2000	6.29	317.965
2000	6.43	311.042

Max	11.0
Mean	10.7
Min	9.8

	Sample B				
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	711	631	-4%	7%	11%
5	639	705	6%	-3%	-10%
10	496	100	27%	85%	79%
15	475	99.5	30%	85%	80%
20	464	99.3	32%	85%	79%
25	460	84.6	33%	88%	82%
30	468	78	31%	89%	83%

	Average				
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	713	630	-5%	8%	12%
5	634	464	7%	32%	27%
10	503	126	26%	82%	75%
15	492	109	28%	84%	78%
20	466	106	32%	85%	77%
25	460	89	33%	87%	81%
30	455	82	33%	89%	82%

volume	time	mL/s
0	2000	6.36 314.4654
0	2000	6.32 316.4557
0	2000	6.54 305.8104

Max	10.9
Mean	10.9
Min	10.8

Sample B					
Time (min.)	B - Control	B - Treated	Control -TR (%)	Treated -TR (%)	C/ T -TR (%)
0	630	526	8%	21%	14%
5	611	172	8%	74%	72%
10	528	108	21%	84%	80%
15	502	81.2	25%	88%	84%
20	486	70.2	27%	89%	89%
25	478	63	28%	91%	87%
30	448	58.1	33%	91%	87%

	Average				
Time (min.)	Avg. - Control	Avg. - Treated	Control-TR (%)	Treated-TR (%)	C/T-TR (%)
0	634	589	5%	12%	7%
5	596	173	11%	74%	71%
10	529	107	21%	84%	80%
15	490	85	27%	87%	83%
20	468	71	30%	89%	85%
25	461	65	31%	90%	86%
30	442	58	34%	91%	87%

Testing Parameters								Time VS Current Reading			
Date	7/30/2024							Time (min.)	Time (hr)	Current (A)	
Time Start	12:56PM							300	5.00	10	
Time Interval (mins)	300-360							305	5.08	10.2	
								310	5.17	10.2	
Interelectrode Distance (cm)	0.5							315	5.25	10.2	
Voltage (Volts)	12							320	5.33	10.2	
Current (Amps)	10.2							325	5.42	10.2	
								330	5.50	10.2	
Turbidity 1	722							335	5.58	10.1	
Turbidity 2	736							340	5.67	10.2	
Turbidity 3	752							345	5.75	10.2	
Turbidity AVG (NTU)	737							350	5.83	10.1	
								355	5.92	10.1	
								360	6.00	10	
Flow Rate 1	GPM	4.9	2000	6.42	311.5265						
Flow Rate 2		4.9	2000	6.43	311.042						
Flow Rate 3		5.0	2000	6.38	313.4796						
Flow Rate AVG (GPM)		4.9									
Flow Rate AVG (m³/hr)		1.1									
Specific Energy Consumption (SEC) [kWh/m³]	0.109										

Sample A					
Time (min.)	A- Control	A- Treated	Control- TR (%)	Treated- TR (%)	C/T - TR (%)
0	660	585	10%	21%	11%
5	626	165	15%	78%	74%
10	540	109	27%	85%	80%
15	505	79.7	31%	89%	84%
20	485	76	34%	90%	84%
25	454	63	38%	91%	86%
30	461	59	37%	92%	87%
Sample B					
Time (min.)	B- Control	B- Treated	Control- TR (%)	Treated- TR (%)	C/T - TR (%)
0	655	601	11%	18%	8%
5	635	146	14%	80%	77%
10	587	102	20%	86%	83%
15	537	73.1	27%	90%	86%
20	496	69.3	33%	91%	86%
25	471	60.6	36%	92%	87%
30	454	53.2	38%	93%	88%
Sample C					
Time (min.)	C- Control	C- Treated	Control- TR (%)	Treated- TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!
Average					
Time (min.)	Avg.- Control	Avg.- Treated	Control- TR (%)	Treated- TR (%)	C/T - TR (%)
0	658	593	11%	20%	10%
5	631	156	14%	79%	75%
10	564	106	24%	86%	81%
15	521	76	29%	90%	85%
20	491	73	33%	90%	85%
25	463	62	37%	92%	87%
30	458	56	38%	92%	88%

Testing Parameters						Time VS Current Reading			Sample A					
Date	7/30/2024					Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	1:56PM					420	7.00	9.7	0	637	566	5%	15%	11%
Time Interval (mins)	420-480					425	7.08	9.8	5	578	170	13%	75%	71%
Interelectrode Distance (cm)	0.5					430	7.17	9.7	10	487	108	27%	84%	78%
Voltage (Volts)	12					435	7.25	9.7	15	473	97.9	29%	85%	79%
Current (Amps)	9.75					440	7.33	9.7	20	464	81	31%	88%	83%
Turbidity 1	689					445	7.42	9.7	25	426	69	36%	90%	84%
Turbidity 2	661					450	7.50	9.6	30	394	59	41%	91%	85%
Turbidity 3	654					455	7.58	9.6						
Turbidity AVG (NTU)	668					460	7.67	9.7	Sample B					
						465	7.75	9.6	Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Flow Rate 1	4.9	2000			mL/s	470	7.83	9.6	0	674	588	-1%	12%	13%
Flow Rate 2	4.9	2000				475	7.92	9.6	5	619	160	7%	76%	74%
Flow Rate 3	5.2	2000				480	8.00	9.6	10	565	116	15%	83%	79%
Flow Rate AVG (GPM)	5.0								15	504	89.6	25%	87%	82%
Flow Rate AVG (m³/hr)	1.1					Max			20	464	76.5	31%	89%	84%
						Mean			25	481	67.9	28%	90%	86%
						Min			30	441	58.1	34%	91%	87%
Specific Energy Consumption (SEC) [kWh/m³]	0.103								Sample C					
									Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
									0	100%	100%	100%	#DIV/0!	
									5	100%	100%	100%	#DIV/0!	
									10	100%	100%	100%	#DIV/0!	
									15	100%	100%	100%	#DIV/0!	
									20	100%	100%	100%	#DIV/0!	
									25	100%	100%	100%	#DIV/0!	
									30	100%	100%	100%	#DIV/0!	
									Average					
						Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)			
						0	656	577	2%	14%	12%			
						5	599	165	10%	75%	72%			
						10	526	112	21%	83%	79%			
						15	489	94	27%	86%	81%			
						20	464	79	31%	88%	83%			
						25	454	69	32%	90%	85%			
						30	418	59	38%	91%	86%			

Testing Parameters				Time VS Current Reading			Sample A				
Date	8/1/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)
Time Start	8:22AM			480	8.00	5.5	0	679	595	5%	17%
Time Interval (mins)	480-540			485	8.08	7.7	5	637	221	11%	69%
				490	8.17	8.6	10	563	145	21%	74%
Interelectrode Distance (cm)	0.5			495	8.25	8.8	15	474	119	34%	83%
Voltage (Volts)	12			500	8.33	9	20	485	104	32%	85%
Current (Amps)	9			505	8.42	9.1	25	427	88	40%	88%
				510	8.50	9.1	30	441	85	38%	88%
Turbidity 1	700			515	8.58	9.2					
Turbidity 2	729			520	8.67	9.2					
Turbidity 3	719			525	8.75	9.2					
Turbidity AVG (NTU)	716			530	8.83	9.2					
				535	8.92	9.3					
				540	9.00	9.3					
GPM		volume	time								
Flow Rate 1	5.0	2000	6.31	316.9572							
Flow Rate 2	4.9	2000	6.45	310.0775							
Flow Rate 3	4.9	2000	6.46	309.5975							
Flow Rate AVG (GPM)	4.9				Max	9.3					
Flow Rate AVG (m ³ /hr)	1.1				Mean	8.7					
					Min	5.5					
Specific Energy Consumption (SEC) [kWh/m ³]	0.096										

Sample B				
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)
0	627	606	12%	15%
5	602	212	16%	70%
10	548	138	23%	81%
15	481	110	33%	85%
20	449	93.5	37%	87%
25	457	81.7	36%	89%
30	455	76.8	36%	89%

Sample C				
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)
0			100%	100%
5			100%	100%
10			100%	100%
15			100%	100%
20			100%	100%
25			100%	100%
30			100%	100%

Average				
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)
0	653	601	9%	16%
5	620	217	13%	70%
10	556	142	22%	80%
15	478	115	33%	84%
20	467	99	35%	86%
25	442	85	38%	88%
30	448	81	37%	89%

Testing Parameters				Time VS Current Reading			Sample A				
Date	8/1/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)
Time Start	9:22AM			540	9.00	9.3	0	652	586	7%	17%
Time Interval (mins)	540-600			545	9.08	9.3	5	588	186	16%	74%
				550	9.17	9.3	10	550	110	22%	84%
Interelectrode Distance (cm)	0.5			555	9.25	9.2	15	511	85.4	27%	88%
Voltage (Volts)	12			560	9.33	9.3	20	453	76	36%	89%
Current (Amps)	9.3			565	9.42	9.3	25	436	66	38%	91%
				570	9.50	9.3	30	422	57	40%	92%
Turbidity 1	698			575	9.58	9.3					
Turbidity 2	699			580	9.67	9.3					
Turbidity 3	713			585	9.75	9.3					
Turbidity AVG (NTU)	703			590	9.83	9.4					
GPM		volume	time								
Flow Rate 1	4.9	2000	6.5	307.6923							
Flow Rate 2	4.8	2000	6.56	304.878							
Flow Rate 3	4.9	2000	6.45	310.0775							
Flow Rate AVG (GPM)	4.9				Max	9.4					
Flow Rate AVG (m ³ /hr)	1.1				Mean	9.3					
					Min	9.2					
Specific Energy Consumption (SEC) [kWh/m ³]	0.101										

Sample B				
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)
0	693	542	1%	23%
5	616	181	12%	74%
10	567	113	19%	84%
15	472	92.7	33%	87%
20	465	75.6	34%	89%
25	472	63.9	33%	91%
30	456	60.1	35%	91%

Sample C				
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)
0			100%	100%
5			100%	100%
10			100%	100%
15			100%	100%
20			100%	100%
25			100%	100%
30			100%	100%

Average				
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)
0	673	564	4%	20%
5	602	184	14%	74%
10	559	112	21%	84%
15	492	89	30%	87%
20	459	76	35%	89%
25	454	65	35%	91%
30	439	59	38%	92%

Testing Parameters					Time VS Current Reading			Sample A					
Date	8/1/2024				Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	10:22AM				600	10.00	10.4	0	685	619	0%	10%	10%
Time Interval (mins)	600-660				605	10.08	9.1	5	651	249	5%	64%	62%
Interelectrode Distance (cm)	0.5				610	10.17	9.4	10	538	168	21%	75%	69%
Voltage (Volts)	12				615	10.25	9.5	15	518	143	24%	79%	72%
Ourrent (Amps)	9.55				620	10.33	9.6	20	490	107	28%	84%	78%
Turbidity 1	652				625	10.42	9.6	25	476	101	30%	85%	79%
Turbidity 2	706				630	10.50	9.6	30	455	85	33%	88%	81%
Turbidity 3	694				635	10.58	9.6						
Turbidity AVG (NTU)	684				640	10.67	9.7						
	GPM				645	10.75	9.7						
	volume				650	10.83	9.7						
	time				655	10.92	9.7						
	mL/s				660	11.00	9.7						
Flow Rate 1	5.1	2000	6.27	318.9793			Max						
Flow Rate 2	5.1	2000	6.27	318.9793			Mean						
Flow Rate 3	4.8	2000	6.56	304.878			Min						
Flow Rate AVG (GPM)	5.0												
Flow Rate AVG (m³/hr)	1.1												
Specific Energy Consumption (SEC) [kWh/m³]	0.101												
									</				

Testing Parameters				Time VS Current Reading				Sample A					
Date	8/1/2024			Time (min.)	Time (hr)	Current (A)		Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	12:58PM			660	11.00	5.4		0	636	567	11%	21%	11%
Time Interval (mins)	660-720			665	11.08	8		5	597	201	17%	72%	66%
Interelectrode Distance (cm)	0.5			670	11.17	8.8		10	497	125	30%	83%	75%
Voltage (Volts)	12			675	11.25	9.1		15	457	90.5	36%	87%	80%
Current (Amps)	9.3			680	11.33	9.2		20	454	81	37%	89%	82%
Turbidity 1	732			685	11.42	9.3		25	431	73	40%	90%	83%
Turbidity 2	697			690	11.50	9.4		30	407	64	43%	91%	84%
Turbidity 3	716			695	11.58	9.5							
Turbidity AVG (NTU)	715			700	11.67	9.5							
				705	11.75	9.7							
				710	11.83	9.6							
				715	11.92	9.7							
Flow Rate 1	GPM	volume	time	mL/s	720	12.00	9.6						
Flow Rate 2	5.0	2000	6.34	315.4574									
Flow Rate 3	5.0	2000	6.34	315.4574									
Flow Rate 3	5.0	2000	6.3	317.4603									
Flow Rate AVG (GPM)	5.0						Max						
Flow Rate AVG (m³/hr)	1.1						Mean						
							Min						
Specific Energy Consumption (SEC) [kWh/m³]	0.098												

Testing Parameters					
Date	8/1/2024				
Time Start	2:58PM				
Time Interval (mins)	780-840				
Interelectrode Distance (cm)	0.5				
Voltage (Volts)	12				
Current (Amps)	9.35				
Turbidity 1	696				
Turbidity 2	704				
Turbidity 3	691				
Turbidity AVG (NTU)	697				
GPM	volume	time	mL/s		
Flow Rate 1	4.9	2000	6.47	309.119	
Flow Rate 2	4.8	2000	6.62	302.1148	
Flow Rate 3	4.8	2000	6.67	299.8501	
Flow Rate AVG (GPM)	4.8				
Flow Rate AVG (m³/hr)	1.1				
Specific Energy Consumption (SEC) [kWh/m³]	0.103				

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
780	13.00	9.3
785	13.08	9.5
790	13.17	9.4
795	13.25	9.4
800	13.33	9.3
805	13.42	9.3
810	13.50	9.4
815	13.58	9.3
820	13.67	9.3
825	13.75	9.3
830	13.83	9.2
835	13.92	9.2
840	14.00	9.2
Max		9.5
Mean		9.3
Min		9.2

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	612	606	12%	13%	1%
5	618	165	11%	76%	73%
10	539	110	23%	84%	80%
15	484	84.5	31%	88%	83%
20	486	69	30%	90%	86%
25	463	60	34%	91%	87%
30	456	56	35%	92%	88%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	694	618	0%	11%	11%
5	606	186	13%	73%	69%
10	524	113	25%	84%	78%
15	545	85.8	22%	88%	84%
20	458	75.5	34%	89%	84%
25	450	67.3	35%	90%	85%
30	445	59.9	36%	91%	87%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	653	612	6%	12%	6%
5	612	176	12%	75%	71%
10	532	112	24%	84%	79%
15	515	85	26%	88%	83%
20	472	72	32%	90%	85%
25	457	64	35%	91%	86%
30	451	58	35%	92%	87%

Testing Parameters			
Date	8/5/2024		
Time Start	9:54AM		
Time Interval (mins)	900-960		
Inter-electrode Distance (cm)	0.5		
Voltage (Volts)	12		
Current (Amps)	8.9		
Turbidity 1	653		
Turbidity 2	681		
Turbidity 3	665		
Turbidity AVG (NTU)	666		
Flow Rate 1	GPM	volume	time
Flow Rate 2	4.9	2000	6.5 307.6923
Flow Rate 3	5.1	2000	6.22 321.5434
Flow Rate AVG (GPM)	5.0	2000	6.32 316.4557
Flow Rate AVG (m³/hr)	5.0		
	1.1		
Specific Energy Consumption (SEC) [kWh/m³]	0.094		

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
900	15.00	9.1
905	15.08	8.9
910	15.17	8.9
915	15.25	8.9
920	15.33	8.8
925	15.42	8.8
930	15.50	8.9
935	15.58	9
940	15.67	9
945	15.75	9.1
950	15.83	9.1
955	15.92	9.1
960	16.00	9.2

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	677	624	-2%	6%	8%
5	568	207	15%	69%	64%
10	537	133	19%	80%	75%
15	499	105	25%	84%	79%
20	423	96	37%	86%	77%
25	439	82	34%	88%	81%
30	421	83	37%	88%	80%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	677	624	-2%	6%	8%
5	568	207	15%	69%	64%
10	537	133	19%	80%	75%
15	499	105	25%	84%	79%
20	423	96	37%	86%	77%
25	439	82	34%	88%	81%
30	421	83	37%	88%	80%

Testing Parameters				Time VS Current Reading			Sample A					
Date	8/7/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	8:16AM			960	16.00	5.5	0	635	561	4%	15%	12%
Time Interval (mins)	960-1020			965	16.08	6.6	5	610	245	7%	63%	60%
Inter-electrode Distance (cm)	0.5			970	16.17	7.2	10	536	158	19%	76%	71%
Voltage (Volts)	12			975	16.25	7.6	15	478	118	27%	82%	75%
Current (Amps)	8			980	16.33	7.9	20	414	101	37%	85%	76%
Turbidity 1	650			985	16.42	8	25	444	89	33%	87%	80%
Turbidity 2	662			990	16.50	8	30	416	85	37%	87%	80%
Turbidity 3	663			995	16.58	8.1						
Turbidity AVG (NTU)	658			1000	16.67	8.1						
	GPM	volume	time	1005	16.75	8.1						
Flow Rate 1	4.7	2000	6.74	1010	16.83	8.1						
Flow Rate 2	4.8	2000	6.65	1015	16.92	8						
Flow Rate 3	4.9	2000	6.45	1020	17.00	8						
Flow Rate AVG (GPM)	4.8				Max	8.1						
Flow Rate AVG (m ³ /hr)	1.1				Mean	7.6						
					Min	5.5						
Specific Energy Consumption (SEC) [kWh/m ³]	0.088											

Testing Parameters				Time VS Current Reading			Sample A					
Date	8/7/2024			Time (min.)	Time (hr)	Current (A)	Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
Time Start	9:16AM			1020	17.00	7.8	0	664	614	3%	10%	8%
Time Interval (mins)	1020-1080			1025	17.08	7.8	5	630	228	8%	67%	64%
Inter-electrode Distance (cm)	0.5			1030	17.17	7.7	10	491	127	28%	81%	74%
Voltage (Volts)	12			1035	17.25	7.7	15	478	115	30%	83%	76%
Current (Amps)	7.65			1040	17.33	7.6	20	463	94	32%	86%	80%
Turbidity 1	677			1045	17.42	7.5	25	488	85	28%	86%	83%
Turbidity 2	692			1050	17.50	7.5	30	452	74	34%	89%	84%
Turbidity 3	676			1055	17.58	7.5						
Turbidity AVG (NTU)	682			1060	17.67	7.5						
	GPM	volume	time	1065	17.75	7.4						
Flow Rate 1	4.8	2000	6.64	1070	17.83	7.4						
Flow Rate 2	4.9	2000	6.5	1075	17.92	7.4						
Flow Rate 3	4.8	2000	6.55	1080	18.00	7.4						
Flow Rate AVG (GPM)	4.8				Max	7.8						
Flow Rate AVG (m ³ /hr)	1.1				Mean	7.6						
					Min	7.4						
Specific Energy Consumption (SEC) [kWh/m ³]	0.084											

Testing Parameters			
Date	8/8/2024		
Time Start	8:03		
Time Interval (mins)	1140-1200		
Interelectrode Distance (cm)	0.5		
Voltage (Volts)	12		
Current (Amps)	6.7		
Turbidity 1	713		
Turbidity 2	706		
Turbidity 3	720		
Turbidity AVG (NTU)	713		
Flow Rate 1	GPM	volume	time
Flow Rate 2	4.7	2000	6.69
Flow Rate 3	4.9	2000	6.43
Flow Rate AVG (GPM)	4.8	2000	6.57
Flow Rate AVG (m³/hr)	1.1		
Specific Energy Consumption (SEC) [KWh/m³]	0.073		

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1140	19.00	2.8
1145	19.08	4.2
1150	19.17	3.4
1155	19.25	4.3
1160	19.33	5.5
1165	19.42	6
1170	19.50	6.4
1175	19.58	6.6
1180	19.67	6.8
1185	19.75	6.8
1190	19.83	6.9
1195	19.92	6.9
1200	20.00	6.9

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	679	640	5%	10%	6%
5	612	385	14%	45%	35%
10	542	227	24%	68%	58%
15	485	170	32%	76%	65%
20	448	147	37%	79%	67%
25	497	129	30%	82%	74%
30	436	115	39%	84%	74%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	664	623	7%	13%	6%
5	602	320	16%	55%	47%
10	504	180	29%	75%	64%
15	483	142	32%	80%	71%
20	471	121	34%	83%	74%
25	456	109	36%	85%	76%
30	446	98.4	37%	86%	78%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	572	632	6%	11%	6%
5	607	358	15%	50%	41%
10	523	204	27%	71%	61%
15	484	156	32%	78%	68%
20	460	134	36%	81%	71%
25	477	119	33%	83%	75%
30	441	107	38%	85%	76%

Testing Parameters					
Date	8/8/2024				
Time Start	10:09				
Time Interval (mins)	1260-1320				
Interelectrode Distance (cm)	0.5				
Voltage (Volts)	12				
Current (Amps)	6.75				
Turbidity 1	666				
Turbidity 2	725				
Turbidity 3	696				
Turbidity AVG (NTU)	696				
Flow Rate 1	GPM	volume	time	mL/s	
Flow Rate 2	4.8	2000	6.56	304.878	
Flow Rate 3	4.9	2000	6.42	311.5265	
Flow Rate AVG (GPM)	4.8	2000	6.64	301.2048	
Flow Rate AVG (m³/hr)	1.1				
Specific Energy Consumption (SEC) [kWh/m³]	0.074				

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1260	21.00	6.9
1265	21.08	6.8
1270	21.17	6.7
1275	21.25	6.7
1280	21.33	6.7
1285	21.42	6.7
1290	21.50	6.7
1295	21.58	6.6
1300	21.67	6.6
1305	21.75	6.6
1310	21.83	6.6
1315	21.92	6.6
1320	22.00	6.5

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	668	613	4%	12%	8%
5	631	309	9%	56%	51%
10	508	169	27%	76%	67%
15	478	134	31%	81%	72%
20	498	111	28%	84%	78%
25	478	96	31%	86%	80%
30	472	93	32%	87%	80%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	726	632	-4%	9%	13%
5	617	268	11%	61%	57%
10	567	178	18%	74%	69%
15	495	128	29%	82%	74%
20	439	105	37%	85%	76%
25	466	96.9	33%	86%	79%
30	480	84	31%	88%	83%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0			100%	100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	697	623	0%	11%	11%
5	624	289	10%	59%	54%
10	538	174	23%	75%	68%
15	487	131	30%	81%	73%
20	469	108	33%	84%	77%
25	472	97	32%	86%	80%
30	476	89	32%	87%	81%

[illegible]

Testing Parameters						
Date	8/9/2024					
Time Start	10:18					
Time Interval (mins)	1500-1560					
Interelectrode Distance (cm)	0.5					
Voltage (Volts)	12					
Current (Amps)	4.1					
Turbidity 1	664					
Turbidity 2	659					
Turbidity 3	695					
Turbidity AVG (NTU)	673					
Flow Rate 1	GPM	volume	time	mL/s		
Flow Rate 2	4.9	2000	6.5	307.6923		
Flow Rate 3	4.9	2000	6.48	308.642		
Flow Rate AVG (GPM)	5.0	2000	6.4	312.5		
Flow Rate AVG (m³/hr)	4.9					
	1.1					
Specific Energy Consumption (SEC) [kWh/m ³]	0.044					

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1500	25.00	6
1505	25.08	7.1
1510	25.17	5.8
1515	25.25	4.9
1520	25.33	4.5
1525	25.42	4.2
1530	25.50	4.1
1535	25.58	4.1
1540	25.67	4.1
1545	25.75	4.1
1550	25.83	4.2
1555	25.92	4.2
1560	26.00	4.2
	Max	7.1
	Mean	4.7
	Min	4.1

Sample A						
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)	
0	664	612	1%	9%	8%	
5	616	466	8%	31%	24%	
10	501	333	26%	50%	34%	
15	490	251	27%	63%	49%	
20	448	195	33%	71%	56%	
25	451	167	33%	75%	63%	
30	454	157	33%	77%	65%	

Sample B						
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)	
0	683	631	-2%	6%	8%	
5	597	456	11%	32%	24%	
10	539	289	20%	57%	46%	
15	505	226	25%	66%	55%	
20	475	199	29%	70%	58%	
25	438	161	35%	76%	63%	
30	430	148	36%	78%	66%	

Sample C						
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)	
0	100%	100%	100%	#DIV/0!		
5			100%	100%	#DIV/0!	
10			100%	100%	#DIV/0!	
15			100%	100%	#DIV/0!	
20			100%	100%	#DIV/0!	
25			100%	100%	#DIV/0!	
30			100%	100%	#DIV/0!	

Average						
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)	
0	674	622	0%	8%	8%	
5	607	461	10%	31%	24%	
10	520	311	23%	54%	40%	
15	498	239	26%	65%	52%	
20	462	197	31%	71%	57%	
25	445	164	34%	76%	63%	
30	442	153	34%	72%	65%	

Testing Parameters					
Date	8/12/2024				
Time Start	9:01				
Time Interval (mins)	1620-1680				
Interelectrode Distance (cm)	0.5				
Voltage (Volts)	12				
Current (Amps)	3.8				
Turbidity 1	683				
Turbidity 2	721				
Turbidity 3	725				
Turbidity AVG (NTU)	710				
	GPM	volume	time	mL/s	
Flow Rate 1	4.9	2000	6.42	311.5265	
Flow Rate 2	4.8	2000	6.67	299.8501	
Flow Rate 3	4.9	2000	6.43	311.042	
Flow Rate AVG (GPM)	4.9				
Flow Rate AVG (m³/hr)	1.1				
Specific Energy Consumption (SEC) [kWh/m³]	0.041				

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1620	27.00	4
1625	27.08	3.7
1630	27.17	3.7
1635	27.25	3.7
1640	27.33	3.8
1645	27.42	3.7
1650	27.50	3.8
1655	27.58	3.8
1660	27.67	3.8
1665	27.75	3.8
1670	27.83	3.8
1675	27.92	3.8
1680	28.00	3.8
	Max	4.0
	Mean	3.8
	Min	3.7

Sample A						
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)	
0	693	668	2%	6%	4%	
5	607	453	14%	36%	25%	
10	557	294	22%	59%	47%	
15	534	240	25%	66%	55%	
20	471	190	34%	73%	80%	
25	472	169	33%	76%	64%	
30	441	147	38%	79%	67%	

Sample B						
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)	
0	754	642	-6%	10%	15%	
5	623	461	12%	35%	26%	
10	584	303	18%	57%	48%	
15	508	215	28%	70%	58%	
20	485	177	32%	75%	64%	
25	521	163	27%	77%	69%	
30	475	142	33%	80%	70%	

Sample C						
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)	
0			100%	100%	#DIV/0!	
5			100%	100%	#DIV/0!	
10			100%	100%	#DIV/0!	
15			100%	100%	#DIV/0!	
20			100%	100%	#DIV/0!	
25			100%	100%	#DIV/0!	
30			100%	100%	#DIV/0!	

Average						
Time (min.)	Avg. - Control	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)	
0	724	655	-2%	8%	9%	
5	615	457	13%	36%	26%	
10	571	299	20%	58%	48%	
15	521	228	27%	68%	56%	
20	478	184	33%	74%	62%	
25	497	166	30%	77%	67%	
30	458	145	35%	80%	68%	

Testing Parameters					
Date	8/12/2024				
Time Start	11:02				
Time Interval (mins)	1740-1800				
Interelectrode Distance (cm)	0.5				
Voltage (Volts)	12				
Current (Amps)	3.7				
Turbidity 1	694				
Turbidity 2	681				
Turbidity 3	699				
Turbidity AVG (NTU)	691				
GPM	volume	time	mL/s		
Flow Rate 1	4.9	2000	6.48	308.642	
Flow Rate 2	4.9	2000	6.47	309.119	
Flow Rate 3	4.9	2000	6.48	308.642	
Flow Rate AVG (GPM)	4.9				
Flow Rate AVG (m³/hr)	1.1				
Specific Energy Consumption (SEC) [kWh/m³]	0.040				

Time VS Current Reading		
Time (min.)	Time (hr)	Current (A)
1740	29.00	4
1745	29.08	3.7
1750	29.17	3.7
1755	29.25	3.7
1760	29.33	3.7
1765	29.42	3.7
1770	29.50	3.7
1775	29.58	3.6
1780	29.67	3.7
1785	29.75	3.7
1790	29.83	3.7
1795	29.92	3.7
1800	30.00	3.6

Sample A					
Time (min.)	A - Control	A - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	669	610	3%	12%	9%
5	576	362	17%	48%	37%
10	495	217	28%	69%	56%
15	501	148	28%	79%	70%
20	443	126	30%	82%	72%
25	477	115	31%	83%	76%
30	457	105	34%	85%	77%

Sample B					
Time (min.)	B - Control	B - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	675	647	2%	6%	4%
5	579	362	16%	48%	37%
10	512	196	26%	72%	62%
15	489	155	29%	78%	68%
20	483	127	30%	82%	74%
25	427	111	38%	84%	74%
30	458	97.1	34%	89%	79%

Sample C					
Time (min.)	C - Control	C - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0		100%		100%	#DIV/0!
5			100%	100%	#DIV/0!
10			100%	100%	#DIV/0!
15			100%	100%	#DIV/0!
20			100%	100%	#DIV/0!
25			100%	100%	#DIV/0!
30			100%	100%	#DIV/0!

Average					
Time (min.)	Avg. - Contol	Avg. - Treated	Control - TR (%)	Treated - TR (%)	C/T - TR (%)
0	672	629	3%	9%	6%
5	578	362	16%	48%	37%
10	504	207	27%	70%	59%
15	495	152	28%	78%	69%
20	463	127	33%	82%	73%
25	452	113	35%	84%	75%
30	458	101	34%	85%	78%

Time (hrs)	NOT PR								PR								NOT PR								PR											
	AMPS				SEC				AMPS				SEC				Current Density				Inflow Turbidity vs. Treated				Inflow Turbidity vs. Treated				Inflow Turbidity vs. Control				Inflow Turbidity vs. Control			
	MAX	MEAN	MIN	SEC	MAX	MEAN	MIN	SEC	N-PR	PR	MEAN	PR	MEAN	PR	MEAN	PR	MEAN	PR	MEAN	PR	MEAN	PR	MEAN	PR	MEAN	PR	MEAN	PR	MEAN	PR						
0	12.0	11.8	11.5	0.133	11.5	11.3	11.0	0.119	45.166	43.140	0	74%	80%	84%	80%	86%	89%	0	14%	19%	24%	26%	31%	31%	37%	26%	31%	37%	31%	37%						
1	11.7	11.5	11.3	0.128	11.5	11.3	11.2	0.122	43.844	43.228	1	79%	88%	90%	85%	89%	91%	1	21%	32%	36%	22%	33%	33%	33%	22%	33%	33%	33%	33%						
2	11.3	11.1	10.9	0.124	11.0	10.7	9.8	0.113	42.552	40.702	2	79%	87%	89%	82%	85%	88%	2	24%	32%	35%	26%	32%	33%	33%	26%	32%	33%	33%	33%						
3	10.5	10.4	10.1	0.111	10.9	10.3	10.0	0.116	41.262	41.524	3	71%	89%	91%	81%	89%	92%	3	26%	34%	36%	21%	34%	34%	34%	21%	34%	34%	34%	34%						
4	10.8	10.6	10.5	0.112	11.0	10.8	10.7	0.117	40.370	41.348	4	80%	85%	88%	85%	90%	92%	4	19%	27%	31%	22%	33%	38%	22%	33%	38%	38%	38%							
5	11.1	10.9	10.8	0.118	10.2	10.1	10.0	0.109	41.701	38.735	5	83%	87%	90%	86%	90%	92%	5	26%	26%	33%	24%	33%	38%	24%	33%	38%	38%	38%							
6	10.6	10.5	9.8	0.114	10.0	9.9	9.8	0.108	40.174	37.738	6	75%	83%	85%	85%	90%	92%	6	20%	31%	36%	16%	24%	31%	16%	24%	31%	31%	31%							
7	10.7	10.5	10.4	0.113	9.8	9.7	9.6	0.103	40.262	36.885	7	81%	86%	88%	83%	88%	91%	7	21%	32%	35%	21%	31%	38%	21%	31%	38%	38%	38%							
8	10.2	10.0	9.9	0.109	9.5	9.4	9.3	0.102	39.343	36.443	8	79%	85%	87%	80%	86%	89%	8	19%	26%	30%	22%	29%	35%	22%	29%	35%	35%	35%							
9	10.0	9.9	9.8	0.109	9.4	9.3	9.2	0.101	37.707	35.563	9	79%	85%	88%	84%	89%	92%	9	30%	33%	36%	21%	35%	38%	21%	35%	38%	38%	38%							
10	10.0	9.4	8.0	0.109	10.4	9.6	9.1	0.101	36.004	36.796	10	72%	80%	84%	79%	86%	89%	10	10%	18%	26%	18%	31%	35%	18%	31%	35%	35%	35%							
11	10.0	9.9	9.7	0.112	9.7	9.0	5.4	0.088	37.883	34.300	11	78%	83%	86%	83%	89%	91%	11	23%	28%	31%	30%	37%	43%	30%	37%	43%	43%	43%							
12	9.9	9.5	9.2	0.106	9.5	9.5	9.3	0.101	36.180	36.150	12	79%	85%	86%	83%	89%	91%	12	24%	28%	31%	25%	32%	38%	25%	32%	38%	38%	38%							
13	9.3	8.6	7.3	0.093	9.5	9.3	9.2	0.103	32.861	35.563	13	69%	75%	78%	84%	90%	92%	13	20%	30%	31%	24%	32%	36%	24%	32%	36%	36%	36%							
14	9.1	8.0	7.1	0.086	9.6	9.2	8.9	0.082	27.546	34.563	14	77%	83%	85%	81%	86%	88%	14	22%	26%	29%	20%	28%	36%	20%	28%	36%	36%	36%							
15	7.4	6.7	6.0	0.072	9.2	9.0	8.8	0.094	25.520	34.300	15	75%	81%	84%	80%	86%	88%	15	20%	21%	31%	19%	37%	37%	19%	37%	37%	37%	37%							
16	8.0	5.9	5.6	0.062	8.1	7.6	5.5	0.088	22.466	29.132	16	49%	63%	70%	77%	85%	88%	16	31%	38%	39%	20%	34%	35%	20%	34%	35%	35%	35%							
17	6.3	6.0	5.8	0.067	7.8	7.6	7.4	0.084	23.023	28.838	17	68%	79%	82%	80%	86%	89%	17	28%	35%	39%	26%	30%	34%	26%	30%	34%	34%	34%							
18	6.2	6.0	5.8	0.066	7.3	7.2	7.1	0.079	22.789	27.428	18	74%	83%	86%	82%	88%	91%	18	33%	35%	41%	21%	29%	37%	21%	29%	37%	37%	37%							
19	6.6	5.2	4.8	0.055	6.9	5.7	2.8	0.073	21.565	28.563	19	65%	76%	81%	71%	81%	84%	19	22%	32%	35%	27%	33%	37%	27%	33%	37%	37%	37%							
20	5.2	5.0	4.9	0.053	7.2	7.0	6.5	0.076	19.235	26.812	20	67%	78%	82%	75%	84%	87%	20	18%	26%	35%	25%	37%	37%	25%	37%	37%	37%	37%							
21	8.5	5.0	4.3	0.040	6.9	6.7	6.5	0.074	19.000	25.461	21	47%	62%	71%	75%	84%	87%	21	27%	33%	35%	23%	33%	32%	23%	33%	32%	32%	32%							
22	5.2	4.8	4.7	0.053	6.5	6.2	6.1	0.068	18.266	23.581	22	64%	76%	80%	70%	86%	88%	22	22%	31%	34%	24%	26%	35%	24%	26%	35%	35%	35%							
23	5.6	5.5	5.4	0.060	5.7	4.8	4.8	0.066	20.987	18.266	23	73%	82%	85%	62%	79%	82%	23	24%	31%	31%	37%	26%	40%	26%	40%	39%	39%								
24	4.7	4.7	4.7	0.057	5.1	4.7	4.7	0.058	20.224	20.224	24	73%	81%	83%	61%	78%	81%	24	21%	29%	32%	21%	29%	32%	21%	29%	32%	32%	32%							
25	5.9	5.9	5.4	0.058	7.1	4.7	4.1	0.054	21.144	18.061	25	68%	79%	83%	64%	71%	77%	25	23%	32%	35%	23%	31%	34%	23%	31%	34%	34%	34%							
26	7.0	6.4	6.2	0.070	4.5	3.5	2.8	0.038	24.551	13.538	26	67%	77%	82%	44%	65%	73%	26	25%	32%	40%	26%	30%	35%	26%	30%	35%	35%	35%							
27	6.7	6.7	6.5	0.070	4.0	3.8	3.7	0.041	25.432	14.448	27	72%	79%	83%	58%	74%	80%	27	20%	30%	33%	20%	33%	35%	20%	33%	35%	35%	35%							
28	6.0	6.5	5.9	0.065	3.9	3.6	3.5	0.035	24.903	13.920	28	52%	67%	75%	64%	79%	84%	28	12%	22%	30%	24%	32%	35%	24%	32%	35%	35%	35%							
29	6.6	6.6	6.6	0.066	4.0	3.7	3.6	0.040	25.197	14.155	29	71%	78%	83%	70%	82%	85%	16%	20%	30%	30%	27%	33%	34%	27%	33%	34%	34%	34%							
30	6.2	6.0	6.0	0.071	3.8	3.5	3.0	0.039	25.007	13.182	30	78%	85%	88%	73%	81%	84%	30	23%	32%	35%	23%	31%	34%	23%	31%	34%	34%	34%							

Appendix F: Pollutant Loading Data



Ag & Environmental Services Labs

Soil, Plant, and Water Laboratory
2400 College Station Road
Athens, Georgia 30602-9105
Website: <http://aesl.ces.uga.edu>

Water Analysis Report

Sample ID

(CEC/CEA Signature)

Client Information		Lab Information	Contact
Auburn University: Armstrong, Megan		Lab #3956	Soil, Plant, and Water Laboratory
238 Harbert Engineering Center		Received: Dec 22, 2023	2400 College Station Road
Auburn, AL 36849		Completed: Jan 3, 2024	Athens, GA 30602
Sample: 1-C		Tests: W42Pb W4NO3 W1	ph: 706-542-5350
Type: Stormwater			e-mail: soiltest@uga.edu

Results

pH: 7.4 (Desired pH range 6.5 to 8.5)

Calculated Hardness: 58 ppm (3.4 gr/gal) - Slightly Hard Water -

(Water hardness is due to the presence of certain dissolved minerals, primarily calcium and magnesium.)

Parameter	Concentration in Sample	EPA Maximum Level*	Parameter	Concentration in Sample	EPA Maximum Level*
Aluminum (Al)	1.31 ppm ^a	0.2 ppm (S)	Phosphorus (P)	0.30 ppm	No Set Maximum
Boron (B)	0.01 ppm	No Set Maximum	Potassium (K)	1.6 ppm	No Set Maximum
Cadmium (Cd)	64.10 ppb ^b	5 ppb (P)	Silica (SiO ₂)	10.55 ppm	No Set Maximum
Calcium (Ca)	14.3 ppm	No Set Maximum	Sodium (Na)	8.4 ppm	No Set Maximum
Chromium (Cr)	negligible	100 ppb (P)	Zinc (Zn)	1.50 ppm	5.0 ppm (S)
Copper (Cu)	0.07 ppm	1.0 ppm (S) 1.3 ppm (P)			
Iron (Fe)	11.84 ppm ^c	0.30 ppm (S)			
Lead (Pb)	150.85 ppb ^d	15 ppb (P)			
Magnesium (Mg)	5.4 ppm	No Set Maximum			
Manganese (Mn)	negligible	0.05 ppm (S)			
Molybdenum (Mo)	negligible	No Set Maximum			
Nickel (Ni)	negligible	No Set Maximum			
Nitrate-Nitrogen (NO ₃ ⁻ -N)	0.93 ppm	10.0 ppm (P)			

* The letter (P) beside an EPA Maximum Level indicates that EPA has established a primary drinking water standard for this parameter. These are parameters which have been shown to cause adverse health effects. The letter (S) indicates that EPA has established a secondary drinking water standard for this parameter. These parameters are not generally considered threats to health, but can cause nuisance problems such as staining, tastes or odors.

ppm: Stands for parts per million. One part per million is equivalent to 1 pound of an element dissolved in 1,000,000 pounds of water. One part per million is the same as one milligram per liter (mg/L).

ppb: Stands for parts per billion. One part per billion is the same as one microgram per liter (µg/L).

NOTE: This test does not imply that this water is safe from bacteria or other chemicals that may be present. If you have concerns in these areas, contact your County Extension Agent.

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Water Analysis Report

Sample ID

(CEC/CEA Signature)

Client Information		Lab Information	Contact
mja0055@auburn.edu		Lab #3957	Soil, Plant, and Water Laboratory 2400 College Station Road Athens, GA 30602 ph: 706-542-5350 e-mail: soiltest@uga.edu
Auburn University: Armstrong, Megan		Received: Dec 22, 2023	
238 Harbert Engineering Center		Completed: Jan 3, 2024	
Auburn, AL 36849		Tests: W42Pb W4NO3 W1	
Sample: 2-C			
Type: Stormwater	Sample Address Armstrong, Megan 1600 Lee County Road 151 Opelika, AL 36804		

Results

pH: 7.4 (Desired pH range 6.5 to 8.5)

Calculated Hardness: 57 ppm (3.3 gr/gal) - Slightly Hard Water -

(Water hardness is due to the presence of certain dissolved minerals, primarily calcium and magnesium.)

Parameter	Concentration in Sample	EPA Maximum Level*	Parameter	Concentration in Sample	EPA Maximum Level*
Aluminum (Al)	1.38 ppm ^a	0.2 ppm (S)	Phosphorus (P)	0.33 ppm	No Set Maximum
Boron (B)	0.01 ppm	No Set Maximum	Potassium (K)	1.8 ppm	No Set Maximum
Cadmium (Cd)	63.70 ppb ^b	5 ppb (P)	Silica (SiO ₂)	10.61 ppm	No Set Maximum
Calcium (Ca)	14.2 ppm	No Set Maximum	Sodium (Na)	8.4 ppm	No Set Maximum
Chromium (Cr)	negligible	100 ppb (P)	Zinc (Zn)	1.11 ppm	5.0 ppm (S)
Copper (Cu)	0.06 ppm	1.0 ppm (S) 1.3 ppm (P)			
Iron (Fe)	12.36 ppm ^c	0.30 ppm (S)			
Lead (Pb)	149.84 ppb ^d	15 ppb (P)			
Magnesium (Mg)	5.3 ppm	No Set Maximum			
Manganese (Mn)	negligible	0.05 ppm (S)			
Molybdenum (Mo)	negligible	No Set Maximum			
Nickel (Ni)	10.00 ppb	No Set Maximum			
Nitrate-Nitrogen (NO ₃ ⁻ -N)	0.88 ppm	10.0 ppm (P)			

* The letter (P) beside an EPA Maximum Level indicates that EPA has established a primary drinking water standard for this parameter. These are parameters which have been shown to cause adverse health effects. The letter (S) indicates that EPA has established a secondary drinking water standard for this parameter. These parameters are not generally considered threats to health, but can cause nuisance problems such as staining, tastes or odors.

ppm: Stands for parts per million. One part per million is equivalent to 1 pound of an element dissolved in 1,000,000 pounds of water. One part per million is the same as one milligram per liter (mg/L).

ppb: Stands for parts per billion. One part per billion is the same as one microgram per liter (µg/L).

NOTE: This test does not imply that this water is safe from bacteria or other chemicals that may be present. If you have concerns in these areas, contact your County Extension Agent.

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Water Analysis Report

Sample ID

(CEC/CEA Signature)

Client Information		Lab Information	Contact
Auburn University: Armstrong, Megan		Lab #3958	Soil, Plant, and Water Laboratory
238 Harbert Engineering Center		Received: Dec 22, 2023	2400 College Station Road
Auburn, AL 36849		Completed: Jan 3, 2024	Athens, GA 30602
Sample: 3-C		Tests: W42Pb W4NO3 W1	ph: 706-542-5350
Type: Stormwater			e-mail: soiltest@uga.edu

Results

pH: 7.4 (Desired pH range 6.5 to 8.5)

Calculated Hardness: 58 ppm (3.4 gr/gal) - Slightly Hard Water -

(Water hardness is due to the presence of certain dissolved minerals, primarily calcium and magnesium.)

Parameter	Concentration in Sample	EPA Maximum Level ^a	Parameter	Concentration in Sample	EPA Maximum Level ^a
Aluminum (Al)	1.67 ppm ^a	0.2 ppm (S)	Phosphorus (P)	0.39 ppm	No Set Maximum
Boron (B)	0.01 ppm	No Set Maximum	Potassium (K)	2.2 ppm	No Set Maximum
Cadmium (Cd)	64.30 ppb ^b	5 ppb (P)	Silica (SiO ₂)	11.32 ppm	No Set Maximum
Calcium (Ca)	14.3 ppm	No Set Maximum	Sodium (Na)	8.4 ppm	No Set Maximum
Chromium (Cr)	negligible	100 ppb (P)	Zinc (Zn)	1.34 ppm	5.0 ppm (S)
Copper (Cu)	0.07 ppm	1.0 ppm (S) 1.3 ppm (P)			
Iron (Fe)	14.84 ppm ^c	0.30 ppm (S)			
Lead (Pb)	150.38 ppb ^d	15 ppb (P)			
Magnesium (Mg)	5.4 ppm	No Set Maximum			
Manganese (Mn)	negligible	0.05 ppm (S)			
Molybdenum (Mo)	negligible	No Set Maximum			
Nickel (Ni)	negligible	No Set Maximum			
Nitrate-Nitrogen (NO ₃ ⁻ -N)	0.64 ppm	10.0 ppm (P)			

* The letter (P) beside an EPA Maximum Level indicates that EPA has established a primary drinking water standard for this parameter. These are parameters which have been shown to cause adverse health effects. The letter (S) indicates that EPA has established a secondary drinking water standard for this parameter. These parameters are not generally considered threats to health, but can cause nuisance problems such as staining, tastes or odors.

ppm: Stands for parts per million. One part per million is equivalent to 1 pound of an element dissolved in 1,000,000 pounds of water. One part per million is the same as one milligram per liter (mg/L).

ppb: Stands for parts per billion. One part per billion is the same as one microgram per liter (µg/L).

NOTE: This test does not imply that this water is safe from bacteria or other chemicals that may be present. If you have concerns in these areas, contact your County Extension Agent.

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Ag & Environmental Services Labs

Soil, Plant, and Water Laboratory
2400 College Station Road
Athens, Georgia 30602-9105
Website: <http://aesl.ces.uga.edu>

Water Analysis Report

Sample ID

(CEC/CEA Signature)

Client Information		Lab Information	Contact
Auburn University: Armstrong, Megan		Lab #3959	Soil, Plant, and Water Laboratory
238 Harbert Engineering Center		Received: Dec 22, 2023	2400 College Station Road
Auburn, AL 36849		Completed: Jan 3, 2024	Athens, GA 30602
Sample: 1-T		Tests: W42Pb W4NO3 W1	ph: 706-542-5350
Type: Stormwater			e-mail: soiltest@uga.edu

Results

pH: 7.5 (Desired pH range 6.5 to 8.5)

Calculated Hardness: 55 ppm (3.2 gr/gal) - Slightly Hard Water -

(Water hardness is due to the presence of certain dissolved minerals, primarily calcium and magnesium.)

Parameter	Concentration in Sample	EPA Maximum Level*	Parameter	Concentration in Sample	EPA Maximum Level*
Aluminum (Al)	2.98 ppm ^a	0.2 ppm (S)	Phosphorus (P)	0.09 ppm	No Set Maximum
Boron (B)	0.01 ppm	No Set Maximum	Potassium (K)	2.1 ppm	No Set Maximum
Cadmium (Cd)	24.50 ppb ^b	5 ppb (P)	Silica (SiO ₂)	5.95 ppm	No Set Maximum
Calcium (Ca)	13.8 ppm	No Set Maximum	Sodium (Na)	13.7 ppm	No Set Maximum
Chromium (Cr)	negligible	100 ppb (P)	Zinc (Zn)	0.68 ppm	5.0 ppm (S)
Copper (Cu)	negligible	1.0 ppm (S) 1.3 ppm (P)			
Iron (Fe)	3.06 ppm ^c	0.30 ppm (S)			
Lead (Pb)	25.72 ppb ^d	15 ppb (P)			
Magnesium (Mg)	5.1 ppm	No Set Maximum			
Manganese (Mn)	0.05 ppm	0.05 ppm (S)			
Molybdenum (Mo)	negligible	No Set Maximum			
Nickel (Ni)	28.00 ppb	No Set Maximum			
Nitrate-Nitrogen (NO ₃ ⁻ -N)	0.93 ppm	10.0 ppm (P)			

* The letter (P) beside an EPA Maximum Level indicates that EPA has established a primary drinking water standard for this parameter. These are parameters which have been shown to cause adverse health effects. The letter (S) indicates that EPA has established a secondary drinking water standard for this parameter. These parameters are not generally considered threats to health, but can cause nuisance problems such as staining, tastes or odors.

ppm: Stands for parts per million. One part per million is equivalent to 1 pound of an element dissolved in 1,000,000 pounds of water. One part per million is the same as one milligram per liter (mg/L).

ppb: Stands for parts per billion. One part per billion is the same as one microgram per liter (µg/L).

NOTE: This test does not imply that this water is safe from bacteria or other chemicals that may be present. If you have concerns in these areas, contact your County Extension Agent.

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2400 College Station Road
Athens, Georgia 30602-9105
Website: <http://aesl.ces.uga.edu>

Water Analysis Report

Sample ID

(CEC/CEA Signature)

Client Information		Lab Information	Contact
Auburn University: Armstrong, Megan		Lab #3960	Soil, Plant, and Water Laboratory
238 Harbert Engineering Center		Received: Dec 22, 2023	2400 College Station Road
Auburn, AL 36849		Completed: Jan 3, 2024	Athens, GA 30602
Sample: 2-T		Tests: W42Pb W4NO3 W1	ph: 706-542-5350
Type: Stormwater			e-mail: soiltest@uga.edu

Results

pH: 7.4 (Desired pH range 6.5 to 8.5)

Calculated Hardness: 56 ppm (3.3 gr/gal) - Slightly Hard Water -

(Water hardness is due to the presence of certain dissolved minerals, primarily calcium and magnesium.)

Parameter	Concentration in Sample	EPA Maximum Level*	Parameter	Concentration in Sample	EPA Maximum Level*
Aluminum (Al)	4.96 ppm ^a	0.2 ppm (S)	Phosphorus (P)	0.13 ppm	No Set Maximum
Boron (B)	0.02 ppm	No Set Maximum	Potassium (K)	2.2 ppm	No Set Maximum
Cadmium (Cd)	24.60 ppb ^b	5 ppb (P)	Silica (SiO ₂)	7.04 ppm	No Set Maximum
Calcium (Ca)	14.0 ppm	No Set Maximum	Sodium (Na)	14.8 ppm	No Set Maximum
Chromium (Cr)	negligible	100 ppb (P)	Zinc (Zn)	1.24 ppm	5.0 ppm (S)
Copper (Cu)	negligible	1.0 ppm (S) 1.3 ppm (P)			
Iron (Fe)	4.29 ppm ^c	0.30 ppm (S)			
Lead (Pb)	27.06 ppb ^d	15 ppb (P)			
Magnesium (Mg)	5.2 ppm	No Set Maximum			
Manganese (Mn)	0.05 ppm	0.05 ppm (S)			
Molybdenum (Mo)	negligible	No Set Maximum			
Nickel (Ni)	32.00 ppb	No Set Maximum			
Nitrate-Nitrogen (NO ₃ -N)	1.40 ppm	10.0 ppm (P)			

* The letter (P) beside an EPA Maximum Level indicates that EPA has established a primary drinking water standard for this parameter. These are parameters which have been shown to cause adverse health effects. The letter (S) indicates that EPA has established a secondary drinking water standard for this parameter. These parameters are not generally considered threats to health, but can cause nuisance problems such as staining, tastes or odors.

ppm: Stands for parts per million. One part per million is equivalent to 1 pound of an element dissolved in 1,000,000 pounds of water. One part per million is the same as one milligram per liter (mg/L).

ppb: Stands for parts per billion. One part per billion is the same as one microgram per liter (µg/L).

NOTE: This test does not imply that this water is safe from bacteria or other chemicals that may be present. If you have concerns in these areas, contact your County Extension Agent.

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Results and interpretations are based on the analysis of a sample collected by the client and delivered to the laboratory.

Water Analysis Report

Sample ID

(CEC/CEA Signature)

Client Information		Lab Information	Contact
Auburn University: Armstrong, Megan		Lab #3961	Soil, Plant, and Water Laboratory
238 Harbert Engineering Center		Received: Dec 22, 2023	2400 College Station Road
Auburn, AL 36849		Completed: Jan 3, 2024	Athens, GA 30602
Sample: 3-T		Tests: W42Pb W4NO3 W1	ph: 706-542-5350
Type: Stormwater			e-mail: soiltest@uga.edu

Results

pH: 7.4 (Desired pH range 6.5 to 8.5)

Calculated Hardness: 56 ppm (3.3 gr/gal) - Slightly Hard Water -

(Water hardness is due to the presence of certain dissolved minerals, primarily calcium and magnesium.)

Parameter	Concentration in Sample	EPA Maximum Level*	Parameter	Concentration in Sample	EPA Maximum Level*
Aluminum (Al)	3.94 ppm ^a	0.2 ppm (S)	Phosphorus (P)	0.11 ppm	No Set Maximum
Boron (B)	0.01 ppm	No Set Maximum	Potassium (K)	2.2 ppm	No Set Maximum
Cadmium (Cd)	28.30 ppb ^h	5 ppb (P)	Silica (SiO ₂)	6.37 ppm	No Set Maximum
Calcium (Ca)	13.9 ppm	No Set Maximum	Sodium (Na)	15.0 ppm	No Set Maximum
Chromium (Cr)	negligible	100 ppb (P)	Zinc (Zn)	0.73 ppm	5.0 ppm (S)
Copper (Cu)	negligible	1.0 ppm (S) 1.3 ppm (P)			
Iron (Fe)	3.22 ppm ^c	0.30 ppm (S)			
Lead (Pb)	30.52 ppb ^d	15 ppb (P)			
Magnesium (Mg)	5.1 ppm	No Set Maximum			
Manganese (Mn)	0.05 ppm	0.05 ppm (S)			
Molybdenum (Mo)	negligible	No Set Maximum			
Nickel (Ni)	30.00 ppb	No Set Maximum			
Nitrate-Nitrogen (NO ₃ -N)	0.96 ppm	10.0 ppm (P)			

* The letter (P) beside an EPA Maximum Level indicates that EPA has established a primary drinking water standard for this parameter. These are parameters which have been shown to cause adverse health effects. The letter (S) indicates that EPA has established a secondary drinking water standard for this parameter. These parameters are not generally considered threats to health, but can cause nuisance problems such as staining, tastes or odors.

ppm: Stands for parts per million. One part per million is equivalent to 1 pound of an element dissolved in 1,000,000 pounds of water. One part per million is the same as one milligram per liter (mg/L).

ppb: Stands for parts per billion. One part per billion is the same as one microgram per liter (µg/L).

NOTE: This test does not imply that this water is safe from bacteria or other chemicals that may be present. If you have concerns in these areas, contact your County Extension Agent.

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Appendix G: Prototype C – Field-Scale Evaluation Data

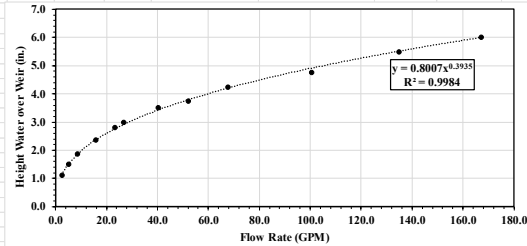
Table 1a: Test Information				Inflow (Interval: 3 min.)				UPSTREAM-EC				DOWNSTREAM-EC				Turbidity Reduction (%)
Test ID	FS1			Sample ID	Time of Day (hh:mm:ss)	Time (hh:mm)	Turbidity (NTU)	Sample ID	Time of Day (hh:mm:ss)	Time (hh:mm:ss)	Turbidity (NTU)	Sample ID	Time of Day (hh:mm:ss)	Time (hh:mm:ss)	Turbidity (NTU)	
Date		12/19/2023		103	9:53:00	0:03:00	1031	200	10:02:00	0:12:00	154					
Test Duration (min.)		45		106	9:56:00	0:06:00	1026	205	10:07:00	0:17:00	386					
Test Start		9:50:00		109	9:59:00	0:09:00	919	210	10:12:00	0:22:00	575					
Basin Inflow		9:55:20		112	10:02:00	0:12:00	1062	215	10:17:00	0:27:00	545					
Skimmer Inflow		10:01:30		115	10:05:00	0:15:00	737	220	10:22:00	0:32:00	464					
Lamella Inflow		10:07:26		118	10:08:00	0:18:00	594	225	10:27:00	0:37:00	420					
Lamella Discharge		12:30:00		121	10:11:00	0:21:00	520	230	10:32:00	0:42:00	409					
Inter-electrode Distance (cm)		0.5		124	10:14:00	0:24:00	533	235	10:37:00	0:47:00	346					
Inflow rate (cfs)		0.7		127	10:17:00	0:27:00	487	24	10:42:00	0:52:00	353					
Inflow Rate (gpm)		314.18		130	10:20:00	0:30:00	450	245	11:02:00	1:12:00	315					
Skimmer Flow Rate (gpm)		8.000		133	10:23:00	0:33:00	485	250	11:22:00	1:32:00	286					
Flow Rate (m³/hr)		1.817		136	10:26:00	0:36:00	535					1	12:30:00	2:40:00	111	49%
Voltage (V)		12		139	10:29:00	0:39:00	511					2	13:00:00	3:10:00	107	50%
Current (A)		8.5		142	10:32:00	0:42:00	500					3	13:30:00	3:40:00	106	51%
Kwh/m³		0.056		145	10:35:00	0:45:00	419					4	14:00:00	4:10:00	116	46%
				AVG												
Current Over Time																
Time (min.)		A														
15		4.5														
20		8.5		41%												
25		9.1		12%												
40		9.2		17%												
45		9.4		29%												
50		9.3		36%												
80		9.3		37%												
166		8.4		47%												
				46%												
				52%												
				56%												
Skimmer Flow Rate																
Time (min.)		gpm														
27		3														
35		3.5														
40		4														
45		6.3														
78		7.9														
Avg Inflow Turbidity (NTU)				653.9												

Table 1a: Test Information				Inflow (Interval: 3 min.)				UPSTREAM-EC				DOWNSTREAM-EC				Turbidity Reduction (%)
Test ID	F53			Sample ID	Time of Day (hh:mm:ss)	Time (hh:mm)	Turbidity (NTU)	Sample ID	Time of Day (hh:mm:ss)	Time (hh:mm:ss)	Turbidity (NTU)	Sample ID	Time of Day (hh:mm:ss)	Time (hh:mm:ss)	Turbidity (NTU)	
Date	1/3/2024			103	11:20:00	0:03:00	1401	205	11:29:00	0:12:00	712					
Test Duration (min.)	30			106	11:23:00	0:06:00	892	215	11:34:00	0:17:00	652					
Test Start	11:17:00			109	11:26:00	0:09:00	759	225	11:39:00	0:22:00	1003					
Basin Inflow	11:19:00			112	11:29:00	0:12:00	785	235	11:44:00	0:27:00	534					
Skimmer Inflow	11:23:00			115	11:32:00	0:15:00	796	245	11:49:00	0:32:00	501					
Lamella Inflow	11:28:00			118	11:35:00	0:18:00	655	255	11:54:00	0:37:00	479					
Lamella Discharge	13:40:00			121	11:38:00	0:21:00	770	265	11:59:00	0:42:00						
ISCOs Started	13:50:00			124	11:41:00	0:24:00	735	275	12:04:00	0:47:00						
Interelectrode Distance (cm)	0.5			127	11:44:00	0:27:00	670	285	12:09:00	0:52:00	425					
Inflow rate (cfs)				130	11:47:00	0:30:00	788	295	12:29:00	1:12:00						
Inflow Rate (gpm)	0.00			AVG			825					1	13:50:00	2:40:00	124	55%
Skimmer Flow Rate (gpm)	#DIV/0!							1	13:50:00	2:40:00	336	2	14:20:00	3:10:00	107	61%
Flow Rate (m³/hr)	#DIV/0!			average	TR control	TR control	TR control	3	14:50:00	3:40:00	309	3	14:50:00	3:40:00	99	64%
Voltage (V)	12			37%	41%	55%	14%	4	15:20:00	4:10:00	298	4	15:20:00	4:10:00	91	67%
Current (A)	6.1			24%	12%	40%	21%	5	15:50:00	4:40:00	267	5	15:50:00	4:40:00	87.9	68%
kwh/m³	#DIV/0!			8%	17%	30%	-22%	6	16:20:00	5:10:00	299	6	16:20:00	5:10:00	82.8	70%
				34%	29%	38%	35%	7	16:50:00	5:40:00	288	7	16:50:00	5:40:00	83.1	70%
				40%	36%	46%	39%	8	17:20:00	6:10:00	281	8	17:20:00	6:10:00	84.2	69%
Temp	40 F			44%	37%	52%	42%	9	17:50:00	6:40:00	277	9	17:50:00	6:40:00	80.1	71%
Humidity		74%		51%	47%	55%		10	18:20:00	7:10:00	273	10	18:20:00	7:10:00	82.1	70%
Pressure	30.16 in.			52%	46%	58%		11	18:50:00	7:40:00	269	11	18:50:00	7:40:00	83.3	70%
Dew Point	33 deg.			53%	52%	60%	48%	12	19:20:00	8:10:00	265	12	19:20:00	8:10:00	83.5	70%
Wind				56%	56%			13	19:50:00	8:40:00	261	13	19:50:00	8:40:00	84.8	69%
								14	20:20:00	9:10:00	257	14	20:20:00	9:10:00	93.2	66%
								15	20:50:00	9:40:00	253	15	20:50:00	9:40:00	90	67%
								16	21:20:00	10:10:00	249	16	21:20:00	10:10:00	90.5	67%
								17	21:50:00	10:40:00	245	17	21:50:00	10:40:00	90.5	67%
								18	22:20:00	11:10:00	241	18	22:20:00	11:10:00	95	65%
								19	22:50:00	11:40:00	237	19	22:50:00	11:40:00	92.7	66%
								20	23:20:00	12:10:00	233	20	23:20:00	12:10:00	94	66%
								21	23:50:00	12:40:00	229	21	23:50:00	12:40:00	92.7	
								22	0:20:00	13:10:00	225	22	0:20:00	13:10:00	102	
								23	0:50:00	13:40:00	221	23	0:50:00	13:40:00	135	
								24	1:20:00	14:10:00	217	24	1:20:00	14:10:00	172	
								Skimmer Inflow (NTU) 274.8947368								68%

Appendix H: Prototype D – Field-Scale Evaluation Data

Weights	Dry	Full	Water	Gallons
Bucket	1.7	41.05	39.35	4.72
Trough	4.6	158.5	153.9	18.45
		Liter	1	0.264172
Height of Weir (in.)				16.5

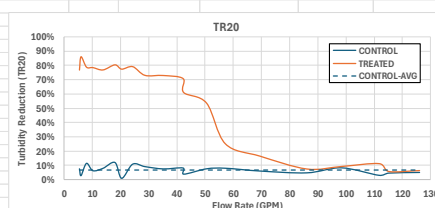
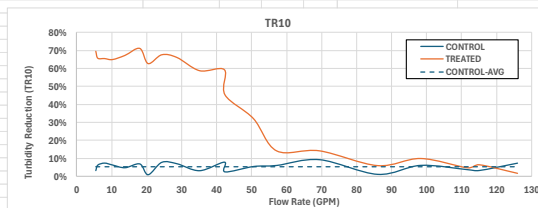
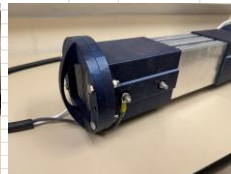
	ID	Water Height (in.)	Height over Weir (in.)	Avg Time (s)	GPM
Lowest	F6	17.625	1.1	6.6	2.4
	F1	18	1.5	54.5	5.2
	F2	18.375	1.9	32.7	8.7
	F3	18.875	2.4	17.9	15.8
	F4	19.3125	2.8	12.1	23.3
	F5	19.5	3.0	10.5	26.9
	F11	20	3.5	7.0	40.3
	F7	20.25	3.8	5.4	52.1
	F10	20.75	4.3	16.4	67.6
	F9	21.25	4.6	11.0	100.7
	F12	22	5.5	8.2	134.9
	F9	22.5	6.0	6.6	167.2
Highest					



	Water Height (in.)	Water Height (in.)	Over Weir (in.)	Flow Rate (GPM)
0		17	0.5	0.30
1		17.0625	0.5625	0.41
2		17.125	0.625	0.54
3		17.1875	0.6875	0.68
4		17.25	0.75	0.85
5		17.3125	0.8125	1.04
6		17.375	0.875	1.26
7		17.4375	0.9375	1.50
8		17.5	1	1.76
9		17.5625	1.0625	2.06
10		17.625	1.125	2.38
11		17.6875	1.1875	2.73
12		17.75	1.25	3.11
13		17.8125	1.3125	3.52
14		17.875	1.375	3.96
15		17.9375	1.4375	4.43
0		18	1.5	4.94
1		18.0625	1.5625	5.48
2		18.125	1.625	6.05
3		18.1875	1.6875	6.66
4		18.25	1.75	7.30
5		18.3125	1.8125	7.98
6		18.375	1.875	8.70
7		18.4375	1.9375	9.46
8		18.5	2	10.25
9		18.5625	2.0625	11.08
10		18.625	2.125	11.95
11		18.6875	2.1875	12.87
12		18.75	2.25	13.82
13		18.8125	2.3125	14.82
14		18.875	2.375	15.85
15		18.9375	2.4375	16.93
0		19	2.5	18.06
1		19.0625	2.5625	19.23
2		19.125	2.625	20.44
3		19.1875	2.6875	21.70
4		19.25	2.75	23.00
5		19.3125	2.8125	24.35
6		19.375	2.875	25.75
7		19.4375	2.9375	27.19
8		19.5	3	28.68
9		19.5625	3.0625	30.23
10		19.625	3.125	31.82
11		19.6875	3.1875	33.46
12		19.75	3.25	35.15
13		19.8125	3.3125	36.89
14		19.875	3.375	38.68
15		19.9375	3.4375	40.52
0		20	3.5	42.42
1		20.0625	3.5625	44.37
2		20.125	3.625	46.37
3		20.1875	3.6875	48.43
4		20.25	3.75	50.54
5		20.3125	3.8125	52.70
6		20.375	3.875	54.93
7		20.4375	3.9375	57.20
8		20.5	4	59.53
9		20.5625	4.0625	61.92
10		20.625	4.125	64.37
11		20.6875	4.1875	66.88
12		20.75	4.25	69.44
13		20.8125	4.3125	72.06
14		20.875	4.375	74.74
15		20.9375	4.4375	77.48
0		21	4.5	80.28
1		21.0625	4.5625	83.14
2		21.125	4.625	86.06
3		21.1875	4.6875	89.04
4		21.25	4.75	92.09
5		21.3125	4.8125	95.20
6		21.375	4.875	98.36
7		21.4375	4.9375	101.60
8		21.5	5	104.89
9		21.5625	5.0625	108.25
10		21.625	5.125	111.68
11		21.6875	5.1875	115.17
12		21.75	5.25	118.72
13		21.8125	5.3125	122.34
14		21.875	5.375	126.03
15		21.9375	5.4375	129.78
		22	5.5	133.60

ONE 6-inch FLOC GENERATOR WITH 18-inch PLATES												Control		Treated	
Date	10/25/2024	Time of Day (HH-MM)	Testing Time (min.)	Inflow Turbidity (NTU)	Current (A)	Water Height (in)	Height Over Weir (in.)	Flow Rate (GPM)	Water Temp (F)	TR10-C	TR20-C	TR10-T	TR20-T		
Time Start	1:00PM	1	1:10PM	10	452	9.7	18 1/8	1 5/8	6.05	71	6%	3%	66%	86%	
Time End	4:00PM	2	1:20PM	20	467	9	18 5/8	2 1/3	7.98	71.5	7%	11%	66%	79%	
		3	1:30PM	30	511	9	18 1/2	2	10.25	72	2%	2%	63%	77%	
Avg. Turbidity	575.7 NTU	4	1:42PM	42	544	8.8	18 3/4	2 1/4	13.82	71	5%	8%	67%	77%	
Avg. Current	8.9 A	5	1:52PM	52	586	8.8	19	2 1/2	18.06	71.5	7%	12%	71%	80%	
Avg. Water Temp	72.2 F	6	2:05PM	65	584	9	19 5/16	2 4/5	24.35	72	8%	11%	68%	79%	
Mix Time	30 secs	7	2:14PM	74	603	9	19 1/2	3	28.68	71.5	7%	9%	66%	73%	
		8	2:22PM	82	599	9.2	19 3/4	3 1/4	35.15	72	2%	7%	59%	73%	
		9	2:30PM	90	620	8.9	20	3 1/2	42.24	72	8%	8%	59%	71%	
Weather (1:30PM)		10	2:39PM	99	607	9.2	20 1/4	3 3/4	50.54	72	5%	8%	32%	54%	
Air Temp	83 F	11	2:46PM	106	615	8.9	20 7/16	4	57.2	72	6%	8%	14%	25%	
Water Temp	71 F	12	2:53PM	113	613	9	20 3/4	4 1/4	69.44	73	9%	6%	14%	17%	
Humidity	41 %	13	3:00PM	120	599	8.8	21 1/8	4 5/8	86.06	73	1%	5%	6%	8%	
Dew Pt.	57 deg	14	3:07PM	127	594	8.8	21 3/8	4 7/8	98.36	72	6%	8%	10%	9%	
Pressure	30.15 in	15	3:22PM	140	587	8.7	21 5/8	5 1/8	111.68	72	4%	3%	5%	11%	
		16	3:30PM	150	593	8.3	21 7/8	5 3/8	126.03	73	7%	5%	2%	7%	
Turbidity Calibration		17	3:40PM	160	566	9.4	18 1/16	1 4/7	5.48	73	3%	8%	70%	77%	
Standard (NTU)	Reading (NTU)	18	3:49PM	169	564	8.8	19 1/8	2 5/8	20.44	73	1%	-1%	63%	77%	
0.1	0.142	19	3:55PM	175	594	8.8	20	3 1/2	42.42	73	3%	4%	45%	61%	
20	19.5	20	4:00PM	180	607	8.2	21 11/16	5 1/5	115.17	74	3%	5%	6%	6%	
200	183														
1000	916														
4000	3829														

Turbidity Calibration	
Standard (NTU)	Reading (NTU)
0.1	0.142
20	19.5
200	183
1000	916
4000	3829



		Control		Treated	
Flow Rate (GPM)	AMPS (A)	TR10-C	TR20-C	TR10-T	TR20-T
5.48	9.7	3%	8%	70%	77%
6.05	9	6%	3%	66%	86%
7.98	9	7%	11%	66%	79%
10.25	8.8	6%	6%	65%	78%
13.82	8.8	5%	8%	67%	77%
18.06	9	7%	12%	71%	80%
20.44	9	1%	1%	63%	77%
24.35	9.2	8%	11%	68%	79%
28.68	8.9	7%	9%	66%	73%
35.15	9.2	3%	8%	59%	73%
42.24	8.9	8%	8%	59%	71%
42.42	9	3%	4%	45%	61%
50.54	8.8	5%	8%	32%	54%
57.2	8.8	6%	8%	14%	25%
69.44	8.7	9%	6%	14%	17%
86.06	8.3	1%	5%	6%	8%
98.36	9.4	6%	8%	10%	9%
111.68	8.8	4%	3%	5%	11%
115.17	8.8	3%	5%	6%	6%
126.03	8.2	7%	5%	2%	7%
		5%	7%		

ONE 6-inch FLOC GENERATOR WITH 18-inch PLATES / AVG WATER TEMP: 72 deg														
Sample 1					Treatment ratio	Sample 17								
Flow Rate (GPM)	6.05	Settling Time (min.)	Control (NTU)	Treated (NTU)		TR-Control	TR-Treated	Flow Rate (GPM)	5.48	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	9.7	0	452	427		0%	6%	Current (A)	9.4	0	555	523	0%	6%
Inflow (NTU)	452	5	442	189		2%	58%	Inflow (NTU)	555	5	527	320	5%	42%
		10	424	155		6%	66%			10	537	169	3%	70%
		15	430	95.1		5%	79%			15	529	146	5%	74%
		20	439	64	3%	86%	85%			20	513	130	8%	77%
Sample 2														
Flow Rate (GPM)	7.98	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated								
Current (A)	9	0	442	467	5%	0%								
Inflow (NTU)	467	5	431	243	8%	48%								
		10	433	161	7%	66%								
		15	436	127	7%	73%								
		20	414	100	11%	79%	76%							
Sample 3														
Flow Rate (GPM)	10.25	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated								
Current (A)	9	0	489	472	0%	3%								
Inflow (NTU)	489	5	498	297	-2%	39%								
		10	479	179	2%	63%								
		15	462	144	6%	71%								
		20	479	111	2%	77%	77%							
Sample 4														
Flow Rate (GPM)	13.82	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated								
Current (A)	8.8	0	544	504	0%	7%								
Inflow (NTU)	544	5	545	292	0%	46%								
		10	518	178	5%	67%								
		15	506	159	7%	71%								
		20	501	127	8%	77%	75%							
Sample 5														
Flow Rate (GPM)	18.06	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated								
Current (A)	8.8	0	586	535	0%	9%								
Inflow (NTU)	586	5	513	273	12%	53%								
		10	546	169	7%	71%								
		15	554	130	5%	78%								
		20	516	116	12%	80%	78%							
Sample 6														
Flow Rate (GPM)	24.35	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated								
Current (A)	9	0	584	548	0%	6%								
Inflow (NTU)	584	5	558	280	4%	52%								
		10	539	189	8%	68%								
		15	548	140	6%	76%								
		20	521	123	11%	79%	76%							

Sample 7					
Flow Rate (GPM)	28.68	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control TR-Treated
Current (A)	9	0	605	561	0% 7%
Inflow (NTU)	605	5	588	432	3% 29%
		10	563	205	7% 66%
		15	590	169	2% 72%
		20	550	164	9% 73%

70%

Sample 8					
Flow Rate (GPM)	35.15	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control TR-Treated
Current (A)	9.2	0	596	560	0% 6%
Inflow (NTU)	596	5	589	421	1% 29%
		10	606	247	-2% 59%
		15	566	195	5% 67%
		20	554	163	7% 73%

71%

Sample 9					
Flow Rate (GPM)	42.24	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control TR-Treated
Current (A)	8.9	0	629	615	0% 2%
Inflow (NTU)	629	5	620	438	1% 30%
		10	580	256	8% 59%
		15	605	199	4% 68%
		20	578	185	8% 71%

68%

Sample 10					
Flow Rate (GPM)	50.54	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control TR-Treated
Current (A)	9.2	0	607	591	0% 3%
Inflow (NTU)	607	5	578	555	5% 9%
		10	574	412	5% 32%
		15	579	324	5% 47%
		20	561	282	8% 54%

50%

Sample 11					
Flow Rate (GPM)	57.2	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control TR-Treated
Current (A)	8.9	0	605	615	2% 0%
Inflow (NTU)	615	5	579	576	6% 6%
		10	578	528	6% 14%
		15	591	492	4% 20%
		20	566	460	8% 25%

19%

Sample 12					
Flow Rate (GPM)	69.44	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control TR-Treated
Current (A)	9	0	613	563	0% 8%
Inflow (NTU)	613	5	623	565	-2% 8%
		10	557	526	9% 14%
		15	582	516	5% 16%
		20	576	511	6% 17%

11%

Sample 13					
Flow Rate (GPM)	86.06	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control TR-Treated
Current (A)	8.8	0	586	585	0% 0%
Inflow (NTU)	586	5	587	554	0% 5%
		10	579	551	1% 6%
		15	560	554	4% 5%
		20	558	541	5% 8%

3%

Sample 14					
Flow Rate (GPM)	98.36	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control TR-Treated
Current (A)	8.8	0	594	569	0% 4%
Inflow (NTU)	594	5	572	557	4% 6%
		10	558	535	6% 10%
		15	557	552	6% 7%
		20	545	538	8% 9%

1%

Sample 15					
Flow Rate (GPM)	111.68	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control TR-Treated
Current (A)	8.7	0	568	587	3% 0%
Inflow (NTU)	587	5	580	585	1% 0%
		10	565	559	4% 5%
		15	550	545	6% 7%
		20	569	520	3% 11%

9%

Sample 16					
Flow Rate (GPM)	126.03	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control TR-Treated
Current (A)	8.3	0	592	593	0% 0%
Inflow (NTU)	593	5	598	565	-1% 5%
		10	550	583	7% 2%
		15	548	544	8% 8%
		20	563	554	5% 7%

2%

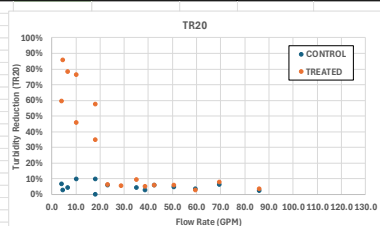
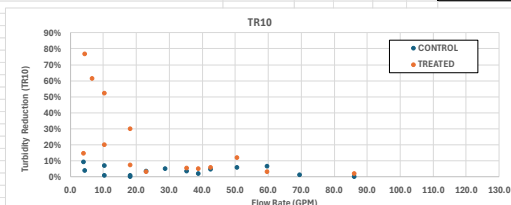
Sample 19					
Flow Rate (GPM)	42.24	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control TR-Treated
Current (A)	8.8	0	592	594	0% 0%
Inflow (NTU)	594	5	580	474	2% 20%
		10	579	325	3% 45%
		15	579	280	3% 53%
		20	571	232	4% 61%

Sample 20					
Flow Rate (GPM)	115.17	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control TR-Treated
Current (A)	8.2	0	619	591	-2% 3%
Inflow (NTU)	607	5	607	580	0% 4%
		10	587	568	3% 6%
		15	569	563	6% 7%
		20	579	571	5% 6%

ONE 6-inch FLOC GENERATOR WITH 18-inch PLATES	
Date	11/22/2024
Time Start	1:30PM
Time End	
Avg. Turbidity	697.5 NTU
Avg. Current	10.2 A
Avg. Water Temp	51.5 F
Mix Time	30 secs
Weather (1:30PM)	
Air Temp	F
Water Temp	F
Humidity	%
Dew Pt.	deg
Pressure	in
Turbidity Calibration	
Standard (NTU)	Reading (NTU)
0.1	0.128
20	19.5
200	185
1000	932
4000	3888

Time of Day (HH:MM)	Testing Time (min.)	Inflow Turbidity (NTU)	Current (A)	Water Height (in)	Height Over Weir (in.)	Flow Rate (GPM)	Water Temp (F)	Control	Treated
1	1:58PM	28	994	10.1	1.44	4.4	50	4%	3%
2	2:05PM	35	900	10.6	18 1/2	2.00	54.8	7%	10%
3	2:10PM	40	774	10.6	19	2.50	52.7	1%	10%
4	2:20PM	50	708	10.6	18 1/5	1.69	52.3	-1%	4%
5	2:27PM	57	722	10.1	18 1/2	3.00	28.7	5%	-2%
6	2:31PM	61	728	10.1	19 3/4	3.25	35.2	1%	1%
7	2:43PM	73	688	10.1	20	3.50	42.4	5%	6%
8	2:50PM	80	672	9.4	21 1/8	4.63	51.8	0%	2%
9	2:57PM	87	695	10	20 1/4	3.75	50.5	6%	5%
10	3:12PM	102	664	9.5	20 3/4	4.25	69.4	1%	6%
11	3:15PM	105	655	9.7	20 1/2	4.00	59.5	7%	3%
12	3:21PM	111	631	10.3	19 7/8	3.38	38.7	5%	5%
13	3:38PM	128	601	10.7	17 7/8	1.38	4.0	9%	60%
14	3:43PM	133	588	10.3	19	2.50	18.1	0%	0%
15	3:50PM	140	567	10	19 1/4	2.75	23.0	3%	6%
16	4:00PM	150	543	10.4	18 1/2	2.00	48.8	1%	-4%

Flow Rate (GPM)	Turbidity (NTU)	Amps (A)	Water Temp (F)	Control	Treated
4.4	994	10.1	50	4%	3%
10.3	900	10.6	54.8	7%	10%
18.1	774	10.6	52.7	1%	10%
6.7	708	10.6	52.3	-1%	4%
28.7	722	10.1	52.3	5%	-2%
35.2	728	10.1	52.1	4%	5%
42.4	688	10.1	52.8	5%	6%
86.1	672	9.4	51.8	0%	2%
50.5	695	10	54.1	6%	12%
69.4	664	9.5	51.4	1%	6%
59.5	655	9.7	50.2	7%	3%
38.7	631	10.3	38.7	2%	5%
4.0	601	10.7	50.3	9%	15%
18.1	588	10.3	50.3	0%	7%
23.0	567	10	50.4	3%	6%
10.3	543	10.4	48.8	1%	-4%

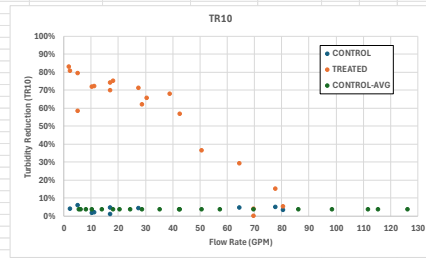
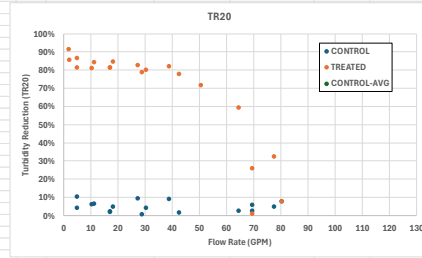


		Control		Treated	
Flow Rate (GPM)	Amps (A)	TR10-C	TR20-C	TR10-T	TR20-T
4.4	10.1	4%	3%	77%	86%
10.3	10.6	7%	10%	52%	76%
18.1	10.6	1%	10%	30%	57%
6.7	10.6	-1%	4%	62%	78%
28.7	10.1	5%	-2%	0%	5%
35.2	10.1	4%	4%	5%	9%
42.4	10.1	5%	6%	6%	6%
86.1	9.4	0%	2%	2%	3%
50.5	10	6%	5%	12%	6%
69.4	9.5	1%	6%	-1%	8%
59.5	9.7	7%	3%	3%	2%
38.7	10.3	2%	2%	5%	5%
4.0	10.7	9%	6%	15%	60%
18.1	10.3	0%	0%	7%	35%
23.0	10	3%	6%	3%	6%
10.3	10.4	1%	-4%	20%	46%
		3%	4%		

ONE 6-inch FLOC GENERATOR WITH 18-inch PLATES / AVG WATER TEMP: 52 deg						
Sample 1						Treatment ratio
Flow Rate (GPM)	4.43	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	
Current (A)	10.1	0	994	907	0%	
Inflow (NTU)	994	5	1028	439	-3%	
		10	967	233	3%	
		15	956	154	4%	
		20	969	141	3%	
						85%
Sample 2						
Flow Rate (GPM)	10.25	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	
Current (A)	10.6	0	900	834	0%	
Inflow (NTU)	900	5	802	763	11%	
		10	837	431	7%	
		15	814	273	10%	
		20	812	215	10%	
						74%
Sample 3						
Flow Rate (GPM)	18.06	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	
Current (A)	10.6	0	768	774	1%	
Inflow (NTU)	774	5	761	742	2%	
		10	767	542	1%	
		15	714	396	8%	
		20	698	330	10%	
						53%
Sample 4						
Flow Rate (GPM)	6.66	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	
Current (A)	10.6	0	708	642	0%	
Inflow (NTU)	708	5	737	549	-4%	
		10	717	272	-1%	
		15	691	182	2%	
		20	679	155	4%	
						77%
Sample 5						
Flow Rate (GPM)	28.68	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	
Current (A)	10.1	0	722	708	0%	
Inflow (NTU)	722	5	731	723	-1%	
		10	686	724	5%	
		15	701	721	3%	
		20	733	685	-2%	
						7%
Sample 6						
Flow Rate (GPM)	35.15	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	
Current (A)	10.1	0	705	728	0%	
Inflow (NTU)	705	5	703	675	0%	
		10	701	689	1%	
		15	733	669	-4%	
		20	697	660	1%	
						5%
Sample 7						
Flow Rate (GPM)	42.42	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	
Current (A)	10.1	0	687	698	2%	
Inflow (NTU)	698	5	656	674	6%	
		10	666	658	5%	
		15	659	662	6%	
		20	659	657	6%	
						0%
Sample 8						
Flow Rate (GPM)	86.06	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	
Current (A)	9.4	0	672	656	0%	
Inflow (NTU)	672	5	666	682	1%	
		10	670	658	0%	
		15	668	669	1%	
		20	657	650	2%	
						1%
Sample 9						
Flow Rate (GPM)	50.54	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	
Current (A)	10	0	695	681	0%	
Inflow (NTU)	695	5	659	656	5%	
		10	655	612	6%	
		15	651	629	6%	
		20	663	654	5%	
						1%

Sample 10						
Flow Rate (GPM)	69.44	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	9.5	0	664	634	0%	5%
Inflow (NTU)	664	5	664	640	0%	4%
		10	656	668	1%	-1%
		15	632	622	5%	6%
		20	624	613	6%	8%
						2%
Sample 11						
Flow Rate (GPM)	59.53	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	9.7	0	655	647	0%	1%
Inflow (NTU)	655	5	630	632	4%	4%
		10	611	634	7%	3%
		15	639	635	2%	3%
		20	634	639	3%	2%
						-1%
Sample 12						
Flow Rate (GPM)	38.68	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	10.3	0	631	623	0%	1%
Inflow (NTU)	631	5	626	614	1%	3%
		10	617	599	2%	5%
		15	630	609	0%	3%
		20	616	600	2%	5%
						3%
Sample 13						
Flow Rate (GPM)	3.96	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	10.7	0	601	547	0%	9%
Inflow (NTU)	601	5	568	534	5%	11%
		10	544	513	9%	15%
		15	548	336	9%	44%
		20	563	243	6%	60%
						57%
Sample 14						
Flow Rate (GPM)	18.06	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	10.3	0	588	538	0%	9%
Inflow (NTU)	588	5	596	556	-1%	5%
		10	588	545	0%	7%
		15	573	437	3%	26%
		20	588	384	0%	35%
						35%
Sample 15						
Flow Rate (GPM)	23	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	10	0	587	561	0%	4%
Inflow (NTU)	587	5	583	564	1%	4%
		10	567	569	3%	3%
		15	573	541	2%	8%
		20	554	552	6%	6%
						0%
Sample 16						
Flow Rate (GPM)	10.25	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	10.4	0	543	540	0%	1%
Inflow (NTU)	543	5	566	434	-4%	20%
		10	538	434	1%	20%
		15	536	435	1%	20%
		20	567	295	-4%	46%
						48%

FOUR 6-inch FLOC GENERATOR WITH 18-inch PLATES													
Date	11/21/2024												
Time Start	11:05AM												
Time End	3:45PM												
Avg. Turbidity	796.2 NTU												
Avg. Current	14.0 A												
Avg. Water Temp	53.0 F												
Mix Time	30 secs												
1:30:00P													
Weather (±30PM)													
Air Temp	58 F												
Water Temp	53 F												
Humidity	26 %												
Dew Pt.	23 deg												
Pressure	in												
Turbidity Calibration													
Standard (NTU)	Reading (NTU)												
0.1	0.128												
20	19.5												
200	185												
1000	932												
4000	3698												
Time of Day (H:M:M) Testing Time (min.) Inflow Turbidity (NTU) Current 1 (A) Current 2 (A) AVG Current (A) Water Height (in) Height Over Weir (in) Flow Rate (GPM) Water Temp (F)													
1	11:05AM	20	801	11.9	15.3	17.47	1.06	2.1	53.2				
2	11:34AM	20	842	12.4	14.8	27.2	1.8	1.50	49	52.3	0%	10%	59%
3	11:40AM	43	799	12.3	14.5	26.8	181/2	2.00	10.3	53.2	0%	6%	72%
4	12:04PM	59	710	12.3	14.2	26.5	19	2.44	18.9	51.6	1%	2%	74%
5	12:15PM	70	785	12.1	13.1	26	191/2	3.00	28.7	52.1	-1%	1%	62%
6	12:24PM	79	710	12.1	14	26.1	20	3/4	4.25	48.4	-4%	3%	6%
7	1:43PM	13	1033	14.3	16.2	30.5	21	4.44	77.5	54.1	5%	5%	15%
8	1:51PM	21	946	14.8	16.8	31.6	205/8	4.13	64.4	54.5	9%	3%	29%
9	2:00PM	30	1039	15.2	17.6	32.8	3/8	3.38	36.7	54.3	-3%	4%	66%
10	2:12PM	42	843	15.1	17.7	32.8	19/49	2.94	27.2	54.5	4%	9%	72%
11	2:20PM	50	834	15.1	18	33.1	19	2.50	18.1	51.4	-7%	5%	75%
12	2:30PM	60	814	14.3	16.3	30.6	21	5.50	80.3	51.2	4%	8%	6%
13	2:40PM	78	789	14.7	16.7	30.34	4/25	3.64	62.4	56	4%	2%	29%
14	2:48PM	78	776	15.1	17.3	32.4	201/4	3.75	50.5	51.2	-4%	-4%	37%
15	2:57AM	89	759	15.3	17.7	33	20	3.50	42.4	53.2	-1%	1%	57%
16	3:04PM	96	743	15.5	18	33.5	19/47	3.06	30.2	53.7	-4%	4%	66%
17	3:14PM	149	749	14.3	16.3	33.7	16 15/16	2.44	16.9	52	5%	7%	81%
18	3:26PM	118	708	15	16.3	33.3	18/47	2.06	11.1	51.8	2%	1%	72%
19	3:32PM	124	713	13.8	18	31.8	18	1.50	49	53.2	-1%	4%	80%
20	3:45PM	137	651	12.5	17.1	29.6	18	1.8	54.1	51	-5%	-6%	91%



		Control		Treated	
Flow Rate (GPM)	Amps (A)	TR10-C	TR20-C	TR10-T	TR20-T
2.06	27.2	4%	-2%	81%	86%
4.94	27.2	6%	10%	59%	81%
10.25	26.8	2%	6%	72%	81%
16.93	26.5	1%	2%	74%	81%
28.68	26	-1%	1%	62%	79%
69.44	26.1	-6%	3%	0%	1%
77.48	30.5	5%	5%	15%	32%
64.37	31.6	5%	3%	29%	59%
38.68	32.9	-3%	9%	68%	82%
27.19	32.8	4%	9%	72%	83%
18.06	33.1	-7%	5%	75%	85%
80.28	30.6	4%	8%	6%	8%
69.44	31.4	-2%	6%	4%	26%
50.54	32.4	-4%	-4%	37%	72%
42.42	33	-1%	1%	57%	78%
30.23	33.5	-4%	4%	66%	80%
16.93	33.7	5%	2%	70%	81%
11.08	33.3	2%	6%	72%	84%
4.94	31.8	-1%	4%	80%	86%
1.76	29.6	-5%	-6%	83%	91%
		0%	4%		

FOUR 6-inch FLOC GENERATOR WITH 18-inch PLATES / AVG WATER TEMP: 53 deg						
Sample 1						
Flow Rate (GPM)	2.06	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	27.2	0	801	279	0%	65%
Inflow (NTU)	801	5	788	247	2%	69%
		10	756	154	6%	81%
		15	768	147	4%	82%
		20	819	116	-2%	86%
						86%
Sample 2						
Flow Rate (GPM)	4.94	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	27.2	0	842	667	0%	21%
Inflow (NTU)	842	5	838	420	0%	50%
		10	790	349	6%	59%
		15	779	241	7%	71%
		20	754	157	10%	81%
						79%
Sample 3						
Flow Rate (GPM)	10.25	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	26.8	0	799	713	0%	11%
Inflow (NTU)	799	5	824	416	-3%	48%
		10	784	223	2%	72%
		15	775	193	3%	76%
		20	750	151	6%	81%
						80%
Sample 4						
Flow Rate (GPM)	16.93	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	26.5	0	710	660	0%	7%
Inflow (NTU)	710	5	695	341	2%	52%
		10	700	183	1%	74%
		15	965	139	-36%	80%
		20	697	132	2%	81%
						81%
Sample 5						
Flow Rate (GPM)	28.68	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	26	0	765	721	0%	6%
Inflow (NTU)	765	5	748	575	2%	25%
		10	773	288	-1%	62%
		15	714	197	7%	74%
		20	760	163	1%	79%
						79%
Sample 6						
Flow Rate (GPM)	69.44	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	26.1	0	701	710	1%	0%
Inflow (NTU)	710	5	710	717	0%	-1%
		10	751	708	-6%	0%
		15	668	689	6%	3%
		20	692	704	3%	1%
						-2%
Sample 7						
Flow Rate (GPM)	77.48	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	30.5	0	1028	1033	0%	0%
Inflow (NTU)	1033	5	1022	967	1%	6%
		10	978	875	5%	15%
		15	1016	786	2%	24%
		20	983	698	5%	32%
						29%
Sample 8						
Flow Rate (GPM)	64.37	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	31.6	0	946	925	0%	2%
Inflow (NTU)	946	5	970	912	-3%	4%
		10	900	668	5%	29%
		15	952	449	-1%	53%
		20	922	384	3%	59%
						58%
Sample 9						
Flow Rate (GPM)	38.68	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	32.9	0	939	852	0%	9%
Inflow (NTU)	939	5	914	648	3%	31%
		10	964	301	-3%	68%
		15	890	210	5%	78%
		20	855	169	9%	82%
						80%
Sample 10						
Flow Rate (GPM)	27.19	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	32.8	0	843	743	0%	12%
Inflow (NTU)	843	5	808	422	4%	50%
		10	806	240	4%	72%
		15	810	174	4%	79%
		20	764	145	9%	83%
						81%

Sample 11						
Flow Rate (GPM)	18.06	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	33.1	0	834	740	0%	11%
Inflow (NTU)	834	5	846	360	-1%	57%
		10	890	205	-7%	75%
		15	805	149	3%	82%
		20	794	129	5%	85%
						84%
Sample 12						
Flow Rate (GPM)	80.28	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	30.6	0	791	814	3%	0%
Inflow (NTU)	814	5	773	760	5%	7%
		10	785	768	4%	6%
		15	790	764	3%	6%
		20	751	750	8%	8%
						0%
Sample 13						
Flow Rate (GPM)	69.44	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	31.4	0	789	754	0%	4%
Inflow (NTU)	789	5	786	752	0%	5%
		10	805	757	-2%	4%
		15	790	703	0%	11%
		20	743	585	6%	26%
						21%
Sample 14						
Flow Rate (GPM)	50.54	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	32.4	0	745	730	0%	2%
Inflow (NTU)	745	5	767	728	-3%	2%
		10	776	473	-4%	37%
		15	746	286	0%	62%
		20	776	211	-4%	72%
						73%
Sample 15						
Flow Rate (GPM)	42.42	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	33	0	759	718	0%	5%
Inflow (NTU)	759	5	752	664	1%	13%
		10	770	327	-1%	57%
		15	844	206	-11%	73%
		20	748	168	1%	78%
						78%
Sample 16						
Flow Rate (GPM)	30.23	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	33.5	0	743	673	0%	9%
Inflow (NTU)	743	5	727	495	2%	33%
		10	772	253	-4%	66%
		15	734	175	1%	76%
		20	712	149	4%	80%
						79%
Sample 17						
Flow Rate (GPM)	16.93	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	33.7	0	749	681	0%	9%
Inflow (NTU)	749	5	703	416	6%	44%
		10	712	225	5%	70%
		15	721	151	4%	80%
		20	732	140	2%	81%
						81%
Sample 18						
Flow Rate (GPM)	11.08	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	33.3	0	708	666	0%	6%
Inflow (NTU)	708	5	686	382	3%	46%
		10	692	196	2%	72%
		15	694	138	2%	81%
		20	662	110	6%	84%
						83%
Sample 19						
Flow Rate (GPM)	4.94	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	31.8	0	713	534	0%	25%
Inflow (NTU)	713	5	690	281	3%	61%
		10	723	146	-1%	80%
		15	688	115	4%	84%
		20	684	96.5	4%	86%
						86%
Sample 20						
Flow Rate (GPM)	1.76	Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	29.6	0	651	156	0%	76%
Inflow (NTU)	651	5	656	162	-1%	75%
		10	686	109	-5%	83%
		15	691	69.5	-6%	89%
		20	688	55.9	-6%	91%
						92%

TWO 6-inch FLOC GENERATOR WITH 18-inch PLATES												Control		Treated	
Date	12/4/2024	Time of Day (HH:MM)	Testing Time (min.)	Inflow Turbidity (NTU)	Current (A)	Water Height (in)	Height Over Weir (in.)	Flow Rate (GPM)	Water Temp (F)	TR10-C	TR20-C	TR10-T	TR20-T		
Time Start	1:45PM									3	4	15	55		
Time End															
Avg. Turbidity	354.9 NTU			324	17	18 3/4	2.25	13.8	46.9	4%	7%	5%	30%		
Avg. Current	15.4 A			366	16.1	19 1/4	2.75	23.0	46.4	2%	2%	11%	13%		
Avg. Water Temp	0.0 F			371	15.4	21 3/8	4.88	98.4	46	2%	5%	6%	4%		
MixTime	30 secs			358PM	15.1	19 3/4	3.25	35.2	45.5	3%	3%	8%	8%		
Weather (1:30PM)				360	14.9	20 1/4	3.75	50.5		5%	4%	2%	7%		
Air Temp	56 F			4:00PM	350	20 1/2	4.00	59.5	46.9	2%	1%	-5%	2%		
Water Temp	50 F			4:17PM	358	14.4	4.50	80.3	46	15%	4%	3%	5%		
Humidity	25 %								0						
Dew Pt.	21 deg														
Pressure	30.28 in														
Turbidity Calibration															
Standard (NTU)	Reading (NTU)														
0.1	0.128														
20	19.5														
200	185														
1000	932														
4000	3888														

TR20

Flow Rate (GPM)	Control (%)	Treated (%)
10	5	25
20	2	10
30	5	5
40	5	5
50	5	5
60	5	5
80	5	5
100	5	5

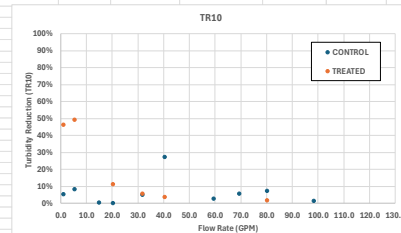
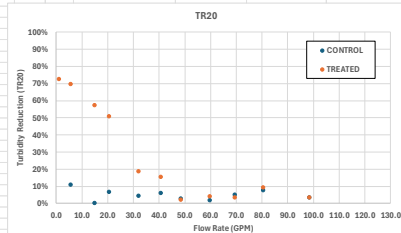
TR10

Flow Rate (GPM)	Control (%)	Treated (%)
10	5	5
20	5	10
30	5	5
40	5	5
50	5	5
60	5	5
80	5	5
100	5	5

		Control		Treated	
Flow Rate (GPM)	Amps (A)	TR10-C	TR20-C	TR10-T	TR20-T
4			4%		65%
13.8	17	4%	7%	5%	30%
23.0	16.1	2%	2%	11%	13%
98.4	15.4	2%	5%	6%	4%
35.2	15.1	3%	3%	8%	8%
50.5	14.9	5%	4%	2%	7%
59.5	14.7	2%	1%	-5%	2%
80.3	14.4	15%	4%	3%	5%
13.8	17	4%	7%	5%	30%
23.0	16.1	2%	2%	11%	13%
35.2	15.1	3%	3%	8%	8%
50.5	14.9	5%	4%	2%	7%
59.5	14.7	2%	1%	-5%	2%
80.3	14.4	15%	4%	3%	5%
98.4	15.4	2%	5%	6%	4%

FOUR 6-inch FLOC GENERATOR WITH 18-inch PLATES						
Sample 1						
Flow Rate (GPM)		Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	17	0	324	302	0%	7%
Inflow (NTU)	324	5	315	299	3%	8%
		10	327	308	-1%	5%
		15	310	268	4%	17%
		20	301	226	7%	30%
Sample 2						
Flow Rate (GPM)		Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	16.1	0	366	339	0%	7%
Inflow (NTU)	366	5	350	347	4%	5%
		10	358	324	2%	11%
		15	351	330	4%	10%
		20	358	320	2%	13%
Sample 3						
Flow Rate (GPM)		Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	15.4	0	368	371	1%	0%
Inflow (NTU)	371	5	368	312	1%	16%
		10	363	347	2%	6%
		15	369	351	1%	5%
		20	354	357	5%	4%
Sample 4						
Flow Rate (GPM)		Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	15.1	0	355	346	0%	3%
Inflow (NTU)	355	5	350	357	1%	-1%
		10	343	326	3%	8%
		15	358	336	-1%	5%
		20	344	326	3%	8%
Sample 5						
Flow Rate (GPM)		Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	14.9	0	349	360	3%	0%
Inflow (NTU)	360	5	340	343	6%	5%
		10	343	352	5%	2%
		15	352	350	2%	3%
		20	345	334	4%	7%
Sample 6						
Flow Rate (GPM)		Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	14.7	0	350	324	0%	7%
Inflow (NTU)	350	5	353	345	-1%	1%
		10	344	366	2%	-5%
		15	359	341	-3%	3%
		20	347	343	1%	2%
Sample 7						
Flow Rate (GPM)		Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)	14.4	0	346	358	3%	0%
Inflow (NTU)	358	5	342	346	4%	3%
		10	305	347	15%	3%
		15	365	339	-2%	5%
		20	342	341	4%	5%

THREE 6-inch FLOC GENERATOR WITH 18-inch PLATES												Control			
Date	12/4/2024	Time of Day (HH:MM)	Testing Time (min.)	Inflow Turbidity (NTU)	Current 1	Current 2	Current (A)	Water Height (in)	Height Over Weir (in.)	Flow Rate (GPM)	Water Temp (F)	TR10-C	TR20-C	TR10-T	TR20-T
Time Start	1:40PM	2:20PM		454	15.3	9.6	24.9	17 1/3	0.81	1.0	48	5%	0%	46%	73%
		2:25PM		380	18	10.6	28.6	18	1.56	5.5	49.8	8%	11%	49%	70%
		2:30PM		359	18	10.5	28.5	18 4/5	2.21	14.8	47.3	1%	0%	-4%	57%
		2:35PM		351	17.6	10.4	28	19 1/8	2.63	20.4	44.9	0%	7%	11%	51%
Avg. Turbidity	376.9 NTU	2:41PM		359	17.6	10.2	27.8	19 5/8	3.13	31.8	44.6	5%	4%	6%	19%
Avg. Current	24.9 A	2:46PM		386	18.3	10.3	28.6	19 15/16	3.44	40.5	40.52	27%	6%	4%	15%
Avg. Water Temp	46.3 F	2:51PM		381	17.8	10.3	28.1	20 1/5	3.89	48.4	46.4	-3%	2%	-3%	2%
Mix Time	30 SECS	2:57PM		389	17.8	10.1	27.9	20 1/2	4.00	59.5	48.2	3%	2%	-1%	4%
		3:03PM		391	17.6	10	27.6	20 3/4	4.25	69.4	46.2	6%	5%	-1%	3%
		3:08PM		380	14.8	9.6	24.4	21	4.50	80.3	46.5	7%	6%	2%	9%
		X		373	14.8	9.6	24.4	21 3/8	4.88	98.4	46.5	1%	3%	-2%	3%
				320			0								
Weather (1:30PM)															
Air Temp	56 F														
Water Temp	50 F														
Humidity	25 %														
Dew Pt.	21 °HS														
Pressure	30.28 in														
Turbidity Calibration															
Standard (NTU)	Reading (NTU)														
0.1	0.128														
20	19.5														
200	190														
1000	952														
4000	3858														



Flow Rate (GPM)	Amps (A)	Control		Treated	
		TR10-C	TR20-C	TR10-T	TR20-T
1.0	24.9	5%	0%	46%	73%
5.5	28.6	8%	11%	49%	70%
14.8	28.5	1%	0%	-4%	57%
20.4	28	0%	7%	11%	51%
31.8	27.8	5%	4%	6%	19%
40.5	28.6	27%	6%	4%	15%
48.4	28.1	-1%	3%	-3%	2%
59.5	27.9	3%	2%	-1%	4%
69.4	27.6	6%	5%	-1%	3%
80.3	24.4	7%	8%	2%	9%
98.4	24.4	1%	3%	-2%	3%

FOUR 6-inch FLOC GENERATOR WITH 18-inch PLATES							
Sample 1							
Flow Rate (GPM)			Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)			0	454	391	0%	14%
Inflow (NTU)	454		5	454	381	0%	16%
			10	465	243	-2%	46%
			15	430	146	5%	68%
			20	455	124	0%	73%
Sample 2							
Flow Rate (GPM)			Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)			0	380	357	0%	6%
Inflow (NTU)	380		5	336	289	12%	24%
			10	349	193	8%	49%
			15	335	185	12%	51%
			20	339	115	11%	70%
Sample 3							
Flow Rate (GPM)			Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)			0	359	344	0%	4%
Inflow (NTU)	359		5	344	316	4%	12%
			10	357	375	1%	-4%
			15	353	314	2%	13%
			20	358	153	0%	57%
Sample 4							
Flow Rate (GPM)			Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)			0	351	342	0%	3%
Inflow (NTU)	351		5	339	339	3%	3%
			10	351	312	0%	11%
			15	341	218	3%	38%
			20	328	173	7%	51%
Sample 5							
Flow Rate (GPM)			Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)			0	359	345	0%	4%
Inflow (NTU)	359		5	363	333	-1%	7%
			10	341	338	5%	6%
			15	359	306	0%	15%
			20	343	292	4%	19%
Sample 6							
Flow Rate (GPM)			Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)			0	367	386	5%	0%
Inflow (NTU)	386		5	376	374	3%	3%
			10	281	371	27%	4%
			15	375	347	3%	10%
			20	363	327	6%	15%

Sample 7						
Flow Rate (GPM)		Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)		0	381	388	0%	-2%
Inflow (NTU)	381	5	384	394	-1%	-3%
		10	384	391	-1%	-3%
		15	375	381	2%	0%
		20	371	373	3%	2%
Sample 8						
Flow Rate (GPM)		Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)		0	389	388	0%	0%
Inflow (NTU)	389	5	376	394	3%	-1%
		10	378	391	3%	-1%
		15	388	381	0%	2%
		20	382	373	2%	4%
Sample 9						
Flow Rate (GPM)		Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)		0	373	391	5%	0%
Inflow (NTU)	391	5	397	386	-2%	1%
		10	369	396	6%	-1%
		15	402	402	-3%	-3%
		20	371	378	5%	3%
Sample 10						
Flow Rate (GPM)		Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)		0	373	380	2%	0%
Inflow (NTU)	380	5	375	341	1%	10%
		10	352	373	7%	2%
		15	366	372	4%	2%
		20	351	345	8%	9%
Sample 11						
Flow Rate (GPM)		Settling Time (min.)	Control (NTU)	Treated (NTU)	TR-Control	TR-Treated
Current (A)		0	363	373	3%	0%
Inflow (NTU)	373	5	370	355	1%	5%
		10	368	379	1%	-2%
		15	347	339	7%	9%
		20	360	360	3%	3%