Environmental and Chemical Engineering REUs and RET

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Using Public Health and Social Marketing to Understand Water Practices in the Community of Toamasina

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My name is Madison Champalou and I am an undergraduate student in the College of Public Health. I am originally from Philadelphia, PA, and moved to Florida to become a Bull at USF. My passion for global aid and working with non-profits began with me working with a non-profit to fundraise and construct schools in rural villages that provide equal access to education. I hope to finish at USF with my master's degree in Public Health before joining the PeaceCorps. With this, I hope to do work centered around communicable diseases, women's health, and sex education, as well as work for the general well-being and health of communities. Outside of school, I enjoy traveling and immersing myself into new cultures, as well as competing in triathlons.

ABSTRACT

Social marketing is used to understand the behaviors and actions of individuals to propel a desired behavior change via strategies that are deemed effective and realistic by a target community. It is crucial for public health and social marketing to be integrated into engineering projects for sustainable change to be implemented. The goal of our research was to understand the Toamasina community's views and practices surrounding point-of-use disinfection and household water storage. With the assistance of our in-country partners, we were able to identify 28 households to participate in our research. In our first household visits, we conducted personal introductions and a demographic survey to gain a base understanding of the Toamasina community. Over the next several weeks, we re-visited each family and used participant observation techniques to collect qualitative data surrounding households' current practices, needs, wants, values, and competing behaviors in regards to water. We were able to complete two to three visits with each family within the timeframe of the project. Our time spent in Toamasina has allowed us to build rapport within the community and identify motivations and barriers around water treatment and storage. This data will be used by researchers in the following years of this project to inform the development of branding and messaging for a social-marketing strategy.

Chlorine demand and decay kinetics in various water sources in Toamasina, Madagascar

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My name is Tione Grant, a native of St. Kitts-Nevis and a dual-degree undergraduate senior in the areas of Chemical Engineering and Applied Mathematics. Outside of the realm of research and academics, I enjoy watching and participating in soccer and cricket matches, as well as travelling. A lifelong desire of mine is to develop a science, technology, engineering, mathematics (STEM) fellowship program for Latin American and Caribbean students that supports them throughout their academic and professional careers. To achieve this goal, I dove headfirst into the world of research, participating in various STEM clubs in high school and spending every collegiate summer participating in research opportunities. Through this deep dive into the world of undergraduate research, I was able to discover my niche within the water industry, and I seek to use my academic and professional careers to aid in the global mission to provide safe, clean water for all.

ABSTRACT

Chlorination is an effective method for treating water to reduce waterborne disease. When dissolved in water, chlorine can both deactivate existing microorganisms (primary disinfection) and prevent recontamination (secondary disinfection). However, a drawback of this treatment is that dissolved chlorine is consumed over time (chlorine demand), and the rate of consumption can vary based on the water quality constituents. This study examined the kinetics of chlorine demand of a locally available chlorination solution when used to treat different water sources in Toamasina, Madagascar. Water samples were collected from ten sources: four Paompy Tanys (hand pumps that access shallow groundwater), five private and public faucets (supplied by Jirama, a government utility), and one rainwater basin. One liter of each sample was added to three beakers and dosed with 5 mg/L, 3 mg/L, and 1 mg/L of chlorine, using a chlorine solution that is readily available for purchase in local markets. The treated samples were mixed, and the remaining chlorine concentration was measured at 1, 2, 4, 8, 24, and 48 hours after dosing. Results showed greater chlorine demand in the Paompy Tany and rainwater samples compared to those collected from the Jirama sources. For two of the Paompy Tany, within 48 hours, the chlorine decayed to levels that would likely not protect against pathogens, representing a public-health risk. Future studies should consider including a secondary treatment technique (e.g., filtration) alongside chlorination of Paompy Tany water to ensure safe human consumption.

Adsorption of ammonium ion from wastewater using chabazite: Comparison of equilibrium and kinetics approaches

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I am Bhagyashree Kulkarni. I am a teacher and science department head at Middleton High school (Hillsborough county public schools). I teach AP Chemistry and Chemistry Honors- I also sponsor clubs like the science national honors society (SNHS) and the Bollywood dance group. I love traveling, cooking, and exploring with my family.

My goal is to prepare students for a STEM career by developing their problem-solving skills and interest in scientific investigation. I am a coordinator for the STEM fair at Middleton High school and encourage students to conduct scientific research on real-world problems. Hence, I look forward to creating a channel between the school and research labs to help students to get an insight into scientific investigations conducted in the labs and expose them to STEM-based careers. During this summer, I enjoyed going back into the research world and having an opportunity to connect academics with my research experience. This experience will help me to guide and engage my students.

ABSTRACT

When the wastewater is discharged into lakes and rivers, high ammonia content leads to eutrophication, algae bloom, loss of aquatic life, and impact on health and recreation. Therefore, removal of ammonium ions in wastewater is crucial. In this study, pretreated chabazite, an ion exchange media, is used in wastewater treatment to adsorb ammonium ions. Synthetic wastewater was prepared by mixing 60% of filtered groundwater from the University of South Florida Botanical Garden and 40% of mainstream wastewater from the Northwest Regional Water Reclamation Facility. Ammonium bicarbonate was added to the mixture to maintain an accurate nitrogen content. Two different concentrations (40 and 100 mg/L ammonium as N) of synthetic wastewater were used for equilibrium and kinetics batch experiments.

For equilibrium: the effect of initial concentration and the comparison with other interactive media in bioreactors were studied. Different amounts of chabazite in the range of 0.05g to 10g were added to 250 mL volumetric flasks, with 200mL of synthetic wastewater in each flask. A flask without any chabazite addition was also used as a control. The flasks were placed on a shaker at 170 RPM for 24 h. Samples were drawn from the flask and analyzed by ion chromatography (IC) to determine the equilibrium concentration of ammonium and other relevant ions. Three different equilibrium models (Freundlich, Langmuir, Adsorption VS. Release) were assessed. Similar experiments were performed with different amounts of lava rock and oyster shells separately using 40mg/L ammonium as N in the synthetic wastewater. Results indicated little to no ammonium adsorption on lava rock and oyster shell media.

For kinetics: similar experiments with 2 and 5 g of chabazite were conducted with 40 and 100 mg/L ammonium as N. Samples were drawn over time and analyzed by IC to determine the concentrations of relevant ions. Chabazite is a promising option for ammonium adsorption in wastewater. The equilibrium and kinetic studies will give an insightful basis for future work of the project, which consists of developing biocarriers coated with zeolite for slow-growing microorganisms consuming ammonium.

Organic Waste Product as Electron Donors for Denitrification in Saline BNR System

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My name is Maria Lucas. I am originally from Buenos Aires, Argentina, but I have spent my last 20 years in the US. I have a bachelor's in business and an MBA from Babson College. Before starting my scientific journey at HCC, I spent 15 years in Management Consulting, serving process-intensive companies in the Life Science industry. I led global-scale business transformations in R&D, Product Development, and Supply Chain. Two years ago, I decided to pursue a degree in the exciting and rapidly evolving area of Biotechnology to complement my business experience in this field. Outside of my professional experience, I enjoy spending time with my family and supporting our local non-profit community in a variety of roles.

ABSTRACT

Incomplete wastewater treatment is a source of anthropogenic nitrogen pollution that has several adverse effects on water bodies, aquatic life, and adjacent human populations. In addition, freshwater resources continue to become overstressed by growing human needs. This research addressed the two issues by incorporating nitrogen removal into onsite wastewater treatment systems and evaluating the effects of using seawater for toilet flushing instead of potable water. Advanced OWTS can incorporate biological nitrogen removal (BNR) processes that use microorganisms to transform nitrogen compounds to N2 and lower the environmental impact of OWTS. The denitrification stage of a BNR system is critical for removing nitrogen and is dependent on the electron donor/s chosen for the system. Microcosms were constructed to evaluate different local materials to use as electron donors for denitrification at 30 ppt salinity. Electron donors used were sulfur pellets, sugar cane bagasse, banana stem, and pine woodchips.

Pine woodchips, sulfur pellets, and banana stems appear to be adequate electron donors for denitrification in 30ppt saline wastewater. In addition, pine woodchips have shown the best nitrogen removal rates and show biological nitrogen removal as a viable, sustainable option to treat saline wastewater.

Design of Nitrogen Denitrification and Phosphorus Retaining Tanks for Agricultural Use

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Dr. Sarina J. Ergas & Dr. Mahmood Nachabe, Faculty Mentors

BIOSKETCH

I am Stephanie Rodriguez, a undergraduate in Civil and Environmental Engineering at the University of South Florida. Born and raised in Florida, I've always had a connection to the outdoors. I enjoy skating through downtown and relaxing at the beach fronts - taking in the Florida sunshine. My goal is to become a structural engineer - particually to create and design outdoor recreational environments for the community. To achieve this goal, after becoming a liscensed engineer, I plan to further my studies into architecture to fuse artistic design with the sciences to create inovative outdoor spaces.

ABSTRACT

Excess levels of nitrogen and phosphorus compounds found in Florida's aquatic systems are negatively impacting the environment and the public health. Due to Florida's large agricultural production of citrus, livestock, and various greenhouse products; water runoff from such areas contain high amounts of nutrients such as nitrogen and phosphorus compounds. To treat the nitrogen and phosphorous compounds, this project implements the concepts of retention and natural denitrification to improve the quality of agricultural runoff before it enters Florida's aquatic systems. Analysis of water quality from a local greenhouse plant nursey was conducted to determine the amounts of nitrogen and phosphorus compounds in the irrigation runoff. Soil analysis of different media/mixtures of media were then conducted to determine the best mixtures for the retention of phosphorus compounds and the denitrification of nitrogen compounds to treat portions of the irrigation runoff. After data collection, the design and construction of two retention tanks began and is continuing to compare different mixtures of media in the treatment of the nitrogen and phosphorous compounds.

Effect of Cs-promotion in Fe-FTS Catalyst for Olefin Production

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I am Isabella St. Pierre-Charles, a first year chemical engineering student at USF. After years of studying music and aspiring to teach, I eventually realized that I wanted to contribute to a more liveable future on Earth. My ultimate goals are to help develop sustainable sources of energy and reusable materials for a cost-comparable alternative to widespread obsolescent products in the research sector of industry or academia.

ABSTRACT

Fischer-Tropsch synthesis (FTS) is capable of converting synthesis gas (CO +H2) derived from landfill gas (LFG) to olefins at high-temperature (HT) and moderate pressure catalysis. Olefins, or unsaturated hydrocarbons, are widely and versatilely used in manufacturing of fuels and plastics. Olefin synthesis commonly requires hydrocracking of alkanes from petroleum and natural gas—relatively limited, increasingly scarce resources. Alternative olefin production methods could alleviate dependence on the fossil fuel industry. Landfill gas can be diverted into dry-reforming of methane to create carbon monoxide and hydrogen "syngas." Syngas, through FTS, can produce olefins. With the promotion of cesium in iron-active catalysts—synthesized by wet impregnation—C2+ olefin ad C5+ HC selectivity of Fe catalysts can be improved in addition to activity and stability. To develop active and stable HT-FTS catalysts selective to olefin and C5+ hydrocarbons, the objectives of this study were to synthesize Cs-promoted Fe catalysts for FTS; test catalysts under reaction conditions of HT, 400 ℃, and moderate pressure, 5 bar; and study the effect of Cs-loading on CO conversion through FTS (activity) and yield of olefins, methane, and carbon dioxide (selectivity). Iron-based catalysts with varying Cs molar concentration were successfully synthesized. Cesium promoted the iron activity toward CO activation and reactivity. Increasing Cs molar ratio improved iron catalysts' selectivity for desirable olefins (C2 - C4) and C5+, while limiting undesirable byproducts (CO2 and CH4). Cesium-promotion improved olefin yield, indicating surface chemistry modification. Given the active, selective, and stable behavior of the 20 mol.% Cs Fe-catalyst, this combination could be further studied to test effective reaction conditions, or more common metals with similar properties to cesium could be compared in cost-reducing efforts: the goal being a viable (if temporary) alternative to the globally dominant fossil fuel industry and an efficient diversion of landfill waste gas.