Puerto Rico Water Resources and Environmental Research Institute

University of Puerto Rico at Mayagüez (UPRM)

About Us

We are one of the 54 Water Resources Research Centers in the United States and its territories. Established in 1964 by the Water Resources Act (1964), the Institute conducts basic and applied research to solve water and environmental problems unique to Puerto Rico, the Caribbean and Latin America. We **conduct research** to find innovative solutions to problems related to water resources and the environment. To do so, we **support students and scientists** with our projects, and provide them with knowledge as an integral part of UPRM education programs. We **publish research** results on our website, in local, national, and international journals and magazines. Our applied research contributes to the development of the next generation of water and natural resources professionals and supports young scientists and engineers.

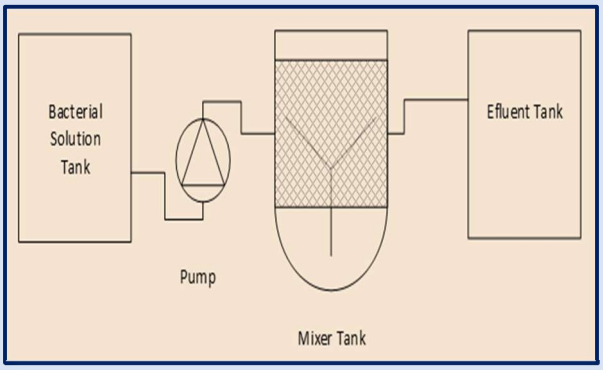
PRWRERI Students, researchers and USGS personnel with Tanya Trujillo, Assistant Secretary of Interior for Water and Science, at USGS-Caribbean Office, San Juan, PR, May 2022.

Regulations for the Design, Operation Criteria and Maintenance of Stormwater Systems in Puerto Rico (in Spanish and English)

The new regulations for stormwater systems design, operation and maintenance are the first update since 1975. The new document contains more than 200 pages with detailed engineering techniques to be used by designers. The regulation applies to all land development. Design procedures are aimed at reducing the magnitude and frequency of local urban flooding. Inclusion of stormwater management to reduce the volume and proper management of sediments in the early stages of project planning is included. It includes new developments in hydrological and hydraulic engineering, as well as flood control structures and climate change. It also includes guidelines for design in the karst zones. Different storm sewer system rehabilitation techniques are presented, including the use of low-impact development practices as a measure of hydraulic capacity recovery of the entire system. The development of operation and maintenance plans for storm sewer systems is established as a requirement. Guidelines are introduced for the design of low-impact development (LID) measures to control and reduce the volume of stormwater runoff in land development projects. This project was a joint venture between the Puerto Rico Water Resources Research Institute as leading office, the University of Puerto Rico at Mayaguez, the Planning Board, and the Department of Natural Resources of Puerto Rico.

Bio composites for Wastewater Treatment for Reuse

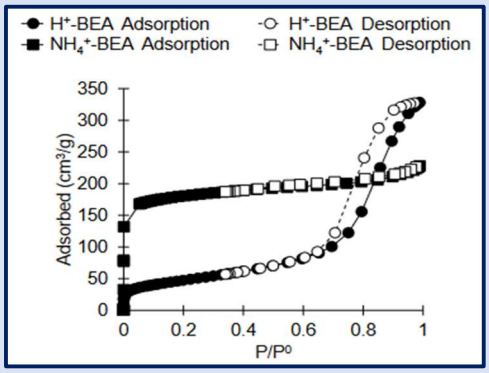
This project seeks to study the capacity of economical composites made of titanium dioxide nanoparticles embedded into a lignin-containing matrix as a cost-effective water treatment for reuse. It relies on the use of bio-polymeric nanocomposites bearing titanium dioxide nanoparticles as a bi-functional and environmentally friendly microbial removal agent. As an added benefit, the use of lignin, cellulose and chitosan for the polymeric matrix will allow the recycling of plant materials readily available in Puerto Rico and facilitate adsorption of different types of inorganic and organic pollutants, commonly found in sanitary waters. One approach is related to the use of titanium dioxide nanoparticles as the dispersed phase within polymer-based nanocomposites. The synergistic co-existence of these two materials (bactericidal reactive oxygen species from TiO_2 and degradable biopolymer matrices) opens a new window of possibilities for its application in biotechnology and environmental engineering. This research will be focused on the nanocomposite synthesis and preliminary evaluation as microbial removal agents addressing the optimization of coliforms and protist removal capacity of the selected nanocomposite and fabrication of a lab-scale prototype of a wastewater reclamation system for real operation in agricultural applications.



Representation of bio-composites for wastewater

Adsorption of Dimethyl Sulfone and Organosilanol Compounds from Water by Zeolite Beta

Dimethyl sulfone and organosilanol compounds (OSCs) create concerns about water contamination for their difficult removal by adsorption with activated carbon due to their low affinity or ion exchange resin. As an alternative, this research evaluated the viability of zeolite beta (both ammonium and hydrogen beta) in the adsorption of trimethylsilanol (TMS) and dimethylsilanediol (DMSD) as OSCs models and dimethyl sulfone ($DMSO_2$). Batch experiments assessed each adsorbent's adsorption capacity, and the non-linear regression analyzed the best isotherm model that fit the experimental data. In addition, measuring the adsorption at different pH values brought an understanding of adsorbate-adsorbent interactions and identified the optimal operation condition. Results showed that hydrogen zeolite beta (H^+-BEA) exhibited higher adsorption capacities than ammonium zeolite beta (NH_4^+-BEA) for OSCs; however, for $DMSO_2$, the higher adsorption was obtained using NH_4^+-BEA. Besides, TMS showed stronger attraction forces for the adsorbents than DMSD and $DMSO_2$, yielding higher removals efficiency. As their adsorption mechanism, a multilayer of the adsorbates could occur, and the adsorbents have heterogeneous surfaces and an exponential distribution of active sites upon them and their energies. Nonetheless, pH increments strongly reduced the adsorption of the contaminants using H^+-BEA for OSCs. However, for NH_4^+-BEA, the changes in pH did not significantly impact the adsorption efficiency. For $DMSO_2$, any of the two adsorbents demonstrate significant changes in adsorption capacity at different pH values.



Nitrogen adsorption-desorption behavior at 77K for H^+-BEA and NH_4^+-BEA.

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