Puerto Rico Water Resources and Environmental Research Institute

http://prwreri.uprm.edu

The Puerto Rico Water Resources and Environmental Research Institute (PRWRERI) is one of 54 similar research centers in the United States, DC, Puerto Rico, Virgin Islands, and Guam/Federated States of Micronesia. Established in 1964 by the Water Resources Research Act, the institute conducts basic and applied research to solve water and environmental problems unique to Puerto Rico and Latin America. Its main objectives are to plan, conduct and otherwise arrange for competent research that fosters: the entry of new research scientists into water resources fields, the education and training of future water scientists, engineers, and technicians, the exploration of new ideas that address water problems or expand understanding of water and water-related phenomena, and the dissemination of research results to water managers, professionals, and the public. The Water Resources Research Act requires the Secretary of Interior to conduct a "careful and detailed evaluation" of the PRWRERI at least once every five years. The most recent review was carried out in 2005. The PRWRERI passed satisfactorily.

Implementation of Suitable Technologies for Animal Waste Management on Small Farms:

Over the last years, population growth, land use changes, farming, livestock industries, urbanization, and industrialization have produced substantial changes in all the watersheds in Puerto Rico. The most critical issues include, water quality degradation, nutrient contamination, and saltwater intrusion. These critical issues lead to conflicts among various water use sectors and regulators. Logical and effective conflict resolutions of water usage and wastewater handling are now needed to ensure the sustainable use of water resources. The Puerto Rico Water Resources and Environmental Research Institute (PRWRERI) has best management practices (BMP's) established in model farms in order to educate the client in simple and economical practices to reduce pollution and minimize conflicts in small farms with animals in confinement.

Solid and liquid separators.

Echevarria Swine Farm

Located in the municipality of Peñuelas in the Rio Inabon to Rio Loco Watershed. This is a 15 sow operation, using an AES model plans. The waste generated in this operation is cleaned to the sides of the structure into 8 inch channels. The wastewater is conducted to a solid and liquid separator where solids are strained and collected, and the liquids go through a conduct to an infiltration ditch. The solids are retained during a 60 days period process, and then, spread in the field as an organic fertilizer.

Adaptation of LEAPE in Puerto Rico:

Non point sources (NPS) pollution has increased significantly in recent years causing serious environmental problems. As a result, regulatory agencies have to adopt and implement educational programs and suitable management options to reduce the impairment of surface and subsurface water bodies.

As a result of the Water Quality Coordination Project, the Puerto Rico Water Resources and Environmental Research Institute (PRWRERI) and the Puerto Rico Department of Natural and Environmental Resources (DNER), started an initiative to adapt an educational and interactive program developed in Cornell University by Deborah G. Grantham. The program titled *Locally led Education an Action for Protecting the Environment* (*LEAPE*) focus in the protection of the water resources and tries to reduce the negative impact of human activities giving management alternatives. The program uses resource information technologies to convey the information to help develop suitable management options for the community in which you wish to establish LEAPE. New technologies should be validated under local conditions prior to their implementation in order to guarantee their effectiveness. This work presents the results of the adaptation phase of LEAPE program to Puerto Rico.

The adaptation phase consisted in the following steps:

1. *Selection of a representative municipality*. The municipality had to have a significant amount of digitalized data. The Planning Board of Puerto Rico has developed an extensive GIS database.
2. *Translation and adaptation*. The LEAPE program was translated into Spanish in addition a series of parameters had to be analyzed and adapted to Puerto Rico's laws and regulations.
3. *Search for examples*. Because LEAPE is an interactive educational program, all the presented examples had to be related to the community in which LEAPE is going to be presented.
4. *Workshops*. LEAPE implementation is through workshops, focused on community leaders and local government personal. These workshops are developed in a comprehensive and interactive way, allowing people to discuss the NPDS issues that affect their community, helping them to find different alternatives to prevent the water pollution.

GIS database.

LEAPE program.

Implementation workshops.

Removal of Copper, Lead, and Cadmium Ions from Aqueous Solutions using Waste Tire Crumb Rubber as Sorbent:

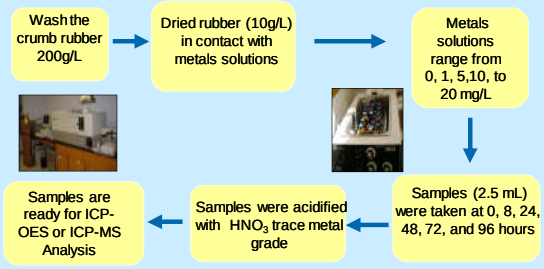
The environmental problem of heavy metal pollution is a world problem concern. Nowadays, exists a variety of methods for metal ions removal like: chemical precipitation, ion exchange membranes, electrochemical methods, solvent extraction, and adsorption. The available heavy metals removal methods are expensive or do not remove the metals at trace levels require for drinking water regulations. For this reason the evaluation of economical materials such as tire rubber has been evaluated as an adsorption process.

Annually approximated 6.5 millions tons of waste from discarded tires is created around the world. The problem aggravates because the waste tire is a non-biodegradable material. Instead some recycling methods for tire waste are currently employed, including it's use in road pavement, rubber roofs, floor mats, drainage systems, playground surfaces, and as solid fuels, some tires are still discarded improperly.

The rubber has some components that could be useful in contaminants removal. Such main components are: natural rubber, synthetic rubber (styrene-butadiene, polybutadiene), and carbon black (22-31%w/w). Other materials present in the tires are: silicon oxide, zinc oxide, stearic acid, sulfur, and extender oils. Previous studies shows the efficiency of using tire rubber as sorbent for metals like: inorganic mercury, lead, cadmium, and chromium. As general conclusions the researches had found that enhancing the surface area and porosity of the rubber material will result in enhancing the removal efficiency of the contaminants.

In this study the evaluation of the removal of cadmium, lead, and copper ions were studied using waste tire crumb rubber as a cheap sorbent. The studies were carried out at different pH, metal initial concentration, and different mesh sizes. The principal aim of the research is to diminish the amount of contaminants below the maximum contaminant level of 1.3 ppm, 0.015 ppm, and 0.005 ppm in drinking water determined by the regulations of the Environmental Protection Agency for copper, lead, and cadmium respectively.

Base on this study we conclude that crumb rubber is an excellent general sorbent for the removal of heavy metals from water up to EPA regulations and the optimum conditions for the sorption process onto the waste tire are: pH 6.0, mesh 30, and 298K.



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