Sustainable Water Cleaning System for Point-of-Use Household Application in Developing Countries to Remove Contaminants from Drinking Water

DeMessie , Sahle

Sun-dried banana peel was pyrolyzed (PBP) and activated to form carbon-fiber adsorbent with superior removal capacity bacterial pathogens as well as copper and lead from drinking water. A point-of-use (POU) water treatment system that is based on PBP adsorption was evaluated with synthesized and real water samples. Pyrolysis of dried BP resulted in the formation of a large porous surface area adsorbent with strongly negative surface charges. Batch and continuous flow studies were conducted to determine the adsorption capacity and the rate of removal of pollutants. Heavy metals Cu(II) and Pb(II) and persistent organic pollutants Heptachlor and Chlordane were efficiently removed. The efficacy of adsorption to remove microorganisms was tested using qPCR quantification technique to measure the concentration of Legionella pneumophila in the inlet and out stream of POU device. The levels Legionella pneumophila, decreased from 9 x 106 CFU/ml to below detection limit <10 CFU. The mechanism of adsorption of metal ions on pyrolyzed BP followed ion exchange and electrostatic interactions resulting in the complexation of adsorbed ions. Adsorbed metal ions did not leach out when spent PBP was flushed fresh water. The results of continuous flow studies were used to develop a high performance POU module for providing safe water in developing countries. This study has shown that simple, acceptable, low-cost interventions at the household and community level are capable of dramatically reducing metal pollutants and improving the microbial quality of household stored water and reducing the risks of diarrheal disease and death.

Awards Won:

Third Award of $1,000