Kinetics and Equilibrium Studies of Biosorption of Lead from Aqueous Solution by Avocado Pear (Pearsea Americana) Fruit Exocarp

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Abstract

The need for safe, efficient and economical methods for the elimination of heavy metals from contaminated water has elicited research interest towards sourcing for low cost and effective biomaterials as alternatives to commercial activated carbon. The effectiveness of avocado pear (Pearsea americana) fruit exocarp for the removal of lead ions from aqueous solution was investigated using batch process under various experimental conditions. Effects of solution pH, contact time, biosorbent particle sizes, biosorbent dose and temperature were investigated. Results obtained show that Pearsea americana exocarp was 98% effective in removing lead from aqueous solution at an optimum pH of 4 in 30 mins contact time. The sorption of lead followed pseudo-second-order kinetic model. This was further supported by intra-particle diffusion and Elovich models. Two isotherms viz: Langmuir, Freundlich were used to analyze the equilibrium data and the equilibrium sorption data fitted into the isotherms with Langmuir having the highest R² value. The results also show that the sorption capacity increased with decrease in particle size and increase with increase in biosorbent dose, while it decreased with increase in solution temperature. The values of estimated thermodynamic parameters including G, H and S showed that the sorption process is spontaneous and exothermic. The study therefore showed that Pearsea americana fruit exocarp could be used as a biosorbent for the treatment of water and wastewater contaminated with lead ions.

Keywords: Avocado pear exocarp, Lead, Biosorption, Isotherms, Kinetics.