Investigation of the removal of cadmium and lead from aquatic systems using structurally different forms of rice husk ashes

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Abstract

Removal by adsorption has been proved to be an excellent method to treat industrial waste effluents, offering significant advantages including the availability of different adsorbants, ease of operation and efficiency. Bio-sorption of heavy metals from aqueous solutions is a relatively new process that has proven very promising in the removal of contaminants from aqueous effluents.

The objective of this study was to develop a novel, low-cost adsorbent from rice husk ash modified by different thermal condition for the effective removal of cadmium and lead from aqueous effluents. Four forms of thermally modified ash from rice husk (Rice husk ash on uncontrolled burn, Rice husk ash on 3 hours at 750 °C, Rice husk ash on 5 hours at 750 °C and Rice husk ash on 5 hours at 1000 °C) were prepared and used to study the adsorption of cadmium and lead ions from aqueous solutions. In this study, adsorption of Cd(II) and Pb(II) onto the four different forms of ash was investigated at different pH condition under constant contact time (180 min), metal ion concentration and adsorbent dosage (50g/L). The adsorption capacities were significantly influenced by the solution pH, with lower pH favoring higher Pb(II) removal for rice husk ash on 5 hours at 1000 °C . The maximum removal efficiency of rice husk ash on 5 hours at 1000 °C for Pb(II) was found to be 77.59 %, at optimum conditions of pH 4.0, contact time of 180 min, biomass dosage of 50 g/L, and temperature of 30 degrees C. Whereas Rice husk ash on uncontrolled burn, Rice husk ash on 3 hours at 750 °C, Rice husk ash on 5 hours at 750 °C forms of ash was found to be lower removal efficiency at lower pH. The removal efficiency of Cd(II) ions on Rice husk ash on uncontrolled burn, Rice husk ash on 3 hours at 750 °C, Rice husk ash on 5 hours at 750 °C and Rice husk ash on 5 hours at 1000 °C forms of ash was influenced by solution pH. The pH of the solution at 4.0, the removal efficiencies of Cd(II) were found to be nearly 20 % at above conditions. The removal efficiency was significantly influenced by solution pH, with higher pH favoring higher Cd(II) removal for rice husk ash on uncontrolled burn. The maximum removal efficiency of rice husk ash on uncontrolled burn for Cd(II) was found to be 76.51 %, respectively, at optimum conditions of pH 6.0, contact time of 180 min, biomass dosage of 50 g/L, and temperature of 30 degrees C.

The different forms of rice husk ash / calsium sulphate (RHA / $CaSO_4$) sorbents were used to investigate the removal efficiency of cadmium and lead ions. The results showed that the adsorption of cadmium ions on to RHA / $CaSO_4$ sorbents were insignificant at pH 4.0. However the, removal of Pb(II) ions on RHA / $CaSO_4$ sorbents were significant at pH 4.0.