Comparison of the Lead Removal Process from Aqueous Solutions by Rice Husk and Activated Carbon

Abstract:

Heavy metals are harmful wastes produced by industry that pose a risk of contaminating ground waters and other water resources. Heavy metals are not biodegradable and tend to accumulate in living organisms, causing various diseases and disorders. Major lead pollution is through cars and battery manufacturers. Exposure to lead can cause anemia, diseases of the liver and kidneys, brain damage and ultimately death. There fore, the removal of lead ions from aqueous solution is an essential task. Several methods have been introduced for treating industrial wastes, but most these methods have been found to be limited. Activated carbon adsorption appears to be a particularly competitive and effective process for the removal of heavy metals at trace quantities. But the process has been high cost for treatment wastewaters. For this reason, the use of agricultural and industrial low cost material as adsorbent for metal ion removal from the wastewater has been highlighted. In this research, the rice husk as an adsorbent was used for removal lead ions from aqueous solution. In order to have a better comparison, is used also activated carbon which is a very popular adsorbent. Kinetic adsorption experiments on the synthesis wastewater were carried out at room temperature, pH = 6, agitation rate 180 rpm and initial lead concentration in the range 1 –500 mg L^{-1}. The results of kinetic adsorption experiments showed that the amount the lead adsorbed increased with increase in agitation time and remained nearly constant after equilibrium time. Process adsorption equilibrium reached for rice husk adsorbent at 60, 90, 120, 90 and 60 min and for the activated carbon adsorbent at 45, 60, 90, 75 and 60 min for initial lead concentration of 1, 10, 50, 100 and 500 mg L^{-1}, respectively. Percent adsorption decreased while metal uptake per unit weight of adsorbent increased as the initial lead concentration increased from 1 to 500 mg L^{-1}. The maximum percent adsorption of lead for rice husk and activated carbon was found to be %98 and %99.7 at initial lead concentration of 1 mg L^{-1}, respectively. The experimental data were fitted using two adsorption kinetic models, the Ho et al. (1996) and Lagergren (1893) models to determine the best fit models for the adsorption of lead onto rice husk and activated carbon. The rate constants, equilibrium adsorption capacities and related correlation coefficients for each model were calculated. Results showed that lead ions adsorption on both adsorbents followed adsorption model of Ho et al. (1996). The experimental isotherm data were fitted to the Langmuir and Freundlich model isotherms and to obtain the characteristic parameters of each model. For over the adsorbents, the Freundlich model agrees very well with experimental data than Langmuir model. According to the evaluation using the Langmuir equation, the maximum biosorption capacities of lead onto rice husk and activated carbon adsorbents was 0.413 and 0.476 mg g^{-1}, respectively.

Keywords: Adsorption, Lead ion, Rice husk, Activated carbon, Kinetic, Isotherm, Equilibrium

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