Analytical methods for investigation of Pb(II) – fired brick clay interactions

A project report presented by

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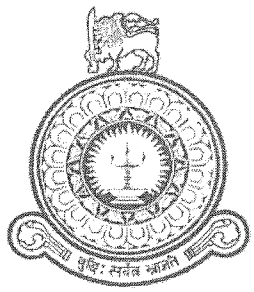

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ABSTRACT

The adsorption potential of fired brick clay as a cost effective and environmental friendly adsorbent in the removal of Pb(ll) from aqueous solutions was investigated. Initial adsorption experiments, carried out as batch processes were used to optimize the experimental parameters, such as stirring time and settling time, and to investigate the influence of different variables, namely, initial lead concentration, pH of solution, mass of brick clay, temperature of solution, ionic strength, firing temperature of brick clay and acid treatment of brick.

Batch adsorption kinetic experiments revealed that equilibrium of Pb(ll)-fired brick process approaches shortly after mixing the Pb(ll) and fired brick clay, and consequently the effect of stirring time and settling time is not significant. The effect of initial Pb(ll) ion concentration on Pb(ll) removal by fired brick clay was investigated (2.0 mg dm^{-3} to 1200.0 mg dm^{-3}) and the adsorption isotherms were modeled by means of the Langmuir and Freundlich isotherms. The Langmuir model (R^2 = 0.9939) fitted better with the experimental data expressing monolayer capacity of fired brick clay for Pb(ll) ions adsorption. The maximum adsorption capacity of Pb(ll) onto fired brick clay is 2.16 mg g^{-1}. The effect of pH on the adsorption process studied over the pH range of 2 to 10 indicates that the percentage removal of Pb(ll) increases with increasing pH from 2.0 to 6.5, then remains constant. As expected, the percentage adsorption of Pb(ll) was increased with increasing mass of brick clay. The maximum Pb(ll) adsorption (over 99%) observed when the firing temperature of brick was between 100 °C and 300 °C. The effect of ionic strength, varied by means of KNO_3 concentration ranging from 0.001 mol dm^{-3} to 1.0 mol dm^{-3} reveals that the presence of potassium ions does not affect the removal of lead ions. The effect of solution temperature on adsorption investigated from 20 °C to 70 °C indicates an increase in retention capacity of fired brick clay with increasing temperature. The thermodynamic parameters computed from the experimental data suggest that the adsorption process be endothermic, spontaneous and follows a physisorption mechanism. The positive entropy change corresponds to an increase in randomness during the adsorption of Pb(ll) onto fired brick clay. Further, the fired brick clay modified by HNO_3 acid treatment reveals that acid activation of brick clay suppresses the uptake of Pb(ll) ions. A glass column packed with brick particles fired at 300 °C was effectively removed over 99% Pb(ll) ions from a 20.0 mg dm^{-3} Pb(ll) aqueous solution up to 6500 cm^3 revealing the ability of applying this extended methodology out of the laboratory for treatment of industrial effluents, containing Pb(ll) ions.