



## Removal of lead and cadmium ions from water using *Annona squamosa* shell: kinetic and equilibrium studies

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### ABSTRACT

Adsorbent prepared from *Annona squamosa* (custard apple) fruit shell (CAS) was successfully used to remove lead (Pb<sup>2+</sup>) and cadmium (Cd<sup>2+</sup>) from aqueous solution in a batch process. Adsorption studies were conducted on a batch process, to study the effects of contact time, initial concentration of metal ions, adsorbent dose CAS, pH and temperature. The optimum contact time and pH for the removal of Pb<sup>2+</sup> and Cd<sup>2+</sup> was 30 min and pH 5, respectively. Kinetic parameters of adsorptions such as pseudo-first order, pseudo-second order were determined. The maximum loading capacity of Pb<sup>2+</sup> and Cd<sup>2+</sup> was found to be 90.93 and 71.0 mg g<sup>-1</sup> of the adsorbent, respectively. The equilibrium data were analyzed by the Langmuir and Freundlich isotherms. Langmuir model gives a better fit than the Freundlich model. The pseudo-second-order kinetics was the best for the adsorption of Pb<sup>2+</sup> and Cd<sup>2+</sup>, by CAS (*A. Squamosa*) with good correlation. Thermodynamic parameters, such as standard free energy change ( $\Delta G^\circ$ ), standard enthalpy change ( $\Delta H^\circ$ ) and standard entropy change ( $\Delta S^\circ$ ), were analyzed. The results suggest that the CAS can be used as an effective, low cost, and eco-friendly green adsorbent for the removal of selected metal ions from aqueous solution.

*Keywords:* Custard apple shell; Adsorption; Desorption; Isotherms

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