

Experimental determination of Cd²⁺ adsorption mechanism on low-cost biological waste.

ABSTRACT

Carbonate shells have an astonishing ability in the removal of Cd²⁺ in a short time period with emphasis on being a low cost adsorbent. In the present study, the sorption capacity of carbonate shells was studied for Cd²⁺ in batch experiments. The influence of different carbonate shell sizes and physico-chemical factors were evaluated and the results were analyzed for its correlation matrices by using Predictive Analytics Software (PASW). The mineralogy state of aqueous solution regarding the saturation index was simulated using PHREEQC to identify the Cd²⁺ uptake mechanism. The Cd uptake rates were calculated as well as Ca²⁺, HCO₃⁻ concentration, pH, ambient humidity and temperature were measured. Cd²⁺ removal of 91.52% was achieved after 5 h adsorption. The adsorption efficiencies were significantly influenced by pH as they increased with the increase of pH from acidic solution (5.50±0.02) to slightly alkaline (7.60±0.05). In addition, the mineralogy state of aqueous solution calculated from PHREEQC confirmed that the increment of Ca²⁺ and HCO₃⁻ concentrations in solution was attributed to the dissolution of carbonate shells. Moreover, the ion exchange adsorption mechanism of Cd²⁺ toward Ca²⁺ was identified as the process involved in Cd²⁺ uptake.

Keyword: Carbonate shell; Cadmium; heavy metal; Adsorption mechanism; Saturation state.