Pb(II) removal from wastewater by modified activated carbon in batch and fixed-bed column studies: synthetic and real wastewater application

ABSTRACT

Activated carbon (AC) prepared from palm kernel was modified by citric acid (CA) to enhance its ability for Pb(II) removal from aqueous solutions. The product obtained was characterized using energy dispersive X-ray spectroscopy, Brunauer-Emmett-Teller method, Fourier transform infrared, spectroscopy, and field emission scanning electron microscope (FESEM). The adsorption of Pb(II) ions onto CA modified activated carbon (AC-CA), was studied in both batch and column mode operations. In the batch studies, a wide range of operating parameters, such as adsorbent dose (0.1–0.95 g), initial metal ion concentration (50–150 mg/L), contact time (15–150 min), and pH (1–5), were investigated. Equilibrium data were fitted using Langmuir, Freundlich, first and second order kinetic models. The experimental data were best characterized by pseudo-second order kinetic model and Langmuir isotherm models; indicative of chemisorption and monolayer adsorption, respectively. ACs and AC-CA were mainly microporous with pores in the range of 1.2–1.76 nm. Although the surface area of AC-600 (1,559.9 m^2/g) was much higher than that of AC-CA (1,267.1 m^2/g), the Pb(II) sorption capacity of AC-CA was larger than that of AC-600. The AC and AC-CA, both showed high Q max of 81.0 and 103.1 mg/g, the high adsorption capacity of the adsorbents is promising in the development of low cost and novel adsorbent. It is concluded that Pb(II) ions removal using palm kernel shells based adsorbent modified with citric acid would be an efficient technique for economic treatment of wastewater.

Keyword: Activated carbon; Activation; Palm kernel shell; Characterization; Lead; Breakthrough time