Removal of heavy metal ions from aqueous solution by chemically modified mangosteen pericarp

Kai Huang*, Yifan Xiu, Hongmin Zhu

School of Metallurgical and Ecological Engineering, University of Science and Technology Beijing, No. 30 of Xueyuan Road, Haidian District, Beijing 100083, China
Tel. +86 10 62334204; email: khuang@metall.ustb.edu.cn

Received 3 April 2013; Accepted 3 July 2013

ABSTRACT

An efficient biosorbent was prepared from mangosteen pericarp by saponification with alkaline solution of calcium hydroxide and sodium hydroxide. Batch wise adsorption tests were conducted to investigate the effect of pH, adsorption isotherm, and adsorption kinetics for heavy metal ions. It was found to exhibit fairly good adsorption behavior for heavy metal ions like lead, cadmium, iron, copper, nickel, and zinc ions, with the selectivity order for metal ion adsorption as Fe(III) > Pb(II) > Cu(II) > Cd(II) > Zn(II) > Ni(II). Their adsorption process can be described well by Langmuir model and pseudo-second-order kinetics equation. Among these metal ions, maximum adsorption capacity was evaluated to be 1.48, 1.20, 0.47, 0.35 mol/kg for Cu(II), Fe(III), Ni(II), Cd(II) at equilibrium pH 5.0 (except for Fe(III) at pH 2.8), respectively, while 1.01 mol/kg for both Pb(II) and Zn(II) in the single metal ion solution. The adsorption capability of the modified mangosteen pericarp for heavy metal ions can be attributed to the functional groups of carboxylic acid and plant polyphenol contained in the pericarp. Large adsorption capacity and short adsorption equilibrium time indicated that the saponified mangosteen pericarp gel can be used as a promising adsorbent for the removal of aforesaid heavy metal ions from waste effluents.

Keywords: Saponified mangosteen pericarp; Polyphenolic compounds; Heavy metal ions; Cation exchange; Adsorption

*Corresponding author.