Kinetic, equilibrium and selectivity studies of heavy metal ions (Pb(II), Co(II), Cu(II), Mn(II), and Zn(II)) removal from water using synthesized C-4-methoxyphenylcalix[4]resorcinarene adsorbent

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ABSTRACT

Batch-mode adsorption study was done for selected heavy metal ions (Pb(II), Co(II), Cu(II), Mn(II), and Zn(II)) using synthetic adsorbent (C-4-methoxyphenylcalix[4]resorcinarene) to investigate the effect of different parameters such as contact time and pH. Selectivity of the adsorbent towards a mixture of heavy metals adsorbates was investigated. Results showed optimum agitation time of 30 min at pH 5.6 and initial concentration of 1 ppm for all investigated heavy metals. Different kinetic models of Santosoa first-order, Lagergren pseudo-first-order and Ho pseudo-second-order were applied on the adsorption experimental data. Results proved that all adsorption processes were followed and pseudo-second-order kinetic model was adopted. The adsorption capacity of C-4-methoxyphenylcalix[4]resorcinarene towards the selected heavy metal ions was 95.00, 89.76, 89.58, 86.43, and 80.96% for Cu(II), Mn(II), Zn(II), Pb(II), and Co(II), respectively. Selectivity of adsorption was tested on a mixture of Cu(II), Mn(II), Zn(II), Pb(II), and Co(II) with an initial concentration of 1 ppm of each heavy metal and agitated time of 10 min with the adsorbent; removal percentage of each metal ion showed different values from each heavy metal alone as it was in decreasing order Cu(II) > Zn(II) > Co(II) > Mn(II) > Pb(II). The rate constant value for each heavy metal adsorption mechanism obtained from Ho pseudo-second-order model was in the order Co(II) > Zn(II) > Pb(II) > Mn(II) > Cu(II).

Keywords: Adsorption; Synthetic adsorbent; Atomic Absorption Spectroscopy; Adsorption selectivity; C-4-Methoxyphenylcalix[4]resorcinarene; Cu(II); Mn(II); Zn(II); Pb(II); Co(II)