Equilibrium and kinetic studies of Cd(II) ion adsorption from aqueous solution by activated red mud

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ABSTRACT

Red mud is an undesirable by-product of bauxite in Bayer process has been used as a low-cost adsorbent for the removal of Cd(II) from aqueous solution by batch mode of experiment. The red mud was activated by acid dilution followed by ammonia precipitation for better adsorption of Cd(II). To achieve optimum condition for adsorption, different variable parameters were studied. X-ray diffraction, SEM and EDX were used to characterize the adsorbent before and after cadmium adsorption. The maximum adsorption capacities of Cd(II) on activated red mud (ARM) were found to be 12.046 and 12.548 mg g$^{-1}$ at temperature 293 and 303 K, respectively. Adsorption data of Cd(II) are best fitted to linearly transformed Langmuir isotherm with $R^2 > 0.99$. The pseudo-second-order model describes the kinetics of Cd(II) adsorption successfully to predict the rate constant of adsorption. Thermodynamic parameters reveal the endothermic, spontaneous and feasible nature of adsorption of Cd(II) onto ARM. The mass transfer study led to compute the external mass transfer coefficient ($k_f$) by the equation of McKay et al. and Weber–Mathews at temperature 293 and 303 K. The desorption efficiency of Cd(II) ions from ARM was 91.29% using 0.2-mol L$^{-1}$ HCl.

Keywords: Activated red mud; Mass transfer; Adsorption; Adsorption isotherm; Thermodynamic parameters

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