Preparation of thiacalix[4]arenetetrasulfonate-modified D201 resin and its adsorption of heavy metal ions

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ABSTRACT

A thiacalix[4]arenetetrasulfonate-modified resin has been prepared by loading thiacalix[4] arenetetrasulfonate onto resins for the adsorption of heavy metal ions. Various factors affecting the adsorption capacities such as different resins, resin size, pH, contact time, and temperature were investigated by batch adsorption experiments, and the adsorption isotherms, thermodynamics, kinetics, selectivity, and regeneration were also studied. It was found that the loading capacity of the D201 resin (macroporous strong basic anion exchange resin) for thiacalix[4]arenetetrasulfonate was substantially higher than those of the D301 (macroreticular weak basic styrene anion exchange resin) and the 717 (strong base styrene anion exchange resin) resins and increased with decreasing particle size of the D201 resin. The adsorption kinetics followed the pseudo-second-order rate law for heavy metal ions, indicating that chemical sorption is the rate-limiting step of the adsorption mechanism. The adsorption of heavy metal ions onto the thiacalix[4]arenetetrasulfonate-modified resin was analyzed and was found to fit better to the Langmuir isotherm than to the Freundlich isotherm, and the maximum adsorption capacities were 78.1, 65.8, 54.3, and 49.8 mg/g for Cu^{2+}, Zn^{2+}, Cd^{2+}, and Pb^{2+} ions, respectively. The prepared modified resin has high adsorption selectivity for heavy metal ions under the co-occurrence of alkali metal and alkaline earth metal ions. The regeneration efficiencies still exceed 90% after five cycles, indicating that the thiacalix[4]arenetetrasulfonate-modified resin could be favorably recycled.

Keywords: Thiacalix[4]arenetetrasulfonate; D201 resin; Adsorption; Heavy metal ions; Regeneration and recycle

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