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Effects of pH, Load Capacity and Contact Time in the Sulphate Sorption onto a Functionalized Mesoporous Structure

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Abstract : The intensive use of water in agriculture, industry, human consumption and increasing pollution are factors that reduce the availability of water for future generations; the challenge is to advance in sustainable and low-cost solutions to reuse water and to facilitate the availability of the resource in quality and quantity. The use of new low-cost materials with sorbent capacity for pollutants is a solution that contributes to the improvement and expansion of water treatment and reuse systems. Fly ash, a residue from the combustion of coal in power plants that is produced in large quantities in newly industrialized countries, contains a high amount of silicon oxides and aluminum oxides, whose properties can be used for the synthesis of mesoporous materials. Properly functionalized, this material allows obtaining matrixes with high sorption capacity. The mesoporous materials have a large surface area, thermal and mechanical stability, uniform porous structure, and high sorption and functionalization capacities. The goal of this study was to develop hexagonal mesoporous siliceous material (HMS) for the adsorption of sulphate from industrial and mining waters. The silica was extracted from fly ash after calcination at 850 ° C, followed by the addition of water. The mesoporous structure has a surface area of 282 m2 g-1 and a size of 5.7 nm and was functionalized with ethylene diamine through of a self-assembly method. The material was characterized by Diffuse Reflectance Infrared Fourier Transform Spectroscopy (DRIFTS). The capacity of sulphate sorption was evaluated according to pH, maximum load capacity and contact time. The sulphate maximum adsorption capacity was 146.1 mg g-1, which is three times higher than commercial sorbents. The kinetic data were fitted according to a pseudo-second order model with a high coefficient of linear regression at different initial concentrations. The adsorption isotherm that best fitted the experimental data was the Freundlich model.

Keywords : fly ash, mesoporous siliceous, sorption, sulphate
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