

A Cheap Mesoporous Silica from Fly Ash as an Adsorbent for Sulfate in Water

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Abstract : This research describes the development of a very cheap mesoporous silica material similar to hexagonal mesoporous silica (HMS) and using a silicate extract as precursor. This precursor is obtained from cheap fly ash by an easy calcination process at 850 °C and a green extraction with water. The obtained mesoporous fly ash material had a surface area of 282 m² g⁻¹ and a pore size of 5.7 nm. It was functionalized with ethylene diamino moieties via the well-known SAMMS method, followed by a DRIFT analysis that clearly showed the successful functionalization. An excellent adsorbent was obtained for the adsorption of sulfate anions by the solid's modification with copper forming a copper-ethylenediamine complex. The adsorption of sulfates was studied in a batch system (experimental conditions: pH=8.0; 5 min). The kinetics data were adjusted 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. The maximum sulfate adsorption capacity of this very cheap fly ash based adsorbent was 146.1 mg g⁻¹, 3 times greater than the values reported in literature and commercial adsorbent materials.

Keywords : fly ash, mesoporous materials, SAMMS, sulfate

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