Removal of sulfur dioxide by Jordanian zeolitic tuff

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Jordan has huge reserves of oil shale distributed in several deposits, but its exploitation and utilization is restricted for several reasons, including its high sulfur content. Combustion of Jordanian oil shale releases large quantities of sulfur dioxide, which must be mitigated prior to release of effluent gas to the atmosphere. Jordan has considerable reserves of zeolitic tuff, containing several zeolite minerals including phillipsite, chabazite and faujasite. In this study, Jordanian zeolitic tuff was used for adsorption of sulfur dioxide. Experiments were conducted with tuff of different particle size ranges (250-500, 500-1000, 1000-2000, 2000-4000 μm) and at different operating temperatures (ambient, 100, 200, 250, 300, and 500°C) in a fixed bed. The effect of moisture content was also considered employing oven and microwave drying of the tuff to remove moisture. The concentration of sulfur dioxide and its flow rate were kept constant (5000 ppm in balance of N_2, and 30 ml/min respectively). The samples used in this study were characterized by X-Ray Diffraction and X-Ray Fluorescence and surface areas were also measured. Approximately 5 g of sample were placed in a quartz tube (internal diameter 10 mm) and heated to a specified temperature, then held for about 15 minutes. A gas stream containing SO_2 was then passed through the tube. The concentration of the non-adsorbed sulfur dioxide was measured using a UIC Sulfur Coulometer (Model CM5015S), and the amount of SO_2 adsorbed was calculated. The adsorption capacity of zeolitic tuff was found to increase with increasing temperature until 200-250°C, at which point it decreased at higher temperatures. It was also found that the removal of moisture from zeolitic tuff considerably affected SO_2 adsorption capacity as well as breakthrough time. As expected the adsorption capacity of zeolitic tuff increased with decreasing particle size due to the increase of active surface area.