SO_2 adsorption onto zeolitic tuff and it thermal regeneration

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Oil shale combustion is a promising option for Jordanian oil shale utilization. Restrictions on the exploitation and utilization of this resource are partly due to the high sulfur content of the oil shale, which leads to production of large quantities of sulfur dioxide during combustion. Mitigation of sulfur dioxide prior to effluent gas release is important for maintaining air quality and preventing environmental problems, e.g. acid rain. A number of effluent gas desulfurization techniques are available. These can be broadly classified into four categories: absorption of SO_2 in liquids, absorption by moist particles, gas phase conversion of SO_2, and sorption by solids. Solid-phase sorption has been examined in this study for SO_2 removal during oil shale combustion using Jordanian zeolitic tuff. Jordan also has considerable reserves of zeolitic tuff containing a variety of zeolite minerals including phillipsite, chabazite and faujasite. Zeolitic tuff samples were sieved into different particle size fractions and characterized by XRD, XRF and SEM. The surface area was also measured. Samples were placed in quartz tubes and heated to a specified temperature and then held for 15 minutes. SO_2 gas was passed through the tube and the concentration of non-adsorbed sulfur dioxide was measured at the outlet. The measurement of the outlet SO_2 was carried out using UIC Sulphur Coulometer (Model CM5015C), and the amount of SO_2 absorbed was calculated. The adsorption capacity of zeolitic tuff was found to increase with increasing temperature up to 200-250°C and then decreased at higher temperatures. It was also found that drying zeolitic tuff, by both conventional and microwave heating had a considerable effect on SO_2 adsorption capacity and breakthrough time. The adsorption capacity of zeolitic tuff increased with the decreasing particle size due to the increase of active surface area. Cyclic thermal regeneration of zeolitic tuff was also investigated. It was found that zeolitic tuff can be regenerated and the initial adsorption capacity was preserved after three regeneration cycles.