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High-Pressure CO_2 Adsorption Capacity of Selected Unusual Porous Materials and Rocks

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Abstract : CO_2 adsorption capacity of several materials - waste (power fly ash, slag, carbonized sewage sludge), rocks (Czech Silurian shale, black coal), and carbon (synthesized carbon, activated carbon as a reference material) - were measured on dry samples using a unique hand-made manometric sorption apparatus at a temperature of 45 °C and pressures of up to 7 MPa. The main aim was finding utilization of the waste materials and rocks for removal of the air or water pollutants caused by anthropogenic activities, as well as for the carbon dioxide storage. The equilibrium amount of the adsorbate depends on temperature, gas saturation pressure, porosity, surface area and volume of pores, and last but not least, on the composition of the adsorbents. Given experimental conditions can simulate in-situ situations in the rock bed and can be achieved just by a high-pressure apparatus. The CO_2 excess adsorption capacities ranged from 0.018 mmol/g (ash) to 13.55 mmol/g (synthesized carbon). The synthetized carbon had the highest adsorption capacity among all studied materials as well as the highest price. This material is usually used for the adsorption of specific pollutants. The excess adsorption capacity of activated carbon was 9.19 mmol/g. It is used for water and air cleaning. Ash can be used for chemisorption onto ash particle surfaces or capture of special pollutants. Shale is a potential material for enhanced gas recovery or CO_2 sequestration in-situ. Slag is a potential material for capture of gases with a possibility of the underground gas storage after the adsorption process. The carbonized sewage sludge is quite a good adsorbent for the removal and capture of pollutants, as well as shales or black coal which show an interesting relationship between the price and adsorption capacity.

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