ABSTRACT

As the global demand for energy increases, CO_2 discharge will also increase due to power stations andother coal-dependent industries. It therefore becomes necessary to develop processes that willenable the capture and storage of CO_2 from flue gas in combustion processes, in order to mitigate the undesirable consequences of CO_2emission. It is for this reason that research on carbon capture and storagehas receivedconsiderable attention recently. Adsorption of CO_2 onto coal ash is a potentially attractive alternative to capturing CO_2 from stationary sources in the context of carbon capture and storage technologies.

Four coal ash samples were used as CO_2 adsorbents in this study, obtained from three different industries, namely: 1) coal power station 2) a petrochemical industry and, 3) a metallurgical plant. Thermogravimetric analysis, X-ray diffraction spectroscopy, and BET isotherms were used to analyse the nature of the samples prior to the adsorption process. A volumetric adsorption system was used to facilitate the adsorption process.

The pulverized fuel ash sample had the highest CO_2adsorption capacity, followed by the spreader stoker ash sample, the chain grate ash sample, and finally the gasification ash sample.The as received ash was found to have a potential to uptake CO_2in a capacity range of 0.17 – 2.8 Mt CO_2, meaning that 1.28 % of the annual sequestrableCO_2 produced in South Africa could be captured using all of the ash produced in one year in South Africa. Coal ash is a suitable material for the adsorption of CO_2,however its adsorption capacity needs to be improved by treatment with acids and amines in order to introduce active functional groups.