ABSTRACT

Due to the continued dominance of fossil fuels in global industry, CO_2 capture and geological storage (CCS) is a vital technology in efforts to combat climate change. Capture technologies are implemented to purify CO_2 streams from industrial sources, and these streams are injected deep underground in specialised geological storage media. However, impurity gases could still comprise greater than 5% of the captured stream and be co-stored with the CO_2. The presence of impurities underground could be detrimental or beneficial to CO_2 storage; but as yet, the influence of many impurities is unclear.

Coal seams, which have been classified as 'unmineable', are unconventional CO_2 storage media that hold importance in areas where saline aquifers are not readily available. The major storage mechanism in this medium is sorption, which must be quantified experimentally for storage capacity estimations. An important impurity in CCS is SO_2, which has very strong sorbing properties and the potential to affect coal storage capacity. In this study, the effect of different concentrations of SO_2 on CO_2 sorption in a typical South African coal was investigated via laboratory-scale volumetric adsorption experiments.

After sorption experiments of binary CO_2-SO_2 mixtures, with SO_2 concentration from 0% to 6.7%, were run for 48 hours at 85 bar and 40°C, it was clear that SO_2 sorbed very strongly to the coal and its sorption is preferential to that of CO_2. The results show that SO_2 interacts with CO_2, and can potentially enhance or inhibit CO_2 sorption, depending on the model used to describe the density of the CO_2-SO_2 mixture. The effect of SO_2 is seen to be significant even at low concentrations (< 2% SO_2), and it is recommended that its effect is taken into account when storage capacity estimations on coal seams are carried out.