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Verification of a CO2 volumetric adsorption system

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ABSTRACT

Carbon dioxide (CO_2) atmospheric emissions are regarded as the major cause of global climate change. South Africa aims to reduce its current emissions of over 400 Mton per annum through carbon dioxide capture and storage (CCS) technology by initially implementing the storage phase. Storage of captured CO_2 into various sites (such as coal, rocks, aquifers and etc) is a globally accepted means to mitigate the accumulation of greenhouse gases (GHG) in the atmosphere.

Before storing CO_2, adsorption isotherms must be generated using a volumetric adsorption system (VAS). A VAS is used to determine the CO_2 storage capacity of coal, and other materials, by monitoring the uptake of a known amount of CO2 under pressure, generating adsorption isotherms. This research aims to commission and verify the reliability of a VAS constructed at the University of the Witwatersrand, Johannesburg, by in-house and external repetitive adsorption tests - using CO_2 as an adsorbate and a homogeneous Witbank basin bituminous coal sample as an absorbent, in pressure steps from 10 bar up to 50 bar.

The operating procedure for the VAS is detailed. The average adsorption of the (in-house) repeatability runs was 0.0411 g CO_2 per g coal (at 50 bar). The inter-laboratory comparison run from an external lab at Aachen University of Technology had maximum adsorption capacity of 0.0250 g CO_2 per g coal. The difference in values is due to a variety of reasons, but essentially can be concluded that the VAS is able to generate CO_2 adsorption isotherms.