Simultaneous Measurements of Adsorption-Induced Swelling in Microporous Materials

Laurent Perrier [C, S], Frédéric Plantier, Gilles Pijaudier-Cabot and David Grégoire
LFC-R, University of Pau, Anglet, France
laurent.perrier@etud.univ-pau.fr

The purpose of our work is to achieve a better understanding of the coupling between adsorption and swelling in microporous materials. This is typically of utmost importance in the enhancement of non-conventional reservoirs or in the valorization of CO2 geological storage. We consider here the case of fully saturated porous solids with pores down to the nanometer size (≤ 2nm). Hardened cement paste, tight rocks, activated carbon or coal are among those materials. Experimentally, different authors tried to combine gas adsorption results and volumetric swelling data, especially for bituminous coal. However, most results in the literature are not complete in a sense that the adsorption experiments and the swelling experiments were not performed on the exact same coal sample [1]. Other authors present simultaneous in-situ adsorption and swelling results but the volumetric strain is extrapolated from a local measurement on the surface sample or by monitoring the two-dimensional silhouette expansion [2]. This paper aims at presenting a new experimental setup dedicated to in-situ and simultaneous adsorption-induced swelling measurements in microporous materials. The setup couples a home-built manometric apparatus for gas adsorption measurements and a digital image correlation setup for full-field swelling measurements. Experiments have been performed on activated carbon fully saturated with CH4 and CO2 at 30°C and up to 120 and 50 bars respectively.

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References

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