

Factors Affecting Sorption Induced Strain of Coal Specimens During Carbon Dioxide Injection: A Review Study

¹Mustafa Abunowara, ¹Usama Eldemerdash and ²Mariyamni Awang

¹Department of Chemical Engineering,

²Department of Petroleum Engineering,

Universiti Teknologi PETRONAS, Tronoh, 31750, Perak, Malaysia

Abstract: Carbon dioxide (CO₂) capture, utilization and storage (CCUS) are considered as a potential approach to mitigate carbon dioxide emissions into geologic formations. Deep unmineable coal seams have been identified as a possible option because it has large CO₂ adsorption capacity, long time CO₂ trapping and extra enhanced coal-bed methane recovery (ECBMR) and CO₂ sequestration. The current practice for recovering coal bed methane is to depressurize the bed, usually by pumping water out of the reservoir, the desorption of gas from coal surface, diffusion of gas to the fracture systems and flow of the gas through the fractures to the wellbores. Hence, an alternative approach is to inject CO₂ into the coal bed seams to increase the mobility of methane recovery. As a result induced adsorption strain (swelling) is one of the main difficulties which face CO₂ sequestration in coal seams. This phenomenon occurs, particularly when the injected carbon dioxide adsorbs on surface of the coal pores and interacts with coal in chemi-physical adsorption isotherm under extreme conditions, which causes the coal to swell. This swelling in confined conditions leads to a closure of coal matrix pores and cleat system, which hinders further CO₂ injection. However, swelling will decrease permeability and adsorption capacity of coal seams and increases CO₂ injectability potential complications. The degree of swelling would be affected by many parameters such as coal rank, water content and petrographic content, mechanical properties (e.g., stress levels and confinements), operating conditions (e.g., gas injection pressure and temperature), free gas and fluid type. Thus these parameters have significant affect on CO₂ continuous injection process in coal seams in long term. This study is a reviewing for the main parameters which have influence on coal swelling during carbon dioxide injection in coal specimens.

Key words: Coal seams, CO₂ sequestration, swelling, gas sorption, supercritical CO₂
