UQ Centre for Natural Gas

Laboratory study of capillary trapping Impact on coal seam gas ultimate recovery

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Introduction

The capillary trapping in coal seam hinders the gas desorption thus is unfavourable for gas production. This work presents the results for a series of gas desorption experiments on two coal samples (from Bowen Basin, Australia), which are carried out in a pressure chamber to quantify the impact of water on gas desorption and its implications to ultimate gas recovery. Coal transient directional deformation was measured using strain gauges. The data was collected and analysed to determine the influence of capillary trapping effect on gas desorption and sample deformation

Experiment Methodology

The samples are dried and vacuumed before the experiment, then the adsorption and desorption tests for nitrogen gas is conducted. After one circle of adsorption/desorption is finished, the nitrogen gas is injected again to reach the adsorption equilibrium. Next, high pressure water is injected to replace the nitrogen in the free space of the chamber, and the desorption is carried out. The data is collected and compared with the cases without the presence of water to acquire the difference of gas recovery rate, strain gauges are attached on samples to measure the strain of coal matrix on two directions.

Samples for experiment

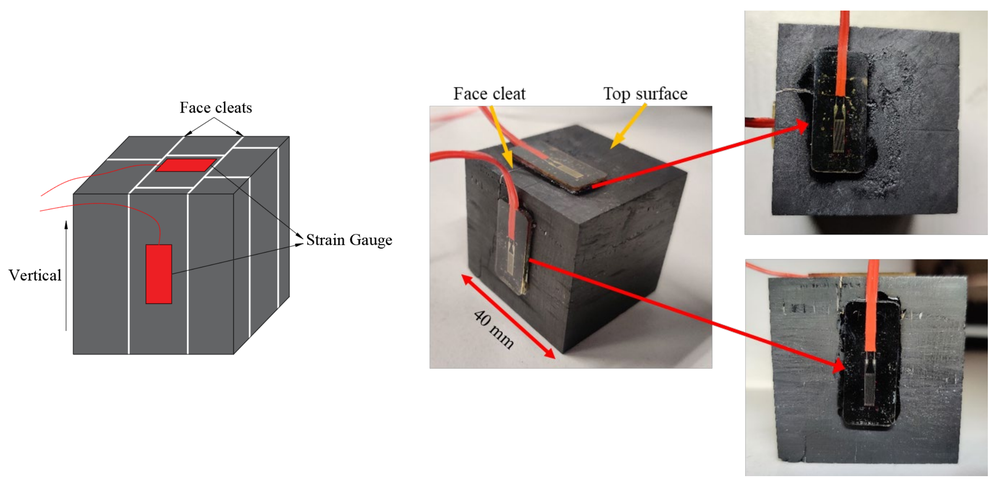


Figure 1: The sample and the installed strain gauges

Experimental apparatus

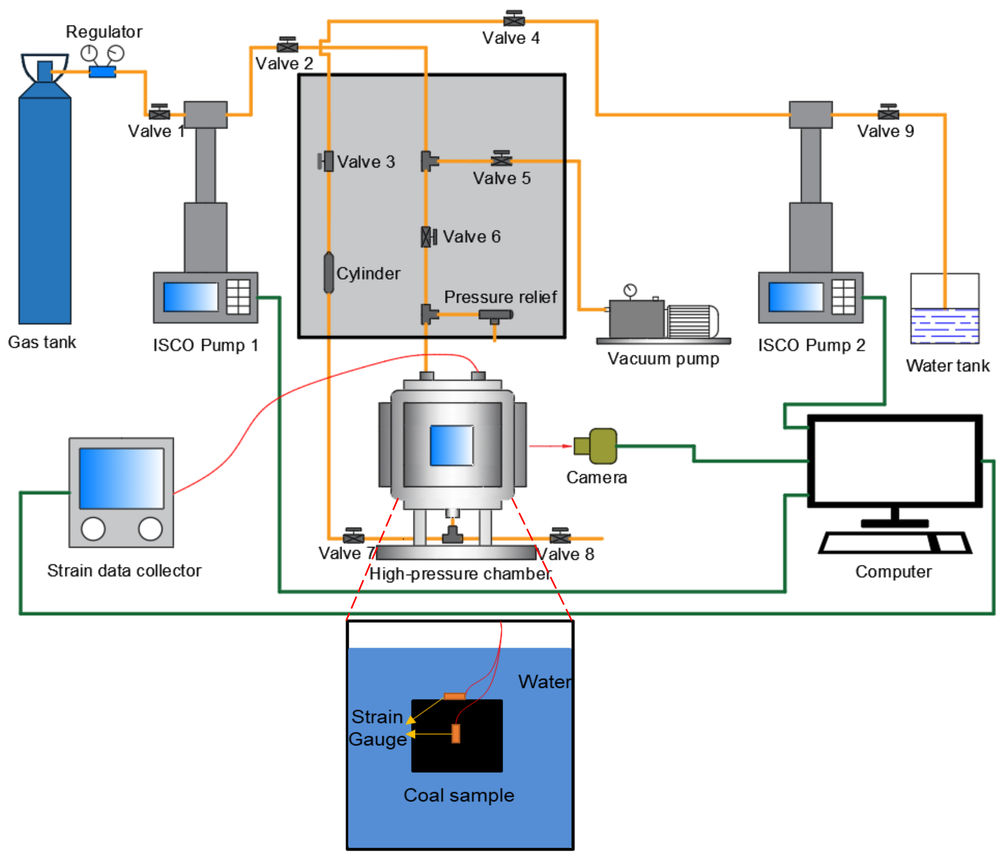
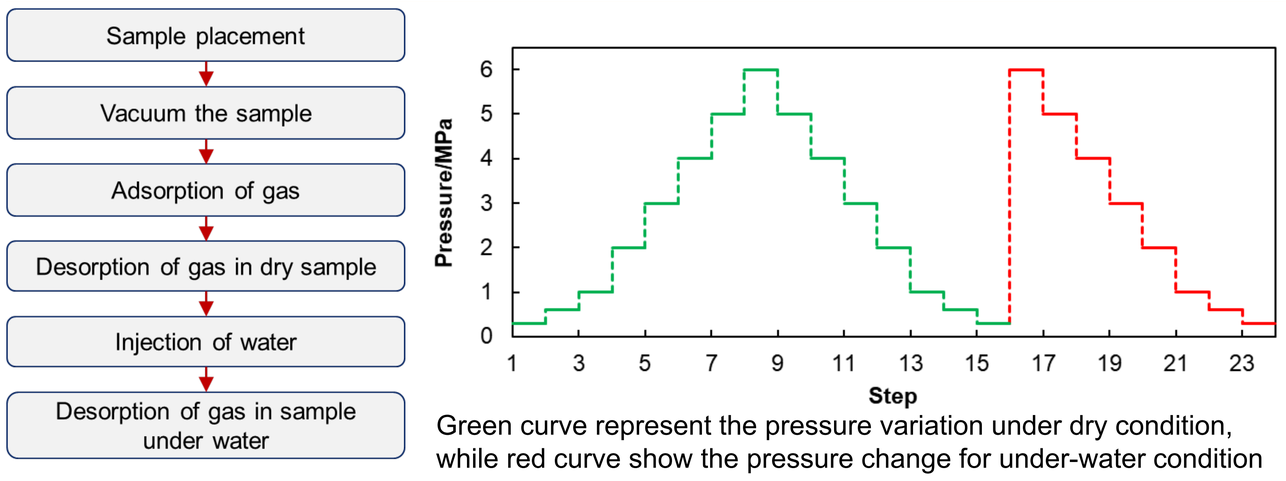


Figure 2: Schematic of experimental apparatus

Experiment procedures

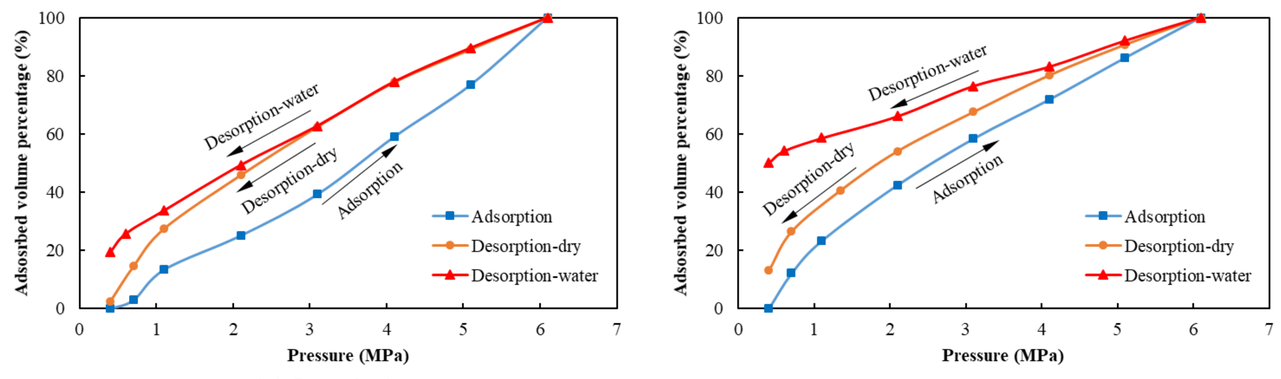


Green curve represent the pressure variation under dry condition, while red curve show the pressure change for under-water condition

Figure 3: Experimental procedure and pressure variation during the experiment

Experiment Results

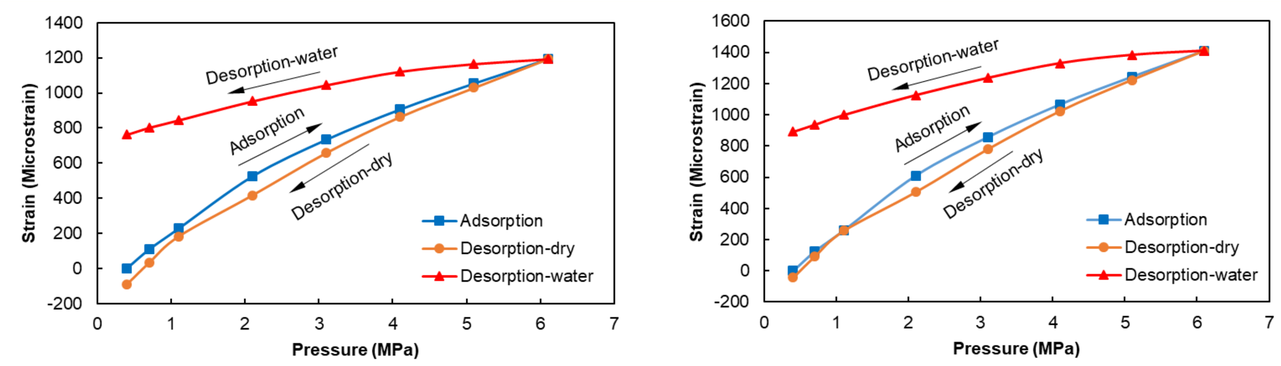
Gas recovery rate



(a) Sample 1 (b) Sample 2

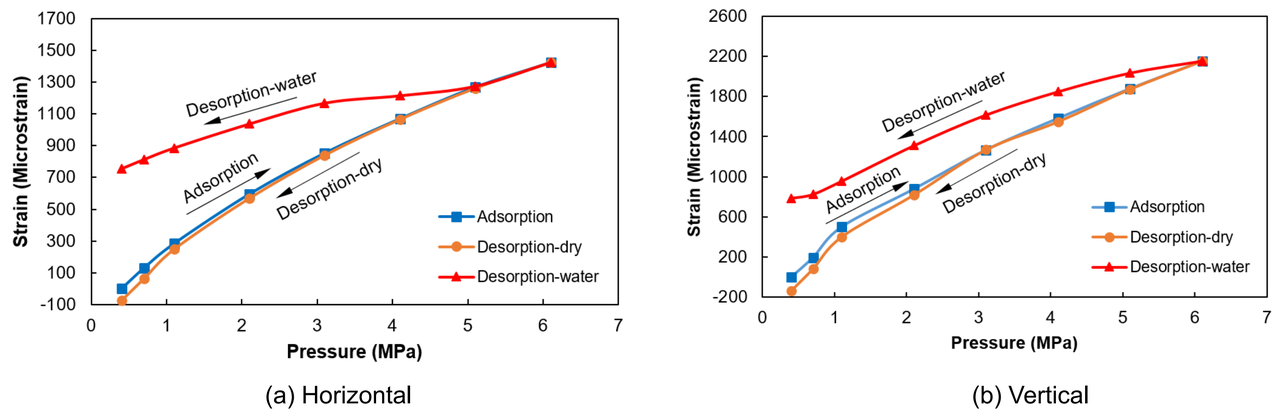
Figure 4: Gas adsorption and desorption rate with and without the presence of water

Matrix strain



(a) Horizontal (b) Vertical

Figure 5: Matrix strain at horizontal and vertical direction for sample 1



(a) Horizontal (b) Vertical

Figure 6: Matrix strain at horizontal and vertical direction for sample 2

Conclusions

1. The presence of water in the coal seam is able to generate capillary pressure in small pores of coal matrix, thus reduce the gas transfer capacity from matrix to cleats.
2. The matrix shrinkage induced by the gas desorption is significantly reduced due to the higher residual gas pressure in matrix caused by capillary trapping effect.

References

1. Saghafi. A., Pinetown. K. & Javanmard. H. 2014. Gas wettability of coal and implications for gas desorption and drainage.
2. Jia L, Li K, Shi X, et al. Application of gas wettability alteration to improve methane drainage performance: A case study. International Journal of Mining Science and Technology, 2021, 31(4): 621-629.

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