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# Changes in Properties of Coal as a Result of Continued Bioconversion

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## Abstract

Andrew Scott in 1994 first proposed imitating the natural/microbial process of biogenic gasification, possibly leading to recharging coalbed methane reservoirs, or setting up natural gas reservoirs in non-producing coalbeds. This study was aimed at identifying the changes in coal properties affecting gas deliverability in coal-gas reservoirs, when treated with microbial consortia to generate/enhance production. The experimental work tested the sorption and diffusion properties for the coal treated and, more importantly, the variation in the relevant parameters with continued bioconversion since these are the first two phenomena in CBM production.

During the first phase, single component sorption-diffusion experiments were carried out using methane and $CO_2$ on virgin coals, retrieved from the Illinois Basin. Coals were then treated with nutrient amended microbial consortia for different periods. Gas production was monitored at the end of thirty and sixty days of treatment, after which, sorption-diffusion experiments were repeated on treated coals, thus establishing a trend over the sixty-day period. The sorption data was characterized using Langmuir pressure and volume constants, obtained by fitting it over the Langmuir isotherm. The diffusion coefficient, D, established the variation trend as a function of pore pressure. The pressure parameter was considered critical since, with continued production of methane, the produced gas diffuses into the coal matrix, where it gets adsorbed with increasing pressure. During production, the pressure decreases and the process is reversed, gas diffusing out of the coal matrix and arriving at the cleat system.

The results indicated an increase in the sorption capacity of coal as a result of bioconversion. This was attributed to increased pore surface areas as a result of microbial actions. However, significant hysteresis was observed during desorption of methane and was attributed to preferential desorption from sorption sites in the pathways leading to pore cavities. This is corroborated by the increased rates of diffusion, especially for methane, which exhibited rates higher than that for $CO_2$. This contradicted the results for untreated/baseline coal, which were in agreement with previous studies. Effort was made to explain this anomaly by the non-monotonic dependence of effective diffusion coefficient on the size of the diffusing particles, where in coalbed environments, $CO_2$ has smaller kinetic diameter than methane.