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Practical Demonstration of Dissolved Gas Injection for Geo-sequestration on Coalbeds

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Conventional geo-sequestration strategies have focused primarily on storage in deep saline aquifers, where DOE low-high estimates of US/Canada potential storage dwarf those of unmineable coal by factors of 40-200x. However, the multifarious challenges of deep aquifer storage have protracted its development and immediate application. Many of these challenges might be addressed by unconventional storage in shallow unmineable coal, including formation integrity and the high cost of capture, purification, compression, pipelines, transportation, and monitoring. Latent geological processes have already amassed hundreds of gigatons of gas in coalbeds as natural gas resource that is well characterized and already exploited by the energy industry. DOE/NETL have stated: 'Coal adsorbs CO_2 over methane⋯at a ratio of 2 to 13 times. This⋯adsorption trapping is the basis for CO_2 storage in coal seams.'Nevertheless, early ECBM field trials, which sought to displace natural gas through injection of pure CO_2 to fill the pore space for storage, found insufficient economic benefits from the process. Carbon GeoCapture has revitalized the approach and adapted it to produce a practical, scalable and commercial method for coal geo-sequestration that injects gas in a more natural way. Water sourced from peripheral wells in the coalbed is pumped to surface and mixed with CO_2 gas in a central wellbore to form a dilute dissolved gas fluid that can be readily flowed through the formation. Because the mass fraction of gas in the fluid is low, any potential coal swelling and injectability loss are effectively eliminated.
WellDog has performed laboratory studies that demonstrate and quantify the displacement of sorbed methane on submerged coal through injected carbon dioxide and have developed a benchtop practical demonstration apparatus that illustrates the key steps in the Carbon GeoCapture sequestration process. The system consists of three main compartments driven with a single pump and connected by plastic tubing with automated valving to control mixing and direct flow. During the demonstration, which lasts ~25 minutes, injection fluid is prepared in the first compartment, a vertical Plexiglas column that represents the injection wellbore. Gas is bubbled through the fluid, or fluid from the base of the column is poured into the top of the compartment while equilibrium is monitored with a pressure gauge. The second compartment consists of a series of clear PVC tubes packed loosely with sieved coal cuttings having a void space filled with water pressurized to 50 PSI to simulate formation pressure. During injection, fluid from the first compartment flows through the coal tubes, while displaced fluid is collected in the third compartment, another vertical Plexiglass column that represents the peripheral production wellbore. Displaced fluid from the coal tubes is observed to have significantly less dissolved gas as compared to the injection fluid, which can be dramatically visualized by depressurizing the two vertical compartments simultaneously, where many more bubbles are observed in the injection tank. Even more dramatic is the expansion of gas in the coal tubes when they are depressurized, where sorbed gas expands and displaces all of the water in the pore space.

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