WesternResearch INSTITUTE

www.westernresearch.org

"Real-Time" Biogenic Methane Production from Coal and Oil Shale

Patent-pending Biotechnology in Clean Energy Production

Background

Coalbed methane (CBM) and oil shale methane can be formed through thermogenic (temperature induced metamorphosis) and biogenic (microbial) processes. It is believed that biogenic methane accounts for 20 to 40 percent of the total methane reserve on earth. Recent studies have shown that biogenic methane production is actively occurring and may account for much of the CBM produced within certain coal and shale deposits including the Powder River Basin and Green River Formation in the Rocky Mountain region. Although the rates of methane conversion from coal and oil shale are usually low under natural conditions, our study has demonstrated that biotechnological enhancement techniques can significantly increase the rates to make economical sense, such as reviving existing depleted wells and sustain high gas production.

Western Research Institute (WRI), in collaboration with the University of Wyoming, has developed Biogenic Methane Enhancement (BME) a cutting edge technology to optimize biogenic production in coal and oil shale. The WRI patent-pending technology has tremendous potential for increasing methane production from coal, oil shale and other organic-rich natural deposits such as lignite, oil sludge, or even petroleum contaminated soils.

Pre-treatment and Enhancement

WRI's BME technology consists of two major steps: 1) pre-treatment and 2) microbial optimization. Step 1 helps release the organic constituents from coal and oil shale, break them down and make them bioavailable to microbial populations for the downstream methane generation (Figure 1). In Step 2, a balance is maintained for key elements to optimize microbial pathways and maximize the methane production (Figure 2).

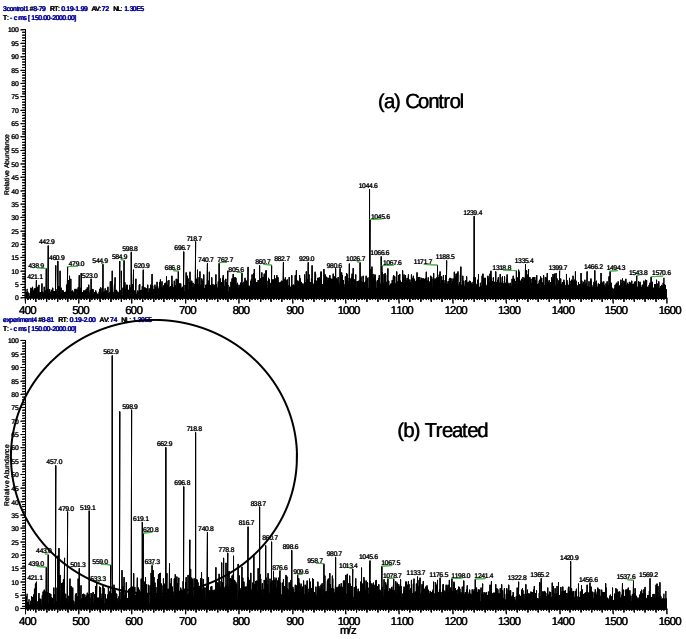

Figure 1. Negative Ion Electrospray Ionization (NI-ESI) Mass Spectra of (a) Control and (b) Treated Water-soluble Fraction in Coal Samples.

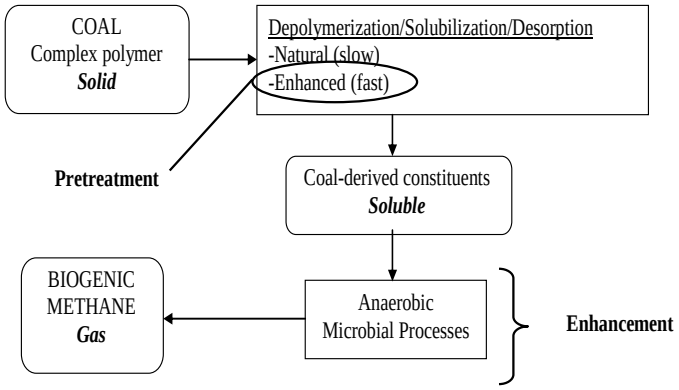

Figure 2. Schematic Summary of BME Technology

CONTACT

Dr. Song Jin, CHMM
Environmental Remediation & Restoration Program
Western Research Institute
365 N. 9th St., Laramie, WY 82072
Tel: (307)721-2404, Fax: (307)721-2256
Email: sjin@uwyo.edu

Each step in BME results in a significant increase of biogenic methane production. In laboratory reactors (Figure 3), the application of the BME technique can achieve up to 1200 percent increase in the production of biogenic methane when compared to background.

Figure 3. Biogenic Methane Reactor in the Laboratory

Real-time CBM Production

Extrapolated from laboratory data, the estimated real-time biogenic methane production profiles in coal samples collected from the Powder River Basin are summarized in Figure 4.

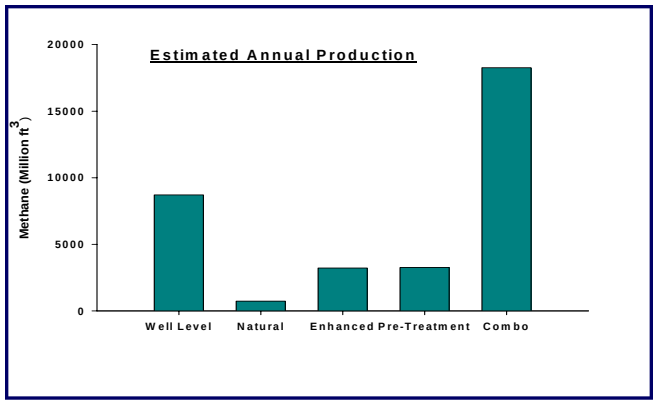

Figure 4. Estimated real-time Biogenic Methane Production in Coal (12 months post-application of BME).

Although real-world performance is yet unknown, the potential gain of utilizing BME technology is significant. For example, a depleting CBM well may be resumed to or higher than its original methane production after 12 months application of BME and the lifespan of the well may be prolonged significantly. BME technology can also be used to revive abandoned or low-production CBM wells, bringing tremendous economical benefits to the industry and land owners.

Real-time Oil Shale Methane Production

Field and isotope fractionation studies have verified that biogenic methane has been produced in oil shale from certain geological formations. Our lab study at WRI indicates that oil shale contains high concentrations of organic compounds, mostly in the form of petroleum hydrocarbons. These compounds are amenable to a consortium of bacteria that can eventually convert them into methane under the proper conditions. The BME process to enhance methane production from oil shale is similar to the techniques applied to coal. Data extrapolated from the laboratory study is presented in Figure 5.

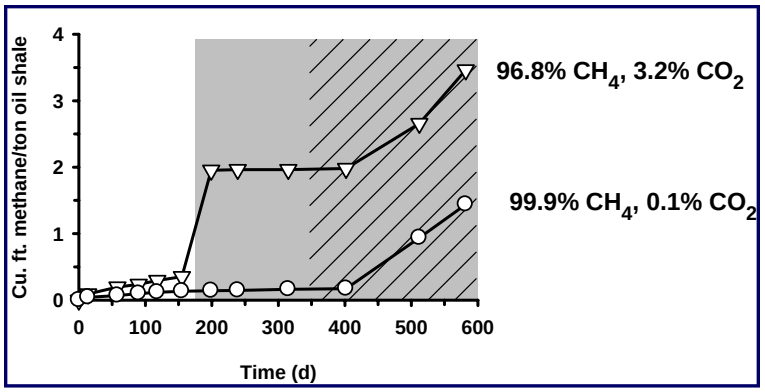

Figure 5. Methane production from oil shale following various treatments.

The BME technology is extremely meaningful for deep oil shale with difficult accessibility. Conversion of petroleum compounds to methane gas has great potential and economic incentives in the energy industry. WRI has ongoing field pilot tests and welcomes the opportunity to apply BME to your site.

WRI is at the forefront in applying biotechnology to enhance real-time biogenic methane production from coal and oil shale.