Coal Bed Methane Rejuvenation Treatment

Technical Description

TTI's CBM Rejuvenation Treatment is a one-time chemical blend delivered to mature CBM production wells. The chemical treatment is injected at low pressure (often by gravity) with a volume of water to be dispersed into the formation. Once emplaced, the chemicals stimulate microbes to generate methane at a much faster rate. These microbes are present naturally in coal formations, and no injection of microbes is required. This technology has been proven to produce new methane in excess of 50,000 MCF per well treatment.

Value Proposition

TTI's CBM Rejuvenation Treatment is a low-cost, high-impact solution for mature coal gas wells. The incremental gas produced has a finding cost between $0.25 and $0.40 per MCF. A treatment with a base case uplift of 50,000MCF would result in 4-8X return on investment. The treatment has been proven to last for an average of 6 years, with many treated wells still producing methane in excess of pre-treatment declines for 8 years or more. The treatment pricing includes site evaluation, project management, and the chemical treatment, and can also include regulatory chemical monitoring post-treatment if required.

Chemical Treatment Composition

TTI's proprietary rejuvenation chemical treatments are delivered as a liquid concentrate to each well site. The components of the treatments are water soluble, non-toxic, non-corrosive, and are frequently used as additives in food. Once diluted with the emplacement water, the concentrations of the components are below 1g/L, and do not impact produced water quality or total dissolved solids, as the chemicals are rapidly utilized by microbes in the formation.

Impact on Coal

Coal is the food source for microbes in formations, and small molecules from the coal are converted into methane during the process of biodegradation. This action occurs in the cleats and fractures in the coal, and the vast majority of the coal is not impacted by microbes. Even with treatment, the biodegradation of coal is slow and would take geologic time scales to measurably change the amount of coal in a formation. The bulk coal material does not change in composition, heat capacity, or rank due to CBM Rejuvenation Treatment. Permeability of the formation is likewise unaffected by treatment.

Site Evaluation and Project Design

TTI will work with the operator to select the appropriate wells from which to collect water during site evaluation sampling. Our proprietary sampling methods yield samples suitable for two phases of analysis in TTI laboratories:

Geochemical: Water chemistry is analyzed to determine which TTI chemical treatment offering is suitable for the reservoir to be treated. Water chemistry data is also used to ensure the make-up water for the treatment is compatible with the reservoir.

Biological: Live microbes are collected to confirm native microbial response to the chosen treatment chemical. DNA sequencing is performed on the collected cells to confirm the presence of methanogenic microbes and the active methanogenic pathway native to the reservoir.

Following laboratory analysis, TTI will present a treatment plan to the operator for consideration and implementation. TTI has four treatment chemical blends in use, and selection is based upon the site-specific biology and water compatibility.

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Treatment Process

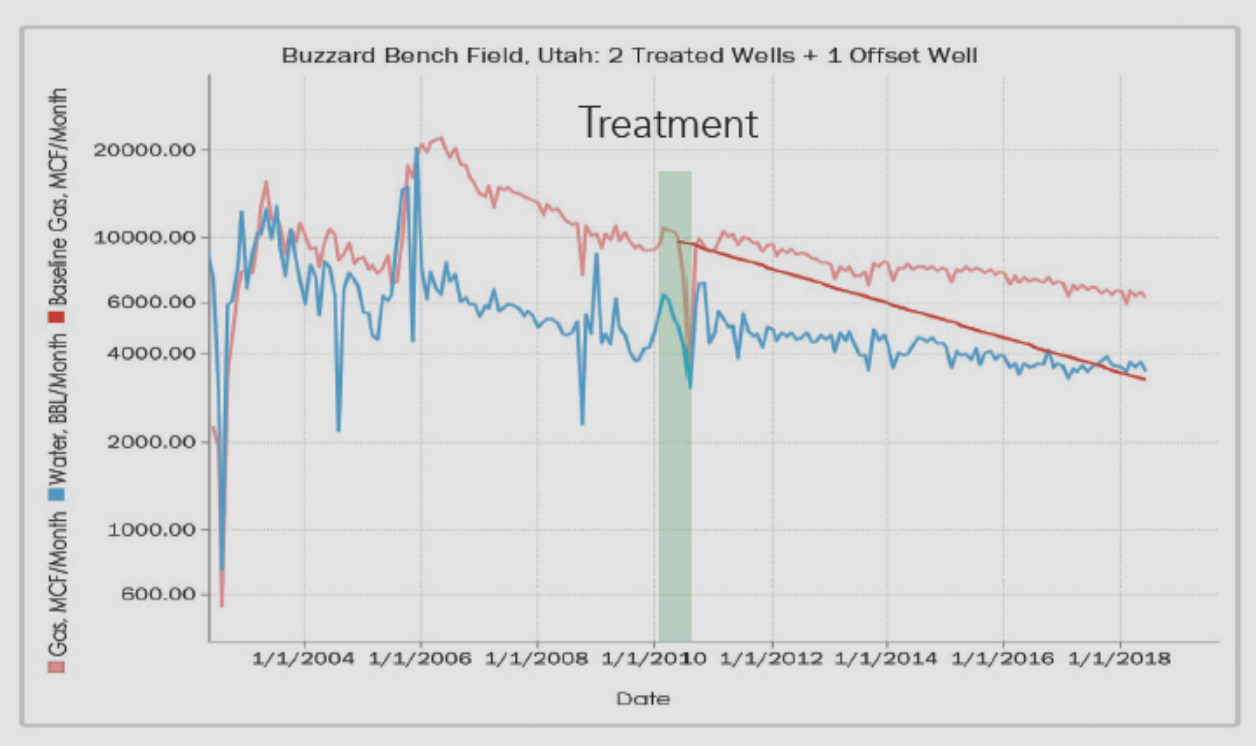
After initial site evaluation, TTI will inject 250-350 gallons of treatment chemical and follow it with 2500 barrels of compatible water. Ideally, this water is sourced from the formation and obtained from the same field, but other compatible water sources can be used if required. The chemical and water are pumped into the formation at low pressure.

The treated well is then shut in with no production for a 45-day incubation period, during which the chemicals are utilized by native microbes, beginning new methane generation. At the end of the shut-in period, new methane generation is underway, and the well can be returned to normal operations. Offset wells will also produce additional gas from the treatment and should be operated normally during the shut-in period.

If necessary for regulatory requirements, the produced water can be monitored post-treatment for persistence of the treatment chemicals. This is rare, as the chemicals are typically consumed within the shut-in period.

The active implementation phase of this process occurs over a period of days and does not require permanent modification of any surface facilities. This allows for the successive treatment of many wells very quickly, resulting in the compounding growth of production for the operator.

Expected Production Results



This graph demonstrates the results of a two well treatment initiated in 2010, located in Utah's Uinta basin. The wells were completed in the Ferron coal (high volatile sub-bituminous B grade), on 160-acre spacing with permeability in the range of 10 md. The uplift in gas production from this project has continued for eight years and has yielded 96,000 MCF of additional gas production to date per treatment, or 192,000MCF total. Similar results have been obtained in many other formations with various permeabilities and coal ranks, and a wide range of formation water salinities.

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