AddFRAC Services Prevents MIC Failures in a Barnett Shale Gas Gathering System

Baker Hughes frac additives lowered costs and risks

Benefits

- Lower operating costs during and after frac operations
- 100% success rate ensured mitigation of system souring and lower HS&E risks
- Single-sourced frac additives for ensured compatibility

Challenges

- Handle a high number of microbially-induced corrosion (MIC) failures in gathering system flowlines
- Deal with biogenic hydrogen sulfide gas production in produced water storage tanks
- Risk of negative environmental impact and potential for personal injury

Baker Hughes solution and results

- AddFRAC™ measurement and control services for complete frac additive supply and support
- Biocide screening to identify most cost-effective product
- Two-phase treatment program to fully address the bacteria problem
- An extensive monitoring program to verify program performance

A North Texas Barnett Shale operator was experiencing a high number of microbially-induced corrosion (MIC) failures in their gathering system flowlines and biogenic hydrogen sulfide gas production in their produced water storage tanks. These costly bacteria-associated issues created a risk of negative environmental impact and potential for personal injury. The incumbent microbiocide program for the frac tanks was ineffective, resulting in contamination of the production wells during the frac job and subsequent contamination of the downstream portions of the system as the fracturing fluid was produced back.

The operator sought a more effective bacteria management program to reduce production losses and HS&E risk in their operating systems. They wanted to partner with a chemical service provider with the expertise to understand the problem at the base level across the entire system so that directed and effective treatment could be most cost-effectively applied.

The Baker Petrolite AddFRAC measurement and control services team worked with the operator to formulate a plan to identify and mitigate the source of the bacterial contamination. Baker Hughes microbiologists and field technicians performed a detailed microbiological survey of the fracturing process, the gas/fluid separation facilities and the gathering system. The survey concluded that the source well water used for fracturing was contaminated with high levels of acid-producing and sulfate-reducing bacteria (typically 10^4 to $>10^6$ APB and SRB/ml). In addition, the reuse of flowback water from frac tanks containing frac sand, scale solids, and other residue added to the bacterial loading in the fracturing water.

Once the sources of bacteria contamination were identified, Baker Hughes technologists carried out detailed microbiocide selection testing using representative fracturing fluids from the field. The testing showed that Baker Petrolite X-CIDE™ 575 microbiocide would provide the most cost-effective treatment. The inadequate performance of the incumbent fracturing fluid microbiocide was verified in the laboratory efficacy studies.

After identifying and discussing options with the AddFRAC Services team, the customer elected to implement a two-phase treatment program to mitigate the bacterial contamination in the fracturing fluids: (1) Frac tank cleaning program, and (2) Frac tank microbiocide treatment program.

Under the new treatment program frac tanks were cleaned between frac jobs to remove the deposits that can harbor the problem-causing bacteria. Once cleaned, X-CIDE 575 microbiocide was added to the tanks prior to filling to facilitate even mixing of the biocide with the frac water. The biocide loading rate was varied based on the source water quality.

An extensive monitoring program was implemented to determine the efficacy of the bacteria mitigation program. Ten percent of the treated frac tanks were monitored to assess the concentration of surviving bacteria populations. In addition, samples were collected from recently fractured production wells early in the flowback period. Evaluation of these samples for viable bacterial concentrations, biocide residual concentration, dissolved H_2S and dissolved iron concentrations were made to confirm efficacy of the program.

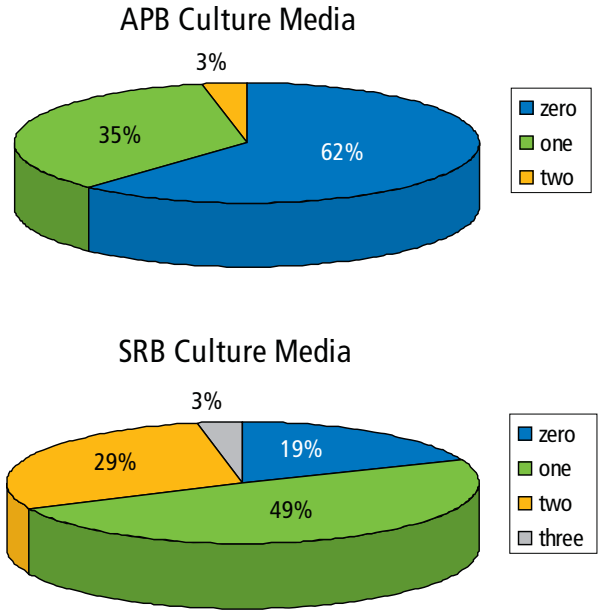
Under the new two-phase treatment program, 54 frac jobs, including 2,490 frac tanks, were treated with X-CIDE 575 microbiocide. All of the treated tanks achieved the customer specification of $\leq 10^3$ viable bacteria/ml (shown above). This represents a three to six log reduction in APB and SRB concentrations.

Follow-up monitoring of well flowback samples gave the customer confidence that the AddFRAC Services were delivering the anticipated value. Biocide residuals and low bacteria concentrations were maintained throughout the flowback period for the new wells. This provided the requisite reduction in downstream bacterial contamination as flowback and produced fluids were transported within the system.

By maintaining focus on the customer's objectives, real, measurable value was delivered to this operator. The benefits realized from the reduced bacterial loading in the system are summarized in the table.

This case history is presented for illustration purposes only as results may vary between applications.

Results	Benefits
80% fewer gathering system flowline failures	Improved TCO with lower HSE risk
Substantial reduction in the number of produced water storage tanks with biogenic H_2S production	Reduced safety risk for the truck drivers that haul produced water to disposal facilities
25% reduction in the total program treatment cost	Improved TCO with improved performance



Bacteria monitoring results for 249 frac tanks treated with X-CIDE 575 Microbiocide. Results expressed as the number of positive culture media bottles in a serial dilution series.

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