CleanStream® Water Treatment Service
Ultraviolet Light Bacteria Control Process for Fresh and Recycled Fluid

CleanStream® service, Halliburton’s ultraviolet (UV) light bacteria control process, uses a mobile unit capable of sterilizing water at flow rates from 10 to 118 bbl/min.

Using the service enables Operators to significantly reduce or eliminate the volume of biocides used to treat for aerobic and anaerobic (sulfate reducing) bacteria. For example, a 5 million gallon water frac treatment that normally requires 5,000 gallons of biocide can now reduce their biocide feed to 500 gallons and still achieve adequate fluid and reservoir integrity. Alternatively, with proper influent water quality, the traditional biocide can be completely eliminated—‘Green’ technology truly becomes ‘Green’ for the industry.

Controlling bacteria growth in downhole fluids and maintaining reservoir integrity is critical. Fracturing fluids and polymers used in floods are excellent food sources for microbes. When present in sufficient numbers, bacterial growth can impact the fluid, making it less effective.

In formation, bacteria growth in excess will lead to corrosion of iron or steel. This growth can also cause the well to sour, producing H₂S, hindering production.

How UV Light Controls Bacteria Growth
The use of UV light for disinfection and bacteria control is commonplace in hospitals, food processing, and water treatment industries. The cellular DNA of micro-organisms absorbs the energy from the UV light, causing damage to their DNA structure. While damage to cellular DNA from UV-A and UV-B spectrum light can be reversed rather easily, UV-C spectrum light, the type of light emitted by the CleanStream™ reactors, is almost always irreparable. In the presence of UV-C light, DNA unravels, as it reconnects, pyrimidine dimers are formed. This mutated DNA makes the bacteria unable to produce proteins or replicate.

Bacteria Problems in Polymer-Based Fluid Systems
In untreated water systems, bacteria are almost always present in either a planktonic or sessile state. Planktonic bacteria are free-flowing and motile. Sessile bacteria are colonies of bacteria encased in a slime layer fixed to a surface referred to as biofilm. For the oilfield, problems associated with biofilms and bacterial growth are bio-fouling and plugging, corrosion of tanks and piping, and degradation of the chemicals used to enhance production of oil and gas. Some of the more serious and longer term problems associated with bacteria come in the form of sulfate reducing bacteria (SRB) which reduce the sulfate ion
to sulfide. In the presence of iron or steel, this can lead to the corrosion of iron or steel and adversely affect productivity.

SRBs also pose possible health hazard in the form of hydrogen sulfide (H₂S) production. While these particular bacteria are not a problem in service chemicals, they may lead to contamination in the wellbore or the production formation which leads to sour gas or oil production and to corrosion and potential plugging by precipitating iron sulfide (FeS).

Bacteria can cause viscosity instability in polymers. In fact, in some environments, bacteria can be the chief cause of polymer degradation. The problem is generally the most severe in the summer months as bacteria are most active in polymerized fluids at temperatures of 60° to 100°F. It's warm, it's dark, it's wet, and there's food. Anaerobic microbes thrive in this environment.

The most likely location for bacteria is frac tanks, holding ponds, and impoundments. Frac tanks may contain several gallons of bacteria-ridden fluid from previous jobs. When new polymer is added, the bacteria have a new food source and begin to multiply rapidly.

Bacteria feed on gels by releasing enzymes that degrade the gels to sugars. The bacteria then absorb the sugar through their cell walls.

**Case History**

**Aerobic Test Results**

*Before CleanStream service treatment – 10⁶ bacteria/mL.*

*After CleanStream service treatment – 10⁵ bacteria/mL.*

**Aerobic SRB Test Results**

*Before CleanStream service treatment – 10⁶ bacteria/mL.*

*After CleanStream service treatment – 10⁵ bacteria/mL.*

CleanStream service provided excellent bacteria control on a fracturing treatment stage volume of 75,416 gallons pumped at 79.3 bpm. No prefilters were used and a small concentration of conventional biocide was used downstream from these samples to provide long-term protection. In the API RP 38 test (left) the presence of bacteria is indicated by the red vials turning yellow. In the API 38SRB test (right) the presence of sulfate reducing bacteria is indicated by the vials turning black.

**For more information about how CleanStream® service can help improve your environmental footprint, contact your local Halliburton representative or email us at stimulation@halliburton.com.**

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