WATER TREATMENT TECHNOLOGY FACT SHEET

BIOCIDES

Process Description

Biocides are applied to flowback water targeted for re-use because the fluids used to fracture rocks heat up when water is pumped into the ground at high speed, causing bacteria and mold to multiply. Furthermore, fracturing waters are often placed in open impoundments that may lie dormant for extensive periods of time, which in turn can facilitate conditions that increase microbe growth, especially in warm regions. Other sources of contamination can include mix water sources from rivers, ponds and lakes, and residue from frac tanks.

Problems associated with the presence of bacteria in fluids include plugging (inhibiting the flow of gas), and corrosion failures of downhole equipment, surface separation and storage tanks, and flowlines. Certain bacteria may facilitate solid deposition (or scale) and induce well damage while some acid producing microbes can cause additional corrosion issues. In addition, polymers used in well treatment fluids are subjected to conditions that are conducive to bacterial growth. Fracture fluids typically contain gels which are organic and can therefore provide a medium for bacterial growth. Bacteria can break down the gelling agent reducing its viscosity and ability to carry proppant. Biocides are added to the mixing tanks with the gelling agents to kill these bacteria.

Appropriate selection of biocides includes sampling of all water sources to identify specific microbes and testing after the application of selected biocides to insure effective results. Also, the selected biocide should not have any interaction with any of the additives in the frac fluid; the biocide should not affect fluid viscosity to any significant extent. Standard biocides being used in the Barnett Shale for instance, include Glutaraldehyde, THPS, DBNPA and Dazomet, which is applied at approximately 150 ppm.

Note: Information is from vendor, however specifications may have changed. Contact vendor for updates.

KEY CONSIDERATIONS

- Problems associated with the presence of bacteria in fluids include plugging, and corrosion failures of downhole equipment, surface separation and storage tanks, and flowlines.
- Biocides are not only used to remove microbial growth in fracturing waters, but are also used to control growth in producing formations.
- Volume of biocides is very low relative to the overall composition of water for fracture treatment: For example, 0.001% and 0.0065% in the Fayetteville and Marcellus Basins, respectively.

Technical Capabilities

The use of biocides are not only used to remove microbial growth in fracturing waters, but are also used to control growth in producing formations since biocides have residual disinfection capabilities. In some cases, depending on operational needs and water quality, the use of biocides is the only water treatment step needed prior to its re-use for fracturing, such as in the Haynesville Shale.

Technical Limitations

Certain components present in water such as; H_2S, iron sulfide, ammonia, or dissolved oxygen, may inhibit the effectiveness of biocide treatment. For water that is treated in conjunction with RO systems, the biocides must be non-oxidizing to prevent permanent damage to the RO membrane.

Although not necessarily a technical limitation, concerns associated with the application of biocides and the potential contamination within the receiving formation are resulting in the research and development of other microbial treatment options such as UV light or ozonation. Schlumberger reportedly is developing a new biocide that would only persist a few hours before becoming non-toxic. Although this new technology has not been field evaluated, a potential reduction in toxicity of chemicals returned to the surface in produced water could help to ease environmental and regulatory

concerns. However, important treatment and operational considerations are unknown at this time, including cost, effectiveness, residual disinfection capabilities, availability, etc.

Costs

Because the volume and type of biocide(s) that are necessary to control microbe growth depend on many factors, a cost associated with application is variable. Costs considerations would include the types of microbes and their concentration, cost effectiveness, cost per liter, cost per square meter treated, and cost per year.

The volume of application for biocides is low relative to the overall composition of water for fracture treatment. For example, approximately 0.001% and 0.0065% of fracture water in the Fayetteville and Marcellus Basins respectively, is composed of biocides.

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