**UV LIGHT**

**Process Description**
UV light exists in a region between visible light and x-rays, occupying a spatial spectrum between 1 to 400 nanometers (1 nm = 10⁻⁹ meters). In the shale gas industry, ultraviolet (UV) light has recently been introduced as a treatment option to help reduce the volume of biocide required to kill or inhibit microbe growth in produced water that is intended for injection or re-use. The use of UV treatment typically takes place prior to adding chemicals to the water, such as biocides or friction reducers, since the presence of constituents in the water can alter the effectiveness of the treatment process.

Although the use of biocides is still necessary when UV treatment is used on make-up waters for microbe treatment, the volume of biocides needed are greatly reduced. This in turn reduces residual biocides in produced water and thus the degree of treatment such wastewater might require. The use of UV light has been shown to reduce bacteria comparable to the efficiency of biocides in a cost effective manner and the equipment used is usually small (footprint) and can be integrated with most production operations. Furthermore, with the application of UV light, there is no formation of disinfection byproduct.

**Technical Capabilities**
UV light can be used to disinfect produced water and keep bacteria viruses, fungi, algae, and protoza from reproducing. The use of UV light is not affected by pH, temperature, or total inorganic carbon.

The effectiveness of UV light on water treatment is dependent on the rate of fluid flow, intensity of the UV light source, and the transmittance level of the fluid (e.g., the ability to allow light to completely pass through). To achieve a level of effectiveness and success, the water needs to be irradiated at an intensity of 110 mW/m² with 254 nm light for one second and a transmittance rate of at least 50% at 80 barrels per minute (bpm).

Recent application of UV light in the Haynesville Shale to treat HVHF fluids for horizontal wells indicated water treatment rates reached up to 120 bpm with disinfection quality equal to or better than the use of biocides. Volumes in the range of 3.4 to 3.7 million gallons of water were treated at an average rate of 80 bpm and initial concentrations of bacteria (1-10 million per cubic centimeter) were reduced by 99%. With the use of UV light, applied biocides to the water were reduced from 5,000 gallons to 500 gallons for a 5-million gallon HVHF stimulation.

**Technical Limitations**
As stated, biocides are still required at reduced volumes for long-term protection from bacteria when used in conjunction with UV light treatment. UV light treatment has no residual kill capacity and as such, the effectiveness of the treatment is limited to waters which can be passed through the treatment system. Microbes or other organisms already present in the target formation are not inhibited.

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**KEY CONSIDERATIONS**
- Can disinfect produced water and keep bacteria viruses, fungi, algae, and protoza from reproducing.
- UV system is capable of reducing the volume of biocides from 5,000 gallons to 500 gallons for 5-million gallon HVHF stimulation.
- Ecosphere estimates costs to treat water with their advanced oxidation process ranges from $0.60 to $0.75 per barrel (bbl).

**Table:**

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<tr>
<th>Treatment Company</th>
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<tr>
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<td>Marcellus</td>
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*Note: Information is from vendor, however specifications may have changed. Contact vendor for updates.*
affected by the UV water treatment process, nor are those that may be present in the additives or propants.

The performance of UV light water treatment on microbes in raw water is affected by the concentration of microbes, suspended solids, TDS (500 ppm) soluble molecules, humic acids and mineral concentrations. Pretreatment would be required to filter out these constituent types.

Because constituents in the make-up water may absorb the UV, decreasing its effectiveness at killing bacteria, the practice of reuse/recycling of produced water in subsequent fracture jobs may be incompatible with the process unless the TDS, etc., are at low enough concentrations that adsorption does not preclude sufficient transmittance for effective treatment.

**Costs**

EPA estimated the capital cost for a UV system at a 1.5-MGD plant is $200,000 which translates into $0.13/gpd. Operation and maintenance cost associated with this system is estimated at 1.5 cents/1,000 gallons of water treated.

Ecosphere Technologies (Ecosphere) has applied UV water treatment as part of an advanced oxidation water treatment process in the Fayetteville Shale. According to Ecosphere, associated costs to treat water with their advanced oxidation process ranges from $0.60 to $0.75 per barrel (bbl); the technology is capable of processing up to 10 bpm.

**References**


Kembe Kleinwolterink, Brandon Watson, Dave Allison, and Matt Sharrock, “UV Light Technology Controls Bacteria while Reducing Environmental Risks,” *World Oil* (December 2009).

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