Multi-Chem, a Halliburton Service, is helping hydraulic fracturing operators develop cost-effective biocide programs that deliver short- and long-term protection against microbial contamination and well souring without impacting safety, production goals and operating expenses.

Each operator has its own unique challenges and key performance indicators, requiring a solution that is customizable to align with all of their objectives, including cost and performance.

Multi-Chem has been using the Multi-Cide service to deliver consistent results across shale plays in the U.S. Although the proposed programs may be different with respect to chemistries, dosages and applications, the results are positive and consistent.

### CHALLENGES AND SOLUTIONS

**For hydraulic fracturing operators, oxidizers are the common solution to mitigate against the risks of short-term bacteria control. However, product selection is key, as oxidizers vary in their protection performance. Some work faster than others, and can create HSE hazards through off-gassing. Another challenge with oxidizers is they provide no long-term, downhole protection.**

Multi-Cide provides sustained long-term bacteria control. It is a multi-component application consisting of a stabilized bromine oxidizer combined with a preservative biocide to provide optimum bacterial control. These specialty chemicals solutions are pumped by Multi-Chem service representatives with Halliburton’s equipment to ensure their applications expertise maximizes the value of your assets.

The Multi-Cide service begins with a pre-job treatment review to determine the most effective biocide program to address specific needs. It also includes post-frac monitoring programs through data input into Multi-Chem’s APX™ (Analysis of Performance eXecution) digital tool for easy interpretation and reporting to help operators make improved decision-making.
PERFORMANCE AND SAFETY RESULTS

Multi-Cide eliminates sulfate reducing and acid producing bacteria (SRB/APB). Customers see significant reduction in bacteria counts 30, 60 and 90 days after stimulation.

The following table presents the volume of barrels treated by Multi-Chem in some of the basins we operate in.

<table>
<thead>
<tr>
<th>Area</th>
<th>Well Count</th>
<th>Stage Count</th>
<th>Barrels Treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Texas (Barnett)</td>
<td>15</td>
<td>707</td>
<td>8,494,501</td>
</tr>
<tr>
<td>East Texas/Louisiana (Haynesville)</td>
<td>51</td>
<td>2,432</td>
<td>25,832,044</td>
</tr>
<tr>
<td>West Texas (Permian)</td>
<td>105</td>
<td>3,210</td>
<td>32,104,716</td>
</tr>
<tr>
<td><strong>Total (September 2018 to July 2020)</strong></td>
<td><strong>171</strong></td>
<td><strong>6,349</strong></td>
<td><strong>66,431,261</strong></td>
</tr>
</tbody>
</table>

Committed to safety

Multi-Cide provides significant reduction in gaseous fumes compared to common oilfield oxidizers, which mitigates the HSE risks associated with off-gassing.

The following graph presents the relative off-gassing when diluted to field concentrations of a Multi-Chem biocide compared to common oilfield oxidizers – chlorine dioxide (ClO₂), peracetic acid (PAA), and bleach. The Multi-Cide technology is 85 percent less volatile than ClO₂, resulting in a significant reduction of potential fumes and gaseous hazard cause by mixing in blender and fac tanks.

Vapor Pressure of Common Oilfield Oxiders

(\(\text{mm Hg @ 25}\))

- **Multi-Chem Biocide**
- **12.5\% Bleach**
- **Peracetic Acid (PAA)**
- **Chlorine Dioxide (ClO₂)**

For a specialty chemicals treatment program characterized by superior service and chemical applications expertise that maximizes the value of your assets, contact us at multichem@halliburton.com

Sales of Halliburton products and services will be in accord solely with the terms and conditions contained in the contract between Halliburton and the customer that is applicable to the sale.

H013749 09/20 © 2020 Halliburton. All Rights Reserved.