OIL & GAS OPERATOR IN THE FAYETTEVILLE SHALE, WHO RECYCLES OVER 90% OF ALL OF THEIR FLOWBACK AND PRODUCED WATER, REPLACES HAZARDOUS CHLORINE DIOXIDE TREATMENTS.

CHALLENGE
An operator in the Fayetteville Shale was experiencing heavy Sulfate Reducing Bacteria (SRB) growth, greater than 10,000,000 colony-forming units of bacteria per milliliter of fluid. This level of bacteria also caused a constant background of Hydrogen Sulfide production at elevated levels. As a stop gap measure, the pit was treated with Chlorine Dioxide (ClO$_2$); however, this solution was expensive and would not prevent a future outbreak of bacteria due to quick dispersion of ClO$_2$.

MIOX’S SOLUTION
MIOX proposed a solution that would treat every barrel of fluid received while maintaining a residual concentration of oxidant in the water to eliminate SRB and APB bacteria and Hydrogen Sulfide. MIOX delivered its mobile Blackwater unit to the site, and using only delivered Sodium Chloride (NaCl) liquid brine, electricity and city water, has treated every barrel of incoming water. This treatment has been successful in reducing the 10,000,000 SRBs regularly seen to less than <1 colony-forming units of bacteria per milliliter of fluid. MIOX’s Blackwater solution treats months’ worth of water for what a single Chlorine Dioxide treatment costs while achieving the same (if not better) results, with a much better safety profile.

CASE STUDY
Blackwater Field Operations

LOCATION
Fayetteville Shale
- Produced/Flowback Water Recycling
- High Oxidant Demand Water
- Average >4k bbls per day

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EQUIPMENT
MIOX Blackwater
Includes two (2) MIOX RIO MOS generators

MIOX OXIDANT PRODUCTION
507 barrels/day of 4500 mg/L of Mixed Oxidant Solution (MOS)

PREVIOUS DISINFECTION
Chlorine Dioxide (ClO$_2$)

No more unpleasant smells. Instead of smelling like Hydrogen Sulfide, the water now smells like a swimming pool.

Site Operator, Fayetteville Shale
Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Untreated</th>
<th>Treated</th>
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</thead>
<tbody>
<tr>
<td>SRB</td>
<td>CFU/mL [MPN]</td>
<td>&gt;10,000,000</td>
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<tr>
<td>APB</td>
<td>CFU/mL [MPN]</td>
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<td>Hydrogen Sulfide (H₂S)</td>
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<td>ORP at Sample Time</td>
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<tr>
<td>Oxidant Demand</td>
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<tr>
<td>Residual Chlorine</td>
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<tr>
<td>Hydrogen Sulfide (H₂S)</td>
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<tr>
<td>Sulfate (SO₄²⁻)</td>
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<tr>
<td>pH</td>
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</table>

MIOX’s Advantage
Mixed Oxidant Solution (MOS) vs. Chlorine Dioxide (ClO₂)

Mixed Oxidant Solution (MOS) completely eliminated the Hydrogen Sulfide causing bacteria at much lower cost that treating with Chlorine Dioxide (ClO₂). A typical 160 mg/L treatment of MOS will use less than 4¢ per barrel of Table Salt and Electricity to operate. The same 160 mg/L treatment of ClO₂ would likely cost between 22¢ and 34¢ per barrel in hazardous chemical feed stocks.

While MIOX is clearly the lower cost solution in the industry, it is also one of the technologies that are the safest to use. Since ClO₂ is a dangerous gas, it requires specialized training, at least two personnel and breathing apparatuses to be on location in the event of an unexpected gas release. The CDC lists the Immediately Dangerous to Life or Health (IDLH) of ClO₂ as 5 ppm. This is 20 times more dangerous than the IDLH of Hydrogen Sulfide (H₂S) at 100 ppm.