Produced Water Challenges And Beneficial Use

September 13th, 2018
Well Count - 2,575
+34,000 Gross BOEPD
2.3 MMBWPD Produced
1.8 MMBWPD Reinjected
500 MBWPD Surface Discharged
What is Surface Discharge?
The disposal of produced water on the surface; Drainages, Creeks, Lakes, etc.

And yes... it is completely legal!

### WYDEQ Effluent Water Quality Standards vs Merit Sample

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Limit</th>
<th>Merit</th>
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<tbody>
<tr>
<td>pH, s.u.</td>
<td>6.5 – 9.0</td>
<td>7.3</td>
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<tr>
<td>Oil &amp; Grease, mg/L</td>
<td>10</td>
<td>ND</td>
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<tr>
<td>Sulfate, mg/L</td>
<td>3,000</td>
<td>2,230</td>
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<tr>
<td>TDS, mg/L</td>
<td>5,000</td>
<td>4,370</td>
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**SULFIDE = H2S**
OREGON BASIN - OVERVIEW

Discovered in 1912
540 Wells
7,300 Gross BOEPD
660 MBWPD Produced
627 MBWPD Reinjected
33 MBWPD Surface Discharged
Discovered in 1930
95 Wells
2,800 Gross BOEPD
320 MBWPD Produced
320 MBWPD Reinjected
NO Surface Discharge
WATERFLOOD PROCESS FLOW DIAGRAM

Central Battery

Surface Discharge

Producing Wells

Gas to Plant / Sales

Oil to Sales

H2O Injection

NPDES SYSTEM
Oil Production may stabilize with the larger ESP BUT the increase in LOE shortens the wells economic life.
Retention times may stabilize BUT for how long?
Produced Water that meets WYDEQ Water Quality Standards provides Beneficial Use that is critically important to many agricultural operations in the arid lands of the State of Wyoming.

Surface Discharge approved Produced Water offers a consistent source of water for any downstream user. Whether keeping drainages or irrigation reservoirs full, water is always available.
Based on decades of Beneficial Use, the WYDEQ Effluent Water Quality Standards are very well suited for the protection of livestock. These limits preserve beneficial plant and animal use.

Produced Water Discharge provides a dependable source of water for livestock and wildlife. It has created wetlands that provide habitat for plants, insects, birds and mammals.
Approximately 2,876 acres of enhanced habitat are supported by Merit Energy’s current produced water discharge volumes in the North Bighorn Basin. These habitats are as follows:

- **Riparian Habitat**
  - 69.3 miles of perennial streams
  - 1,552 acres of riparian vegetation

- **Lacustrine Habitat**
  - 586 acres of lakes and ponds

- **Wetland Habitat**
  - 738 acres of wetlands and wet meadows

**Our landowners want MORE**

**Wyoming needs MORE**

**We have to discharge MORE**
We reviewed 31 specific sulfide reduction technologies and ranked them based on:

- Efficacy, Safety, Cost & Environmental Persistence
- Hazardous Materials Management / Waste

5. Ion Exchange:
   Pros: Removes H2S & Reduces TDS
   Cons: High CAPEX/OPEX / Extensive O&M

4. Fixed Bed Sorbents:
   Pros: Removes H2S w/ Non-Hazardous Material
   Cons: Solid Waste Handling / Extensive O&M

3. Aeration:
   Pros: Removes H2S
   Cons: High CAPEX/OPEX / Extensive O&M

2. pH Adjustment:
   Pros: Increases pH to keep H2S from generating
   Cons: Increases TDS / On-Site Chemical Storage

1. Oxidation – Specifically, SuperOxygenation:
   Pros: Converts Total Sulfide / Low OPEX
   Cons: High CAPEX
• Dissolved Oxygen + Dissolved Sulfide = Biochemical Oxidation
• Dissolved Sulfides are metabolized in 15-30 minutes
• Dissolved Sulfides are oxidized to Sulfur and Sulfate

2 H\textsubscript{2}S + O\textsubscript{2} → 2 H\textsubscript{2}O + 2 S
H\textsubscript{2}S + 2 O\textsubscript{2} → 2 H + SO\textsubscript{4}

This is a well documented reaction and is included in the Water Environment Federation Manual of Practice 25, “Control of Odors and Emissions from Wastewater Treatment Plants”.
MEC PILOT TEST – BATTERY 1 NORTH

O2 Generator

O2 Vessel

25,000 BWPD CIRCULATION

500 BBL TANK

Pump

3,000 BWPD

3,000 BBL WATER TANK

3,000 BBL WATER TANK

PIT #1
86’ DIA
6,207 BBLs CAP
Pilot Test started @ 09:00 on 9/19/17
THANK YOU!