Microbial Huff-N-Puff
Unconventional Shale EOR in the Permian Basin

Unlock Reservoir Value with Advanced Bio-Chemical Technology

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Mission and Vision

- **Mission:** Unlock Reservoir Value with Advanced Subsurface Microbiology Technology
- **Vision:** Tomorrow’s Oil from Yesterday’s Wells

- **2X EUR** for Unconventional Shale Oil
- **Increase Oil Recovery Rate by 12% or more for Conventional**
The Inventory of Ongoing and Historical Projects
Laboratory: Subsurface Bio-Chem Technology Support

Aerobic & Anaerobic Cultivation

Microbiological

Chemistry

Service & Research

http://ultrecovery.com/lab/
Challenges: **Unconventional Resource**

- **Production Decline for the First 24 Months**

  - In the formation near Midland, some major oil companies’ wells lost **52% of their output after first 12 months**.
  - While most of the E&Ps **lost 70% of their output after the first 12 months**.
Principles: Why Rapid Decline Rate and Low EUR?

- The otherwise flowed back fracturing fluid additives left in the shale formation
  - Impair the fracture network conductivity
  - Block the flow paths for reservoir fluids
  - Low viscosity of slick water leads to relatively poor proppant placement
Principles: Why Rapid Decline Rate and Low EUR?

- Real-time monitoring of the damage on fracture surfaces caused by chemical infiltration with SEM and NMR:
  - Pores on shale matrix is at the scale of Nanometer, while the friction reducer and guar are at the scale of micron.
  - Permanent permeability loss caused by the chemical and emulsion blockage on fracture surfaces.

<table>
<thead>
<tr>
<th>Sequence number</th>
<th>Time</th>
<th>Sagittal plane 1</th>
<th>Sagittal plane 2</th>
<th>Sagittal plane 3</th>
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<tbody>
<tr>
<td>1</td>
<td>20 min</td>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
<td><img src="image3" alt="Image" /></td>
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<td>2</td>
<td>60 min</td>
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<td>3</td>
<td>150 min</td>
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<td><img src="image8" alt="Image" /></td>
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</tbody>
</table>

Red color: Pores
Blue Color: HPAM (Friction Reducer)
Principles: How to Stimulate the Indigenous Microbes?

Microbes
- Present but dormant
- Exist only in water phase

When all 3 present = Growth
- Remove any of the 3 = No Growth

Carbon
- Oil & Fracturing Chemicals (HPAM, Gel, Emulsion, etc.)
- Food source

Nutrients
- Proprietary Additives
Principles: Biodegradation of Fracturing Fluid Additives

- Stimulating the beneficial bacteria to degrade the fracturing fluid additives with the proprietary nutrients.
Pilot #1: ULTRSHALE® Pilot in the Delaware Basin

**Note:** The 500 bbl water with nutrient may only enter into limited fractures and near the wellbore, diverter technology is required to distribute more nutrients to more fractures, and ultimately uplifts the decline curve much higher.

### Well Basics:
- Unconventional Horizontal Fractured well
- TVD: 9800 ft.
- Lateral: 4580 ft.
- Fractured Stages: 20
- Proppant intensity: 1,100 lb/ft
- Porosity: ~7%
- Permeability: ~800 nd
- Well completed in 2014
- Initial prod: 625 BOPD
- Cum Prod: 174 Mbbls 04/19
- Injected nutrient: 500 bbl
- Shut in: 7 days

<table>
<thead>
<tr>
<th>180 Days After</th>
<th>EUR Increase</th>
<th>9%</th>
<th>25 MBO</th>
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</table>

**Ave Liquid Prod (BLPD)**
- Pre-treatment: 145.0 133.0 137.0 138.5
- Post-treatment: 166 194 249 259 233

**Ave Liquid Prod Uplift %**
- 40% 82% 95% 61%

**EUR Incremental = 18,000 bbl**
Pilot #2: ULTRSHALETM Pilot in the Midland Basin

Well Basics:
- Unconventional Fractured Vertical well
- TVD: 9000 ft.
- Porosity: ~9%
- Permeability: ~0.05 md
- Well completed in 2014
- Initial prod 108 BOPD
- Cum Prod 13,300 bbls
- Injected nutrient: 500 bbls
- Shut in: 7 days

EUR Increase
12%
2.1 MBO

Incremental EUR = 2,200 bbl
Market Projection: Potential Unconventional EOR

- Permian selected candidate wells (assuming single section wells)
  - Horizontal wells 6039, RevitaWell™ adds 18000*6039 = 109MM bbls
  - Vertical wells 30378, RevitaWell™ adds 2200*30378 = 67 MM bbls
  - RevitaWell™ EOR adds 176MM bbls recoverable from Permian
- Permian only market potential of adding $9 Billion at $55 flat WTI price
- Permian basin adds 2000+ new horizontal wells, which will build big inventory of ULTRSHALE™ EOR

<table>
<thead>
<tr>
<th>Play Name</th>
<th>Vertical Wells</th>
<th>Horizontal Wells</th>
<th>EOR Potential (MM bbls)</th>
</tr>
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<tbody>
<tr>
<td>Permian</td>
<td>30,378</td>
<td>6,039</td>
<td>176</td>
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<tr>
<td>Eagle Ford</td>
<td>0</td>
<td>14,973</td>
<td>159</td>
</tr>
<tr>
<td>DJ</td>
<td>8,046</td>
<td>7,815</td>
<td>103</td>
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<tr>
<td>Bakken</td>
<td>0</td>
<td>11,358</td>
<td>91</td>
</tr>
<tr>
<td>SCOOP/STACK</td>
<td>0</td>
<td>2,535</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>38,424</td>
<td>42,720</td>
<td>549</td>
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</table>

$30 Billion Market
**Comparisons: ULTRSHALETM Vs. Drilling & Fracturing**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Drilling &amp; Completion</th>
<th>ULTRSHALETM</th>
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</thead>
<tbody>
<tr>
<td>Budget</td>
<td>$10MM per HZ well</td>
<td>$10MM per 100 HZ wells</td>
</tr>
<tr>
<td>Estimated Flowing BBLs</td>
<td>1,000 BOPD</td>
<td>10,000 BOPD (100 BOPD per well)</td>
</tr>
<tr>
<td>Cost per Flowing BBL</td>
<td>$10,000 per flowing bbl</td>
<td>$1,000 per flowing bbl</td>
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Cost Per Flowing BBL for **ULTRSHALETM EOR is < 10% of Drilling and Completion**

It is time for **Game Change** in developing unconventional shale oil in the downturn of petroleum industry and economic depression.
QUESTIONS?

THANK YOU

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