The science of Organic Oil Recovery involves essentially feeding microbes that are living in oil reservoirs with a custom-formulated biodegradable organic nutrient so that the microbes exponentially multiply. The microbes interact with the immobile trapped oil and thereby alter the interfacial tension of the oil causing microscopic droplets to form. The micro oil droplets are then released and can be produced back to the surface.

The five steps of the Titan Process include:

**Step 1: Candidate Selection**

The general field characteristics that the Titan Process can ideally be applied include:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>API Gravity</td>
<td>16-41˚F</td>
</tr>
<tr>
<td>Temperature</td>
<td>&lt;185˚F</td>
</tr>
<tr>
<td>Permeability</td>
<td>&gt;50md (have treated as low as 7.5md)</td>
</tr>
<tr>
<td>Salinity</td>
<td>&lt;10% (ideal)</td>
</tr>
<tr>
<td>Total dissolved solids (TDS)</td>
<td>&lt;10% (ideal)</td>
</tr>
<tr>
<td>Porosity</td>
<td>14-30% (normal range)</td>
</tr>
<tr>
<td>Formation type</td>
<td>Sandstone, carbonate</td>
</tr>
<tr>
<td>Water cut</td>
<td>50-98%</td>
</tr>
<tr>
<td>pH</td>
<td>6-8 (ideal but depends on microbe ecology able to work outside this range)</td>
</tr>
</tbody>
</table>

Water flood response is a top indicator of success with Titan Organic Oil Recovery

**Step 2: Laboratory Analysis**

If the petrophysical information appears favorable, representative samples of produced water are collected and evaluated to determine if a favorable microbial community exists in the reservoir. A suitable nutrient stimulant is tailored for the specific microbe community.

**Step 3: In situ Microbial Response Pilot Test**

The nutrient package is blended and pumped into a single oil producer followed by 150% displacement volume. The well is shut in and sampling is collected on a scheduled basis.

**Step 4: Targeted Waterflood Implementation**

Offset injector wells are selected for treatment on a scheduled basis.

**Step 5: Full Field Development**

This step occurs when the field shows a noticeable increase in oil production. The well is then monitored and additional treatments may be recommended.

**Features**

- Microbial Population Expansion depends on:
  - Temperature
  - Salinity
  - Chemical compounds in the water
  - Volume

**Benefits**

- Substantial Increase in Oil Production
- Significant Increase in Cash Flow
- Reserves Increase
- Oil Fields Can Be Tested Easily and Inexpensively
- Low Cost Field Pilots
- No Capital Expense
- Field Net Present Value Increases
- Well Abandonment may be Deferred

In partnership with:
Improved Oil Mobility | Smaller micro droplets move more easily through the pore matrix
---|---
Pore to Pore Displacement | Fluid mobility creates a vacuum which is filled by fluids from adjacent pore spaces
Relative Permeability | Relative permeability of water decreases and relative permeability of oil increases
Wettability | Oil droplets are more easily released from the rock surface
Water Cut Decreases | Due to the higher relative permeability of oil, less water is produced
Viscosity | Apparent viscosity decreases with the formation of the droplets and the reduction in the resistance to flow
Interfacial Tension | The interfacial tension between oil and water decreases as the microbes become more hydrophobic at the pore interphase to help separate the oil
Waterflood Sweep Efficiency | Only in high permeable areas (thief zones) the combination of the micro-droplets, water and microbes can combine and agitate to form a temporary mild emulsion which temporarily divert water elsewhere

*The Micro Droplet Effect*
Dead California Well (Shut In Since 2003) Returned to Production in 2008

Canadian Water Injector Treatment Impacts Offset producer

California Offshore, production up 200% three years after treatment

Canadian Unit Response to Titan Process

Saskatchewan Production Response: 200%, 1 Treatment

Dead California Well (Shut In Since 2003) Returned to Production in 2008