THE RELATIVE PERMEABILITY MODIFIER AND ITS APPLICATIONS / CASE STUDY

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RPM – What is it?

Relative Permeability Modifier.

- Reduces the effective permeability to brine with no loss in the effective permeability to hydrocarbon.
  - Hydro-phobic polymer.
RPM - Properties

• **Low Viscosity.**
  - 1.4 – 2.0 cp.

• **Base fluid is recommended to be 2%KCl but it also could me mixed with:**
  - KCl up to 9.5 lb/gal.
  - NaCl up to 9.6 lb/gal.
  - NaBr up to 11.5 lb/gal.
  - CaBr₂ up to 12.0 lb/gal.
  - CaCl₂ up to 9.9 lb/gal.

• **Compatible with most acids.**
• **Bleach and strong oxidizers removes the polymer from the rock face.**
• **Crude oil will negate the fluid-loss properties of LO-Gard treatment.**
RPM - Applications

- The treatment is targeted for wells with permeability up to 6 Darcies.
- It is usable in temperature ranges up to 350°F.
- The original concept used this treatment to help control fluid loss in perforating/gravel pack completions and in Hz OHGP.
- Further applications included:
  - Lost circulation
  - Well clean out
  - Cementing
  - Fracturing
  - Drilling operation
Lab Testing

3rd Party Lab testing in Aberdeen:

- 2 x 2D Cores.
- Measure Permeability with N2.
- Saturate 1st core in formation water.
- Determine permeability to brine in injection direction for 1st core.
- Determine initial permeability to oil in production direction for 1st core.
- Saturate 1st core in formation water.
- Treat with RPM.
- Determine permeability to brine in injection direction for 2nd Core.
- Determine permeability to oil in production direction for 2nd Core.
Lab Testing

Table 6: Regained permeability test results

<table>
<thead>
<tr>
<th></th>
<th>Before LO-Gard application</th>
<th>After LO-Gard application</th>
<th>Percent regained permeability (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permeability to brine</td>
<td>1240</td>
<td>60</td>
<td>4.8</td>
</tr>
<tr>
<td>Permeability to oil</td>
<td>1632</td>
<td>1160</td>
<td>71</td>
</tr>
</tbody>
</table>
Applications

Fluid Loss Control
- LoGard

Water Shut Off
- WaterWeb

Acid Diversion
- Guidon AGS

Frac Applications
- CWF

RPM
Case History #1 – Ecuador – RIH with SAS

Challenges
- High circulation rate for effective clean up.
- Fluid loss rate before running screens.
- Reducing screen plugging damage.

Well Data:
- Hz Section: 1000ft of 6 1/8” ID with SAS
- 3000 md sandstone formation.
- BARADRIL-N DIF Completion brine: 8%KCl Brine + 0.2% Surfactant.

Well Condition during pre-screen clean up:
- 16 bbl/hr loss rate after a 50 bbl carbonate pill

Contingency plan was to pump LO-Gard.
- 35 bbl LO-Gard treatment was pumped.

Results:
- Static fluid loss reduced to 2 bbl/hour.
- Screen run without measurable losses.
Case History #2 – Brazil

Challenges

• New well completion with an unexpected gas zone flowing after perforation.
• Increasing completion fluid density. Increased fluid loss into the perforated zone.

Well Data:

• Vertical 2,150 m depth of perforation.
• Sergi Formation with 18% Porosity

Well Condition before treatment:

• 4.8 bbl/hr loss rate after particulates and viscous pills pumped.

Contingency plan was to pump LO-Gard.

• 10 bbl LO-Gard treatment was pumped.

Results:

• Static fluid loss reduced to 0 bbl/hour.
• Operator completing the well with no more delays.
• Economic value created was $52,000
Case History – Water Shut off SPE 101977

- Bar charts showing the number of successes, failures, and cases with not enough data.
- Graphs illustrating the relationship between temperature, lithology, formation permeability, and water production before and after intervention.

The charts depict a clear trend indicating improvements in water shut-off effectiveness with specific parameters.
Case History – Water Shut off SPE 101977
Thanks you