Well Integrity Improvement Using High Temperature Swellable Technology

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Topics

• Explanation of Swellable Technology

• Research and Development of High Temp Technology

• Applications for Analogous E&P
Swellable Elastomer Technology

- Developed around 17 years ago for non-cemented completions
- Provides annular isolation or flow diversion
- Highly reliable for the intended use, simple to use, and cost effective
- No moving parts, no pipe manipulation, no balls to drop, or application of hydraulic force to activate.
Swellable Elastomer Technology

- Elastomers are designed to increase in volume when exposed to hydrocarbons and/or water
- Natural rubber swells by diffusion when exposed to hydrocarbons
- To swell in water the base elastomer must have material added that will promote swell
Swellable Packer Technology

• Packer construction and typical use
Swellable Packer Technology

*Design Considerations for High Temperature*

- Elastomers mechanical properties reduce as temperature increases
- Anti-Extrusion barriers are required above 350°F
- Considerations for temperature cycling need to be addressed
High Temperature Packer Construction

Design Considerations for High Temperature

- Anti-extrusion barriers
High Temperature Packer Construction

Design Considerations for High Temperature

• Design Validation
High Temperature Packer Construction

Design Considerations for High Temperature

- Temperature affects – volumetric thermal expansion
Packer Performance Predictions

<table>
<thead>
<tr>
<th>Input Parameters</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casing Size</td>
<td>5.50 in.</td>
<td>139.7 mm</td>
</tr>
<tr>
<td>Minimum Restriction</td>
<td>8.50 in.</td>
<td>215.9 mm</td>
</tr>
<tr>
<td>Sealing ID - Minimum</td>
<td>8.50 in.</td>
<td>215.9 mm</td>
</tr>
<tr>
<td>Sealing ID - Maximum</td>
<td>8.50 in.</td>
<td>215.9 mm</td>
</tr>
<tr>
<td>Maximum Δ Pressure</td>
<td>3,000 psi</td>
<td>206.9 bar</td>
</tr>
<tr>
<td>Wellbore Deviation</td>
<td>0.0 deg</td>
<td>0.0 deg</td>
</tr>
<tr>
<td>Setting Depth Temperature</td>
<td>500 deg F</td>
<td>260.0 deg C</td>
</tr>
<tr>
<td>Setting Depth</td>
<td>8,102 ft.</td>
<td>2,469 meter</td>
</tr>
<tr>
<td>RIH Time</td>
<td>24.00 hr.</td>
<td></td>
</tr>
</tbody>
</table>

Packer Diameter vs Time

Time (Days)
High Temp Swellable Packer and Cement
High Temp Swellable Packer and Cement
High Temp Swellable Packer and Cement Case History

Description of Problem

- Annular casing pressure buildup a problem on majority wells
- Pressure seen on both A & B annuli after steam cycle.
- Problem at times severe enough to result in well abandonment
- Cement failing under radial and axial loading
High Temp Swellable Packer and Cement Case History

Proposed Solution

- Run swell packers as part of 5.5” Casing
- Position packer inside 9.625” casing above shoe
- Setting in the casing gives a none sealing diameter as opposed to the open hole
- Packer lengths tried are 15’ and 20’
High Temp Swellable Packer and Cement Case History

Results to date

- Over 50 packers have been installed
- Annulus pressure reduced by 67% on average
- 73% of wells with swell packers have less than 200 psi
- All wells without swell packers have pressure above 200 psi
- Positive results after cycles
- Top jobs show to affect the success of the swell packers
Irregular Shaped Boreholes

- Drilling in offset horizontal stress environments
Irregular Shaped Boreholes

- Drilling in offset horizontal stress environments
Conclusion

• High temperature swellable packer technology enhances cements ability to provide wellbore integrity for wells exposed to high temperature during steam injection cycles

• The technology is easy to adapt to a variety of operational parameters

• The technology is easy to implement and operationally simple to adopt.
Questions?