Oil Production Increases by 238% in Chevron’s Tengiz Field

Case study: VDA system improves zonal coverage of stimulation treatments in large carbonate reservoir

Challenge
Improve zonal coverage during acid stimulation and increase oil recovery.

Solution
Use the Schlumberger VDA* viscoelastic diverting acid system to create diversion and stimulate previously unstimulated zones.

Results
Increased production by an average of 238%—and achieved full zonal coverage—in all the treated wells.

Acid stimulation in Tengiz field
The Tengiz field in Kazakhstan is a large carbonate reservoir in which zonal coverage during acid stimulation of wells is a significant issue. Conventional stimulation methods tend to inject acid only into the higher permeability layers or the first stimulated zones.

The primary method that Chevron used for stimulating Tengiz field wells was to inject 15% HCl conveyed by coiled tubing (CT). Spotting the acid in front of the different reservoir layers provided diversion.

VDA fluid rapidly develops viscosity in situ.

Diversion achieved using the VDA system
Laboratory results have shown that viscoelastic diverting acid systems provide diversion during stimulation of limestone reservoirs. Based on these results, Schlumberger used the VDA system to stimulate eight wells in the Tengiz field. Production logs and pressure transient tests were performed before and after stimulation to evaluate the results.

Significant production increase
All eight wells stimulated with the VDA system showed a significant increase in production and achieved a high negative skin value. The prestimulation average production rate was 52,030 bbl/d and the poststimulation average production rate was 123,670 bbl/d—an increase...
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The chart shows the production increase from preproduction (52,030 bbl/d) to postproduction (123,670 bbl/d), an increase of 238%.

All eight wells stimulated with the VDA system showed a significant increase in production and achieved a high negative skin value. The prestimulation average production rate was 52,030 bbl/d and the poststimulation average production rate was 123,670 bbl/d—an increase of 238%.

<table>
<thead>
<tr>
<th>Well No.</th>
<th>Conveying Method</th>
<th>PLT</th>
<th>Prestim. Rate, bbl/d</th>
<th>Poststim. Rate, bbl/d</th>
<th>Prestim PI, bbl/d/psi</th>
<th>Poststim PI, bbl/d/psi</th>
<th>Prestim Skin</th>
<th>Poststim Skin</th>
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<tr>
<td>Well No. 1</td>
<td>CT</td>
<td>Yes</td>
<td>11,930</td>
<td>20,940</td>
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<td>No</td>
<td>6,600</td>
<td>11,370</td>
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<td>5.8</td>
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<td>28,000</td>
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<td>NA</td>
<td>NA</td>
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<td>12,250</td>
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<td>3.0</td>
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<td>−4.8</td>
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<td>0.5</td>
<td>2.4</td>
<td>15.6</td>
<td>−2.8</td>
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</table>

of 238%. Production logs showed that the system was able to divert part of the acid from the most permeable zones to the other zones, achieving full zonal coverage.

Treatment results indicated that the VDA system

- was able to achieve full zonal coverage in stimulating these large limestone reservoirs, whether conveyed through CT or bullheaded from surface
- was a more effective diversion method than coiled-tubing-conveyed methods that used conventional linear acid systems
- allowed oil recovery from the zones with the greatest formation damage, which was not previously achieved using conventional stimulation methods because stimulation fluids tend to migrate to the most permeable zones.