Case Study
ProOne Downhole Drilling Fluid
Major Operator Elk Hills, CA
May 25th, 2012

“In 30 years I have never seen anything reduce torque like ProOne Downhole Drilling Fluid”

- Company Man

Summary:

Project TD: 15,000 ft.

Substrate: Chert
Torque as found: 14,900 to 16,200 Avg. 15,550 ft.-lbs.
Total System Volume: 1200 barrels
Slug Pit: 105 barrels
Mud Pit: 450 barrels - Balance in closed looped system: 645 barrels

Treatment: ProOne Down Hole Drilling Fluid
Bit Depth: 12,025 ft.
Slug Pit: 5%
Mud Pit: Balance of the mud system 3%

Results:

Torque Reduced from: Avg. 15,500 ft.-lbs. to Avg. 8,500 ft.-lbs.
= 45% Reduction
Elk Hills, CA
May 25th, 2012

Torque Average: 15,539 ft./lbs.
ROP Average: 4.3 fph
Bit Weight: 22,900 lbs.

Torque: 12,883 ft./lbs.
ROP Average: 5.2 fph
Bit Weight: 23,800 lbs.

ProOne DHDF added to Slug Pit at 06:00. Torque begins to drop.
Elk Hills, CA
May 25th, 2012

Torque: 9,158 ft./lbs.
ROP Average: 4.3 fph
Bit Weight: 25,400 lbs.
ProOne is in full circulation at 3%. - Top of Torque Range

Torque: 8,041 ft./lbs.
ROP Average: 4.5 fph
Bit Weight: 24,500 lbs.
ProOne DHDF remains in full circulation at 3%. Bottom of Torque Range.
ProOne was re-introduced to the mud system to bring up to 3% of the systems volume. Torque was reduced back to 8,743 ft. lbs. while RPM was decreased to 65RPM.

ProOne was diluted through hydration to 2% by volume. Torque returned to 14,478 ft.lbs. of torque.
Torque: **10,239 ft./lbs.**
ROP Average: **5.5 fph**
Bit Weight: **35,000 lbs.**

ProOne is at 3% of total volume. RPM is reduced again to 55RPM and WOB has increased from 24,400 lbs. to 35,000 lbs. Torque only rose to 10,230 ft.lbs.
Case Study
ProOne Downhole Drilling Fluid
Major Operator Shafter, CA
July 31, 2012

Solved torque & drag problem in this highly deviated well.

Summary:

Project TD: 13,000 ft.

Substrate: Sand/Shale Clay & Chert
Torque as found: 8,500 ft.-lbs.
Drag: 84,000 lbs.
Circulating Drag: 30,000 lbs.
ROP: 135 fph

Treatment: ProOne Down Hole Drilling Fluid
Bit Depth: 12,656 ft.
Slug Pit: 5%
Mud Pit: Balance of the mud system 3%

Results:

Torque Reduced from: 8,500 to 6,000 ft.-lbs. = 29.4% Reduction
Drag from: 84,000 to 50,000 lbs. = 40% Reduction
Circulating Drag from: 30,000 to 12,000 = 60% Reduction
ROP: 135 to (148 to 155 fph) range = 15% Increase
**Trial Well Conditions:**
A deep, highly deviated well was being drilled with a 12.8 ppg clay-based mud system. High and erratic torque and drag levels were encountered while drilling 6/18” hole below 12,500’, with a well deviation of over 87°. Projected TD was 13,000’, and the rig top drive capacity was rated at 9,500 ft.-lbs. with the existing drill pipe.

The use of oil as a drilling lubricant was not considered, in order to avoid any interference with the downhole imaging tool and to minimize and adverse effect on the resulting mud log.

**Challenge:**
A desire was expressed to attempt to extend the total depth of the well an additional 500’, to ~13,500’. At the same time, while drilling below 12,500’ (about 500’ from the initially projected TD) torque and drag in this highly directional well were becoming excessive and wildly variable, potentially limiting the ability of the rig to obtain the desired TD with current conditions.

In light of the increased TD and hole configuration/torque and drag challenges, a decision came to utilize the ProOne DHDF as a lubricant additive, building up to 3% by volume to specifically reduce the high torque; this would serve as a field test to determine any effect on the imaging tool or mud log.

**ProOne Trial Specifics:**
Sinclair Well Products was contacted at 3:30pm on July 31st, to deliver enough of the product to obtain a 3% by volume concentration in the active mud system at the rig. Product delivery was scheduled, and 24 drums arrived on location by 8:30pm the same day.

Starting at midnight (depth 12,656’), the product was added to the system in 100 barrel, 5% by volume pills/sweeps, until the desired 3% concentration was obtained (total of 18 drums). Drilling continued during this process until 4am (12,836’), where a tooling failure required a subsequent bit/tool trip.

After the bit/tool trip, the hole was continued to 13,000’, where another tool failure prompted another trip and subsequent end of the well. No additional product was added for maintenance, and well completion operations went as planned with no torque/drag issues.

**Results/Observations:**
The addition of ProOne DHDF reduced torque and drag immediately and significantly. The enhanced lubricity provided by DHDF extended rig capacity on this well, supporting the desire to deepen the well an additional 500’, and possibly further.

Torque and drag levels were reduced significantly during this test, and torque and drag readings also became far less erratic after adding the product, which should provide more consistent WOB and other benefits to the drilling operation over time.

Further trials will continue to validate the technical and operational advantages of utilizing the environmentally acceptable ProOne DHDF as a supplemental drilling fluids lubricant. Improvements should result in reduced torque/drag levels, less trouble-time related to highly deviated wells, reduced/improved drilling time and cost, and other secondary benefits.
The information below reflects the conditions prior to and during the trial:

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Depth</th>
<th>Torque (ft lbs)</th>
<th>Drag (#, pump off)</th>
<th>Drag (#, pump on)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/31, 4:30pm</td>
<td>12,300’</td>
<td>7,200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7/31, 6pm</td>
<td>12,340’</td>
<td>8,500</td>
<td></td>
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<tr>
<td>7/31, 6:30pm</td>
<td>12,400’</td>
<td>8,600</td>
<td>65,000</td>
<td></td>
</tr>
<tr>
<td>7/31, 7:30pm</td>
<td>12,450’</td>
<td>7,500</td>
<td>74,000</td>
<td>57,000</td>
</tr>
<tr>
<td>7/31, 8:30pm</td>
<td>12,500’</td>
<td>7,700</td>
<td>66,000</td>
<td>28,000</td>
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<tr>
<td>7/31, 9:30pm</td>
<td>12,550’</td>
<td>7,400-7,800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7/31, 10:30pm</td>
<td>12,600’</td>
<td>7,800-8,800</td>
<td>76,000</td>
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<tr>
<td>7/31, 11pm</td>
<td>12,650’</td>
<td>8,500-8,900</td>
<td>75,000</td>
<td>30,000</td>
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<tr>
<td>8/1, 12:30am</td>
<td>12,700’</td>
<td>8,000-8,500</td>
<td>84,000</td>
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</tr>
<tr>
<td>8/1, 1:30am</td>
<td>12,750’</td>
<td>7,000</td>
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<tr>
<td>8/1, 3am</td>
<td>12,800’</td>
<td>7,200-8,000</td>
<td>50,000</td>
<td>16,000</td>
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<tr>
<td>8/1, 4am</td>
<td>12,835’(trip)</td>
<td>6,000-6,600</td>
<td>50,000</td>
<td>14,000</td>
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<td>8/2, 10am</td>
<td>12,850’</td>
<td>5,800-6,400</td>
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<td>8/2, 11:15am</td>
<td>12,900’</td>
<td>6,200-6,700</td>
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<td>8/2, 12:30pm</td>
<td>12,950’</td>
<td>6,800</td>
<td>50,000</td>
<td>12,000</td>
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<tr>
<td>8/2, 2pm</td>
<td>12,988’</td>
<td>6,800</td>
<td>19,000</td>
<td>9,000</td>
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</table>

Direct Results

1. **ProOne reduced torque from 8,500 ft. lbs. to 6,000 ft. lbs. (a direct reduction of 29.4%)**
2. **ProOne reduced drag from 84,000 lbs. to 50,000 lbs (direct reduction of 40%)**
3. **ProOne reduced circulating drag from 30,000 lbs. to 12,000 lbs. (direct reduction of 60%)**

Before adding ProOne, torque was 6,600ft lbs. when off bottom; after it was added, torque circulating off bottom dropped to ~5,200 (reflecting a 21% reduction/improvement).

Before adding ProOne, ROP was at ~135 fph (inconsistent, with highly variable and erratic torque and drag readings). After the addition, ROP increased to ~148-155 fph. (15% improvement; however, too erratic to be considered a direct quantitative improvement)

The addition of ProOne had no adverse effect on either the downhole imaging tool or the mudlog.

Bit/tool trip after adding ProOne went very smooth, with minimal amount of tight spots and drag. Drilling resumed with the new bit/tool, with rotary torque levels at or below 6,000 ft. lbs.

Future Recommendations/Opportunities:

1. Utilize ProOne as an additive on future ‘critical well-path’ wells, to reduce anticipated or observed torque and drag, to increase depth capacity of rigs (especially on highly deviated wells), reduce circulating and trouble-time due to tight hole, and enhance WOB and ROP.
2. Identify a future well candidate, to quantify the potential ROP increase from using ProOne as a regular lubricant/torque reducer additive in a clay-based system.
Case Study
ProOne Downhole Drilling Fluid
Major Operator, West Texas
July 19th, 2012

Conditions:

Well #1 was drilled straight to KOP with no torque issues. ProOne was contacted because Well #2 was approaching max torque limits shortly after intermediate casing due to a 12 degree tangent, starting at 500 feet. It appeared that the well could not be completed.

“We would have not been able to finish this hole without ProOne.”
- Company Man

Summary:

Well #2 Total Depth: 15,445 ft.
Torque as found: 15,550 ft.-lbs.
Total System Volume: 1389 barrels
Slug Pit: 105 barrels
Mud Pit: 450 barrels

Treatment: ProOne Down Hole Drilling Fluid
Bit Depth: 8,280 ft.
Slug Pit: 5%
Mud Pit: Balance of the mud system 3%
Balance in closed looped system: 849 barrels

Results:

Well was completed
Torque Reduced to: 9,700 ft.-lbs. = 37% Reduction
12% ROP Increase in the Lateral
Curve completed in half the time
Saved 2 Drill Bits & 2 Trip Outs
Over $300,000 in documented savings
# Case Study
## ProOne Downhole Drilling Fluid
### Major Operator, West Texas
#### July 19th, 2012

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### Downhole Drilling Fluid

<table>
<thead>
<tr>
<th></th>
<th>Oil Base Mud: 80% Diesel / 20% Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mud Weight: 8.9 @ 8,126 ft.</td>
</tr>
<tr>
<td></td>
<td>Viscosity: 58</td>
</tr>
<tr>
<td></td>
<td>Yield Point: 17</td>
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</tbody>
</table>

### Oil Base Mud w/ ProOne Downhole Drilling Fluid @ 3% by Volume

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>Mud Weight: 8.9 @ 9,950 ft.</td>
</tr>
<tr>
<td></td>
<td>Viscosity: 56</td>
</tr>
<tr>
<td></td>
<td>Yield Point: 17</td>
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</tbody>
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### Performance & Savings Comparison from Well #1 to Well #2 (300 yards apart)

#### Drill Bit Savings

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Well #1</td>
<td>9 Drill Bits</td>
</tr>
<tr>
<td>Well #2</td>
<td>7 Drill Bits</td>
</tr>
<tr>
<td></td>
<td>2 Drill Bits x ($15,500.00ea,) =</td>
</tr>
<tr>
<td></td>
<td>$31,000.00</td>
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<tr>
<td></td>
<td>Two Trips out</td>
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<td>$120,000.00</td>
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</table>

#### Dig Curve

<p>| | |</p>
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<tbody>
<tr>
<td>Well #1</td>
<td>64 hours</td>
</tr>
<tr>
<td>Well #2</td>
<td>30 hours</td>
</tr>
<tr>
<td></td>
<td>34 hours x $2,500.00 =</td>
</tr>
<tr>
<td></td>
<td>$85,000.00</td>
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</tbody>
</table>

#### Overall Lateral ROP (EOC to TD) Improvement (12% increase)

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<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Well #1</td>
<td>4,052ft @ 22.75fph</td>
</tr>
<tr>
<td>Well #2</td>
<td>4,437ft @ 25.50fph = Increase of ROP of 12% savings</td>
</tr>
<tr>
<td></td>
<td>21 hours x $2,500.00 =</td>
</tr>
<tr>
<td></td>
<td>$52,500.00</td>
</tr>
</tbody>
</table>

#### No Hard-banding Needed!!! (magnets stayed clean)

|               | $12,047.00 |

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### Gross Savings

|               | $300,547.00 |

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**ROI after cost of product - over 100% !**
ProOne DHDF added @ 3% by volume

24 drums of ProOne in @ 3.3%

20 hrs. after installation reached max reduction

ProOne DHDF added @ 3% by volume

add 3 drums of ProOne

add 3 drums of ProOne

add 4 drums of ProOne for a total 55

5 drums added plus 2 for mud pulled over to system

add 2 drums

add 3 drums

add 2 drums

add 3 drums

add 5 drums of ProOne

add 5 drums of ProOne

add 4 drums of ProOne for a total 55

5 drums added plus 2 for mud pulled over to system