Microparticulate Used to Complete and Protect Well Integrity

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INTRODUCTION

• Wellbore preparation is fundamental for zonal isolation integrity.
• Much research is focused on inadequate zonal isolation.
• Fluid displacement efficiency is of key importance.
• Use of an innovative microparticulate efficiency fluid for enhancing displacement efficiency will be discussed.
BENEFITS/ADVANTAGES

• **Optimal mud-removal system** for recovering valuable OBM fluid.

• **Proven density range** of 8.15 to 14.0 lbm/gal (can be foamed to a stable foam down to 8.15 lbm/gal).

• **Adjustable rheology**, enabling the plastic viscosity (PV) and yield point (YP) properties to be tailored to specific wellbore conditions and placement hydraulics to optimize displacement efficiency.
BENEFITS/ADVANTAGES—CONTINUED

• Cost effective
  • Enables larger volumes to be pumped.
  • Increasing hole cleaning and cement bonding.

• Can be used as a stable fluid in places where other fluids are unstable.
  • Elimination of settling.
  • Use in horizontal situations.
BENEFITS/ADVANTAGES—CONTINUED

• Can replace WBMs for displacement and recovery of OBM.

• Provides potential to consolidate for stabilization and protection from corrosion of casing above TOC.

• Increases compatibility with fluids, using less or even no surfactant package.

• Admixture friendly with all cementing additives.
BENEFITS/ADVANTAGES—CONTINUED

• Prevents recontamination of the wellbore by removing WBM from the pump schedule.

• Can be mixed on-the-fly with normal equipment—no footprint needed for batch mixing.

• Can be made with reused water.
# INTRODUCING EFFICIENCY FLUIDS: ENHANCING WELLBORE PREPARATION FOR CEMENTING OPERATIONS

<table>
<thead>
<tr>
<th>Fluid Type</th>
<th>Hierarchy Function</th>
<th>Wellbore Cleaning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Density</td>
<td>Rheology</td>
</tr>
<tr>
<td>Spacer</td>
<td>Adjustable</td>
<td>Adjustable</td>
</tr>
<tr>
<td>Flush</td>
<td>Limited</td>
<td>Limited</td>
</tr>
<tr>
<td>Scavenger cement</td>
<td>Limited</td>
<td>Limited</td>
</tr>
<tr>
<td>Water-based mud</td>
<td>Adjustable</td>
<td>Adjustable</td>
</tr>
<tr>
<td>Efficiency fluid</td>
<td>Adjustable</td>
<td>Adjustable</td>
</tr>
</tbody>
</table>
## INTRODUCING EFFICIENCY FLUIDS: ENHANCING WELLBORE PREPARATION FOR CEMENTING OPERATIONS

<table>
<thead>
<tr>
<th>Fluid Type</th>
<th>OBM Recovery</th>
<th>Can Be Designed to Set</th>
<th>CBL Above TOC</th>
<th>Contact Time</th>
<th>Add. Equip Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spacer</td>
<td>High</td>
<td>No</td>
<td>No</td>
<td>Limited by cost</td>
<td>No</td>
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<tr>
<td>Flush</td>
<td>Low</td>
<td>No</td>
<td>No</td>
<td>Limited by cost</td>
<td>Yes</td>
</tr>
<tr>
<td>Scavenger cement</td>
<td>Medium</td>
<td>No</td>
<td>Yes</td>
<td>Limited by cost</td>
<td>No</td>
</tr>
<tr>
<td>Water-based mud</td>
<td>Medium</td>
<td>No</td>
<td>No</td>
<td>Limited by cost</td>
<td>Yes</td>
</tr>
<tr>
<td>Efficiency fluid</td>
<td>Very high</td>
<td>Yes</td>
<td>Yes</td>
<td>Very long (low cost)</td>
<td>No</td>
</tr>
</tbody>
</table>
PARTICLE-SIZE DISTRIBUTION

• **Improves stability** for long horizontal wellbore applications by decreasing terminal velocity of solids.

• **Provides increased water capacity** via increased cumulative surface area of particles leading to lower slurry densities and greater stabilities.

• **Removes mud filter cake from narrow side** annular gaps, due to particle size and lower rheology.
CASE HISTORIES—JOB 1—SMALL VOLUME JOB

- Canadian County, OK—remove OBM economically.
  - 5.5-in. Production casing.
  - 12,658-ft TVD.
  - 17,682-ft MD.
  - 248°F (120°C) BHST.
  - Shale formation.
CASE HISTORIES—JOB 1—SMALL VOLUME JOB

Fluid Positions at Job End
Time = 16:55:50 Volume In = 1326.32 bbl

Job 1 fluid positions graph illustrating fluid positions at the end of the job; visually created using cementing modeling software.
CASE HISTORIES—JOB 1—SMALL VOLUME JOB

CBL from the previous jobs without the fluid (left) compared to the CBL using the microparticulate efficiency fluid (right).
CASE HISTORIES—JOB 1—SMALL VOLUME JOB

CBL 100 ft inside intermediate casing.
CASE HISTORIES—JOB 1—SMALL VOLUME JOB

CBL on TOC inside annular space with efficiency fluid.
CASE HISTORIES—JOB 2—LARGE VOLUME JOB

- Stephens County, OK—complete removal of OBM.
  - 5.5-in. Production casing.
  - 14,657-ft TVD.
  - 20,708-ft MD.
  - 220°F (104°C) BHST.
  - Shale formation.
Job 2 fluid positions graph illustrating the fluid positions at the end of the job; visually created using a cementing modeling software.
CASE HISTORIES—JOB 2—LARGE VOLUME JOB

Job 2 middle of lateral.
CASE HISTORIES—JOB 2—LARGE VOLUME JOB

Job 2 TOC of cement.
CASE HISTORIES—JOB 2—LARGE VOLUME JOB

Job 2 microparticulate efficiency fluid above TOC.
CONCLUSIONS

• An innovative solution for removing OBM economically has been introduced as a microparticulate efficiency fluid.

• Can be placed in the wellbore at volumes and costs similar to WBMs, while also exhibiting bonding behavior above the TOC, which helps reduce the possibility of casing corrosion.
CONCLUSIONS—CONTINUED

• Rheology can be adjusted to help ensure stability during long horizontal applications.

• Rheology and density of the system can be adjusted for improved displacement efficiency, leading to improved bond logs.

• Can be mixed on-the-fly with normal equipment—thus no batch mixing footprint.

• Can be made with recycled water.
MOVING FORWARD

So, Will This Product Work Offshore?

Pros
- OBM recovery
- Wellbore cleaning
- Wellbore integrity

Cons
- Logistics
- APB ??
- Subsea wellheads
Thank You