QUIK-WEDGE™ – Another “One Size Fits Many” Lost Circulation Material for Sealing Unknown Fractures

Hong (Max) Wang, Ph.D.&P.E.
Sharp-Rock Technologies, Inc.
Challenge: Unknown Opening Sizes

Pores

Vugs

Natural Fractures

Induced Fractures
“One Size Fits Many” for Unknown Sizes
Particle Accumulation for Seal Strength
WEDGE-SET™ - A Foam-wedge Enhanced High Fluid Loss Pill

+ 

FOAM-WEDGE

Plug Zone  Water Zone  Dewater Barrier

DEA Tech Forum Nov. 2011
6-min YouTube Demo
QUIK-WEDGE™ - Dual-Component, Quick Fracture Shut-off LCM

• Dual components
  – Proprietary fracture quick shut-off particulates
  – Foam-Wedge S, M & L
    • Highly compressible - “One size fits many”
    • Highly permeable – Collect particulates to form a seal

• Directly mixed in mud/cement
  – Prevention
  – Remediation
QUIK-WEDGE Particulates
– Instantaneous Seal Formation

A Quantified Fracture Quick Shut-off Capability

Concentration, ppb

Flow-through Volume, ml/ft

0 10 20 30 40 50 60 70 80 90

0 10 20 30 40 50 60 70 80 90

Concentration, ppb
QAQC on the Particulates

- Manufacturer’s Tests
  - Test on 650 μ slots for sealing
  - Each batch

- 3rd Party Tests
  - LC50 test - Passed
  - GC/MS test - Passed

- An Major Operator’s Tests
  - Seals formed in every tests (650 μ slots)
  - Seals held 3000 psi (650 μ slots)
  - Random sampling tests - Passed
    - 3 out of 75 superbags
  - Rheology effects
    - Small and adjustable
  - No sagging observed
Allow an Over-Kill Approach for Success

Seal by Many rather than One

Formed Seal Less Likely Interfered by DP
Pumping through BHA

- **FOAM-WEDGE S**
  - Has been pumped through various BHA with Mud Motor, LWD, Bit Nozzles at a rate above 2.5 BPM

- **FOAM-WEDGE M**
  - In mud at 0.25 ppb
  - Tested Rates
    - 2.5, 5, 10 bpm

- **FOAM-WEDGE M & L**
  - Use PBL Sub or equivalent by-pass tools
  - Test BHA before using if no by-pass tools

- **FOAM-WEDGE M & L**
  - Remove pump intake and discharge screens, drillpipe screens before pumping
Case History 1: Eagle Ford Shale Drilling
- multiple faults from the seismic map
Results Comparison

• Conventional LCM 20 ppb
  – Day 1: lost 53 bbl
  – Day 2: lost 185 bbl
  – Day 3: lost 851 bbl

• QUIK-WEDGE
  – A 40 bbl sweep mud pill (50 ppb QUIK-WEDGE + 0.5 ppb FOAM-WEDGE S)
  – Mud losses stopped as soon as a sweep pill went around the bit
  – Easy to use
    • Mixing time ~ 20 min
    • No issue passing through BHA
    • When another fracture was encountered, just pumped another sweep pill.
Daily Mud Loss Summary

Daily Oil Based Mud Losses During Drilling Naturally Fractured Formations

Days from the Mud Losses Began

Daily OBM Losses
With Conventional LCM
With QUIK-WEDGE

With Conventional LCM
With QUIK-WEDGE
Case History 2: Eagle Ford Shale Drilling
- Slowing down pump rates can help

- Loss rate was ~40 bph.
- 40 bbl 50 ppb with 0.5 ppb FOAM-WEDGE S
- Pill 1: It didn’t slow the losses down.
- Pill 2: After it passing through bit, pump rate was slowed and losses subsided about half.
- Pill 3: It was pumped even slower, minimizing losses.
- Optional: Use larger foam-wedges
QUIK-WEDGE Case History 3

• Mississippi land drilling
  – Losing total returns in the 6 ¾” open hole without clear understanding of the location of the loss zones. OBM environment.
  – Loss mechanisms may include natural fractures, possible faults and induced losses due to pack-offs.
    • The pack-offs further complicated the situation.
Recommended Solution & Results

• Recommended
  – 100 bbl QUIK-WEDGE mud pill
    • 80 ppb QUIK-WEDGE
    • 0.5 ppb FOAM-WEDGE S
    • 0.25 ppb FOAM-WEDGE M
    • 0.2 ppb FOAM-WEDGE L
  – Set the bit well above the possible loss zone
  – Pump the pill out of string at 5 bpm or higher
  – Slow down to 0.5 bpm to the needed squeeze pressure

• Results
  – 500 psi squeeze pressure was achieved
Case History 4: Deepwater GOM QUIK-WEDGE Particulates Only

**QUIK-WEDGE Well** (Particulates Only)

<table>
<thead>
<tr>
<th></th>
<th>CSGRUN</th>
<th>CMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>16” CSG</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>14” LNR</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Total Mud Loss, bbl</td>
<td>1317</td>
<td></td>
</tr>
</tbody>
</table>

**Reference Well**

<table>
<thead>
<tr>
<th></th>
<th>CSGRUN</th>
<th>CMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>16” CSG</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>14” LNR</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Total Mud Loss, bbl</td>
<td>9190</td>
<td></td>
</tr>
</tbody>
</table>

Difference = 7,792 bbl SBM

**Benefits:**

1. Total Mud Savings = $2.4 million
2. Assured Cementing
3. Enhanced Drilling Safety
Dual Component QUIK-WEDGE™ Summary

A Quantified Fracture Quick Shut-off Capability

Concentration, ppb
Flow-through Volume, ml/ft
Success Ensuring Wellbore Strengthening Solutions
Enabling Overkill for Unknown Fractures and More

- High Fluid Loss Particulate Technology
- “One Size Fits Many” Foam Wedge Technology
- Ultralow Spurt Loss Particulate Technology
- Critical Invasion Volume Determination Technology

- WEDGE-SET® Solution
  Remedial Only
  Natural or Induced Fractures

- QUIK-WEDGE™ Solution
  Prevention and Remedial
  Natural or Induced Fractures

- STRESS-SHIELD™ Solution
  Prevention
  Induced Fractures
Lost Circulation Strategy

• Prevention
  – Induced fractures
  – Small natural fractures

• Remediation
  Induced or natural fractures
Remediation

- **Partial Losses**
  - QUIK-WEDGE + FOAM-WEDGE S Sweeps

- **Total Losses**
  - QUIK-WEDGE + FOAM-WEDGE S, M, and L
    - Function 1: Sealing
    - Function 2: Messenger Pill – Reveal fracture location and size
Prevention

• Using particulates only
  – Induced fractures
    • Concentration is determined based on rock mechanics calculations
    • Example: Offshore Deepwater
  – Natural fractures
    • ~20 ppb in mud to seal up to 650 micron fractures
Ensure Cementing Success

- Deepwater narrow mud weight window
- Naturally fractured formations
## Comparison

<table>
<thead>
<tr>
<th></th>
<th>QUIK-WEDGE</th>
<th>WEDGE-SET</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Color</strong></td>
<td>Grey</td>
<td>White</td>
</tr>
<tr>
<td><strong>Sealing Mechanism</strong></td>
<td>Quick Shut-off</td>
<td>Form a Filter Plug Gradually</td>
</tr>
<tr>
<td><strong>Initial Composition</strong></td>
<td>Particulates</td>
<td>Particulates + FOAM-WEDGE S</td>
</tr>
<tr>
<td><strong>Sealing Extension</strong></td>
<td>+ FOAM-WEDGE S, M or L</td>
<td>+ FOAM-WEDGE M or L</td>
</tr>
<tr>
<td><strong>Fluid Loss</strong></td>
<td>Ultra Low Spurt</td>
<td>Ultra High Fluid Loss</td>
</tr>
<tr>
<td><strong>Mixing Fluid</strong></td>
<td>Mud</td>
<td>Water/Oil</td>
</tr>
<tr>
<td><strong>Sealing Strength for Small Openings</strong></td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td><strong>Sealing Strength for Large Openings</strong></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td><strong>Major Placement Method</strong></td>
<td>Sweeps</td>
<td>Hesitation Squeeze</td>
</tr>
<tr>
<td><strong>Treatment Time</strong></td>
<td>Short (QUIK)</td>
<td>Long (Filtration)</td>
</tr>
</tbody>
</table>