Southern Arabian Peninsula Chapter

Novel Approach for Safely Treating Lost Circulation; Reduce Kicks; Improve Cross Flow Management; and Reduce NPT

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Khursaniyah Field Introduction

Safe, Reliable And Effective Means Of LCM Deployment

LCM Products Which Meet The Challenge Of Extreme Operating Conditions
Khursaniyah Field Introduction
Challenges in drilling high pressure wells in the Khursaniyah field, Saudi Arabia:

• High pressure flow from Base Jilh Dolomite formations
• Loss circulation across the depleted Upper Jilh formations
• Variations in formation pressure causing well flowing, losses, and stuck pipe
• Interconnected fracture systems
Khursaniyah Field Introduction
DSI is part of Schoeller Bleckmann Oilfield Group

Original version of the PBL tool was invented in 1987 in Canada

Extensive history worldwide with all major operators

Tool Used in All Phases of E&P: Drilling/Completion, Workover and Thru-Tubing

Tool Sizes 1-11\slash{}16” OD to 12” OD
PBL Tool Components

- Simple Design
  - Few moving parts
  - Ball / Dart Activated
  - Ball Deactivated
- Robust
  - API internal threads
- Practical
  - Multi-Cycle (5 or 10)
  - Large Bore
- **Well Control**
  - Sleeve default position is closed
LCM Deployment

PBL Deployment Video
Applications and Benefits

Key PBL Critical Design Features
- Multiple activations (5 or 10) allows the placement of LCM and hole clean-out while continuing drilling operations
- Isolates BHA during placement of LCM and Cement
- Re-establishes circulation during stuck pipe to reduce chance of LIH
- Sliding Sleeve closed position enhances Well Control

Lost Circulation Focused Features
- Pump large concentrations of LCM (up to 220 lbs/bbl)
- Pump rates are not limited by MWD and Motor manufacturers
- Prevents plugging of Bits, Motors and MWD tools
- Eliminates multiple trips to spot high-viscous LCM pills
- Able to spot several pills in one run due to multi-activation capability
- Able to maintain designed nozzle size on bits to maximize ROP
The Fast Dart option for the PBL Tool can be used:

- When higher density drilling fluids are encountered to assure that PBL will activate even when pumps go down
- If the drill string or annulus becomes plugged or packed off
Hydraulics - Constant ECD

DSI PBL’s Ball Seat has a large ID which creates negligible pressure drop prior to Activation.

After Activation and Deactivation Balls drop into Ball Catcher Cage there is enough flow area so there is no noticeable pressure seen.
LCM Application Comparison

LCM Applications - DSI-PBL Sub
- Larger port diameter
- Higher TFA per port
- Allowing Higher circulation rates (with lower pressure)
- Allowing Larger LCM particle sizes to be pumped through.
MISSION STATEMENT

**Turbo-Chem** is dedicated to reducing drilling project costs for our customers by minimizing risks associated with:

- Lost Circulation
- Differential Sticking
- Torque and Drag
- Bit Balling
- Shale Instability

OUR STORY

Our company was chartered in March 1982 in Lafayette, Louisiana USA. The Turbo-Chem team has been serving the drilling community for over 35 years in various drilling fluids related technical and management applications.

Over 20 Patents, several pending we have stayed true to our original focus of solving drilling problems through innovative chemistry.
• Operator: Saudi Aramco
• Well name/area: KRSN 334
• Khursaniyah, Eastern Province KSA
• Rig: ADC-32
• Co Man: Jerry L.
• Gas Well, Jild Formation
• Problem: Total losses, Cross Flow
• Mud type/weight: 19.4 ppg WBM/145 pcf
• Hole size: 12”
• OH Volume 180 bbl
• TCI Eng: K Kiddy
Severe / Massive Losses: EZ Squeeze™

**EZ Squeeze™**: Patented
- Single Sack
- Ultra Strong, cementing
- High Solids Squeeze Material

**SwellLCM™**: Patented
- Single pail
- Acid Soluble, Gel-Swelling Agent combined with viscous fluid designed to allow Cement or EZ Squeeze to set up into massive fractures.
Severe / Massive Losses: EZ Squeeze™

**EZ Squeeze™**, and it’s performance, is unique to other types of LCM used for severe loss remediation. When placed in and/or across a loss zone, the liquid phase of the slurry is squeezed out, leaving a solid plug behind. **EZ Squeeze™** differs from other types of LCM’s in that it rapidly forms a solid plug, with a compressive strength higher than that of cement, within the loss zone rather than remaining at or near the face of the wellbore. This minimizes the possibility of the seal being removed during drilling operations. This will eliminate redundant remedial treatments in the loss zone. Solving the loss problem AS SOON AS POSSIBLE after it occurs prevents excessive mud volume from entering the formation, further propagating the fractures and compounding the loss problem. **EZ Squeeze™** can be mixed in water, diesel, brine and any base oil.
Patented, Ultra Strong De-Fluidizing cementing lost circulation material

- Seals by laying down a massive bed of solids for mud to seal against

- Chemical reaction results in a hard, cement-like plug

- Chemical reaction is not time nor temperature dependent (can be pre-mixed)

- Resulting plug will not erode or wash out

- Highest amount of solids per pill in the industry

- Used to remediate moderate or severe lost circulation

- Has stopped cross flows and underground blowouts

- Highly utilized in increasing casing shoe and liner gap integrity

- Increases hole integrity near the well bore

- Can stop lost circulation in heavy brines

- Has been shown to patch holes in casings and seal perforations for washouts.
Company A’s High Solids Squeeze plug after 50 psi ↓

Company A’s High Solids Squeeze plug after 100 psi ↓

Turbo-Chem’s EZ Squeeze plug after 500 psi ↓

Turbo-Chem’s EZ Squeeze plug after 2500 psi ↓

Compressive Strength
Independent Lab Results

<table>
<thead>
<tr>
<th>Cross Sectional Area (Sq. Inches)</th>
<th>Maximum Load (lbs.)</th>
<th>Compressive Strength</th>
<th>Compressive Strength after Correction Factor Applied</th>
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<tbody>
<tr>
<td>3.53</td>
<td>11,160</td>
<td>3,161</td>
<td>Plug made @ 1250 psi</td>
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<tr>
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<td>9,520</td>
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<td>3.53</td>
<td>18,990</td>
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<td>Plug made @ 1500 psi</td>
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>5000 PSI Compressive Strength
Turbo-Chem’s SwellLCM™ is a unique product that has been used with great success when pumped ahead of EZ Squeeze™ or Cement, in extreme lost circulation zones. SwellLCM’s unique blend of super absorbent and Bio-Polymer combine to form a Low Shear Rate Viscous Fluid that expands to fills large-continuous fractures, helps remediate casing shoe failures and cavernous formations which normally would require cementing, sidetracking or plug and abandonment procedures. SwellLCM can be mixed in a low pH (3-4) Freshwater ONLY.
**Biopolymer** ➤ Derivatives of aquatic components.

**Hydro - Gel** ➤ Unique polymerizing super absorbent that can absorb water and swell greater than 50 times its original size.

**LSRV** ➤ Product polymerized to form a Low Shear Rate Viscous Fluid.
SwelLCM “co-mingles” with EZ Squeeze to form a plug that will seal major fractures and vugular zones. Using SwelLCM ahead of EZ Squeeze will eliminate the need for multiple LCM pills and reduce down time and high costs associated with cementing procedures.
Due to ECD imbalance, fracture activated anytime pumps are on for total losses. Static losses are 80-100 bbls/hr.

All prior LCM pill attempts failed once pumps are activated due to the extreme density and downhole ECD overlap. Backside pressure must be maintained at 154 pcf to control cross flow.

Proposed 100 bbl SwellLCM, 3 bbl spacer and 200 bbl EZ Squeeze tandem pill

Pumped EZ Squeeze at 145 pcf, SwellLCM at 138 pcf.

As soon as SwellLCM cleared BHA, 15 bbl gain was recorded.

Only one squeeze was required, pressure build up to exceed 900 psi.

Soak 4 hours and drill ahead

Achieved TD with no further losses.

– High torque during cleanup was found to be due to cement in annulus.

– Wash and ream without any further issues.
Lessons Learned

1. **Placement**: LCM should be pumped from a stationary bit position to ensure maximum strength.

2. **Volume**: Dependent on hole size the volume of singular or Tandem pills should exceed or equal hole size sometimes by 2-4X dependent on situation.

3. **Mixing and premixing**: EZ Squeeze can be pre-mixed but not pre-weighted. SwellLCM should be mixed just prior to pumping.

4. **Rock Strength**: LCM will follow the path of least resistance.

5. **Position**: Should the loss zone be above the bit position than the likelihood of success is less likely as it is more likely that fluid from above the loss zone will enter than below.
Integrity Test

Integrity Test Video
**SPE WORKSHOP:** Lost Circulation: Natural and Induced Fractures—Carbonates and Other Formations
6–7 December 2017, Dubai, UAE

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Questions?

Thank You