Application of a Unique Loss Circulation Curing Cement Spacer during Cement Placement in Geothermal Wells

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Introduction

Maintaining Well Integrity

Zonal isolation – replacing drilling fluids with cement

Pumping spacer ahead of cement

Downhole losses – partial to total losses

Wellbore shielding spacer – cure losses

Remediate moderate to total losses in low fracture gradient formation
Problem

Unconsolidated formations – loss circulation, no cement to surface

Not adequate pre cement job mud conditioning

Loss circulation materials, low density cement – high cost, reverse circulation cement job

Multiple remedial cement jobs to fill the annulus

Trapped water in the casing to casing annulus
Solution

Biopolymer – biodegradable spacer system

Mitigate loss circulation during cementing

Strengthen wellbore wall with a seal, minimize cement fall back

16 cement top jobs reduced to 3 top jobs to have cement back to surface
Low invasion fluid technology to minimize filtrate invasion and formation damage.

Strengthen the wellbore, ECD can exceed fracture gradient without losses and thickening time is lower.

Used in high temperature, high permeability formations with low fracture gradient, fragile, unconsolidated and fractured formations.
Sealing Fluid - Mechanism

- Initially micelles are free floating in the fluid
- Figures 1a1-d (Brandl et al. 2011)
As differential pressure increase micelles migrate towards the formation, are adsorbed, break apart on form a protective barrier.
Sealing Fluid - Mechanism

At max differential pressure micelles form an impenetrable surface layer
Sealing Fluid - Mechanism

As differential pressure is released, micelles return to the flowing fluid.
Cementing Best Practices

Pre job mud conditioning: Stagnant drilling fluids have high static gel strengths prior after drilling casing point. Twice bottoms up circulation is recommended.

Centralizers: Eccentric holes the flow rates increase in the wide side of the hole, and worst cases no flow on narrow -side. 70-80 % centralization of casing for good cement sheath all around the casing.

Spacer Volume: Rule of Thumb: 10 min of contact time across 1000-1500 ft of open hole. Larger holes more time, leading edge – mud, trailing edge-cement, avoid intermixing if the volume is less.
Cementing Best Practices

Pump Rate: Displacement and pre job conditioning rates should be as high as possible without exceeding fracture gradients.

Hole Size: Ideal open hole to casing size diameter is 1.5 to 3 inches. Less annular spaces and eccentric hole cause cement on wide side, larger hole sizes can lead to low annular velocities.

Rheologies: Thinner fluids channels through heavier fluids it is displacing.

Densities: Successive fluids in the well bore needed to be heavier to help in the displacement process.
Spacer Design Strategy

Volume sufficient to maintain separation between mud and cement system with rheology to push mud out of the hole.

Specialized lost circulation properties, prevent losses and stop losses already encountered.

Wellbore shield allows cement to circulate under conditions that would otherwise fracture and cause losses when cementing.
Synergistic LCM to be mixed with the WBS spacer when losses were encountered during drilling.

Heavier cement can be circulated in well, when had severe losses with drilling with mud.
Execution

Well Pad A, 2 wells during cementing total losses encountered, no returns to surface. In order to get cement to surface 16 and 7 top jobs for 20” casing.

Demonstration plan was designed to try the WBS spacer on the well A # 3. During drilling the same loss sections were encountered. Though the losses were seen during cementing, only 2 top jobs were for TOC to surface.

The top jobs needed 166 cubic mt of cement for each, on the third well only 22 cubic mt were required.
The system concentration was composed of 15 lb/bbl of WBS concentrate and 30 lb/bbl of LCM. 65 bbls of WBS spacer was used with a slurry density of 9.1 lb/gal.

Cost of WBS spacer increases the cement job cost, dramatically reduced overall cost. ($330 K )

Additional savings include better initial cement jobs and fewer remedial top up jobs.
Conclusion & Recommendations

Seals Lost Circulation
Improves zonal isolation
Improves ECD’s at casing depth which reduces Formation Breakdown
Prevents fall-back of cement tops
Provides Superior Hole-Cleaning performance
Thanks and Questions

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