WEL-Sure™ LCM With Non-Damaging Diverting Carrier Fluid Controlled Losses, Enhanced Sand Cleanout Efficiency, Preventing Formation Damage

Objectives

- Design of a fluid which enables sand cleanouts with workover equipment in areas of high fluid loss.
- Engineer a non-damaging lost circulation fluid system to achieve optimized diversion and temporary sealing.
- Validate LCM fluid performance through formation core testing.
- Verify performance through field pilot tests.

Our Approach

- The operator's requirements arose from the production of formation sand causing partial or total plugging of the wellbore, resulting in reduced production. In many cases, there was more than 100 ft of perforated interval to be cleaned out.
- Due to the reservoir's high permeability and low pressure, the equivalent circulating density (ECD) generated during cleanout can exceed the gradient to balance the reservoir, inducing losses to the reservoir which, in turn, causes partial or no circulation, inefficient sand cleanouts, and formation damage. While researching fluid solutions to the lost circulation aspect of this problem, it was observed that many potential LCM fluids were damaging to the formation, reducing permeability and subsequent production.
- The solution was developed in two stages. Initially, a non-damaging synthetic-based polymer was used to achieve diversion from loss zones. This approach was tried on 5 wells. Due to the severe losses encountered in some zones, the fluid was not capable of completely curing losses. While the fluid was non-damaging and did not have any negative impact on production, only partial success was achieved with respect to enhanced circulation and cleanouts.
- In the second phase of the project, the polymer-based fluid solution was enhanced with fine particulates to add a mechanical diversion attribute to the fluid to control the zones experiencing higher losses. The development process involved engineering the PSD of solid particles and designing a solid mesh system to generate effective bridging.
- The WEL-Sure LCM was the bridging material used as it dissolves completely leaving no residue in or on the formation. The rate of dissolution is dependent upon time, temperature, and the pH of the system. After several filtration and bridging laboratory tests, the appropriate combination of particle size and polymer concentration was achieved. The performance of the fluid was verified through a series of regain permeability tests carried out on cores with excellent results in terms of diversion and filtration control. Effective loss control was achieved with only a 5% impact on final core permeability.

The Weatherford WEL-Sure LCM controls losses and degrades to liquid form over time, avoiding reservoir damage and eliminating the need for secondary operations to remove LCM.

LOCATION
Colombia

WELL TYPE
Onshore, vertical

FORMATION
Colorado

LINER SIZE AND TYPE
7-in., 23 lb/ft, 6.366-in. ID

BOTTOMHOLE STATIC TEMPERATURE (BHST)
150°F (65 °C)

DEPTH
3,600 ft (1,097 m)

PRODUCTS/SERVICES
- WEL-Sure LCM

Weatherford®

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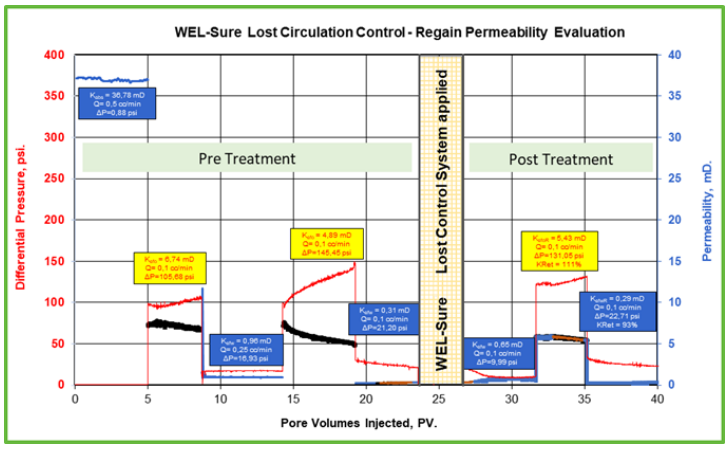
Our Approach (continued)

- In field applications, circulation was maintained by intermittent pumping of WEL-Sure LCM pills as sand was lifted, exposing new loss zones. In one well with a 153-ft (46-m) perforated interval, of which 40 ft (12 m) was covered with sand, initial circulation was established by pumping a 30-barrel pill of WEL-Sure LCM.
- After the pill was displaced, an increase in pressure was observed and constant returns were observed with continuous sand cleaning. Eventually, as sand was removed and new loss zones exposed, a slight increase in the loss rate was observed. A 10-barrel pill was again pumped to seal the untreated area and full returns were again observed. Cleaning continued until reaching the top of the cement plug at the plug back TD.
- The sand cleanout across the entire overbalanced interval was completed successfully.

Value to Customer

- The Weatherford solution delivered a cost savings via reduced operational time and material losses.
- The improvements in the efficiency of cleaning returned up to 60% savings in time.
- Additionally, the WEL-Sure LCM engineered fluid system resulted in complete cleaning to TD.
- The operator was able to sustain well productivity while controlling losses.



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