



Pressure balance between the wellbore and formation is often quite sensitive due to narrow pore pressure and fracture pressure window. It gets more attention while drilling through fractured or vuggy rocks, which could easily attribute to downhole mud losses. Sealing the loss zone is of great concern, since it may take significant amount of resources before re-commence to drilling in a safe environment. GEOS has successfully cured a challenging thief zone with specially tailored LCM blends while drilling for a major operator.

Situation:

While drilling through a vuggy, cavernous, and fractured tuffs in 12 ¼ in hole with WBM, faced and cured downhole losses rates of which varied from seepage to total loss. .

Well Information:

Interval drilled: 12 ¼ in hole 2,237 m to 2,530 m
Max. F.L. Temp.: 57 °C
Formation: Highly fractured and vuggy volcanic rocks, tuff, marl, siltstone, argillite.
Drillstring: Rotary BHA with PDC bit.
Nozzles: 6 x 32/32"

Challenges and Problems:

- Highly fractured and vuggy volcanic rocks and marls, loss zones confirmed with geomechanical study.
- Offset well was abandoned due to downhole losses.
- Erratic downhole losses with rates between 20 bbl/hr to total losses.

Solutions:

- To control losses, formulated an LCM blend using data from geomechanics study.
- To overcome plugging of the shaker screens, made ready low API sized screens.
- To overcome plugging of the nozzle, adjusted LCM particle size distribution and simulated hydraulics with larger nozzles.

Application:

Using data from geomechanics study, formulated an LCM blend. While drilling 12 ¼ in hole with WBM, premixed different kinds of LCM depending on expected downhole losses; and pumped in accordance with actual loss rates. LCM concentrations varied between 80 lb/bbl to 100 lb/bbl.

Modified shaker screens from 140 API to 45 API and let LCM blend into active system. Pumped 30-50 bbl LCM pills and circulated, bypassed shakers when needed. By doing so, thief zones were sealed immediately after opening, and disable fracture width to propagate.

LCM composition was consisted of medium and coarse materials, with angular, flake, fibrous, and granular particles. The particle sizes range from 100 µ to 4000 µ.

Pumped 35 bbl 80 lb/bbl LCM when observing first downhole loss with 30 bbl/hr rate. After LCM pill got out of nozzles, the downhole loss was ceased and drilling continued without any delay. After 20m of drilling without downhole losses, another fracture has been encountered with a loss rate of 360 bbl/hr. Immediately pumped 35 bbl LCM pill and the losses were stopped. Similar scenarios occurred in the continuing couple of hundreds of meters. All of the losses were sealed and drilling went smoothly without losses.

Total loss was observed twice as the well gets deeper, and both of them were secured to get 100% mud return after pumping 40-50 bbl 100 lb/bbl LCM immediately.

Results:

- Partial (30 bbl/hr) loss was controlled by 80 lb/bbl LCM pill
- Severe (360 bbl/hr) loss was controlled by 80 lb/bbl LCM pill
- Total loss was controlled by 100 lb/bbl LCM pill
- A total of 300m of severe loss-expected interval was drilled safely with minimum mud loss.

About LCM Composition:

General formulization of LCM used in the application is shown below.

Additive Name	Definition	Concentration (lb/bbl)
GEOCARB M	High Purity Calcium Carbonate; Medium	15-25
GEOCARB C	High Purity Calcium Carbonate; Coarse	15-25
GEOCARB 1000	High Purity Calcium Carbonate; 1000 µ	15-25
MIXSEAL M	Fibrous, Angular, Flake Mixture; Medium	5-15
MIXSEAL C	Fibrous, Angular, Flake Mixture; Coarse	5-15
MICA M	Muscovite; Medium	5-15
FIBROCEL M	Cellulose Fiber; Medium	5-15
FIBROCEL C	Cellulose Fiber; Coarse	5-15
RUBBER CRUMB	Rubber Crumb; Coarse	15-25