

Case study: Middle East

# MAX-LOCK enabled quick, effective drilling through difficult loss zone

A major Middle East operator faced many challenges in mitigating lost circulation while drilling the 8½-in. carbonate formation (gas cap) section of a field. The troublesome loss zone consists of vugs linked by networks of fracture channels.

Typically, the operator would pump a series of lost circulation material (LCM) pills to attempt to cure losses. If the losses persisted, cement plugs, side tracking and setting packers were all used to stop the losses—all costly and time-consuming methods for eliminating downhole losses.

Although this type of loss zone can be mitigated with the methods mentioned, offset well data showed a high probability for the losses to increase once drilling resumed and/or the LCM pill was circulated out or sidetrack started.

Baker Hughes designed the **MAX-LOCK™ lost circulation material** for this very type of fractured, vugular formation. The MAX-LOCK LCM can be squeezed into the vugs and travel through the fractures to fill other vugs in the loss zone network that might have been encountered once drilling resumes. The thixotropic behavior prevents further flow through the loss zone after squeezing.

Once the MAX-LOCK LCM is “set,” it retains a compressive strength that isolates the loss zone from the wellbore and prevents lost circulation from occurring in the treated zone after drilling resumes. The MAX-LOCK LCM is also acid soluble and can be remediated during the completion phase to maximize reservoir output

in highly permeable fractured zones. In this case, the operator drilled this section with a 10.7 ppg KCl polymer mud weighted with calcium carbonate.

Drilling commenced as planned until a sudden and total loss of circulation was observed at a depth of 5,207 ft (1587 m). Immediate action was taken to maintain hydrostatic head across the gas cap and avoid any well control issue. A 12.5 ppg mud cap was continuously pumped at 60 bbl/hr through the annulus while preparing LCM pills.

Three conventional LCM pills were pumped while MAX-LOCK was mobilized to the rig. The third conventional LCM pill aided in reducing the loss rate from “total losses” to a partial return.

Based on laboratory testing and simulating downhole conditions, Baker Hughes personnel recommended 55 bbl of MAX-LOCK to cure the targeted loss zone and allow the operation to regain full circulation.

This engineered approach allowed the MAX-LOCK LCM to be spotted effectively across the loss zone. The drill pipe was then pulled to the calculated pill top. The static losses and displacement were monitored while tripping to the top of the pill and an additional 25 bbl was squeezed into the loss zone using the ECD pressure while circulating at two stands above the calculated top of the pill.

MAX-LOCK was allowed to “set” while pulling out of the hole to change the bottomhole assembly as per the drilling program. The directional BHA was run into the hole, washing down

## Challenges

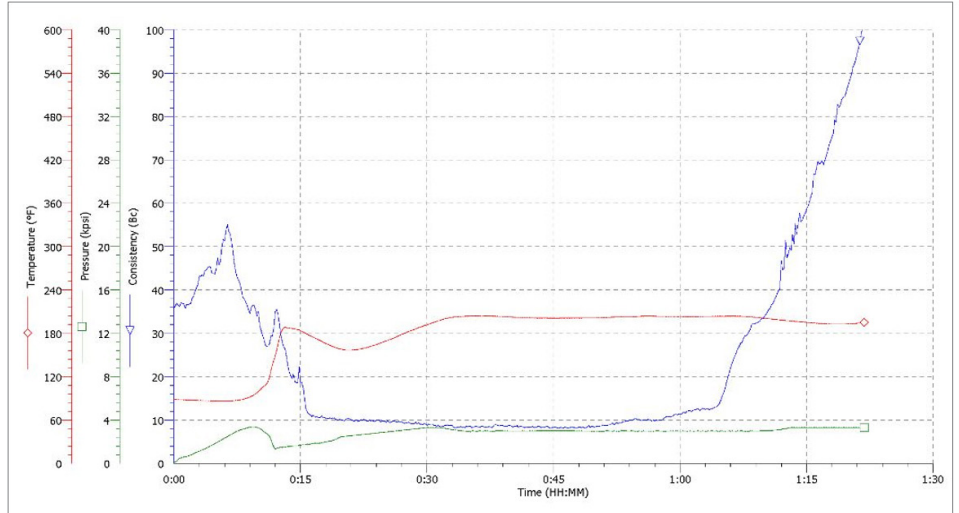
- Severe to total loss circulation in fractured vugular carbonate formation/reservoir
- Potential gas migration
- Mechanical instability

## Results

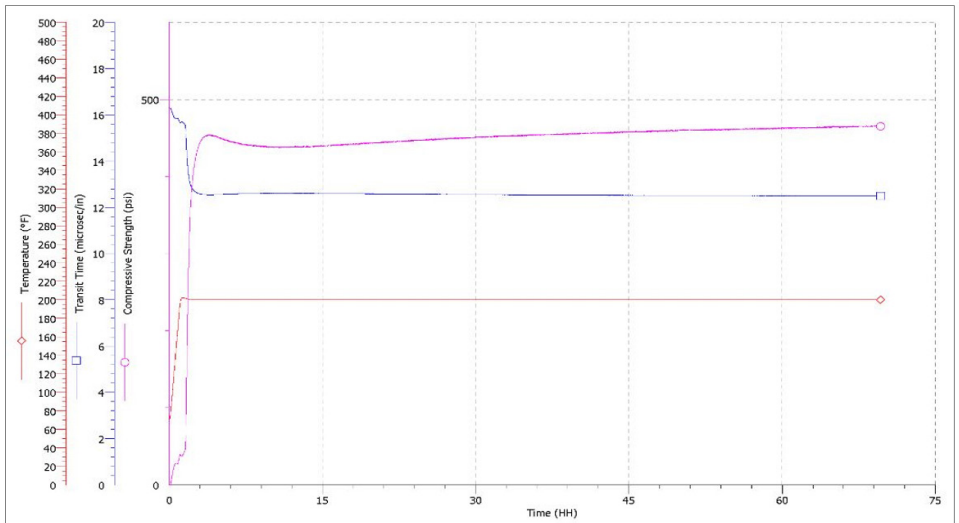
- Isolated troublesome loss zone, allowing drilling operations to continue
- Eliminated downhole losses, and also the need for multiple cement plugs, side tracking, and setting packers
- Drilled section to TD with no losses from targeted section

to bottom with no static or dynamic losses. Once on bottom, drilling resumed without any losses to TD. The losses were fully abated throughout the liner running operation to desired setting depth.

This successful application of MAX-LOCK LCM enabled the operator to drill through a difficult loss zone quickly and effectively, without damaging the reservoir formation with unnecessary LCM material or cement.



Setting time chart



Comprehensive strength chart