



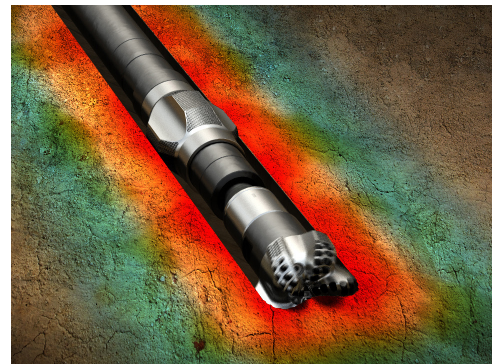
## Lost Circulation Materials

# Plugging Perforations with Engineered LCM Pills Saves Operator US\$500,000 in Rig Time and Eliminates Cement Plug Operation

Location: Qatar

### OPERATOR'S CHALLENGE

Due to an increase in water cut, the operator decided to set a whipstock at 4,155 m above two sets of perforations. The perforations would be temporarily plugged with lost circulation material (LCM), allowing the operator to open the sidetrack window and to drill ±3,000 m of 5 3/4-in. lateral hole through the Mishrif carbonate formation. After the new open hole was stimulated with a formic acid precursor, the perforations would be reopened and stimulated with hydrochloric acid (HCl).



However, the static loss rate in the perforated zone was 115 m<sup>3</sup>/hr. The total perforated interval was 2,423 m with an 850-m net perforated zone, as follows:

- Top perforations – 1,720 m to 2,320 m (600 m)
- Bottom perforations – 3,795 m to 4,045 m (250 m)

CHALLENGE	SOLUTION	RESULT
An 850-m perforated zone with a static loss rate of 115 m <sup>3</sup> /hr needed to be plugged so that a sidetrack could be drilled into a new pay zone above the perforations.	Two acid-soluble LCM pills were spotted and squeezed in sequence across the perforations, so that the perforations could be reopened later.	The loss rate fell to 15 m <sup>3</sup> /hr after the LCM plug was in place, allowing the operator to drill the new pay zone successfully without a complicated cement plug job.

### HALLIBURTON'S SOLUTION

The Baroid team recommended spotting two acid-soluble LCM pills to control the static losses; one conventional and one containing DUO-SQUEEZE® R LCM. DUO-SQUEEZE R LCM – a Halliburton “Engineered, Composite Solution” containing optimized types and sizes of materials that are 100% acid-soluble, as well as an OSPAR-compliant swelling natural polymer that is acid-breakable.

Pill 1 contained a final LCM concentration up to a 615 kg/m<sup>3</sup> of sized calcium carbonate and the BAROFIBRE® additive, natural cellulose. It was spotted and squeezed against the entire net perforation interval.

This was followed by Pill 2, which combined sized calcium carbonate, BAROFIBRE and DUO-SQUEEZE R LCM. This pill was also squeezed into the formation.

LOST CIRCULATION MATERIAL	CONCENTRATION	
	PILL#1 CONVENTIONAL LCM PILL	PILL#2 DUO SQUEEZE R PILL
Drill Water	0.85 m <sup>3</sup>	0.85 m <sup>3</sup>
BARAZAN® D Plus	6 kg/m <sup>3</sup>	6 kg/m <sup>3</sup>
Calcium Carbonate 150 μ	100 kg/m <sup>3</sup>	50 kg/m <sup>3</sup>
Calcium Carbonate 600 μ	100 kg/m <sup>3</sup>	50 kg/m <sup>3</sup>
Calcium Carbonate 1000 μ	100 kg/m <sup>3</sup>	50 kg/m <sup>3</sup>
Calcium Carbonate 2300 μ	100 kg/m <sup>3</sup>	75 kg/m <sup>3</sup>
BAROFIBRE®	75 kg/m <sup>3</sup>	75 kg/m <sup>3</sup>
BAROFIBRE® Coarse	75 kg/m <sup>3</sup>	75 kg/m <sup>3</sup>
BAROFIBRE® Super Fine	75 kg/m <sup>3</sup>	75 kg/m <sup>3</sup>
DUO-SQUEEZE™ R		240 kg/m <sup>3</sup>
<b>Total LCM Concentration</b>	<b>625 kg/m<sup>3</sup></b>	<b>690 kg/m<sup>3</sup></b>

Both pills were pumped through a milling bottomhole assembly (BHA) at 5 m<sup>3</sup> per minute, and circulated for three hours after the spotting of each pill. The bottomhole temperature of the loss zone was approximately 135°F.

- After Pill 1, the initial static loss rate of 115 m<sup>3</sup>/hr decreased to < 50 m<sup>3</sup>/hr.
- After Pill 2, the static loss rate dropped to 15 m<sup>3</sup>/hr.

With these results, the operator was able to open the window, displace the wellbore to a low-solids, non-dispersed water-based mud (LSND WBM) and commence drilling the new 3,000-m reservoir section. The hole was swept with a BAROFIBRE LCM pill while drilling, which further reduced losses to < 1 m<sup>3</sup>/hr.

**ECONOMIC VALUE CREATED**

Spotting the two customized LCM pills to plug the perforations saved two days of rig time and eliminated the cost of an acid-soluble cement plug operation and wait-on-cement (WOC) time. The operator’s resulting estimated savings exceeded US\$500,000.