UFS | APPLICATION EXCELLENCE™

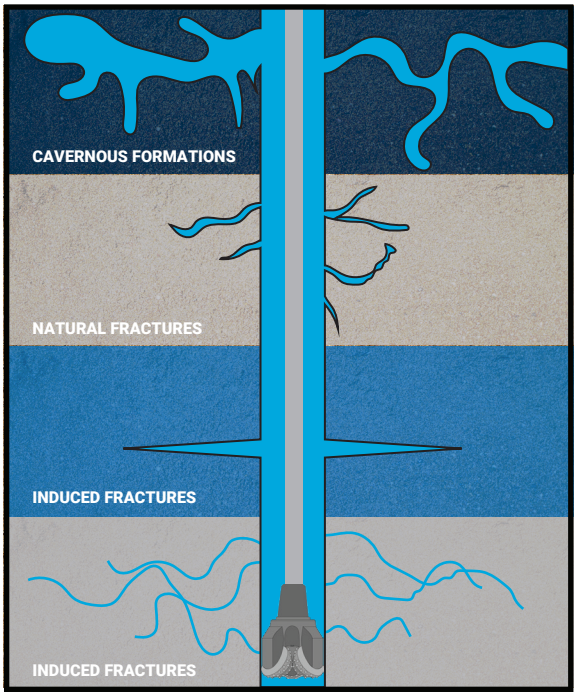
Universal Fluid Services

APPLICATION EXCELLENCE IN FLUID LOSS MANAGEMENT

DRILLING FLUID CIRCULATION LOSS WHILE DRILLING

Lost circulation is the single most costly problem plaguing drilling operations. The resulting loss of valuable drilling fluid, increase in non-productive rig time, and lost holes make it the single most expensive drilling phenomenon. Lost circulation can also lead to severe well control incidents.

Lost circulation can be broadly categorized into induced losses through high-pressure mechanical fracturing and naturally occurring losses from cavernous vugular carbonate formations, naturally occurring fractures or faults in transition zones, and highly permeable formations in unconsolidated sands or gravel sections.



Drilling Fluid Loss Categorization

Drilling fluid losses are typically broken into categories by the loss rate in barrels per hour. This being said, it is essential to remember that loss rate is merely a reference point. It is essential to determine and control the cause of the fluid loss by means of treatment appropriate for the situation.

Fluid losses while drilling are generally classified as:

Seepage Fluid Losses
Seepage fluid losses are typically less than 10 bbl/hr. They may be due simply to incomplete sealing of a permeable formation. In most cases, the addition of lost circulation material consisting of fibers and fine granules is an effective solution.

Partial Fluid Losses
Partial losses of the total fluid volume are those that range between 10 and 100 bbl/hr. These are typically the result of encountering natural or partially induced fractures. Treatment with medium size to large granular lost circulation materials will generally help control these situations.

Severe/Total Fluid Losses
Severe losses exceed 100 bbl/hr and can include complete loss of fluid returns. Large fractures, cavernous formations, and unconsolidated gravel zones tend to be the reasons for severe losses. The loss of large drilling fluid volumes requires immediate action to ensure the well is not lost. These treatments consist of high-volume squeezes and plugs of lost circulation materials.

Wellbore Strengthening
Wellbore strengthening operations reinforce the wellbore to prevent or mitigate lost circulation by bridging/sealing lost circulation fractures with lost circulation materials (LCMs) of various types. The purpose of these substances is to increase the pressure that a wellbore can sustain without significant fluid loss and widen the drilling mud weight window.

The common LCMs that generally are mixed with the drilling fluid to seal loss zones may be grouped as:

- Fibrous
- Flaked
- Granular
- A combination of fibrous, flaked, and granular materials

THE APPLICATION EXCELLENCE APPROACH
TO PREVENTION OF LOST CIRCULATION

It is impossible to totally prevent lost circulation. Some formations bear naturally fractured, cavernous, or high-permeability zones that cannot be avoided if the target zone is to be reached. This is when the Application Excellence approach becomes vitally important. Together, the Universal Fluid Services Drilling Specialist and the Drilling Operator **evaluate** the situation and map out a plan of action. If lost-circulation zones are anticipated, the Drilling Specialist will **advise** which preventive measures should be taken, such as the leakoff tests (LOT) and formation integrity tests (FIT), and which loss of circulation materials (LCMs) should be added to the drilling fluid. During job **execution**, lost circulation precautions taken will include:

- Maintaining proper mud weight
- Minimizing annular-friction pressure losses during drilling and tripping in
- Adequate hole cleaning
- Avoiding restrictions in the annular space
- Setting casing to protect upper weaker formations within a transition zone
- Updating formation pore pressure and fracture gradients for better accuracy with log and drilling data

After completion of the project, the Drilling Specialist and the Drilling Operator will thoroughly assess the successes and shortcomings of the job and utilize knowledge gained to begin planning for the next well.

THE PRINCIPLE OF BRIDGING TO PREVENT LOST CIRCULATION

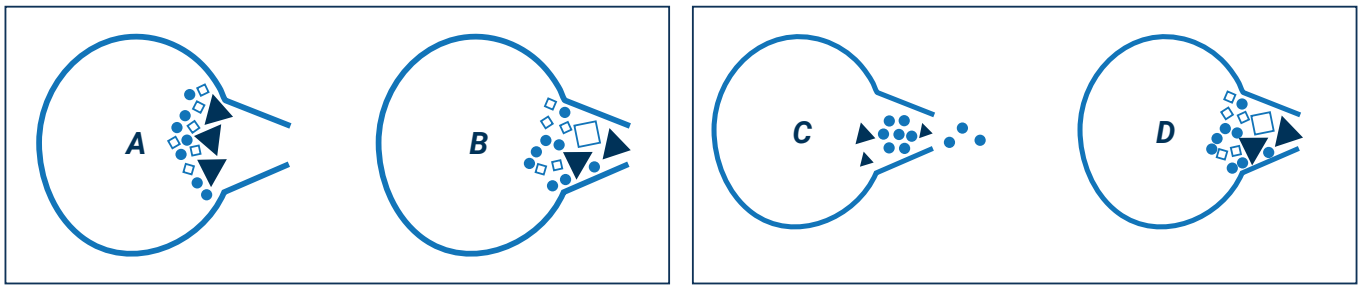


Figure A: Fracture seal at wellbore face
Figure B: Fracture seal within the formation

Figure C: Small LCMs failing to form a bridge
Figure D: Initial bridge is formed with large particles and the final seal with smaller particles

TYPICAL TREATMENTS TO PREVENT LOST CIRCULATION

PRODUCTS	MUD WEIGHTS				COMMENTS
Mud Weights PPG	7.0 to 12.5	12.6 to 15.0	15.1 to 17.0	17.1+	Add recommended amounts to active system
Micro-Fiber Fine	10 - 25 ppb	10 - 25 ppb	10 - 15 ppb	5 - 10 ppb	
Micro-Fiber Medium	10 - 25 ppb	10 - 25 ppb	10 - 15 ppb	5 - 10 ppb	
Micro-Fiber Coarse	0	0	0	0	
Calcium Carbonate Sized	10 - 40 ppb	10 - 30 ppb	15 - 25 ppb	10 - 15 ppb	
Total ppb LCM	30 - 80 ppb	30 - 70 ppb	25 - 50 ppb	20 - 30 ppb	

PRODUCTS	MUD WEIGHTS				COMMENTS
Mud Weights PPG	7.0 to 12.5	12.6 to 15.0	15.1 to 17.0	17.1+	Pump sweeps as needed. Do not over treat as this can lead to a buildup of solids and increased ECD's
Micro-Fiber Fine	10 ppb	10 ppb	10 ppb	7 ppb	
Micro-Fiber Medium	10 ppb	10 ppb	10 ppb	7 ppb	
Micro-Fiber Coarse	10 ppb	10 ppb	10 ppb	7 ppb	
Calcium Carbonate Fine	10 ppb	10 ppb	10 ppb	7 ppb	
Calcium Carbonate Coarse	10 ppb	10 ppb	10 ppb	7 ppb	
Total ppb LCM	30 - 50 ppb	30 - 50 ppb	30 - 50 ppb	35 ppb	

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