MudOUT Oil-Based Drilling Mud Filter Cake Remover

Innovative Single-Stage Oxidant/Surfactant System

MudOUT System

New technology for breaking/removing oil based filter cake in oil well completion process

- Surfactant solubilizes hydrocarbons
- Coated oxidant provides controlled release leading to uniform filter cake breakdown
- Generates low pH (<1) to dissolve carbonates
- Single injection

Process Advantages

- One step process removes organic and inorganic components of filter cake, unlike acids or solvents
- Customizable to well-specific conditions
  - Oxidant can be formulated to optimally attack and dissolve filter cake
  - Time released oxidant for controlled reactions under various conditions
- Improves permeability
- Faster, more complete removal of filter cake than conventional treatment with formic acid

Cost Advantages

- Single-step treatment
  - Lower cost than conventional treatments:
    - Requires no pre-treatment to achieve water-wet surface
    - Generates low pH, no follow up acid treatment
    - Shorter time from well completion to production

Experimental Set-ups

Multi-mixer

HTHP filtration press

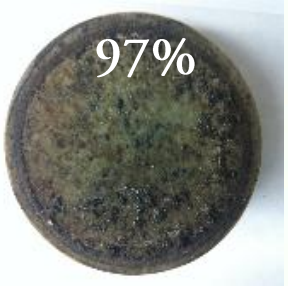
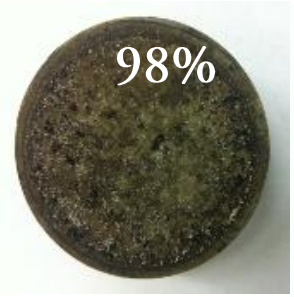
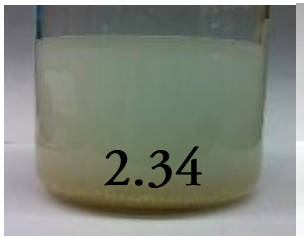
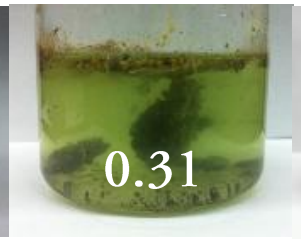
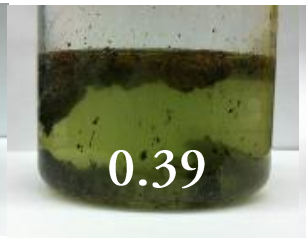
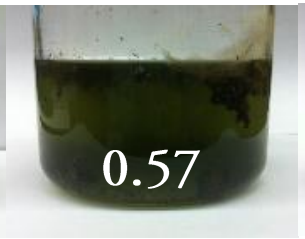
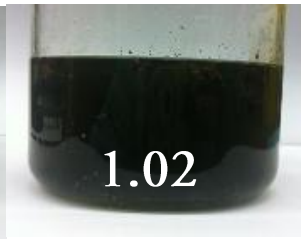
Experimental Procedures

- Prepare optimized oil-based drilling mud
- Formation of filter cake
- Prepare specified MudOut system
- Soak filter cake over 4, 8, 20, and 42 hours
- Chemical analysis for each test
- Determine filtration rate before and after each treatment

Summary of Results
Excellent Filter Cake Removal and Permeability

Test	Treatment	KCl Brine	Temp.	Removal Efficiency (4 hrs)	Removal Efficiency (8 hrs)	Removal Efficiency (20 hrs)	Removal Efficiency (42 hrs)	Permeability Ratio (k_f/k_i)
1	MudOUT	5%	140 °F	84%	87%	94%	98%	1.13
2	MudOUT	5%	190 °F	95%	97%	98%	98%	2.10
3	MudOUT	18%	190 °F	90%	97%	98%	98%	2.00
4	MudOUT	18%	250 °F	91%	95%	97%	98%	1.23

Example Photos of Filter Cake and Filtrate
MudOUT at 18% Brine and 190°F

Hours:	0	4	8	20	42
Percent Removal:		 90%	 97%	 98%	 98%
pH:	 2.34	 0.31	 0.39	 0.57	 1.02
		Removed from core by 4 hours	Begins to break up by 8 hours	Darker color indicates organics & inorganics are solubilized & dissolved	

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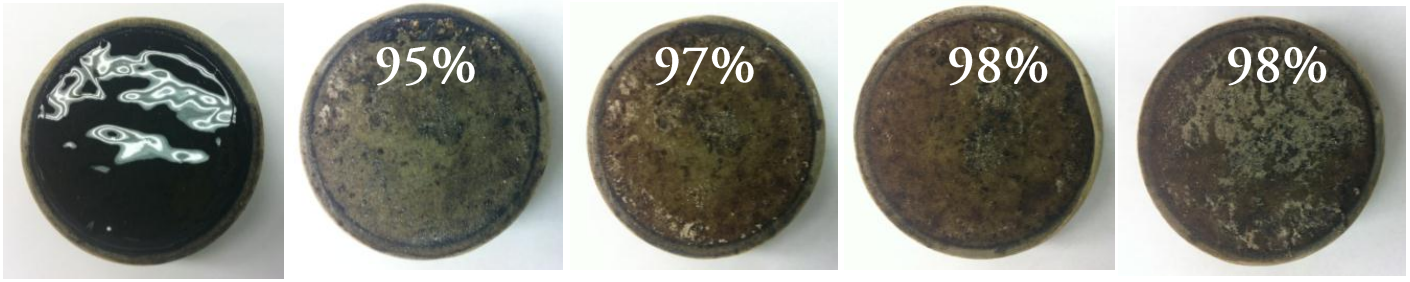
Example Photos of Filter Cake and Filtrate
5% Brine at 190°F

Hours:	0	4	8	20	42
Percent Removal:		95%	97%	98%	98%



Removed from core by 4 hours

Darker color indicates organics & inorganics are solubilized & dissolved

Comparison of MudOUT and Formic Acid
5% Brine at 190°F

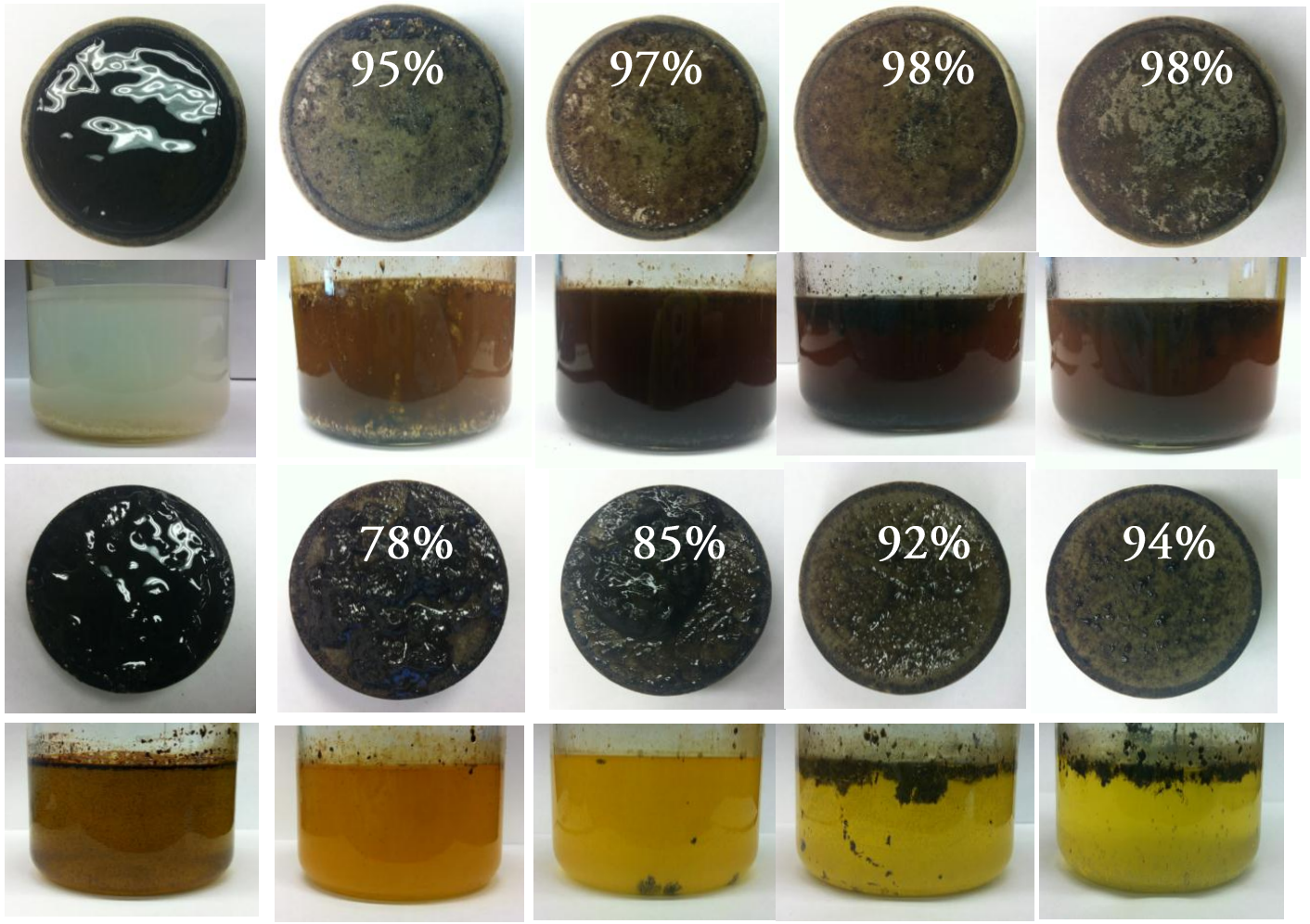
Hours: 0 | 4 | 8 | 20 | 42

MudOUT

Mudout solution removes, dissolves, and solubilizes filter cake organics and inorganics – as seen by dark color of solution.

Formic Acid

Formic acid provides incomplete break up of filter cake.



Summary

- MudOUT can remove 98% filter cake under all test conditions
    - 140°F – 250°F
    - 5% - 18% Brine
- Acidic pH created in all tests
- Filter cake dissolved/solubilized
- MudOUT out preforms acid:
    - Higher percent removal at all intervals
    - Higher permeability ratio
    - Solubilizes/dissolves all of filter cake