SPE Denver General Meeting: January 2026

Society of Petroleum Engineers

Beyond Friction Reduction:

Evaluation of Fracturing Fluids for Improved Cluster Efficiency and EOR

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Outline

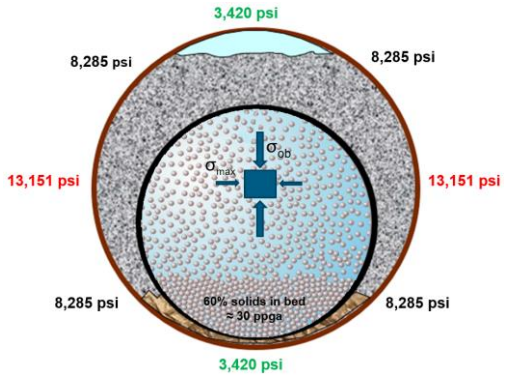
- Introduction
- Project Scope
- Evaluation Testing Description
- Laboratory Testing Results
- Field Trial Observations
- Conclusions

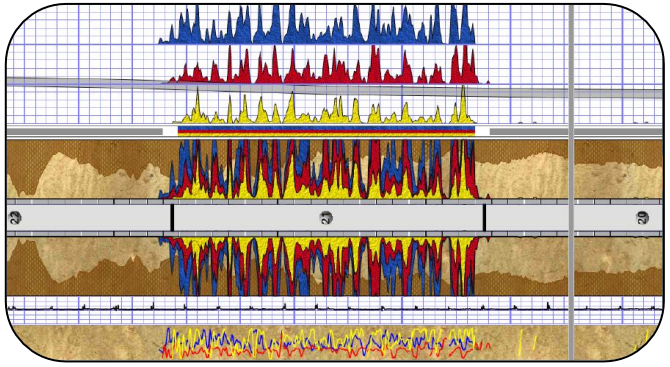
Beyond Friction Reduction

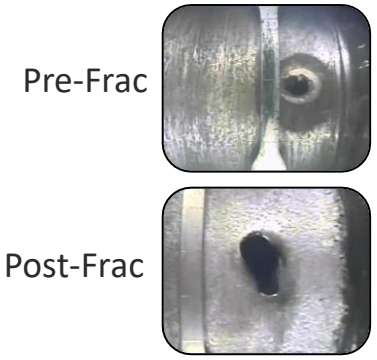
Introduction

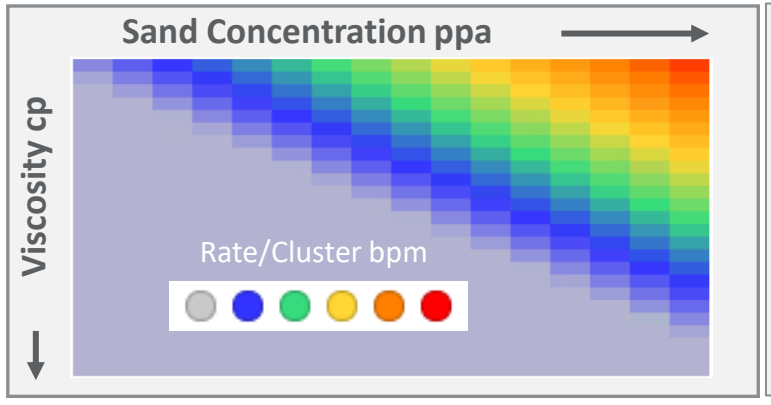
- The industry has prioritized surface performance indicators like friction reduction efficiency and economic factors over formation compatibility.
- Traditional approach ensures surface efficiency, but does not address formation damage, proppant placement, or the fluid's ability to enhance oil recovery.
- Current evaluation balance surface performance with subsurface outcomes through comprehensive fluid evaluation:
  - Effective Friction Reduction Testing
  - Regain Conductivity Testing
  - Oil Recovery from Rock Matrix → Spontaneous Imbibition
  - Nanotechnology Fluid Analysis
  - Emulsion / Flow Back Testing

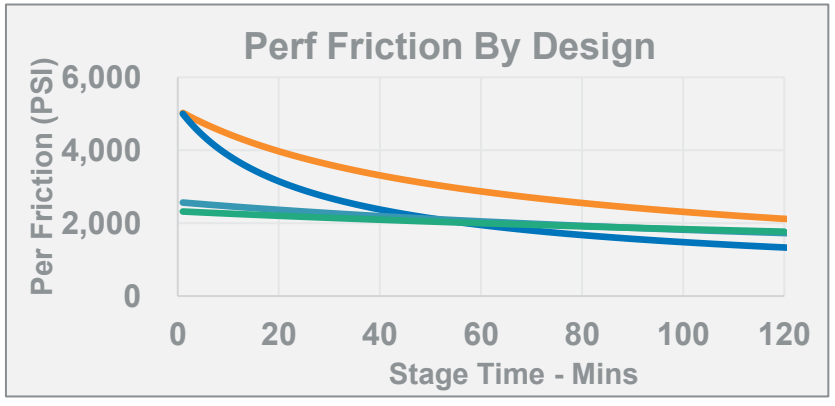
Beyond Friction Reduction



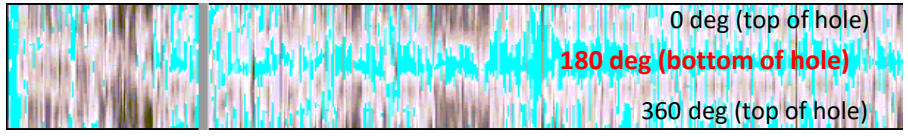






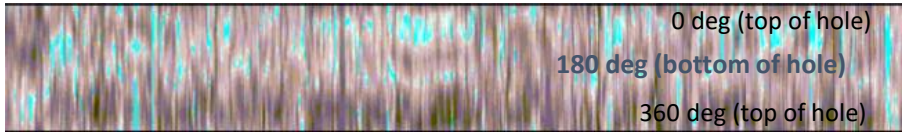


Un-centralized, no rotation during cement job

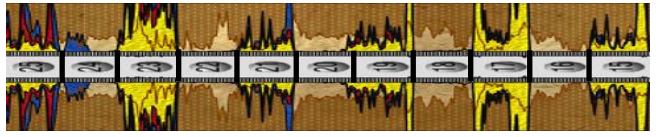


Poor Stage Isolation

Centralized, rotated during cement job



Good Stage Isolation



Our Approach for Success

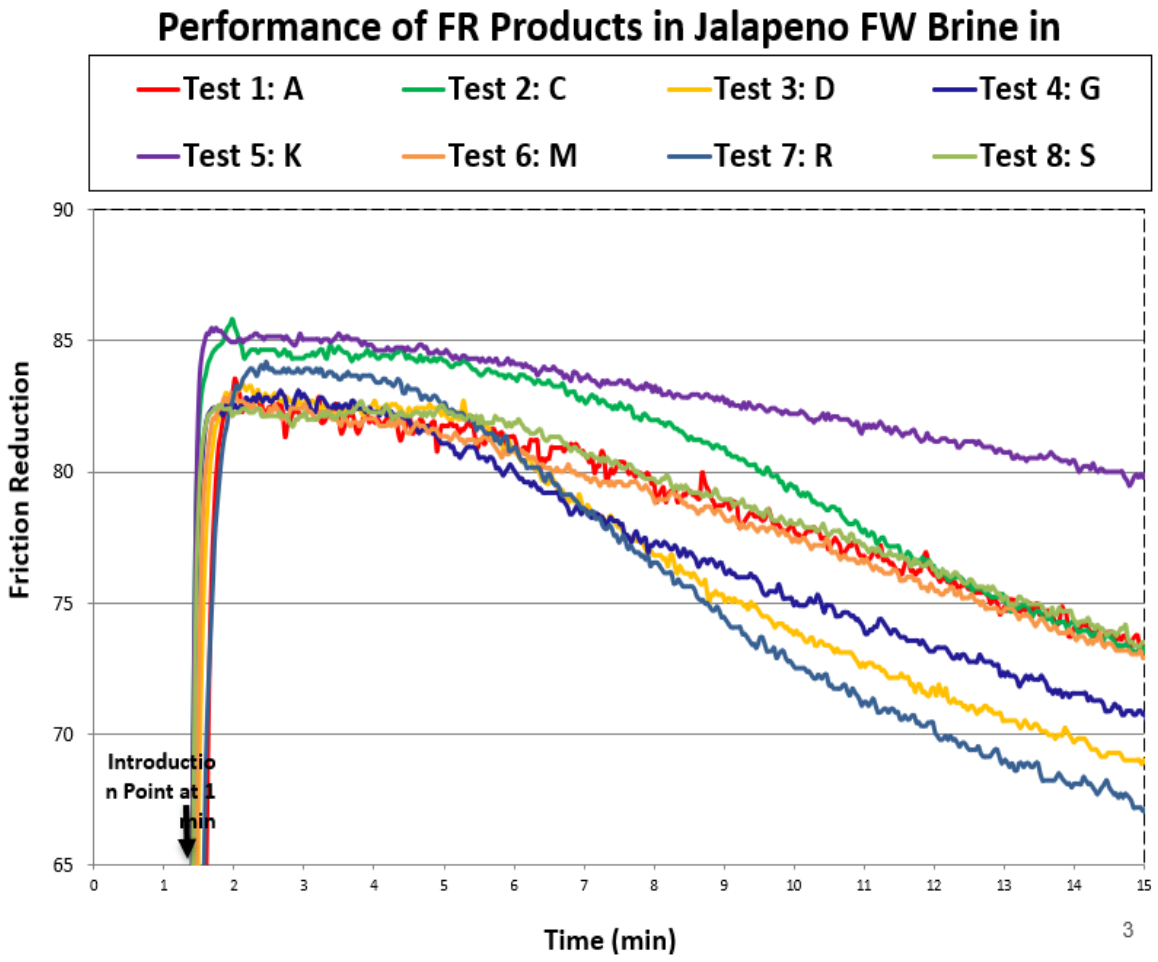
Effective cluster spacing is driven by high cluster efficiency

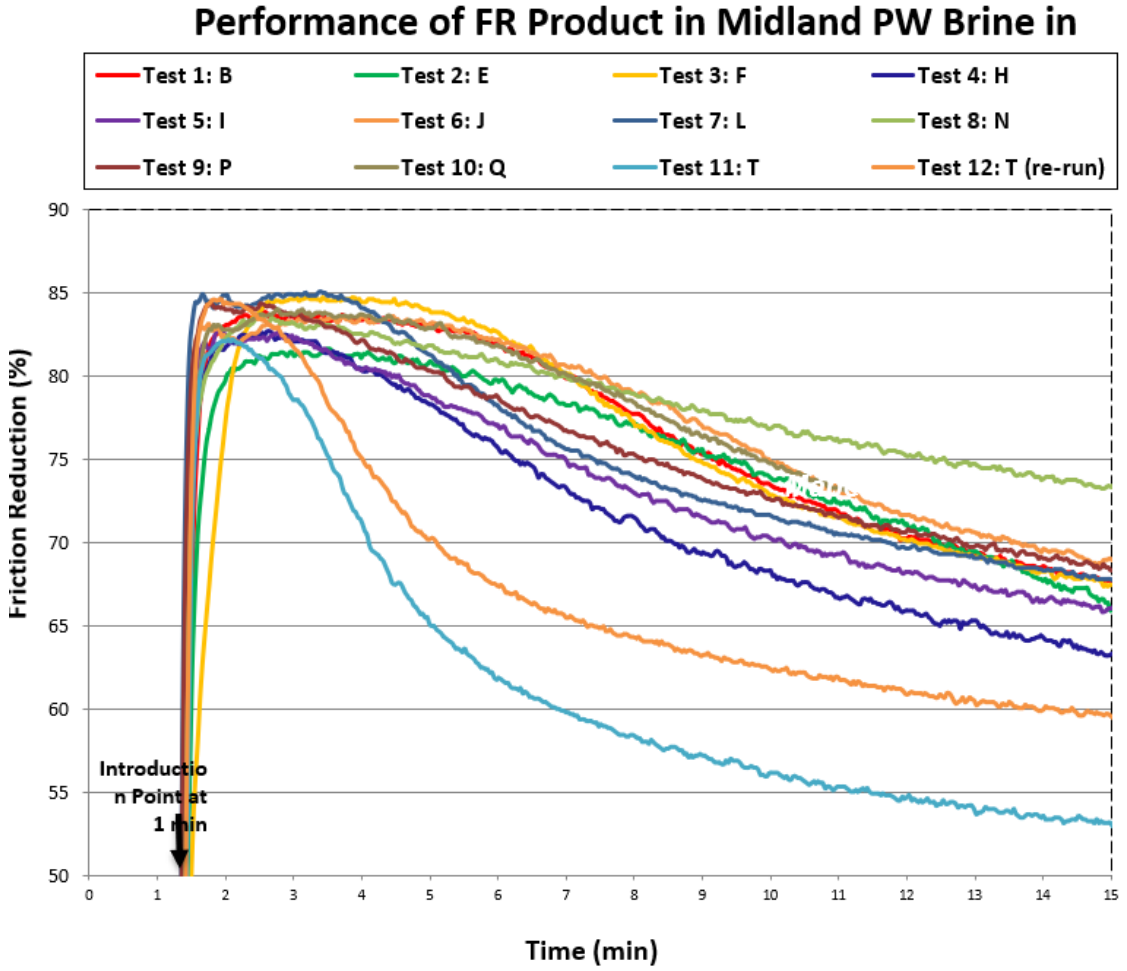
- **Orienting perfs** in the same plane can help reduce NWB tortuosity
- **Perf friction** should be designed to overcome NWB tortuosity, Sh min, and stress shadowing
- **Rate cluster/hole**, viscosity, mesh size, and sand ramp in pump schedule are also factors
- RA tracer, fiber, & down hole cameras are great **diagnostics** for measuring cluster efficiency

Cluster efficiency matters if you…

- care about cluster spacing
- want uniform proppant/fluid distribution inside pipe

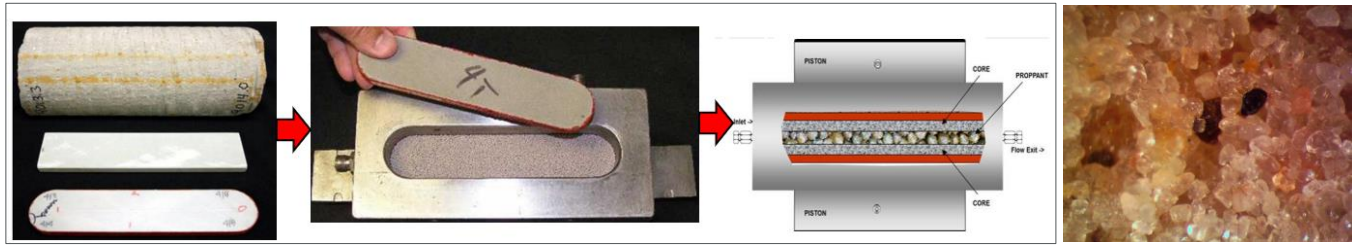
Friction Loop Results

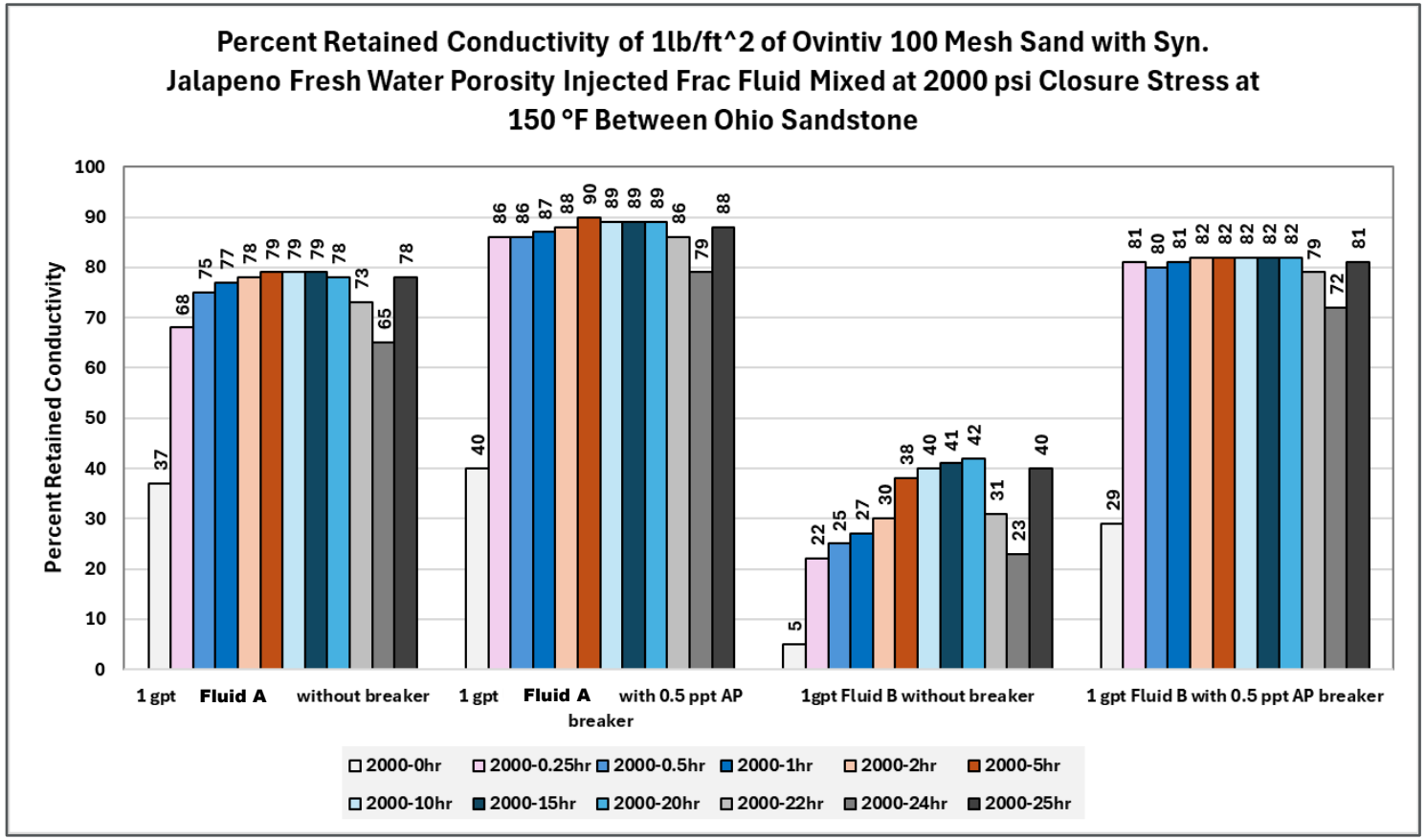




Regain Conductivity Results

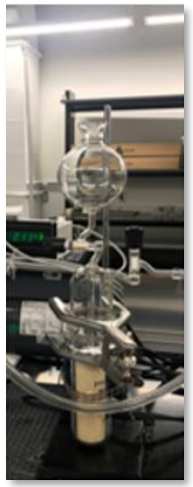
- 19 FR Products (FW & RW)
- 1 lb/ft^2 Proppant Loading
- 1.0 gpt FR
- Production Chemicals
- 150^{o}F temperature
- 1,000 & 2,000 psi closure stress





Oil Recovery. High Temp Spontaneous Imbibition Setup

Yost Core Plugs

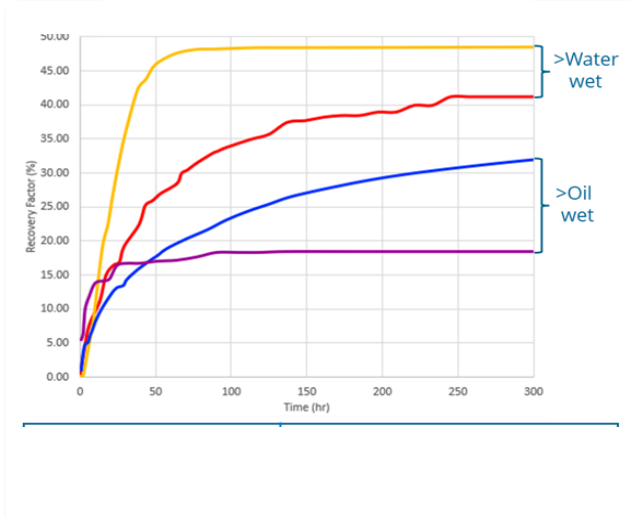


Vacuum and Oil Saturation

HPHT Aging Cells (1-1.5 months)

Custom Built High Accuracy Amott Cells

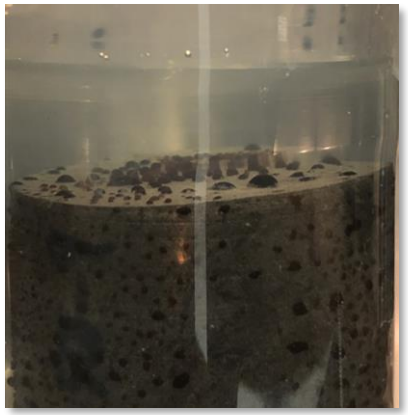
Plugs in Frac Fluid Design



results

Produced Oil with Time ~ 500 hr (20 days)

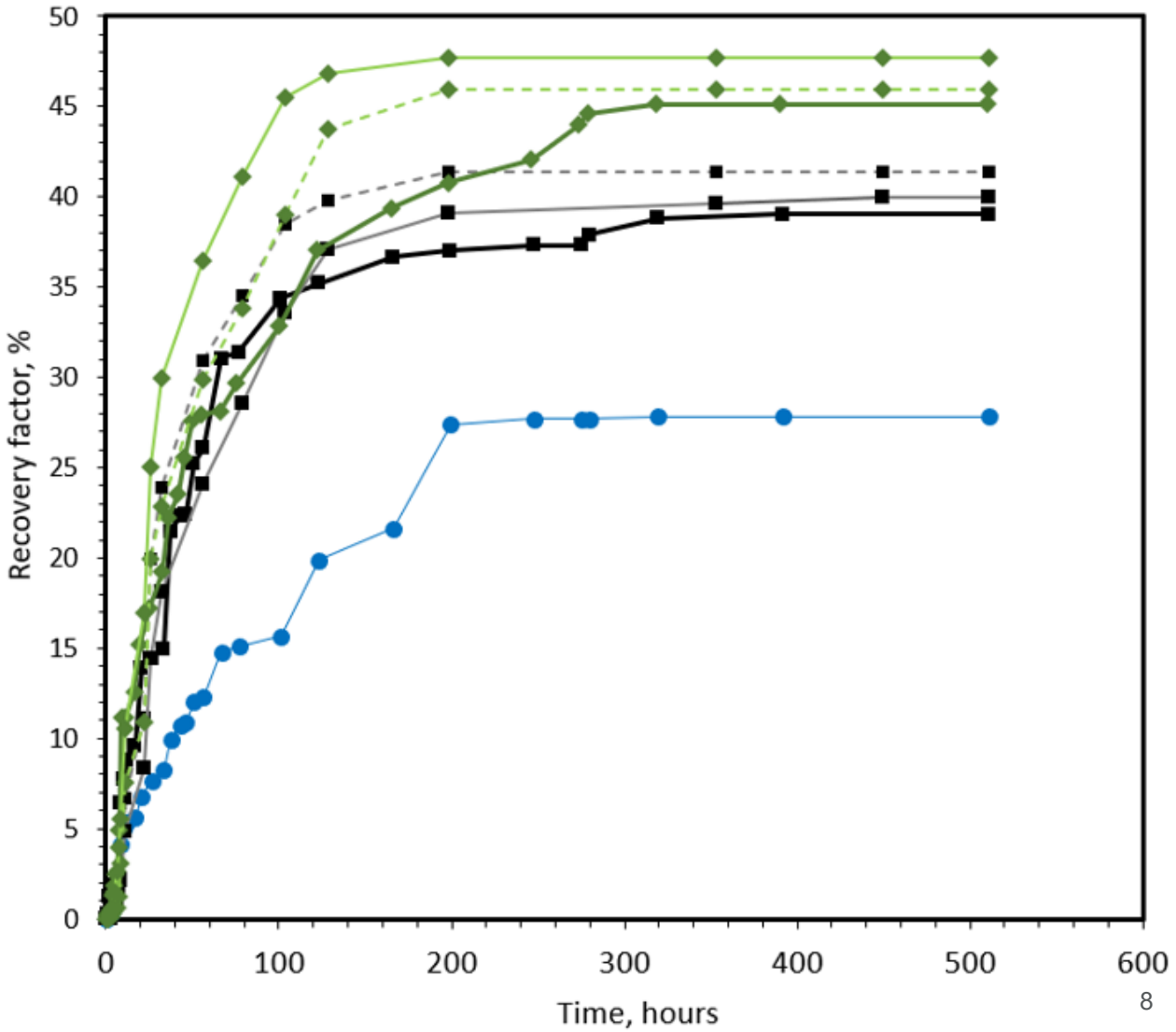
Oil Production In Action from the Yost Core



Even the tightest rocks imbibe and drain fluids

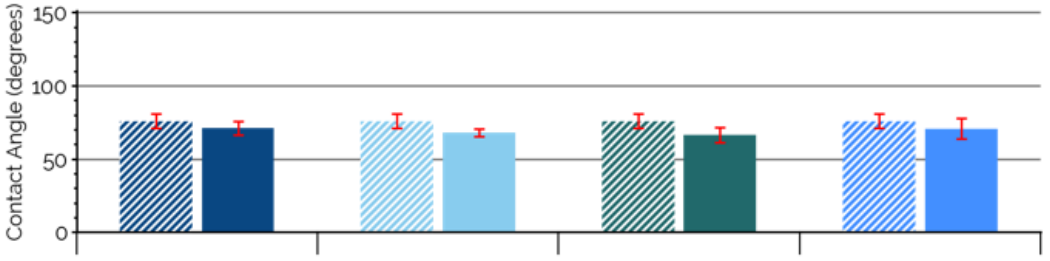
Oil Recovery. Spontaneous Imbibition Results

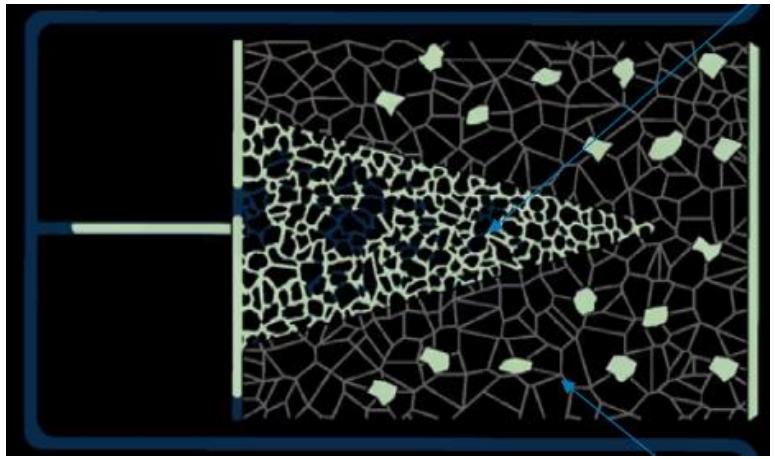
- Core Aging Process (6-8 weeks)
- Restore Native Wettability
- High Accurate Amott Cells
- BHT
- 1.0 gpt FR
- Production Chemicals

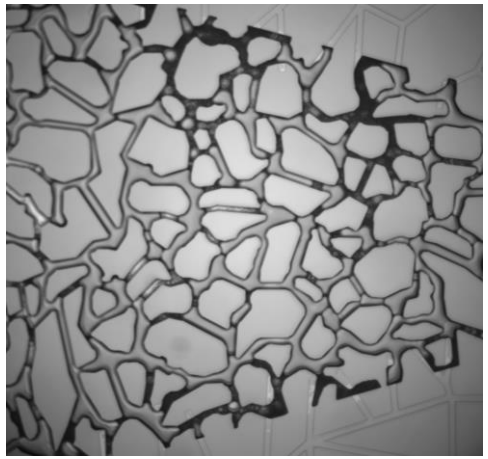


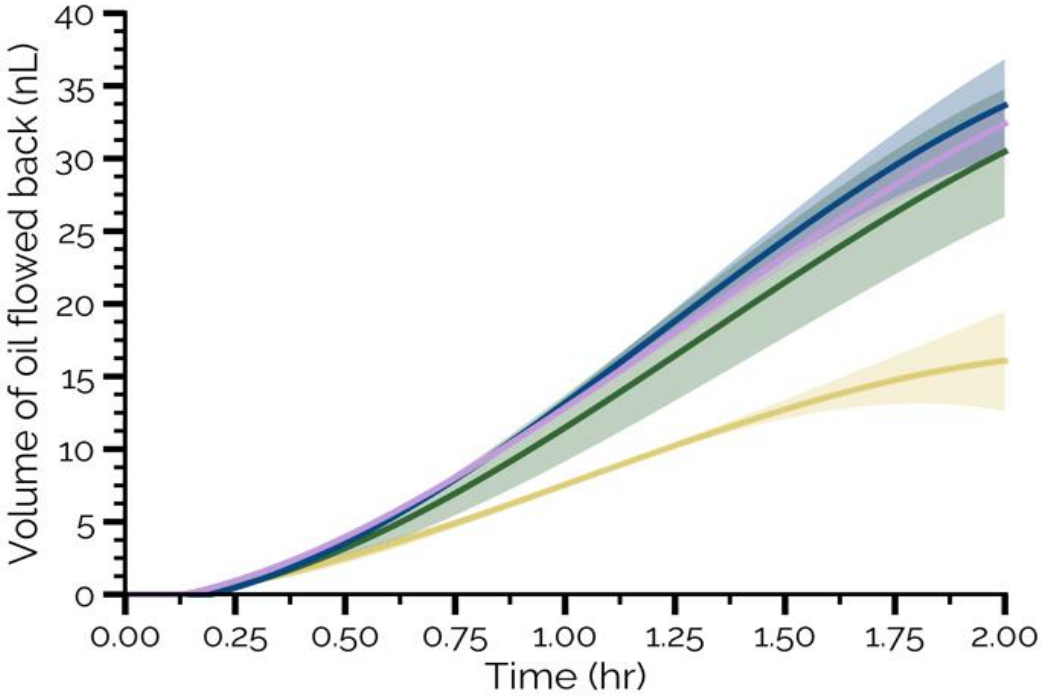
Nanotechnology Flowback Results

- Synthetic Reservoir Analog
- Reservoir Conditions
- Surface Wettability & Pore-throat Size
- Evaluate & Improve Fluid System
- Oil recovery & Chemical Performance





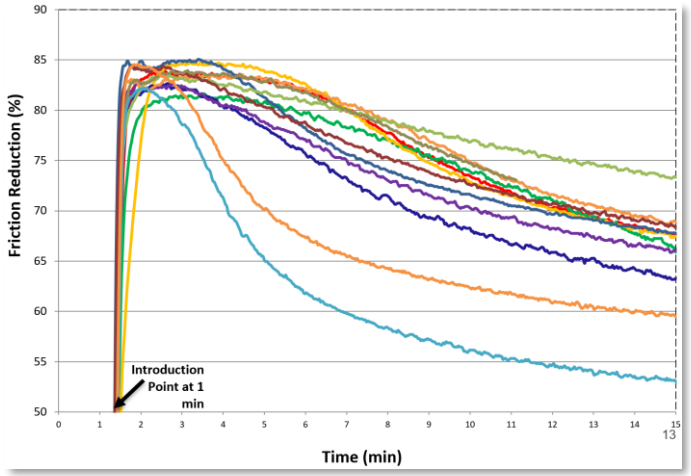




Beyond Friction Reduction

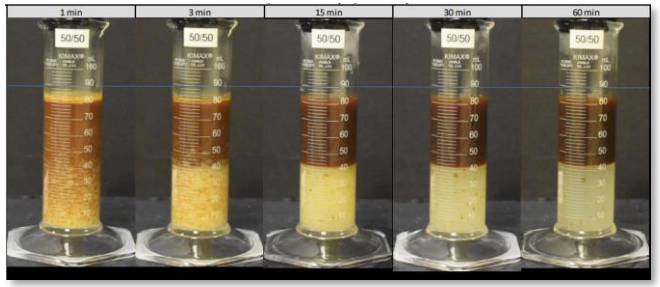
Retained Conductivity (optimize performance of FRs and other chems)

Friction Loop
(effective FR concentration)



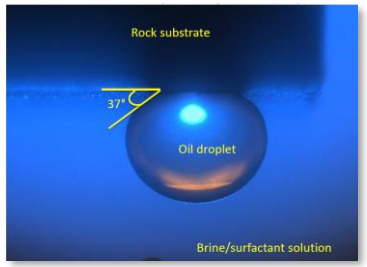
Biocide Kill Studies

Emulsion (flowback challenges)

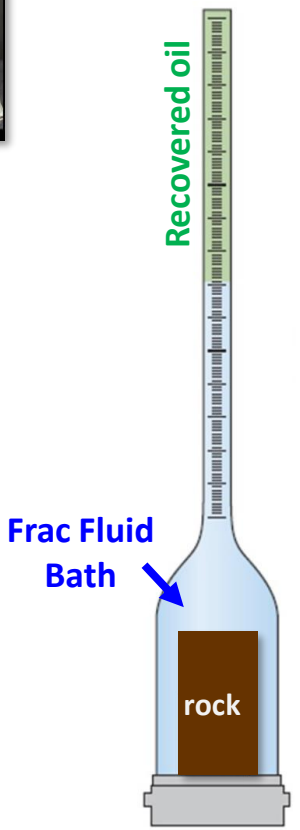


Scale Inhibitor Efficacy

Contact Angle, Interfacial Tension, Cloud Point,
(the dials of oil recovery and product stability)

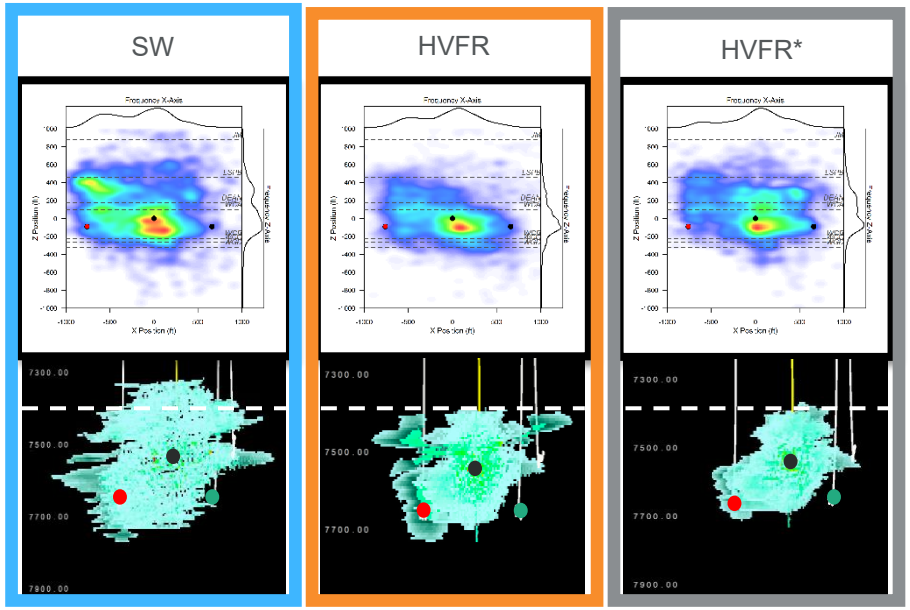


Amott Cells
(oil recovery from rock matrix)

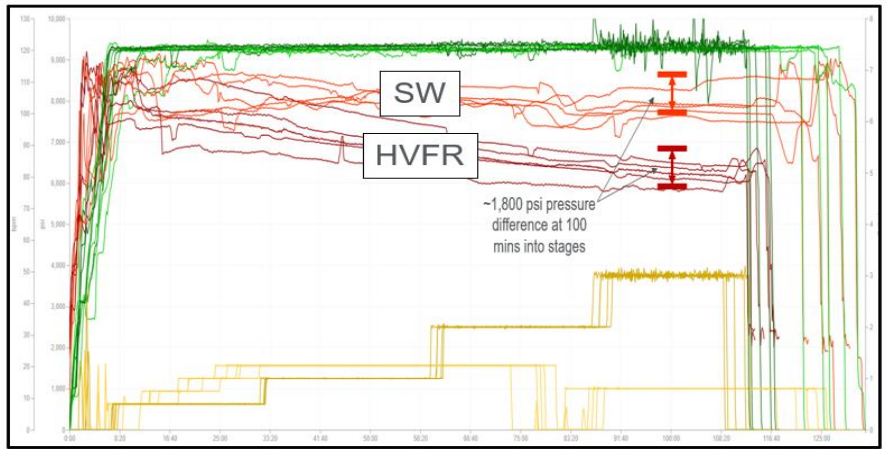


HVFR Diagnostics

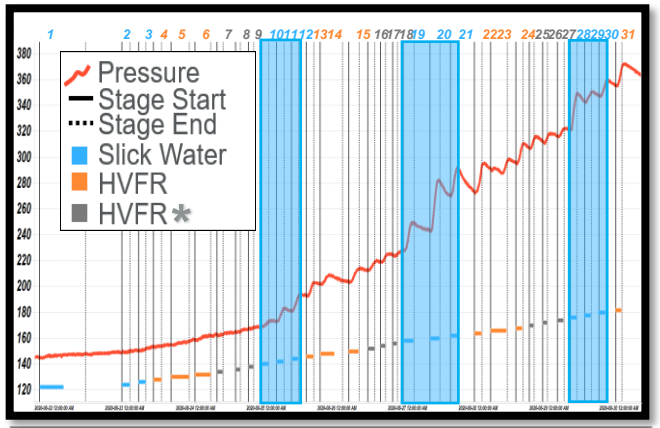
Micro-seismic vs Modeling

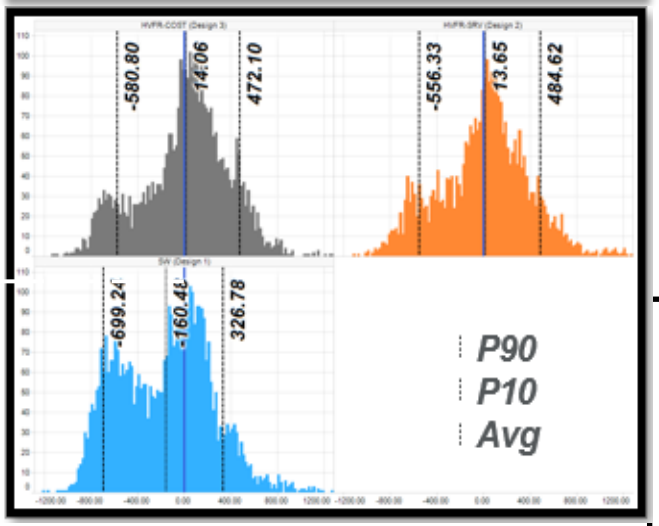


Actual Treatment Plots

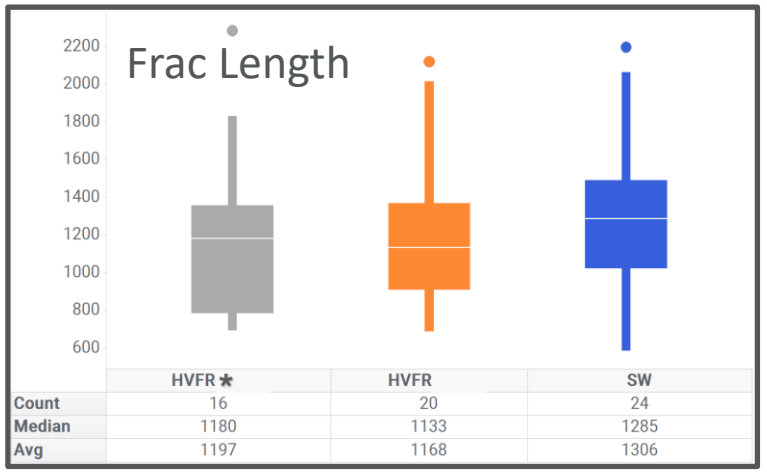


Offset Pressure Monitoring



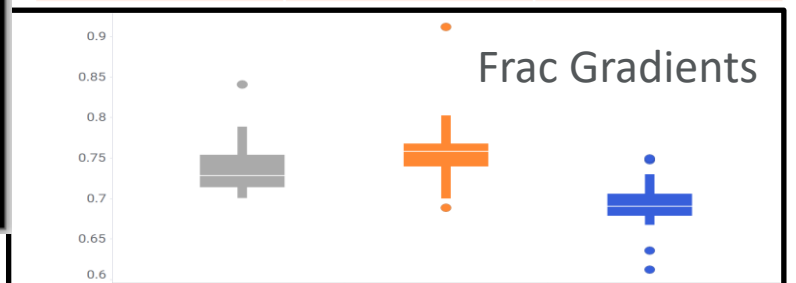


Seal Wellbore Pressure Monitoring



	HVFR*	HVFR	SW
Count	16	20	24
Median	1180	1133	1285
Avg	1197	1168	1306

SW Frac Hits	HVFR Frac Hits	Avg Distance
42%	16%	1,947 ft
75%	61%	1,298 ft



	HVFR*	HVFR	SW
Count	15	19	23
Median	0.73	0.76	0.69
Avg	0.74	0.76	0.69
Outliers	1	2	4

Conclusions

- The industry has prioritized surface performance indicators like friction reduction efficiency and economic factors over formation compatibility.
- Traditional approaches like flow loop and field tests have limitations in addressing formation damage, proppant placement, and fluid's ability to enhance oil recovery.
- Fluid selection and evaluation is crucial for optimizing frac design and well performance.
- Not all products are created equal, do your homework!
- Field trials combined with the appropriate diagnostic techniques are vital for asset development.

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Thank You!

Questions?