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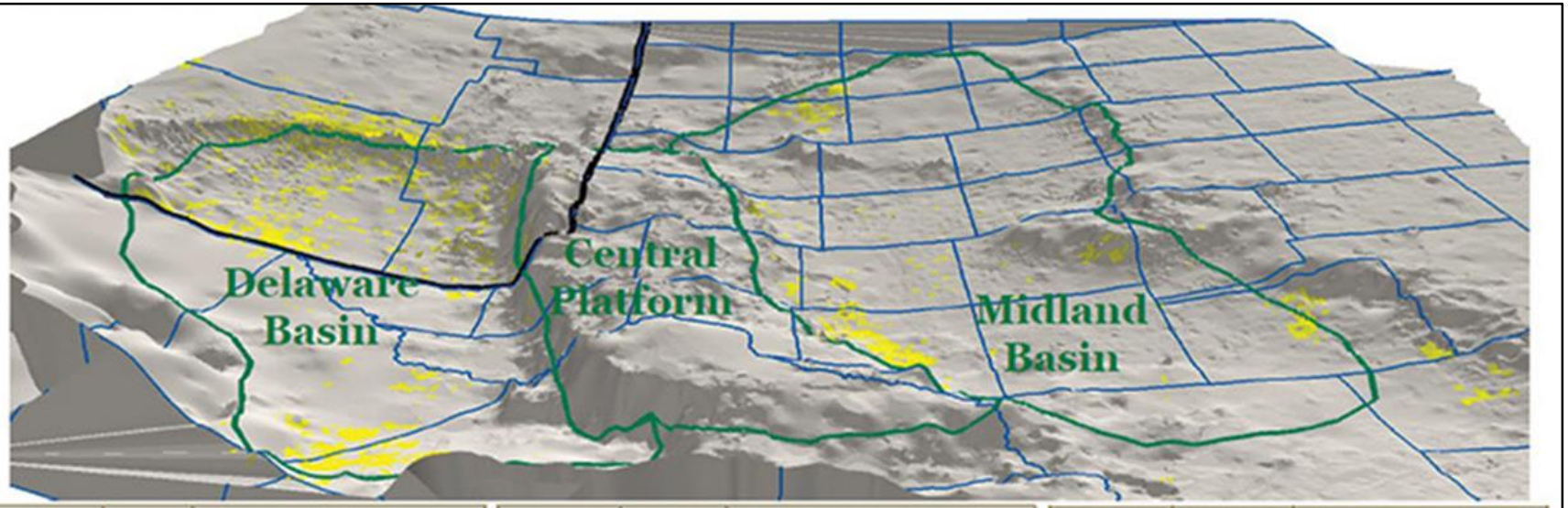
Continuous Improvement Leads to a Better Direct Emulsion System

Bill Shumway

Customer Challenge - Unconventional Drilling in the Permian



PERIOD	SERIES	DELAWARE BASIN FORMATION
GUADALAUPE	DELAWARE GROUP	LAMAR BELL CANYON
		CHERRY CANYON
		BRUSHY CANYON
LEONARD		UPPER AVALON SHALE
		LOWER AVALON SHALE
		1ST BONE SPRING
		2ND BONE SPRING
		3RD BONE SPRING
WOLFCAMP		WOLFCAMP
PENN		PENNSYLVANIAN

PERIOD	SERIES	CENTRAL PLATFORM FORMATION
GUADALAUPE	WHITE-HORSE	TANSILL
		YATES
		7 RIVERS
		QUEEN
		GRAYBURG
	WARD	SAN ANDRES
		GLORIETA
LEONARD	YESO	PADDOCK
		BLINEBRY
		TUBB
		DRINKARD
		ABO
WOLFCAMP	WOLFCAMP	HUECO
		BURSUM
PENN	PENNSYLVANIAN	

PERIOD	SERIES	MIDLAND BASIN FORMATION
GUADALAUPE	WHITE-HORSE	TANSILL
		YATES
		7 RIVERS
		QUEEN
		GRAYBURG
	WARD	SAN ANDRES
		GLORIETA
LEONARD	CLEAR FORK	UPPER LEONARD
		UPPER SPRABERRY
		LOWER SPRABERRY
		DEAN
WOLFCAMP		WOLFCAMP
PENN		PENNSYLVANIAN

Shale gas wells

Many wells per field

Need to drill fast and economically

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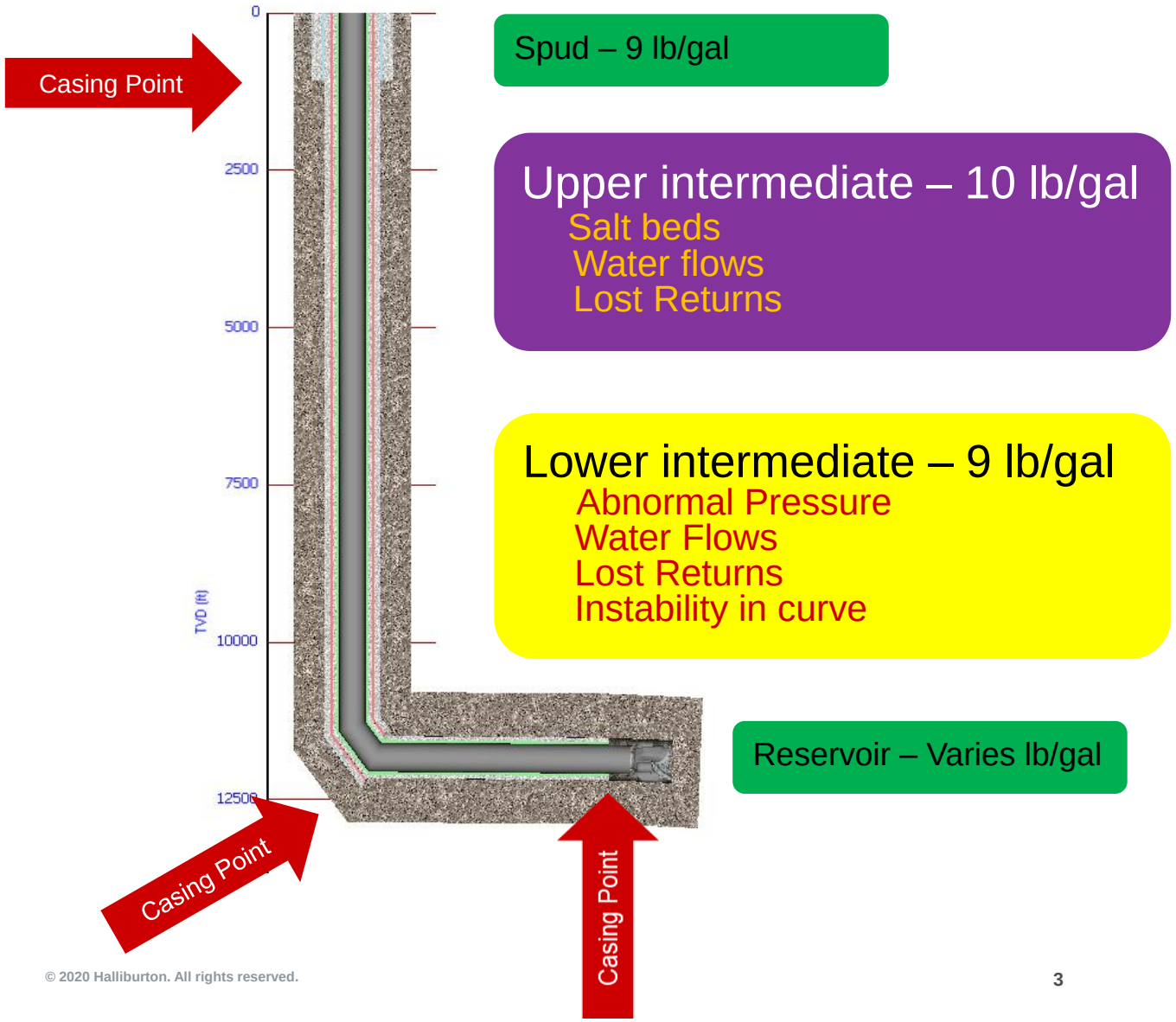
Customer Challenge - Typical Well



Spud – 9 lb/gal

Upper intermediate – 10 lb/gal
- Salt beds
- Water flows
- Lost Returns

Lower intermediate – 9 lb/gal
- Abnormal Pressure
- Water Flows
- Lost Returns
- Instability in curve

Reservoir – Varies lb/gal

Potential Solutions	Drawbacks
Set casing in intermediate section	Expensive Narrow production string
Oil Mud	Cost Not good with water flows
Standard water mud	Washes out salt beds Dilute or reformulate for lower intermediate
Saturated Salt mud	To heavy for lower pressure zone, losses
MMH/MMA fluids	Intolerant to salt
Direct Emulsion	Less established technology

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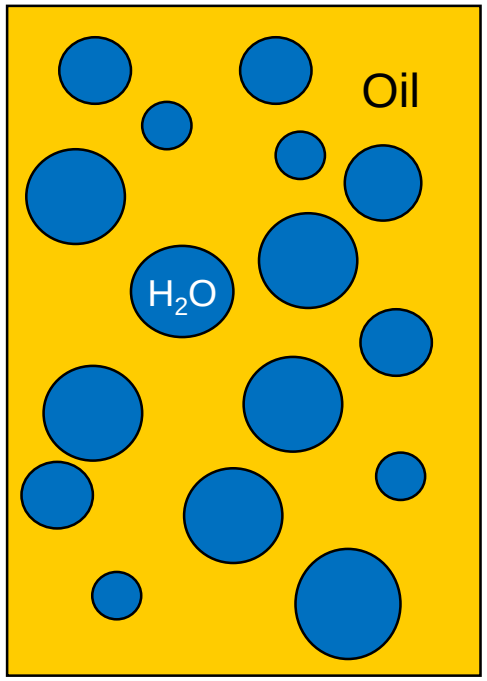
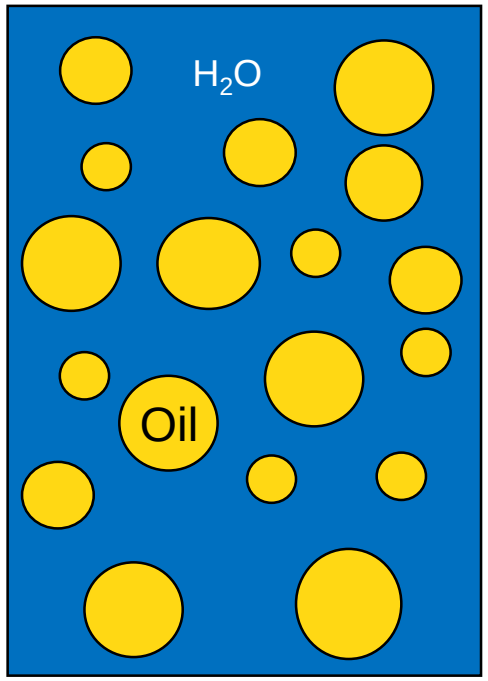
What the heck is Direct Emulsion?



Invert Emulsion
Oil continuous
i.e. Oil Based Drilling fluid



Direct Emulsion
Water Continuous
Reduced density
aka Emulsion or Invert Emulsion^{-1}

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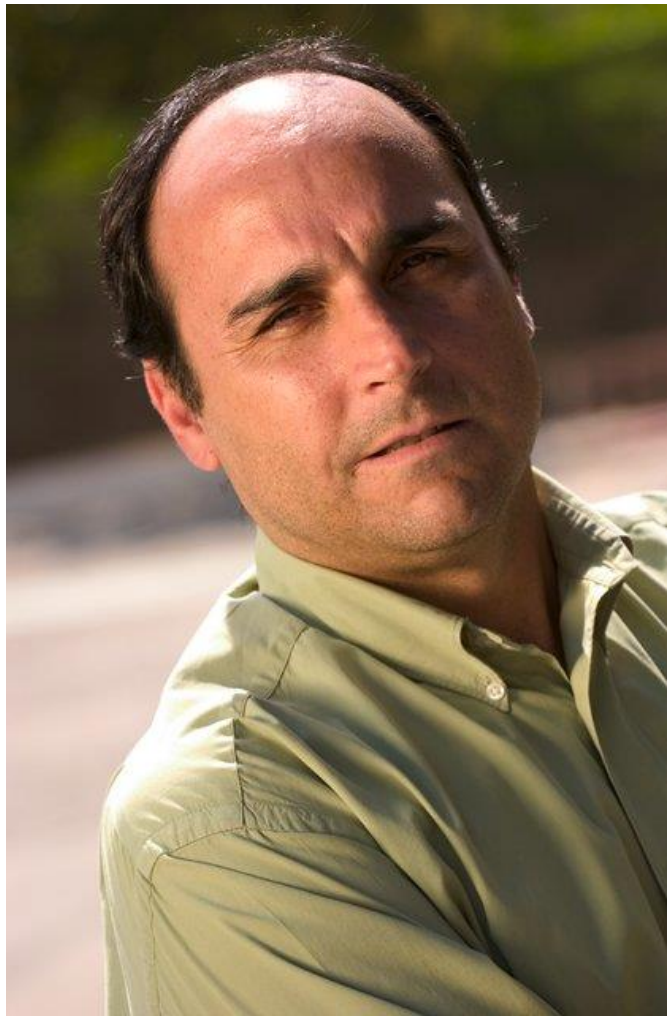
Customer Requirements



I want a 10 lb/bbl NaCl water based mud. Its got to be able to hold up to 20% oil content minimum, 30% would be preferred.

It has to be low rheology, especially with common contaminants. ECD is critical on these wells.

It has to be stable to the bottom hole temperature of 200°F.

And, it has to be stable with little or no phase separation upon standing for 48 hours.

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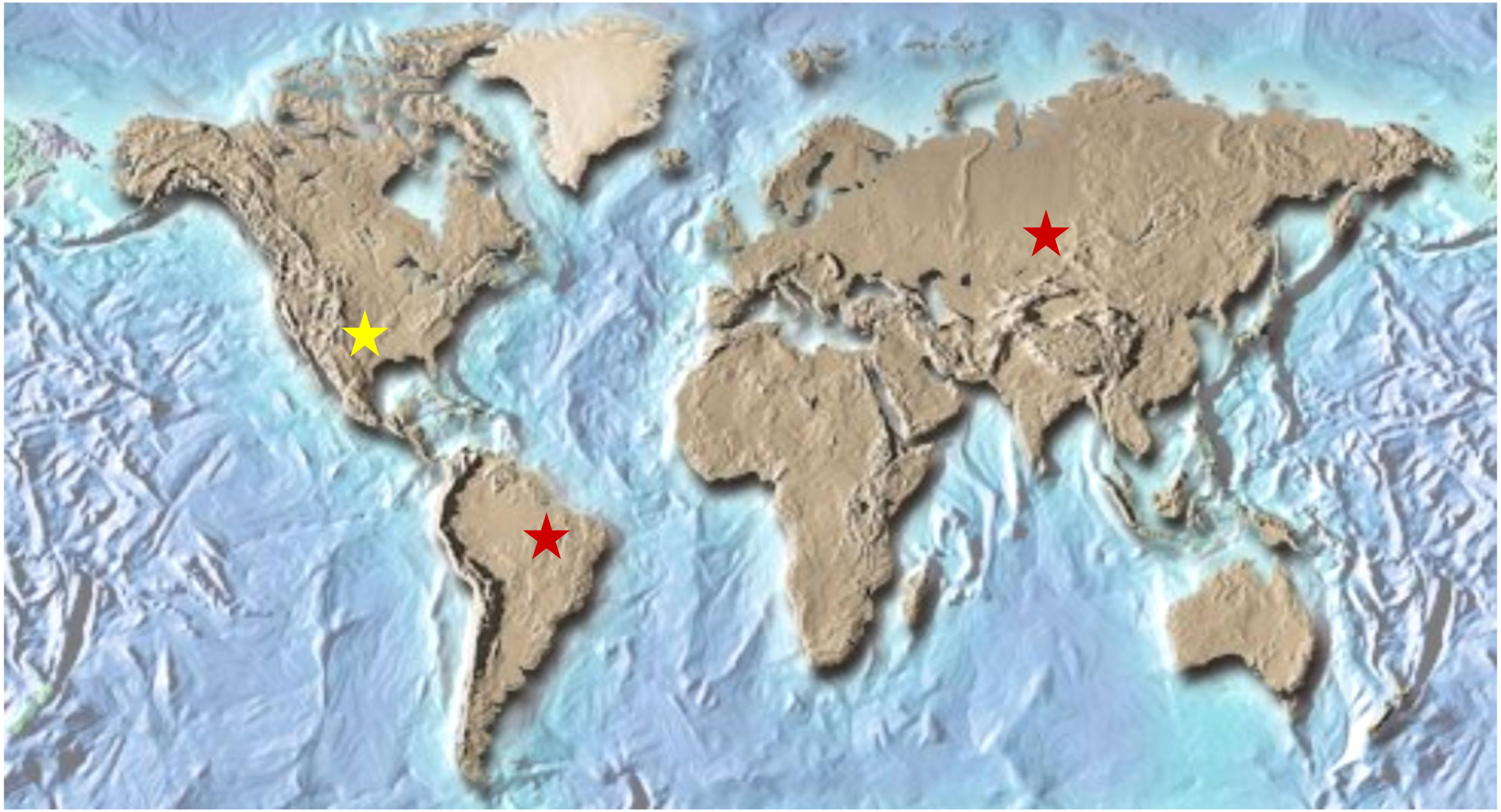
Piece of cake… Not so fast



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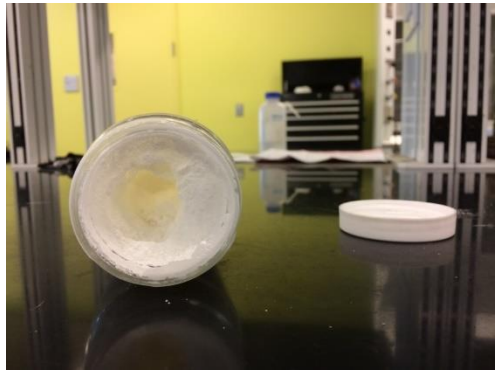
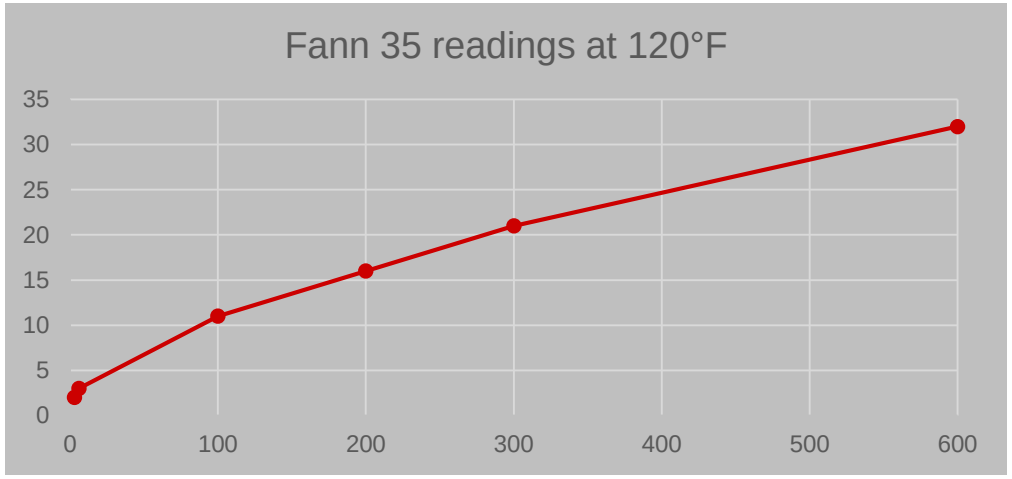
Development





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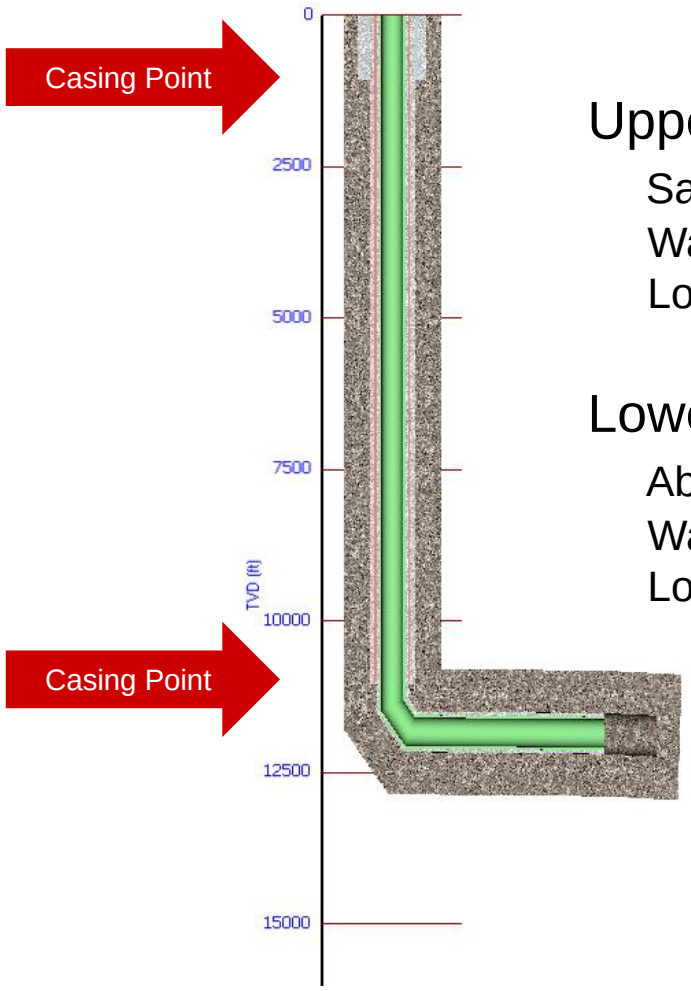
Field Trial – Delaware Basin New Mexico



Upper intermediate – 9.7 lb/gal

- Salt beds
- Water flows
- Lost Returns

Lower intermediate – 9.1 lb/gal

- Abnormal Pressure
- Water Flows
- Lost Returns

Field trial successful

AADE-18-FTCE-409

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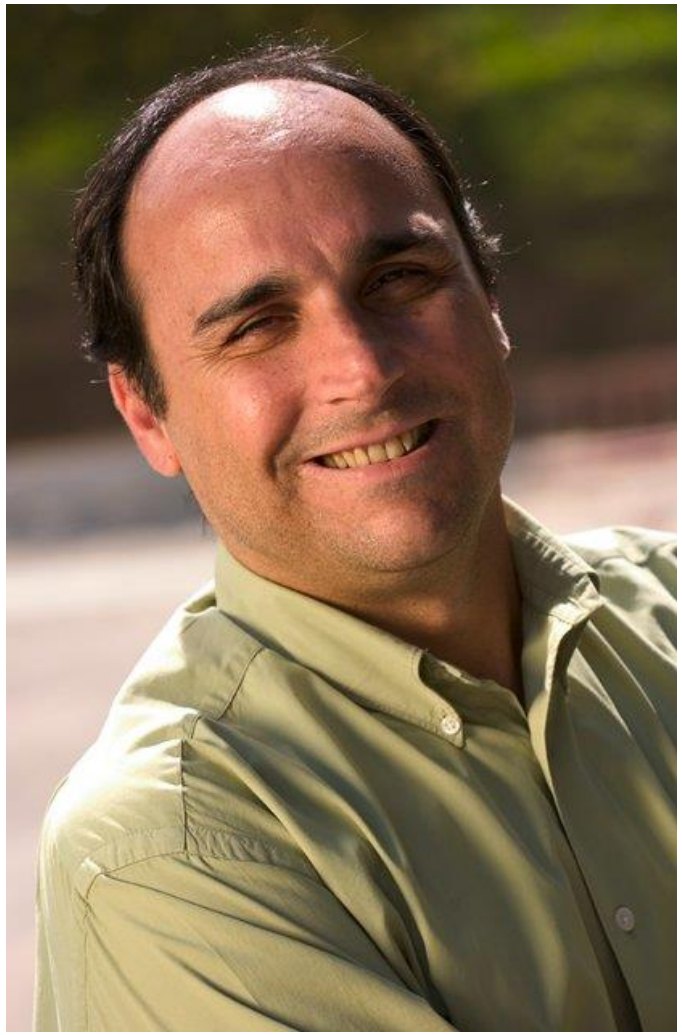
That new fluid was great!



It met all our performance goals. We avoided washout in the salt sections and losses through the interval.

Let’s drill some more wells.

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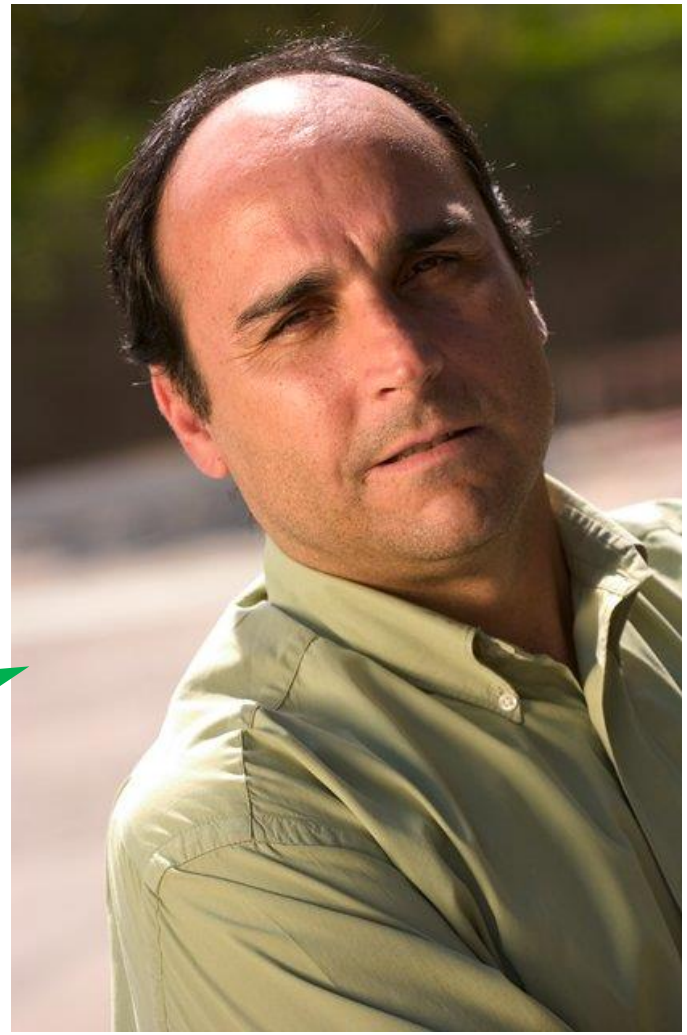
Can you add some more oil to it and make it lighter?

What was that weird thing that happened when we added more emulsifier?



I can re-use this fluid right?

Salt water is expensive. Can we build it with produced water?

Can I use it on some wells above 200°F?

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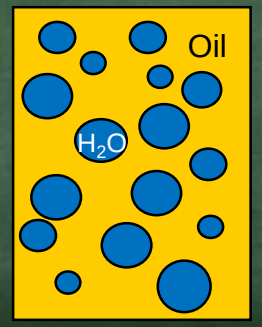
Finding the Boundaries

Recommendation

Treat produced water with soda ash

BHT max 225°F



WOR max 50/50

Avoid excess emulsifier

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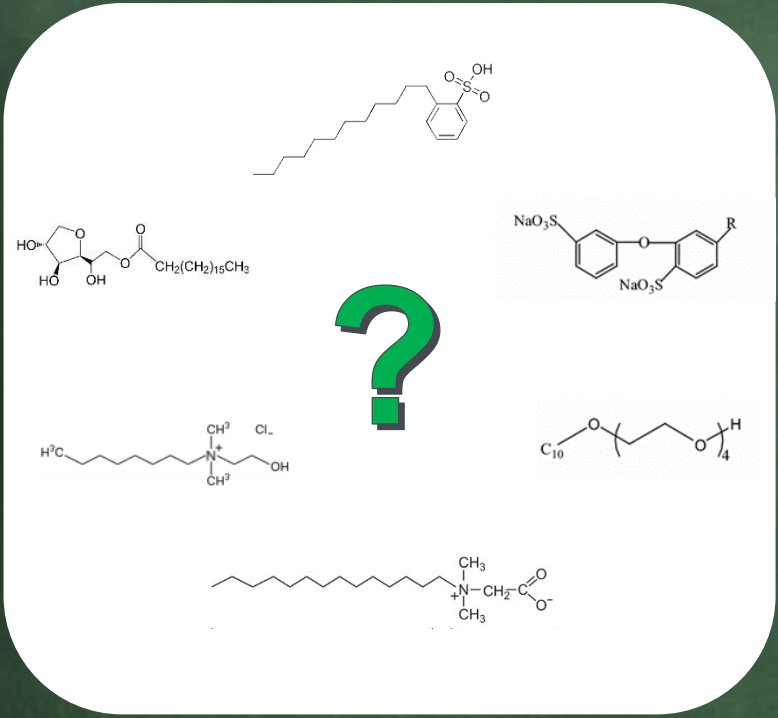
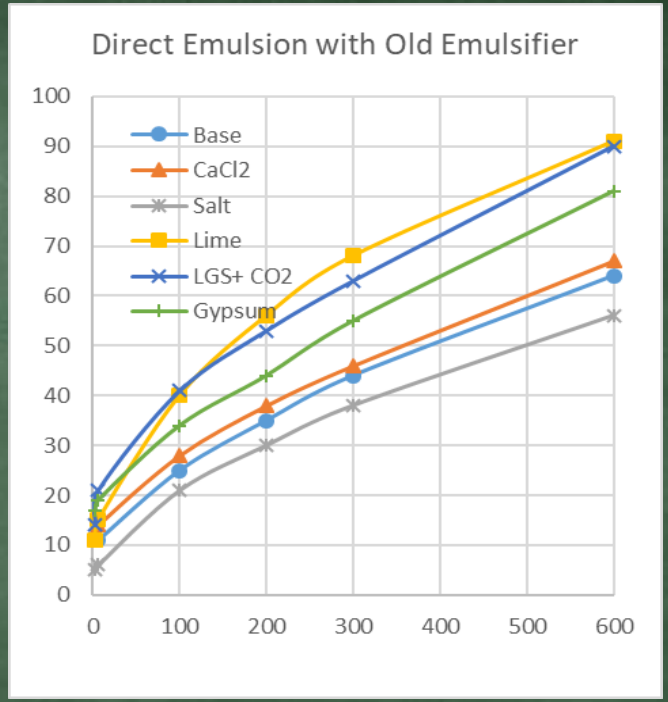
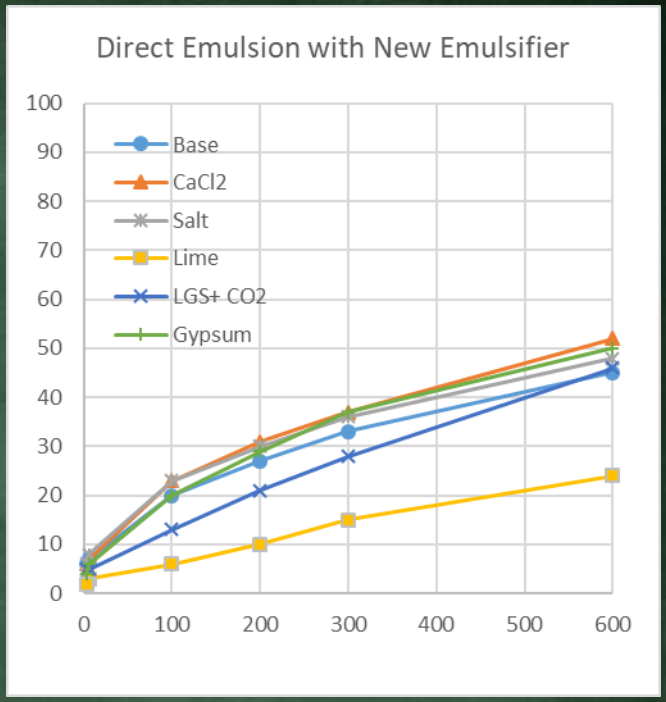
Rebuilding the system

New Emulsifier Chemistry Needed







Overall rheology improved
System temperature limit raised to 275 °F
WOR ratio max lowered to 40/60
Use of produced water acceptable
Problems with excess emulsifier eliminated

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Recent drilling success

- Delaware Basin – Similar drilling to previous wells
- Water flows increased total hardness above previous safe limit of old emulsifier
- New system drilled successfully
- Operator had been using OBM
- Using Direct Emulsion system saved approximately $100,000 USD per well

Conclusions

New technology is seldom “perfect” the first time

Exactly how something new will be used isn’t usually known ahead of time

Service providers should expect to perform continuous improvement


THANK YOU
Asante
Dziękuję
شكرا
Gracis
Tack
Merci
Danke
nuqneH