

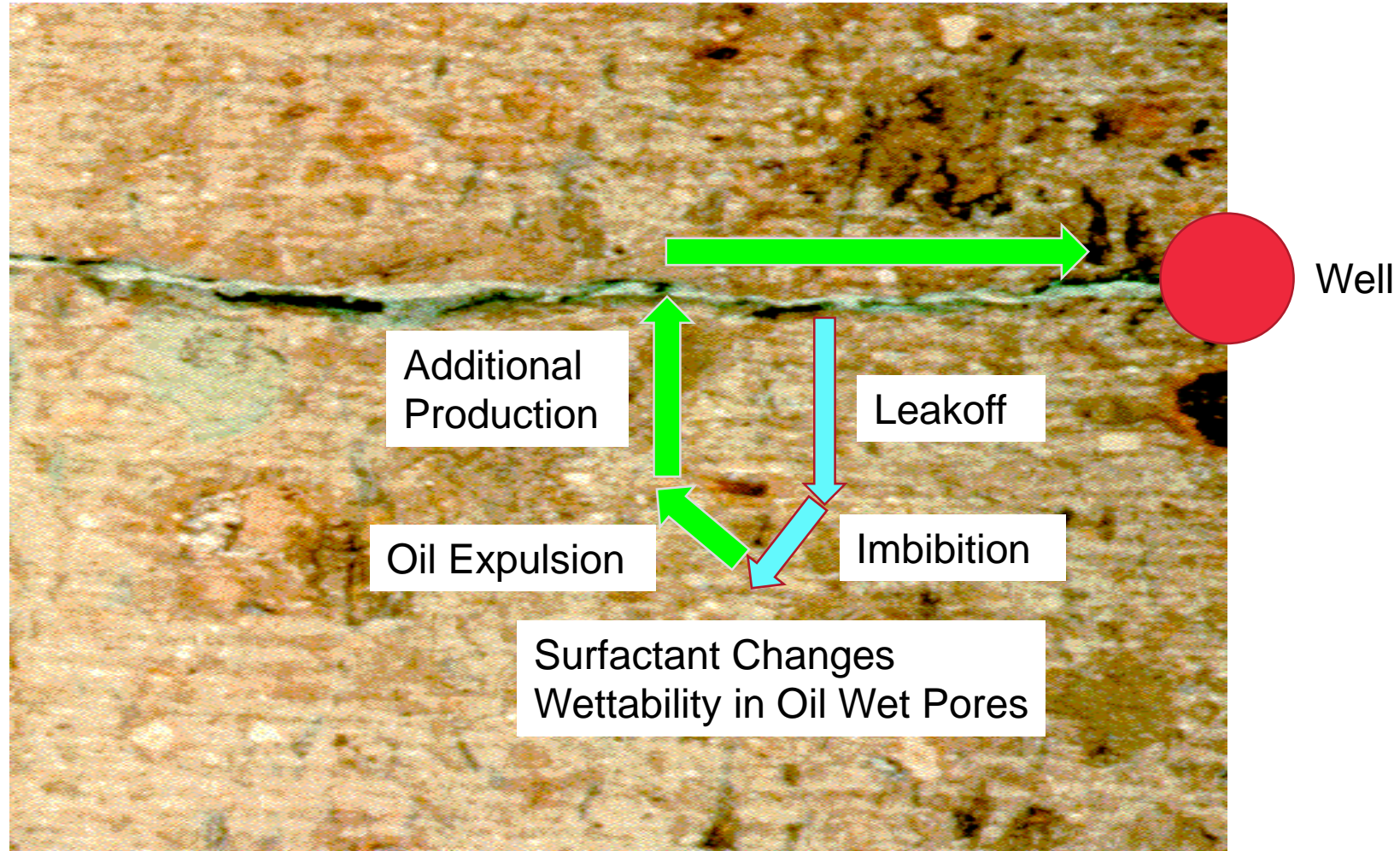


Selecting Surfactants to Squeeze More Oil Out of Rock

Liberty Engineering Solution



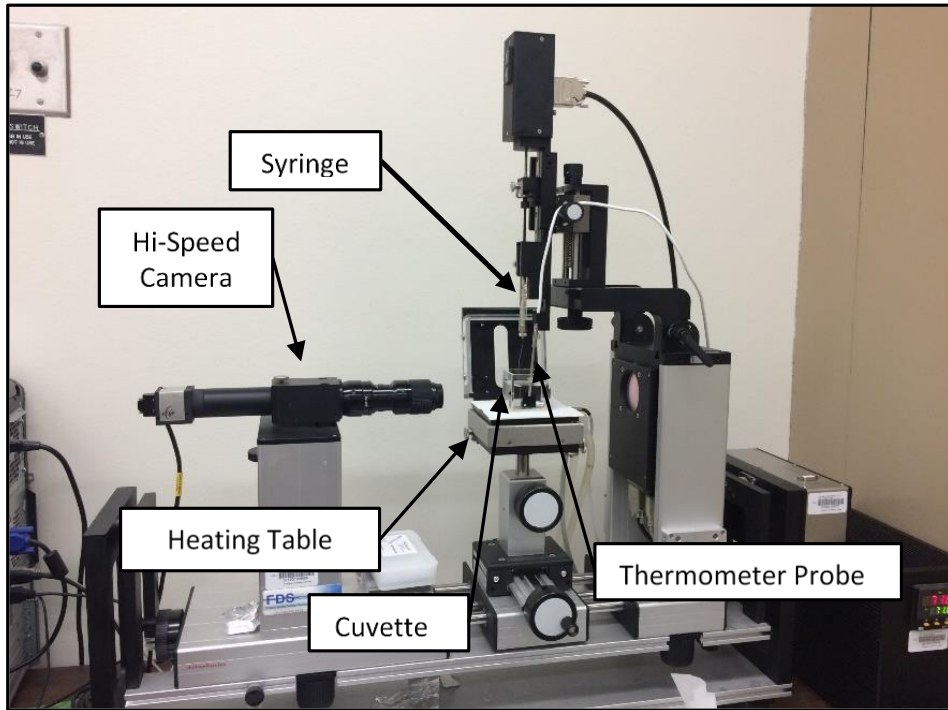
Surfactants Could Improve Oil Recovery (EOR Process)



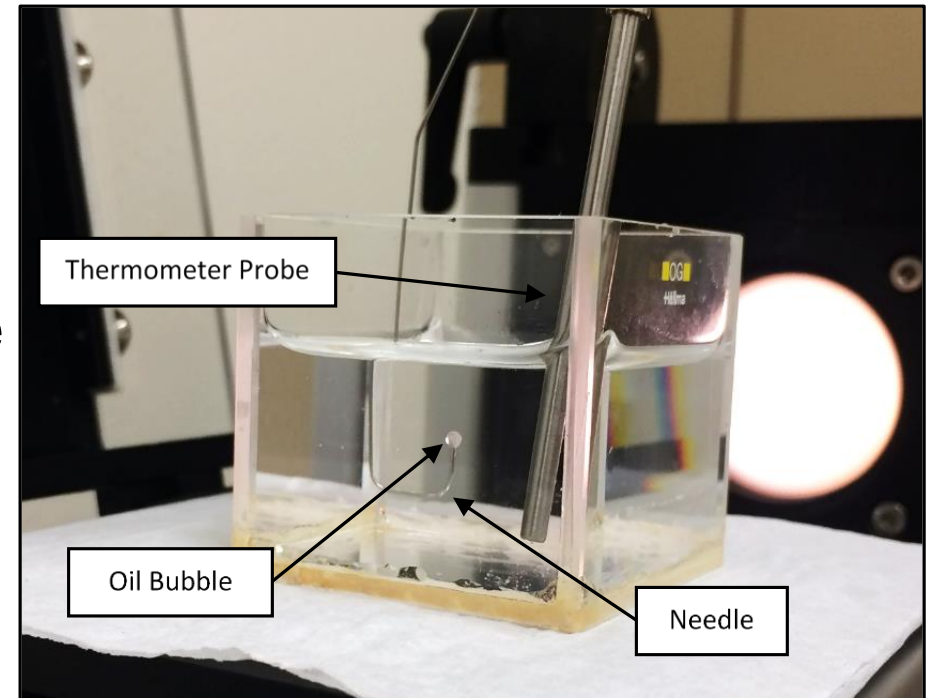
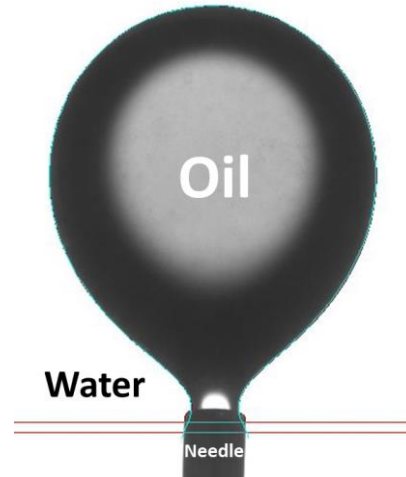
Applications

- In main frac treatment
- Frac hit protection with Pre-Loads or Active Protect

Interfacial Tension (Oil and Frac Fluid)

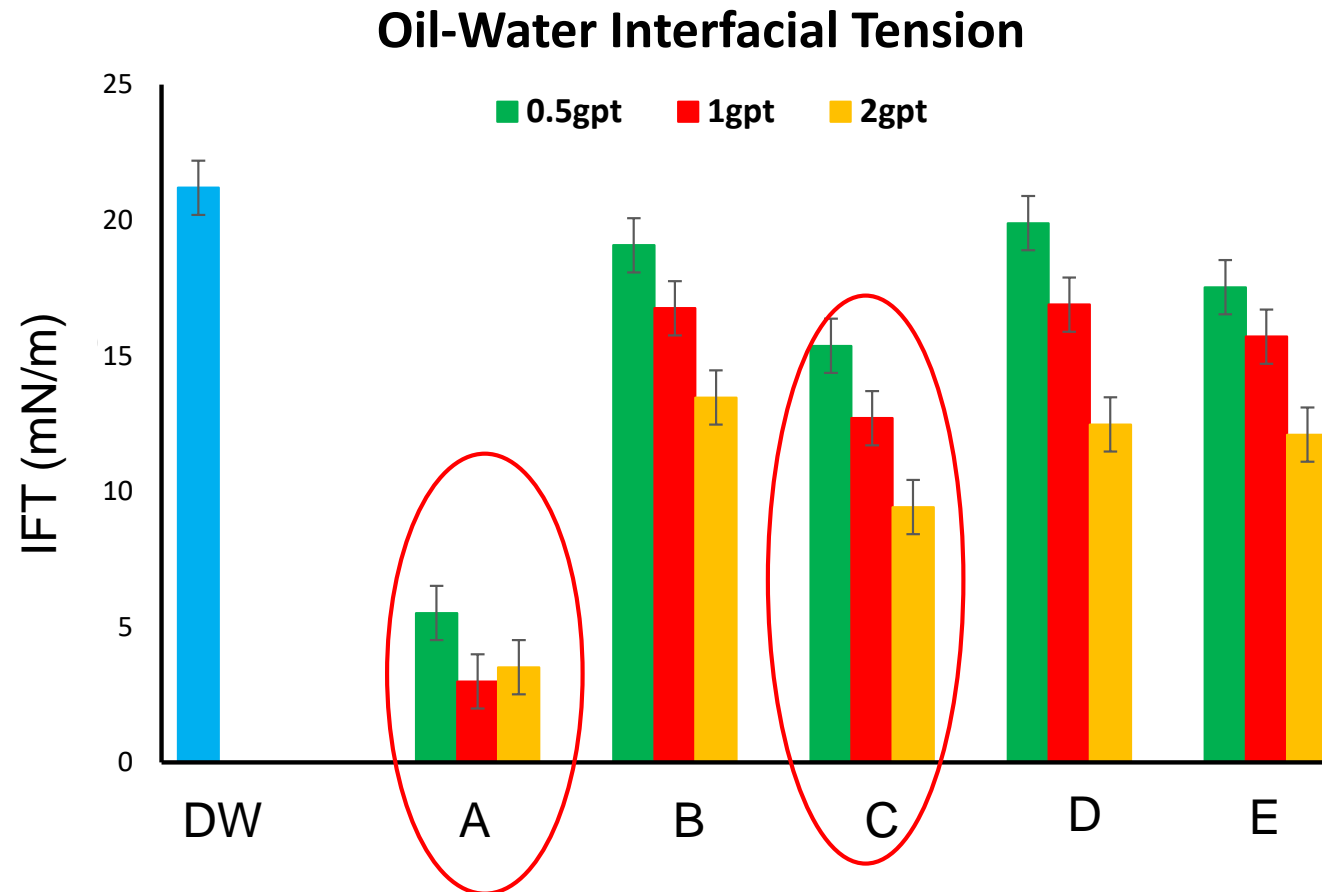


IFT ~ Bubble Size



Courtesy: Dr David Schechter, Texas A&M

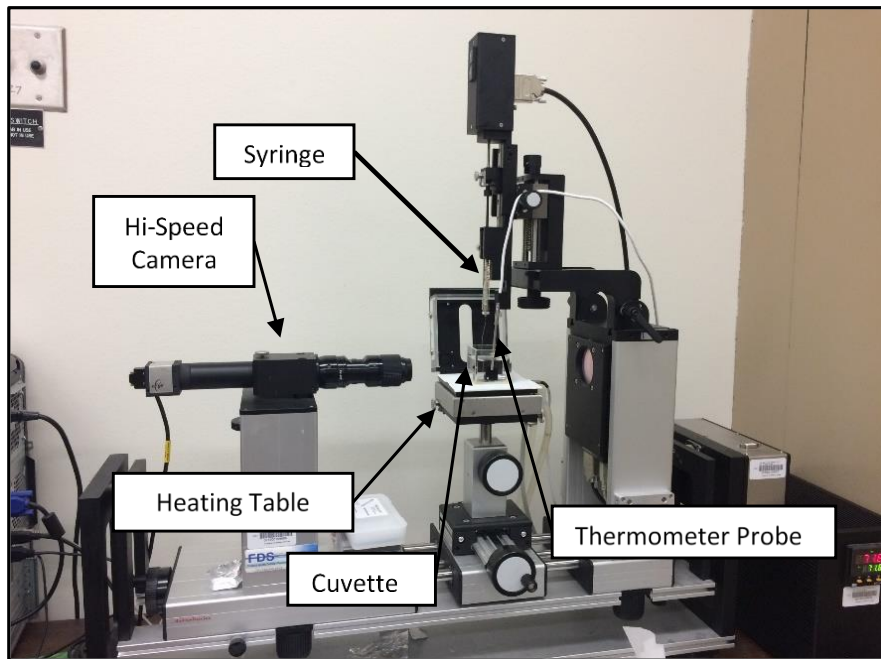
IFT for Different Surfactants



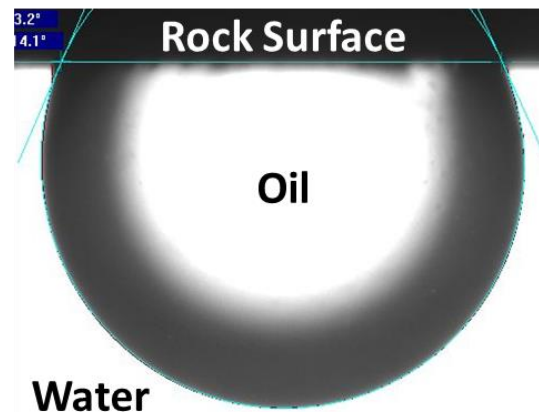
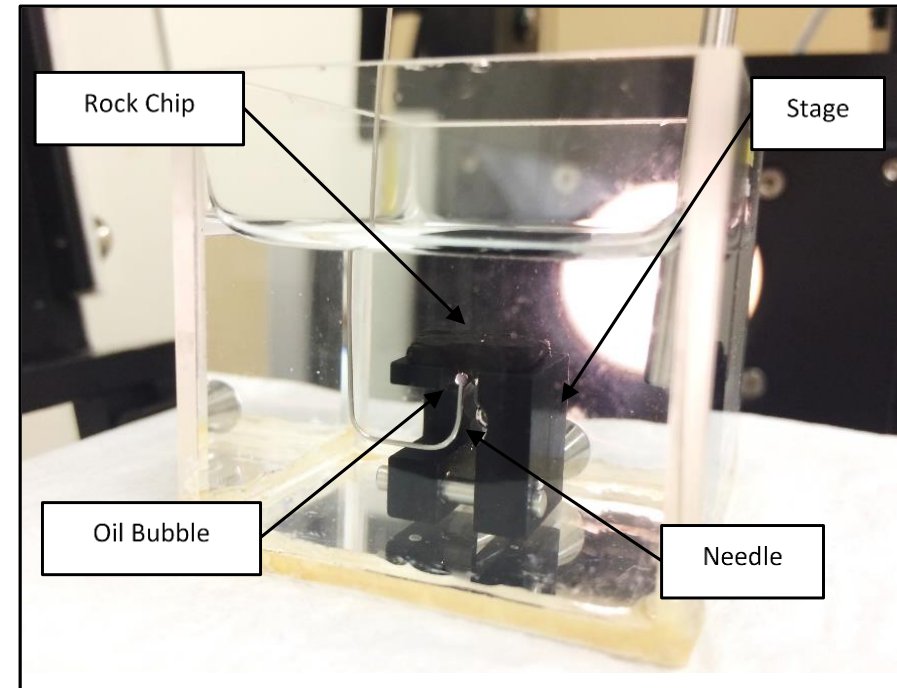
Courtesy: Dr David Schechter, Texas A&M

Contact Angle – A Measure of Rock Wettability

Correlates reasonably well with comprehensive core imbibition and oil expulsion tests



Test uses small rock chips



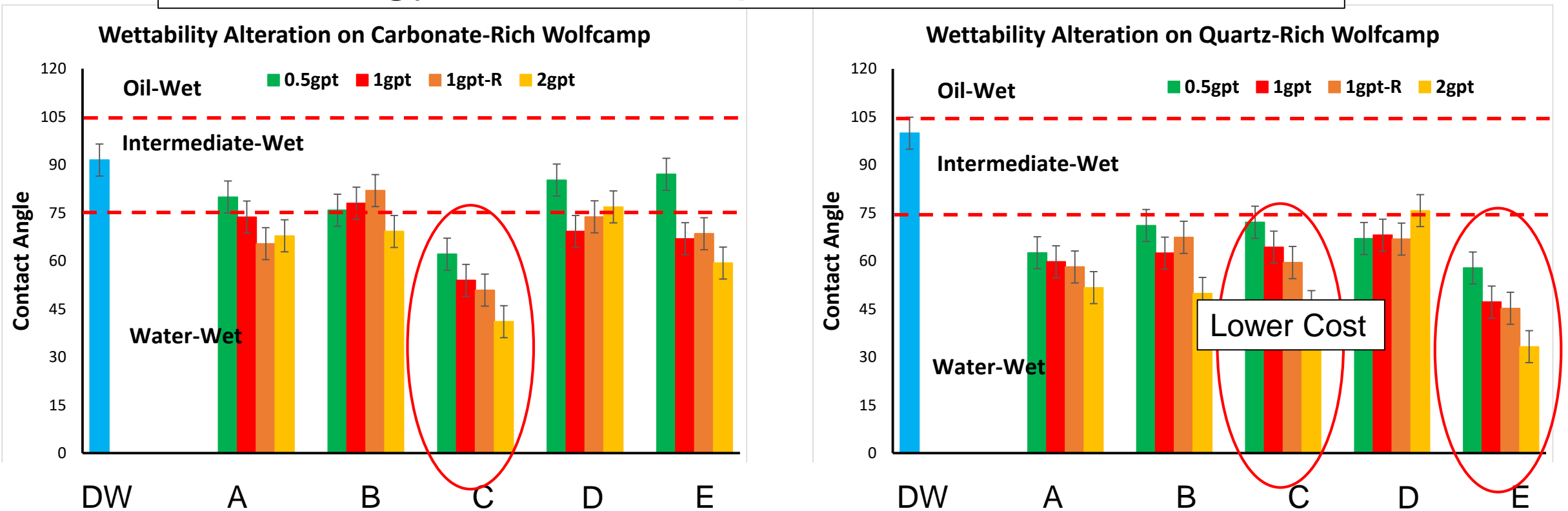
Contact Angle

Courtesy: Dr David Schechter, Texas A&M

Wettability Change with Different Surfactants

Contact angle change is ability of surfactant to change rock wettability to more water-wet, which can aid in additional oil expulsion and recovery.

Mineralogy and cost impact surfactant selection



Courtesy: Dr David Schechter, Texas A&M

In Summary

- IFT and contact angle measurements are good indicators for surfactant selection.
- Contact angle measurements have been shown to correlate reasonably well with comprehensive core imbibition and oil expulsion tests and are faster and cheaper.
- Liberty can perform this testing to help select best possible surfactant type with lowest cost.
- Validation and field testing is still needed to see if oil recoveries are quantifiably increased.



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