



SPWLA SAUDI ARABIA CHAPTER (SAC) 9th Topical Workshop

CORING AND CORE ANALYSIS: CHALLENGES AND BEST PRACTICES

Virtual Workshop Series (Feb, Mar & Apr 2021)

A Need for Better Understanding of Oil Field Chemistry

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Schlumberger

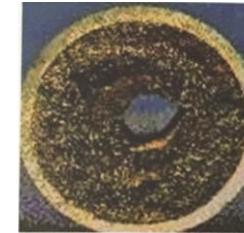
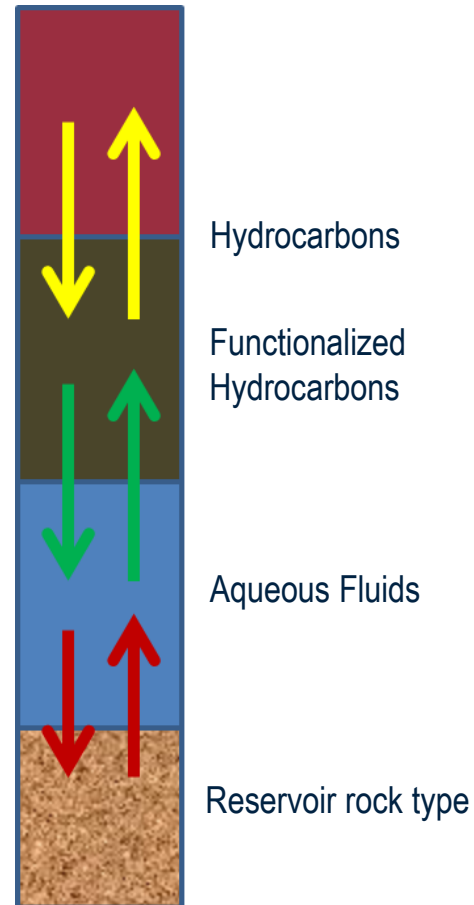
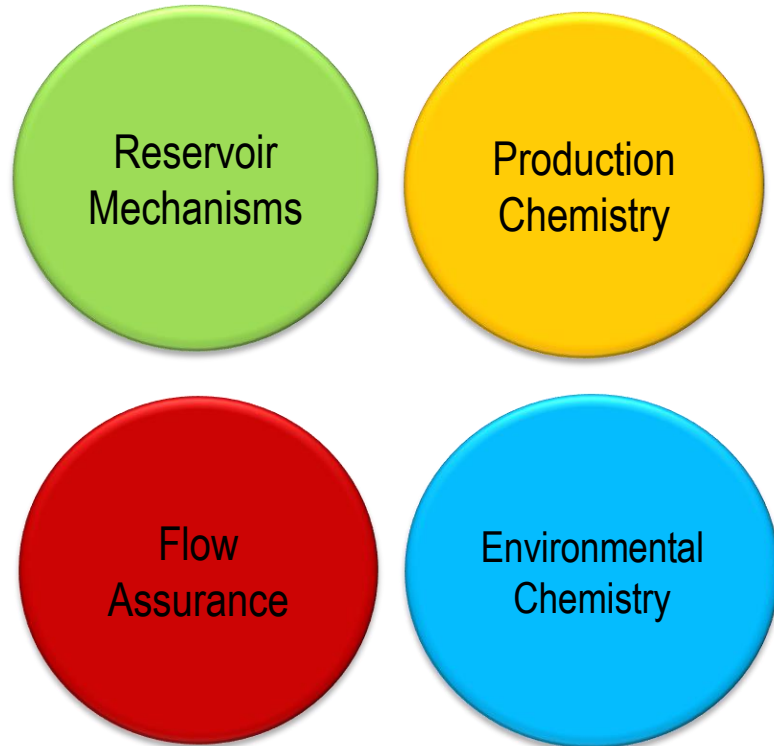
Agenda

- Oilfield Chemistry - Challenges
- Crude Oil Components - Perspectives
- Solid - Liquid - Liquid Interfaces
- Liquid - Liquid Interfaces
- Wellsite analysis of Chemicals
- Conclusions

Objective

- Is there a need for better understanding of oilfield chemistry?

Reservoir Composition - Many Interfaces in Dynamic Equilibrium



Wax



Corrosion



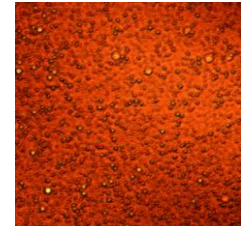
Organic Scale



Asphaltenes



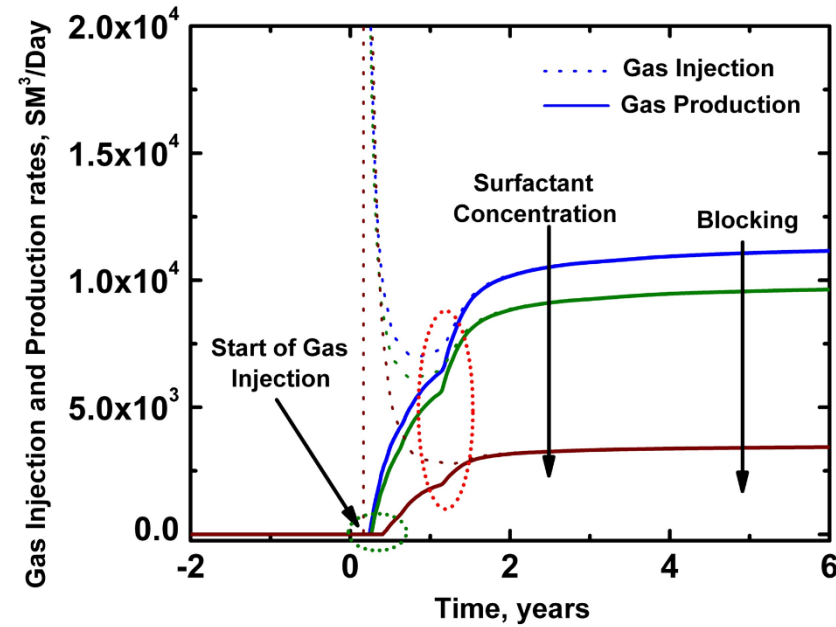
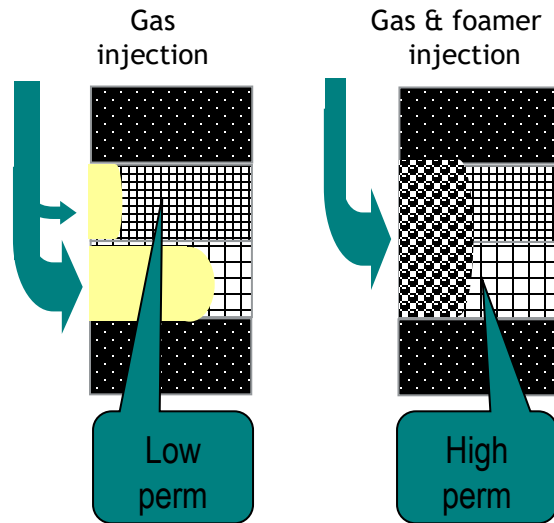
Inorganic Scale



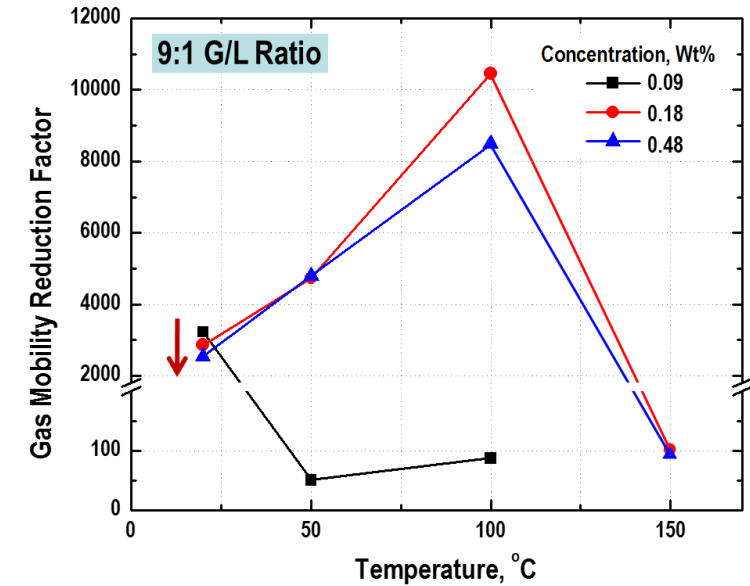
Emulsions

Conformance Control with Foams - Challenges

Communicating Layers



ECLIPSE 100

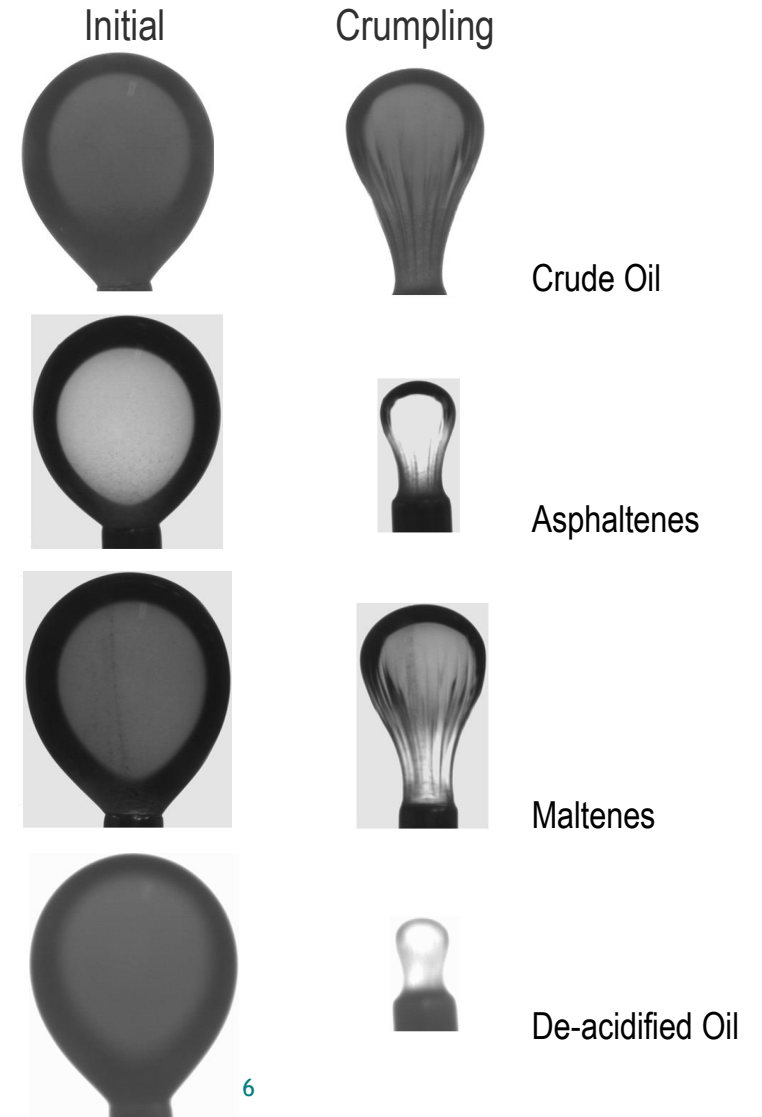
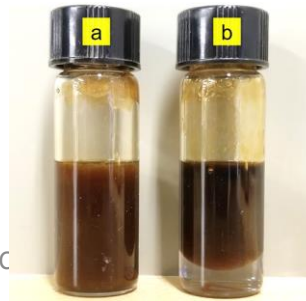
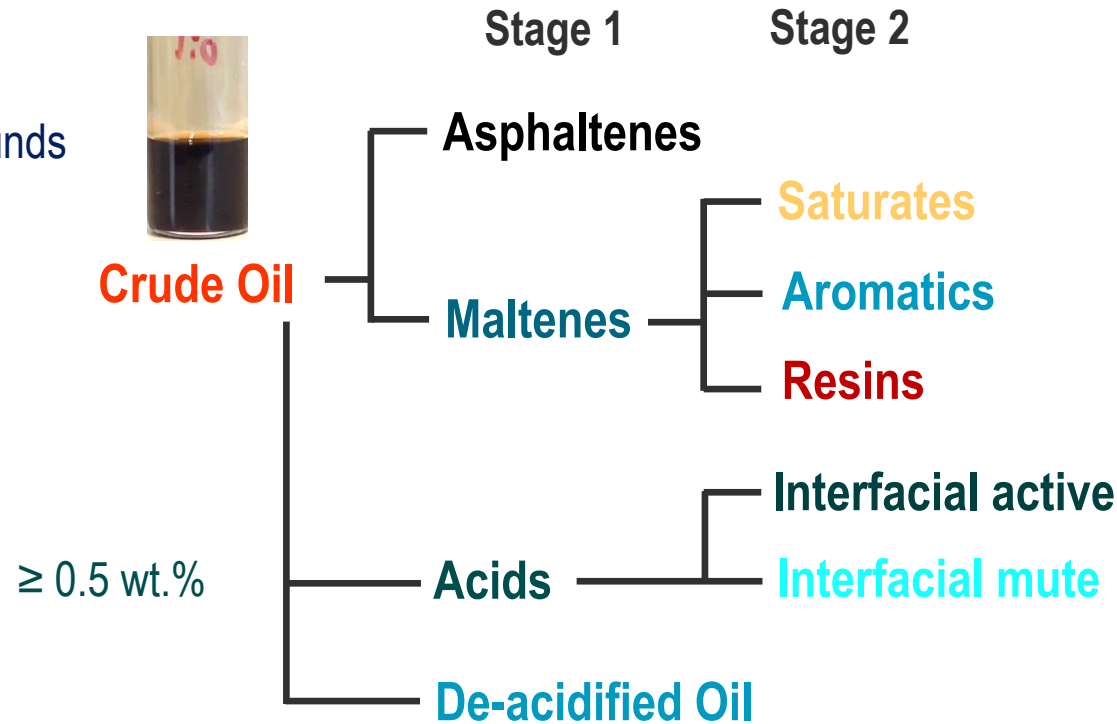


$$M_{rf} = \frac{1}{1 + (M_r \cdot F_s \cdot F_w \cdot F_o \cdot F_c)}$$

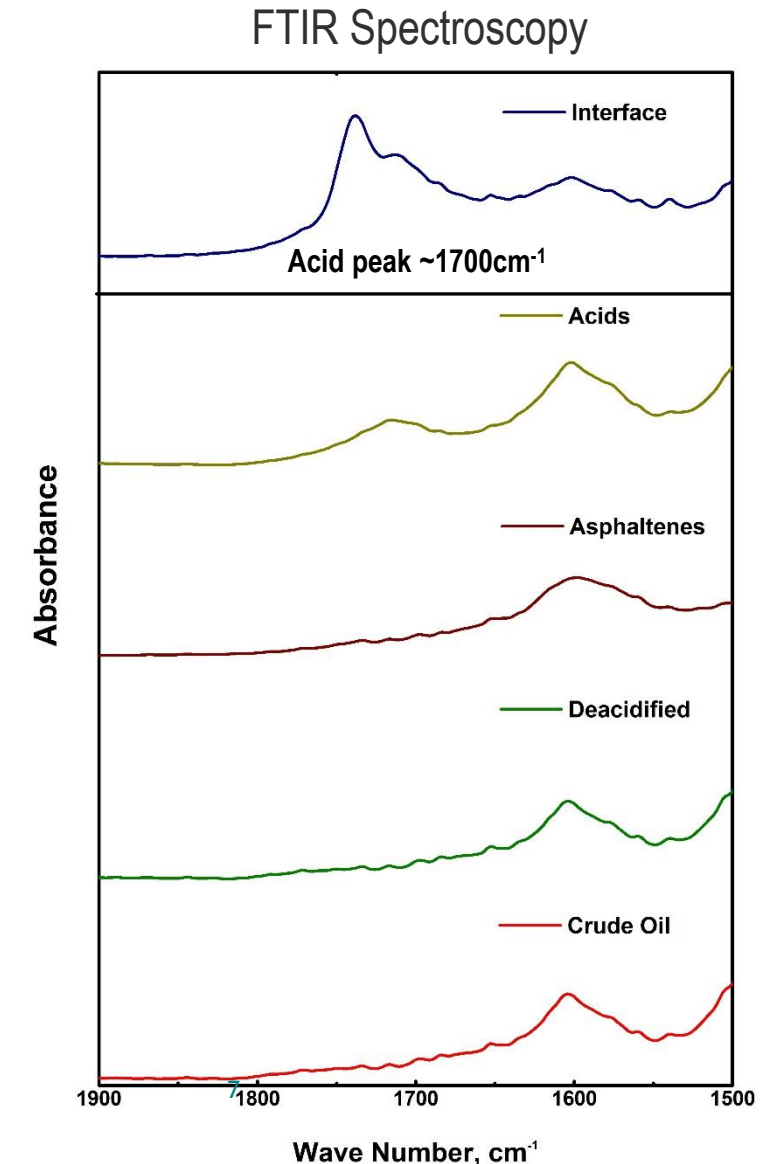
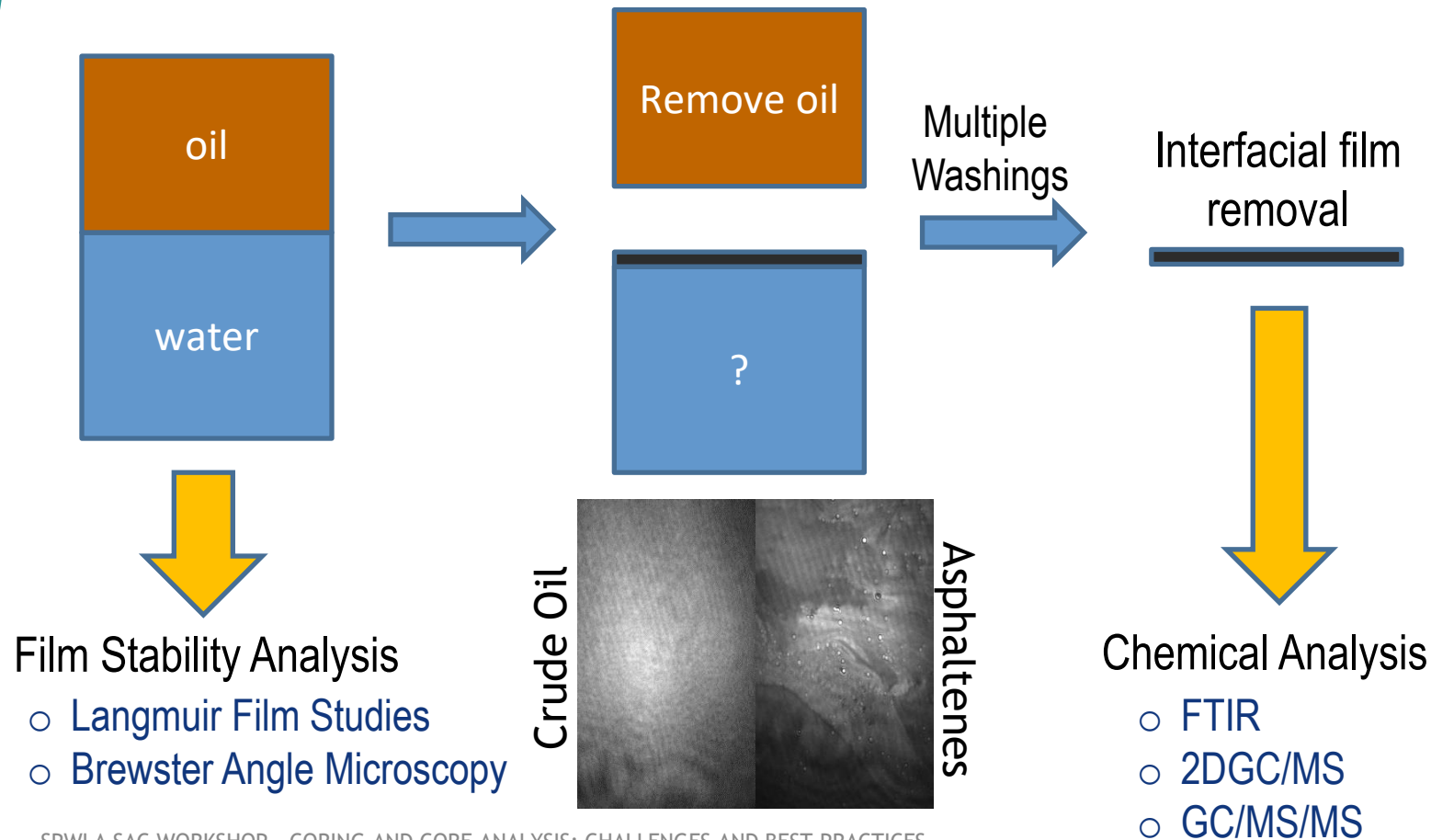
Oil components break the foam and current models are not sufficient to capture the impact

Fluid Chemistry - Role of Polar Species, L/L Interface

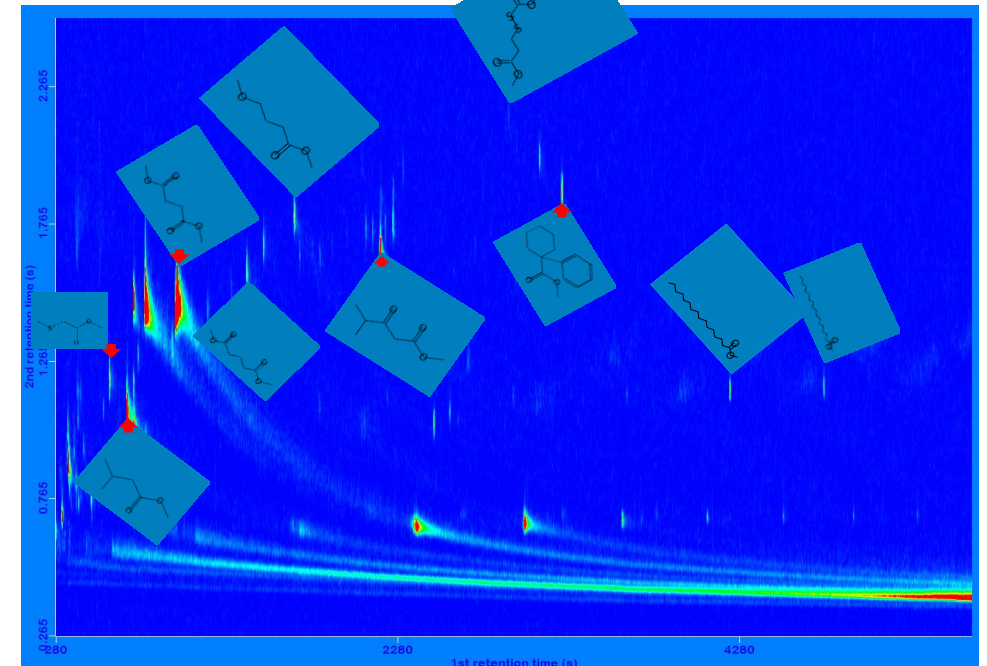
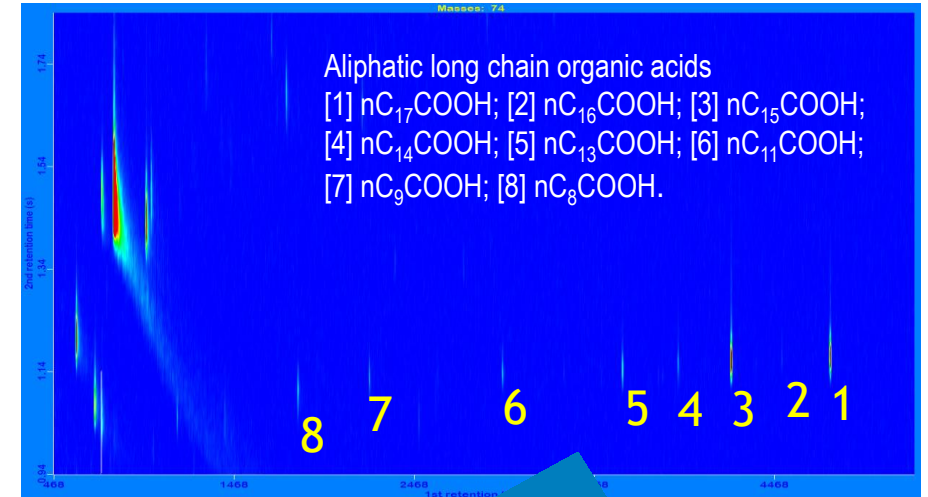
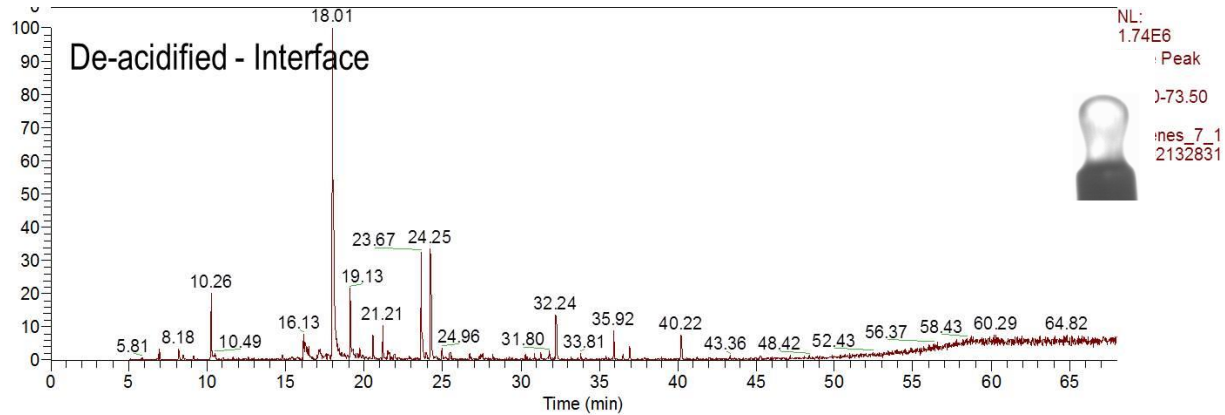
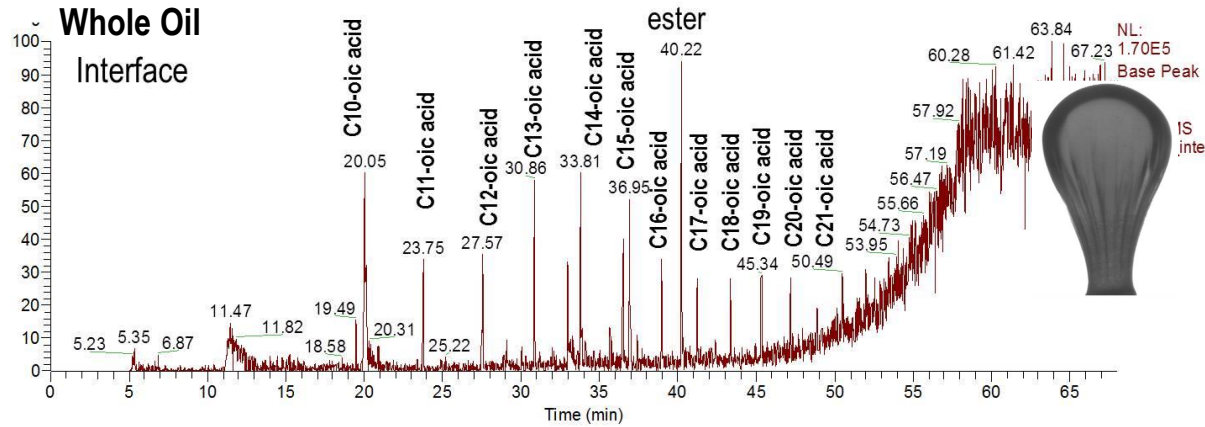
> 50,000 Compounds



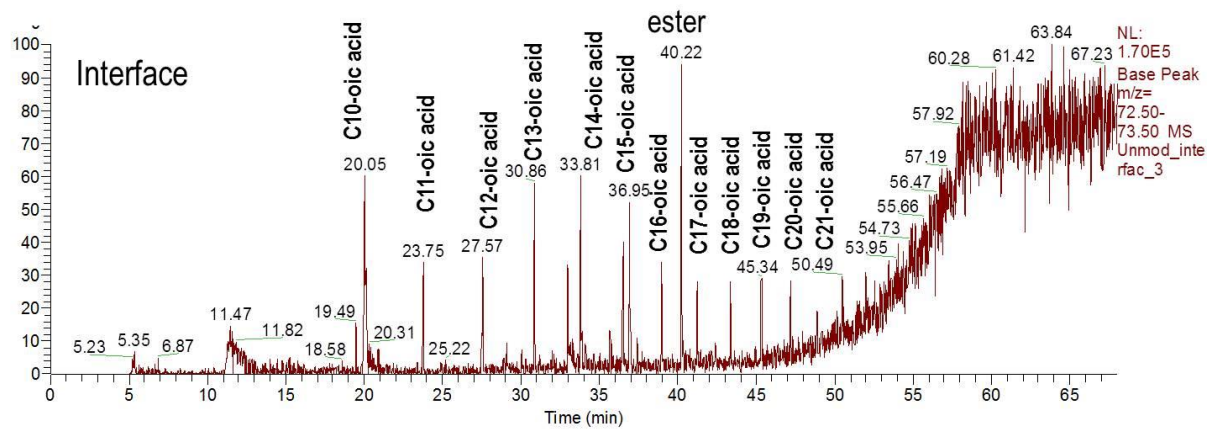
Interfacial Film Preparation and Analysis & Chemistry



O/W Interfacial Film Chemistry - GC/MS/MS, 2D-GC/MS

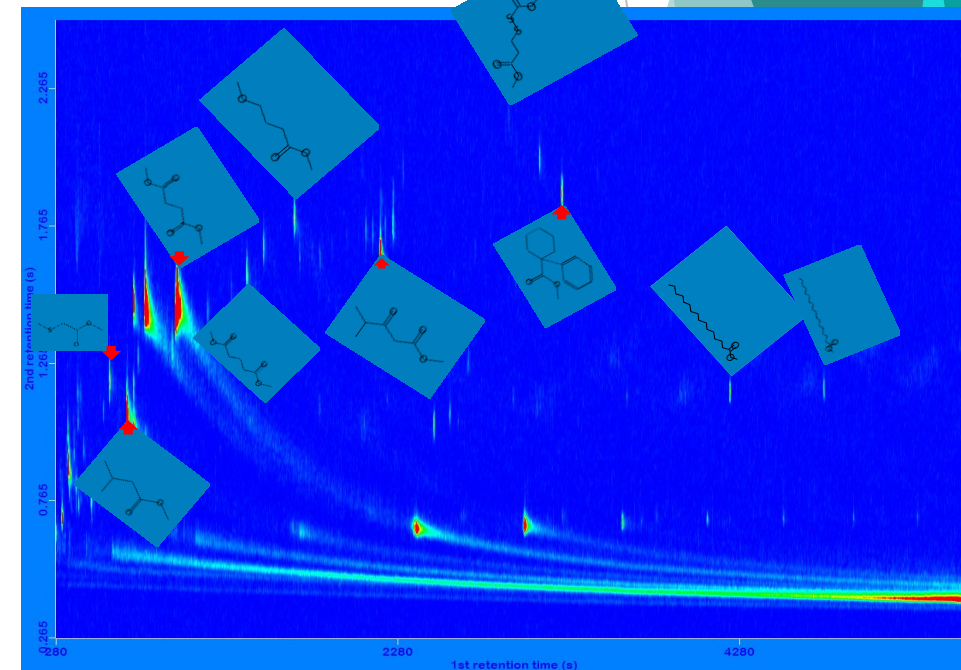
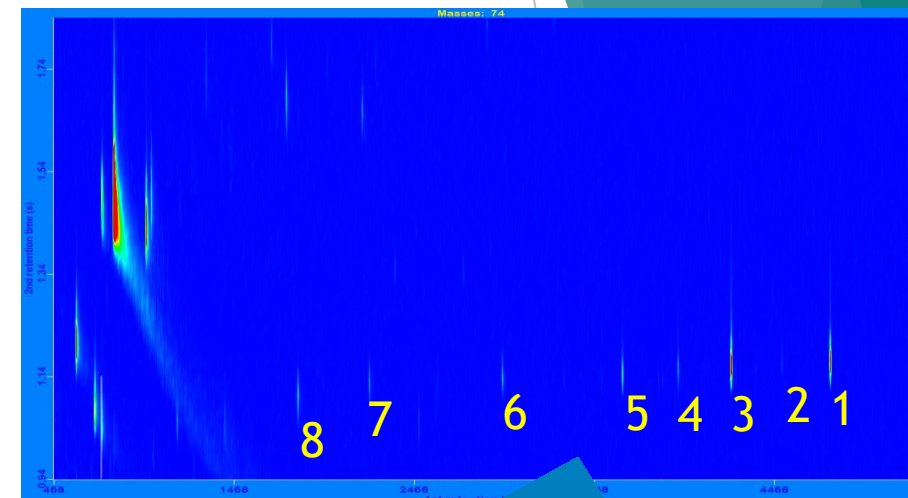


O/W Interfacial Film Chemistry - GC/MS/MS, 2D-GC/MS

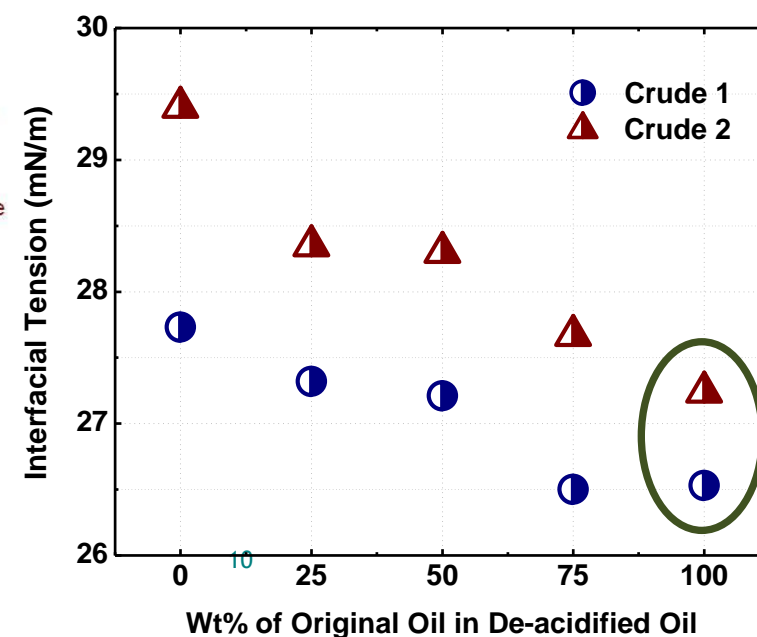
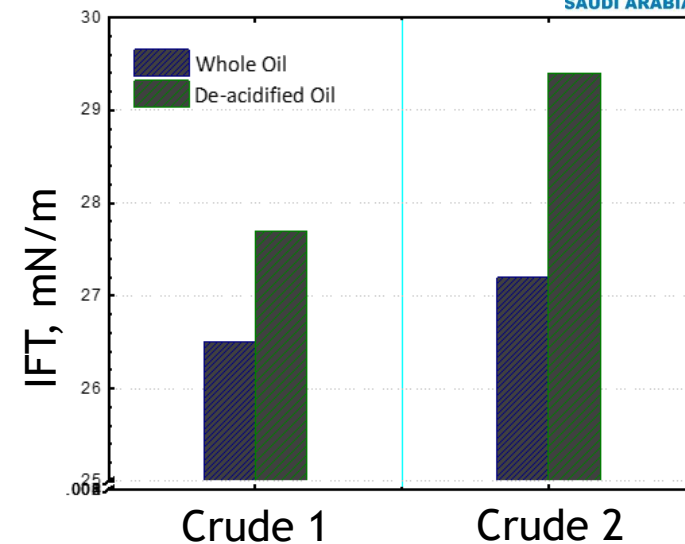
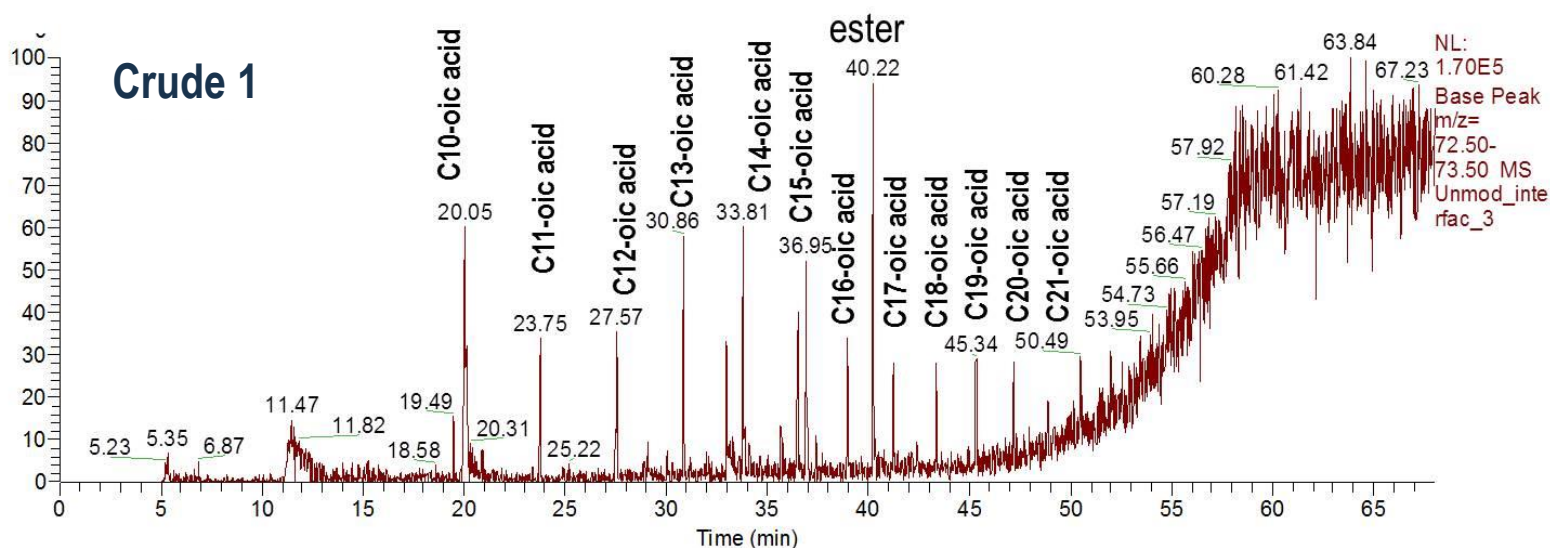
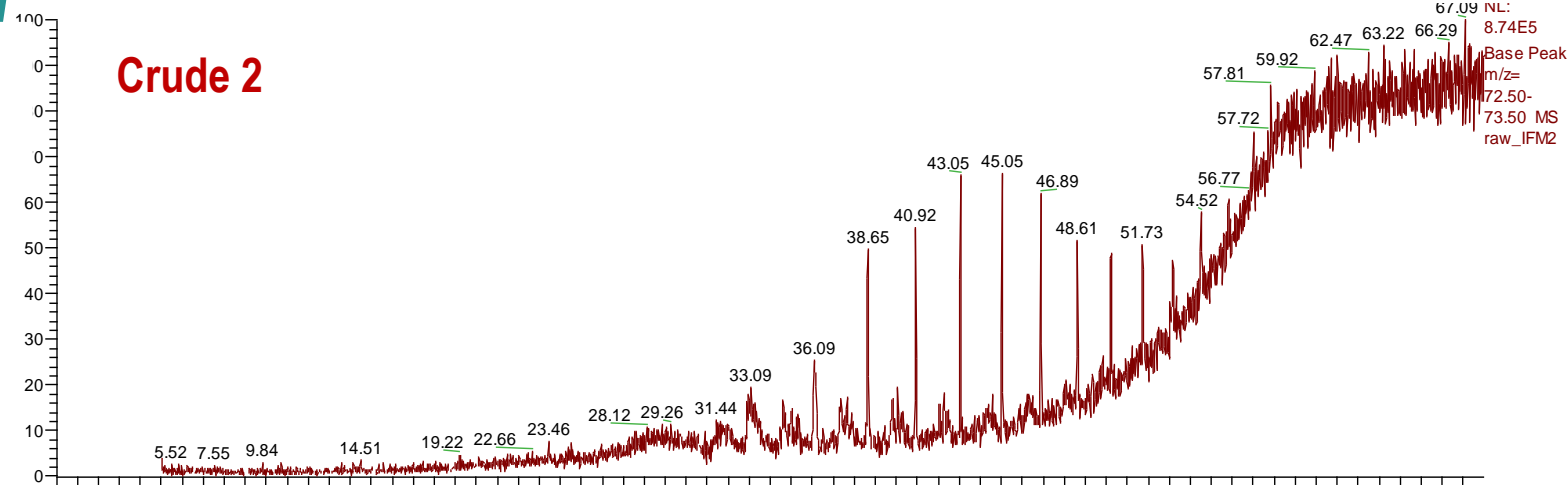


Interfacial Film Composition

Compound class	Normalized percentage (%) based on GC peak area
Linear alkanes	4.0
Aromatics (exclude toluene and xylene)	43.6
Linear acids	7.4
Hetero-acids	45.0



Interfacial Film Chemistry - 2 Middle East Crudes



Quantifying Naphthenic Acid Effect on O/W IFT

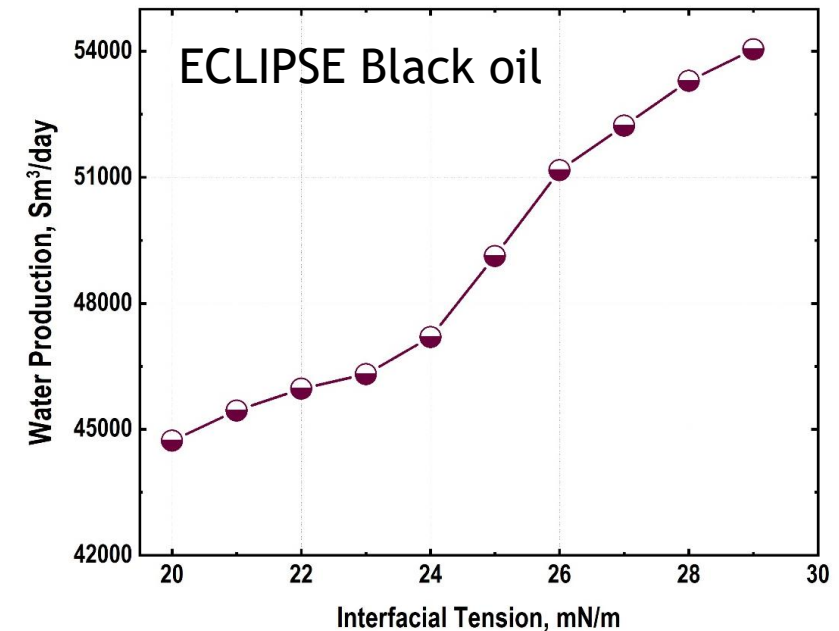
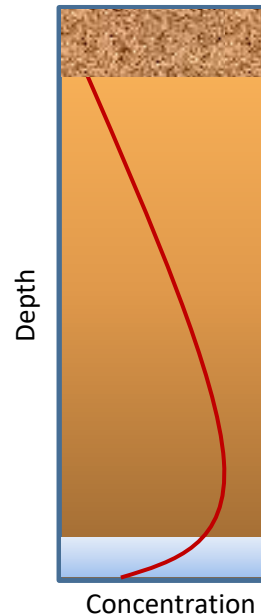
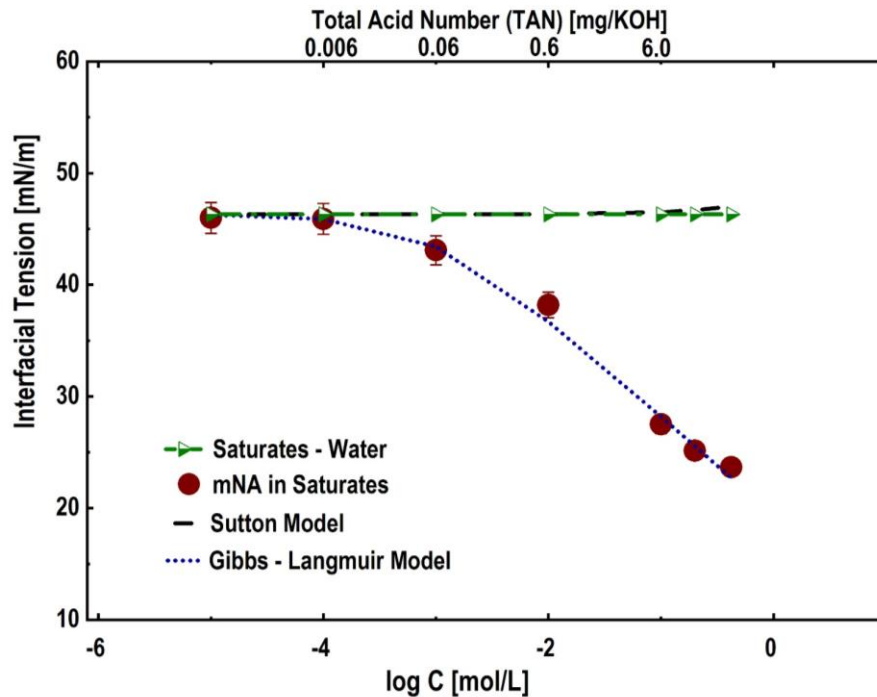
Sutton Equation[#]

$$\gamma_{ow} = \left[\frac{1.58(\rho_w - \rho_o) + 1.76}{T_r^{0.3125}} \right]^4$$

Current Model

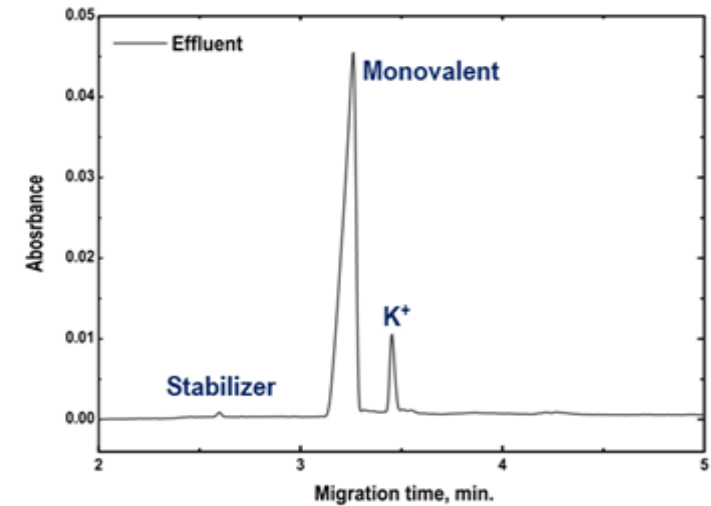
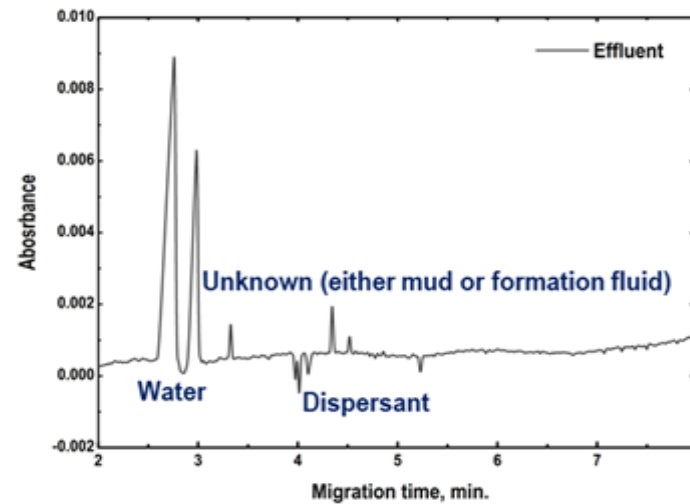
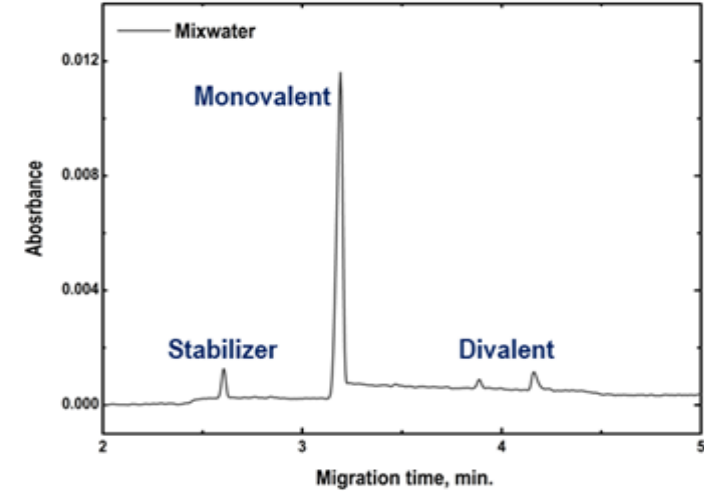
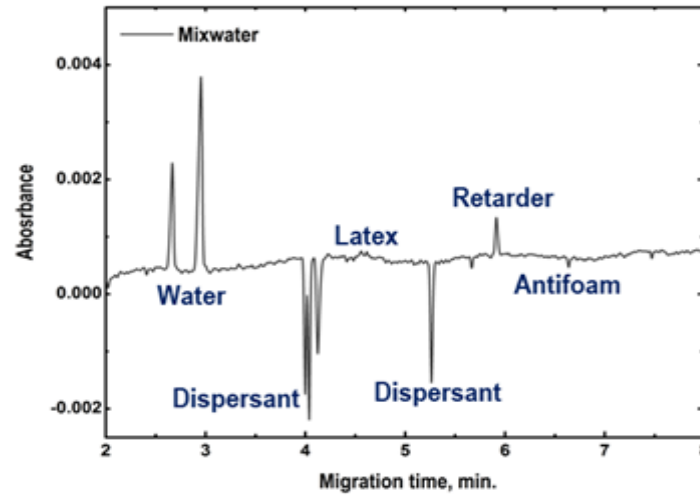
Gibbs - Langmuir

$$\gamma_{ow,correct} = \left[\frac{1.58(\rho_w - \rho_o) + 1.76}{T_r^{0.3125}} \right]^4 - RT \ln(1 + K_L C) \quad \text{Our proposal}$$



Inhibitors & Additives in Produced Water

Individual Additives



A Few Final Thoughts...

- ▶ Polar Chemistry of Crude Oil Matters!
- ▶ This complex chemistry is related to the geochemical origin of the oil
- ▶ Fractions of the oil composition governs numerous reservoir mechanisms and production issues
- ▶ A better knowledge of Water and Crude Oil Chemistry is the key in making production more efficient
- ▶ Many solutions can be found in fundamentals of surface and colloid chemistry
- ▶ New analytical techniques combined with specialized preparation techniques and surface chemistry will be the way forward

Thank You



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