Interactions and Identification of Surface Active Material at the Hydrate/Oil and Asphaltene/Oil Interface

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Oil/water emulsions, or more importantly, stable emulsions, are a major area of flow assurance research due to their impact on production, transport, and refining of crude oil. The final stage of the demulsification process of an oil-water emulsion involves the coalescence of water droplets to form larger and larger droplets until the water and oil separate into two distinct layers. This last step of coalescence is hindered by emulsion stabilization agents that may be present in the crude oil, such as waxes, acids, resins, and asphaltenes. One of the main stabilization effects is thought to be caused by asphaltenes forming a viscous, cross-linked three dimensional network of asphaltene aggregates across the droplet surface which hinders the coalescence step. Resins are a class of compounds that contain some of the most polar components in crude oils. This resin class can be further sub-divided into resins that co-precipitate with asphaltenes (bound resins) and those that remain in the maltene faction (free resins). Prior work using a micromechanical force apparatus to measure inter-particle surface adhesion has shown that both classes of resins interact with both asphaltene and hydrate particles to reduce their inter-particle adhesion, with the bound resins being the most effective. In this presentation, we further investigate the nature of these surface active resins, their chemical composition, effect on oil/water emulsion stability, asphaltene solubility and hydrate agglomeration and growth. Furthermore, these results are compared to “magic” non-plugging oils to determine similarities and differences in the composition of their surface active compounds.