Isolation of Interfacial Material from Athabasca Bitumen

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Funding Grants: G.S. Boebinger (NSF DMR-1157490), R.P. Rodgers (FFI)

Water-in-oil emulsions are one issue commonly encountered during steam-aided petroleum production and refining. If left untreated, the water in these emulsions can cause severe corrosion issues and equipment failure. Therefore, a key objective in petroleum production is to understand what compounds are drawn to the oil/water interface in an effort to separate the water from the oil. Here, we report a novel method to isolate interfacial materials (IM) from bitumen, the residue from petroleum refining used for road surfacing.

Water was added to silica gel to generate four different silica gels (17.6, 33.3, 53.8, and 66.6% water per gram of silica gel). Immediately after IM isolation, silica gels 17.6% to 53.8% water per gram are "stained" (**Figure 1**). The staining is a mark of failure, i.e. the result of irreversible adsorption of non-interfacially active species to the silica gel surface.

However, once the silica gel is water-saturated (66.6% water per gram of silica gel), a sufficient number of water monolayers are present (~26) to prevent irreversible adsorption, and IM compounds are selectively isolated. Subsequent analysis by FT-ICR MS (**Figure 2**) reveals that interfacially active crude oil components are highly enriched in oxygen, and thus function as naturally occurring surfactants. Even though the surfactants comprise only ~1% of the crude oil mass, their removal achieves the desired result: prevention of stable emulsion formation in the 99% (by weight) of the material that remains. Emulsion tests with isolated interfacial material yield emulsions that are stable for days (inset in Figure 2).

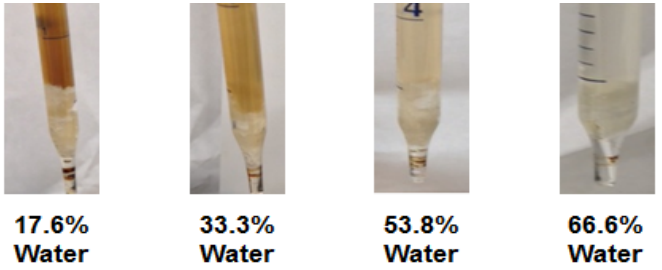

Figure 1. Silica gel appearance after interfacial isolation.

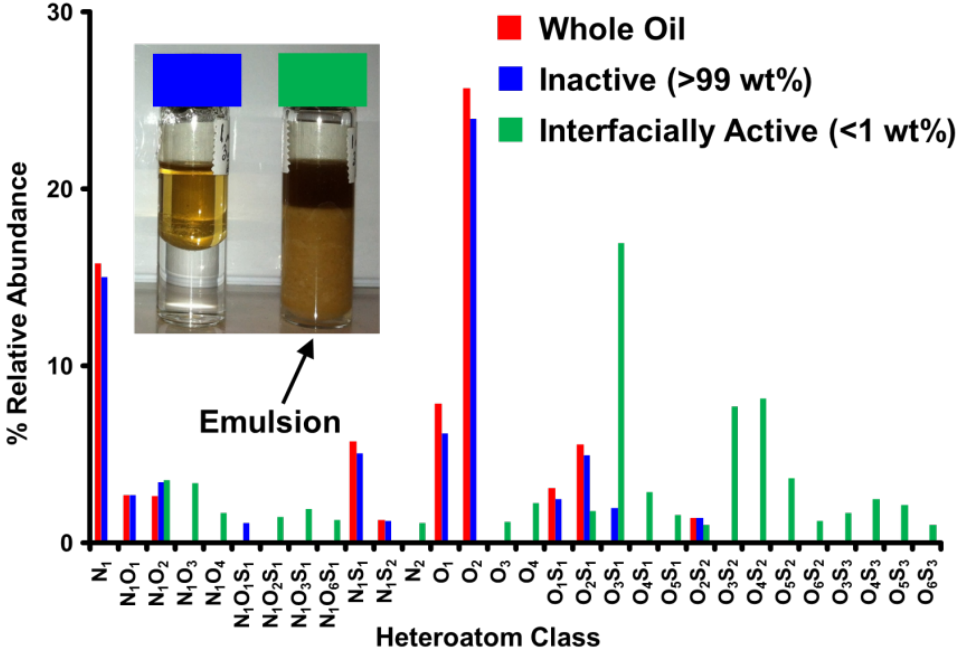

Fig. 2. Molecular-level analysis of oil (red), interfacially inactive (blue), and interfacially active (green) species.

Facilities: 9.4T Fourier Transform – Ion Cyclotron Resonance (FT-ICR) Mass Spectrometer (MS)