ABSTRACT

Molecular characterization of oil components is important for understanding and modeling petroleum behavior during production and refining processes. For those components with boiling points (bp) > 524°C, gas chromatography (GC) can be used to separate samples before analysis. For asphaltenes (bp > 524°C), GC cannot be used but gel permeation chromatography (GPC) has proven useful (Dettman et al. Energy & Fuels, 2003, 19, 1300-1404). Analyses of Athabasca asphaltenes GPC fractions revealed that the asphaltenes consist of two types of species: 'crunchy' (graphic in appearance and oily), with molecular weights from 400 to 2000 g/mol measured by low resolution mass spectrometry. Work has continued to separate the asphaltenes by polarity. Firstly, Athabasca asphaltenes were subfractionated into four parts based on differential solubility in pentane and centrifugation (Norway et al. Ind. Eng. Chem. Res. 199, 964-972). Secondly, adsorption chromatography was used to isolate acidic species from the asphaltenes. The four 'polarity' fractions and acid species were characterized including elemental and metal contents and Fourier transform infrared (FTIR) and nuclear magnetic resonance (NMR) carbon type analyses. Their elution profiles by GPC were also compared.

PENTANE ASPHALTENES SUBFRACTIONATED BY "SIZE"

Gas Permeation Chromatography (GPC) was used to separate Athabasca pentane asphaltenes (PA) by size into sub-fractions. First to elute (A to B below), are cruise in texture, the later to elute (C to H below) are oil in texture.

Present work describes characterizations results of the crunchy and oily asphaltenes as well as sub-fractionation of pentane asphaltenes by polarity.

Crunchy and Oil Asphaltenes Have Different Characteristics:

1. Metals Analyses

Pentane Aromatics GPC Fractions

2. Confocal Microscopy:

Confocal microscopy (Fraction E) shows areas with relatively strong yellow fluorescence and the groundmass with lower fluorescence. The siltations are due to changes in solvent evaporation rate. The excitation wavelength range was 450-460 nm with a barrier filter of 515 nm. Crunchy asphaltenes (Fraction A) do not fluoresce under these conditions.

3. Molecular Weights by Negative Ion, Electrospray Ionization, Linear Trap Quadrupole Mass Spectrometry (ESI) LTQ MS) and Vapor Pressure Osmometry:

The precipitates obtained from the four ratios of pentane consisted of crunchy asphalt asphaltenes while the supernatant was predominantly oily asphalt. The precipitates had the highest metal contents and the lowest carbon to nitrogen, and carbon to sulfur ratios.

2. Adsorption of Acidic Species:

The ion exchange Sephadex AAE 25 (Medda et al. SPE 51 International Symposium on Oilfield Scale, SPE40040, Aberdeen, UK) was used to separate acidic species from either pentane asphalt or whole asphaltenes. The acids from the elution were treated with pentane 40:1 ratio to precipitate the asphaltates present.

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