Interactions between Asphaltenes and Water in Solutions in Toluene

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Binding of water by asphaltenes dissolved in toluene was investigated for two asphaltene samples, OMV1 and OMV2, from the same reservoir deposit. Solubility of water in asphaltene solutions in toluene was found to increase with an increasing asphaltene concentration, indicative of solubilization of water by asphaltenes. Fourier transform infrared (FTIR) spectroscopy of stretching modes of OH groups in the region of 3800-3100 cm\(^{-1}\) was used to obtain insight into the state of water in water-unsaturated asphaltene solutions in toluene. The number of water molecules bound to one asphaltene molecule was determined for water-saturated solutions (OMV1 and OMV2) and for water-unsaturated solutions (OMV1 only). These numbers were found to decrease from several water molecules per asphaltene molecule to below unity upon an increase of the asphaltene concentration in toluene from 0.1 to 20 g/L, suggesting that binding of water by asphaltenes dramatically depends upon the aggregated state of asphaltenes and that the mechanism of water solubilization by asphaltenes differs significantly from water solubilization in reverse micelles formed by conventional surfactants.

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