508g Oxygenated Hydrocarbon Ionic Surfactants Exhibit CO2 Solubility

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Several oxygenated hydrocarbons, including acetylated sugars, poly(propylene glycol) and oligo(vinyl acetate), have been used to generate CO2-soluble ionic surfactants. Surfactants with vinyl acetate tails yielded the most promising results, exhibiting levels of CO2 solubility comparable to those associated with fluorinated ionic surfactants. For example, a sodium sulfate with single, oligomeric vinyl acetate (VAc) tails consisting of 10 VAc repeat units was 7 wt% soluble in CO2 at 25 oC and 48 MPa. Upon introduction of water to these systems, only surfactants with the oligomeric vinyl acetate tails exhibited spectroscopic evidence of a polar environment that was capable of solubilizing the methyl orange into CO2-rich phase. For example, a single phase solution of CO2, 0.15 wt% sodium bis(vinyl acetate)8 sulfosuccinate and water, at loading of W values ranging from 10 to 40 at 25°C and 34.5 MPa, exhibited a methyl orange peak at 423 nm. This result indicated that the core of a reverse micelle provided a microenvironment with a polarity similar to that of methanol. Quantum chemical calculations indicate that the acetylated sugars may be too hydrophilic to readily form reverse micelles, whereas the VAc-based surfactants appear to have the correct balance of hydrophilic and hydrophobic forces necessary to form reverse micelles.