Investigation of Water and Oil Dispersions During Hydrate Formation with and without Production Chemicals at Different Water Cuts

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Subsea deepwater oil and gas flowlines cooling to bottom ocean temperatures provide a favorable environment for hydrate formation. Hydrates plugs are very costly to remove and present a potential safety, environmental and production risk. It has been previously suggested that water consumption for gas hydrate formation could favor water droplet coalescence which may result in emulsion breakage and/or inversion [Hoilland et al., 2005; Greaves, 2007]. This could affect the flowability of the system as well as the effectiveness of chemical treatments. This work reports experimental findings to enhance the understanding of the effect of hydrate formation on oil and water dispersions when treated and not treated with production chemicals (e.g. anti-agglomerants and thermodynamic inhibitors). A high pressure stirred autoclave equipped with three in-situ conductivity meters was utilized to study water or oil dispersion in a bulk phase before and after hydrate formation. The conductivity meters were equally spaced vertically throughout the liquid phase aiming to better characterize the emulsion behavior. Water consumption due to hydrate formation was calculated based on the pressure changes in the gas accumulator that maintained the cell pressure constant. A Particle Video and Imaging probe (PVM) provided in-situ images for visual analysis of the dispersion. This experimental set-up permitted the study of the entrainment of water/oil droplets in the bulk phase and its coalescence after hydrate onset. That can potentially destabilize the dispersion and create a free water phase and/or invert the continuous phase. Oil and water dispersion behavior was investigated at a 50 vol.% and 80 vol.% water cut in the presence of a model brine (3.5 wt.% sodium chloride) using mineral oil and crude oil as the oil phase, one commercial anti-agglomerant, and two thermodynamic hydrate inhibitors (methanol and ethanol). The measurement of the relative conductivity, relative viscosity and visual observations (PVM) provided insight into the timescale, hydrate volume fraction, and mechanism leading to emulsion inversion and/or destabilization.