Impact of Gas Hydrate Inhibitors on Halite Scale Precipitation: An Experimental and Morphological Investigation

Authors Seyed Ahmad Hosseini (Politecnico di Torino) | Edris Joonaki (Heriot-Watt University) | Jim Buckman (Heriot-Watt University) | Bernardo Ruggeri (Politecnico di Torino) | Bahman Tohidi (Heriot-Watt University)

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Abstract
Inorganic scale deposition is one of the most serious flow assurance problems. One of these exotic scales is halite (NaCl). Injection of hydrate inhibitors (HIs) [methanol, monoethylene glycol (MEG), triethylene glycol (TEG)] to prevent plugging of flow lines and tubing could induce precipitation of halite scales. Thus, utilizing these chemicals might adversely affect salt solubility, causing scaling problems, particularly halite scales, in high total dissolved solid (TDS) brines. In this study, the influence of HIs on scaling of a supersaturated NaCl solution with and without inhibitor was experimentally investigated.

The results of these experiments show that increasing the concentration of HIs results in a higher amount of halite precipitation. Moreover, the effect of methanol on halite precipitation is more severe compared to MEG and TEG. On the other hand, the static efficiency results illustrate that raising the concentration of HI reduces the scale inhibition efficiency in the presence of methanol and TEG to a lower extent, while the inhibitor could have a 100% inhibition efficiency in the MEG solution. Furthermore, in the case of methanol, the optimum inhibition efficiencies at HI concentrations of 10 and 40 wt% were observed at SI concentrations of 500 and 200 ppm, respectively. Alterations in the morphology of halite in the presence of HIs were analyzed using optical microscopy and environmental scanning electron microscopy (ESEM) techniques. In this study, the effect of morphology changes of halite due to the addition of HI is addressed for the first time. These investigations can help provide a better understanding of the mechanism of halite scaling in the presence of HIs.

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Scale inhibitors are widely used to prevent salt precipitation within reservoirs, in downhole equipment, and in production facilities. The scale inhibitors not only must have high effectiveness to prevent scale formation, but also have good adsorption– desorption characteristics, which determine the operation duration of the scale inhibitors. This work is focused on the development of a new scale inhibitor for preventing cal-cium carbonate formation in three different synthetic for-mation waters. 1 Department of Oil and Gas Field Development and Operation, Oil and Gas Faculty, National Mineral Resources University (Mining University), Saint Petersburg, Russia 199106. Edited by Yan-Hua Sun. Abstract The effect of hydrate inhibitors on oilfield scale formation has been studied. A self-consistent activity model is presented to model the effect of methanol on carbonate equilibrium, calcite, barite, gypsum, celestite, and halite solubility in a gas/methanol/water/salt solution. Gas hydrate is a crystalline solid consisting of gas molecule surrounded by a cage of water molecules, which forms at certain high pressure and low temperature regimes. Gas hydrate formation is particularly troublesome for offshore gas wells where the producing temperature is low due to both adiabatic expansion of gas and seawater cooling. Interestingly, only 0.38 mg/L BHPMP is needed to inhibit barite precipitation from a similar solution containing 40% ethylene glycol (Figure 7f). Gas hydrate morphology describes the relationship between gas hydrates and the surrounding marine sediments. The morphology of gas hydrates determines the basic physical properties of the sediment-hydrate matrix. Many remote techniques for gas hydrate detection and quantification are highly dependent on the hydrate morphology. Little attention has been paid to the hydrate morphology until now because previous methods of hydrate collection preserved only the grossest morphologies (e.g., lumps and nodules of hydrate [38]). However, recent advances in pressure coring and