Protic Ionic Liquids as Thermodynamic Gas Hydrate Inhibitors

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Flow assurance in oil/gas production greatly depends on managing gas hydrate formation. Frequently, thermodynamic hydrate inhibitor (THI) injection is implemented as means of avoiding gas hydrate formation by shifting the thermodynamics to unfavorable conditions at lower temperatures and higher pressures. Recently, Ionic Liquids (ILs) suitability as THIs has been investigated by many research groups due to their thermal stability, corrosion resistance, and low vapor pressure. Most of the focus has been on aprotic ILs (AILs) based on imidazolium. Unlike AILs, protic ILs (PILs) are obtained by a simple Bronsted acid-base reaction, which can be easily synthesized and tend to be less costly. The aim of this work is to verify the appropriateness of PILs obtained from the precursor bases monoethanolamine (MEA), and diethanolamine (DEA), and precursor acids acetic acid and formic acid, as thermodynamic inhibitors for methane gas hydrates by assessing their impact at 10 wt% and 20 wt% in aqueous solution. Gas hydrate phase equilibria is measured in a high-pressure cell using the isochoric method with stepwise temperature increase. Additionally, gas hydrate dissociation temperatures are correlated to ice melting temperatures for each of the studied aqueous solutions. Synergy of the PILs with monoethylene glycol (MEG) is also considered. The results show that the PILs are on average as effective as MEG as THIs at the same wt%. It is possible to notice that the effectiveness of the PILs depends on the precursor acid, but not the precursor base. Finally, only an additive effect is obtained by mixing MEG with the PILs.

Acknowledgments

FAPESP grant #2022/05244-4 and #2020/06315-7.