Experimental Measurement and Predictions of Gas Hydrate: A case Study from Oman

Asa’d AL Mashrafi

Abstract

Gas hydrate is one of the major problems associated with natural gas transportation and processing. Pipeline blockages due to hydrate is frequently reported in oil and gas facilities. Inaccurate hydrate predictions and improper mitigating methods are the main reasons behind hydrate blockages. Prediction of hydrate formation is carried out using thermodynamic correlations/models which rely on temperature, pressure and composition of the fluid. Various correlations have been published with different capabilities and accuracy levels that vary depending on the system conditions in which they either under- or over-estimate the hydration formation point. Short falling in selecting the best-fit hydrate prediction model may have significant impacts on system design, operability and integrity which consequently could result in considerable expenditure losses. This study was conducted to perform a hydrate prediction measurement for a field in Oman using online testing with live gas samples and compare the results with various published hydrate prediction models to examine the correlation accuracies. The study also aims to demonstrate the effect of major hydrate formers in hydrate formation curve. Experimental data sets have been used for this study from two different gas fields.

Hydrate formation temperatures at different operating pressures were measured for the selected online gas stream using experimental set-up. The obtained experimental results have been compared with similar published data and indicate a good agreement. The comparison analysis between the experimental data and most published correlations using well-known software packages showed a good agreement within 2 °C discrepancy. The impact of hydrate formers on hydrate formation curve demonstrated that H2S can significantly shift the hydrate curve to extreme right in the phase envelope when the amount of H2S is increased by even less than 10 mole%. Increasing the amount of CO2 in natural gas mixture resulted in lower hydrate formation temperature which shifts the hydrate curve to the left. Methane and ethane have a minor impact on hydrate formation curve. On the other hand, the effects of heavy hydrocarbons namely C5+ were confirmed to be very minimal on hydrate formation curve due to the large size of these components. An operational example of hydrate formation in transportation pipeline was demonstrated where hydrate can be formed as a result of low temperature generated by Joule Thompson (JT) effects.