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Successful LDHI Qualification for Produced Fluids in a Flexible Riser at 10°F

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Abstract

A new subsea tieback in the Gulf of Mexico (GoM) is expected to experience temperatures as low as 10°F in the system due to high levels of expansion cooling. The system will operate within the hydrate region, at a high degree of sub-cooling. Current test methods used to select and determine the effectiveness of Low Dosage Hydrate Inhibitors (LDHIs) are capable of evaluating at temperatures down to 39°F. A new test method was developed to effectively evaluate the performance of LDHIs at temperatures as low as approximately 10°F.

The flowline for the subsea tieback is un-insulated and the flexible riser is partially insulated by the layers in the construction of the pipe. The fluids will experience expansion cooling due to the Joule-Thomson effect as they move up the riser and will not be able to adequately take advantage of the "warm" surrounding seawater. As a result, the lowest expected temperature in the system is 10°F. This lower temperature also means a higher degree of sub-cooling. Typically, the higher the sub-cooling, the higher the dose rate required to inhibit hydrates using an LDHI. To date, there is no data supporting anti-agglomerate low dosage hydrate inhibitors (AA-LDHIs) are effective with black oils at operating temperatures between 10°F and 30°F. A new test method was required to show that an AA-LDHI will effectively inhibit hydrates at the system conditions of the subsea tieback.

A description of the new test method used to evaluate AA-LDHIs at temperatures below 39°F will be presented as well as the results. The results include the evaluation of produced fluids with and without the addition of AA-LDHI. These results demonstrate that hydrate formation and the effectiveness of AA-LDHI to inhibit hydrate blockage can be detected at low temperatures using the new test method. It is shown that the AA-LDHI effectively inhibits hydrate blockage at approximately 10°F. It is also demonstrated that the mixture of produced water and AA-LDHI will not freeze at system temperatures.

Introduction

Hydrate Conditions in the Gulf of Mexico.

It is not uncommon for subsea systems in Deepwater GoM to operate within the hydrate formation region during flowing, shut-in and restart operations if an un-insulated flowline is used for the system. The ambient seafloor temperature in the GoM in water depths greater than 3500 ft is 39°F. Therefore, without any insulation for the flowline the temperature of the produced fluids quickly reaches the temperature of the surrounding seawater. The presence of produced gas, produced or condensed water, a low operating temperature of 39°F and the high pressures often associated with Deepwater facilities meet the requirements for hydrate formation conditions. The surrounding seawater temperature of 39°F is typically the lowest temperature for subsea systems in the GoM.

Current Test Methods.

LDHIs can be used to prevent hydrate blockages for all system operations. Types of equipment commonly used to evaluate the performance and select the minimum effective dosages (MEDs) of LDHIs include; Rocking Cell apparatuses, Autoclaves, Flow Loops and Flow Wheels.