OTC 19485

HYDRAFLOW: A Multiphase Cold Flow Technology for Offshore Flow Assurance Challenges

R. Azarinezhad, SPE, A. Chapoy, R. Anderson, SPE, and B. Tohidi, SPE, Heriot-Watt University

Abstract

Flow Assurance is a major challenge in offshore and deepwater operations. The current approach is based on preventing/delaying gas hydrate formation by using thermodynamic inhibitors (methanol, etc) and/or kinetic hydrate inhibitors and/or operating outside the hydrate stability zone by pipeline insulation and/or active heating.

The above techniques are not economical and in some cases practical for deepwater operations, long tiebacks, and ageing reservoirs (i.e., high water cut). The industry needs new and novel techniques to tackle Flow Assurance in these challenging conditions. The approach presented in this communication, i.e., Hydraflow, is based on gas hydrates management, instead of prevention.

HYDRAFLOW concept is based on allowing gas hydrate formation but preventing their agglomeration and pipeline blockage. The idea is to convert most or all of the gas phase into hydrates and transfer them in the form of hydrate slurry in the pipeline. Where produced water is limiting factor for hydrate formation, excess water (e.g. seawater) can be added. It is also possible to adjust the hydrate slurries viscosity by adjusting the amount of water. Anti-agglomerants and other additives might be necessary to control the hydrate crystal size and prevent solid blockage in these systems.

Where possible, it is proposed to use a "Loop" concept which allows circulating the liquid phase (totally or partially) and its associated additives. The recycled fluid acts as carrier fluid, transferring produced hydrocarbons to their destination (e.g. platform). In this case, all or part of the additives including anti-agglomerants (AAs) can be recycled, hence reducing the operational costs and potential environmental impact.

This paper presents the latest results of development of the HYDRAFLOW technology, including hydrate growth and kinetic for different systems (low and high GOR) and effect of salts (e.g. from reservoir brines or added seawater).

Introduction

Progressively, oil and gas production and transportation are extending to deeper water, mature fields and long tiebacks. These conditions, which involve low temperatures combined with high pressures, high water cuts and longer transfer times, are well inside hydrate risk zone and a major challenge in deep water field development to ensure unimpeded flow of hydrocarbons. It also means that existing flow assurance techniques – which have limitations on preventing hydrate formation – are becoming less practical and economic. Therefore, the industry needs new and improved ways of tackling this problem. This has resulted in the introduction of novel techniques where hydrates are not prevented, but managed to prevent their agglomeration and pipeline blockage. These techniques are generally regarded as cold flow, which have several common characteristics, including, 1) no heating or insulation, 2) hydrates are not prevented but allowed to form and 3) their agglomeration is avoided by various techniques. Several research groups are working on various cold flow concepts, most notably SINTEF-BP (Wolden et al., 2005, Larsen et al., 2001, Lund et al., 2000) and NTNU (Gudmundsson, 2002). IFP has also studied hydrate slurries in flowing conditions and particularly in multiphase flow lines (Peysson et al., 2003). CSIRO/IFP are also investigating hydrate transport in continuous gas phase.

HYDRAFLOW is a new patented cold flow assurance technology, developed at the Centre for Gas Hydrate Research, Heriot-Watt University. The *HYDRAFLOW* concept is based on allowing gas hydrate formation but preventing their agglomeration and pipeline blockage. The idea is to convert most or all of the gas phase into hydrates and transfer them in the form of hydrate slurry in the pipeline. Where produced water is limiting factor for hydrate formation, excess water (e.g. seawater) can be added. It is also possible to adjust the hydrate slurries viscosity by adjusting the amount of water. Anti-agglomerants and other additives might be necessary to control the hydrate crystal size and prevent solid blockage in these systems. This