Wax Control in the Presence of Hydrates

Project Fact Sheet

Program
2007 Ultra-Deepwater Program

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07121-1201

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36 Months

RPSEA Share
$400,000

Cost Share
$100,000

Prime Contractor
University of Utah

Participants
None

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Research Objectives

Unique challenges are associated with transporting fluids through long subsea pipelines. One way of preventing wax precipitation in long subsea lines is to insulate them – an expensive solution. One idea that has been tested recently, but not been implemented commercially, is cold flow. The idea is to use a non-heated, uninsulated pipeline to transport oil-water mixtures in cold, subsea environments where both Projects and waxes are likely to form. The concept in cold flow is to create slurry of Project and/or wax particles and transport the oil-water mixture in the presence of this slurry. The seed particles in the slurry act as nucleation sites and prevent or minimize further wax deposition. This project developed a fundamental understanding of alternatives for preventing wax formation in deep water, uninsulated subsea pipelines. This project involved two phases: (1) a comprehensive literature review concerning flow in subsea pipelines, hydrate and wax formation, and methods designed to prevent or mitigate deposition; and (2) experimental evaluation of "one or two" of the most promising technologies/concepts based on the review.

Approach

This project used a two-phase approach to identify the most promising technologies and forwarding them for further testing toward commercial maturity. First a comprehensive literature survey was undertaken on this subject, and all the possible options for wax control in cold-flow subsea pipelines was considered. This review and analysis yielded two technologies for further evaluation. These technologies were selected based on our analysis coupled with interaction and feedback from the industrial board and from RPSEA. Testing of deep-sea flow assurance technologies required good understanding of oil and chemical characterization, properties measurement, fluid rheology (including slurry hydrodynamics) and interfacial and surface properties.

Accomplishments

The Technology Status Assessment, Phase I Report, and Final Technical have been completed. The literature review examined and evaluated: a) Cold Seeding and/or production chilling strategies, b) Injected chemicals or internal coatings, c) Chemical Inhibition / dissolution, d) Sonic management methods, e) Pigging, f) Bio-degradation (microbial), g) Coiled tubing for flowline and export line remediation, h) Active heating (flowline, export line, etc.), and i) Innovative technologies.

The team completed the design of the flow loop for testing, measured model oil properties, identified a particle analysis system for purchase, designed and built a steel loop, calibrated the pressure transducers, completed a heat exchanger design, identified a model oil with a wide difference between wax appearance temperature and pore point, and completed the construction of the stainless pipe-in-pipe heat exchanger. It then tested several mixtures and developed it findings and recommendations.

Significant Findings

A number of cold flow tests were performed at various thermal fluxes, flow rates, and solids loading. Negligible amounts of deposits were recorded using pressure drop measurements and were visually confirmed in the clear loop. Thus, the feasibility of cold flow was demonstrated. While performing these experiments, it was evident that small thermal flux also did not lead to significant deposits. One possible reason for this was the cloud point depression that was caused by the precipitation and deposition of wax in the reservoir. This hypothesis was tested and proven. This has implications on how cold flow must be implemented in practical applications.

One of the concerns when using cold flow is the uncertainty surrounding restarting when a pipeline with oil and slurry is shut down. The restart process under cold flow conditions was compared with the restart process in conventional shutdowns (oil temperature starting above the wax appearance temperature). It was shown that the restart pressures for cold flow were lower than those under conventional conditions, and core failures were possible with cold restart.

Future Plans

Additional cold flow work will need to be performed on other oil samples to further prove the concept in the lab. Following that, a series of controlled shallow water field tests is suggested using live field fluids.

Acknowledgements

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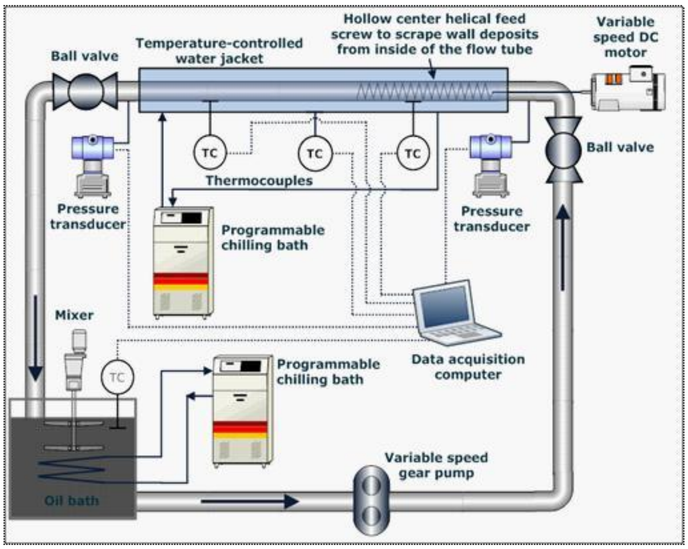

Schematic of the flow loop used in studying cold flow