

TUHFP JIP Monthly Progress Report

Hydrate Blockage Formation: Restart Investigations

The experimental work will be performed in the University of Tulsa's Hydrate Flow Loop Testing Facility with the objective of developing a better understanding of hydrate blockage risk factors. The work consists of three tasks supported by 60 experimental runs with the hydrate flow loop and 100+ runs in the jumper facility. These tasks are:

Task 1: Risk assessment of hydrate plugging during steady-state operations

- Steady-state flow with hydrate experiments (6 months)
 - Variables of interest: Gas-Oil Ratio, flow rate, flow pattern prediction, superficial mixture liquid velocity, no-slip Holdup, diffusion coefficient for gas components, Interfacial tension between hydrocarbon and aqueous phases, fugacity between hydrocarbon and aqueous phases, gas-liquid interfacial area, Water droplet size distribution, onset temperature, cooling rate, fluids viscosities, brine concentration and liquid loading.
- Simulation of past experiments will be performed with TU-PVTSim based simulation tool to derive experimental hydrate formation rates and correlate the results as a function of operating conditions.

Note: The 30 hydrate experiments in the Hydrate Test Loop can be thought of as numbers of experiments that can be allocated depending on need during matrix evaluation from the variable set mentioned above from collaboration of working committee, the University of Tulsa, and project champions.

Task 2: Risk assessment of hydrate plugging during restart operations

- Experimental studies with transient flow facilities (18 months)
 - Effect of liquid loading, water cut, flow velocity
 - Examination of difference between gas and liquid dominated systems during inhibitor displacement and during restart operations in the jumper test facility.
 - Feasibility studies on low-pressure hydrate formation in the restart tests conducted in the jumper test facility.

Task 3: Hydrate Plug Characteristics

- Formation of plugs & measurements of plug characteristics (6 months) by measuring pressure drop for permeability and fluid displacement and gamma densitometer measurements for porosity.
- Evaluation of dissociation methods (18 months) compared to plug dissociation simulation tools and compare pressure dissociation with chemical dissociation with MEG.

Desired Results from this work include:

- Develop a Risk Matrix for hydrate blockages (both transient and steady state operations) to enable application of the study results to actual project work.
- Identify testing Oils by important physicochemical properties rather than field terms. This will help in the identification of analogue oils and understanding the differences in test results correlated with fluid properties.
- Perform more experiments with high liquid loaded systems while maintaining low GOR (<500 SCF/BBL). This will aid in completing the data set obtained from prior experimental work.

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<input type="checkbox"/> 2008 <input checked="" type="checkbox"/> 2009 <input type="checkbox"/> 2010		
<input type="checkbox"/> January <input type="checkbox"/> February <input type="checkbox"/> March	<input type="checkbox"/> April <input checked="" type="checkbox"/> May <input type="checkbox"/> June	<input type="checkbox"/> July <input type="checkbox"/> August <input type="checkbox"/> September <input type="checkbox"/> October <input type="checkbox"/> November <input type="checkbox"/> December
Activity Summary & Accomplishments:		
<p>Task 1: Risk assessment of hydrate plugging during steady-state operations</p> <ul style="list-style-type: none"> Documentation of the work on hydrate rate of formation constants continued. The steady state test matrix was reviewed by the advisory committee. Modification of the test facility to return it to its steady state testing mode continued. 		
<p>Task 2: Risk assessment of hydrate plugging during restart operations</p> <ul style="list-style-type: none"> Phase I of the experimental jumper study is complete. Documentation of the results continued. Modifications to the current jumper facility were initiated in order to conduct the mixing and displacement experiments using thermodynamic inhibitors. This was required because the existing jumper was constructed of acrylic pipe that is not resistant to methanol. Due to its high impact strength, small thermal expansion coefficient ($65 \times 10^{-6} /K$) and low weight (just one-third the weight of acrylic), polycarbonate tubes will be used for the facility modification. 8 -10 sample ports will be added to the vertical and horizontal sections of the new test facility in order to determine the inhibitor concentration gradient along the jumper configuration. Once the samples are taken, the inhibitor concentrations at various levels of the aqueous phase will be analyzed using a gas chromatograph (GC) coupled with a mass spectrometer. An extension proposal to study inhibitor flow behavior in subsea jumpers was developed. The proposed project involves the experimental investigation and computational analysis of the mixing and displacement phenomena that take place during hydrate inhibition of jumper type configurations using MEG and methanol. Construction of the 4-ft section to demonstrate that sufficient cooling can be achieved prior to committing to the order of all the Pyrex sections continued. 		
<p>Task 3: Hydrate plug characteristics</p> <ul style="list-style-type: none"> Hydrate plug characterization and dissociation studies are complete. Processing and analysis of the data continued. A first pass inhibitor dissociation model for Nitrogen was developed. 		

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Activities Planned Next Period:

- Continue working with Champions Creek, Estanga, and Hernandez on details of test matrix and alternatives for hydrate formation in the test loop.
- Simulation of past flow loop experiments will continue to aid planning and understanding as we go forward.
- Complete documentation of Phase I displacement studies.
- Shakedown tests with MEG and MEOH will begin.
- The construction of the new jumper facility that can be cooled with glycol is still in progress. Work is underway to determine the optimum range of glycol circulating velocity and temperature to assure adequate heat transfer conditions between the cooling fluid flowing in the annulus and the working fluids moving inside the inner pipe. Tests with the 4' long Pyrex in Pyrex prototype will be conducted to validate design parameters.
- Data processing of the hydrate plug characterization experiments will continue.
- Continue modeling heating and depressurization dissociation tests to determine what parameters, if any, must be changed to bring the predictions in line with the experimental dissociation times. Targeted parameters are the dissociation temperature, porosity, and heating rate. Modify the inhibitor dissociation model to account for MEG and methanol dissociation. Compare inhibitor dissociation simulations to experimental data.
- Documentation of the work on formation rate constants based on heat and mass transfer limitations of the flow loop will continue.
- Begin steady state test program.

Percent Complete: 70 %