Hydrate 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 Holpup, 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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☐ 2008 ☒ 2009 ☐ 2010

☐ January ☐ February ☐ March	☐ April ☐ May ☐ June	☒ July ☐ August ☐ September	☐ October ☐ November ☐ December

Activity Summary & Accomplishments:

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

- Tests to determine the volume percent hydrate in the total liquid (vol% H in TL) that can be transported without flow disturbances and without forming a plug continued. Eleven tests have been completed to date, 7 new ones this reporting period.

Task 2: Risk assessment of hydrate plugging during restart operations

- Phase I of the experimental jumper study is complete.

- Modifications to the previous jumper facility have continued in order to begin the THI – water mixing experiments as well as the hydrate experiments using cyclopentane, The limited chemical resistance of the acrylic along with the fact that the previous facility design did not allow for sufficient expansion and contraction of the plastic components led to the decision of replacing the material of the pipes in the jumper. Polycarbonate pipes were used to substitute the acrylic tubes and the assembly of the new jumper facility was completed. The design of the new polycarbonate pipe in pipe facility for the formation of hydrates was also completed.

- Construction of the 4-ft section to demonstrate that sufficient cooling can be achieved was completed and testing was initiated

Task 3: Hydrate plug characteristics

- Hydrate plug characterization and dissociation studies are complete. Processing and analysis of the data continued.

- Development of the first pass inhibitor dissociation model continued. The model allows for heat transfer from the wall through the water and hydrate layers and recalculates the dissociation temperature as the MEG moves into the cell and as the hydrate dissociates.

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.

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• Shakedown tests with MEG and MEOH will continue. • The construction of the new jumper facility that can be cooled with glycol is still in progress. 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 will be completed. Component parts for the pipe in pipe jumper will be ordered and construction will be initiated. • 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. Compare the inhibitor dissociation model that account for MEG dissociation to experimental data. • Continue steady state testing.
Corrective Action: None, project on schedule and on budget
Percent Complete: 80 %