Tulsa University Hydrate JIP
Monthly Progress Report
December 2008

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, oil viscosity, 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

- The database was expanded by modeling four new flow loop tests to determine what effect water cut, liquid loading and salinity have on formation rates. Efforts to understand the high liquid loading effect and to correlate hydrate formation rates continued. Efforts to correlate hydrate formation rates for the 19 cp model oil tests to mass transfer coefficients using temperature driving force were begun.

Task 2: Risk assessment of hydrate plugging during restart operations

- The month of December was spent analyzing the oil-water test results. To complete the data set, gas restart experiments with two additional fluids (kerosene and a 68cP oil) are needed. A sensitivity analysis to determine which parameter(s) are affecting liquid hold was begun.
- Construction of the jumper section that can be cooled with glycol continued. Cyclopentane hydrates were made without aid for nucleation and tests to evaluate the representativeness of cyclopentane hydrates during restart flow will be conducted in a small piece of 3" clear pipe before conducting tests in the jumper.

Task 3: Hydrate plug characteristics

- Plug characterization tests continued in December with a new procedure allowing draining of the plugs from free liquids and improved permeability measurements with the 19 cP lube oil. Plugs form when the slug of hydrate slurry stops flowing due to wall friction. Plug permeability is in the order of 10s to 100s of Darcys if calculated using Darcy's law, even though non-permeable plugs have been formed, mainly with fresh water. Preliminary results indicate that the permeability of the plug decreases as gas is circulated through it.

Activities Planned Next Period:

- Continue working with Champions Creek, Estanga, and Hernandez on details of test matrix and alternatives for hydrate formation in test loop. Construction of the jumper section for the hydrate tests will continue.

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• 5 gas restart tests will be conducted using a 68 cP oil that is more viscous than the 19 cp oil and 5 with kerosene that is less viscous. Experiments with liquid restarts will begin and the sensitivity analysis to determine which parameter(s) are affecting liquid hold up will continue. • Autoclave tests with cyclopentane and natural gas will be completed and then tested in the flow loop prior to conducting a test in the jumper. • Analysis of plug characterization experimental results will continue. Experiments will continue using gas flow through a low spot configuration to generate different types of plugs. • Continue development of hydrate rate constant correlations as a function of liquid loading, water cut and fluid type. Process new flow loop test results as generated. • Simulation of past flow loop experiments will continue to aid planning and understanding as we go forward.
Percent Complete: 50 %