
Project 2– Mechanistic Study of Turbulent Flow Wax Deposition

Objective

The objective of this study is the microscopic visual investigation of the wax deposition at the fluid-deposition interface under different shear rates. The possible outcomes of this study will enhance our understanding of mechanisms of wax deposition under flowing conditions and serve as a basis for the development of better deposition models or closure relationships.

Project Description

High uncertainties are common in wax deposition models. The inherent problems with available wax deposition models are:

- **Can the models be used as reliable predictive tools for field cases?** - Available models use fitting parameters that were obtained from limited laboratory data set. A model cannot be used as a predictive tool unless those fitting parameter values can be pre-determined in a reasonably accurate manner based on known inputs. The absence of adequate closure relationships in available models prevents the utilization of them as reliable predictive tools. With a substantial degree of empiricisms, the up-scaling of wax deposition models to field cases is difficult due to the diversity of the produced fluids and operating conditions. The models need to have a stronger physical basis to reduce uncertainties.
- **Physical mechanisms by which shear force affect deposition are still unclear** - Various hypotheses, which require satisfactory physical validation, have been proposed. The hypotheses affect the mathematical formulation of the model and all associated closure relationships. Consequently, model formulations tend to be empirical and not mechanistic. Microscopic visualization investigation of wax deposition is aimed to elucidate the physical mechanisms due to shear (low and high) and drive towards reliable closure relationships in the existing and new models.

A step-by-step process from static to laminar and finally to turbulent flow conditions is required given the limited references on experimental setup and procedures. Since the initiation of this project in the fourth quarter of 2013, TUPDP has completed project scoping, the establishment of the experimental setup, procedure, and semi-quantitative analysis technique, and completion of static test experiments. A dynamic visualization setup was built and incorporated into the TUPDP mini loop facility. This setup will be modified with a high-resolution camera and new cell and used for microscopic experiments using model oil (mineral oil – food grade wax mixture). A semi-quantitative analysis will be applied to the visualization results as applicable.