

Summer 2015

NSERC USRA Report

Displacement of Shear Thinning Fluids

Reily Blackner

Before the oil extraction process can occur an annulus shaped pipe must be inserted deep into the ground to carry the oil from the well to the surface. During the drilling the pipe is filled with drilling mud while being pushed downward, undergoing various angle changes creating a non-linear path. After the drilling is complete the drilling mud has to be pushed out so that cement can be put in to solidify the pipe position and maintain its structure. If there is any mud that does not get pushed out before the cement is put in then it will decrease the structural integrity of the pipe.

For the last four months I have been working in the Complex Fluids Lab at UBC run by Professor Ian Frigaard. Our goal has been to run over five hundred experiments based around finding the most efficient ways to displace drilling mud from a pipe at various angles and flow rates. The purpose of these experiments has been to analyze the behavior of the various shear thinning fluids and apply these results to the real world model within the oil industry.

The following is a summary of our experimental procedure. For six experiments two fluids are needed, one dyed black and one transparent, they are each created by adding various concentrations of Xanthan to change the viscosity properties and Glycerol to change the density of water. The black fluid is first put into a four meter long tube, then the clear fluid is loaded behind a gate at constant pressure of 10-psi. Once the gate is opened the transparent fluid flows into the tube and begins to interact with the black fluid. Cameras are used to record the displacement behavior and Ultrasonic Doppler velocimetry (UDV). UDV probes are used to monitor flow rates during the experiment. Mostly the experiments display interesting mixing behaviors but every once in awhile a perfect profile would occur allowing for no mixing to occur between the two fluids, thereby replicating our desired experimental outcome.

Throughout the summer I was responsible for various projects. These included; redesigning a fully acrylic rig used for carbopol invasion experiments, modifying the apparatus used to run the experiments, and performing data analysis using image processing in conjunction with MATLAB.

We have made significant progress towards understanding how these shear thinning fluids behave. During the next term more data analysis will continue. This will help determine the cause for ideal behavior to occur and how to translate it to a real world situation.