Proceedings of the Canadian Society for Mechanical Engineering International Congress 2020
CSME Congress 2020
June 21-24, 2020, Charlottetown, PE, Canada

Fluid placement in a closed-end pipe with application in the plug and abandonment of oil and gas wells: experiments

Soheil Akbari[1], Seyed Mohammad Taghavi[1*]
[1] Department of Chemical Engineering, Université Laval, Québec City, Québec, G1V 0A6, Canada
*seyed-mohammad.taghavi@gch.ulaval.ca

ABSTRACT

The plug and abandonment (P&A) of oil and gas wells is a crucial process to prevent the migration of the reservoir fluids and avoid the contamination of fresh water resources, soil, and atmosphere. In order to plug and abandon a well, the cement plug placement is conducted via several methods, such as the dump-bailing method, i.e. dumping of the cement slurry into an in-situ fluid in the wellbore, at specific intervals. In this process, an extensive range of Newtonian or non-Newtonian fluids is used to displace and remove the in-situ fluid (drilling fluid or water) in the wellbore. Based on the large number of parameters of the flow, such as the density and viscosity differences between the fluids, the geometry type (pipe, annulus, etc.), the operation conditions (velocity, geometry inclination, dumping height), various kinds of placement and mixing flows can occur, and different flow regimes (e.g. inertial, viscous) can develop. Motivated by the fluids mechanics of this process, we experimentally investigate the placement of a fluid in an inclined closed-end pipe to replace a slightly lighter fluid. In our experiments, the heavy fluid can be Newtonian or viscoplastic, and the light fluid is always Newtonian. The fluids of our interest are miscible. We investigate the effects of the flow parameters, such as the density difference, the indication angle, the viscosity ratio between the fluids, and the rheological parameters on the placement flow patterns, and quantify the different flow regimes versus the appropriate dimensionless groups that describe the flow.

Keywords: Plug and abandonment (P&A), Fluid placement, Density difference.