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January 1988

For presentation at CSChE 38th Conference at Edmonton, Alberta, October 2 - 5, 1988 and for publication in Conference Abstracts

ENERGY RESEARCH LABORATORIES
DIVISION REPORT ERL 88- 01(OPJ)

This work was supported in part by the Federal Panel on Energy R&D (PERD)

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Differential pressure (d/p) cells are commonly used in chemical and petroleum plants to monitor flowrate or rheological parameters. In many cases, the processes operate at high pressures involving pulsing flow due to the type of feed pumps or compressors used. Instruments designed for steady continuous flow can be used in pulsing flows, however, consideration must be given to account for the effect of the non-uniform flow.

Simulations of pressure as a function of time were carried out for:

(1) gas flows at high pressure through an orifice, and
(2) pressure drop across the preheater of a primary upgrading pilot plant during gas-liquid two-phase flow.

The gas flow was driven by either single or multiple piston compressors in parallel. Orifices coupled with d/p cells were used to monitor the pulsing gas flows. The pressure drop fluctuated with large amplitudes because the driven frequency was low. The simulated results indicated that the average flowrate was lower over a range of low average pressure drops than that with steady continuous flow at the same reading. The simulations have provided good results and have verified that accurate orifice calibration can be obtained for reasonably wide ranges at ambient conditions thus expensive calibration procedures can be eliminated.

Heavy oil was fed by a piston pump. The liquid stream merged with the pulsing gas stream to concurrently pass through a small bore preheater before discharging into the reactor. A capillary two-phase flow model was used in conjunction with the pulsing phenomena of feed pump and compressor to simulate the pressure drops across the preheater as a function of time. This allowed the feasibility of on-line rheology measurements based on the d/p readings to be examined. The model predictions agreed reasonably well with those of the experiment.

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