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Study of oil-soluble and water-soluble drag reducing polymers in multiphase flows

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Abstract
Gas-oil-water and oil-water flows are common in the production and transportation of petroleum fluids thus, fluid flow with reduced frictional pressure drop (drag), and lower operating costs are highly desired. Drag reducing polymers (DRP), which do not require additional infrastructure, meet this requirement. The effects of water-soluble polar ZETAG® 8165 and nonpolar oil-soluble polyisobutylene (PIB) DRP on pressure gradient and percentage drag reduction were assessed using two-phase air-water and air-oil flows, and three-phase air-oil-water flow. The conduit comprised a 22.5 mm internal diameter and 2.48 m long horizontal pipe. Also, the fluid flow pattern and DRP shear stability were studied. The resultant interaction between the DRP state and the external environment governed its ability for dampening turbulent eddies, streamlining the velocity field, and eventually increasing the thickness of the laminar sublayer. The DRP state includes its chemical structure and hydrodynamic size, while the external environment comprises fluid flow pattern, polarity, phase morphology, and intensity of turbulence. These imply that the functional mode of a DRP is more involved than previously known. ZETAG® 8165, having longer branches and ion-pairs around the backbone, showed less shear degradation than the fairly straight-chain PIB. The effects of these structural differences were also manifested in their varying abilities to transpose flow pattern, and reduce drag and pressure gradient.

Author Keywords
drag-reducing polymers; flow pattern; gas-oil-water flow; pressure drop

Index Keywords
Air, Drag reduction, Drops, Flow of fluids, Flow of water, Flow patterns, Fluid dynamics, Hydraulics, Multiphase flow, Operating costs, Polymers, Pressure drop, Pressure gradient, Shear flow, Two phase flow, Velocity; Drag-reducing polymers, External environments, Frictional pressure drops, Functional mechanisms, Intensity of turbulences, Lower operating costs, Oil water flow, Structural differences; Drag

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