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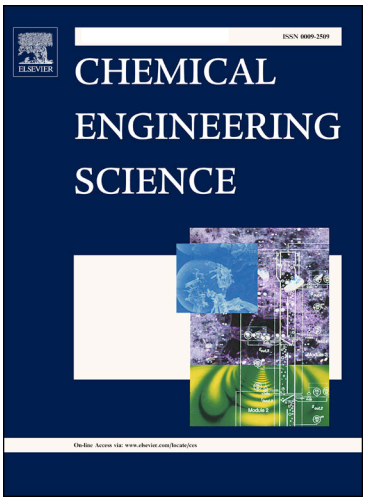

PHASE INVERSION PHENOMENA IN VERTICAL THREE-PHASE FLOW: EXPERIMENTAL STUDY ON THE INFLUENCE OF FLUIDS VISCOSITY, DUCT GEOMETRY AND GAS FLOW RATE

Alex Roger Almeida Colmanetti, Marcelo Souza de Castro, Marcel Cavallini Barbosa, Oscar Mauricio Hernandez Rodriguez

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Alex Roger Almeida Colmanetti[1], Marcelo Souza de Castro[2], Marcel Cavallini Barbosa[1] and Oscar Mauricio Hernandez Rodriguez[1]

[1]Industrial Multiphase Flow Laboratory (LEMI), São Carlos School of Engineering, University of São Paulo (USP), São Carlos, SP, Brazil
alex.colmanetti@usp.br, marcel.cavallini.barbosa@usp.br, oscarmhr@sc.usp.br

[2]School of Mechanical Engineering, University of Campinas (UNICAMP), Campinas, SP, Brazil
mcastro@fem.unicamp.br

Abstract.
Improper sizing of pipelines and production tubings in the petroleum industry is often caused by lack of understanding of three-phase flow, which is characterized by gas flowing together with an immiscible water-oil mixture. There is the presence of a continuous liquid phase and a liquid dispersed phase, as observed in liquid-liquid flows, i.e., one can observe either a dispersion or emulsion of oil in water (o/w) or dispersion or emulsion of water in oil (w/o). The transition from o/w to w/o, or the other way around, is defined as phase-inversion. This phenomenon is characterized by a sharp increase in the pressure gradient, leading to significant pressure loss in the oil production system. The goal is to investigate the effects of oil viscosity, channel geometry (circular pipe or annular duct) and superficial gas velocity on the phenomenon of phase inversion in vertical liquid-liquid-gas flows, using oil with three different viscosities (ranging from 70 mPa·s to 280 mPa·s), tap water and compressed air as working fluids. The experiments were carried out in three different geometries: (i) glass pipe of 50 mm i.d., (ii) glass pipe of 95 mm i.d. and (iii) concentric annular duct with 95 mm of hydraulic diameter (glass outer pipe and PVC internal pipe). The experiments were performed under equivalent Reynolds number to evaluate the geometry effect. New data as total pressure gradient and volumetric fractions were obtained for all geometries. The results suggest that the extrapolation of results obtained in circular pipes with low viscosity oil and low gas flow rates to annular-duct flow with viscous oils and high gas flow rates can lead to significant errors.