Abstract Submitted
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Effects of soluble surfactant and viscoelasticity on pressure-driven turbulent bubbly channel flow[1] ZAHEER AHMED, Koc University, Turkey, DAULET IZBASSAROV, PEDRO COSTA, OUTI TAMMISOLA, KTH Mechanics, Sweden, METIN MURADOGLU, Koc University, Turkey — Particle-resolved direct numerical simulations are performed to investigate the combined effects of soluble surfactant and viscoelasticity on structure of pressure-driven turbulent bubbly channel flow ($Re_\tau = 180$). Incompressible flow equations are solved fully coupled with FENE-P viscoelastic model and soluble interfacial and bulk surfactant concentration equations. A non-linear equation of state relates surface tension to interfacial surfactant concentration. The method is first validated using benchmark turbulent single- and two-phase flows. Then massively parallel simulations are performed to examine effects of viscoelasticity and surfactant on turbulent bubbly flows. We found that clean bubbles move toward the walls due to inertial lift force, resulting in formation of wall-layers and a significant decrease in the flow rate. An addition of strong enough surfactant alters the direction of lateral migration of bubbles resulting in a nearly uniform bubble distribution across the channel. For the viscoelastic case, shear-thinning effects promote inertial lift, enhancing formation of bubbly wall-layers and consequently strong decrease in the flow rate. Formation of wall-layers is determined by the interplay of viscoelasticity and surfactant, when they act together.

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