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Suspension flows in a pipe covered with permeable surfaces[1]
MARYAM BAGHERI, CHANGWOO KANG, PARISA MIRBOD, University of Illinois at Chicago — The flow of particulate suspensions driven by a constant pressure gradient is examined in a pipe where its walls are replaced with a permeable surface. We explore non-colloidal suspensions of rigid and spherical particles in a Newtonian fluid over a wide range of bulk particle volume fraction ($0.1 \leq \phi_b \leq 0.5$) and the permeability of the porous medium. Direct numerical simulations (DNS) are performed to solve conservation equations of the flow coupled with the constitutive equation of suspensions (Diffusive Flux Model) and Darcy's law in a porous medium. We aim to elucidate the effect of the permeable surface on the suspension flows. The velocity and concentration profiles are presented for various control parameters and show that the velocity of suspensions enhances by the slip effect at the suspension-porous interface. We evaluate the rate of suspension flows and slip velocity at the suspension-porous interface induced by the permeable surface. It reveals that the rate of suspension flow decreases as the bulk volume fraction ϕ_b increases and it builds up as the permeability of the porous media increases. We also show that there are two different regimes characterizing the slip velocity normalized by both shear rate and penetration depth, at the suspension-porous interface, namely the strong permeability regime and the weak permeability regime.

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