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Transitional Flow of Herschel-Bulkley Fluids in Pipes[1] DOGUKAN KARAHAN, MUSTAFA USTA, DEVESH RANJAN, CYRUS AIDUN, Georgia Institute of Technology — This study aims to elucidate transitional flow characteristics of shear-thinning Herschel-Bulkley fluids using direct numerical simulation. Unlike Newtonian fluids where transition point can be described by a single Reynolds number, Herschel-Bulkley fluids require specification of a Reynolds number, Hedstrom number, and power law index to characterize the transition point. Computational studies are carried out using a second order accurate, unstructured, open-source finite volume solver over a limited range of parameters to identify transition points and flow behavior. Comparisons of statistics are made with literature whenever applicable, and results show excellent agreement. Results indicate strong increase in transition Reynolds number with increasing Hedstrom number. The mean flow properties support existence of the linear profile in the viscous sublayer. On the other hand, a universal logarithmic law does not generally hold. Turbulent fluctuation profiles also indicate strong variability with varying Hedstrom number. The analysis of instantaneous structures clearly reveal the transition delaying behavior due to yield stress and shear thinning.

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Dogukan Karahan
Georgia Inst of Tech

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