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Maximum drag reduction asymptote for particulate pipe flows
NISHCHAL AGRAWAL, Institute of Science and Technology Austria, GEORGE CHOUEIRI, University of Toledo, BJORN HOF, Institute of Science and Technology Austria — Adding polymers or particles to a flow can alter the drag experienced by it. For instance, polymers in a flow reduce drag but their ability is bounded by a limit, the maximum drag reduction asymptote. However, the effect of particles on drag is ambiguous, with studies reporting contradicting observations; even in cases where particles are reported to reduce drag no asymptotic limit is know. The ambiguity arises because in addition to particle concentration, particle shape, size and density affect the drag. Hence, various particles behave differently in distant ranges of Re and concentration. In the present study, we experimented in a pipe flow setup with neutrally buoyant spherical and elongated particles, covering wide ranges of both Re and concentration. Based on friction factor, we found that spherical particles do not show drag reduction at any Re while the elongated particles do within an specific interval of Re. This interval strongly depends on particle concentration and relative size of pipe to particle, and within this interval the friction factor reaches a minimum value. These drag reduction maxima fall onto a distinct curve which can be considered the maximum drag reduction asymptote for a given particle shape, irrespective of the pipe diameter or concentration.

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