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The importance of bubble deformability for strong drag reduction in bubbly turbulent Taylor-Couette flow[1] DANIELA NAREZO GUZMAN, DENNIS P.M. VAN GILS, CHAO SUN, DETLEF LOHSE, Physics of Fluids Group, Faculty of Science and Technology, J.M. Burgers Center for Fluid Dynamics, and IMPACT Institute, University of Twente, NL — Drag reduction (DR) in two-phase turbulent Taylor-Couette (TC) flow is studied for Reynolds number up to Re $= 2\times10^6$ for pure inner cylinder (IC) rotation, thus extending the previously explored range. DR based on the global torque as a function of the global gas volume fraction (α) over the range 0% up to 4% is obtained. We observe two DR regimes: moderate DR up to 7% for Re $= 5.1 \times 10^5$ and stronger DR for Re $= 1.0 \times 10^6$ and 2.0×10^6, remarkably finding more than 40% of DR for $\alpha = 4\%$ at Re $= 2.0\times10^6$. Furthermore, TC flow is locally studied in each regime (Re $= 5.1 \times 10^5$ and 1.0×10^6) at a fixed $\alpha = 3\%$: statistics of the local liquid flow azimuthal velocity and the local gas concentration are obtained. The local bubble Weber number (We) is computed close to the IC showing that the crossover from the moderate to the strong DR regime occurs roughly at the crossover of $We \sim 1$. We find that a larger local gas volume fraction close to the inner wall has a positive effect on the azimuthal velocity decrease, which is responsible for the observed DR. However for strong DR what is more important for the α values explored here is bubble deformability close to the boundary layer.

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