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Rigid spherical particles in highly turbulent Taylor-Couette flow[1]

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Many industrial and maritime processes are subject to enormous frictional losses. Reducing these losses even slightly will already lead to large financial and environmental benefits. The understanding of the underlying physical mechanism of frictional drag reduction is still limited, for example, in bubbly drag reduction there is an ongoing debate whether deformability and bubble size are the key parameters. In this experimental study we report high precision torque measurements using rigid non-deformable spherical particles in highly turbulent Taylor-Couette flow with Reynolds numbers up to 2×10^6. The particles are made of polystyrene with an average density of 1.036 g cm^{-3} and three different diameters: 8mm, 4mm, and 1.5mm. Particle volume fractions of up to 6% were used. By varying the particle diameter, density ratio of the particles and the working fluid, and volume fraction of the particles, the effect on the torque is compared to the single phase case. These systematic measurements show that adding rigid spherical particles only results in very minor drag reduction.

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