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Bubble drag reduction requires large bubbles[1] RUBEN VERSCHOOF, ROELAND VAN DER VEEN, CHAO SUN, DETLEF LOHSE, Physics of Fluids, MESA+ institute, University of Twente, the Netherlands — In the maritime industry, the injection of air bubbles into the turbulent boundary layer under the ship hull is seen as one of the most promising techniques to reduce the overall fuel consumption. A few volume percent ($\leq$ 4%) of bubbles can reduce the overall drag up to 40% and beyond. However, the exact mechanism is unknown, thus hindering further progress and optimization. Here we show that bubble drag reduction in turbulent flow *dramatically* depends on the bubble size. By adding minute concentrations (6 ppm) of the surfactant Triton X-100 into otherwise completely unchanged strongly turbulent Taylor-Couette flow containing bubbles, we dramatically reduce the drag reduction from more than 40% to about 4%, corresponding to the trivial effect of the bubbles on the density and viscosity of the liquid . The reason for this striking behavior is that the addition of surfactants prevents bubble coalescence, leading to much smaller bubbles. Our result demonstrates that bubble deformability is crucial for bubble drag reduction in turbulent flow.

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