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The maximum drag reduction of turbulent flows with flexible and rigid polymer solutions in semi-dilute concentrations RODRIGO MITISHITA, GWYNN ELFRING, IAN FRIGAARD, University of British Columbia — Polymer solutions in the semi-dilute regime are commonly employed in transport of fluids in industrial applications. For instance, the high viscosities compared to the solvent allow for particle suspension, and the viscoelasticity of the solutions contributes to weaken eddies in turbulent flows, leading to the drag reduction phenomenon. Increasing the polymer concentration leads to more drag reduction until the maximum drag reduction (MDR) limit, which is universal in terms of average drag reduction, even for polymers with distinct drag reduction mechanisms prior to MDR. However, to the best of our knowledge, the similarities and differences between the dynamics of turbulence at MDR with flexible and rigid polymers remain unclear. In this work, we present an experimental investigation of turbulent flows with semi-dilute polymer solutions of xanthan gum (rigid polymer) and partially hydrolyzed polyacrylamide (flexible polymer) at high Reynolds numbers in a rectangular channel. The MDR state with each solution is analyzed with Laser Doppler Anemometry measurements of velocity profiles, turbulent intensities and energy spectra of velocity fluctuations, to explain similarities and potential differences in the drag reduction mechanism.

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