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Scaling of Polymer Degradation Rate within a High-Reynolds-Number Turbulent Boundary Layer BRIAN ELBING, MICHAEL SOLOMON, MARC PERLIN, DAVID DOWLING, STEVEN CECCIO, University of Michigan — An experiment conducted at the U.S. Navy's Large Cavitation Channel on a 12.9 m long flat-plate test model produced the first quantitative measurements of polymer molecular weight within a turbulent boundary layer. Testing was conducted at speeds to 20 m/s and downstream distance based Reynolds numbers to 220 million. These results showed that the rate of polymer degradation by scission of the polymer chains increases with increased speed, downstream distance and surface roughness. With the surface fully rough at 20 m/s there was no measureable level of drag reduction at the first measurement location (0.56 m downstream of injection). These results are scaled with the assumption that the rate of degradation is dependent on the polymer residence time in the flow and the local shear rate. A successful collapse of the data within the measurement uncertainty was achieved over a range of flow speed (6.6 to 20 m/s), surface roughness (smooth and fully rough) and downstream distance from injection (0.56 to 9.28 m).

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