

Lifetime studies of localized turbulence in pipe flow of dilute polymer solutions

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In pipe flow turbulence first occurs in the form of localized structures, called ‘puffs’ which have a finite lifetime. The probability of puff decay is exponentially distributed, which is characteristic for a memoryless process [1]. In this present study we extend the lifetime studies to dilute polymer solutions in the drag reduction regime [2]. Experiments have been carried out in a 900 D long pipe with a diameter of $D=4$ mm using different concentrations of polyacrylamide (PAAM) in water. We find that the turbulence lifetime decreases with polymer concentration and that overall the transitional regime is shifted to higher Reynolds numbers (figure 1). Also the shape of the probability curves changes and lifetimes increase much more slowly than in the Newtonian case.

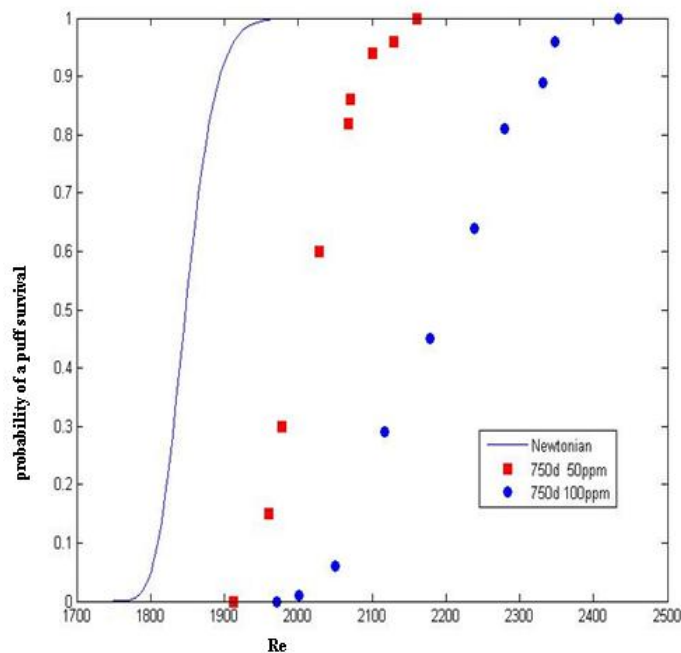


Figure 1. Probability of the puff in 50 ppm and 100 ppm PAAM water solution to survive after 750 d at different Reynolds number

References:

1 Björn Hof, Jerry Westerweel, Tobias M. Schneider & Bruno Eckhardt, ‘Finite lifetime of turbulence in shear flows’, Science, 2006,443, 59-62

2. Toms BA “Some observations on the flow of linear polymer solutions through straight tubes at large Reynolds number”, Proc. 1st Intl. Congr. Rheol. N. Holland, Amsterdam 2:135-41, 1948