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Viscoelastic flow instabilities in static mixers: onset and effects on the mixing efficiency SIMONA MIGLIOZZI, GIOVANNI MERIDIANO, LUCA MAZZEI, PANAGIOTA ANGELI, Dept. of Chemical Engineering, University College London, CORAL COLLABORATION — Purely elastic instabilities occur in the absence of inertial effects, induced by the combination of strong elastic forces with nonlinearities of the flow. In a laminar mixing process, the onset of these instabilities is likely to occur in the window of applied flow rates, therefore it is of paramount importance to understand the effects of their onset on the mixing efficiency. In this work, we experimentally investigate the onset of elastic instabilities in two in-line mixers with different geometric features, i.e. a Kenics helical mixer and a GFX mixer, characterised by a double X-shaped bars geometry. Concentrations maps were obtained at different mixer lengths by means of Planar Laser Induced Fluorescence. We mapped the onset of the instabilities with Reynolds and Deborah numbers. Three fluids with different rheological behaviour – i.e. a Boger fluid and two shear-thinning fluids – were tested to deduce a generalised effect of the fluid elasticity on the mixing patterns. The effect of the instabilities depended on the different kinematics induced by the two distinct geometries: for the helical mixer the typical lamellar structure is not recovered and the two liquid streams remain unmixed, while for the GFX mixer the concentration maps oscillate in time in a quasi-periodic fashion. In both cases, the onset of instabilities worsens the mixing efficiency with respect to the Newtonian case.

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