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Dampening the asymmetric instability in pipe flow of shear thinning fluids using elasticity DAVID DENNIS, CHAOFAN WEN, ROBERT POOLE, University of Liverpool — Recent experimental results have shown that the asymmetric flow of shear-thinning fluid through a cylindrical pipe, which was previously associated with the laminar-turbulent transition process, is actually a non-hysteretic and reversible, supercritical instability of the laminar base state. These experiments were performed using largely inelastic shear-thinning fluids (aqueous solutions of xanthan gum) and it was found that the greater the degree of shear-thinning the larger the magnitude of the asymmetry. In this talk we show that a viscoelastic fluid (an aqueous solution of high molecular weight polyacrylamide), with approximately the same shear-thinning characteristics as the inelastic fluid, does not exhibit the asymmetry when freshly mixed. However, once the elasticity of this fluid is degraded (by prolonged shearing) the asymmetry reappears. This suggests that the shear-thinning nature of the fluid causes the instability and the viscoelastic nature works to dampen the asymmetry. To test this hypothesis we add varyingly small amounts of polyacrylamide to xanthan gum solutions and find an inverse relationship between viscoelasticity and the magnitude of the asymmetry, although the Reynolds number at which the instability is first observed stays approximately constant.

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