Plane sudden expansion flows of viscoelastic liquids

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Abstract

In marked contrast to the flow through sudden contractions, the laminar flow of viscoelastic liquids through sudden *expansions* has received very little attention in the literature and is largely restricted to a handful of papers. The general view from this existing literature regarding viscoelastic expansion flow at low Reynolds number is that the amount of recirculating fluid seems to be suppressed and then, at high enough Deborah number, totally eliminated. The mechanism for this suppression is thought to be the ability of the polymer molecules to relax their stresses upon entry to the expansion and, in general terms, similar to the phenomena of extrudate swell. In this paper we report the results of a systematic numerical investigation, using a finite volume technique and the high resolution 'CUBISTA' scheme for the convective terms in the constitutive equations, of the creeping flow (Re=0.01) of three 'model' viscoelastic fluids, the UCM, Oldroyd B and the PTT models, through a 1:3 two-dimensional sudden expansion using meshes an order of magnitude more refined than previous studies (Darwish et al (1992) and Missirlis et al (1998 **recheck YEAR**)). Our results show that the degree to which recirculation is in fact suppressed is far less than previous studies have suggested and that, contrary to the

earlier works of Darwish et al and Missirlis et al, at high Deborah number a significant recirculation region still exists downstream of the expansion.

References

Darwish et al (I don't have this paper, so I can't write the reference).

Missirlis KA, Assimacopoulos D and Mitsoulis E 1998. A finite volume approach in the simulation of viscoelastic expansion flows. *J. Non-Newt. Fluid Mechanics*, 78, 91-118.

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