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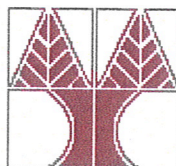
Book of Abstracts



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11:00

Plane sudden expansion flows of viscoelastic liquids

R. Poole, M.A. Alves, P.J. Oliveira, F.T. Pinho

Department of Engineering, University of Liverpool, Brownlow Street, Liverpool, L69 3GH, U.K.

Departamento de Engenharia Química, CEFT, Faculdade de Engenharia, Universidade do Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal

Departamento de Engenharia Electromecânica, Unidade Materiais Têxteis e Papeleiros, Universidade da Beira Interior, 6201-001 Covilhã, Portugal

CEFT, Faculdade de Engenharia, Universidade do Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal AND Universidade do Minho, Largo do Paço, 4704-553 Braga, Portugal

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. The meshes used in the computations are one order of magnitude more refined than the previous studies of Darwish et al (1992) and Missirlis et al (1998). 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 (1992) and Missirlis et al (1998), at high Deborah number a significant recirculation region still exists downstream of the expansion.

References

Darwish M S, Whiteman J R and Bevis M J, Numerical modelling of viscoelastic liquids using a finite-volume method, *J Non-Newtonian Fluid Mechanics* 45, 311 (1992).

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

11:20

DPD simulations of dilute polymer solutions in microchannels

V. Symeonidis, G.E. Karniadakis, B. Caswell

Division of Applied Mathematics, Brown University,

182 George St., Box F, Providence, RI 02912, USA

Dissipative Particle Dynamics (DPD) is a simulation method at mesoscopic scales that bridges the gap between molecular dynamics and continuum hydrodynamics. It can simulate efficiently complex liquids and dense suspensions using only a few thousands of virtual particles and at speed-up factors of more than one hundred thousands compared to Molecular Dynamics. In this work we employ DPD for simulations of dilute polymer solutions using bead-spring representations. We present comparison of two time-marching schemes: the popular velocity-Verlet thermostat and the alternative Lowe-Andersen thermostat. We demonstrate the details and potential of Lowe's scheme. Schmidt number effects are investigated for a series of cases, including the fractional extension of λ -DNA molecules under shear (using the Marko-Siggia wormlike chain spring law) and Poiseuille flow in microchannels. We present comparison with experimental and Brownian Dynamics results. Effects on the polymer depletion layer, power-law velocity profiles and apparent viscosities are presented as a function of the number of beads per polymer chain.

References:

- [1] V. Symeonidis, G.E. Karniadakis, B. Caswell: "Dissipative Particle Dynamics Simulations of Polymer Chains: Scaling Laws and Shearing Response Compared to DNA Experiments", *Physical Review Letters*, 95, 076001 (2005).
- [2] V. Symeonidis, G.E. Karniadakis, B. Caswell: "Simulation of λ -phage DNA in microchannels using Dissipative Particle Dynamics", *Bulletin of the Polish Academy of Sciences*, 53, (December 2005).
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