A numerical study on fibre-induced drag reduction

Project aim

To account for the effect of the fibres on the fluid mechanics, the Navier-Stokes equations are supplemented by the divergence of the fibres stress tensor. The fibre stress is computed by the well-known constitutive equations valid for solutions of non-interacting, cylindrical rods. The simulations are compared to experimental data provided by the literature. The comparison involves the friction factor dependence on Reynolds number and fibre concentration. We find good agreement in all observable trends at relatively small levels of drag reduction. This suggests that the constitutive equations for dilute solutions of rods correctly reproduce the small drag reduction regime. At large drag reduction the simulations disagree with experimental data. The discrepancies are mainly due to the exclusion of hydrodynamic interactions between polymers. The inability of the model to reproduce flow statistics at large drag reduction suggests that interactions between polymers play a crucial role in this regime.

Progress

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Dissertations

1. Gillissen, J.J,J, 2008, Direct Numerical Simulation of Fibre induced turbulent channel flow, PhD thesis Delft University of Technology

Scientific publications

1. J.J.J Gillisen, B.J, Boersma, P.A. Mortenson, & H.I Andersson, 2008, Fibre Induced drag reduction, J. Fluid Mech, ,602, 209-218.

Project leaders

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Research theme

Complex dynamics of fluids

Participants

G Ooms, BJ Boersma

Cooperations

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Funded

TUD

1st 100% 2nd - 3rd -

Start of the project

2003

Information

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