

Numerical simulations of incompressible piezoviscous fluids in lubrication problems

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Abstract

We comment on numerical simulations of incompressible pressure-thickening and shear-thinning fluids in flow problems arising in lubrication. In particular, we discuss finite element approximations to the flow in a plane slider bearing, without resorting to the so called lubrication approximation. We obtain the numerical solutions as long as the variation of the viscous stress $\mathbf{S} = 2\eta\mathbf{D}$ with the pressure p is limited, say $|\partial\mathbf{S}/\partial p| \leq 1$.

We will document by examples that the eventual practice to avoid numerical difficulties by cutting the viscosity off for large pressures leads to results that depend solely on the artificial cut-off parameter.

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Keywords: simulations of incompressible fluid flows, pressure-thickening viscosity, shear-thinning viscosity, piezoviscous lubrication, plane slider