

Transient Squeeze Flow of Viscoplastic Liquids

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We examine the axisymmetric squeeze-flow, under creeping flow conditions, of viscoplastic materials placed between two parallel disks using the continuous constitutive model suggested by Papanastasiou and, more recently, the discontinuous Bingham model. This is the first transient simulation of such liquids and allows us to also determine the shape of the liquid/air interface, initially located inside the disks, as it is displaced towards their edge. We employ the mixed finite element method coupled with a quasi-elliptic mesh generation scheme in order to follow these large deformations. The material yields in part of the domain as the disks approach each other, departing from the corresponding Newtonian solution. Unyielded material arises around the two stagnation points of flow at the disk centers verifying previous steady state calculations. The unyielded region increases with the Bingham number, but decreases with time. If wall-slip is present, the unyielded region decreases significantly and may even totally disappear.

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