Issues in the Modeling of Paste Extrusion

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In a recent article (Patil et al., JNNFM, 2006), a rheological constitutive equation was proposed to model the incompressible flow of poly-tetra-fluoro-ethylene (PTFE) paste and its structural development (fibrillation between the PTFE particles) during flow. The constitutive model was a combination of shear-thinning and shear-thickening viscosity terms, depending on a structural parameter, , which obeyed a convective-transport equation. In the latter, a non-objective flow type parameter, , was employed, which depended on the magnitudes of the rate-of-strain and vorticity tensors. The issue of an objective flow type parameter was addressed by the authors (JNNFM, 2009). Despite its complexity and severe slip at the wall exhibited by the paste, good convergence was obtained even for very high apparent shear rates. The corrected model predicted higher structural levels (more fibrils) in PTFE paste flow through extrusion dies. The new results were more consistent with experimental observations; however some key features found experimentally are still missing. These discrepancies between theory and experiment are presented, and some issues regarding a more appropriate modeling of the material are discussed.