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Start up of Capillary Flow of Polytetrafluoroethylene (PTFE) Paste: Experiments and Simulations

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In the process of paste extrusion of PTFE, a paste is first formed by mixing the PTFE resin with a lubricant whose concentration varies from 16% to 25% wt%, depending on the resin and the geometrical characteristics of the extrusion die. The system behaves like a semi-solid material when it is extruded at 35 °C at various piston velocities in tapered capillary dies. During extrusion, the pressure in the system follows three distinct zones: (i) first rises to a maximum over a finite time and then falls rapidly to a value just below the steady-state, (ii) a steady-state follows, and (iii) towards the end of the extrusion, a slight pressure increase occurs. To solve numerically such problems of semi-solid processing, it is important to include in the constitutive modeling both the compressibility of the paste and its apparent yield stress. Several regularized models that overcome the discontinuity of the yield stress models have been proposed and analyzed over the years. Some of these in conjunction with yield stress models are used in this work in order to predict and explain the existence of the maximum pressure (yield pressure) in the start up of capillary flow of PTFE paste.