Axisymmetric squeeze flow of viscoplastic Casson and Herschel-Bulkley medium

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We develop an asymptotic solution for the axisymmetric squeeze flow of viscoplastic Casson and Herschel-Bulkley fluids between two parallel discs that are approaching each other with a constant velocity. The no-slip and slip yield boundary conditions at the wall are considered. The standard lubrication-style expansions of the problem predict a plug speed which varies slowly in the principal flow direction. This variation implies that the plug region cannot be truly unyielded. Our solution shows that this region is a pseudo-plug region in which the leading order equation predicts a plug, but really it is weakly yielded at a higher order. We follow the asymptotic technique suggested earlier by Balmforth and Craster (1999) and Frigaard and Ryan (2004). For the threshold stick-slip boundary conditions partial slip (stick-slip) or full slip at the wall (slip) are possible, depending on the ratio of two dimensionless parameters. We confirm numerically obtained solution, using Accelerated proximal gradient suggested by Treskatis et al. (2016, 2018).