

Nonhomogeneous incompressible Bingham fluid: regularity of a weak solution

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The equations for the nonhomogeneous incompressible Herschel-Bulkley fluid are considered and existence of a weak solution is proved for a boundary-value problem which describes three-dimensional flows between two eccentric cylinders when in each two-dimensional cross-section annulus the flow characteristics are the same. The rheology of such a fluid is defined by a yield stress τ_* and a discontinuous stress-strain law. A fluid volume stiffens if its local stresses do not exceed τ_* , and a fluid behaves like a nonlinear fluid otherwise. The flow equations are formulated in the stress-velocity-density-pressure setting. Our approach is different from that of Duvaut-Lions developed for the classical Bingham viscoplastic fluids. We do not apply the variational inequality but make use of an approximation of the generalized Bingham fluid by a non-Newtonian fluid with a continuous constitutive law.