

Stability of Plane Poiseuille Flow and Energy Growth in the Case of a Bingham Fluid

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The present work examines the stability of three-dimensional perturbation of Poiseuille flow of Bingham fluid. The principal characteristic of the basic flow is the presence of the plug zone, which moves as a rigid solid. The movement of the interface between the yielded and the unyielded zones depend only on the shear stress in the yielded zone. A Chebychev collocation method is applied within a temporal stability framework to compute eigenvalues and maximum transient amplification factor. It is found that Poiseuille flow of Bingham fluid is linearly stable, and for sufficiently large Reynolds, the least stable mode is an interfacial mode. Due to the non-normality of the operators, transient amplification of the disturbance kinetic energy is observed. The results show that amplification factor decreases with increasing the Bingham number B . Conditions for no energy growth are then determined. When $B \gg 1$, it is shown that the critical Reynolds number increases as the square root of B . This result is compared with the conditional stability based on an energy method (Nouar and Frigaard in 2001).

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