Instability Control of Viscous Fluid in Boundary Layer Flow

Mehidi Bouam Nadia
Faculté des Sciences Exactes, Laboratoire de Physique Théorique, Université de Béjaia, Algeria

A. Djema
Faculté des Sciences Exactes, Laboratoire de Physique Théorique, Université de Béjaia, Algeria

A. Mehayech
Faculté des Sciences Exactes, Laboratoire de Physique Théorique, Université de Béjaia, Algeria

Z. Haddad
Faculté des Sciences Exactes, Laboratoire de Physique Théorique, Université de Béjaia, Algeria

Abstract:

In this paper, we examine the stability of surface waves propagating on the free surface of Newtonian viscous fluid film flowing down a vertical cylinder. Our interest is with the long-wavelength instability in a two-dimensional gravity-driven flow of an incompressible and axisymmetric flow. The scale conservation equations for momentum and mass for incompressible flow, and the corresponding boundary conditions, are first introduced. We will see that exactly three independent basic parameters appear in the dimensionless equations of the problem; in addition to the radius of curvature, we can also choose the Reynolds number Re and the Weber number We, which respectively give the relative importance of the effects of inertia and surface tension compared with those of viscosity. This study describes an asymptotic approach to controlling the formation of long waves on the surface of a viscous film flowing by gravity on the surface of a vertical cylinder. Control is ensured through the perpendicular injection and suction of fluid through the cylinder wall. We examine in detail the influence of these effects on capillary instability in the case of marginal stability.