

Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Linear and Weakly Nonlinear Analysis of Shear-Induced Stabilization of Rayleigh-Taylor Problem ABDULLAH KEREM UGUZ, RANGA NARAYANAN, University of Florida, Chemical Engineering Department — Shear induced Rayleigh-Taylor instability in an open-channel flow and in a closed container is studied in this paper. It is known that when a liquid is sheared with constant stress, the interface is not flat and the stability limit is decreased. In this study, for both cases, i.e., open channel flow and closed flow, at the base state, a flat interface between the two liquids is satisfied and the stability of this base state to small disturbances is studied via linear stability analysis. In the open channel flow, the critical point remains unchanged compared to the classical Rayleigh-Taylor instability, but the critical point exhibits oscillations and the frequency of these oscillations depends on the wall speed. On the other hand, in a closed geometry, moving the wall stabilizes an otherwise unstable configuration. This result shows the importance of taking the second fluid layer as active, provided a flat interface is an allowable base solution. The physics of the stabilization is explained. A weakly nonlinear analysis is used to study the nature of the bifurcation via dominant balance method and it is concluded that the problem shows a backward pitchfork bifurcation just like the classical Rayleigh-Taylor instability problem.

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Date submitted: 10 Aug 2005

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