Non-Linear Stability of an Electrified Plane Interface in Porous Media

Yusry O. El-Dib and Galal M. Moatimid

Department of Mathematics, Faculty of Education, Ain Shams University, Roxy, Cairo, Egypt

Reprint requests to Dr. G. M. M.; E-mail: galmoa@hotmail.com

Z. Naturforsch. **59a,** 147 – 162 (2004); received August 29, 2003

The non-linear electrohydrodynamic stability of capillary-gravity waves on the interface between two semi-infinite dielectric fluids is investigated. The system is stressed by a vertical electric field in the presence of surface charges. The work examines a few representative porous media configurations. The analysis includes Rayleigh-Taylor and Kelvin-Helmholtz instabilities. The boundary – value problem leads to a non-linear equation governing the surface evolution. Taylor theory is adopted to expand this equation, in the light of multiple scales, in order to obtain a non-linear Schrödinger equation describing the behavior of the perturbed interface. The latter equation, representing the amplitude of the quasi-monochromatic traveling wave, is used to describe the stability criteria. These criteria are discussed both analytically and numerically. In order to identifiy regions of stability and instability, the electric field intensity is plotted versus the wave number. Through a linear stability approach it is found that Darcy's coefficients have a destabilizing influence, while in the non-linear scope these coefficients as well as the electric field intensity play a dual role on the stability.

Key words: Non-linear Stability; Porous Media; Electrified Plane Interface; Multiple Scale Technic.