Labyrinthine Instabilities of Miscible Magnetic Fluids in a Hele-Shaw Cell

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ABSTRACT

This thesis reports the The first completely experimental study on the labyrinthine instabilities at the miscible interface between dense magnetic fluids and less dense diesel oil. The liquids are confined in a Hele-Shaw cell and the magnetic fluid drop maintains a circular geometry initially. Labyrinthine fingering instabilities are trigger by the dipolar forces under an uniform perpendicular magnetic field. The influence of the magnetic field strength、drop diameter and gap width on the induced labyrinthine fingering instabilities are investigated. Two distinct instabilities are observed: (i) the miscible labyrinthine fingers caused by the magnetic dipolar forces; (ii) the primary waves dominated by the third-dimensional effects. Vigorousness of the labyrinthine fingers is confirmed iquantitatively to be affected significantly by a dimensionless magnetic Peclet number quantitatively.The wavelengths of the primary waves can be approximated as 7±1 times of the gap of Hele-Shaw cell, λ～(7±1)h which is consistent with the earlier findings in the viscous fingering instabilities.

Keywords : labyrinthine instability， Hele-Shaw cell，miscible interface，magnetic fluids.

Table of Contents

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