Numerical and Experimental Study of Water Drop Movement Subjected to an Air Stream in Porous Medium

A. Yekta[1], D. Stemmelen[1], S. Leclerc[1]

[1]LEMTA,UMR 7563 CNRS - Université de Lorraine, 54518 VANDOEUVRE-LES-NANCY France

Abstract

Considering a liquid drop in relative movement with respect to the air flow at uniform velocity, the liquid will be driven to the surface by the viscous friction. Internal vortices will appear inside the drop. This problem is already well studied in fluid mechanics and is known as a classic problem. The idea of the present work is to resume the same analysis in a porous medium within an approximately spherical zone of the porous medium saturated with liquid (drop) surrounded by a gas flow.

If Darcy's law (the velocity field simply proportional to the pressure gradient) is assumed to describe the hydrodynamic situation, it can be shown that there would be no internal rotation in the liquid zone and the drop must move somehow by uniform transition.

We have simulated the problem of two-phase flow of a water drop in a porous medium using COMSOL Mutliphysics® [2], [3], where we have validated the obtained results by experimental data obtained from Magnetic Resonance Imaging (MRI) method. The effects of presence of capillary pressure and application of different rules have been studied, Fig. 1.

Reference

1. M.A. Diaz-Viera, D.A. Lopez-Falcon, A. Moctezuma-Berthier, A. Ortiz-Tapia, COMSOL Implementation of a Multiphase Fluid Flow Model in Porous Media, from proceedings of the COMSOL Conference 2007, Boston.

2. Haidong Liu, Prabhamani R. Patil and Uichiro Narusawa, Viscous Flow Between Two Parallel Plates Packed with Regular Square Arrays of Cylinders, Department of Mechanical & Industrial Engineering, Northeastern University, Boston, Massachusetts 02115, U.S.A.

Figures used in the abstract

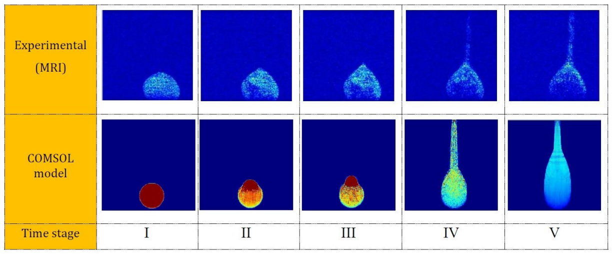

Figure 1: Comparison between experimental data (MRI) and numerical modeling of movement of a water drop (saturated zone) in an air flow through a porous media.