Effects of Gas Trapping on Foam Mobility in a Model Fracture

K. Li [1]

W.R. Rossen[1]

K.H.A.A. Wolf [1]

[1] Technology University of Delft, the Netherlands

E-mail: K.Li-2@tudelft.nl

ABSTRACT

A microfluidic device is one of the most stimulating research tools for foam studies, because it provides the opportunity to visualize foam behaviour directly[1]. In this study, we employ a model similar to microfluidics, directly applicable to flow in geological fractures. The 1-meter-long model represents a fracture channel with one roughened and one smooth wall. It has a width of 15 cm and a hydraulic aperture of 128 µm. The model is made of glass plates and enables direct investigation of foam flow (Figure 1) through the channel using a high-speed camera. We conducted a series of foam experiments in the model. Local equilibrium between processes of foam creation and destruction is reached within our long model. We study the dynamics of gas trapping at different velocities and gas fractional flows. We observe that velocity affects the fraction of gas which is trapped in the model at low foam qualities. Gas trapping lessens and foam mobility increases as superficial velocity increases. This contributes to the shear-thinning mobility of the foam. At high foam qualities, the relation between trapped gas and foam mobility is weaker: gas trapping is insignificant and has little effect on foam mobility. When gas fractional flow increases at high foam qualities, flow alternates between slugs of gas and foam.

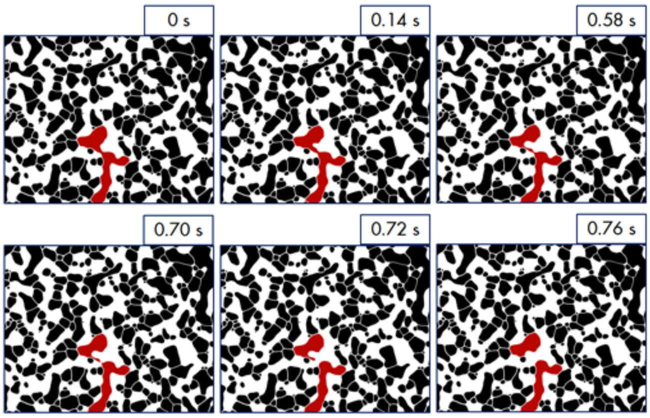

Figure 1: Foam generation by snap-off: liquid in white, gas in black, with the snap-off process highlighted in red (image size: 1.95 x1.56 cm).

[1]. J. Marchalot, J. Lambert, I. Cantat, P. Tabeling and M.C. Jullien. EPL (Europhysics Letters), 83(6), 64006, 2008.