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Iinvestigation of Foam Development in Porous Media Using X-Ray Computed Tomography

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The development of foam when mixtures of gas (N2 or Xenon)-surfactant (sodium dodecyl sulfate) solutions flow in a granular porous media (diameter = 4.5 cm, length = 18 cm) containing a surfactant solution has been investigated with the aid of X-ray computed tomography (CT). The evolution of the fluid distribution is presented. Liquid fractions determined from the CT images are presented. The liquid fraction profiles exhibit essentially a similar trend: (1) a low (less than 55%) upstream liquid saturation, (2) a high (100%) downstream liquid saturation, and finally (3) a transition zone where the liquid saturation increases smooth and rapidly towards the downstream. Within the upstream region the liquid saturation declines gradually from the inlet. For example, at t = 0.61 (dimensionless time) the liquid fraction decreases by almost 10% from the inlet to the position at 7.5 cm. The further decrease of the liquid fraction (secondary desaturation) manifests itself more clearly after the leading edge of the foam displacement front reaches the outlet of the porous medium. At a fixed position, for example at 12.0 cm, the saturation decreases over time, from about 38% to less than 18%. Even at the position 2.0 cm, where the steady state profile indicates that much liquid still remains in the core, the liquid saturation decreases from 55% to 48%. An interpretation of these observations is developed based on novel ideas about foam rheology.

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