MICROGRAVITY SCIENCES AND PROCESSES (A2)
Science Results from Ground Based Research (4)

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FLUSHING OUT ENTRAPPED VISCOUS FLUID FROM POROUS MEDIUM

Abstract

Porous materials are widely used in microgravity for fluid transport, because capillary forces arising on phase interfaces serve actual driving forces in the absence of other mass forces. These principles were used successfully for collecting residual fuel from the tanks in microgravity, for transporting fluid in heat exchangers and for delivering water to the roots of plants in hydroponics. Flows in heat exchange reactors could be described using the methodology of two-phase fluids flow in porous environment. The problem is also relevant to underground seepage of viscous fluids – non-aqueous phase liquid contaminants, for example. In frontal displacement of a more viscous fluid by a less viscous one Saffman – Taylor instability of the interface could result in formation of "fingers" of displacing fluid penetrating the bulk of the displaced one. The growth of fingers and their further coalescence could not be described by a linear analysis. Growth of fingers causes irregularity of the mixing zone thus affecting the displacement quality and heat exchange forecasts. Numerical investigations of the instability in displacement of viscous fluid by a less viscous one in a two-dimensional and three-dimensional geometry were carried out and analyzed before. However, an important problem is flushing out of viscous fluid entrapped in porous medium. The problem is relevant to underground removal of liquid contaminants and to secondary extraction of entrapped oil from host rock formations. The present paper provides an approach to investigating this problem and developing optimal strategies for flushing out entrapped viscous fluid from porous media.
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