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MICROGRAVITY INVESTIGATION OF CAPILLARY DRIVEN SEEPAGE FLOWS IN ARTIFICIAL POROUS MEDIA AND NATURAL SANDS

Abstract

This paper considers two types of experiments in microgravity (I. Imbibition of a porous medium during parabolic flights of an Airbus A300-ZeroG aircraft organized by the European Space Agency; II. Imbibition of a porous medium on the Discovery STS-91 orbiter conducted within the framework of the MIRROR GAS program) A description of the features of the experiments is given, mathematical models and numerical algorithms are proposed for modeling such processes. Numerical simulation results are compared with experimental data. Validation of mathematical models and numerical codes is carried out on an experimental basis.

In experiments during parabolic flights, multiple imbibition of an artificial highly permeable porous medium under the action of capillary forces is investigated. The drainage regime is several times replaced by the imbibition regime due to the alternation of periods of microgravity with periods of hypergravity. Experiments have shown that fluid flows better through an already wetted medium: it rises higher with each subsequent parabola. For mathematical modeling of such a process it is necessary to take into account the effect of hysteresis. The paper describes such mathematical models, as well as the peculiarities of processing experimental data.

In experiments on the Earth orbit, a natural porous medium (quartz sand - 80Thus, the importance of conducting experiments in microgravity conditions is shown, since in experiments in Earth conditions, gravity prevails over capillary forces and masks important mechanical aspects of the imbibition process under the influence of capillary effects. The possibility of determining the unknown empirical constants of the mathematical model on the experimental basis is shown.

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