IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Fluid and Materials Sciences (2)

Author: Mrs. Lusine Paremskaia
Lomonosov Moscow State University, Russian Federation

Ms. Evgeniya Skryleva
Lomonosov Moscow State University, Russian Federation
Ms. Elena Mikhalchenko
Scientific Research Institute for System Analysis, Russian Academy of Sciences (RAS), Russian Federation

CONCENTRATION-CAPILLARY MECHANISM IN A MULTIPHASE FLOW UNDER MICROGRAVITY CONDITIONS

Abstract

It has been well studied that it is capillary forces that can become the main source of fluid movement when the level of gravity decreases. Experiments in orbital flight conditions confirm this hypothesis regarding thermo-capillary effects caused by changes in fluid temperature. Less studied is the role of the concentration-capillary mechanism in the development of mass transfer in a liquid, the source of which is also the spatial heterogeneity of surface tension. This causes it to move in the direction of increasing surface tension. The surface carries with it the layers of liquid adjacent to it. As a result, if the free surface belongs to a bubble, then it begins to be displaced in the direction opposite to the flow of liquid. This ability of gas bubbles to spontaneously move in a liquid in the direction of decreasing surface tension is called capillary drift. The study of a multiphase flow in a plane-parallel microchannel under microgravity conditions was carried out. The Hele-Shaw cell, which is a thin channel between two parallel planes, was chosen as a model for this channel. Channel geometry, fluids, and conditions were selected based on analysis for application in fluid management in space. Features of gas injection were selected taking into account the required pressure gradient, injection frequency and costs. Mathematical models describing such a process are proposed. The results of numerical simulation are compared with experimental data. The investigations were performed using the facilities of National Research Centre "Kurchatov Institute" Federal Science Centre "Scientific Research Institute for System Analysis of the Russian Academy of Sciences" and supported by the state task No. 1023032900401-5-1.2.1 (FNEF-2024- 0002) on the topic "Mathematical modeling of multi-scale dynamic processes and virtual environment systems"