Paper ID: 16284
oral

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

Author: Prof. Antonio Viviani
Seconda Universita' di Napoli, Italy, antonio.viviani@unina2.it

Dr. M. O. Denisova
Institute of Continuous Media Mechanics, Russian Academy of Sciences (RAS), Russian Federation, denisova@icmm.ru
Dr. K.G. Kostarev
Institute of Continuous Media Mechanics, Russian Academy of Sciences (RAS), Russian Federation, kostarev@icmm.ru
Dr. A. V. Shmyrov
Institute of Continuous Media Mechanics, Russian Academy of Sciences (RAS), Russian Federation, shmyrov@icmm.ru
Prof. Andrew Zuev
Institute of Continuous Media Mechanics, Russian Academy of Sciences (RAS), Russian Federation, zal@icmm.ru

SURFACTANT TRANSPORT INTO THE DROP UNDER CONDITIONS OF WEAK GRAVITATIONAL CONVECTION

Abstract

The paper presents the results of experimental study of mass transfer between the drop of initially homogeneous insoluble fluid and aqueous solution of a surface-active agent (surfactant). The research has been carried out in the framework of terrestrial modeling of the space experiment "Diffusion of a surfactant into a drop" scheduled for implementation on board the spacecraft Foton-M4 in autumn 2013. In the laboratory experiments a chlorobenzene drop, having the form of a short cylinder with flat ends and free lateral surface, was placed in a thin horizontal liquid layer filling a Hele-Shaw cell, which allowed us to maximally suppress the effect of the gravitational convection and thus to model the microgravity conditions. The flow structures and surfactant concentration fields inside and outside the drop during its saturation by the surfactant (isopropyl alcohol) were visualized using the interferometric technique. The research shows that under the terrestrial conditions even at a weak gravitational convection the penetration of the surfactant into the drop is a rather complicated process specified by the initial surfactant concentration in the solution and by the degree of the solution inhomogeneity. Diffusion of the surfactant into the drop gives rise to local concentration and surface tension variations along the drop interface, which results in the development of a large-scale three-dimensional convective motion of gravitational and solutocapillary nature inside and around the drop. When the initial surfactant concentration 0 of the solution exceeds 30one and becomes a dominant flow pattern both in the drop and in the layer. At 0 = 50phase boundary between the drop and the solution disappears due to an increase in the mutual solubility of the basic fluids. As a result a three-component liquid mixture is formed. The work was supported by Russian Academy of Sciences program 12--1-1008, Russian Foundation for Basic Research project . 10-01-96028 and grant for International Research Teams of Ministry of Education and Science of Perm Region -26/210.