MICROGRAVITY SCIENCES AND PROCESSES (A2)
Microgravity Sciences onboard the International Space Station and Beyond (6)

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STUDY OF HEAT TRANSFER ENHANCEMENT BY VIBRATIONS IN THE MICROGRAVITY EXPERIMENTS

Abstract

Vibrational convection refers to the specific flows that appear when a fluid with density gradient is subjected to external vibration. The density gradient may result from the inhomogeneity of temperature or composition. The case of small amplitude and high frequency vibration (when the period is much smaller than the characteristic viscous and heat (mass) diffusion times) is of special interest. In this case, the flow field can be represented as a superposition of 'quick' part, which oscillates with the frequency of vibration, and 'slow' time–average part (mean flow), which describes the non–linear response of the fluid to a periodic excitation. This effect is more pronounced in the absence of other external forces (in particular, static gravity).

The study of vibrational impact on fluids has fundamental and applied importance. Vibrational convection provides a mechanism of heat and mass transfer due to the existence of mean flows. In weightlessness, it is an additional way of transporting heat and matter similar to thermo- and solutocapillary convection. Mean flows show some similarity with gravity-induced convection and might serve as a way to control and operate fluids in space.

Heat transfer and convective pattern flows created by vibrations have been extensively studied in the experiment IVIDIL onboard of International Space Station and in Parabolic flights. The experimental techniques of IVIDIL and in parabolic flights were somewhat similar. However the governing parameters which describe convection are different. On one hand the level of microgravity better on the ISS and duration of microgravity is longer. On the other hand the level of vibrational energy applied to the test liquid is much weaker on the ISS than in the parabolic flight experiments. These limitations are imposed by safety. We combine and compare results from both space platform keeping accent on the results from the of the ISS experiments.