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THERMAL VIBRATIONAL CONVECTION IN A PLANE LAYER EXCITED BY ROTATING FORCE FIELD

Abstract

The excitation of thermal vibrational convection in a nonisothermal liquid takes place under the action of oscillating force fields [1]. This convective mechanism is of particular interest under microgravity conditions. The work is devoted to an experimental study of thermal convection in a plane layer with boundaries of different temperatures excited by an inertial force field rotating in the plane of the layer. The field is created by circular translational vibrations of the layer. In case of rotating field, the thermal vibrational mechanism acquires some specific features [2]. Experiments are performed in the gravity field, so that thermal convection along with the vibrational mechanism is determined by the classical gravitational convective mechanism. The layer is horizontal, and depending on whether the upper or lower boundary of the layer has a higher temperature, the gravity field has a stabilizing or destabilizing effect. In experiments, the temperature difference of the layer boundaries, its thickness, fluid properties, as well as the amplitude and frequency of vibrations vary.

Studies have shown that vibrations cause a threshold excitation of thermovibrational convection, even in a layer heated from above, when the gravity field has a stabilizing effect. The excitation of convection is accompanied by a threshold increase in heat transfer. When the layer is heated from below (at positive Rayleigh number), vibrations results in a decrease in the threshold of gravitational convection excitation. The experimentally found boundary of fluid quasiequilibrium in the plane of the control parameters, the gravitational and vibrational Rayleigh numbers, is in satisfactory agreement with the theoretical one [2].

The effect on convection of another complicating factor, the rotation of the layer in its plane, was investigated. It is found that the rotation has a stabilizing effect on both convective mechanisms, the stability curve rises on the plane of the control parameters. In this case, the ratio of the velocities of rotation of the cavity and the force field plays an important role.

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References

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