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CONVECTION OF LIQUID WITH INTERNAL HEAT RELEASE IN A ROTATING CONTAINER

Abstract

Thermal convection of liquid with internal heat release in rotating horizontal cylinder with isothermal boundaries is studied experimentally. The study follows the experiments [1]. The convective flows are generated by thermovibrational convection mechanism [2, 3] due to the external force field (the gravity one) rotating in the cavity frame. It is shown that the effect of relatively quickly rotating force field on the nonisothermal liquid is characterized by a vibrational number and results in excitation of the averaged convective flows. The convection is also controlled by the Coriolis force and the centrifugal one (the last plays a stabilizing role in our problem). The effect of inertia forces is determined by dimensionless rotation velocity and centrifugal Rayleigh number. The threshold of convective flows excitation and heat transfer in wide range variation of mentioned dimensionless parameters are investigated. The results of experiments with different volumetric power of heat release, liquid viscosity, rotation velocity, cavity diameter and its relative length are summarized and analyzed. In case of rapid rotation the temperature distribution is practically axisymmetric and has a maximum at the cavity axis. The heat transfer in this case is only slightly different from the molecular one. The intensive convection arises in a threshold way with decrease of rotation velocity. The threshold of convection excitation and the structure of the flow depend on the dimensionless rotation velocity. For its large values the flow looks like a system of longitudinal rolls and the threshold does not depend on the dimensionless rotation velocity. At low frequency the threshold grows with frequency and the flows look like the vortex cells periodically arranged along the axis.

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Bibliography

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