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AVERAGED CONVECTION OF A VISCOUS FLUID IN A ROTATING HORIZONTAL ANNULUS

Abstract

The threshold excitation of thermal vibrational convection [1] in horizontal rotating cylindrical layer of a low-viscous liquid was found and experimentally studied in [2]. Convective flows have the shape of rolls extending along the axis of rotation (two-dimensional flow). The characteristic size of the structure exceeds the thickness of the layer several times. When reducing the speed of rotation the toroidal vortex structures (three-dimensional flow) develop in a threshold way. The threshold of convection excitation is characterized by centrifugal Rayleigh number and modified vibration parameter [1]. The dimensionless speed of rotation which characterizes the effect of the Coriolis force plays an important role in the averaged convection [3]. In present paper the influence of this parameter on the threshold of thermal vibrational convection and heat transfer is investigated. It is found that the threshold curve (vibration parameter versus the dimensionless rotation speed) is U-shaped. The right branch (high frequency domain) is characterized by the separation of the thresholds of two-dimensional structures and three-dimensional ones. At left (low frequency) region both instability modes, toroidal vortices and longitudinal rolls, occur simultaneously. With the appearance and development of convective structures their azimuth drift relative to the cavity is registered. The dependence of the drift velocity on the dimensionless rotation velocity, speed of the cavity rotation and the temperature difference between the layer boundaries is studied.
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