ONSET OF CONVECTION IN A ROTATING FLUID WITH VARIABLE VISCOSITY

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ABSTRACT

The problem of rotating natural convective flow about the vertical axis with variable viscosity confined between two horizontal plates is investigated by linear stability analysis. The transformed governing equations are numerically solved by using the Galerkin method. The computed results are compared for special cases with those results of earlier researchers (Chandrasekhar [1] and Stengel et al., [12]) and are found to be in excellent agreement. We have studied both stationary convection and oscillatory convection. The threshold values of Rayleigh number and wave number are computed and presented for various boundary conditions viz. rigid-rigid, rigid-free, free-rigid and free-free and for different values of physical parameters viz., Taylor number Ta, viscosity ratio c and Prandtl number Pr. For rigid-rigid boundary conditions we have studied the effect of c, Ta and Pr on the vertical velocity and temperature eigenfunctions at the onset. It is observed that the rotation rate stabilizes the dynamical system. The occurrence of co-dimension two bifurcation point (CTP) is shown for various boundary conditions.

KEYWORDS: Variable viscosity, Coriolis force, Exponential fluid, Galerkin method.