PHYSICS AND ASTRONOMY

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ABSTRACTS

Nonisothermal, Convecting Liquid States. Marshall P. Cady Jr., Department of Natural Sciences, Indiana University Southeast, New Albany, Indiana 47150.——A horizontal parallel plate glass cell sandwiched between two heat baths has been used to evaluate the critical Rayleigh numbers for transitions between discrete convection states. The convection states are established by heating the water containing cell with the lower of the heat baths and cooling with the upper heat bath. This results in a liquid layer which is unstable to convective motion, provided the resulting buoyant force exceeds the viscous dissipation force. The parameter describing the relative magnitudes of these forces is the dimensionless Rayleigh number defined by

$$R = (g \propto d^2 C L^3 / k_\eta) \Delta T$$

where L is the cell height (1.440 cm) and ΔT is the temperature difference between the upper and lower cell boundaries. A dual Savart plate interferometer with a 632.8 nm helium-neon laser light source is used to monitor both vertical temperature distributions within the cell and fluid motion.

The first, third, and fourth critical Rayleigh numbers have been successfully determined by analyzing the interferometer fringe patterns for R values between 9,200 and 720,000 at room temperature. Since R_I characterizes the transition fron nonconvection to the simplest time-independent convection, it was determined by evaluating the intercept of the observed temperature gradient at cell center with the gradient expected for pure heat conduction only. We find that

$$R_I = 1667 \pm 137.$$

This is in good agreement with the theoretical value of 1708.

R_{III} characterizes the transition from steady state convection to time-dependent convection. However, the amplitude of the time dependency of the fringe proved to be too small to analyze with a photocell so a sudden increase in the standard deviation of the temperature gradient with R was used to evaluate R_{III}. It is found that

$$R_{III} = 3.30 \times 10^4 \pm 12\%.$$

The transition R_{IV} from low amplitude time-dependent convection to high amplitude time-dependent convection was determined by photocell evaluation of the rate of fringe fluctuations verses R and extrapolation to a rate equal to zero. We find that

$$R_{IV} = 4.42 \times 10^4 \pm 14\%.$$

It proved to be impossible to evaluate the transition from two-dimensional steady convection to three-dimensional steady convection, R_{II}, with a Bryngdahl interferometer. Furthermore, the transition from time-dependent to turbulent convection was coarsely evaluated by visual inspection of fringe as $R_V = 5x10^5$.

Viscosity Determination of Newtonian and Non-Newtonian Fluids. ROBERT H. L. HOWE, Eli Lilly Company, Lafayette, Indiana 47906, and DAVID J. HOWE, Esmark Corporation, Columbia, Missouri 65201.——The procedure for determining the viscosity of a heavy bio-oxidation substrate is presented. The mathematical relationship of the viscosity and the rotational speed is derived. Some experimental data are illustrated.