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OSCILLATING GRID TURBULENCE

Xu Shu ZHANG and B.R. MORTON

Geophysical Fluid Dynamics Laboratory
Monash University, Clayton, Vic. 3168
AUSTRALIA

ABSTRACT

A grid of rectangular mesh oscillated sinusoidally in a direction normal to its mean plane generates a band of disturbance flow which will be turbulent at sufficiently large Reynolds numbers and laminar-periodic at small Reynolds numbers. Oscillating grid turbulence generated in this way has been used by a number of authors to determine as a function of Richardson number the rate of turbulent entrainment or mixing across a density step produced either by a change in temperature or a change in salinity. The present study is concerned rather with the actual mechanisms of entrainment and set out to investigate in greater detail the passage of fluid across the mean interface separating rotational and irrotational flow from the unstirred to the stirred side. As the intensity of the turbulence is presumably gained by breakdown of vortex sheets generated at the oscillating (and therefore accelerating) grid, and initial series of experiments has been carried out at lower Reynolds numbers at which the structure of motion can more easily be visualized. It will be shown that very little motion is induced ahead of an advancing grid; whereas behind it the region is divided into a two-dimensional honeycomb of forward wake flow behind the bars and reversed flow behind the apertures. Techniques of image analysis have been used to measure the rate at which a stirred layer thickens at low Reynolds number and therefore the rate of entrainment, and to find the effect of bar shape and grid to aperture ratio to provide a basis both for selection of grids and for an empirical model of the laminar-periodic motion. These experiments are being extended also to higher Reynolds numbers to provide information on the turbulence generated as a function of grid geometry and grid motion. The entrainment process will be illustrated as one in which gulps of irrotational fluid are rolled across the interface on a scale comparable to that of energetic scales of turbulent motion near the interface and those gulps can be followed for some distance from the mean interface. It may be argued that the actual process of entrainment is inertial and therefore driven by local pressure gradients.

NOTE: This paper was unavailable at press time. This abstract was prepared by the Organizing Committee. Unbounded copies of the paper may be obtained from the author(s).