SHEAR EFFECTS ON A HEATED SALINE CURRENT IN AN ESTUARY

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When cold, fresh water meets warm, salty water, mixing at the front is controlled by double diffusion and shear. An example of double diffusive favorable interfacial mixing was observed in the Saemangeum Estuary in winter of 2002 and 2003. The present work investigated main two points. First, the dependence of the bulk mixing rate on the density ratio is investigated. Second, eddy diffusivity in the mixing layer is studied. The estimated diffusivity ratio must differ from that in "run-down" salt finger laboratory experiments, which did not include turbulence and shear effects.

Two parameters determine the stability of the flow. The density ratio ($R_\rho = \alpha\Delta T / \beta\Delta S$) is assessed to determine salt finger effects on the interfacial mixing, where ΔT and ΔS are differences in temperature and salinity and α and β are the coefficients of thermal expansion and haline contraction. Shear effects are considered. The relative strength of shear is measured by the Richardson number ($Ri = N^2 / S^2$), where S is mean velocity gradient and N is the buoyancy frequency.

When the relative strength of shear to buoyancy is assessed by the Richardson number, the shear effects for fixed density ratio are studied. When density ratio is smaller than 1, flow should be unstable. However, just after the outlet, the unstable flow mixed and became baroclinically stable; from this mixed flow, an intrusion was produced. As expected in this condition, the mixing rate (q/UH) is very sensitive to the shear effects (Fig. 1). As shear increases, the bulk mixing rate becomes larger.

When turbulence strongly inhibits fingers from growing, the Osborn-Cox model is considered to estimate the ratio of eddy diffusivity. Eddy diffusivities of salt and heat are estimated from the mean gradient and dissipation rate of salt and heat variance. The estimation found that eddy diffusivity of temperature is larger than that of salinity. Eddy diffusivity or flux ratio is similar to diffusively stable flow, not to salt finger. The present work estimates only maximum possible ratio of diffusivities or fluxes of salt and heat. Therefore, the presented results overestimate eddy diffusivity of salinity. If we measure scalar fluxes more accurately, then ratio could be smaller than the presented value.

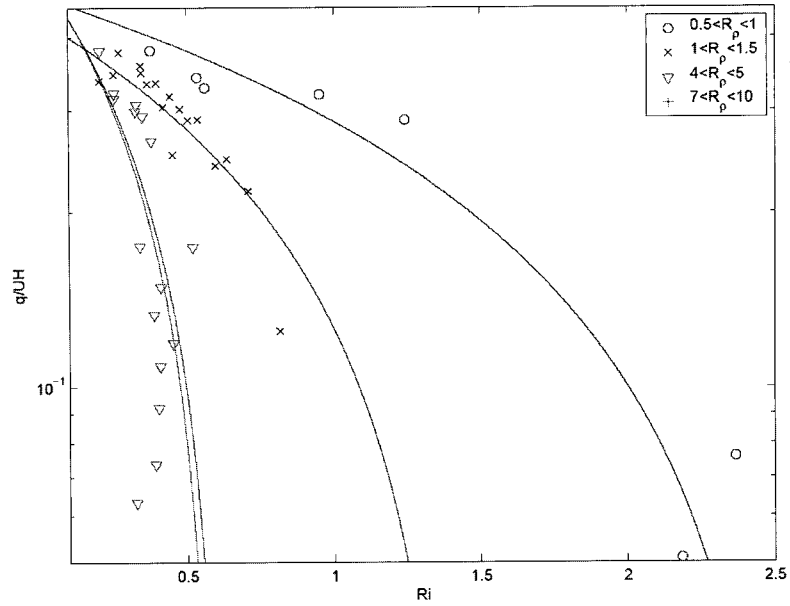

Fig. 1 Bulk mixing rate depending on the Richardson number in the various salt finger favorable conditions

REFERENCES

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