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Flow visualization of pollutant mixing in freshwater body near the density maximum

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Mixing in water bodies forms a major part of the environmental hydraulic studies. In the present study, effects of density variations in freshwater manifested in the form of convection currents on the water quality parameters is studied. Convection forms a dominant mixing mechanism for near-stagnant lakes i.e., with high residence times. However, due to tedious computations involved in simulating natural convection, water quality models available commercially or open-source solve vertically hydrostatic equations which fail to capture the circulation currents. A hydrodynamic model is conceptualized for describing the setting up of vertical circulation currents driven by the buoyancy. 2D incompressible Navier-Stokes, plus equations for transport of scalars (heat and concentration) are formulated and solved. Concentration profile of a conservative parameter is simulated to study the anomaly in temperature-density relationship on mixing. Density is assumed to be a function of temperature only (at 0.1Mpa) and various formulations like linear, quadratic and IAWPS (The International Association for the Properties of Water and Steam) are used in the model. The phenomenon is investigated near 4°C i.e., at the anomalous behavior of temperature-density curve. Impact of this anomaly on the hydrodynamics and subsequently on the mixing of water quality parameter is studied and visualized to facilitate interpretation and use. Modeling and simulation results for the hydrodynamics are validated against reported work.

Biography

Tapas Nandy is Chief Scientist and Head of Waste Water Technology Division at CSIR-NEERI, Nagpur. He has extensive experience of 30 years in research and development in the field of wastewater treatment and water resources management. He has published more than 50 papers in reputed research journals and 5 patents in his credit. He has vast experience in implementation of full scale technologies for wastewater treatment and water recovery.

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