NUMERICAL SIMULATION OF REMOVAL OF TRAPPED SALTWATER FROM A BAR BLOCKED ESTUARY

MANASA RANJAN BEHERA[1] and MURALI. K[2]

[1]Research Scholar, Department of Ocean Engineering,
Indian Institute of Technology Madras, Chennai 600036, INDIA.
(Tel: +91-44-22578627, Fax: +91-44-22578627; e-mail: behera_iitm@yahoo.co.in)
[2]Assistant Professor, Department of Ocean Engineering,
Indian Institute of Technology Madras, Chennai 600036, INDIA.
(Tel: +91-44-22578627, Fax: +91-44-22578627; e-mail: murali@iitm.ac.in)

The interaction of continuous freshwater flow from upstream watershed into a bar-blocked estuary is investigated using Computational Fluid Dynamics (CFD). The trapped water in the blocked estuary is gradually displaced by the freshwater inflow. The interface point, defined as the point of confluence between the initial saltwater wedge and the freshwater, is considered to be characteristic of the interaction between the water bodies and the same has been investigated. The effect of slope of the estuary (α), length of the estuary (L), density difference between the freshwater and the saltwater ($\Delta\rho$) and the incoming freshwater discharge (Q) on the wedge movement are considered and investigated.

In this paper, the effect of continuous flow is considered for comparison of numerical results with the experimental results of Coates and Guo (2003). The removal of saltwater by freshwater inflow is achieved through a process of conversion of kinetic energy to potential energy (Debler and Armfield, 1997, Debler and Imberger, 1996). In this study, the experimental setup used by Coates and Guo (2003) is considered for the purpose of modeling the freshwater saltwater interaction process using CFD. A schematic of the numerical model is shown in Fig.1. A comprehensive numerical study is presented in this paper on the dynamics of the wedge formed by interaction of freshwater and saltwater in a bar blocked estuary. The numerical model has been compared with the experimental results reported in the literature for the purpose of validation. The numerical results have shown satisfactory comparison with the experimental results available in the literature. Hence utility of the numerical modeling is demonstrated. A more suitable analytical model that compares well with the past data, to predict the displacement x_w of the salt wedge nose in time t, is reported in the previous work of the author (Behera and Murali, Communicated) based on the principle of conservation of energy. The numerical results are compared with the analytical model (Fig.2).

In addition the numerical experiments have shown that the incoming discharge level, the bed slope, the density excess, and the length have greater influence on the wedge displacement. However, the analytical relationship includes all these parameters and can be used as a general purpose predictive tool.

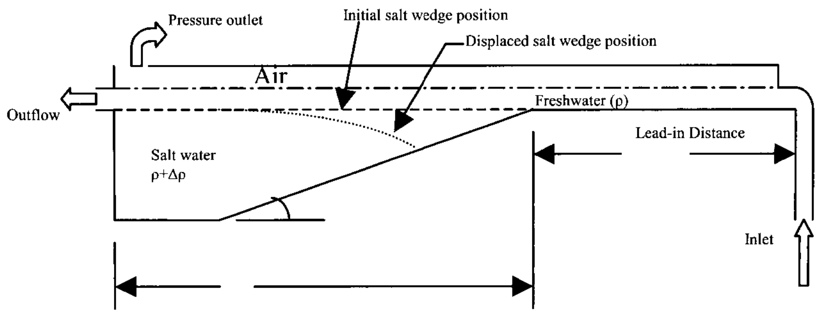

Fig. 1 Schematic diagram of the numerical model (not to scale)

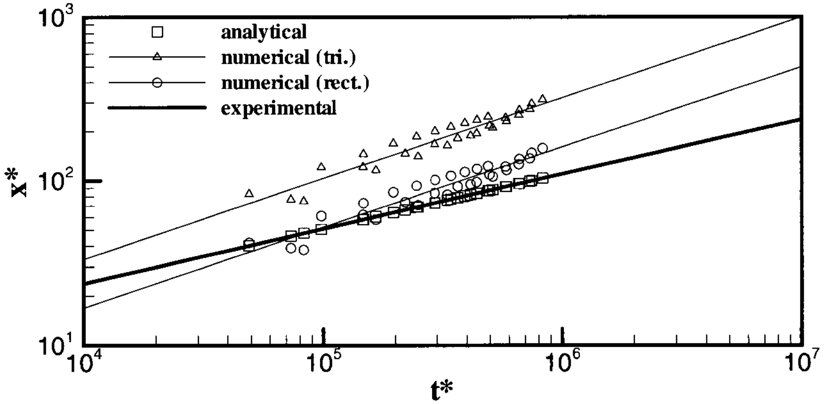

Fig. 2 comparison between analytical, numerical and experimental results

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