PERFORMANCE OF CORMIX MODEL APPLIED TO DENSE JET FLOW

A. ETEMAD-SHAHIDI[1] and A.H.AZIMI[2]

[1]Assistant Professor, College of Civil Eng., Iran Uni. of Sci. & Tech.,
Tehran, Iran, P.O.Box 16675-163
(Tel: +98-21-7896623, Fax: +98-21-7454053, e-mail: etemad@iust.ac.ir)
[2]Research Associate, College of Civil Eng., Iran Uni. of Sci. & Tech.,
Tehran, Iran, P.O.Box 16675-163
(Tel: +98-21-7896623, Fax: +98-21-7454053, e-mail: a_h_azimi@iust.ac.ir)

In this paper a numerical study for determining the multi-port diffuser design of a dense jet flow is described. In some cases, it is necessary to dispose wastewater that has a higher density than the water into which it is discharged. Industrial effluents are often more dense than the receiving water. Therefore, efficient and effective method of mixing can be obtained by discharging it upwards as a high velocity turbulent jet. Examples include industrial discharges into marine or estuarine environments such as salt water from desalination plants, (Pincince and List, 1973). The behavior of plume trajectory and its dilution are commonly studied with physical models and laboratory experiments. In the presence of computer technology, simulation of discharged flow and their corresponding parameters results in saving in time and expenses compared to using laboratory and field experiments. Numerical models such as CORMIX are firmly established as a common tool to simulate the plume behavior. Initial dilution obtained from laboratory experiments in the buoyancy dominated near field (BDNF) and buoyancy dominated far field (BDFF) have been extensively verified and compared with numerical simulation models (Tsanis et al., 1994).

A series of experiments are conducted for simulation of a dense mixture of gypsum, which is discharged into the Indian Ocean at Richards Bay, South Africa (Roberts and Toms, 1987). In these experiments, the nozzles discharged the effluent inclined upwards at 60°. Most tests were of the inclined jets for which the angle of the crossflow to the vertical plane through the jet (ϕ) was 0° (jet opposing the crossflow), 30°, 60°, 90°, 120°, 150°, and 180° (coflowing).

27 test cases where the nozzle discharged the effluent inclined upwards at 60° were simulated with CORMIX model. Effluent was discharged in a uniform density water column and ambient current affected the discharged plume in these cases.

Comparison between measured and predicted dilutions in both ϕ=60° and ϕ=30° classes shows that CORMIX model performs well but, the model is overestimating the dilution. In these conditions, the average estimations error is 26.6% and 50.7%, respectively. When the jet is counterflow (ϕ=0°) CORMIX overpredicted the dilution. In this regime the average error of estimation is +38.7% (standard deviation is 9.2%). The CORMIX relative error for different cases is illustrated in Fig. 1.

As shown in this figure, the maximum error of estimation for all prediction is within ±50% that shows CORMIX is able to simulate the dilution of dense jet flows. Fig. 1 indicates that, when the angle of the crossflow to the vertical plane is 90°, 120° and150°, CORMIX results are accurate and the average error of prediction is less than 20%. CORMIX results are not reliable when the angle of the crossflow to the vertical plane is 30°. When ϕ=60° or ϕ=180° the results have good correlation with the observation but have less accuracy.

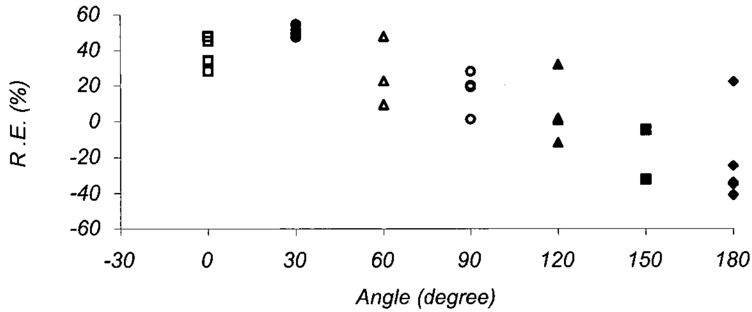

Fig. 1 The CORMIX relative error for different horizontal angle. The angle of the crossflow to the vertical plane for solid diamonds (♦) is 180°, solid three angles (▲) is 150°, solid rectangles (■) is 120°, diamonds (◊) is 90°, circles (O) is 60°, three angles (Δ) is 30° and rectangle (□) is 0°

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