Numerical calculation of flow field and SS concentration for a full-scale rectangular clarifier

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Extended Abstract

Numerical study has been performed to figure out the flow characteristics and concentration distribution of a large –scale rectangular final clarifier in wastewater treatment facility located in Suyoung final clarifier in Busan, Korea. The final clarifier is modeled by 2-dimensional rectangular coordinate by the approximation of 3-D features of inlet and weir part in the clarifier. Special emphasis is given on the prediction of the removal efficiency of suspended solid (SS) together with the visualization of the calculated flow pattern in the clarifier.

Most numerical research efforts of this area appeared in open literature have been restricted to primary clarifiers with discrete particle suspensions at relatively low concentrations operating in a neutral density environment. But the model developed in this study is able to predict the behavior of the sediment induced density currents.

A control-volume based-finite difference method by Partankar is employed together with the SIMPLEC algorithm for the resolution of pressure-velocity coupling. The k- ε turbulence is incorporated for the evaluation of Reynolds stresses. Further a number of empirical formulas are considered for the modeling of SS and calculation of its induced density effect.

The computer program is evaluated against experimental data by the method of radiotracer, which is known as one of the robust visualization techniques in a full-scale flow field study. Comparison is successfully made on the calculated residence time distribution (RTD) curves with measurement inside the clarifier as well as the exhaust. In detail, RTD profiles are generally in a good agreement with the experimental RTD curves at the upstream and center section but a visible difference is observed at the location of discharged weirs. This is partly caused by the radiotracer detection made away from the calculated middle centerline in a clarifier because of the existence of a moving scrapper at that location. Another reason is the limit of present 2-D model to describe the complicated 3-D feature of weirs.

Further the calculation results predict well the well-known flow pattern such as the waterfall phenomenon at the front end of the clarifier, the bottom density current in the settling zone and the upward flow in the withdrawal zone, which are caused by the density effect by suspended solid.

Thus it is believed that the program developed in this study shows the possibility as a viable tool to assist in the design and determination of optimal operating condition of a final clarifier. But the quantitative evaluation of 3-D configuration of the weir will be one of the major research topics in near future.

Keyword: *Radiotracer, Wastewater treatment, Residence time distribution curves, Waterfall phenomenon, Density-induced flow, Clarifier, Suspended solid*