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An investigation on initial dilution of thermal wastewater discharges into shallow receiving waters with 60° inclination

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ABSTRACT

In this study, effects of shallow water depths on initial dilution levels of heated water discharge from thermal effluent outfalls concerning water surface boundary effects using an inclined circular port were investigated. Receiving water environment was selected as stagnant and uniform characteristics. The inclination angle of discharge port was θ = 60°. Normalized port depths, H/dF, which was obtained from water depth (H) over port diameter (d) multiplied by densimetric Froude number (F) of jet defined as dF, were calculated for experimental set-ups. H/dF values were 3.871, 1.545, 1.160, 0.774, and 0.388 from deep to shallower depths, respectively. Rhodamine B was used as tracer of experiments. Normalized forms of impingement point horizontal distance values, x_i/dF, and vertical distance values, y_i/dF were decreased according to decreased water depths, H/dF. According to obtained results of this study, jet impingements occurred in the upper boundary of the receiving water body and they got closer to the nozzle when H/dF values decreased. In addition, the decreasing H/dF values caused a decrease in dilutions of horizontal distances for both complete jet centerlines (especially impact points compared to experimental) and VP estimates of free jet conditions. According to this study, VP dilution estimations were found very close to experimental impingement point dilutions no matter how VP software originally designed for only free jet conditions. This study suggests VP UM3 model can calculate realistic and conservative jet centerline dilutions at the impingement point in very limited depths in the range of normalized water depth ratio H/dF between 0.388 and 1.545.

Keywords: Thermal outfall; Visual plumes; Positively buoyant jet; Initial dilution; Restricted discharge depth; Impact point dilution; Nozzle inclination

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