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Investigation of horizontal cold water discharge initial dilutions at various temperature differences using duckbill valve

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ABSTRACT

Thermal pollution, that is a temperature change in natural water body, can have adverse effects on the organisms in the aquatic environment as river, lake, or ocean. A common cause of thermal pollution is the use of water as a cooling and heating system by power plants, liquefied natural gas (LNG) regasification terminals, and industrial manufacturers. Cold water discharges into a receiving water body, which are mainly originated from LNG regasification terminals from open cycle heating units, are a kind of thermal effluent. Disposal of cold water with an environmentally protective way can be applied as a dilution method using marine outfall systems. In order to obtain a better dilution in a marine outfall, there is a multiport diffuser at the end of the pipeline. Experimentally performed single port analysis of an outfall is a method of initial dilution investigation for performance determination of designed system. Because of the fact that cold water discharge is denser than receiving ambient water in the marine environment, it is a negatively buoyant dense jet. In this study, horizontally discharged cold water jet initial dilutions at various temperatures were experimentally investigated in a laboratory model using duckbill valve discharge port. Three discharge temperature differences were used as $\Delta T_0 = -3$, -5, and -7°C in the laboratory model for determination of the initial dilutions, S, in the cold water jet centerline. Densimetric Froude numbers (F) were calculated as 446.03, 358.43, and 321.76 for the selected temperature differences, respectively. This laboratory model study was also aimed at obtaining some experimental coefficients, such as impingement point distance, as design criteria for horizontally discharged cold water outfalls using duckbill valves.

Keywords: Thermal pollution; Cold water discharge; Negatively buoyant jet; Dilution; Marine outfall; Duckbill valve

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