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Desalination plant discharge calculator

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ABSTRACT

The impacts of a desalination plant discharge on the marine environment depend on the physical and chemical properties of the desalination plant reject streams, and the susceptibility of coastal ecosystems to these discharges depending on their hydrographical and biological features. Therefore, a good knowledge of both the effluent properties and the receiving environments is required in order to evaluate the potential impacts of desalination plants on the marine environment. The brine flows are considerably large, generally up to 40% (for membrane based technologies, like reverse osmosis, RO) and up to 90% (for thermal technologies, like multi-stage-flash, MSF, including cooling water) of the intake flowrate. Thus either almost as large or even considerably larger flows than the required freshwater water flow. Salinity and temperature directly influence the density of the effluent. The various density differences between the brine and the receiving water represented by the buoyancy flux causes different flow characteristics of the discharge. The dense RO effluent flow has the tendency to fall as negatively buoyant plume and spread as a density current on the sea-floor. The effluent from thermal desalination plants is distinguished by a neutral to positive buoyant flux causing the plume to rise and to spread on the sea-surface. This article describes a discharge calculator to compute the effluent properties (i.e. density, flow, temperature, salinity, etc.) and substance concentrations at the discharge point. It allows the input of up to three different effluent types with different individual flows, properties and constituents, which are then merged at the discharge point. This allows the consideration of desalination effluents be blended with other effluents like treated wastewater or cooling waters from the process itself or a cogenerating power plant. Furthermore, the calculator characterizes the effluent properties and computes basic discharge characteristics by comparing the effluent properties with ambient characteristics. In addition, the calculater includes simple approaches to compute estimates regarding the initial mixing. Results of computations for different case-studies demonstrate the potential of the calculator to estimate the order of magnitude of expected temperature, salinity or substance concentration at the discharge point and its surroundings. It allows furthermore to analyze the need for advanced discharge technologies which aim for enhanced effluent dispersion in the receiving environment and adequate discharge siting to avoid pollutant accumulation and to protect sensitive regions. It also allows to interpret the probability of interaction with the intake.

Keywords: Brine disposal; Concentrate; Jets; Plumes; Mixing; Density; Dispersion; Model

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