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Performance Assessment of the Gold Coast Desalination Plant Offshore Multiport Brine Diffuser during 'Hot Standby' Operation

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Abstract : Alongside the rapid expansion of Seawater Reverse Osmosis technologies there is a concurrent increase in the production of hypersaline brine by-products. To minimize environmental impact, these by-products are commonly disposed into open-coastal environments via submerged diffuser systems as inclined dense jet outfalls. Despite the widespread implementation of this process, diffuser designs are typically based on small-scale laboratory experiments under idealistic quiescent conditions. Studies concerning diffuser performance in the field are limited. A set of experiments were conducted to assess the near field characteristics of brine disposal at the Gold Coast Desalination Plant offshore multiport diffuser. The aim of the field experiments was to determine the trajectory and dilution characteristics of the plume under various discharge configurations with production ranging 66 – 100% of plant operative capacity. The field monitoring system employed an unprecedented static array of temperature and electrical conductivity sensors in a three-dimensional grid surrounding a single diffuser port. Complimenting these measurements, Acoustic Doppler Current Profilers were also deployed to record current variability over the depth of the water column and wave characteristics. Recorded data suggested the open-coastal environment was highly active over the experimental duration with ambient velocities ranging 0.0 – 0.5 m•s⁻¹, with considerable variability over the depth of the water column observed. Variations in background electrical conductivity corresponding to salinity fluctuations of ± 1.7 g•kg⁻¹ were also observed. Increases in salinity were detected during plant operation and appeared to be most pronounced 10 – 30 m from the diffuser, consistent with trajectory predictions described by existing literature. Plume trajectories and respective dilutions extrapolated from salinity data are compared with empirical scaling arguments. Discharge properties were found to adequately correlate with modelling projections. Temporal and spatial variation of background processes and their subsequent influence upon discharge outcomes are discussed with a view to incorporating the influence of waves and ambient currents in the design of brine outfalls into the future.

Keywords : brine disposal, desalination, field study, negatively buoyant discharge
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