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Numerical simulation of the effect of groundwater salinity on artificial freezing wall in coastal area

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During the engineering projects with artificial ground freezing (AFG) techniques in coastal area, the freezing effect is affected by groundwater salinity. Based on the theories of artificially frozen soil and heat transfer in porous material, and with the assumption that only the variations of total dissolved solids (TDS) impact on freezing point and thermal conductivity, a numerical model of an AFG project in a saline aquifer was established and validated by comparing the simulated temperature field with the calculated temperature based on the analytic solution of rupak (reference) for single-pipe freezing temperature field T. The formation and development of freezing wall were simulated with various TDS. The results showed that the variety of TDS caused the larger temperature difference near the frozen front. With increasing TDS in the saline aquifer (1∼35g/L), the average thickness of freezing wall decreased linearly and the total formation time of the freezing wall increased linearly. Compared with of the scenario of fresh-water (<1g/L), the average thickness of frozen wall decreased by 6% and the total formation time of the freezing wall increased by 8% with each increasing TDS of 7g/L.

Key words: total dissolved solids, freezing point, thermal conductivity, freezing wall, numerical simulation

Reference

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