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Assessment of the innovative freezing-melting technology for desalination of the Mediterranean seawater in the Gaza Strip, Palestine

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ABSTRACT

Although the freezing-melting process is not widely used commercially, perhaps the most significant potential advantage of desalination by freezing is the very low energy required compared with other desalination processes. Five seawater samples of 3,000 mL each were collected from different locations at the Gaza Strip beach. The physicochemical characteristics of the raw seawater samples were tested. The seawater samples were poured into an identical flask connected directly to an external stainless steel single-phase freezer (thermally protected-Sichuan Dandy Co. Ltd. 220 Volt, 50 Hz) with an energy consumption of 0.1 kW/h to be crystallized by direct freezing (at −20°C). Then the physicochemical analysis was undertaken on the water produced from three repeated freezing-melting (FM) cycles for each seawater sample. The average water mineral reduction percentages ranged from 39.0% to 45.5%, (49.7%–52.8%), and (56.0%–59.0%) for the 1st, 2nd, and 3rd FM cycles, respectively. The overall average removal percentage of dissolved minerals and constituents after the 3rd FM cycle for North Gaza, Gaza, Middle area, Khan Younis, and Rafah seawater samples was 84.7%, 85.6%, 87.3%, 86.4%, and 87.6%, respectively. The time of crystallization in the 1st, 2nd, and 3rd freezing cycles was 80, 50, and 30 min, respectively. The consumed energy for produced water after the three cycles of freezing was 0.018, 0.022, 0.018, 0.023, and 0.021 kW/L for the North Gaza, Gaza, Middle Area, Khan Younis, and Rafah seawater samples, respectively. The FM technique could be used as a pretreatment method for other methods of desalination.

Keywords: Desalination; Freezing-melting; Gaza Strip; Palestine; Mediterranean seawater

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