Treatment of sulphate wastewater by freeze desalination

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ABSTRACT

Cooling and freezing can be used to produce fresh water from brackish water, industrial brines and leachates from industrial wastes. The aim of this study was to identify how cooling and/or freezing can be used for the recovery of drinking water from sulphate rich solutions associated with various cations. It was found that: (i) If the solution contains only Na₂SO₄, after pre-treatment with sodium alkalis, it can be removed from solution through cooling down to 0.33 mol/L (31.7 g/L SO₄) through crystallization of Na₂SO₄·10H₂O; (ii) the solubility of Na₂SO₄ upon cooling is influenced by the Cl-concentration; (iii) the Reverse Osmosis-Cooling (ROC) process is most suitable for treatment of saline solutions rich in Na₂SO₄, as it can be precipitated through cooling as Na₂SO₄·10H₂O, followed by reverse osmosis to produce drinking water; (iv) The energy required to cool water, containing 100 g/L Na₂SO₄, from 25°C to 0°C, amounts to 10.66 kWh/t water. When the water is further cooled down to freeze 90% of the water, the energy consumption increased from 10.66 kWh/t to 37.74 kWh/t.

Keywords: Freeze desalination; Reverse osmosis cooling