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Development of Double-Sided Wet-Fabric Evaporator of Seawater Utilizing Wind and Solar Energy Efficiently

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Summary

A double-sided wet-fabric evaporator of seawater was examined experimentally and theoretically. The evaporator consisted of a rectangular fabric of hydrophilic material, which was stretched between two horizontal bars and slanted so as to utilize the effects of wind and solar energy efficiently. Seawater was soaked up from a gutter by a strip of cloth suspending from the rectangular fabric, and was then infiltrated through the fabric. The fabric was stretched tight crosswise so that the seawater flowed uniformly in the fabric.

The performance of the evaporator was simulated by a one-dimensional trangient model, and the simulation results may be summarized as follows:

(1) Under the subtropical and maritime climate conditions of Okinawa Island, the wet fabric evaporates water of 5.2 kg/m^2-day on average over a year. The evaporation rises to 10 kg/m^2-day on fine days from summer to autumn.

(2) The evaporation rate increases with increasing solar radiation, wind speed and ambient air temperature, and decreases with increasing humidity and concentration of the effluent seawater. The strong factors are the solar radiation, the wind speed and the humidity.

(3) When the influent seawater is being controlled corresponding with the present values of the weather factors and the evaporation is rapidly increasing, the regulation of the effluent concentration fails and an about 3 wt. % rise of the effluent concentration occurs. When the evaporation is rapidly decreasing, an about 1 wt. % fall of the effluent concentration occurs. These are attributed to the slow flow rate of seawater in the fabric.

A double-sided wet-fabric evaporator was constructed and tested outside at Okinawa Island. The test results may be summarized as follows:

(4) The hourly evaporation increased linearly with the solar radiation, and the experimental data were in fair agreement with the model simulation results.

(5) The daily evaporations were measured on December, and the average of these data was in good agreement with the model simulation result obtained with the weather data of Okinawa Island.