Chemical Engineering Master's Defense

Efficiency Improvements in a Horizontal Desalination Unit

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abstract

The horizontal desalination unit described herein utilizes the humidification-dehumidification process to purify water using air as a carrier gas. The temperature required to drive the process is low enough that waste heat from a fuel combustion or solar collectors can be used. A unit in which air travels horizontally affords several advantages over similar vertical "Dewvaporation" towers, including ease of construction and potentially increased efficiency. The objective was to build and test two horizontal units, determine the efficiency of operation, and isolate ways of improving future units. The desalination units consisted of: 1. A series of aligned, corrugated, polypropylene (PP) sheets covered on the outside with absorbent, wet cloth. 2. A basin that caught unpurified water dripping downward from the absorbent cloth. 3. Ten pumps to cycle the basin water back onto the cloth. 4. An air blower on the front of the unit that drove air horizontally across the cloth, increasing the humidity of the air. 5. A steam generator on the back of the unit producing steam that mixed with the incoming air to increase the temperature and humidity. After the air mixed with the steam, the air made a 180° turn to travel inside the corrugations in the PP sheets, creating a countercurrent heat exchanger as the exiting air transferred its heat to the incoming air. causing purified water to condense from the cooling, oversaturated air. The second unit used more PP sheets, had a modified air inlet structure, and was more efficient in distillate production. The second unit produced distillate at a rate of 0.87 gal/hr at 21 ppm. Recommendations for future iterations of a horizontal unit include the implementation of a continuous pump design, a center divider in the unit to inhibit mixing of water in the basin, a modification of the basin to accommodate the unit center divider, and optimization of air and steam flow rates.

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