ANALYSIS AND SIMULATION OF A MULTI-EFFECT ABSORPTION HEAT PUMP DRIVEN BY SALINITY DIFFERENCES

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ABSTRACT

Strategies for harnessing energy from salinity difference have been studied for many years. The earliest strategies were impractical and expensive; these involved the use of ion selective or semipermeable osmotic membranes. A different approach which eliminates the need for membranes was introduced in the late seventies. This method exploits the vapor pressure difference between two waters of different salinity. This method has limitations in that a large vapor transfer and a large amount of heat transfer are required in order to produce a small amount of power. The present study also uses vapor transfer. Instead of directly harnessing the vapor pressure difference to produce power, however, it would exploit the elevated temperatures produced during the non-isothermal absorption of vapor on the surface of concentrated brine.

According to the new strategy, an open cycle multi-effect absorption heat pump system driven by salinity difference energy is designed. The system consists of three major parts, a multi-effect heat pump, a regeneration device, and make-up units. Through this system, low temperature heat can be elevated to high temperatures. Two

applications are proposed and studied, steam generation and desalination.

In this study a detailed computer model of the system has been developed. The model covers the three parts of the system and combines them for system simulation. Transient process simulation is included. Noncondensible gases are considered in the analysis. The analysis also considers pleat plate geometry other than flat plate geometry in order to reduce the heat leakage.

The performance of this system depends on several intrinsic parameters, such as the system salinity level, the system temperature level, thermal resistance, mass resistance and thermal losses. Optimization is carried out based on configuration parameters, operational parameters and other parameters. Configuration parameters include heat exchanger plate length, number of chambers, and pleat geometry. Operational parameters include mass flow rate, make-up ratio, and optimum pressure levels in the two extra chambers. Other parameters include heat exchanger materials selection as well as fluid working pairs selection.