DESIGN OF TWO GENERATIONS OF A DEVICE FOR DISTILLING FRESH WATER BY AN OPEN CYCLE ABSORPTION HEAT PUMP

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Michael G. Brown

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ABSTRACT

Traditional methods of mechanical power production involve the use of thermal or pressure gradients. In this age of reduced energy resources, efforts are under way to find new ways of establishing these thermal and pressure gradients. A relatively recent proposal for developing an energy gradient involves the use of an open cycle absorption heat pump. The heat pump utilizes the mass transfer of low pressure steam between two fluids of differing salinity concentrations. Since the mass is transferred in the gas phase, the steam's latent heat of vaporization is also transferred from the high vapor pressure fluid to the low vapor pressure fluid. The resultant temperature differential is a manifestation of energy known as concentration energy. The research detailed in this paper demonstrates the ability to distill fresh water using a temperature gradient derived from concentration energy.

To date, there have been two generations of distillation systems using concentration energy as the heat source. The first generation system reliably produced 2.0 kg/hr.m of fresh water. There are currently efforts underway to operate a second generation distillation system which is expected to be able to produce water with a specific energy consumption rate that would be competitive with current distillation process. One potential economic advantages of such a system is that the bulk of the energy required for the distillation of water is derived from the concentration differential between inexpensive and readily available fluids (i.e. sea water and bittern). Aside from pumping costs, the latent heat of vaporization for the distillation process is provided free of charge by the absorption process (which is exactly the reverse of the evaporation process used in distillation). This study describes the state of the art in distillation using concentration energy.

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