Design of a Solar Pond for Solar Energy Storage/Recovery and Salt Production in Coastal and Rural Areas of the UAE

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Abstract

The main objective of this project is to develop, analyze and design a solar pond for solar energy recovery and use in salt production in remote coastal and inland areas and to assess the design from economical, environmental and safety perspectives. The attached schematic diagrams show a solar energy recovery and salt production system from a solar pond. It is expected to select and develop the process, make material and energy balances, and simulates the process using suitable software.

A solar pond is a large area solar collector that uses water- a pond between one to four meters deep- as a working material for collection of radiant energy and its conversion into heat (up to 95° C) , storage of heat and transport of thermal energy out of the system. Solar energy will warm a body of water, but the water loses its heat and rises unless some method is used to prevent this process. Solar ponds stop this process because of the large quantities of salt that are dissolved in the hot bottom layer of the pond making it too dense to rise to the surface and cool. The salinity gradient in solar ponds prevents convection currents, thus making a solar pond much more efficient in solar heat storage than a body of water of the same size.

The primary desalination process can be done by reverse osmosis (RO), multi-effect distillation (MED), or multistage flash distillation (MSF). The MSF is the dominant desalination method followed by the MED and RO. As shown in figure (1), the reject concentrate from the primary desalination process provides make-up water to the salinity-gradient solar pond (SGSP), which in turn provides feed brine to the desalination unit. The highly saline brine from the desalination unit will be fed to a brine concentrator and recovery system (BCRS). The BCRS is driven by the thermal energy from the SGSP, producing a near-slurry salt discharge. Instead of dumping the salt discharge to the sea, a portion of it can be used as a supply to the SGSP. By this action, a zero brine discharge is achieved, heat energy is produced (thus lower the energy needs), and the cost is reduced.

The other portion of the salt discharge can be treated for salt production [4]. This system's approach addresses two critical environmental issues for inland desalting plants: (1) reusing the brine concentrate thereby negating the need for disposal (zero discharge); and (2) providing additional pollution-free renewable energy for the desalting process.

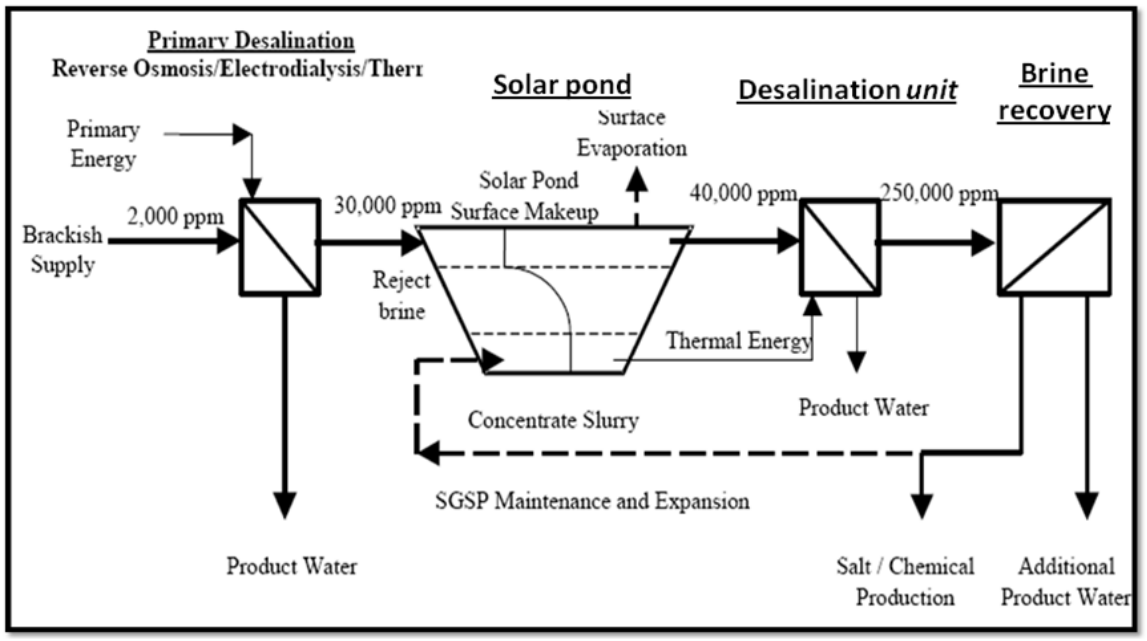

Figure 1 : Schematic of Zero Discharge Desalination System.