ENHANCED RESOURCE EFFICIENCY IN THE DESALINATION SECTOR THROUGH RESOURCE RECOVERY FROM BRINE

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Abstract

Desalination is an energy intensive process which produces a huge amount of wastewater: around 2 liters of wastewater are generated for every liter of freshwater produced. This volume of wastewater poses a significant management problem, as well as critical pressures in the sea environment (for seashore desalination plants) and the underground aquifers (for inland desalination plants). The United Nations Environment Program (UNEP-MAP) has recognized the problem of brine disposal as one of the major threats to the Mediterranean Sea[1]. More specifically, one of the most significant seagrasses of the Mediterranean Sea (Posidonia Oceanica), which is protected under the Barcelona Convention, has been identified to be highly vulnerable in salinity changes and as a result to brine exposure (**Riera, 2012; Latore, 2005; Palomar et al., 2011**).

The SOL-BRINE project sought to eliminate water pollution and environmental damage associated with brine release, by introducing a new technique capable of achieving Zero Liquid Discharge (*ZLD*) from desalination plants. The demonstration plant that will be presented in this paper was installed in Tinos Island in Greece and has been operated regularly since January 2013. The plant has the capacity to treat over 200 tonnes of brine per year and can lead to high recovery of resources, both water (recovery>90%) and dry salt (full recovery).

Keywords

▪ Brine Treatment ▪ Desalination ▪ Zero Liquid Discharge (ZLD) ▪ Solar energy ▪ Mediterranean Sea ▪ Tinos Island

The SOL-BRINE concept

The overall scope was to develop an energy autonomous brine treatment system for the total elimination of the brine, so as to address effectively the complex issue of sustainable water management and desalination. The innovative features of the system include (**Xevgenos et al., In Press**):

- Total brine elimination. The system has been designed in line with the Zero Liquid Discharge principle;
- Water Recovery (>90%);

[1] [1] "*One of the two major, urgent threats to the Mediterranean Sea environment is the pollution caused by the increased number of desalination plants and the releases and the effects of brine to the Mediterranean Sea*": Part of the speak of Director, Ms Maria Luisa Silva Mejias to the launching conference of the project "Governance & Financing for the Mediterranean Water Sector" held in Barcelona on 28-29 May, 2013. See also: http://ufmsecretariat.org/mediterranean-water-governance/

- Production of useful end-products. Through the operation of the prototype system the following two products are produced: (a) distilled water of high quality and (b) dry salt. Both products have increased market potential;

- Energy autonomous operation. Solar thermal collectors are used for delivering hot water (delivered at 80ºC approximately) and a photovoltaic generator for electricity. All energy requirements are covered exclusively through the use of solar energy; and

- Use of state-of the art technology: the evaporation of water is realized through custom designed vacuum evaporation technology (evaporator and crystallizer) and solar dryer.

The SOL-BRINE concept is summarized in the following Figure.

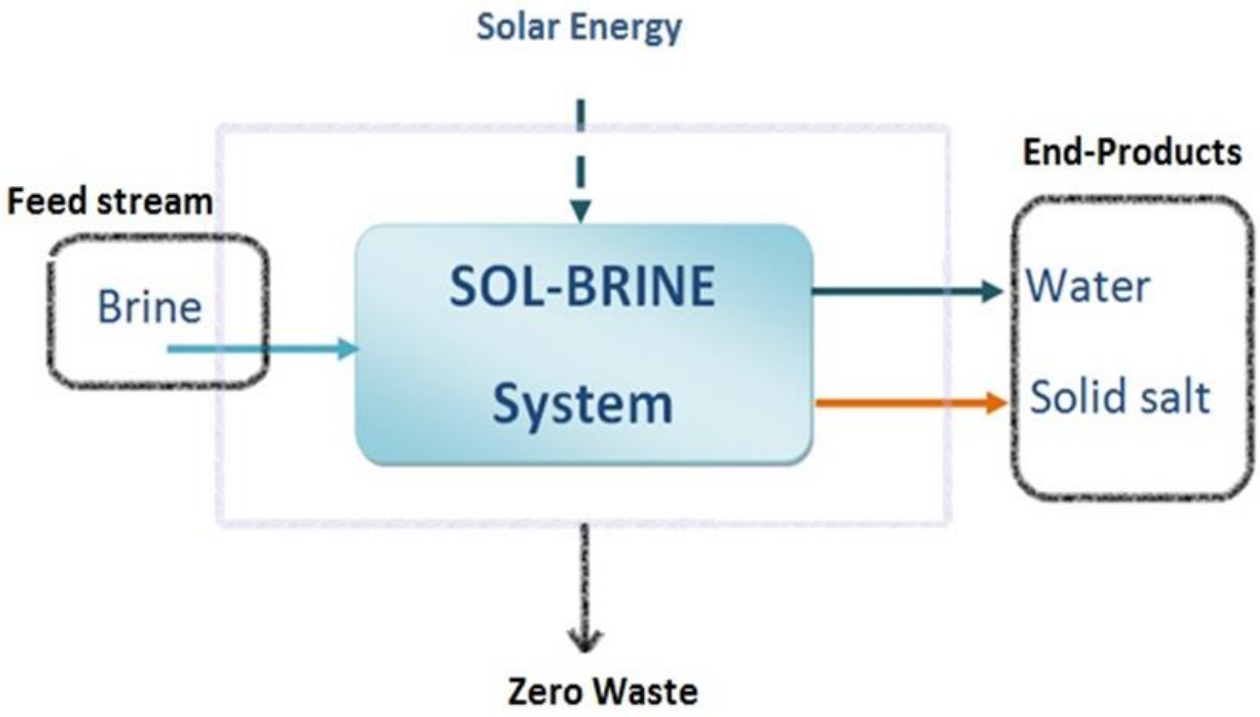

Figure 1. The SOL-BRINE concept

The SOL-BRINE system

In the course of the project, an innovative, energy-autonomous (through solar energy) pilot system was developed for the treatment of brine from an existing desalination plant. The system was installed in Tinos Island with a capacity of $2m^3$/day (feed volume rate of brine effluent). It was able to treat a small portion (<1%) of the total quantity of brine effluent produced from the desalination plant. The system comprises three treatment stages: (a) an evaporator unit, (b) a crystallizer unit and (c) a dryer unit (see also Figure 2).

The prototype system has been tested thoroughly and the technology has been demonstrated in pilot scale. The system results are very promising and can be further exploited with its market uptake. The results of the project are available in the project website (http://uest.ntua.gr/solbrine).

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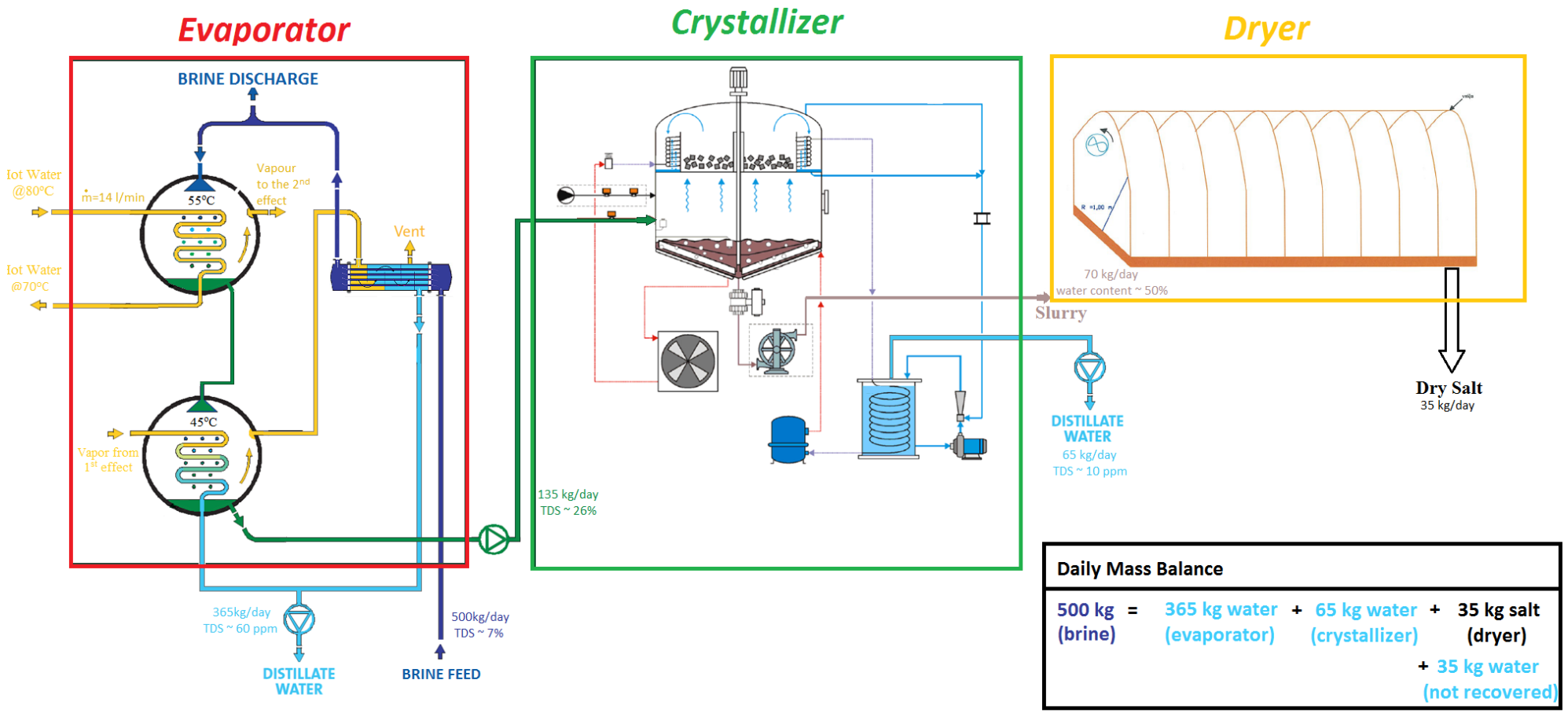

Figure 2. Process flow diagram of the SOL-BRINE system. The figures represent the daily mass balance of the system