

Thermal-driven Water Treatment Systems for Full Separation of Solute-Water

Technical Summary

A novel thermal-driven desalination system (for seawater or any impaired water) is studied to accomplish objectives to fully separate/recover water and thus produce dry salts from seawater or impaired water at high energy efficiency. As the solute and water are fully separated, the system can obtain dry residual salts or particle minerals for valuable product in addition to distilled water. The system can be optimized and managed to operate at high energy efficiency relying on medium-temperature industrial waste heat or concentrated solar heat. The zero discharge (of wastewater) will leave minimized environmental impacts, which is advantageous over other technologies that waste disposal or storage is required.

The water treatment system consists of a full separation (FS) tank and a multi-effect distillation (MED) subsystem, which are integrated with coupled energy and mass flow. Utilizing thermal energy from industrial waste heat or heat from concentrated solar energy, vaporization of the effluent (concentrated salt-water solution) from the multi-effect distillation (MED) subsystem is achieved in the full separation (FS) tank. The heat carried by the vapor flowing out of the FS tank is utilized by the MED subsystem for distillation of primary impaired water. In the MED subsystem, water is extracted and the

remaining concentrated salt-water solution is fed to the FS tank for evaporation, which separates and collects all the salt or minerals.

The flow and heat transfer for cold brine (or impaired water) and steam (from both the FS tank and MED) are arranged in three schemes: parallel, countercurrent, and concurrent, depending on the flow and distribution of cold impaired water to the multiple distillation effects. Energy and mass balance analysis for each individual devices and the entire system have been done to address viability of this technology. Simulation results and issues of design point and setting of parameters have been determined. Results of our experimental prototyping are correlated to theoretical results.

Questions to Network

The technical questions proposed to the network would be:

- 1) Identification of potential use cases
- 2) Partnership opportunities for water treatment projects
- 3) Analysis of detailed process financials
- 4) Analysis of process engineering and design of plant
- 5) Comparison to the state of the art and technology review.