Thermal Desalination for Increased Distillate Production
Technology #16554

Applications

Applications for this technology are found in chemical engineering, industrial water treatment, and power.

Problem Addressed

The global demand for a steady economical supply of fresh water continues to increase. One of the main known modes of increasing the existing water supply is seawater desalination: a proven process that can reliably convert the seemingly limitless supply of seawater to high quality water suitable for human consumption. Thermal desalination techniques rely on alternating evaporation and condensation of water. These techniques are robust and reliable but have little potential for further improvements. This technology offers a tool for the optimized design and thus improvement of the thermal desalination systems.

Technology

A methodology is proposed to identify improved thermal-based desalination structures. It is based on the notion of superstructure, allowing for the simultaneous representation of numerous feed, brine and vapor routing schemes. By adjusting the flow routings, the superstructure is capable of representing the common thermal desalination structures, as well as an extremely large number of alternate structures, some of which might exhibit advantageous behavior. The superstructure is built around a repeating unit which is a generalization of an effect in a multi-effect distillation system (MED) and a stage in a multi-stage flash system (MSF).

The superstructure is proposed as an improved tool for the structural optimization of thermal desalination systems, whereby the optimal selection of components making up the final system, the optimal routing of the vapors as well as the optimal operating conditions are all variables simultaneously determined during the optimization problem. The proposed methodology is applicable to both stand-alone desalination plants and dual-purpose (water and power) plants wherein the heat source to the desalination plant is fixed. It can be extended to also consider hybrid thermal-mechanical desalination structures, as well as dual-purpose plants where the interface of power cycle and desalination is also optimized for.

Moreover, the optimal location of vapor extraction is heavily dependent on the exact distillate production requirement in question. Two novel configuration forms are informed by the optimization. The first is an integrated MED–TVC + MED + MSF system, while the second is an integrated MED–TVC + MSF system.

Advantages

- New desalination structures identified
- The invented structures produce larger amounts of distillate from a fixed heat input system
• Lower heat transfer requirements needed

**Categories For This Invention:**

Energy  
Power Plants  
Water Treatment  
Desalination

**Intellectual Property:**

Thermal desalination for increased distillate production  
Issued US Patent

**Inventors:**

Alexander Mitsos  
Tawfiq Dahdah

**Publications:**

*Structural Optimization of Seawater Desalination: II Novel MED–MSF–TVC Configurations*
Desalination  
July 2014  
*Structural Optimization of Seawater Desalination: I. A Flexible Superstructure and Novel MED–MSF Configurations*
Desalination  
July 1, 2014

**External Links:**

MIT-SOS Lab  
http://mitsoslab.scripts.mit.edu/index.php

**Image Gallery:**

![Image Gallery](Image)