Desalination and Water Treatment
www.deswater.com
doi: 10.1080/19443994.2014.982960

57 (2016) 2845–2854
February

Taylor & Francis
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Downloaded by [Gwangju Institute of Science and Technology], [Mr Joon Ha Kim] at 21:10 27 January 2016

Smart water grid: desalination water management platform

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Received 25 July 2014; Accepted 19 October 2014

ABSTRACT

This paper presents a desalination process powered by a microgrid. Desalination is critically important for many countries demanding potable water beyond that available in nature. The desalination process requires a stable power supply system. As the stable power supply system, microgrid, which is a distributed small capacity power system integrating renewable energy with energy storage, has become important. In this paper, small capacity desalination plant powered by a microgrid is implemented and its features are described. The desalination plant is operated by electricity provided from either renewable energy resource such as solar cell or power grid. Overall control of the desalination plant is carried out by a programmable logic controller and status of water production is monitored by energy management system. The implemented desalination plant consumes 5 kW and produces 1 m^3/h of fresh water.

Keyword: Desalination; Reverse osmosis; Microgrid; Energy management system; Renewable energy; Transmembrane pressure

1. Introduction

Currently, the most widely employed desalination technologies are multi-stage flash distillation (MSFD) [1], multi-effect distillation (MED) [2], and reverse osmosis (RO) [3]. While MED and MSFD utilize thermal energy, RO uses the mechanical pressure of a pump. Fig. 1(a) shows the MED method where fresh water is obtained through heat exchange between hot steam within a pipe and seawater sprayed over the pipe. In the 1st Effect, the sprayed seawater evaporates to become vapor due to the heat of the steam pipe. This high-temperature vapor then evaporates more seawater in the 2nd Effect and is eventually expelled as fresh water after losing heat. This process occurs continuously without need for additional heat provision aside from the initial heat supplied by the boiler, and thus the process can conserve energy to some extent. Fig. 1(b) shows the MSFD method where fresh water is produced using the flashing phenomenon, which instantaneously creates vapor as soon as inputting heated seawater into a low pressure vessel. The flashing vapor produced at this point preheats the seawater flowing in the condenser before reaching the heater, and then the flashing vapor is released as fresh water after undergoing condensation. This process has the advantage of being applicable to mass production

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