Desalination and Water Treatment
www.deswater.com

doi:10.5004/dwt.2019.23680

156 (2019) 148–160
July

Experimental investigation on a hybrid desalination and cooling unit using humidification-dehumidification technique

C. Chiranjeevi[a,*], T. Srinivas[b], R. Shankar[a]

[a]*Department of Thermal and Energy Engineering, SMEC, VIT, Vellore, TN, India, email: chiranjeevi_c@yahoo.com (C. Chiranjeevi)*
[b]*Department of Mechanical Engineering, Dr B R Ambedkar National Institute of Technology Jalandhar, Punjab, India*

Received 31 August 2018; Accepted 26 December 2018

ABSTRACT

Rapid growth in urbanization, industrialization and decrease in rainfall rates all over the world demands more fresh water for human use, industries and agriculture purpose. The novel desalination technologies for converting saline water into fresh water have more value and demand. Present work aim at evaluating the performance of an integrated air cooling and two stage desalination system using humidification dehumidification (HDH) technology experimentally by varying flow rate and temperature of saline water. The components of the proposed system are designed, developed and carried out experiments for different operating conditions to get optimum operating conditions. The plant consists of a solar water heater (SWH), two air preheaters, two humidifiers, two dehumidifiers with a normal and a vapour compression refrigeration water chiller. The influence of saline water temperature and flow rate on air temperature, desalination yield, recovery ratio, energy utilization factor (EUF), air cooling effect and coefficient of performance (COP) of the cooling system are studied. The experimental observations recommend higher saline water temperature with high flow rates to air preheaters and humidifiers, circulating and chilled water to dehumidifiers with lower possible temperatures. The integrated plant yields 240 W of cooling energy and a maximum fresh water of 2180 ml/h with 15 m^3/h air flow at saline water temperature of 54.5°C with a flow rate of 200 LPH. Experimental results show a maximum EUF of 0.5 for the hybrid plant and 0.45 for conventional plant single stage plant. A maximum COP of 2.2 with a recovery ratio of 0.78 is observed from the experimental results.

Keywords: Humidification; Dehumidification; Desalination; Cooling; Hybrid systems; Fresh water

*Corresponding author.

Presented at the InDA Conference 2018 (InDACON-2018), 20–21 April 2018, Tiruchirappalli, India