Desalination and Water Treatment
www.deswater.com

doi: 10.1080/19443994.2013.775670

51 (2013) 7361–7378
December

Taylor & Francis
Taylor & Francis Group

Exergy and thermo-economic analysis of solar thermal cycles powered multi-stage flash desalination process

Mohamed A. Sharaf Eldean[a,*], H.E. Fath[b]

[a]*Faculty of Petroleum & Mining Engineering, Department of Engineering Science, Suez University, Suez, Egypt*
Tel. +20 1060082458; email: dean_fpme@yahoo.com
[b]*Faculty of Engineering, Department of Mechanical Engineering, Alexandria University, Alexandria, Egypt*

Received 19 October 2012; Accepted 9 February 2013

ABSTRACT

Solar thermal power cycles assisted multi-stage flash brine recycle (MSF-BR) distillation process are thermo-economically analyzed and evaluated. In this work, the analyses are compared according to three different configurations via two techniques of solar thermal power cycles. The first technique is considered for only desalination process; however, the second is considered for desalination and electric power generation via organic Rankine cycle. Solar parabolic trough concentrator (PTC) field is considered to dominate sufficient thermal power for MSF plant. Water steam working fluid is used for a direct vapor generation (DVG); however, Therminol-VP1 working substance is used for an indirect vapor generation (IDVG) through the PTC field. Moreover, the optimized configuration from the first technique is compared with the power generation and desalination (the second technique). The comparisons are proceeding for the MSF-BR desalination plant with total productivity in the range of 5,000m^3/d which the gain ratio is increased up to 12 with 40 stages. The thermo-economic results reveal that first technique achieves remarkable results related to the PTC area, the SPC, kWh/m^3, and the thermo-economic product cost, $/GJ.

Keywords: Solar organic Rankine cycle; Thermo-economic; MSF-BR

*Corresponding author.