An experimental study on the effects of direct and indirect use of solar energy on solar seawater desalination

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ABSTRACT

The use of solar energy for increasing the amount of water heating inside the solar still unit provided an important basis for various process designs in this research. Concerning the wide use of solar energy, solar panels have been used for heating water through thermal elements. In the first setup, a cylindrical parabolic collector (CPC) was used together with 300-watt and 500-watt solar panels, the results of which were then compared with each other. Based on the results the system best performs when more powerful solar panels and a longer CPC device were used. In the second setup, solar heating was achieved by direct use of solar still units. According to comparative results between the two experimental setups, the use of direct thermal elements in the solar still unit provided better performance compared to the use of indirect thermal energy. The highest amounts of fresh water were 3.679 kg and 3.945 kg per day in the first and the second setups, respectively.

Key words | desalination, seawater, solar energy, solar still unit, thermal energy

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INTRODUCTION

Water is one of the most valuable materials on Earth, which depends on the survival of all living organisms. Since most of the water on the planet has been salty for many years, many scientists have come up with solutions for seawater desalination. Researchers have always taken ways of enhancing solar still productivity into consideration by examining the effect of various parameters.

The water depth in the basin is one of the most important parameters affecting the amount of desalinated water (Tiwari & Tiwari 2006). Absorbent materials are significantly effective in improving the thermal performance of the solar still (Abdallah *et al.* 2009).

Solar distillation is a promising alternative to provide fresh water that is part of the essential needs of the people (Omara *et al.* 2013). An investigation of economic appraisal for the solar still has suggested that the water production cost is comparable to that reported by previous researchers (Ayoub & Malaeb 2014).

The system efficiency might decrease with increasing the volume of water (Altarawneh *et al.* 2017). Mathematical modeling of solar desalination and optimization of solar still structure has been performed (Feilizadeh *et al.* 2017).

The results have shown that the use of sand or steel fibers in the basin, as well as steam cooling, shall increase the temperature of saline water compared to the reference (Hassan & Abo-Elfadl 2017). The reduction of the boiling point of saline water may also increase the system efficiency by employing a vacuum pump in the solar still (Morad *et al.* 2017).

The daily amount of distillation is affected by the water depth and fan speed of the solar still (Omara *et al.* 2017). The presence of an agitator in the solar still has improved the heat transfer and increased the amount of distillation per day (Rajaseenivasan *et al.* 2017).

Black rubber can also be used as a solar energy absorber in the basin (Sathyamurthy *et al.* 2017). The growth of

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