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Modified hemispherical solar distillers using contiguous extended cylindrical iron bars corrugated absorber

A.E. Kabeel[a,b,*], Mohammed El Hadi Attia[c], Moataz M. Abdel-Aziz[d], Wael M. El-Maghlany[e], A.S. Abdullah[a,f], Mohamed Abdelgaied[a], Ravishankar Sathyamurthy[g], Sayed A. Ward[b,h]

[a]*Mechanical Power Engineering Department, Faculty of Engineering, Tanta University, Tanta, Egypt, emails: kabeel6@f-eng.tanta.edu.eg (A.E. Kabeel), a.abdullah@psau.edu.sa (A.S. Abdullah), mohamed_abdelgaied@f-eng.tanta.edu.eg (M. Abdelgaied)*
[b]*Mechanical Power Engineering Department, Faculty of Engineering, Delta University for Science and Technology, Gamasa, Egypt, email: drsayedw@yahoo.com*
[c]*Department of Physics, Faculty of Science, University of El Oued, 39000 El Oued, Algeria, email: attiameh@gmail.com*
[d]*Mechanical Power Engineering Department, Faculty of Engineering, Horus University, New Damietta, Egypt, email: dr.moataz86@yahoo.com*
[e]*Mechanical Engineering Department, Faculty of Engineering, Alexandria University, Egypt, email: elmaghlany@alexu.edu.eg*
[f]*Mechanical Engineering Department, College of Engineering, Prince Sattam bin Abdulaziz University, Saudi Arabia*
[g]*Department of Mechanical Engineering, King Fahd University of Petroleum and Minerals, Dhahran, Dammam, Saudi Arabia, email: raviannauniv23@gmail.com*
[h]*Electrical Engineering Department, Shobra Faculty of Engineering, Banha University*

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ABSTRACT

The current experimentation work aims to enhance the hemispherical solar distiller's yield by employing contiguous extended cylindrical iron bars as energy storage corrugated absorbers. After installing the contiguous extended cylindrical iron bars, the absorber surface is similar to the semi-circular corrugated surface; the extended cylindrical iron bars represent sensible storage materials. To get the optimal diameter of contiguous extended cylindrical iron bars that achieve the highest performance, three hemispherical distillers were designed, fabricated, and tested in the same El Oued, Algeria weather conditions, namely; first is a conventional hemispherical distiller (CHD), and the second and third are hemispherical distillers that include contiguous extended cylindrical iron bars (HD-CECIB) at different diameters of (8, 10, 12, and 14 mm). The experiments were conducted in two scenarios; in the first scenario, contiguous extended cylindrical iron bars with diameters of 8 and 10 mm were installed in the second and third distillers (HD-CECIB8 and HD-CECIB10), respectively. In the second-test scenario, contiguous extended cylindrical iron bars with diameters of 12 and 14 mm were installed in the second and third distillers (HD-CECIB12 and HD-CECIB14), respectively. The results show that 14 mm represents the optimal diameter of contiguous extended cylindrical iron bars that achieve the highest performance. The cumulative yield of a reference CHD reached 4.8 L/m^2·d. In comparison, the utilization of contiguous extended cylindrical iron bars with 14 mm diameter (HD-CECIB14) improved the accumulative yield to 8.35 L/m^2·d with an improvement of 74% when compared to CHD. Also, the daily thermal efficiency of HD-CECIB14 reaches 70.3%, with an improvement of 72.3% compared to CHD. Furthermore, the economic feasibility illustrated that using contiguous extended cylindrical iron bars of 14 mm diameter is a very effective choice because it reduces the distillate water costs produced by 41.2% compared to CHD.

Keywords: Hemispherical solar distillers; Extended cylindrical iron bars; Corrugated absorber; Sensible storage materials; Optimal diameter; Solar energy

* Corresponding author.