Retraction

Retracted: Thermal Analysis of the Solar Dish Array Concentrator System

Advances in Materials Science and Engineering

This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] Y. H. Mahmood, R. Y. J. Al-Salih, S. Amer Mahdi, and A. Mohamed Ibrahim, "Thermal Analysis of the Solar Dish Array Concentrator System," *Advances in Materials Science and Engineering*, vol. 2022, Article ID 1823630, 8 pages, 2022.

Research Article

Thermal Analysis of the Solar Dish Array Concentrator System

Yaseen H. Mahmood,[1] R. Y. J. Al-Salih,[1] Saif Amer Mahdi,[1] and Abdelrahman Mohamed Ibrahim [ID][2]

[1]*Department of Physics, College of Sciences, University of Tikrit, Tikrit, Iraq*
[2]*Accounting and Financial Management, School of Management Studies, University of Khartoum, Khartoum, Sudan*

Correspondence should be addressed to Abdelrahman Mohamed Ibrahim; amibrahim@uofk.edu

This research aimed at fabricating solar array concentrator. It is one of the best options for solar energy concentration. Compared with other systems, because of the higher concentration ratios and high control focal length, good accept angles, higher efficiency, rigid with high wind, and low cost, the system has been locally designed and fabricated to produce steam. The dimensions of the active aperture area of $3.25 \, m^2$ were studied. The absorber receiver, which conveyed water as heat in a closed cycle with an appropriate pump, produced steam at a higher temperature and with more efficiency. The best characterizations of the system are the focal length 1.25 m, concentration ratio 103, optical power 1.2 kW, losses 0.2 kW, and efficiency 60–70%.

1. Introduction

Man is looking for new sources of energy to cover his growing needs in the applications of advanced life. But some sources of energy are known for their depletion and the cost of their high exploitation and the negative impact of their use in modern times. Man has been alerted to the possibility of taking advantage of the heat of the Sun, which is characterized as renewable energy. It is as sustainable as energy that can be obtained from wind, flowing water, or other natural phenomena from which energy can be produced. The world is clearly aware of the great danger it is causing. The use of other common sources of energy (especially oil and natural gas) to pollute and destroy the environment, which makes renewable energy, is the best option for some countries. Several research has been carried out in solar energy to develop the main components and parts of energy uses [1–5]. A parabolic dish with reflector is used for melting snow to produce water. The receiver arrangement focuses to melt the snow and store the water in the tank [6] with the help of dynamic simulation, a small solar concentrator. With the aid of a Computational Fluid Dynamics simulation, a solar trough concentrator and a pipe with flowing water are set in the concentrator focus. This work aims to investigate the feasibility of generating steam from such a system as well as analyzing the generated steam quantitatively and qualitatively. Effects of variation of solar radiation intensity, ambient temperature, water flow rate, and pipe diameter on the quantity and quality of the generated steam have been investigated. A 130 kg of "steam could be generated per day with a 0.01 m diameter with 0.0042 kg/s flowing water" [7] privatize development of the new solar receiver (DSG) provides a solution to get rid of the difficult operating situations in that time [8]. Design and fabrication of three low-cost solar concentrators are with diameter 5, 10, and 20 m, and the focal length is 0.3 m. The result of this study is high reflective facets and increases the rib angle and applies full stress [9]. Recently designing diameter of 1.4 m and receiver diameter of 0.3 m the surface area of $1.53 \, m^2$ from this component, has been done diameter Solar bifocal design by low-cost material which contains fabricating solar array concentrators, such that the receiver work on a thermosiphon 650 kJ where these materials are sufficient for Solar bifocal design It is one of the best options for solar energy concentration [10]. Two concentrators for solar water heating design used metal dish with reflectivity of 95% because the efficiency is 73% covered by mirror, output energy is 1853 W, and the second with reflectivity up to 80%,

result by covered with a layer of 60% efficiency and output energy of 1551 W, [11]. In Tunisia, a (3.8) meter solar dish is designed to decrease the heat losses and steam production, and many experimental tests were conducted [12]. The tracking system is added to produce steam generation [13]. PDSC is a solar dish with aperture area of $16 \, \text{m}^2$, the diameter of the solar boiler is $0.126 \, \text{m}^2$. The system is analyzed by using Taguchi method analysis to find heat transfer. The change flow rate between inlet and out let temperature is one of more influencing factors[14]. Two types of solar collector are discussed with non-concentrating and high concentrating with application and studied the optical heat loss and tracking system such as different heat transfer and thermal storage for system [15].(Table 1)

2. Theoretical Analysis of System

2.1. Mirrors. When a surface reflects light incident in some ranges of wavelengths, the reflected light conserves most of physical features of the original light.

There are three types of mirror.

(i) 1- plane

(ii) 2- concave

(iii) 3- convex

The surface that has the ability to reflect the light must be greatly smooth. The features of the picture in plane mirror must be steady and in the same size and dimension as the original body that is behind the mirror. The reflected picture must not only be steady from up and down but must also be reversed from the sides (left and right) [16].

" Concentration ratio (CR) is defined as the area of collector (Ac) to area of receiver (Ar):

$$CR = \frac{A_C}{A_r}. \tag{1}$$

" The greatest value of the concentration ratio in three dimensions for the collector is given by the following equation [17, 18]:

$$CR_{\max} = \frac{1}{\sin \theta^2}. \tag{2}$$

The incident ray on the surface of a mirror will be truckled according to the two laws given below:

The first law: the incident beam and the reflected beam and the column from the point of incident fall are all located in one level perpendicular to the point of incident

The second law: the angle of incident equals the angle of reflection

2.2. Heat Transfer. We can calculate the characterization of the system and heat transfer from equations (3)–(13) as follows [17, 18]:

$$Q_{\text{out}} = \eta_0 I_b A_a - U_L (T_r - T_{\text{amb}}) A_r. \tag{3}$$

Efficiency of collector:

$$\eta_{\text{collector}} = \frac{Q_{\text{out}}}{A_a \, I_b} = \eta_0 - \frac{A_r}{A_{\text{amb}}} \frac{U_l (T_r - T_a)}{I_b}, \tag{4}$$

$$Q_{\text{out}} = Q_{\text{opt}} - Q_{\text{loss}}, \tag{5}$$

$$Q_{\text{opt}} = A_a \rho_{s-m} \tau_g \alpha_\gamma S I_b, \tag{6}$$

$$Q_{\text{loss}} = A_r U_L (T_r - T_{\text{amb}}), \tag{7}$$

$$T_r = \frac{T_{\text{out}} + T_{\text{in}}}{2}, \tag{8}$$

$$U_l = \left(\frac{1}{h_w + h_r}\right)^{-1}, \tag{9}$$

$$h_r = 4\sigma\varepsilon T^3, \tag{10}$$

$$N_U = 0.3 \, \text{Re}^{0.6}, \tag{11}$$

$$R_e = \frac{V.D_{\text{out}}}{\nu}, \tag{12}$$

$$h_w = \frac{K_{\text{air}}}{D_{\text{out}}} N_u. \tag{13}$$

[16].

3. Experimental Work

3.1. Concentration. The solar dish array, as shown in Figure 1, consists of 52 square shaped plane mirrors with reflectivity (95%) and area $(25 \times 25) \, \text{Cm}^2$. Figure 2 shows that the mirror is fixed on a metal frame, and moved up, down, left, and right by four screws to add the spot of solar radiation at one location focus. It is one of the best options for solar energy concentration. Compared with other systems, because of the higher concentration ratios and high control focal length, well accept angles, higher efficiency, rigid with high wind, and low cost, the system has been locally designed and fabricated to produce steam such that the dimensions of the active aperture area of 3.25 m and the active area $3.14 \, \text{m}^2$ such that the incident beam, the reflected beam, and the column from the point of incident fall are all located in one level perpendicular to the point of incident.

3.2. Receiver. Receiver is most important to convert solar radiation to heat energy. We used 4 mm cylindrical steel with dimensions of 20 cm in length and 25 cm in diameter, and two disc metals was used, one fixed at the front and the other behind by three screws, Figure 3. It consisted of 10 rolls of copper pipe with a diameter of 6 mm which we fixed at the focus.

3.3. Water Pump. A pump was used to push water, which is used in houses to circulate between the metal tank through the pipes and the solar receiver.

TABLE 1: Nomenclature.

Simple	Abbreviations
A_a	Aperture area of the collector
A_r	Aperture area of the receiver
Q_{opt}	The rate of the optical energy absorbed by the receiver
Q_{out}	Useful energy delivered to the total incoming solar energy
Q_{Loss}	The rate of the energy lost from the receiver to the ambience
ρ_{s_m}	Specular reflectance of the concentrator
τ_g	Transmittance of the glass
α_γ	Absorbance of the receiver
I_b	Beam insolation incident on the collector aperture
S	Receiver shading factor
T	Averaged receiver temperature
T_{amb}	Ambient temperature
UL	The overall heat loss coefficient
T_{out}	Temperature of the fluid exiting the receiver
T_{in}	Temperature of the fluid entering the receiver
H_w	Convective coefficient
H_r	Radiation coefficient between the receiver (or glass cover) and the ambient
$\sum$	Stefan–Boltzmann constant
E	Emittance of the absorbing surface
Nu	Nusselt number
Re	Reynolds numbers
V	Wind speed
D_{outer}	Diameter of the receiver
N	Viscosity

FIGURE 1: Concentrator before mirror is fixed and after mirror is fixed.
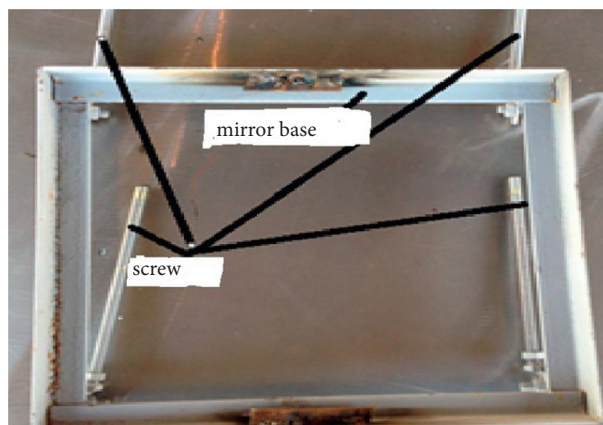

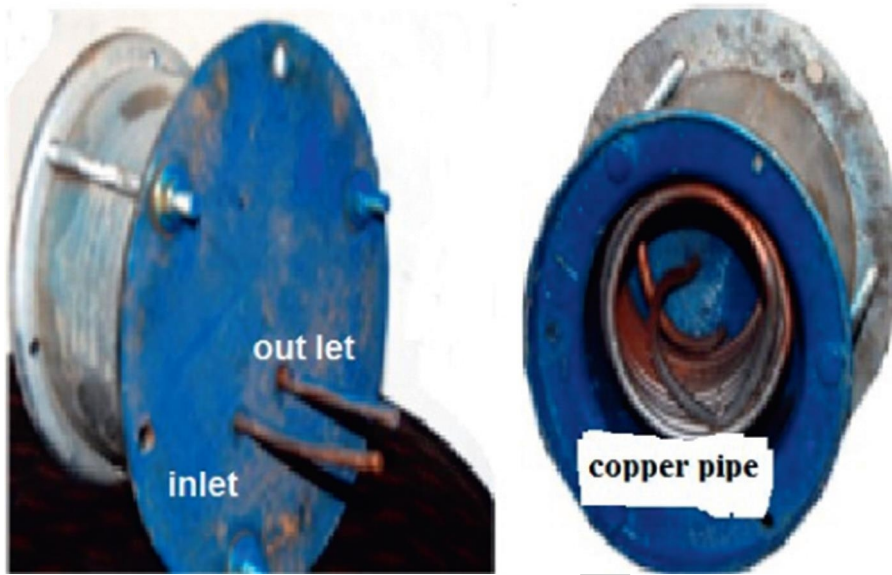
FIGURE 2: Mirror frame.

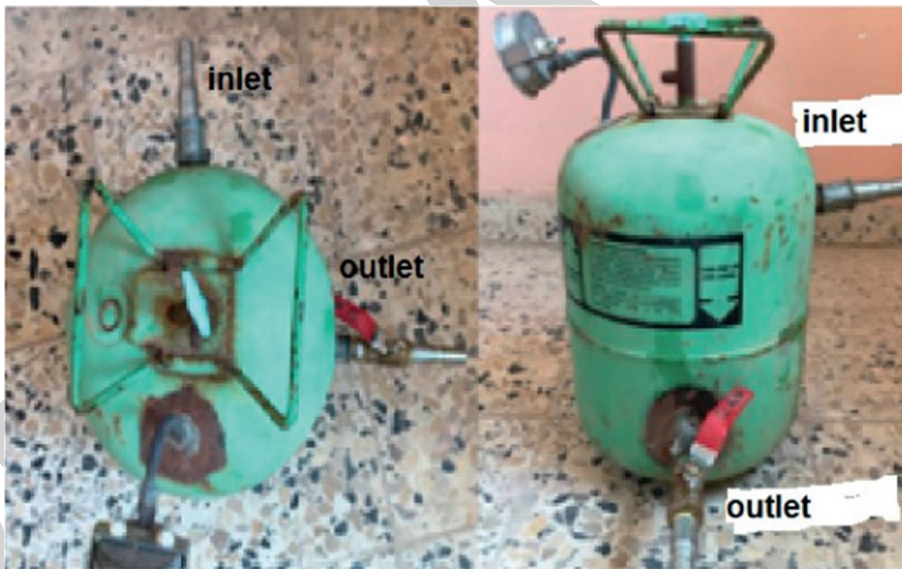Figure 3: The receiver, from rear and front.
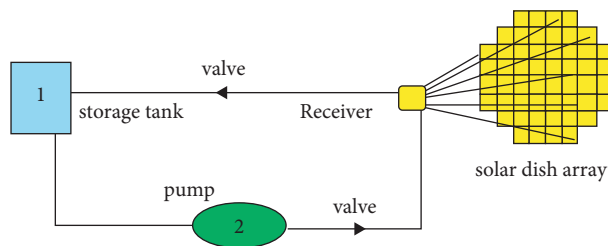

Figure 4: Storage tank.

Figure 5: Schematic connection of system.
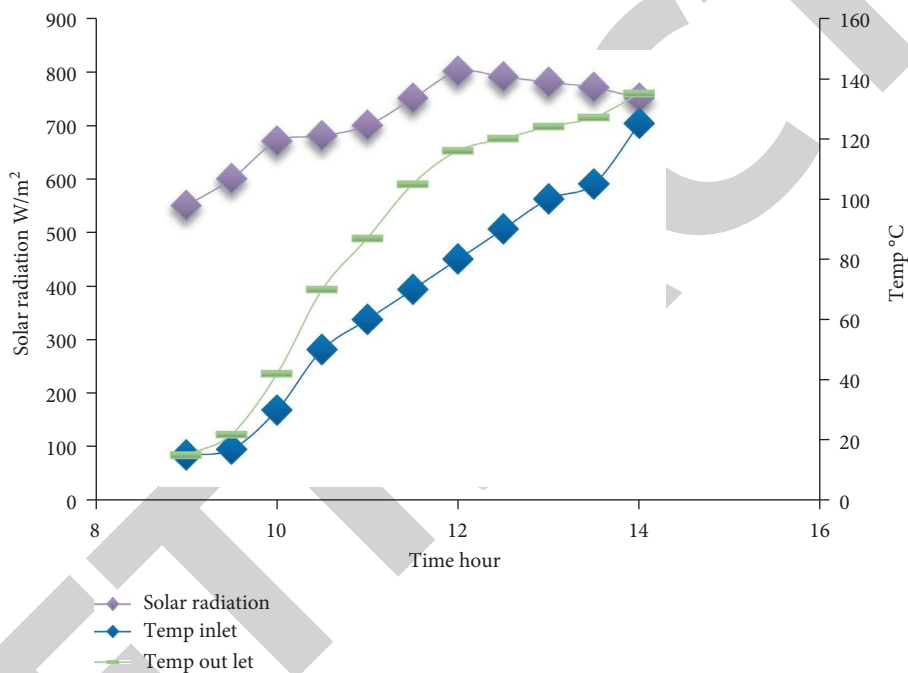
FIGURE 6: Solar dish component system.

FIGURE 7: Relation between Solar radiation with time and temperature.

3.4. Storage Tank. We used a cylindrical steel tank Figure 4 with diameter 0.3 m, and capacity 20 L, and added two valves.

E-piping connections: we used a plastic pipe to connect all components for more isolation of all piping enfold by heat wool with aluminum cover. Figure 5 shows the scheme explicates, how to connect storage tank with pump, and a one-way valve to the receiver and another valve with storage tank. Figure 6 demonstrates the experiential connected all parts of the system fabricating, which is solar array concentrators by the pump worked to push the water from the storage tank to pump steam, which conveyed water as heat in a closed cycle with an appropriate pump produced steam at a higher temperature and with more efficiency.

System tested: after connecting all parts of the system, we fixed the concentrator to the south of the solar radiation incident directed on the mirror and fixed by the screws in the rear mirror to reflect the radiation on the receiver; after 10 mins, the temperature of the receiver will reach up to 350°C; at this time; the pump works to push water from the storage tank to pump and to receiver and return to the storage tank and measure the temperature from inlet and outlet from the receiver with time and other parameters of the system.

4. Results and Discussion

Solar radiation and temperature with time have been studied in Iraq-Tikrit with longitude (43.68) and altitude (34.59).The recording time was in March 2018 as described in Figure 7. In this zone, the maximum solar radiation was found between 9:00 AM to 2:00 PM; after this time, the solar radiation begins to decrease between 1:00AM to sun set; the relation between the temperature and time is increased because the system is a closed cycle (the inlet and out let temperature) when solar radiation increase (Figure 7). It is compatible with [10, 11].
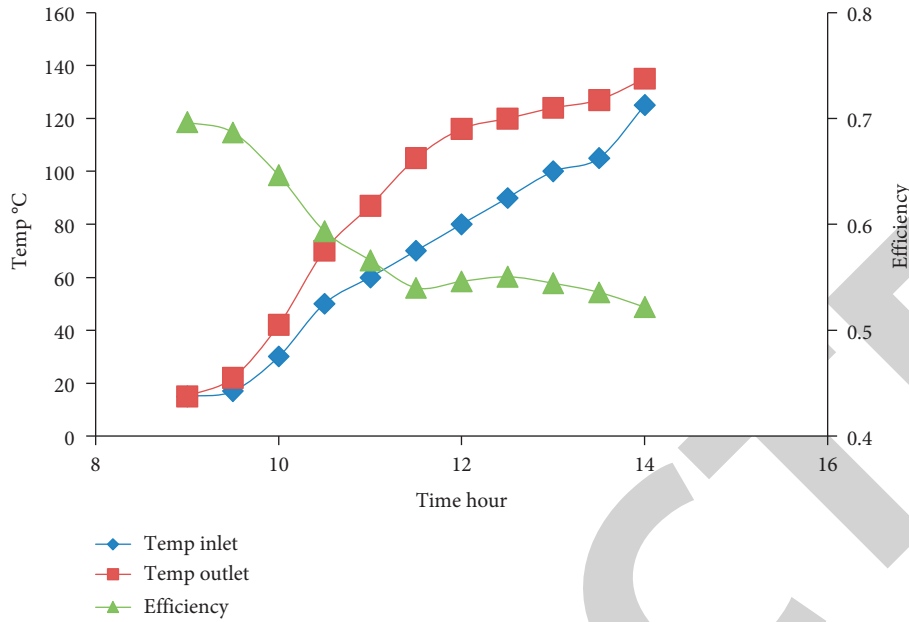
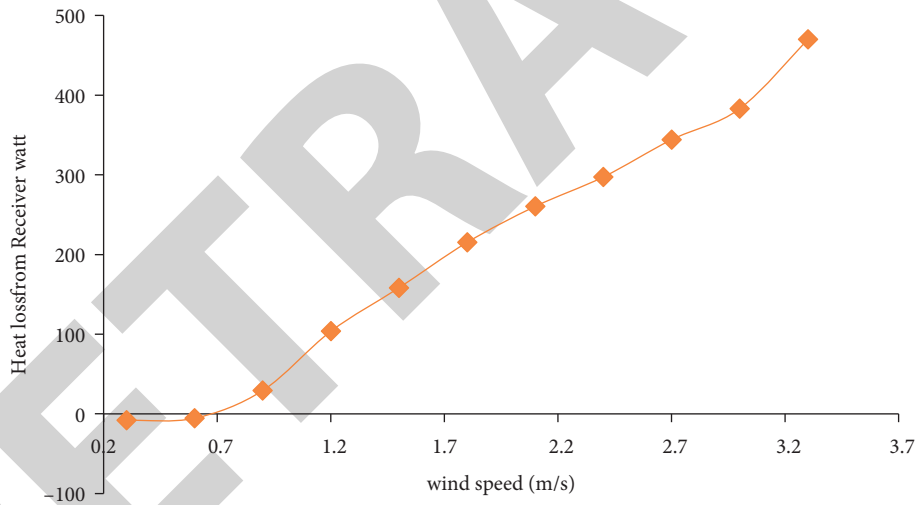FIGURE 8: Relation between efficiency with time and temperature.

FIGURE 9: Heat loss from receiver for wind speeds.

Also, by using equation (3)–(13) and writing in Microsoft Excel, another characterization of the system is found as shown in Figure 8. It shows the variation of temperature and efficiency with time for the receiver. The higher the solar radiation is for the period between nine and one o'clock at noon; the water temperature increased in the circulating between the tank and the receiver so as the water continues to circulate several times due to the closed cycle with the water pump; this behavior is similar to the fabricated solar array [16]. It was observed that efficiency decreased related with receiver temperature because of the loss of the radiation which is proportional to the fourth power of receiver temperature as mentioned before. Also, the results of the efficiency for the receiver are decreasing to higher temperature difference and reduced due to loss to continuous exposure to ambient air, as well as loss by convection [19].

The heat loss of the receiver increases as the temperature increases. Figure 9 with the wind speed increases due to contact between the liquid and the tubes with the surrounding air. The loss should reduce the size of the receiver and packaging with thermal wool [18].

In a clear day, when the wind speed is low, the loss is low and the optical energy increases. As a result, the system becomes more efficient as seen in Figure 10 and compatible with the source [18, 19].
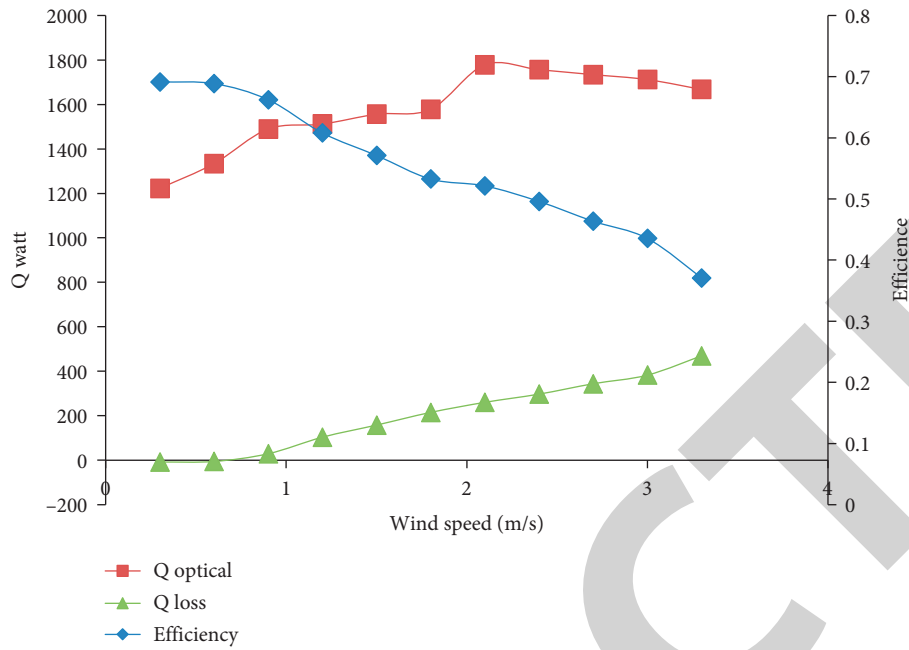
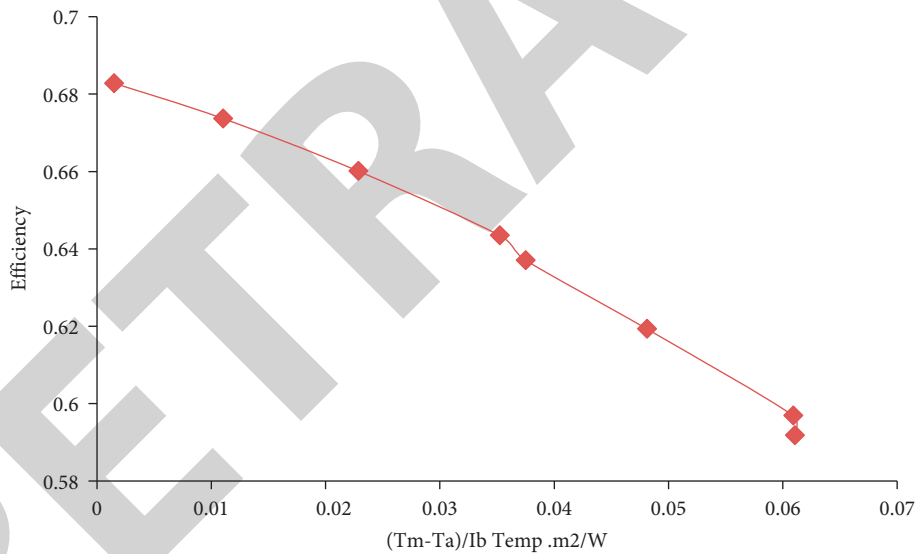FIGURE 10: Relation between efficiency with wind speed.

FIGURE 11: Relation between efficiency with work temperature divided to solar radiation.

From equation (5), the thermal output value was being transferred from the concentrator to the boiler. This results a collector with high efficiency. Figure 11 shows the efficiency of the system due to the work temperature divided to solar insulation. The system is suitable with these parameters and the same with the source [19, 20].

5. Conclusion

The solar dish array concentrator has been produced according to the matching theoretical equation data, based on the theoretical and experimental examination of a closed cycle solar array collector system. The reflectivity of the array concentrator is high (up to 90 percent). The closed cycle with

pump raises the temperature of the output water in the receiver cavity, increasing system operating efficiency, and making it an excellent system for solar thermal to make steam. In Iraq, it is feasible to utilize it for solar thermal.

Data Availability

The data underlying the results presented in the study are available within the manuscript.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this paper.

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