Design and Fabricated of improvement Parabolic Trough Solar Collector

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Abstract. In this research we design Solar radiation is collected by a combination of Parabolic length 6m and Diameter 3m. So the Aperture area will be 15.6m². aluminum Foil Used to reverse sunlight because characterized by high reflexivity (90)% . using a manual moving system to follow the sun solar radiation. This type of solar concentrator is widely used in solar energy. The oil was used to pass in a copper pipe were used to receive heat, long 160m and a diameter (0.48)mm was rolled on a tube of iron with a diameter (6)cm, a number of rolls is 561 roll which was painted in black. Hot oil moves by pump to a thermal transformer that evaporates the water. The system was installed At coordinates (Iraq – Tikrit (°36 '34) (43°45) in the months of February, March and April. It is the time of the spring and these months characterized by moderate temperature. The results showed the efficiency of converting solar radiation into thermal energy stored in oil(54.7). system was tested in the spring months and was the highest temperature reached by the outlet oil (176) The system has stability in the temperature difference of the oil inlet and outlet. The highest thermal capacity was recorded in a month (march) With a value of(8469 ) The highest value of the work as a function of pressure (2) bar.

1. Introduction
Parabolic trough solar collector is concentrations in the form of Parabolic are used to focus the solar radiation in the focal that is shaped along the focal point [1].The sun is the only source of energy as a gas ball with a radius of about (6.96 x10⁸) m and its mass (2x10³²)Kg [2]. Where the intensity of solar radiation falling on the circumference of the earth (1353 Watt/m²) [3]. Solar energy is often used as an alternative to fossil fuels because it is safe, uncontaminated and its techniques are simple [4]. This energy can be converted in several ways, including thermal transformation, photoelectric transformation and biotransformation [5]. Solar concentrators, which work to focus the bright solar radiation on the reflective surface, are used for a specific area known as the focal point [6] and of its kind tower power that use flat mirrors,round concentrates with parabola, cylindrical concentrates with parabola (PTC) [7].

The aim of the research is to design and construct an equivalent parabolic system capable of assembling solar radiation and converting it into heat stored in oil. The advantage of this is to evaporate water with heat exchanger.

2. Experimental Setup

2.1 Collector
Solar radiation is collected by a combination of Parabolic length 6m and Demeter 3m. So the Aperture area will be 15.6m². aluminum Foil Used to reverse sunlight because characterized by high...
reflexivty (90)% , cheap price and easy to use . Where it was pasted on the inner surface of the inverter. Focus center is calculated using the program (Graphical Design of a parabolic Trough concentrator).

2.2 Tracking system
Because the process of solar complexes type PTCS need an effective solar tracking the system is placed on a circular axis on wheels that can be easily move manually by an angle (360°). It can also be moved vertically at an angle (45°-90°).

2.3 Heat exchange type
A copper pipe were used to receive heat, long 26m and a diameter (0.48) mm was rolled on a tube of iron with a diameter (28)cm, a number of rolls is 38 roll. as a heat transfer from the solar collector to the heat exchanger By a small pump . The heat exchanger is made of an iron tank with diameter (30) cm, height (32)cm and thickness 1.5mm hot oil is made in tubes that allow heat to pass through the water which will steam and generate pressure.

2.4 Fluid type
The oil used in the system is of the type used transformer cooling oil, this oil Available in local markets in addition to cheap prices. which is characterized by (70-85) viscosity and with high temperature tolerance, Figure (1) Show the Parabolic Trough Solar Collector.

2.5 Measurement
The system also contains a set of measurement tools and includes , measure the temperature of inlet and outlet of oil and water temperature By using (TES thermometer 1310 type-k) , Measuring the flow velocity of oil By using (Flow meter), Measuring steam pressure By using (Pressure gauge), As well as measuring the intensity of solar radiation By using (The daystar meter).

![Figure (1) Parabolic Trough Solar Collector](image)

3. Results and discussion
The system was installed At coordinates (Iraq – Tikrit (°36’ 34) (43’45) in the months of February, March and April . It is the time of the spring and these months characterized by moderate temperature. Figure (2) shows the temperature of the inlet oil.
Figure 2. Average Value of Solar Radiation and HTF Temperature and HTW Water Storage Temperature with time a: Test at 11 February 2018, b: Test at 13 March 2018, c: Test at April 2018

The temperature of the outlet oil and the temperature of the water in the heat exchanger as well as the intensity of the solar radiation. These data are the average for the spring months. The results showed that the highest value of solar radiation at the hour (12:15). The temperature of the outlet oil has risen in proportion to the high intensity of solar radiation. The temperature of the oil inlet required 1 hours to raise the temperature of the same temperature of water to a temperature proportional to the intensity of solar radiation. This is due to the conversion efficiency of the heat exchanger which is designed to have the highest thermal exchange capacity. Figure (3) shows the change in temperature and the intensity of solar radiation versus time.
The results showed an increase in the value of the change in temperature at the first 3 hour due to a decrease in the temperature of the oil inlet. then take the curve stability, and this means stability of the work System despite the increase in the intensity of solar radiation. Heat Capacity is calculated using equation:

\[ Q = m^o \cdot c_p \cdot (\Delta T) \] ..........................

Where:
Q: Heat Capacity, \( m^o \): mass flow rate, \( c_p \): Specific heat capacity, 
\( \Delta T \): Temperature difference

Figure (4) shows the Heat useful and the intensity of solar radiation versus time.
by using Equation

\[ \eta = \frac{Q}{I} \times 100\% \]

\[ \text{(2)} \]

Where:
\( \eta \): Efficiency, \( I \): Solar Radiation.

Which represent the efficiency of the system in converting the intensity of solar radiation into thermal energy stored in oil, the efficiency curve diagram shown in Figure (5). Where the highest efficiency (54.7).

**Figure 4.** Average Value of Heat Capacity with time: a: Test at 11 February 2018, b: Test at 13 March 2018, c: Test at April 2018
Figure 5. Average Value of The. Efficiency and Exp. Efficiency with time: a: Test at 11 February 2018, b: Test at 13 March 2018, c: Test at April 2018.

The work was calculated as a function of pressure using the equation, as shown in Figure (6).

\[ w = 2.3 \cdot RT \log \frac{P_2}{P_1} \]  

(3)

Where:

\( W \): work, \( R \): Constant, \( T \): Temperature, \( P_1 \): atmospheric Pressure, \( P_2 \): Pressure Steam.
4. Conclusion
Experience has shown that it is possible to build a solar system (6)m length, (2.6m) width, (15.6m) Aperture Area, using cheap, simple and uncomplicated materials. Where the efficiency of converting solar radiation into thermal energy stored in oil (54.7). system was tested in the spring months and was the highest temperature reached by the outlet oil (176) The system has stability in the temperature difference of the oil inlet and outlet. The highest thermal capacity was recorded in a month (March) With a value of (8469) The highest value of the work as a function of pressure (2)bar. The results showed that using oil as a transfer medium is better than using water, where the researcher water in a solar complex similar to the efficiency (51.7%).

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