

# Design and Fabrication of Parabolic Trough Collector

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## ABSTRACT

### Article Info

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The objective of the research paper is to describe the phenomena of parabolic trough collector. The main purpose of our project is to increase the temperature of water by solar collector in the shape of parabolic mirror reflects the incident solar energy on the longitudinal axis of the solar collector. The difference in geometric shape of the parabolic collector helps in large way. Because of this parabolic collector achieve high outlet temperature of the working fluid. And it allows the parabolic concentrator to be integrated with solar thermal system. The thermal analysis of the collector receivers takes into consideration all modes of heat transfer; convection in to the receiver pipe, in the annulus between the receiver and the glass cover and from the glass cover to ambient air conduction through the metal receiver pipe and glass cover walls; and radiation from the metal receiver pipe and glass cover surfaces to the glass cover and the sky respectively.

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## I. INTRODUCTION

Solar energy is the most encouraging alternatives energy source which will meet a significant part of energy demand. Solar energy has its own favourable circumstances, for example, it is accessible free of cost, unlimited, free from contamination, accessible in all parts of the world, and it is accessible in plenitude. One of the approaches to gather solar energy proficiently is by converting it into heat. Solar collector helps in converting solar energy into heat energy. A parabolic trough is a type of solar collector that is straight along its breadth and thickness, lined

with a polished metal mirror or a highly reflecting surface.

## II. METHODS AND MATERIAL

### A. Working principle

Solar radiation from sun falls on concentrator and concentrates on copper tube. Parts of radiations strikes on parabolic concentrator reflect back to copper tube which is surrounded by evacuated glass tube. Evacuated tube surrounded copper tube reduces convection losses. Water flowing through copper tube is natural circulation because of gravity. It absorbs

heat and gets heated. Temperature of water is measured by digital thermometer.

**B. Objective**

**To reduce convection :-** There are outside air which is directly comes in contact with copper tube if tube is open so in order to reduce convectional losses evacuated tube employed.

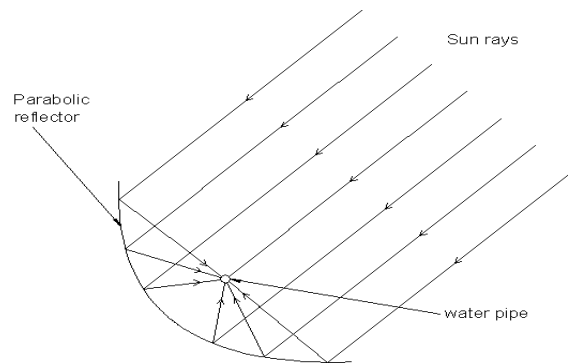
**To reduce losses due to irregularities:-** There are also some radiations scattered due to irregularities on reflector surface so we will try to eliminate this problem use mirror polished stainless steel sheet as a reflector.

**To reduce losses due to improper geometry:-** Geometry of parabola and related factor also greatly influence on performance of collector so that proper geometry of parabola as a reflector is employed in assembly.

**To increase concentration ratio :-** Large concentration ratio enables maximum concentration of solar radiation. So there are always try to increase concentration ratio.

**To increase outlet temperature :-** There are so many applications where maximum temperature of fluid required so using parabola as a collector for maximum solar radiation collections and always increase outlet temperature.

**C. Calculations**



The fig shows parabolic reflector which having dimensions:

Focal length = 150mm

Ark length = 688.75mm

Concentrating area = 60cm × 90cm

Receiving area = 2.5cm × 90cm

$$\begin{aligned} \text{Concentrating ratio} &= \frac{\text{Concentrating area}}{\text{Receiving area}} \\ &= 5400/225 \\ &= 24 \end{aligned}$$

Table 1 : Material Required

Sl. No.	Component	Dimensions
1.	Parabolic trough collector	Length = 900 mm , width = 600 mm
2.	Two Horizontal shaft	Length = 200 mm , Diameter = 15 mm,10mm Material = Mild steel
3.	Bearing housing	Length = 15mm Inner diameter = 25 mm Outer diameter = 30 mm Material = Mild steel
4.	Motor	Torque = 16 kg-cm RPM = 60
5.	Stand	Height = 600 mm Length = 1000mm Material = Mild steel
6.	Internal Storage tank	Length = 300 mm Thickness = 1 mm Diameter = 280 mm Material = Aluminium

7.	Outer casing of tank	Length = 400 mm Thickness = 1 mm Diameter = 320 mm Material = Sheet metal
8.	Insulation	Thickness = 6mm Material = Cotton
9.	Reflective surface	Thickness = 0.6mm Material = Stainless Steel
10.	Absorbing pipe	Outer diameter = 12 mm Thickness = 0.5 mm Material = Copper
11.	Ball Bearing	Outer diameter = 25 mm Inner diameter = 10 mm Thickness = 10 mm

to the concentrator frame on both sides in ball bearing. The worm is fabricated on lathe, first operation - turning for getting require diameter, second operation - threading for making teeth of worms, third operation - step turning on both sides for fixing bearing, fourth operation - step turning to fix the coupling. An aluminium rod is firstly fixed on lathe machine and following operation has been done, 1 Facing, 2 Step turning, 3 Taper turning, 4 Drilling.

### III. RESULT AND DISCUSSION

The thermal efficiency of the collector is strongly related to atmospheric conditions, like the direct solar radiation, the room temperature and the cloudiness. The maximum output temperature was 62 °C at 1:30p.m with a direct solar radiation of 783.58 W/m<sup>2</sup> and minimum was 34.5°C at 11:4 p.m with a direct solar radiation of 16.17 W/m<sup>2</sup>.

#### D. Line diagram

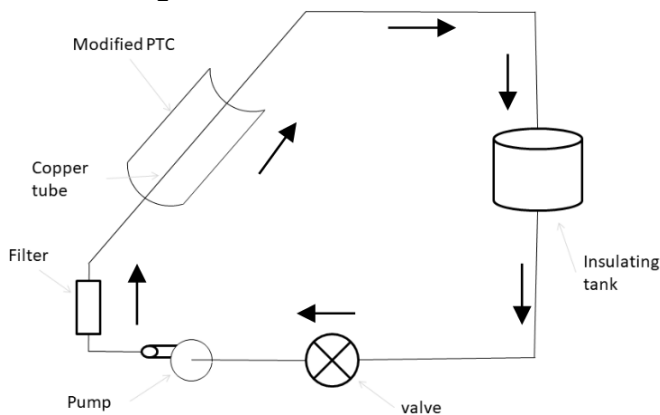


Fig: - Line diagram of PTC

#### E. Fabrication of Model

The stand contains four vertical legs which carry the load and four inclined legs which act as a support for stand. The legs are welded together by leg connecting plate. The frame was fabricated by using Mild steel flats, and it bended manually using hammer. Stainless steel sheet was used as a reflector surface to concentrate sunlight. The horizontal shaft is welded

#### Advantages

- 1) NO fuel required
- 2) NO Pollution and global warming effects
- 3) Sunlight available for free of cost
- 4) Predictable, 24/7 power

#### Applications

- 1) It can be used for steam generation by using multistage PTC
- 2) It can be used as a drier
- 3) Automatic solar tracking system with the timer will be employed
- 4) Electric generation by employing additional equipment
- 5) Used as a water filter

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