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"DESIGN DEVELOPMENT AND ANALYSIS OF SOLAR PARABOLIC TROUGH HEAT COLLECTOR"

AZAD KUMAR MISHRA[1], AMOL TRIPATHI[2]

[1]Research Scholar, Dept. of Mechanical Engineering, Rewa Institute of Technology, Rewa, Madhya Pradesh, India.
[2]Asst.Professor, Dept. of Mechanical Engineering, Rewa Institute of Technology, Rewa, Madhya Pradesh, India.

Abstract - *Compound Parabolic Concentrator with circular glass protected to absorber with stainless steel tubing inner and parabolic reflectors is first designed and then fabricated and also thermal overall performance analysis. Here the incident rays, after mirrored image from the reflector, aren't centered at a factor however are simply accumulated on a line of absorber floor. Layout of compound parabolic trough sun rays collector (CPC) without monitoring is presented on this work. The thermal performance is obtained that is between (80%-85%) with glass cover at mass go with the flow charge 1 ml/sec at awareness without want to monitoring system. Effects are calculated for Indore metropolis by using the use of manufactured prototype. CPC is commonly oriented in E-W direction. The top part of the reflector does no longer intercept a great deal radiation and saves a large quantity of reflector fabric with simplest a little loss in attention. Design and fabricate CPC model for a half acceptance angle θc= 68.38º to achieve higher concentration. Receiver designed includes stainless-steel tubing of about 21 mm ID to control water flow rate and to obtain high output temperature of water. Also an optimum mass flow rate for maximum efficiency is evaluated experimentally.*

Key Words: **CPC(Compound Parabolic Concentrator)**

1.INTRODUCTION

In present, energy is primary demand for human culture. The country within which a lot of energy produce is a lot of developed than alternative. Energy is incredibly necessary for doing any work. All the energy sources we have a tendency to square measure victimization nowadays is classified into 2 groups; renewable and non-renewable. Renewable energy comes by natural processes which are resupply constantly. In its numerous forms, it derives directly from the sun. Energy generated from solar, wind, ocean, tidal, hydropower, biomass, energy resources, bio fuels and hydrogen is renewable resources. Non-renewable energy is energy sources that can't resupply within the close to future like coal, oil, oil and gas. Renewable and non-renewable energy sources are accustomed produce secondary energy sources as electricity. Energy is one among the crucial inputs for socio-economic development the rate at which energy is being consumed by a nation typically reflects the amount of prosperity that it might come through and total energy consumption has enhanced along with economic and population growth and, at a similar time, varied environmental issues related to human activities became more and more serious. Additionally to a rise in value of fuel product and resources are going to be exhausted in an exceedingly comparatively short amount of your time. These high costs of fuel resources square measure poignant economic and social development worldwide. The impact of energy crises is especially felt in less developed countries where a high percentage of national budgets for development should be pleased to the purchase of fuel product. to reduce the dependency on foreign fuels with high worth, most countries have initiated programs to develop energy sources supported domestic renewable resources. In order to attain the goals of property development, it's essential to attenuate the consumption of finite natural resources and to mitigate the environmental burden to among nature's restorative capability. There is currently a global accord that the new sources of energy need to be renewable to satisfy the global energy demand within the long run. Solar thermal power plants square measure one among the foremost promising choices for renewable electric power production. not like traditional power plants, concentrating solar energy systems offer an environmentally friendly supply of energy, produce nearly no emissions, and consume no fuel other than sunlight. The goal of this project is to identify general strategies and specific design ideas for achieving increased collector efficiency. This thesis has investigated enhancements within the design of a parabolic trough module by wanting 1st at the structural conception of the collector to scale back quality whereas maintaining structural stability. The water is applied because the heat transfers fluid in an exceedingly solar parabolic trough collector system. Firstly, the system dynamic model was established and valid by the important in operation information in typical summer and spring days in references. Secondly, the alteration characteristics of

much radiation, recess water temperature and rate of flow are analysed and compared with the standard operating condition. The model use for learning, system design, and much understanding of the performance of parabolic trough systems.

2. RESEARCH OBJECTIVE

The general objective of this research is to design, manufacture and by experimentation investigate the performance of the model parabolic trough solar energy generation system. The experimental investigation determines the temperature variations of the current fluid, the solar energy absorption rate, the temperature variations of the ambient temperature and therefore the instant efficiency of the system as a perform of time.

2.1 THE SPECIFIC OBJECTIVE:-

1. To make cost effective solar trough collectors that it's affordable to common person.

2. To develop a robust system that amounts to a minimum maintenance during its operation

3. A system capable of operation under transient solar conditions like clouds, dust storm.

3. METHODOLOGY

Literature Survey: Books, journals and articles are reviewed in solar technology, performance improvement and the current solar technology practice of different countries.

• Prototype Design: A prototype of the parabolic trough is designed with some specified dimensions. To simplify the design process, appropriate software is used. The applied software also helps to visualize the prototype before manufacturing.

• Manufacturing prototype: After the design process is completed, the prototype is manufactured. Based on the design parameters and design materials, the prototype of the parabolic trough is manufactured in the Mechanical Engineering Department workshop.

• Installation of Prototype: The prototype of the parabolic trough is installed at the site very close to the Mechanical Engineering Department.

• Experimental Investigation: After the prototype is installed, experimental investigation were conducted by recording data.

• Analysis and Interpreting the Result: The test results are compiled and compared with the results obtained using a mathematical model to check the validity of the result & compare all the result.

3.1 DIMENSIONAL MODELLING OF THE SYSTEM

The Parabolic concentrating collector assembly was modelled by using CRE-O

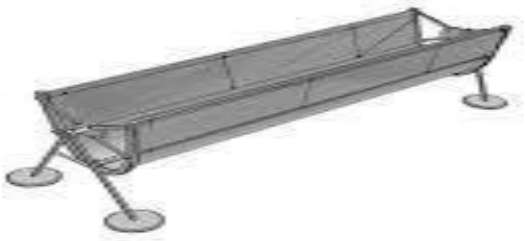


Fig -1: Solar Parabolic Trough Collector Assembly

Component	Typical dimension
Diameter of tube (od)	25 cm
Width	80 cm
Focal Length	30 cm

Length	260 cm
Aperture Area	20800cm^2

Individual components were designed in 3 D and then were assembled.

3.2 THE COMPONENTS MODELLED WERE

1. Support structure
2. Absorber support
3. Absorber pipe along with glass cover
4. Reflector sheet

3.3 EXPERIMENTAL MEASUREMENT AND CALCULATION FOR STAINLESS STEEL RECEIVER WITH GLASS COVER WITH THE HELP OF TABLE

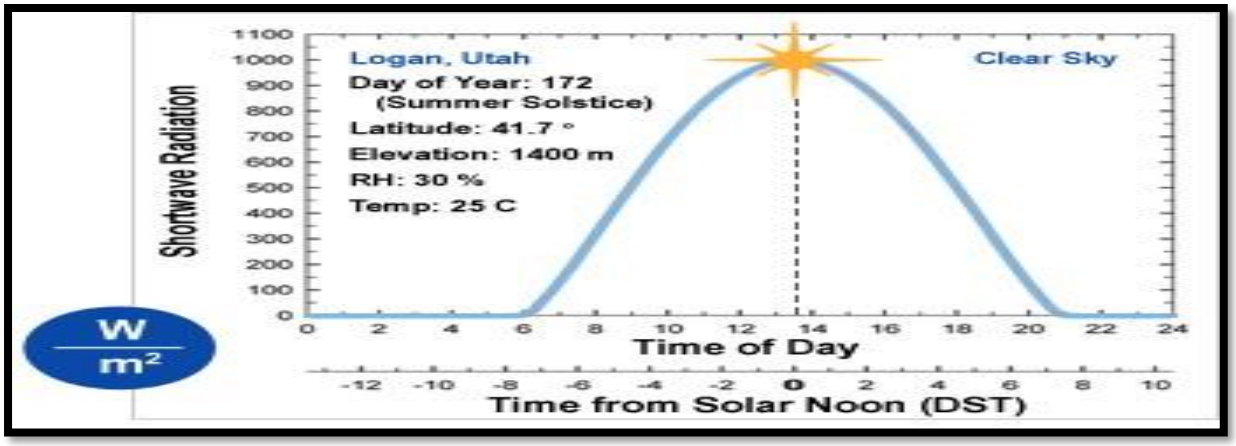
Time (hours)	Tamb(K)	Tin(K)	Tout(°K)	ΔT (K)	Collector efficiency (%)
09:30	302	310	333	23	78
10:30	304	310	340	30	79
11:30	307	311	351	40	81
12:30	309	314	358	44	81.78
13:30	**309**	**314**	**373**	**59**	**85.29**
14:30	308	311	363	52	82
15:30	307	309	352	43	81.64

Mass flow rate, 1.ml/sec, ambient temperature; Tin, inlet fluid temperature; Tout, outlet fluid temperature; ΔT, temperature gradient.

Solar radiation –

Time	Solar Radiation W/m^2
12:15	960
12:19	920
12:48	984
01:19	930
01:30	1080
01:58	1020
02:04	1010

Average radiation coming from the son (G) = 968w/**m**



Graph: Solar radiation Vs time

3.4 EXPERIMENTAL SETUP AND TESTING

The experimental setups used for testing the manufactured SPTC's are shown schematically in Figure. In this experiment, water was filled from one end of the SS absorber pipe with other end opened. The temperature of water was measured by using electronic thermometer and tabulated for every hour from 09:00 am to 04:00 pm.

4. CONCLUSIONS

The parabolic trough solar collector system is mainly used for the power production as the temperature of steam coming from it is very high. It is also used for water heating, air heating and other applications as well. The CPC technology can be very useful for the water heating applications if cost of the system is reduced to some extent. In this proposed work there is a use of systems approach (Graphical approach) for the evaluation, comparison, ranking and optimum selection of the CPC system. Following conclusions can be drawn from the proto type testing:

Use of circular receiver with stainless steel tubing yields overall efficiency of about 80% - 85% use of glass cover to the receiver Maximum efficiency obtained is nearly equal to 85%. The effect of increase in mass flow rate of water on the performance parameters such as efficiency and outlet temperature is discussed. As mass flow rate increases, efficiency first increases, reaches maximum value and then starts to decrease while we use the constant flow rate 1 ml/sec.

RECOMMENDATION

• The parabolic trough is tested using water as heat transfer fluid. For future work, it is recommended that oil be used as heat transfer fluid.
• The utilization of renewable energy in Bharat should be increased, as there is a global concern that the developing nations could be faced with energy crisis and global warming. It is expected that more damage and pollution of the environment will continue.
• Parabolic trough solar collector is one of the options for renewable energy and this technology should be adopted in industries that utilize fossil fuel for water heating and steam generation.

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