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Multi- Tube Direct Steam Generator – Advancement in Solar Energy Utilization

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Abtsract: Parabolic trough collectors are the most mature solar power technology; however no large scale plants have been built in over a decade. In the view of lengthy in deployment, the Project objective is developing an improved trough technology for near term deployment and closely patterned after the best of the prior-generation troughs. The objective of the present study is to develop, design, construction and testing of a parabolic trough collector system, using concentrator collector heat from the sun is concentrated on a black absorber located at focus point of the reflector in which water is heated to a very high temperature to form steam [1]. This can be achieved by increasing the length of the absorber tube and the exposure area. It consists of several phases, from contracting and feasibility, through design, construction, operation and analysis of a system. It also describes the tracking system unit by manual tilting of the lever at the base of parabolic trough to capture solar energy. The obtained results from this method are discussed with other available methods.

Key words: Solar collectors · Reflecting surface · Absorber

INTRODUCTION

Nowadays, parabolic trough solar energy generation systems (SEGS) feature directly irradiated tubular heat collection elements (HCE) that transfer enthalpy to a heat transfer medium (HTM). The collector field consists of many parabolic troughs and receivers and the hot HTM is collected in a manifold. Steam is generated by exchange with the HTM in a power block separate from the collector field. It greatly increases the collector equipments and consequently the cost parabolic trough collector field [1]. And also it is very difficult to clean to oil surfaces which require a special waste treatment. Our objective is replacing the collector field and steam generator with a smaller number of parabolic reflectors and Multi-Tube receivers incorporating direct steam generation [2].

Problem Identify and Solution: In the view of this, present study focus Multi- Tube direct steam generator (MTDSG) to convert liquid into thermal energy. The Multi-tube receiver combines multiple tubes with a single receiver surface [3]. In the same fashion as current HCEs, sunlight is absorbed by the outer surface of the receiver. The receiver contains a tube bundle, within which steam is directly generated. A Multi-tube direct steam generator consolidates two major functions in a solar electric generation system:

- It combines multiple heating tubes into a single irradiated receiver;
- It eliminates the separate steam generation block [4]. Such process intensification directly reduces the capital and operating costs of the parabolic trough collector field, the single most expensive component of an SEGS, as well as the cost of the power block.

Fabrication Process of Solar Panel

Making of Supporting Structure (Frame): The material selected for frame is Mild Steel which has very hard, weld able, ductile and high load bearing capacity. The sequences of operations carried out are:

The parabolic profile is generated using flats in hydraulic bending machine according to the required numbers (4). Then the parabolic profiles are assembled in a mild steel passing through the centre of the parabola [5]. Both the ends of the pipe are supported so that it can be tilted at any direction. A slot is provided at one end of the parabolic setup to lock the trough at the required angle. Two vertical arms made of stainless steel are provided at the edges to support the receiver tube. The receiver tube is covered by borosilicate glass tube edges being sealed with aluminum bush and the air gaps are sealed using high Temperature sealant.

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Gluing of Reflective Film over Aluminum Sheet: The sequences of process involved are:

- Cleaning the sheet with soap oil.
- Passing the aluminum sheet between the rollers with a line speed of 10-25 rpm.
- Gluing the reflective film.
- Roller temperature should not exceed 65ºc.
- The edges must be sealed using polyurethane protective tape.

Making of Receiver Tube: Copper is well suited for absorbing the heat available since it has a thermal conductivity of 394 W/my next to silver. The Copper tubes are cut according to the required length and the tubes are connected using 'U' bends. Then brazing is done at the edges of the connected 'U' bends. After these the tubes are coated using black chrome which has high heat absorbing capacity with negligible remittance [6]. Then it is placed inside the glass tube with minimum clearance between them.

Making of Bush: The material that has been selected for making bush is aluminum, because it has less weight and good corrosion resistance. O rings have been put on the bush to provide a seal between glass tube and copper tubes. Then the holes for inlet and outlet are drilled in the bush according to the required dimensions.

RESULTS AND DISCUSSION

For Continuous Flow of Water:

Mass Flow Rate = 0.0625 kg/sec Time: 10.00 to 11.00 a.m.
Temp Vs. time for m = 0.0625 kg/s

Using the above values the graph is plotted between time and temperature the below graph shows the temperature increases gradually with respect to time. The maximum temperature obtained is 70°C. There is no pressure rise indicated and no sign of steam formation.

Similarly for Various Timings and Mass Flow Rate Results Were Analyzed: Stagnation Condition

The above below shows that there is an increase in pressure corresponding to temperature rise in stagnant condition. The maximum temperature obtained is 134°C and dry steam is generated. The temperature rise depends on the climatic conditions.

Table 1: Time Vs Temperature

Time in Minutes	Temperature in °C
0 - 5	56
5 - 10	58
10 - 15	58
15 - 20	60
20 - 25	61
25 - 30	64
30 - 35	65
35 - 40	67
40 - 45	68
45 - 50	69
50 - 55	69
55 - 60	70

Table 2: Pressure Vs Temperature

Pressure in Bar	Temperature in °C
0.5	82
1	101
1.5	111
2	121
2.5	129
3	134

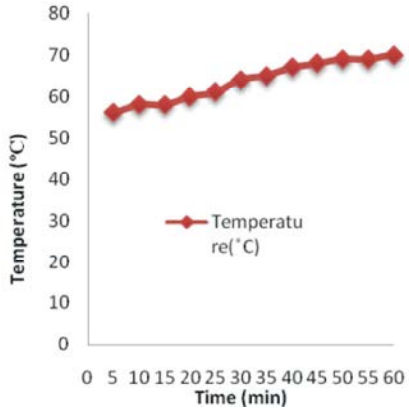

Fig. 1: Variation of Temperature Vs Time when m = 0.0625 kg/s

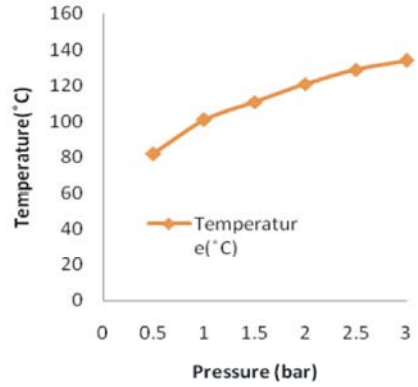

Fig. 2: Variation of Pressure Vs Temperature in Stagnation Condition

CONCLUSIONS

Direct Steam Generation developed a prototype for multi tubes. The proposed work is capable enough to generate steam directly from water without using any auxiliary equipment which directly reduces the cost of the parabolic collector. Further modifications can be done by using some advanced materials and improved design to increase the pressure and temperature of the proposed design [7]. These theoretical results are well considered as input parameters for further development of the experimental work.

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