AN INVESTIGATION ON NANOCOATING TUBES FOR SOLAR FLAT PLATE COLLECTOR WITH DIFFERENT MATERIALS AND PEBBLES AS ABSORBERS

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Abstract—At the outset, it is well known that utilization of energy and safety of energy are greatly interrelated and matches to a major concern in the Indian energy sector. Basically, India is a country which is called tropical region with abundant solar energy. Hence there is a chance of harnessing solar energy directly using solar thermal conversion systems like solar heaters. This paper addresses about a powder chemical-based technique to prepare solar absorber nano coating mixture gel consisting of black paint, titanium dioxide, nickel aluminium amalgam with acetone as the binder. This work mainly focuses to improve the absorber temperature and performance by applying nano coatings to the tubes of flat plate collectors to enhance heat transfer coefficient. In this work, an attempt is made on different mix of composition of nano coatings to apply on flat plate a collector tube which leads to high absorptivity of renewable energy. Finally, the outcomes of this paper is focused on high absorbing factor, raise in temperature, to increase the performance of solid flat plate collector.

Keywords—Solar energy, nano coating, absorbing temperature, flat plate collector

I. INTRODUCTION

SOLAR COLLECTORS

Sunlight based energy authorities are uncommon sort of warmth exchangers that change sun based radiation energy to inside energy of the shipping medium. The significant element of any solar planetary system is the sunlight collectors. This is a gadget which assimilates the approaching sunlight based radiation, changes over it into warmth, and moves this heat to a liquid (typically air, water, or oil) moving through the collector. Flat plate collector is one of the significant sunlight based energy catching gadget which uses air or water as working fluid[1]. The sun based energy accordingly collected is conveyed from the coursing liquid either straightforwardly to the high temp water or space conditioning equipment[2] or to a heat energy stockpiling tank from which can be drawn for use around evening time or potentially shady days.

There are fundamentally two sorts of sun oriented collectors: non-concentrating or fixed and concentrating. A non-concentrating collector has a similar area for blocking and for retaining sunlight based radiation, while a sun-tracking concentrating sun based collector typically has bowl shaped reflecting surfaces to catch and focus the sun’s ray [3] radiation to a pin point receiving area, along these lines expanding the radiation transition. An enormous number of sun powered collectors are accessible on the lookout. Run of the utilisations of the different kinds of authorities are introduced to show degree of their pertinence. These incorporate sunlight based water heating, which contain thermo siphon, coordinated collector storage, direct and secondary systems and air systems, space warming and cooling, which include, space warming and service high temp water, and heat siphons, refrigeration, industrial cycle heat, which involve air[6] and water frameworks and steam generators, desalination, which contain the parabolic box, power tower, sun heaters, and science applications. As can be seen sun energy systems can be utilized for a wide scope of utilisations and give huge advantages, consequently, they should be utilized at whatever point conceivable.

II. COMPONENTS OF SOLAR FLAT PLATE COLLECTOR:

Flat plate collectors are the most well-known sunrays collectors for sun powered water warming systems in homes and sun based space heating. A regular flat plate gatherer is a protected box with a glass or plastic cover (frequently called Glazing) and a dim shaded absorber plate.

Sun powered collectors ingests the approaching sunlight radiation[4], changing over it into thermal energy at the retaining surface, and moving the energy to a liquid coursing through collector. Fundamental components of sun oriented flat plate fluid collectors are shown in Fig 1a, 1b and 2.
Fig. 1: liquid flat plate collector without pebbles

Fig. 2: components of liquid flat plate collector

III. DEVELOPMENT OF THE SOLAR FLAT PLATE COLLECTOR WITH NANO COATINGS

Fig 3: Applying coating to brass, steel, copper and aluminum tubes
Fig 4: Liquid flat plate collector with different nano coating tubes and pebbels

Authors have developed new arrangement of flat plate tubes by replacing copper tubes with steel and aluminum tubes for a new flat plate tube Skelton to assess [5] the performance of Flat plate collector. It is noticed that for applying nanocoating to steel tube to cumbersome because of less adherence of nanocoating mixture (black paint, titanium dioxide, nickel aluminum alloy with aceton as the binder) to steel tubes. Hence each steel tube is degreased before applying coating to it as shown in fig 3, it is observed that steel tubes and aluminum tubes are attached to Skelton of flat plate and leak proof verification is done. Further, the skelton in fixed in the flat plate collector body and filled with different size pebbles.

By its nature, subsurface (sometimes called “body”) reflection is a scattering reflection. While polishing will cause all of the surface reflecting light to go in the same direction, there isn’t much you can do to stop subsurface reflection from scattering. Different materials absorb light of different colours, and allow others to pass, so light that undergoes subsurface reflection picks up some colours.

IV. RESULTS AND DISCUSSION

Case Study - I  Temperature readings of continuous flow without pebbles.

The test is conducted on a sunny day (25/03/2019). The test conducted is the absorption performance of the coated brass, aluminium and copper tubes.

<table>
<thead>
<tr>
<th>Description</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature</td>
<td>36oC</td>
</tr>
<tr>
<td>Material of the tubes</td>
<td>Brass, aluminum and Copper tubes</td>
</tr>
<tr>
<td>Quantity of water used</td>
<td>100 litre</td>
</tr>
<tr>
<td>Initial temperature of water</td>
<td>34oC</td>
</tr>
<tr>
<td>Coatings used</td>
<td>Black paint.</td>
</tr>
</tbody>
</table>

The below readings of different metals of continuous flow without pebbles on the date of 25/03/2019 are obtained as: Table 4.1 Temperature readings with variation of time without pebbles on 25/03/2019
<table>
<thead>
<tr>
<th>Timings</th>
<th>Initial Temperature</th>
<th>Brass Flowing Fluid Temperature</th>
<th>Aluminum Flowing Fluid Temperature</th>
<th>Copper Flowing Fluid Temperature</th>
<th>Steel Flowing fluid temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:30 – 10:45 AM</td>
<td>34ºC</td>
<td>41ºC</td>
<td>39ºC</td>
<td>38ºC</td>
<td>40ºC</td>
</tr>
<tr>
<td>11:00 -11:15 AM</td>
<td>34ºC</td>
<td>42.3ºC</td>
<td>40.5ºC</td>
<td>40ºC</td>
<td>40.5ºC</td>
</tr>
</tbody>
</table>

**Fig 4.1: Graphical representation of temperature readings on 25/03/2019**

**Inference:** The table 4.1, figure 4.1 clearly states the representation of the temperature readings obtained on coated steel tubes being used. Initial temperature of water is 34ºC and the results clearly show the temperature gradually increasing with respect time on 25/03/2019.

**Case (b): Temperature readings of continuous flow with pebbles.**

The below readings of different metals of continuous flow with pebbles on the date of 25/03/2019 are obtained as:

Table 4.4 Temperature readings with variation of time with pebbles on 25/03/2019

<table>
<thead>
<tr>
<th>Timings</th>
<th>Initial Temperature</th>
<th>Brass Flowing Fluid Temperature</th>
<th>Aluminum Flowing Fluid Temperature</th>
<th>Copper Flowing Fluid Temperature</th>
<th>Steel Flowing fluid temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:30 – 12:45 PM</td>
<td>34ºC</td>
<td>46ºC</td>
<td>44.5ºC</td>
<td>44ºC</td>
<td>45ºC</td>
</tr>
<tr>
<td>1:15 – 1:30 PM</td>
<td>34ºC</td>
<td>48ºC</td>
<td>46ºC</td>
<td>45ºC</td>
<td>46ºC</td>
</tr>
</tbody>
</table>
**Inference:** The table 4.2, figure 4.2 clearly states the representation of the temperature readings obtained on coated steel tubes being used. Initial temperature of water is 34°C and the results clearly show the temperature gradually increasing with respect to time on 25/03/2019.

**V. CONCLUSION**

The experimental investigation reveals that the performance of brass tube is better than copper and aluminum tubes but it is noticed that the aluminum tube also performing equally against brass with coating rather than without coating. Hence it is recommended that brass and steel tubes with coating after degreasing can be used in flat plate collector.

**REFERENCES**


