IMPLEMENT OF SOLAR ENERGY IN THERMAL POWER STATION FOR INCREASE SENSIBLE HEAT OF MAKEUP WATER FOR SAVE THE CONVENTIONAL ENERGY, A REVIEW & CASE STUDY

Prakash Kumar Sahu\(^1\)  
Department of Mech. Engg  
UIT-RGPV Bhopal  
hpprakash2286@gmail.com

Prof. Dr. A. C. Tiwari\(^2\)  
Department of Mech. Engg  
UIT-RGPV Bhopal  
aseemctiwari@yahoo.com

ABSTRACT

Solar energy is the most abundant non conventional source of energy, this study carried out to obtain a clear understanding of modern concept and access its uses in Thermal Power Station. To evaluate the Sensible heat of Makeup Water in Thermal Power Station by the using of solar energy. The study shows that the method commonly applied for increasing the temperature of Makeup Water by help the process of Evacuated Tube Solar Water Heater. It shows that this method is achieving an optimum efficiency by using nonconventional source of energy & save conventional energy consumption.


INTRODUCTION

*Sensible Heat*: Heat that changes the temperature of a substance when added or subtracted from the substance. \((0^\circ \text{C}-100^\circ \text{C})\). Solar energy, radiant light & heat from the sun, has been harnessed by humans since ancient times using a range of ever-evolving technologies. Solar radiation along with secondary solar-powered resources such as wind and wave power. Hydroelectricity and biomass, account for most of the available renewable energy on the earth. Only a minuscule fraction of the available solar energy is used. Solar powered electrical generation relies on heat engine & photovoltaic. Solar energy uses are limited by humans ingenuity. A partial list of solar application include space heating and cooling through solar architecture. Potable water via distillation and disinfection, daylighting, solar hot water...
Solar Collector:- It consists of an absorber plate which receives solar radiations through one or more transparent glass cover. Solar collector mainly classified in two types:

1. Concentric type: In concentrating type solar collector the radiation of beam collected at one point. As parabolic dish, solar trough.[3]
2. Non concentric type: In non concentrating type the collector area (the area that intercepts the solar radiation) is the same as the absorber area as.
   (A) Flat plate collector,
   (B) Evacuated tube.

Evacuated tube:- Evacuated tube do the work based on solar water heating system, it is most energy efficient and cost effective system, this system maintain the temperature (60°C-120°C), the life of the Evacuated tube is 20 to 25 years, Evacuated tube acts as an absorber in the solar water heater, each evacuated tube consist of two glass tubes made from extremely strong borosilicate glass. The tube has very low reflectivity and high transmivity that radiation can pass through. The inner tube has a layer of selective coatings that maximize absorption of solar energy and minimize the reflection, thereby locking the heat. the ends of tube are connected to the copper header are fused together and a vacuum is create between them. This process is called the evacuation, as by definition, it means the air is pumped out from the cavity. Vacuumed is created for recreate the thermos flask effect as vacuum acts as an insulator and does allow short wave radiation to escape through the glass tube. This traps the solar radiation much more effectively and hence can higher temperature can be achieved it means that the evacuated tube collector have a capacity to perform better than the flat plate collectors in cold and coldly climates. On the internal surface of the borosilicate glass tube there is a absorber plate which collects the radiation that passes through the glass layer this absorber plate is mostly of aluminium or copper as both of these metals have a high reflectivity and transmivity quotient. it is also painted black so as to allow it to absorb maximum amount of solar radiation. in this system number of tube connect on the array in which flow the water, and number of array connect by the storage tank[2].

Character of evacuated tube material:

1. Borosilicate glass very low reflectivity and high transmivity of radiation.
2. The inner tube selective coating so maximize absorption.
3. And minimize the reflection of solar rays.
The Evacuated tube maintains the temperature by taking six hour direct radiation of the sun in any season given below:[2]

<table>
<thead>
<tr>
<th>Season</th>
<th>Atmospheric Temperature</th>
<th>Temperature Rise</th>
<th>ΔT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>35°</td>
<td>83.33°</td>
<td>48.33°</td>
</tr>
<tr>
<td>Rainy</td>
<td>30°</td>
<td>71.60°</td>
<td>41.6°</td>
</tr>
<tr>
<td>Winter</td>
<td>20°</td>
<td>60°</td>
<td>40°</td>
</tr>
</tbody>
</table>

Table:1 Evacuated tube maintained the temperature

**LITERATURE REVIEW**

It is well recognized that in order to increase the efficiency of solar thermal power plants, solar selective coating switch high thermal stability are required. In recent years, significant efforts have been made in the field of solar selective coatings to achieve high solar absorptance and low thermal emittance at higher temperatures. Transition metal based cermet have emerged as novel high temperature solar selective coatings, which are currently being used for solar thermal power plants for electricity generation. Mid- and high temperature solar selective coatings. Among these, the sputtering technique has been used successfully to deposit these. Coatings on large area substrates such as flat-plate collectors and evacuated tubes and have been commercialized widely used for heating water [3]. Design simulation construction and measured initial performance of solar water heater study by A.Walker.& F-Mohjuri. For the installed at the top of the flour establish hot water collector recirculation loop in the social security, administration where the solar radiation available then find that the evacuated tube collector and active control successful in operation. So increase temperature of solar water collector[4]. The inclination of the evacuated tube tilt angle according to condition 15° to 90°[5]. Solar one produced 10MW of electricity. It was completed in 1981 and produced power from 1982 to 1986. In 1986, the worlds largests solar thermal electricity facility begein to be built in california Mojave Desert. The LUZ solar energy generating station (or LUZ -SEGS) contains rows of mirrors that concentrate the suns
energy on to a system of pipes circulating heat transfer fluid. The heated transfer fluid is used to produce steam, which powers a conventional turbine to generate electricity[6]. More than 300MW of solar thermal electricity were built before the company had financial difficulties and was sold. They are still producing power today, 20 years later. In 1996, US Department of Energy and an industry consortium begin operating solar two an upgrade the solar power tower until the project end in 1999[7].

When I visit the Thermal Station, I analyze that the sensible heat of Makeup water are at the level of atmospheric temperature. After the above study I thought that, if we use Evacuated tube types of solar heater, the temperature of sensible heat of DM makeup water rises.

**WORKING PROCESS AND EXPERIMENTAL SETUP**

The Evacuated tube do the work in solar thermal energy conversion system, if we use this system in 6MW thermal power station, the water available from the sea or river, which treatment in the Treatment plant, after treatment send the Makeup water tank in the Makeup water storage tank, in 6MW plant WATER require 16000 litre per day, we implement solar collector Evacuated tube type for 16000 litres. total 32 solar arrays use in every solar arrays 60 Evacuated tube fitted capacity of each array is 500 liter water heated. the dimension of each solar array is 12 feet\times 13 feet. the tank require capacity of 20,000 litre storage of hot water. Here temperature of Makeup water at the atmospheric temperature, to maintain the temperature of Makeup water (35°C-90°C) with the help of Evacuated tube, for increase the sensible heat of the water before inter the boiler. Evacuated set in this system after the storage tank, to where pass the makeup water to the tube, in the storage tank the temperature of water 35°C, after passes the evacuated tube temperature of Makeup water, we find after that direct radiation of the sun light find the temperature of water 83.33°C, 71.6°C, 60°C summer, rainy, and winter season respectively. After maintain this temperature water send to the Thermal Power Plant cycle. In which water convert into steam in the boiler, in next process steam send to the turbine.

![Flow diagram of the working process.](image)
Calculation

Take the temperature of Makeup water 35\(^0\)C at the normal condition, and then maintain the temperature by Evacuated tube as given below in the table:

<table>
<thead>
<tr>
<th>Season</th>
<th>Atmospheric Temperature</th>
<th>Temperature Rise</th>
<th>(\Delta T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>35(^0)C</td>
<td>83.33(^0)C</td>
<td>48.33(^0)C</td>
</tr>
<tr>
<td>Rainy</td>
<td>35(^0)C</td>
<td>71.60(^0)C</td>
<td>36.6(^0)C</td>
</tr>
<tr>
<td>Winter</td>
<td>35(^0)C</td>
<td>60(^0)C</td>
<td>25(^0)C</td>
</tr>
</tbody>
</table>

Table: 2 .evacuated tube maintained the temperature on working process

For increasing the temperature of makeup water required heat can be calculated by this equation:

\[
Q = mC_p (T_{out} - T_{in})
\]

\(Q = mC_p\Delta T\), Where \(Q\) = heat required for heat the water, \(C_p = \) specific heat at constant temperature, \((C_p = 4184 \text{ J/kg } ^\circ\text{C})\)

\(T_{out} = \) temperature of water out to the evacuated tube,
\(T_{in} = \) temperature of water inter in the evacuated tube,
\(\Delta T = \) temperature difference between out let & inlet water

**For 6MW power plant**

Makeup water required per 24 hours (one day) \(m = 16,000\) litres
Temperature of makeup water at atmospheric condition = 35\(^0\)C

**Case-I**

Required heat \(Q\) for increase the temperature from 35\(^0\)C to 83.33\(^0\)C in 24 hours (one day) for 16,000 litre is given by \(Q = 16000 \times 4184 \times 48.33\)

\(Q = 3235403520\) J (772762.8547 kilo cal.)

Let in summer season working day of power station =115 days

So save energy in summer season = 88867728.29 kilo cal.

**Case-II**

Required heat \(Q\) for increase the temperature from 35\(^0\)C to 71.60\(^0\)C in 24 hours (one day) for 16,000 litre is given by, \(Q = 16000 \times 4184 \times 36.6\)

\(Q = 2450150400\) J (585208.369 kilo cal.)

For rainy season let the working day of power station =115 days

So saved energy in rainy season = 67298962.45 kilo cal.
Case-III

Required heat $Q$ for increase the temperature from $35^\circ C$ to $60^\circ C$ in 24 hours (one day) for 16,000 litre is given by $Q = 16000 \times 4184 \times 25$

$Q = 1673600000$ J ($399732.4926$ kilo cal.)

For winter season let the working day of power station = 115 days, So saved energy in winter Season $= 45969236.65$ kilo cal.

RESULT

If we use of Evacuted tube type solar water heater in 6MW thermal power station for saving energy for sensible heat of makeup water in working day of different season(take 115 day/season) that is given below in the table:

<table>
<thead>
<tr>
<th>Season</th>
<th>Save energy (kilo cal.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>88867728.29</td>
</tr>
<tr>
<td>Rainy</td>
<td>67298962.45</td>
</tr>
<tr>
<td>Winter</td>
<td>45969236.65</td>
</tr>
</tbody>
</table>

Table: 3 Energy save in difference season

Total saved conventional energy in duration of one year $= 202135927.40$ kilo cal.

Life of an evacuated tube is 20 to 25 years so energy saving by this system can be 20 to 25 years at a rate of $202135927.40$ kilo cal./year.

CONCLUSION

Solar thermal energy is expected to emerge as an important source of renewable energy for meeting the ever-increasing energy requirements of the world. In this regard, there is an increasing demand for spectrally selective coatings for mid-temperature as evacuated tube for solar heater applications.Due to this process we find that the any power station reduces the fuel consumption in the boiler, so reduce the fuel cost for sensible heat of water also reduces the maintenance cost due to this 20 to 25 years life of the tube. This system also not only controls the green house effect but also controls the enviromental pollution such as $\text{NO}_x$, $\text{CO}_x$, $\text{NH}_x$.

FUTURE SCOPE

The solar collector does the work theory of solar thermal energy conversion. This is the renewable source of energy, so to use of this system we can save the fuel in thermal power station for sensible heat of water. To use of this system we can reduce the consumption of fossil fuel(coal, petroleum oil, natural gas) that not only controls the green house effect but also helps to keep clean the environment. This system can be used in small and large power plant. By using number of
tubes according to requirement this system can use to heat domestic water, milk plant, hospital, nursing homes, hotel etc.

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REFERENCES