Experimentation and Analysis of Heat Generated In Solar Collector with nano Fluids-Review

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Abstract- *— The concept of renewable energy gained importance after the degradation as well as shortage of fossil fuels. Out of many renewable resources solar energy is the best one. The solar energy has benefits of being non-polluting, limitless and sustainability. It can be best used for converting it into the other forms of energy s heat and electricity. The present study has been carried out to examine the performance of v-trough solar collector using copper oxide (CUO) as the Nano-fluid.*

I. INTRODUCTION

Since 1980, the renewable energy has gained momentum and contributed much to the energy supply reserves and the environment. There are many ways and many methods such as like v-trough type solar collector, Linear Fresnel collector, Flat plate collector, bowl type collector and v-trough type solar collector, etc. Through there are several other traditional energy sources too which can be used instead of solar energy is such as wind energy, hydro-energy, tidal energy, geo-thermal energy, etc. The selection of energy source must be based on the basis of environment, economic and safety concerns. The solar energy is a best energy source which has benefits of non-polluting limitless and more sustainability. It also assists in the reduction of greenhouse gases pollution.

Solar Collectors

A Solar energy collector is a heat-exchanging device that utilizes solar radiation energy to generate thermal energy. The basic function of a solar collector is to absorb the incident solar radiation, converts it into heat, and transfers this heat to the working fluid circulating throughout the whole system. This heat can either be used directly in industrial applications or can be stored.

Solar collectors can be classified broadly in two types:

Non-concentrating collectors:

This type of collector has the same area for intercepting the radiations as well as for absorption. It captures direct as well as diffuse solar radiations. They are restricted only to low temperature (<120°C) applications such as heating of swimming pools, space heating, water pre heating for domestic or industrial use. Three main types of non-concentrating collectors are:

i. Flat plate collectors
ii. Hybrid PVT collectors
iii. Enhanced hybrid PVT collectors

Concentrating solar collectors

These types of solar collector make use of an optical device to concentrate a large amount of solar rays to a smaller intercepting area reducing the heat losses. This increases the radiation heat flux which in turn increases the temperature achieved, resulting in higher thermodynamic efficiency. Concentration can be accomplished by the use of mirrors or lens, through the reflection or refraction of solar radiation.
The collectors which fall in this category are:

i. V-trough trough collector(PTC)
ii. V-trough dish collectors
iii. Heliostat field collectors
iv. Linear fresnel reflectors (LFR)

Advantages of Concentrating Collectors

1) Higher thermodynamic efficiency can be attained as heat transfer fluid can reach to higher temperature in a concentrating surface as compared to flat plate collector.
2) Simple in design and reflecting surfaces require less material, thus reducing the cost per unit area of the solar collecting surface.
3) Selective surface treatment and vacuum insulation are done to reduce the heat losses, thus increasing the collector efficiency.
4) Due to the relatively small area of the receiver, heat losses are less, thus increasing the thermal efficiency.

5) Since higher temperature can be attained with concentrating solar collector, the amount of heat which can be stored per unit volume is larger; therefore the cost of heat storage is less as compared to non-concentrated collectors.
6) Higher temperatures ease the use of power generation equipment to produce both electricity and heat.

Disadvantages of Concentrating Collectors

1) Out of the diffuse and beam solar radiation components, concentrating collectors can intercept only the beam component because diffuse component is difficult to be reflected and thus, disappear.
2) Flux on the absorber surface is non-uniform while the flux in flat plate collectors is uniform.
3) Costly orienting systems are required to track the sun.
4) High initial cost.
5) To maintain the quality of reflecting surface against weather, dirt, oxidation etc., additional maintenance cost is required.

II. LITERATURE SUMMARY

1. A.KARTHIKEYAN,G.BALAKRISHNAN, V.THAJTHEEN:

In this the difference of heat change between the flat plate collector and the solar collector is determined. With the help of the pump the whole water is to be circulated fully in the system and the energy classification is also explained.

2. M.MURUGAN, R.VIJAYAN, A.SARAVANAN:

In this the heat transformation is applied and the shape of the collector is in v-trough shape. In which countries it this type of setup is installed is also explained detail. Example: INDIA, SOUTH AFRICA, EGYPT, MEXICO.

3. HUIWANG, JIN ZHONG XU, JUNJIE ZHU, HONG-YAN CHAN:

In this the technologies the performance analysis and the material conformation of copper oxide is explained. The tests such as XRD test, TEM test

4. V.RAJIVE:

In this journal the detail explanation about the v-trough solar collector and how it is constructed is explained. The thermal heat analysis of the v-trough solar collector is shown in this journal. In this it gives the maximum solar concentration ratio of 1.8 suns have been proposed and its efficiency is about 70.54% or 1.41 suns and the temperature is increased up to 85.9 ^{o} c.

5. OVAIS GULYAR, ADNAN QAYOUM, RAJAT GUPTA:

In this journal the preparation of Nano-fluids like Al2o3 and Tio2 is explained and the method is to produce such Nano-fluids is also explained in detail.

6. HOSSEIN CHAJI, YAHYA AJABSHIRICHI, ESMAEIL ESMAEIZADEH,SAEID ZEINAIL HERIS

In this the performance analysis of Tio2 mixed with water and forms an Nano-fluids. According to this the thermal efficiency of producing stream in normal flat plate solar collector by using Tio2 Nano-fluid. It increases the efficiency of up to 2.6% to 7%.

7. GUOGANG RAN, DEWEI HU, EILEEN W.C.CHANG, MIGUEL A.VARGAS REUS, PAUL REIP, ROBERT ALLAAKEI:

In this the performance of copper oxide is explained and the size of copper oxide is ranges from 20.95 nm. The TEM energy gives the ratio of copper to oxygen is 54.18% to 45.26%. According to this the BET analysis it gives the surface value as 15.69 m^2/g.

8. M.MAHENDRAN, G.C.LEE, K.V.SHARMA, A.SHAHRANI, R.A.BAKAR:

In this the performance of the titanium oxide is explained in detail. According to this the sun rays is obtained maximum temperature at 2 p.m. at this time the efficiency that is obtained in the collector by using Nano fluid of Tio2 is 0.3 to about 0.73 whereas the normal collector consists of 0.58. Therefore the efficiency is increased while adding Nano fluids is by 16.7%.

9. R.KUNNEMEYER, T.N.ANDRESON, M.DUKE, J.K.CORSON:

In this the performance of the prototype was carried out in two different ways. Such as without glazing and another with glazing and thermal insulation. The collector proposal has achieved the optical efficiency of 70.54% or 1.41 suns and their temperature is about 85.9^{0}c.

10. VIJAYAN GOPALSAMY:

In this aluminium oxide (Al2o3) and deionized water of Nano-fluid is used as heat transfer on v-trough trough solar collector. It is proposed by using of magnetic stirrer process. The mixture level is of 0.5% to 2.5%.

III. WORKING

It consists of a reflector in a v shape to reflect direct solar radiation and concentrating them onto the focal line of the parabola. A receiver tube is placed on this focal axis, which absorbs the concentrated solar radiation flux. It is either made up of stainless steel, iron or copper or plated with a selective coating on the outside surface. The selective coating has a high absorptance for incoming radiations but low emittance for the infrared radiations in the solar energy spectrum to decrease the thermal radiation losses. Inside the receiver tube, heat transfer fluid (HTF) flows, takes up the concentrated radiation which falls on the tube and transforms the solar radiation into thermal energy. Receiver tube is enclosed by a glass cover to minimize the thermal losses to the surroundings. The annulus space between the concentric glass cover and the tube is evacuated to maintain the vacuum which is generally a material of low thermal conductivity and high viscosity as heat transfer takes place through radiation in this zone. CuO/water nanofluids were used as the working fluid in three different concentrations with the mass flow rate ranging from 160 l/hr. to 100 l/hr. The test consists of pumping nanofluid mixture, from the storage tank, through the collector inlet to the receiver tube, where it get heated and then flows back to the storage tank. A pump circulates the working fluid in the system. Two thermocouples are mounted on the inlet and outlet to measure the temperature rise. With the help of solar power meter and anemometer, solar radiation intensity and wind speed were continually measured during the experiment. The PTC was oriented in north-south direction to track the sun. The experiments were performed at different mass flow rates and varying concentrations of Nano fluids. Readings of inlet and outlet temperature were measured from 9:30 am to 2:30 pm in a day.

Different Constituents of the v-trough Solar System:

A v-trough system consists of the following parts explained in detail:

1. Reflector

It is made up of the mirrors arranged v shape. These glass strips have high 96%. A sheet of stainless steel is employed to give the v-trough structure. Stainless steel is suitable to give mechanical strength to the v-trough structure.

2. Receiver Tube

The receiver tube consists of a copper tube painted black. It is concentrically covered by the glass tube of inside diameter 64mm, outside diameter 66mm and length 90 cm which is attached to the copper tube by the glass to metal seals on both ends.

3. Storage Tank

It's made up of plastic and has the capacity of 6 litre. The fluid stored inside it is circulated throughout the whole system by using a pump of 18 W capacity. This pump is placed inside the storage tank. Fluid from the tank flows to the inlet and passes through the receiver tube. After gaining heat in the tube, it flows out from the inlet. The inlet of the tank is connected to the inlet of the receiver tube and outlet of the storage tank is connected to the outlet of the ball valve. Glass wool insulation is used on the tank to protect it from heat loss.

4. Support Structure

It is used to support the whole v-trough system and provide resistance against wind loads, stress loads etc. It minimizes the alignment errors. Cast iron is the material used to construct it. It's painted in green colour to prevent it from corroding. The manual tracking system is also attached to the support structure.

5. Insulation

In the v-trough system, pipes and storage tank are insulated. Pipe is firstly covered with aluminium foils to reduce the heat loss during the heat flow in piping system and then soflon insulation is used over that.

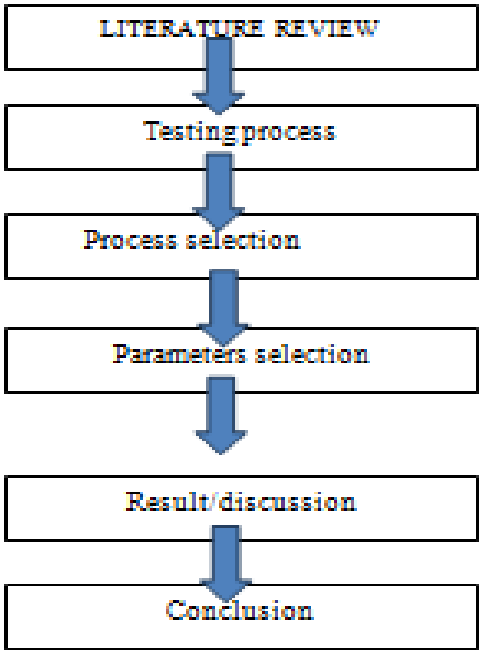
The insulation used on the storage tank is glass wool. It is used to avoid heat loss due to its low conductivity. Thermocol sheets are also used for wrapping the glass wool insulation. Tracking Mechanism is a rectangular support structure of cast iron, bicycle hub, handle, stopper and clutch wire. One end of clutch wire is placed on bicycle hub and the other end is connected to the back side of the reflector. A handle is attached to the hub to rotate it manually.

6. Ball Valve

Ball valve is used to regulate the flow of working fluid in the inlet pipe and the variation of volume flow rate of Nano fluid. Its one side is connected to the outlet of the receiver tube and the other end is connected to the outlet of the

storage tank. It is opened according to the required mass flow rate.

IV. PROPOSED METHODOLOGY



V. CONCLUSIONS

Hence based on this I came know that the addition of Nano fluids the efficiency of the system i.e. the heat generated is high when compared with normal water supply. In order to meet the objectives specified in the study experimentation has been carried out to check the performance of v-trough solar collector over others by using CUO H2O based Nano fluids. Finally the results are validated with the help of CFD software.

VI. ACKNOWLEDGMENT

The heading of the Acknowledgment section and the References section must not be numbered.

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