International Journal of Research
Available at https://edupediapublications.org/journals

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

Parametric Analysis Of A Parabolic Trough Collector Solar Thermal Power Plant On Effect On Nano-Fluids

Mayank Kumar[1]

M.tech, Department of Mechanical Engineering Bhagwant Institute of Tehnology, Muzaffarnagar, U.P, India

Vipul Kumar Sharma[2]

Assistant Professor, Department of Mechanical Engineering Bhagwant Institute of Tehnology, Muzaffarnagar, U.P, India

ABSTRACT: This thesis deals with improving the activity of a parabolic collector through innovative solar thermal power plant by methods controled by Nano fluids. One of the testing issues in a solar thermal power plant, from the control perspective, is to keep up the thermal procedure factors near their coveted levels. A solar gatherer is a device that changes sun radiation into warm, which is then exchanged to working liquid. The utilization of solar authorities reduce vitality costs after some time as they don't use non-renewable energy sources or power like that as in conventional water warming. Convective warmth exchange can be more impressive by improving thermal conductivity of the liquid. Recent nanotechnology gives new potential results to improve warm exchange execution associated with unadulterated fluids. Nano fluids has upgraded thermal conductivity as it has more expansive zone to volume proportion and high turbulence properties. Due to its novel properties Nanoliquid is applicable in numerous fields of warmth exchange, as microelectronics, pharmaceutical procedures, and cross breed powered motors, in pounding, machining, vehicle thermal administration, local fridge, chiller, warm exchanger and in heater pipe gas temperature reductor. Information of the rheological conduct of Nano fluids is observed to be exceptionally basic in choosing their appropriateness for convective warmth exchange applications.

Keywords – Concentrated Solar Power (CSP), HTF, Portable Trough Collector (PTC)

Introduction

The present effect of petroleum products on environmental change and the normal consumption of non-renewable energy sources soon [1] , there is an earnest requirement for perfect and manageable vitality assets. Solar energy innovations are promising energy assets. The improvement in resources will expand nations energy security through dependence on an indigenous, unlimited and generally import-free asset, improve maintainability, lessen contamination, bring down the expenses of moderating environmental change, and keep non-renewable energy source costs lower than something else. The present business proficiency of photovoltaic innovation has achieved over 20%, thermal innovation has accomplished efficiencies of 40-60% [1] . Besides, as indicated by [3] , solar thermal innovation is relied upon to get together to 6% of the force to be reckoned with's necessities by 2030 and 12% by 2050. Solar thermal innovation would assume a huge part in the diminishment of CO_2 all inclusive. [6] Solar thermal innovation is expansive with traditional petroleum derivatives because of engineering advancements, mass power creation, economies of scale and enhanced task [4] . This statement is keen on enhancing the activity of a solar thermal power plant by programe control methods. Solar thermal innovation using concentrating parabolic trough authorities is the principal solar innovation to exhibit its matrix power potential.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

Parabolic trough collectors

A parabolic trough consists of a straight parabolic reflector that concentrates light onto a recipient situated along the reflector's central line. The recipient is a tube situated straightforwardly over the center of the parabolic mirror and loaded with a working liquid. The reflector takes after the sun amid the sunshine hours by following along a solitary hub. A working liquid (e.g. water) is warmed to 150– 350 °C (300– 660 °F) as it moves through the recipient and is then utilized as a warmth hotspot for a power age framework. Solar energy can be utilized by three procedures concoction, electrical and thermal.

1.Chemical process, through photosynthesis, keeps up life on earth by delivering sustenance and changing over CO2 to O2.

2.Electrical process, utilizing photovoltaic converters, gives power to rocket and is utilized as a part of numerous earthbound applications.

4.Thermal process, can be utilized to give a great part of the thermal energy required for solar water warming and building warming.

Problem Statement

The overall prerequisite of energy is diligently expanding and makes it ineluctable to make the utilization of unpredictable assets. The sun is one of the significant energy sources that can possibly satisfy this rising energy require. Solar thermal innovation is unavoidable in development of the network, country and Earth. Sun is a gigantic pool of clean energy and this spotless power is known as Solar Energy. Change of these approaching solar radiations should be possible specifically or by implication in other helpful types of energy as warmth and power which can be used, further according to the prerequisite of the humankind. The sun is giving an extraordinary supply of solar energy for more than 4 billion years. Solar energy was utilized by the old individuals to warm their homes and dry garments yet their utilizations were generally crude. Radical increment in worldwide oil costs, broad utilization of petroleum products, debilitating ascent in contamination and nursery impact have driven a substantial number of nations around the world to complete broad research here.

Objective

The main objective of our project is

1. To improve the heat transfer in a parabolic trough solar collector using ZnO/water as the Nanofluid in forced convection system.
2. To do extensive research analysis on parabolic trough collectors.
3. To calculate and analyze parameters such as heat flux and heat coefficient.

Literature Review

In spite of the fact that the expenses of solar energy have gone down, but the leveled expenses of solar energy are still significantly higher than customary energy. The leveled cost of solar concentrated power (CSP) is four times than that of supercritical coal without carbon catch and capacity [1].

Warmth exchange can be upgraded by expanding the thermal conductivity of the warmth exchange liquid (HTF). Thermal conductivity of metallic particles, metallic oxides and nanotubes is generally higher than that of fluids. Expansion of fine particles into warm exchange fluids can essentially expand the warmth exchange rate [6– 8].

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

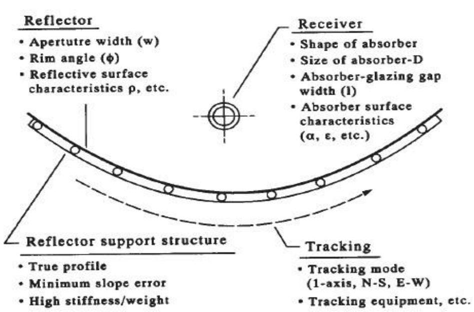
Numerous investigations have been made on the exhibitions of PTCs using manufacturing oils and nanofluids as warmth exchange liquid. The later are shaped by suspending nanoparticles (1nm-100nm) in a conventional warmth exchange liquid.

HEAT TRANSFER IN NANOFLUIDS:

Suspended nanoparticles in ordinary fluids, called nanofluids, have been the subject of concentrated investigation worldwide since spreading specialists as of late found the peculiar thermal conduct of these fluids. Existing hypotheses couldn't clarify the improved thermal conductivity of these fluids with little molecule fixation. Micrometer-sized molecule liquid suspensions display no such sensational upgrade. This distinction has prompted investigations of different methods of warmth exchange and endeavors to build up an exhaustive hypothesis.

PARABOLIC TROUGH COLLECTOR

A parabolic trough collector system consists of a reflecting surface which resembles a parabolic shape. This reflecting surface is mostly made of reflecting mirrors or anodized aluminium sheets. The solar radiations falling on the reflecting surface is concentrated on the focal line of the parabola where a receiver tube carrying the heat transfer fluid is placed. Absorber tube either painted black or electroplated with nickel or chromium to increase the absorptivity of the tube. The heat transfer fluid picks up the heat from the absorber tube which is utilized later in the desired way. The temperature in this type of system can reach as high as 400^0c, depending upon the type of reflecting surface, absorber tube materials and heat transfer fluid. A parabolic trough collector system must be positioned in agreement with the sun's position so that it can reflect the incoming beam radiations to the absorber tube.



IMPLEMENTATION AND PROPOSED WORK

Geometry of Parabolic Trough Solar Collector:

Parabolic Trough Solar Collector (PTSC) which is additionally called tube shaped parabolic gatherer utilizes direct imaging focus. These collectors are included a round and hollow concentrator of parabolic cross – sectional shape, and a roundabout tube shaped beneficiary situated along the central line of the parabola. The round and hollow parabolic reflector concentrates all the radiations onto a metallic tubular beneficiary put along its length in the central plane. The warmth exchange liquid is permitted to move through the collector.

Radiation concentration at a parabolic trough:

Parabolic troughs have a central line, which comprises of the central purposes of the parabolic crosssections. Radiation that enters in a plane parallel to the optical plane is reflected such that it goes through the central line.

Geometrical parameters of real parabolic troughs:

In the wake of leading more research on solar energy and solar gathering, the choice was made to have:

Trough Length = 1m, So that information can undoubtedly be extrapolated for numerous parabolic troughs put together as a solitary unit.

Safeguard tube breadth = 1.27cm,

Parabola edge = 120deg, to get more prominent survey zone.

Opening width = 0.7m

Central length = 0.303221m

Condition of parabola: y2 = 1.21284 x

Focus proportion = 55.1181

Methodology of Experiment

Forced Convection: Constrained convection happens when the streams flows in the liquid are initiated by outer means, for example, fans, stirrers, and pumps making a falsely incited convection current.

Technique:

- Different segments are associated in like manner.
- The pump is exchanged on and any spillage is checked
- The ball valve is changed in accordance with required position and stream rate is estimated.
- Initial temperatures of liquid in supply and sink tanks are estimated.
- The temperature of fluids is again estimated at customary interim.
- The try is directed for 6-8 hrs.
- For next trail, the situation of ball valve is changed to shift the stream rate.

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

- The try is rehashed and perceptions are organized.

Free Convection: In this sort of convection, the development of particles which constitutes convection happens by the variety in thickness of the liquid. As we definitely know, as temperature expands, the thickness declines and this variety in thickness will compel the liquid to travel through the volume. This makes convection happen.

Strategy:

- Different parts are associated likewise.
- Both ball valves ought to be in completely vacant position.
- Initial temperatures of liquid in supply and sink tanks are estimated.
- The temperatures of fluids are again estimated at standard interim.
- The test is directed for 6-8 hrs.
- The analyses is rehashed and perceptions are classified.

Both constrained and free convection is completed for various fluids and at required stream rates.

Conclusion

The empirical correlations between dimensionless numbers of convection were found and are as in the table given below :

FLUID	RELATION
0.4% ZnOnanofluid Free Convection	$\boldsymbol{Nu = 2.024671*1012(Gr.Pr)-1.895257}$
0.4% ZnOnanofluid Forced Convection	$\boldsymbol{Nu = 1.17498769 (Re)0.019895Pr1/3}$

From the experimentation it was discovered that there was an expansion of 34.6% in the last temperature came to by the store. By water it was seen that the most extreme temperature came to was 41.5oC yet by utilizing nanofluid temperatures up to 52oC was come to.

By the expansion of nanoparticles to the base liquid the thermal conductivity estimation of the base liquid is expanded as appeared in the counts where as the particular warmth esteem diminishes i.e. there is increment in warm conduction however in the meantime the temperature rise and fall happens at a quicker rate.

References

Timilsina GR, Kurdgelashvili L, Narbel PA, A review of solar energy markets, economics and policies. Policy Research Working Paper; 2011.

Xiaowu W, Ben H. Exergy analysis of domestic-scale solar water heaters. Renew Sustain Energy Rev 2005;9(6):638–45.

Wang X, Wang R, Wu J. Experimental investigation of a new-style double-tube heat exchanger for heating crude oil using solar hot water. ApplThermEng 2005;25(11–12):1753– 64.

Al-Madani H. The performance of a cylindrical solar water heater. Renew Energy 2006;31(11):1751–64.

Ho CD, Chen TC. The recycle effect on the collector efficiency improvement of doublepass sheet-and-tube solar water heaters with external recycle. Renew Energy 2006;31(7):953–70.

Eric DK. Engines of creation. 4th edition. London: Oxford Press; 1986.

Maxwell JC, A treatise on electricity and magnetism, vol. 1. UK: Oxford.

erekhov VI, Kalinina SV, Lemanov VV. The mechanism of heat transfer in nanofluids: state of the art (review). Part 2.Convective heat transfer.ThermophysAeromech 2010;17(2):157–71.

S. Kakaç, A. Pramuanjaroenkij, Review of convective heat transfer enhancement with nano-fluids,Int. J. Heat Mass transfer, vol. 52, pp. 3187-3196,2009.

K. Das, U.S. Choi, Wenhua Yu, T. Pradeep, Nano-fluids science and technology,John Wiley & Sons.

S. Z. Heris, S. Gh. Etemad, M. N. Esfahany, Experimental investigation of oxide nanofluids laminar flow convective heat transfer, IntCommun Heat Mass Transfer, vol. 33, pp. 529-535, 2006.

H. Tyagi,P. Phelan, R. Prasher, Predicted efficiency of a low temperature nano-fluid based direct absorption solar collector, J Sol. Energy. Eng, vol. 131, pp. 041004, 2009.

T. P. Otanicar, P. E. Phelan, R. S. Prasher, G. Rosengarten, R. A. Taylor, Nanofluidbased direct absorption solar collector, J Renew Sustain Energy, vol. 2, pp. 33102, 2010.

V. Khullar, H. Tyagi, P. E. Phelan, T. P. Otanicar, H. Singh, R. A. Taylor, Solar energy harvesting using nanofluids-based concentrating solar collector, J NanotechnologyEng Med, vol. 3, pp. 031003, 2012

Manual making of a parabolic solar collector Gang Xiao

A review on nanofluids - Part 1: Theoretical and Numericalinvestigations

Xiang-Qi Wang and Arun S. Mujumdar

Experimental investigations of the viscosity of nanofluidsat low temperatures

BahadirAladag, Halelfadl Salma, NimetiDoner, Thierry Mare', Duret Steven,

Patrice Estelle'

Preparation and Stability of Nanofluids-A Review Sayantan Mukherjee, SomjitParia