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Design, Fabrication and Testing of Evaculated Heat Pipe Solar Collector Using Nano Fluid

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ABSTRACT

The demand for energy is severely increased as the world's population is quadrupled in the last half century. Researchers and technocrats have been developing renewable technologies in order to meet these global energy challenges. Solar energy is cleaner and the most promising renewable energy source. Now a days use of Nano fluids in solar-thermal technology for heat transfer enhancement is topic of interest. In this work study evacuated tube Two Phase Closed Thermo syphon (TPCT) is used. The objective of proposed work is to study experimental performance of heat pipe evacuated tube solar collector, which uses the circular heat pipes with CuO-H2O Nano fluid. Thermal performance of Nano fluid charged Two Phase Closed Thermo syphon evacuated tube solar collector is better than conventional heat pipe evacuated tube solar collector. The enhancement in instantaneous collector efficiency obtained is 18-20%. At the same time effect of inclination angle and mass flow rate on performance of heat pipe evacuated tube collector is also studied.

Keywords: TPCT, Nano fluid, Heat Pipe.

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I. INTRODUCTION

The solar energy is the most capable of the alternative energy sources. Due to increasing demand for energy and rising cost of fossil type fuels (i.e., gas or oil) solar energy is considered an attractive source of renewable energy that can be used for water hearing in both homes and industry. Heating water consumes nearly 20% of total energy consumption for an average family. Solar water heating systems are the cheapest and most easily affordable clean energy available to homeowners that may provide most of hot water required by a family. Solar heater is a device which is used for heating the water, for producing the steam for domestic and industrial purposes by utilizing the solar energy. Solar energy is the energy which is coming from sun in the form of solar radiations in infinite amount, when these solar radiations falls on absorbing surface, then they gets converted into the heat, this heat is used for heating the water. This type of thermal collector suffers from heat losses due to radiation and convection. Such losses increase rapidly as the temperature of the working fluid increases.

Types of Nano fluids:-

There are several types of the Nano fluids Important among them are as follows-

- Metallic Oxides (Al2O3,CuO)
- Nitride Ceramics(AIN,SiN)
- Carbide Ceramics(SiC,TiC)
- Metals(Cu,Ag,Au)
- SWCNT,DWCNT
- Semiconductors(TiO2,Sic)

II. OBJECTIVE

- The solar energy is the most capable of the alternative energy sources. Due to increasing demand for energy and rising cost of fossil type fuels (i.e., gas or oil) solar energy is considered an

attractive source of renewable energy that can be used for water hearing in both homes and industry.

- Heating water consumes nearly 20% of total energy consumption for an average family. Solar water heating systems are the cheapest and most easily affordable clean energy available to homeowners that may provide most of hot water required by a family.

- Solar heater is a device which is used for heating the water, for producing the steam for domestic and industrial purposes by utilizing the solar energy.

- Solar energy is the energy which is coming from sun in the form of solar radiations in infinite amount, when these solar radiations falls on absorbing surface, then they gets converted into the heat, this heat is used for heating the water.

III. ADVANTAGE AND APPLICATION

Advantages:

- The vacuum envelope of HPC reduces both the convection and conduction losses, so it can be operate effectively at the high temperatures

- They collect both direct and indirect radiation and their efficiency is high at low incidence angles.
- The efficiency of HPC is high in comparison with the others collectors. Since, it uses the liquid–vapor phase change materials to transfer the heat inside the collector..
- The size of the solar collector can be reduced by using the heat pipe technology and as a result of this reduction, the overall cost was reduced also.
- The HPC is very suitable for very cold regions.

Application:-

- Boilers.
- Refrigeration and Air Conditioning System.
- Home electric gizzard system.
- Sugar Industry.
- Thermal Power Plant.
- Heat Exchanger.

IV. LITERATURE REVIEW

Vishwajeet Khalipe, Padmakar Deshmukh, [1] "Experimental Study of Evacuated Tube Two Phase Closed Thermpsyphon (TPCT) Solar Collector with Nanofluid" The thermal performance of solar collector with heat pipe containing nanofluid is better than that of conventional heat pipe collector. There is 10-15% rise in instantaneous collector efficiency due to Nano fluid as a working fluid.

Ahmed Kadhim Hussein, Lioua Kolsi, Sanatana Kata, Brundaban Sahoo,[2] "A Review of Nano Fluid Role to Improve the Performance of the Heat pipe Solar Collectors", The future attention must be directed towards the effect of the optical properties of nanofluid on the performance of HPC together with the other fluid properties except the thermal conductivity. The future works must be directed towards inventing a non-toxic and low cost nanoparticles to reduce further the cost of nanofluid based solar collector and to meet quickly with the market needs.

N. H. Mujawar, S. M. Shaikh,[3] "Thermal Performance Investigation Of Evacuated Tube Heat Pipe Solar Collector With Nanofluid", The solar collector instantaneous efficiency is found to increase by increasing the tilt angle from 20°to 30°for cases, pure water and CuO/water nanofluid. While, the heat transfer rate decreases by increasing the tilt angle beyond 30°to 35°.

Khullar Etal [4] Aluminium based nanofluid both theoretically & experimentally on concentrating parabolic solar collector (CPSC). The aluminium based nano particles were suspended in Therminal VP-1 base fluid with 0.05% volume concentration. The results were compared with the conventional concentric parabolic solar collector which reveals that increase in 5-10% of thermal efficiency was observed. Currently, Titan C.Paul,et.al summarized their experimental investigation on next generation solar collectors (CSP) using NEILS (Nanoparticle Enhanced Ionic Liquids) as working fluids their results revealed that thermal conductivity was enhanced around 5% depending on the base fluid and ionic concentration. The heat capacity of nanofluid using Al2O3 nano particles was enhanced by 23% and 26% for nanofluids using silica nano particles and similarly 20% enhancement in convective heat transfer capacity was also observed.

R shanthin and R. Velraj [5**]**discovered that recent pioneering advancement in the use of nanofluids as the working fluid in the two phase gravity assisted thermosyphon (TPGAT)significantly improved the heat transfer performance. In the present study, the performance enhancement of TPGAT using carbonaceous and metalbased nanofluid as the working fluid is investigated. The experiments are conducted at various heat input in the evaporator and at different fill ratios.The results of the experiments revealed that the nanoparticles play a major role in enhancing the performance by bombarding the formation of vapourbubbles in the evaporator section. It is also found that the fill ratio has varying role in the

condenser and evaporator section at various heat input of the evaporator section.

V. METHODOLOGY

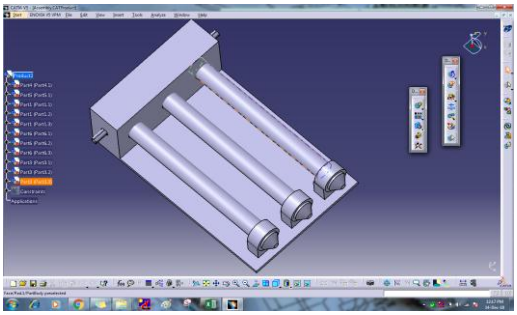
Heat Pipe Solar Collector (HPC)

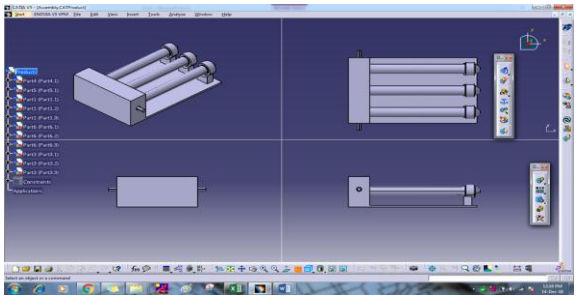
The heat pipe or some times called the evacuated tube solar collector (ETC) consists of a heat pipe maintained inside a glass enclosure. This type of collector are invented in order to solve the problems which are appeared in the conventional flat-plate solar collectors. Since , the latter collectors efficiency are connected significantly with the weather conditions. In other words, their performance decreases dramatically in the cold, cloudy and windy days. In addition to the severe weather conditions, both the condensation and moisture cause early failure of internal pipe materials and reduces the collector performance. Also, the limited quantity of heat transferred by the classical base fluid Moreover, the forced circulation system due to the pump and its extracted power, extra space required for the natural circulation system due to the position limitations required, the night cooling due to the reverse flow of cooled water, freezing of the water on cold nights, pipe corrosion due to the use of water can be considered as an additional problems. All these mentioned drawbacks can be solved by using the heat pipe solar collector which consists from a heat pipe (a highly efficient thermal conductor) inside a vacuum-sealedtube, as shown in Fig.2.The heat pipe solar collector has significant advantages over the flat-plate solar collector in terms of the heat loss. Available types of heat pipe solar collector can be classified into two groups; one is the single-walled glass heat pipe and the other is the Dewar tube. There are many variations of the two basic types; for example, the heat extraction can be through a U-pipe, heat pipe or direct liquid contact

Design of the Evaculated Solar Pipe Heat Conductor

The Solar operated motorised hydraulic jack is designed in CATIA software. The parts in the assembly are solar panal, Evaculated Heat Pipe, Tank.

The CATIA model is as shown in following fig.





This paper provides an integrated approach to manufacturing, designing of Sola . In comparison between CuO Nano fluid and water when used as working fluid, CuO Nano fluid shows better heat transfer characteristics as compared to water. The heat pipe shows a higher thermal resistance during startup, but eventually reduces with increase in heat input. CuO shows lesser thermal resistance than the water during initial startup. In condenser section, pipe wall temperatures increase towards the end where the coolant outlet pipe was located. The increase was due to the gain of heat by coolant water flowing from inlet to outlet section of condenser. The thermal performance of solar collector with heat pipe containing nanofluid is better than that of conventional heat pipe collector. There is 10-15% rise in instantaneous collector efficiency due to nanofluid as a working fluid. Nanoparticles must be dispersed uniformly in the base fluid to enhance the solar-weighted absorption and increase the efficiency of the solar collector. 5-Volume fraction of nanoparticles must be chosen accurately to enhance the performance of nanofluid collectorIt is recommended to use carbon nanohorns (CNHs) as a nanoparticles to improve the optical properties of the HPC. This is due to their large surface area and large number of cavities. Further efforts must be directed towards various significant challenges in the field of nanotechnology and its application in the solar collector such as : Brownian motion of particles , particle migration , changing thermophysical properties with temperature , tendency of nanoparticles to agglomeration , changing nanofluid properties by using additives and the stability of nanofluids. The results of the reviewed papers indicated that the overall performance of HPC is a function of nanofluid properties and the other properties of system heat loss coefficient of solar collector, and obtains the amount of more heat energy.

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