A REVIEW – ON SOLAR HEAT EXCHANGER WITH NANO FLUID AS WORKING FLUID

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***Abstract*: Nano fluids are the cooling medium of the future with enhanced thermo physical properties and heat transfer performance can be applied in many devices for better performances. The application of nanofluids is to achieve the highest possible thermal properties at the smallest possible concentrations, by homogeneous dispersion and stable suspension of nanoparticles in the host fluids. Nanofluids plays vital role in various thermal applications such as automotive industries, heat exchangers, solar power generation etc. here in this work a review of nano fluid solar heat exchanger were done and identify the different process parameters on which the performance of solar heat exchanger depends.**

***Keywords*: solar heat exchanger, heat, process, ribs, flow rate, Nusselt number**

1. Introduction

Nanotechnology is a branch of science and technology which makes use of the particles in the Nano scale order, namely in the molecular and atomic order respectively. In this field, the particles considered are analysed individually from their bulk specifications. The properties of the bulk materials on the whole are expected to remain unchanged, whereas at the Nano scale order these properties alter. When these solid particles of Nano scale order are dispersed in any fluid medium known as the base fluids collectively they are stated as nanofluids. In this study the behaviour of these nanofluids are analyzed when they are used in the heat exchangers Thus, the use of Nano particulate metallic oxide in the main coolant to improve the heat flow of the resulting liquid is known as nanofluid. The use of nanofluids remains insufficient for true life because of the contradiction between the researchers and the lack of theoretical understanding. There have been numerous experiments on the effects of nano fluids on double heat exchangers at very low volumes, and especially on the effect of constant wall temperatures occurring in steam heat. Even so many researchers have talked about the effect of changing the temperature on nanofluid heat transfer when tested using a double heat transfer device.

2. Nano Fluid

Nowadays, it is seen that the liquid coolants which are used today, they have very poor thermal conductivity (with the omission of liquid metal, which cannot be used at most of the relevant useful temperature ranges). For example, water is evenly poor in heat conduction than copper, in the case with engine coolants, the oils, and organic coolants. The liquid having thermal conductivity and it will be limited by the natural restriction on creating turbulence or increasing area. To overcome this problem the suspension of solid in cooling liquid is a better option and a new fluid will be made which is used to increase the thermal conduction behaviour of cooling fluids.

3. Benefits of Use of Nano fluids in Solar Collectors

Nanofluids create the following advantages over conventional liquid, making them suitable for use in solar collectors:

- Solar energy consumption will increase by reshaping the shape of the mass and the quantity of nanoparticles.
- The nanoparticles, which are suspended, increase the surface area, but reduce the thermal capacity of the solids due to the small particle size.
- Delayed nanoparticles increase the heating efficiency of the heat transfer system.
- The characteristics of the liquid can be changed by changing the concentration of nanoparticles.
- Extremely small size of nanoparticles ideally allows them to pass through pumps.
- Nanofluid can be opted for using optical (sunlight absorption and lowering in infrared flow).

4. Existing Research works

Many of the researcher perform different methods to optimized solar heat exchanger and many other uses different Nano- fluids to enhance the heat transfer rate inside the solar heater some of the work is mention in the below section.

1. Ehsan Ebrahimnia-Bajestan et.al (2016) In this work, they had shown an innovative approach to improving the heat transfer properties of the solar system is the use of nanofluids as a heat medium. In this study, the heat transfer of the TiO_2 vapour of nanofluid water based on the gas pipeline was investigated through experiments and samples. So some modifications were introduced into the double standard model, usually to get more accurate estimates of the characteristics of the change in nanofluid heat. This modified model examined the effects of concentrations of particles, diameters, atoms, and particles and basic solids on the heat transfer rates of different numbers of Reynolds. The results suggested that the single-stage method, even temperature-dependent, depends on temperature-dependent temperatures, estimation of the transfer characteristics of the heat transfer of nanofluids.

2. Andrey Yasinskiy et.al (2018) In this work, they had showed an analysis of the properties of nanofluids based on TiO_2, such as physical stability and their heat transfer coefficients. Nanofluids were prepared with eutectic mixtures of diphenyl oxides and biphenyls by adding nanoparticles of TiO_2 and 1-octadecanethiol (ODT) nanoparticles, which were used as surfactants. Nanofluids were tested for their thermal and physical properties such as stability, density and mass. The introduction of TiO_2 nanoparticles, accompanied by an equal amount of ODT, showed a dramatic increase in the properties of systemic heat exchanger in a solar power plant (CSP).

3. Hussein et.al (2017) In this research work, they had shown an overview of the latest advances in the use of Nano-liquid in the heat pipe solar collectors. Here, Nanoparticles had dispersed in basic fluid to increase sunlight absorption and to increase the efficiency of solar collector. It is recommended to use carbon Nano horns (CNHs) as nanoparticles to enhance optical properties of HPC (Heat Pipe solar collector). This is due to their large area and a large number of cavities. The results of reviewed paper showed that the general practice of HPC is the function of the properties of nanofluids and other system properties.

4. Omar Bait et.al (2018) In this paper, they had presented an comprehensive overview of the role of nanofluids in many fields, especially in solar technology by using Pyramid solar still. Benefits of using nanofluids had been highlighted about their positive effects on improving the thermal performance of solar stills (direct solar distillation) with acceptable complications. Undoubtedly, this study showed that Nano fluids have relevant characteristics in improving thermal conductivity in comparison with base fluids which are free from any additional metal or metal oxide Nano-sized particles. An experimental research was carried by using the mathematical models and noted the results obtained by using experiment.

5. Alibakhsh Kasaeian et.al (2015) In this work, they had revealed that the adverse effects of human activities on the environment have received special attention, especially in global temperatures. To combat climate change, clean and sustainable sources of energy must be developed rapidly. Studies in the area suggested that the use of nanofluids in the solar system offers the only advantage over conventional liquid. This article described the use of nanofluids on various types of solar collectors, solar panels and solar systems. In addition to the enormous energy exchange, the efforts made on the ESS have been reviewed. Based on literacy, the improved heating of nanofluid is the most important fact, or to increase efficiency in the solar system, but high hardness does not always increase efficiency. The absorption of nanofluids in amounts of solar collectors reduces the heat resistance of the interface and reduces the difference between temperature and heat medium.

6. P. Chandrasekaran et.al (2014) In this work, they had presented the study that aims to investigate the solidity of water-based material at nanofluids. The material for changing the nanofluids stage is prepared by the Nanoparticles of copper oxide and nuclear reactors in the material that changes in a basic phase. The presence of nucleation agents eliminates the problem of the sub-subcontract, changing the material phase, and it will allow the evaporation to operate at higher temperatures in the cold. Increased cost of heat transfer material to alter the phase nanofluids without condensation is a gift to a very cool application to save heat energy. There have been several experiments on the strength of the nano-phase fluid material of the water-based agent and the following conclusions were made based on experimental results. The main problem of submergence in water was slightly reduced by the addition of a surfactant and was completely erased by the addition of a nuclear reactor.

7. **Z. Said et.al (2014)** In this study, they had analyzed the theory of entropy, possibilities for improving heat transfer capacity and pressure drop for a solar collector that works with nanofluids based on Nano-carbon wall as an absorption device. It has been observed that nanofluids nanotubes a wall carbonate reduces the generation of entropy with 4.34% and increases the coefficient of heat transfer, with 15.33% of the fluid-absorbing theoretical theory. Reducing the power of nanofluids collecting the sun is set to a higher 1.20% working fluid. In addition, the characteristics of the capacitive convection transfer, the pressure drop and the nanofluids pumping power in a flat, digital solar collector, was tested using a variety of properties from an experimental measure. It has been observed that more fractions of the nanoparticle are able to obtain high-quality fluids. Virtually one has little effect on power and pressure drop from the pump, which is conducted for this fractional measure of the size of the nanotubes of wall carbon nanotubes.

8. Ali Najah Al-Shamani et.al (2014) In this research paper, they had experimentally showed the use of nanofluids for cooling attracts considerable attention in many industrial applications. Compared to conventional fluids, nanofluids improve the heat transfer rates, as well as optical properties, thermal properties, efficiency, and solar transfer coefficients and the signal strength coefficient. The effects of different nanofluids on cooling rates, and thus on the effects of the solar system, can be investigated. Studies have evaluated the potential of nanofluids to cool the heating system. The second part of this article provides an overview of the research, implementation and development of the solar collector system. The descriptions were made on the type of photovoltaic / thermal analysis, sampling and digital sampling, simulation and laboratory experiments. Nuclear technology allows the production of nanoscale particles. The suspension of these particles in the common fluids creates new types of heating fluid.

9. Thaklaew Yiamsawas et.al (2013) In this work, they had performed experimental tests which determine the viscosity of suspended TiO_2 and Al_2O_3 nanoparticles suspended in a mixture of ethylene glycol / water (e.g. 20/80 wt.-%). The experiments were carried out in fractions of different sizes between 0% and 4%, and the temperature range of 15-60 ° C was performed somewhat between experimental comparisons and theoretical and correlation models for this presentation. To calculate the required energy of the first energy pump to determine the gel. It is believed that for future production may be considered the difference of the size, including the size and shape of the nanoparticle, the size of the mother's molecule, the temperature, the pH of the nanofluids to obtain an estimate The better the viscosity.

10. M. Faizal et.al (2013) For solar heating, increasing the heat transfer zone can increase the temperature in the system. This method, however, leads to larger and larger collectors. Then the cost and energy required to produce solar collectors will increase. Using numerical methods and literature data, efficiency, reducing costs, and exercising energy savings are calculated for different nanofluids. It can be assumed that the high density and specific heating of nanoparticles lead to higher thermal efficiency and CuO nanofluid is the highest value compared to other three nanofluids. Small and small solar collectors that can work with nanofluids can produce. So it reduces the weight of energy and the cost of collecting.

11. F.S. Javadi et.al (2013) In this work, their review is a broad overview of the scientific advances that have emerged in the practice of solar collectors using nanofluids. Increasing fossil fuel prices and the rapid decline in normal energy sources are among the major energy issues. Many researchers had used these features of nanofluids using many methods and techniques. Mathematical methods and numbers and experimental validation methods were used. The use of nanofluid instead of conventional solids improved heat transfer, as well as optical and thermal properties, efficiency, solubility, and solar collector. In addition, there was no study of the effects of optical properties of Nano fluorescence, such as the variability and potential dependence of solar collectors. Similarly, efforts should be made to analyse the two phases of nanofluid and nanofluid properties with more than one nanoparticle. Solar collectors have great potential for heat production and are suitable for applying in heating and heating systems.

12. Masoud Saberi et.al (2013) In the study, the laminar heat transfer forced the convection nanofluids with the aluminium / water and zirconium / water through the riser at the constant limit state of the thermal conductivity, which is investigating the numbering. The single phase and two stages of the mixture are used to analyse the thermal behaviour of nanofluids. In addition, the effects were examined by the number of nanoparticle, Reynolds and fractions of the size of the nanoparticles on the heat transfer coefficients of convection. The result of a phase and this mixed model is compared with experimental data. The result of the mixing model to predict the convection heat transfer coefficient indicates a good deal with experimental data, while the secondary nanofluids prediction distributes the average temperature in the pipe from a stage sample that is better Over the sample of the mixture compared to the experimental data, the addition, according to the results of the convection heat transfer figures of nanofluids, is high. Water, similar to the experimental data.

13. M. Chandrasekar et.al (2011) this paper had presented a unique heat transfer characteristics of the nanofluids of monocrystalline alumina (Al_2O_3) which is water based, uniformly flowing heat pipes with a fully developed laminar flow and turbulent flow regime were examined to study the mechanism of heat transfer in nanofluids. The nanoparticle shift, along with the volcanoes of turmoil in chaotic core and promotional mechanisms, such as thermophoresis, in the laminar substrate, is believed to be the reason for improving the heat transfer in the unrested region. . The experimental characteristics of the convection heat transfer of Al_2O_3 nanofluid / water were made in fully developed laminar, and the area where the turbulence of the flow varies from the pipe with constant heat. The investigation was conducted as follows. The heat transfer coefficients were increased by 17%, up to 24% and 34%, respectively, with a concentration of nanofluids of 0.1%, 0.15% and 0.2%, compared to the amount of water in The length of the element under the laminar flow.

14. R. Mokhtari Moghari et.al (2011) this work was based on improvement techniques which is to increase the heat transfer of the laminar flow of convective mixtures of aluminium nanofluids-in the fixed-temperature change boundary variability apparatus utilizing a sample of two-phase and effective mixtures of nanofluids expression properties. The three-dimensional Navier-Stokes energy and quantitative equations were fractionated using discretised quantitative methods, while the SIMPELC algorithms were advised to connect fast. The calculation results show that in quantitative and incremental increments of Nano particles increase the number of Nusselt in the inner and outer walls, while not affecting the friction factor. The mixed intensity of nucleic acid Al_2O_3 in semen is simulated using two mixtures. The results show that, although the second flow in the annex is very small, compared to most flows, the second movement plays an important role in transferring heat and mass inertia.

15. Mohammad Kalteh et.al (2011) this article examined the forced laminar transfer of convection heat of copper and hot water nanofluids in microchannel isothermally. The Eulerian model of the two liquids believed that the flow of internal nanofluids simulates and manages the mass, obedient and energy microchannel for two stages is solved by using quantitative limits. Also, improvements in heat transfer increases with the increase in the volume of Reynolds and the size of the nanoparticle, as well as the reduction in the diameter of the nanoparticle, while the pressure rise slightly decreases. Reducing the pressure and heat transfer due to the flow of nanofluids with honey and water in a microchannel-parallel plate examines the isotope digital to a wide range of Reynolds numbers, concentrations of nanoparticles and diameters of nanoparticle. It has been observed that the speed and temperature relative to the basic liquid phase and the nanoparticle are small and less important.

16. Mohammad Hojjat et.al (2010) In this study, they had done an experiment which investigated the forced change of three different nanofluids containing heat exchangers flowing along the same heated pipe. Nanofluids are prepared by separating nanoparticles γ- Al_2O_3, CuO and TiO_2 in carboxymethyl cellulose (CMC) aqueous. All nanofluids, as well as essential fluids, show poor behaviour. The results of the heat transfer test showed that the coefficient of heat and mean change of nanofluids was greater than that of the base. It had shown that the increment in heat transfer rate by increasing nanoparticle storage. For the given quantity and concentration of nanoparticles, the local heating coefficient decreases with the axis of the axis from the test part. The length of the nanofluids heat pipes seems to be larger than the main fluids and became longer when the nanoparticle concentration would increase.

17. Liang Liao et.al (2009) In this study, attention was paid to the effect of liquid temperatures on the resistance and absorption of aqueous suspension of non-surfactant carbon nanotubes. While the change in heat of Nano tubular suspension, high carbon concentrations of high mass or high temperatures have been significantly improved. The fluctuating temperatures do not affect the flow characteristics - but they have a profound effect on heat characteristics. Particular attention has been paid to the effect of liquid temperatures on heat transfer and falling flow. The main result is that suspended fluids do not differ significantly in pure water. Waste contains similar currents, such as pure water. The heat transfer coefficient of cement increased as the accumulation of carbon dioxide increased. It also rises with increased fluctuating temperatures.

18. K.B. Anoop et.al (2009) Here, thermal simulation studies of heating currents, heat exchanger in developing areas of fixed heat flow were performed with nanofluids of aluminium. The main purpose was to evaluate the influence of the particle size on the heat exchanger in the developing region. It has also been observed that in developing areas, heat transfer coefficients show greater improvement than developed areas. Based on the experimental results, heat stress has been proposed in developing regions for the current range of nanofluids. Experimental transfer of heat exchanger with aluminium nanofluids was developed in developing areas of constant flow of heat pipes. The following investigations were conducted. It has been observed that both nanofluids, with particles of 45 nm and 150 nm, exhibit characteristics of heat transfer higher than main fluids. As the particle concentration increases and the growth rate increases, the coefficient of the coefficient of heat change. It has also been observed that in developing areas, the heat transfer coefficient is higher in the more developed region.

19. S. Zeinali Heris et.al (2009) in this study, they had made an experimental setup with the liquid containing the nanometre-sized particles which were suspended, called nanofluids. These fluids can be used to increase heat transfer rates for different applications. In this study, experimental heat transfer for Cu / water nanofluid via a circular tube was investigated. The results showed that the heat transfer coefficient was increased by increasing the nanoparticle concentration as well as the number of seeds. An experiment investigated the transfer of heat energy from zinc / water transfer to nanofluid in a circular pipe. The flow rate is the logarithm and the boundary conditions of the heat are the constant wall temperature.

20. Doohyun Kim et.al (2009) in this paper, they had investigated experimentally the effects of nanofluids on convection heat transfer which was carried out by constant rectangular pipelines with heat flow states in the laminar regime and the flow of uniform heat flux. Stability nanofluids, an aqueous suspension of aluminium and amorphous carbon nanoparticles, are obtained by two methods and one step. When comparing heat and polygon heat, the improvement of heat transfer is higher than the heat speed of nanofluids. The displacement of nanoparticles has improved the heat exchange at the entrance. To examine the effects on heat transfer, the coefficient of output from the convection, the heat and the presence of the supernatant nanoparticles were measured thermal and convection heat transfer coefficients of stable amino acids and amorphous nanofluids.

21. Murshed et.al (2008) here**,** experimental and combined theories on thermal reactions and viscosity of nanofluids were performed. The temperature and the mass of nanofluids were measured and found higher than the base valves. The transport of heat and viscosity of nanofluids increases with the nanoparticle fraction. The temperature of nanofluids has also been observed to be highly temperature dependent. The two models are based on static mechanisms to predict the rising heat of nanofluids with spherical and cylinder nanoparticles. The proposed model demonstrates a good deal with the experimental results and provides a better prediction of the effective heating currents of nanofluids compared to existing models.

22. Yurong He et.al (2007) in this study, the stable aqueous nanofluids TiO_2 with the size and concentration of different particles (agglomerates) were developed and measured for their thermal connection and static rheological behaviour. Then, Nanofluids measure their heat for the transfer and flow of behaviour when flowing through the vertical pipes both in the laminar and in the flow of the chaos. The experimental behaviour of the flow and heat behaviour transfers the aqueous TiO_2 nanofluids flowing directly under the laminar and flow of the turbulent. Given the number of Reynolds flow and particle size, the coefficient of convection heat transfer factor increases with the concentration of the nanoparticle, both in laminar and flow disorders under the influence of the concentration of particles .This seems to be the main mode of flow of unrest.

5. Conclusion

The solar energy is the renewable source of energy which is available in abundant quantity; it is mainly used for heating air and water. To increase the heat transfer of solar heat exchanger different parameters where optimized. To increases the heat transfer inside the solar heat exchanger Nano fluids were used, due to which the heat carrying capacity of working fluid increases. The heat transfer inside the solar heat exchanger is also increase with the increases in turbulence inside the solar heat exchanger. To increase the turbulence inside the heat exchanger different types of turbulators were used.

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