Study the Impact on the Rate of Heating of Water with Nanofluid using A Parabolic Dish

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Abstract: Through this paper I have hereby presented research work on Enhancement of heat transfer in solar collector using Nano-fluid which increases the overall performance of the system. Nano-fluid based solar collector are commonly used in areas such as industries, heating and cooling for domestic purpose, thermal power plants, solar cooker, automobiles, etc. This paper contains literature survey which provides enhancement in heat transfer in solar collectors using Nano fluid.

Keywords Heat transfer, solar collectors, Nano fluid.

1. INTRODUCTION

- *Nano Fluids in Solar Energy*

The usage of Nano fluids for the devices like solar collectors as an operational medium is a relatively an innovative idea. In order to recover the physical properties for improving direct solar Collectors, various studies have to be approved out. As solar power is willingly available, researchers are emerging the various means to make effective use of this vitality. Nano fluids are latent heat transfer fluids with enhanced thermo physical properties and heat transmission performance can be applied in many devices for healthier performances (i.e. energy, heat Transfer and other performances).Nanoparticles deliver the following possible benefits in solar power plants.

The very minor size of the particles preferably lets them to permit through pumps without adverse effects.[1]. Nano fluids can engross energy directly--- hopping intermediate heat transmission steps. The Nano fluids have great preoccupation in the solar range and low emittance in the infrared). A more unchanging receiver temperature can be reached inside the collector[2].Enhanced heat transfer via better convection and thermal conductivity which may enhance the performance of a receiver. Preoccupation efficiency may be enhanced by modifying the Nanoparticle size and shape to the application [3]. One of the most actual methods to rise the solar collector efficiency is to replace the working fluid, water, by great thermal conductivity fluids. At current Nano fluids are predictable to excellent heat transmission properties as relate to the conventional heat transmission fluids.

Nano fluids are deferments of metallic or nonmetallic nanoparticles like copper, aluminum silicon, alumina (Al2O3) in a base fluid such as water, ethylene glycol. Common fluids such as water, ethylene glycol, and heat transfer oil plays a vital role in numerous industrial processes such as generation of power, heating or cooling processes, chemical processes, and microelectronics.[4] However, the thermal conductivity of these fluids is moderately low and thus cannot able to reach high heat exchange rates in thermal engineering devices. A method to solve this obstacle is using extreme fine solid particles adjourned in common fluids so that their thermal conductivity will be upgraded. [5] Experiments have exposed that Nano fluids have large higher thermal conductivities compared to the base fluids.

These suspended nanoparticles can variation the transport and thermal properties of the base.[6] Nano fluids show healthier stability, rheological properties, and significantly higher thermal conductivity. For various industrial and automotive submissions Nano fluids are the original generation heat transfer fluids because they exhibit excellent thermal performance. [7] Newly, many researchers have inspected the effects of Nano fluids on the upgrading of heat transfer in thermal engineering devices, both experimentally and theoretically. [8] The excellent features of Nano fluids are upsurge in liquid thermal conductivity, liquid viscosity, and heat transfer coefficient. [9] Consuming Nano fluids as a (Direct Absorption Solar Collector) DASC leads to following advantages:

- Erraticism of the shape, size, material, and volume fraction of the nanoparticles allows for tuning to get the most out of spectral absorption of solar energy throughout the fluid volume.
- Improvement in the thermal conductivity can lead to proficiency improvements, although small, by more effective fluid heat transfer; and, finally.
- Huge progresses in surface area due to the very minor particle size, which makes Nano fluid-, based solar systems attractive for thermo chemical and photo-catalytic procedures.[10]

2. EXPERIMENTAL SET – UP

Solar water heater comprises the technology that converts heat concentrated from the parabolic thermal collector at an optical focal point utilized into heating the water inside the copper cylindrical tank kept at the focus, where in all radiations are absorbed. Copper is an eminent component into solar thermal heating systems used in both primary circuits and in receiversi.e.in heat exchangers and pipes for water tanks, because of its high heat conductivity, high resistance to corrosion by water and atmospheric exposure, mechanical strength and sealing and joining by soldering. Further, the set up heats up to maximum temperature of 87degree centigrade on Nano fluid along with water to enhance the efficiency, which is further utilized for several purposes like radiant space heating in this set up. Here is the specification listed down:

The complete set up work is preceded efficiently keeping a few considerations in mind:

- Dimension of parabola disc.
- Frame size.
- Fabrication material used, Gear, motor.
- Copper Cylinder configuration.
- Other relevant information, like the wind velocity profile, temperature of environment and radiation data.

fig. 1. Experimental set up of parabolic solar collector

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Fig. 2 .Frame of parabola shape

With the help of wire using technique shape of parabola is constructed. For effective shape of parabola we used the formula of [$y=x^2/4$] to calculate the perfect shape and curvature of parabola. Initially we implement the point P as the focal point of the parabola after construction. The value is exact 4 for the focal point (it could be numerical for the installation site) and the area of dish = $2.5m^{2.}$.

Fig.3 Concentrator copper cylinder

- We have use copper cylinder in this experiment because it is carrying with very good thermal conductivity. The copper cylinder used in this experiment is of 4mm thickness.
- 386w/m ^{0}c is the thermal conductivity of the copper. The water is has been made to pass through, As the concept is that the cylinder will heat up and the water inside will pass and will be heated up and for maximum effective use we have painted the cylinder in black in color for maximum heat absorptivity and so on the process is been carried out systematically.

- Cylinder is been hanged with the strong base or we can say as the hanger had been designed for the cylinder in which it can be hanged, area of Cylinder is = .15m^2
- As seeing in the cylinder we have placed 2 pipes in the face of the cylinder, one pipe is for Inlet and other pipe is for Outlet. Both play a very significant role in this experiment.
- The image of the copper cylinder is been displayed below:

3. RESULT AND DISCUSSION

It basically deals with the results in the form of graphs. The graphs are obtained by the experimental work on the parabolic dish in a ray concentrator by using the water as a working fluid. This chapter mainly deals in, the increasing or decreasing in the solar radiation, the whole day increasing and decreasing of the temperature is been recorded.

- **Calculations for the heat balance & for the efficiency**

$$h_a=2.5(\Delta T)^{0.25}$$

Convective heat transfer coefficient

where h_a is the convective heat transfer coefficient and (ΔT) be the temperature difference.

Over all heat transfer

$$U=[1/h_a+dx_1/kx_1]$$

Where U is the overall heat transfer coefficient, dx_1 be the thickness of the insulation and kx_1 be the thermal conductivity of the insulated material.

$$Q=m\ C_p\ (\Delta T)$$

Useful energy

Q is the useful energy, (m) be the mass flow rate, and C_p be the specific heat of water whose value is 4.18 kJ/kg k, (ΔT) be the temperature difference.

$$Q = U\ A\ (\Delta T)$$

Loss for the receiver and for the water tan

Here Q is the total loss from receiver and the water tank, U be the overall heat transfer coefficient, (A) be the area of receiver and the area of water tank and (ΔT) be the temperature difference.

Total energy input from the su

$$S = A_c * I$$

Where (S) be the total input from the sun, the (A_c) be the area of collector in m^2 and (I) be the solar radiation in (w/m^2)

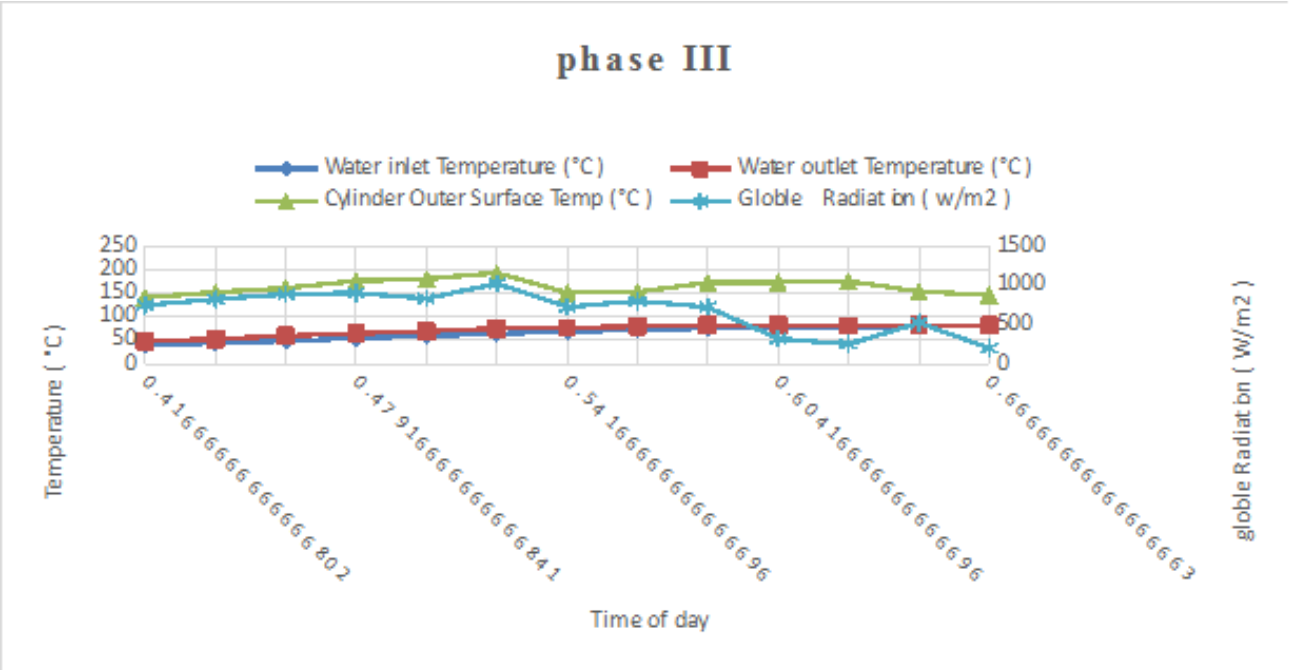

Fig .4 . Over all graph of the different parameters with normal fluid water

Table -1 Solar parabolic dish with water

Time of Day (Hours)	Water inlet Temperature (°C)	Water outlet Temperature (°C)	Cylinder Outer Surface Temp (°C)	Flow Rate(kg/min)	Global Radiation (w/m^2)
10:00	40.9	47.6	140.2	1.5	745
10:30	43.9	52.9	151.4	1.4	820
11:00	48.6	59.3	160.4	1.3	885
11:30	54.1	64.7	175.6	1.36	900
12:00	59.3	68.7	179.9	1.38	830
12:30	63.5	75.2	192.6	1.46	1020
13:00	69.1	76.3	150.3	1.44	720
13:30	71.3	79.6	152.4	1.4	800
14:00	75.6	81.2	172	1.37	720
14:30	77.8	81.9	172.6	1.36	320
15:00	78.3	80.3	175.3	1.4	250
15:30	79.4	82.3	152.8	1.39	520
16:00	80.5	81.2	145.6	1.3	200
Average	**64.79**	**71.63**	**163.1**	**1.38**	**671**

Table - 2 solar parabolic dish with Nano Fluid

Time of Day	Water inlet Temperature (°C)	Water outlet Temperature (°C)	Cylinder Outer Surface Temp (°C)	Flow Rate(kg/min)	Global Radiation (W/m^2)
10:00	38.6	47.8	152.4	1.63	822
10:30	42.9	52.8	160.2	1.48	890
11:00	47.5	57.9	155.3	1.46	918
11:30	52.2	62.8	190.2	1.53	962
12:00	57.3	68.6	163.3	1.33	1002
12:30	62.8	73.9	188.1	1.36	1009
13:00	67.2	75.9	189.1	1.3	990
13:30	70.1	76.4	164.3	1.41	520
14:00	72.3	79.1	140.2	1.45	740
14:30	74.3	81.2	156.2	1.43	760
15:00	75.3	83.3	149.2	1.46	600
15:30	79.8	84.9	142.2	1.41	490
16:00	82.3	87.1	139.8	1.39	522
Average	**63**	**71**	**160**	**1.43**	**786**

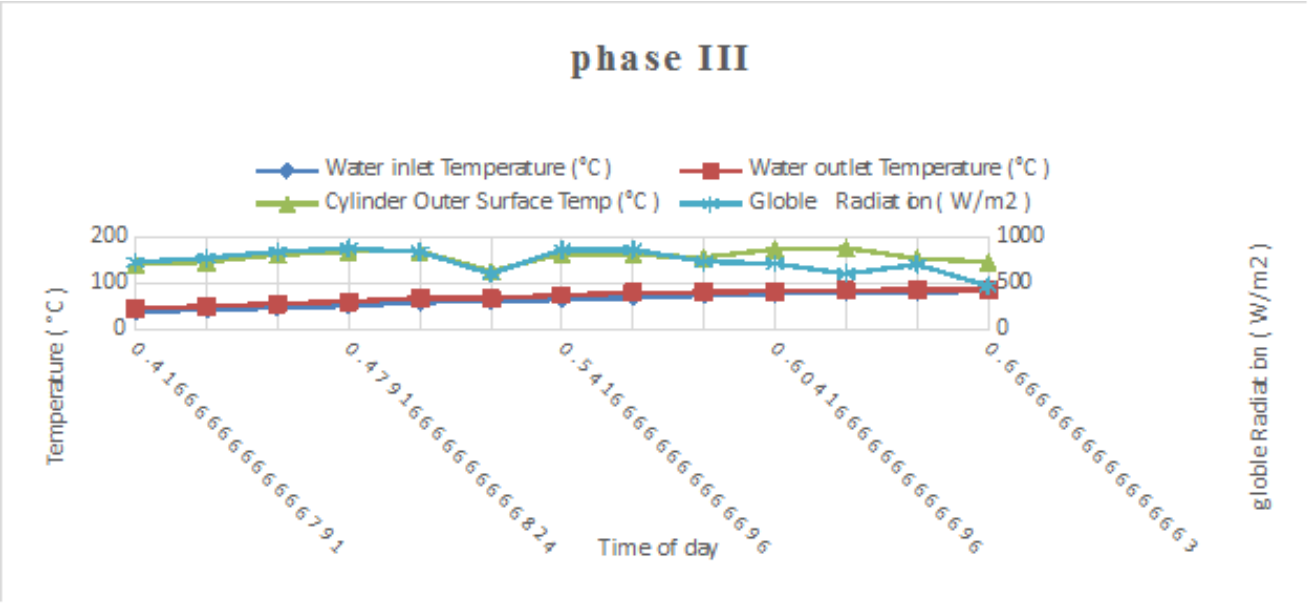

Fig. 5. Over all graph of the different parameters with normal fluid water

CONCLUSION

Through this paper I have hereby presented research work using parabolic disc concentrators & with the use of the incident light to attain concentration at of energy at focal point to produce maximum temperature. From this review, various ways of enhancing the heat transfer rate by using Nano-fluids. Heat transfer rate varied according to the different concentration and different mass flow rates, as from various reviews the use of Nano-fluid in solar collector indicates that, Nano-fluid gives the best result for enhancing the heat transfer of solar collector as compare to the water based solar collector. It has been conclude that using Nano-fluid in solar collector the efficiency increased up to 7 % as compared to water.

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