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"DIRECT ABSORPTION OF SOLAR ENERGY, ANALYSIS THE HEAT TRANSFER PERFORMANCE USING NANO- FLUIDS"

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ABSTRACT

In the contemporary scenario, increment in power requirement is a day by day game. As the stress on such resource increase there is increment in depletion of such resources. Hence, use of renewable energy is best alternative source available. Considering all renewable energies, solar energy is available in great volumes which are also used in solar collectors to harness sun's potential. The traditional liquids which are utilized for the heat transferring medium in sun powered collectors, tend to possess thermal and heat absorption characteristics that have very low magnitude. It has been discovered that these regular liquids have a restricted ability to convey up heat, which thus confines the collector's execution. It has been watched that for ordinary liquids, suspending the nanoparticles in them can be a decent substitute in light of the enhanced thermal properties. Another sun-oriented collector named „Direct Absorption Solar System" (DASC) is used for experimentation. DASC is more productive collector than the regular type solar collector, as in DASC the fluid absorbs solar thermal energy volumetrically and consequently captures more heat energy. Being a relatively new technology, it has been looked onto very less in the previous years and it has been observed that solar collector efficiency enhancement takes place by 4 – 18 % than the conventional fluids Current test work relates to the use of nanofluids and performance evaluation of the DASCs and it is discovered that by utilizing CuO – H 2 O nanofluid, collector efficiency increments up to 6%, for mass flow rate of 60 to100ml/hr. The collector effectiveness is additionally influenced by the volume portion of nanoparticles. In present work it is accounted for that at higher volume fraction focus the issue of settling down of nanoparticles, which brings about bringing down the collector effectiveness. As volume fraction goes down from 0.05% to 0.005%, productivity is hiked by2% – 2.5% on a normal. This collector efficiency improvement can be accomplished up to 10 – 15 %, by removing molecule agglomeration issue. e.g. settling down of nanoparticles, make this suitable for higher mass flow rate.

Keyword: *Nanofluid (CuO-H2O), Nanoparticle (CuO), DASC, Digital Solerimeter, Pyranometer, Temperature Sensor, Infusion Set, Volume Fraction, Efficiency*

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I. INTRODUCTION

Solar Energy

Since time immemorial, the energy present in abundance is the solar energy. In fact, it is very much important energy source the entire solar system with it being the basic source of all the varieties of energy whether being conventional or non-conventional, renewable or non- renewable, wind or tidal energy. All these energy sources come indirectly from the ultimate source,the sun.Themost intriguingrealityaboutsolarenergyisthe magnitudeoftheincident solar radiation striking the earth in one dayis almost equal to the world energyrequirementa year. Hence harnessing the solar energyposes significant problems that amount to such large- scale loss in energy.

When this sun-based radiation strikes the skin of earth then a portion of this is assimilatedand thusly, the increment in surface temperature can be seen. As the system‟s temperature increases, environment soaks in large amount of heat as it is lost at an elevated rate from the system. The system can then be in steady-state if the rate of heat dispersedto the atmosphere gets on equal terms with that of solar heat gain [5].

The gross incident radiation from the sun, per unit time, falling on unit surface kept at right angles to the incident radiation, in space, just outside is known as Solar Constant. The numerical value of the solar constant is about 1350 W/m2 [8].

Extraterrestrial solar radiation is the sun-based radiation striking the surface at square angles to the sunlight external to the earth's atmosphere. This outer space sun‟s radiation at an average earth-sun distance is called the solar constant. Whensolarradiationadvances through the environment, some of it is reflected again into space, mostly consumed via airand water vapour, and partially scattered. The incident radiation striking the surface of the earth is known as beam radiation, and the scattered radiation that achieves the surface from the sky is known as diffuse radiation.

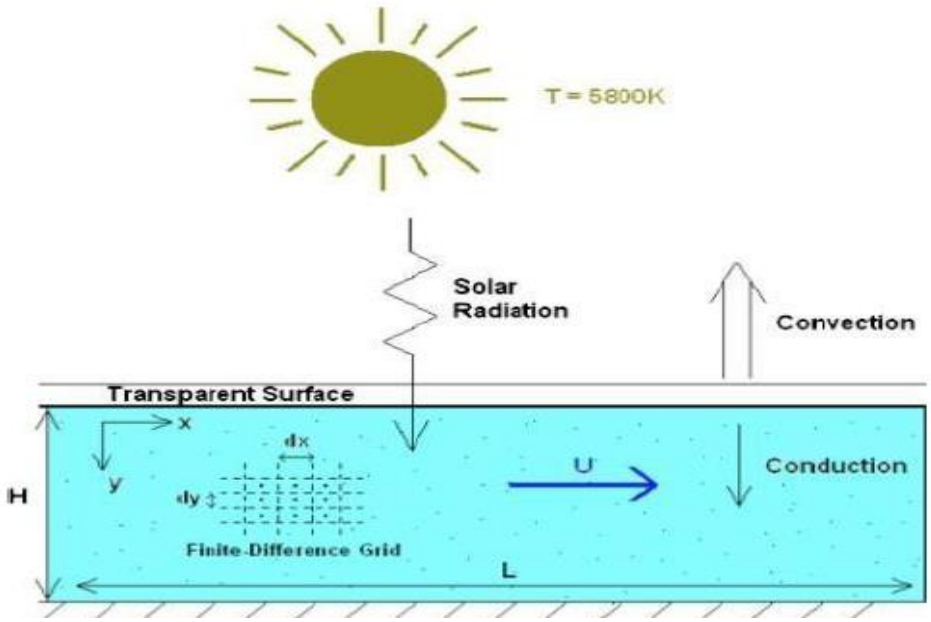

Figure1 Schematic diagram of DASC[4]

II. METHODOLOGY

Main steps of the methodology are as follows:

a. A SHRAE Standards 93-77 the testing of solar collectors.

b. Experimental Set-up.

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c. Direct absorption method is used the experiment.
d. Nano fluid used:
    - Base fluid–Water
    - Nano-particles–Copper Oxide (CuO)

ASHRAEStandards93–77[21,7]

Following ASHRAE (The American Society of Heating, Refrigerating and Air-Conditioning Engineers) standards are used this study.

1. Finding the solar radiation in plane of collector, a pyranometer as classified bythe World Meteorological Organization should be used.
2. Data ought to be taken amid the middle of the day, ideally when the sunrays incident angle is under 30˚.
3. A number of tests ought to be led, every one of which decides the average efficiencyof a 5 – min period.
4. In computing efficiency, the gross frontal area is taken in to account in lieu of aperture area.
5. The efficiency plot is manifested by devising efficiency as an element of contrast between the initial fluid temperature and then compassing temperature divided by the incident solar radiation.
6. It is vital the collector to performance preconditioning test before the start of experiments. The collector must be left in the open three consecutive days with no passage of fluid through it and with normal incident sun-based radiation estimated in the plane of the collector gap surpassing 17,000 kJ/m2days.
7. Before the efficiency test, the time steady is resolved.

III. EXPERIMENTAL SET–UP

The model the test apparatus is manifested in Figure.4.1. Small geometry is chosen so as to duce uired analysis. In this set-up CuO-H2O based nanofluid is used. An IV Set is brought up the sole purposes of constant nanofluid flow.

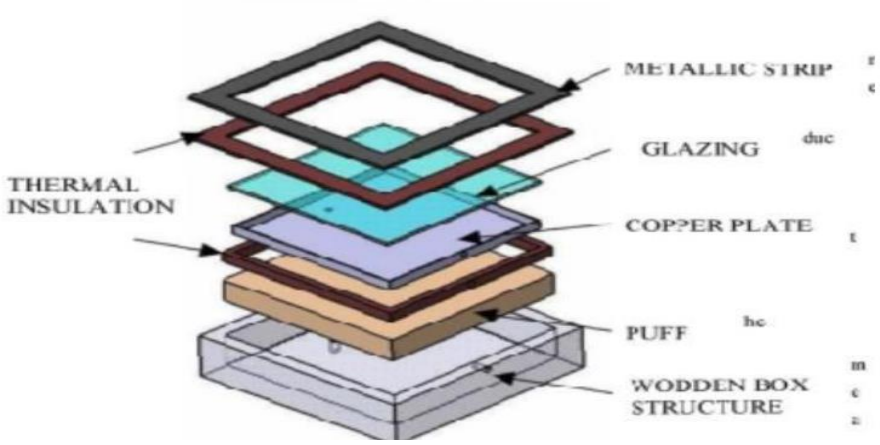

Figure 2 experimental set up

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Figure 3 Top View of DASC

IV. RESULT & DISCUSSION

Here a thorough elucidation of the result and their analysis, which were obtained after performing the experiment are given and shown. Here calculation DASC is followed by the variation it shows in efficiency and also the effect of nanofluid on the collector‟s performance.

Table 1.1

Time	TotalSolarRadiation 'W'			HeatAbsorbed'W'			Efficiency'η'%		
	(31/5/23)	(2/6/23)	(3/6/23)	60 ml/hr (31/5/23)	80 ml/hr (2/6/23)	100 ml/hr (3/6/23)	60 ml/hr (31/5/23)	80 ml/hr (2/6/23)	100 ml/hr (3/6/23)
10:00 AM	32.213	34.928	34.561	2.0131	2.7031	3.281	6.636	8.557	10.44
11:00 AM	41.012	40.998	39.987	2.431	3.2168	3.7981	5.693	8.842	10.51
12:00 PM	48.592	45.831	47.898	2.6123	3.5335	4.4521	5.939	8.439	9.987
1:00 PM	57.634	53.18	56.377	3.1687	3.7916	5.0831	5.835	7.956	9.589
2:00 PM	50.219	49.231	50.981	2.7831	3.6328	4.5171	6.078	8.184	9.729
3:00 PM	45.981	45.161	45.531	2.570	3.4288	4.2198	6.408	8.34	10.284

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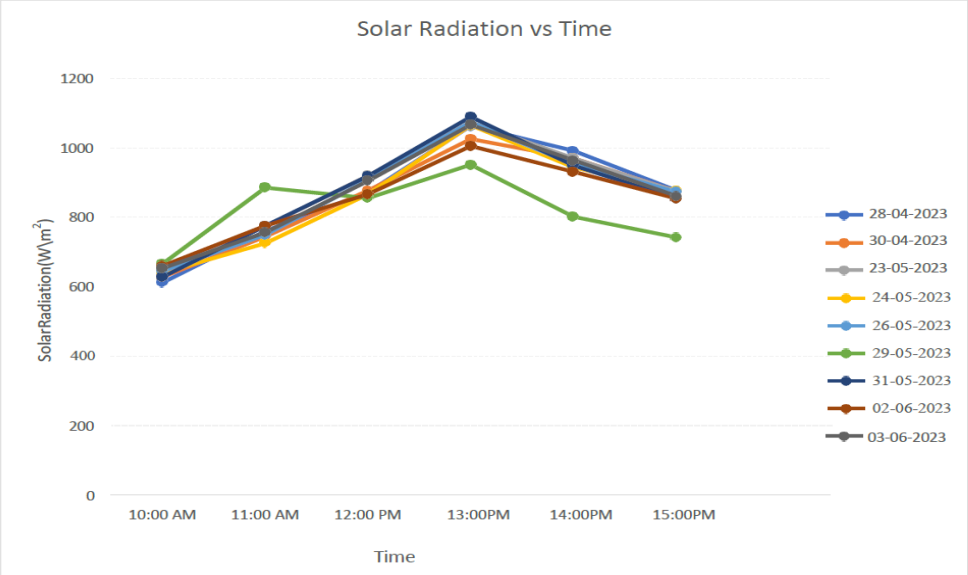

Figure.4 (Solar Radiation Variation with time on different days)

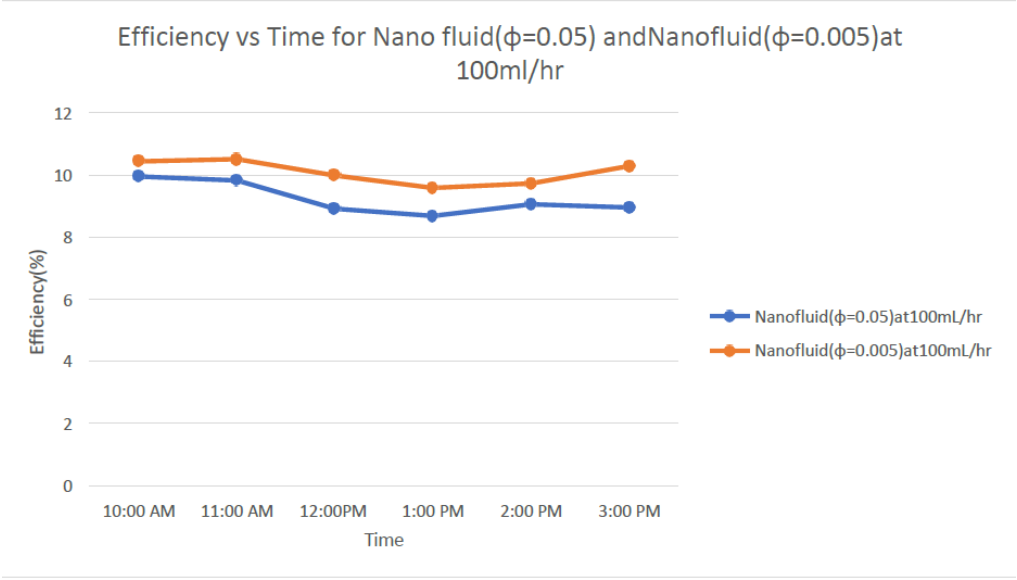

Figure.5 (Efficiency vs Time) flow rate–100ml/h

V. CONCLUSION

The current thesis focuses upon experiment and simplified analysis of how DASC work. The concluded points of this experimental work are given below:

1. Use of CuO-H2O nano fluid increases the efficiency of the collector in the rangeof4-7%.

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2. Nanofluid with 0.005% volume fraction exhibit efficiency increment by 2.0-2.7 % than ϕ=0.05 nanofluid used.

3. The small particle size is the main reason augmented efficiency, steering it to an elevated heat absorption rate and leading to efficiency improvement.

4. The very basic complications associated in use of nanofluids which include particle agglomeration and cost of preparation of nanoparticles is high and should be focused upon.

VI. SCOPE OF FUTURE WORK

1. The significance of nano fluids in sun based energy systems is a modern expedition field,

2. There is also a numerous result and analysis available and in the same time various differences in results and principles used in application.

3. So,it is necessary to further theoretical as well as experimental work, investigations to increment efficiency of solar collector and to deduce solid and valid results.

4. It can be summarized that great potential of nanofluids is seen in solar thermal applications and they are answer the heat transfer limitation of conventional heat transfer fluid.

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