PERFORMANCE EVALUTION OF LIQUID FLAT PLATE COLLECTOR BY COMPARING THE NORMAL WATER WITH NaCl SOLUTION AS A WORKING FLUID

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ABSTRACT

With over exploitation of fossil fuels, each passing day we are inching closer to witness the extinction of natural resources. This can cause imbalance in nature. Many scientists believe it is a distant threat of which humans are not aware off. Scientists are rigorously working on to reduce the threat. One such is alternative of fossil fuels, which can reduce its exploitation to a great extent. Non conventional energy proved handful in this situation of energy crisis. Sources like, solar, wind, hydal are abundant in nature and can be harnessed to any extent.In this experiment, water and salt solution is used as liquid to be heated up within the copper pipes. Two experiments are conducted simultaneously; in first instance water is taken as the liquid to be flown inside the copper pipe. When sunrays falls on the aluminium sheet beneath which copper pipe is brazed, water gets heated up, the inlet and outlet temperature are observed. In second instance, water is mixed with common salt (NaCl) and salt solution is prepared, this solution is made to run through and the copper pipes and further it gets heated up. Inlet and outlet temperature of the salt solution at extreme end of the pipe is observed via hydrometer.On using Nacl solution there is an increase in 5-6% collector efficiency as compare to normal water.

Keywords: Liquid Flat Plate Collector, Nacl Solution, Water

I .INTRODUCTION

With the natural resources hitting new lows with each passing days, it has dented the economy of many countries which relied heavily on them. Scientists are working hard on finding alternatives for these resources. Non conventional energy resource turns out be boon in this acute energy crisis situation. Non conventional energy is far much better than the fossil fuels and other resources. In terms of availability, costs, affect on environment and many more factors under which non conventional energy is preferable over fossil fuels. The only factor which underlines the advantages is it's sparsely distribution across the earth. With the advancement of technical era, more and more technology is put into work to harness non conventional energy. Major products being solar cell and wind mill are the gift of technology. Our area of concern is solar liquid collector, which utilizes solar energy to heat up water.

K. Chung et al: Evaluated the pressure variation on the collector and the wind uplift force. Two suggestions are composed to reduce the wind uplift; these are lifting the model and guide plate. Wind speed used for the evaluation of wind uplift is in the range of 20-50 m/sec. There is significant effect on wind uplift using guide plate normal to the wind. The effect of lifting the model is not much effective to reduce the wind lift.**Ahmet**

Koca et al: Experiment was performed to evaluate the exergy and energy performance of the integrated flat plate solar collector with phase changing material for thermal storage. Mobilterm 605 is used as a working fluid with thermal conductivity .145W/mK. PCM material used is CaCl2.6H2O. Energy and exergy efficiencies are 45% and 2.2%.**Katharina Resch et al:** a review was done on the Thermotropic layers used for the overheating protection. Their transmittance is the function of the temperature of the collector. At greater temperatures transmittance declines reduce the collector temperature. Thermotropic hydrogels, thermotropic polymer blends and thermotropic systems with fixed domain are mainly applied for overheating protection.

II.EXPERIMENTAL SETUP

The setup used in the experiment consists of a wooden frame, a thin glass sheet, aluminium sheet, copper pipe and insulating material. The dimension of wooden frame is 900mm x 1245mm. Wooden frame is being insulated using glass wool having 5 cm thickness, copper pipe of 10 mm diameter is placed inside the frame, which is brazed over aluminium sheet of 3 mm thickness. Glass sheet is placed above the aluminium sheet which is directly facing the sun. In this way when sun rays falls over the glass sheet, it concentrate the rays on the aluminium sheet resulting in the heating of the metal sheet. This heated metallic sheet heats up the copper pipe beneath it by conduction. As a result, liquid flowing inside the pipe gets heated up.

Figure 1. Solar Collector for Water Heating

2.1 Important Dimensions

inner diameter of copper tube	10mm
thickness of tube	2 mm
spacing between tubes	100 mm

2.2 Equipments Used

1. Solar power meter
2. Temperature Sensors
3. Rotameter

1. Solar power meter: Solar power meter is used to measure the intensity of solar radiations.
2. Temperature Sensor: The Dial gauge type temperature sensor is used to measure the temperature of the inlet and outlet water from the liquid flat plate collector.
3. Rotameter: It is a device to measure the flow rate of water which is circulated in the collector. It gives the amount of water flowing through the tubes of collector.

III.CALCULATION AND RESULT

3.1 Formulae Used

Collector efficiency is defined as the ratio of the heat transferred to the flowing fluid to the heat received from the incident radiation (I) falling on the surface of the collector.

Collector efficiency= $\eta = \left(\frac{m * C_p * \Delta T}{I * A}\right)$

M_f= mass flow rate of liquid

C_p= specific heat capacity of liquid

ΔT= change in outlet and inlet temperature of the liquid

I=Solar intensity

A= Area of collector

Table1. Data Obtained in Experiment

FOR NORMAL WATER AS A WORKING FLUID:

Time	Outlet Temperature of water T_2 (°C)	Inlet Temperature of water T_1 (°C)	Water Flow Rate M_f (kg/s)	Solar Intensity I (W/m^2)	Temperature difference ΔT (T_2-T_1) (°C)	Efficiency η (%)
10:30 AM	32	26	0.007	613	6	25.5
11:30 AM	36	26	0.007	654	10	39.9
12:30 PM	39	26	0.007	727	13	46.7
1:30 PM	42	26	0.007	800	16	52.2
2:30 PM	40	26	0.007	740	14	49.4
3:30 PM	33	26	0.007	625	7	29.2
4:30 PM	31	26	0.007	602	5	21.6

Table 2.Data Obtained in Experiment

FOR SALT SOLUTION AS A WORKING FLUID:

Time	Outlet	Inlet	Water Flow	Solar	Temperature	Efficiency

	Temperature of water T_2 (°C)	Temperature of water T_1 (°C)	Rate M_f (kg/s)	Intensity I (W/m^2)	difference ΔT (T_2-T_1) (°C)	η (%)
10:30 AM	33	26	0.007	613	7	29.7
11:30 AM	37	26	0.007	654	11	43.6
12:30 PM	40	26	0.007	727	14	49.8
1:30 PM	44	26	0.007	800	18	58.4
2:30 PM	41	26	0.007	740	15	52.8
3:30 PM	34	26	0.007	625	8	33.1
4:30 PM	32	26	0.007	602	6	25.9

3.2 Graph Analysis

Comparison of efficiency of liquid used within collector (normal water and salt solution)

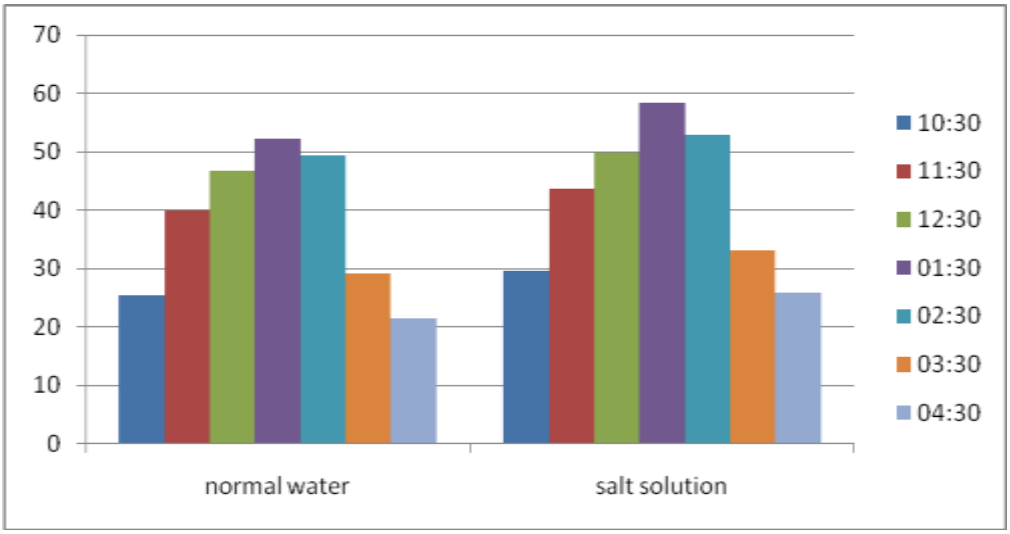

Table 3.Comparison Between Two Working Fluids

Type of Working fluid	Maximum efficiency η(%)	Max Temperature difference ΔT(°C)	Mass flow rate m_f(kg/sec)
Normal Water	52.2%	16	0.007
Nacl Solution	58.4%	18	0.007

IV.CONCLUSION

At last we came to conclusion after conducting experiment and doing research analysis that liquid solar collector using salt solution as liquid will be more efficient than the one using normal water as is its liquid. There is difference of 5-6% in terms of collector efficiency of normal water and solar collector using salt solution.

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BIOGRAPHICAL NOTES

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