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Enhancement of Double Slope Solar Still with Different Nanofluids and Hybrid Nanofluids Compositions

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ABSTRACT: Water is essential for life. The supply of drinking water is important issue in many areas in any nation. So, Distillation is the method of desalinate backrish water or seawater. Due to limited of fossil fuel, more attention is given to renewable resources. For, this method solar energy is act as energy resources. To, analyse the productivity of double slope solar still, experiment are made by different nanofluids and hybrid nanofluids. A nanofluid is a fluid containing nanometer-sized particles, called nanoparticles. These fluids are engineered colloidal suspensions of nanoparticles in a base fluid. The nanoparticles used in nanofluids are typically made of metals, oxides, carbides, or carbon nanotubes. Nanofluids are act as heat transfer medium in our experiment. The *hybrid* nanoparticles may be defined as two or more different materials in the nanometer size. It's same as nanofluids. For this reason, nanofluids are randomly selected by different properties. The selected nanofluids are Al_2O_3 , CuO, ZnO, TiO_2 . The Hybrid nanofluids are $Al_2O_3+TiO_2$, CuO+ZnO.

KEYWORDS: Double slope solar still, Al_2O_3 , CuO, ZnO, TiO_2 , $Al_2O_3+TiO_2$, CuO+ZnO.

I. INTRODUCTION

Over 97 % of water available on the earth's surface is salty and environmental pollution caused predominantly by anthropogenic activities is also contributing to the degradation of fresh water resources. The reported that 78 % and 96 % of the rural and urban populations used clean drinking water on a global scale respectively. So, 4 billion cases of diarrhea are reported annually, with 88 % of them being ascribed to the use of unclean water, and insufficient sanitation and hygiene. Nevertheless, a sustainable source of energy is required to provide fresh water to a larger proportion of the world population. The quality of water can be improved through desalination. A nanofluid is a fluid containing nanometer-sized particles, called nanoparticles. These fluids are engineered colloidal suspensions of nanoparticles in a base fluid. Suspending small solid particles in the energy transmission fluids can improve their thermal conductivity and provides an effective and innovative way to enhance their heat transfer characteristics significantly. Nanofluids are prepared by synthesis method. While synthesis of nanofluids, two step method is most common method. Nanoparticles, nanofibers, nanotubes, or other nanomaterials used in this method are first produced as dry powders by chemical or physical methods. Then, the nanosized powder will be dispersed into a fluid in the second processing step with the help of intensive magnetic force agitation, ultrasonic agitation, high-shear mixing, homogenizing, and ball milling. Nanoparticles, nanofibers, nanotubes, or other nanomaterials used in this method are first produced as dry powders by chemical or physical methods. Then, the nanosized powder will be dispersed into a fluid in the second processing step with the help of intensive magnetic force agitation, ultrasonic agitation, high-shear mixing, homogenizing, and ball milling. Paper is organized as follows. Section II describes the previous experiment in same field by using nanofluids. Procedure to conduct the experiment is given in Section III. Section IV presents experimental results showing results of experiment. Finally, Section V presents conclusion.

II. LITERATURE SURVEY

[1]A.E. Kabeel et al (2014) studied the performance of conventional type solar still with condenser by using Al_2O_3 . Here, Aluminium Oxide at 0.1 wt% is used. The higher performance of modified still is achieved for continuous running fan of speed 1350 rpm through all the day time 53.22% higher than the productivity of the conventional still. [2] Swellam W. Sharshir et al (2019) studied the performance of various pyramid solar still with nanofluids and without nanofluids. In this paper, the experiment is conducting in three stages. The use of DPD, DPDW, and DPDW + CuO enhanced the total freshwater productivity by about 28.38%, 45%, and 72.95%, respectively, compared to the TPD. [3]Suraj Choudhary et al (2020) studied the performance of solar still with flat plate collector by using ZnO nanofluids. The solar still is connected with flat plate collector to circulate the nanofluid in closed-loop, When the ZnO nanofluid was used, that representing an improvement of 13.2% compared with the case of water. [4]M. Saleh et al (2017) studied the performance of synthesis of nano-structured ZnO by hydrothermal method and their application in solar-still. At maximum levels of concentration between 300 and 400 mg, the percentage of increase of the still efficiency reaches about 38%. Nano-rod achieves higher results than the spherical one. [5]Saman Rashidi et al (2019) studied the performance of single slope solar still with Al_2O_3 nanofluids. By using Al_2O_3 as working fluid, the productivity is increase about 25%. [6]Rees Alexa Robert et al (2018) studied the performance of Double slope solar still with Al_2O_3 nanofluids. With the addition of the nanofluid, the distillate output was 33.9litres, which makes the production rate 35%, which shows the increase in production by 15%. Therefore, the rate of distillate production was increased by 15% with the addition of nanofluid to the feed water.

III. METHODOLOGY

The performance of Double slope solar still is to be analysed by three stages. I) without nanofluids, II) with nanofluids. The Experiment conducted from morning 6:00 am to evening 6:00 pm in the month of March. The double slope solar still is fabricated and total dimensions of the still were $0.8m \times 0.8m \times 0.1 m$. The inclination of the glass cover can be fixed with 30° . The basin still also consists of a flat absorber plate made up of 3mm thick mild steel plate, 3mm glass cover, condensate channel, with thermocol insulation.



Fig.1 Photographic view of double slope solar still

The water stored in solar still was maintained at 2 cm depth as capable of carrying 12 litre of water. In first stage, the water in solar still is doesn't mix with nanofluids. The productivity of solar still noted for each and every hour. In second stage, the experiment is conducted by four types of nanofluids. The nanofluids are prepared by two step method. Various data's are collected nanofluids likewise thermal conductivity, thermal efficiency, and Spectrum range.



Data collected for water based nanofluids:-

Parameter	Al2O3 + Water	ZnO + Water	TiO2 + Water	CuO+ Water
Thermal Conductivity	40 W/mk	50W/mk	4.8 W/mk	77 W/mk
Absorbance Area	2.37 m ²	2.3 m ²	1.92 m ²	2.7 m ²
Absorption Spectra range	At 234nm	At 355 nm	400-700 nm	At 125 nm
Volume concentration with Thermal efficiency	0.1% 7%	4% 13.4%	3% 0.27%	0.008% 52%

The mixing ratio of nanofluids is calculated by the expression of relation between the volume fraction and mass of nanoparticles:-

$$\% \text{ volume concentration, } \phi = \left[\frac{\left(\frac{W_{nf}}{\rho_{nf}} \right)}{\left(\frac{W_{nf}}{\rho_{nf}} + \frac{W_{bf}}{\rho_{bf}} \right)} \right] 100$$

The volume concentrations for nanofluids are fixed as 0.5% for selected nanofluids. The 400 ml of nanofluids is mixed with water stored in solar still. The nanofluids are Al₂O₃, CuO, ZnO, and TiO₂. Hybrid nanofluids are used as ratio of 50:50. The hybrid nanofluids used in this experiment are Al₂O₃+ TiO₂, CuO+ZnO.



Fig.2 Picture of Nanoparticles

Specification of nanofluids:-

Specification Nanoparticles	Particle Size	Specific Surface area	Isoelectric Point	Density
Aluminium Oxide	30-80 nm	~ 110 m ² /g	8-9	0.5g/cm ³
Cupric Oxide	30-80 nm	60-80 m ² /g	9.5	0.99g/cm ³
Zinc Oxide	30-80 nm	100-120m ² /g	8.7-10.3	0.69g/cm ³
Titanium Dioxide	30-80 nm	80 m ² /g	6.5	0.56g/cm ³



IV. RESULT AND DISCUSSION

The Experiment conducted in different conditions such as without nanofluids, with Al₂O₃, CuO, ZnO, TiO₂. Each and every hour the temperature in solar still are noted. And productivity is noted. Maximum temperature value of double slope solar still was 74°C at 2.00 Pm. The sky was clear and there was no freeze during the experimental days. Maximum radiation was obtained 925w/m² 1.00 Pm on absorber plate in the still.

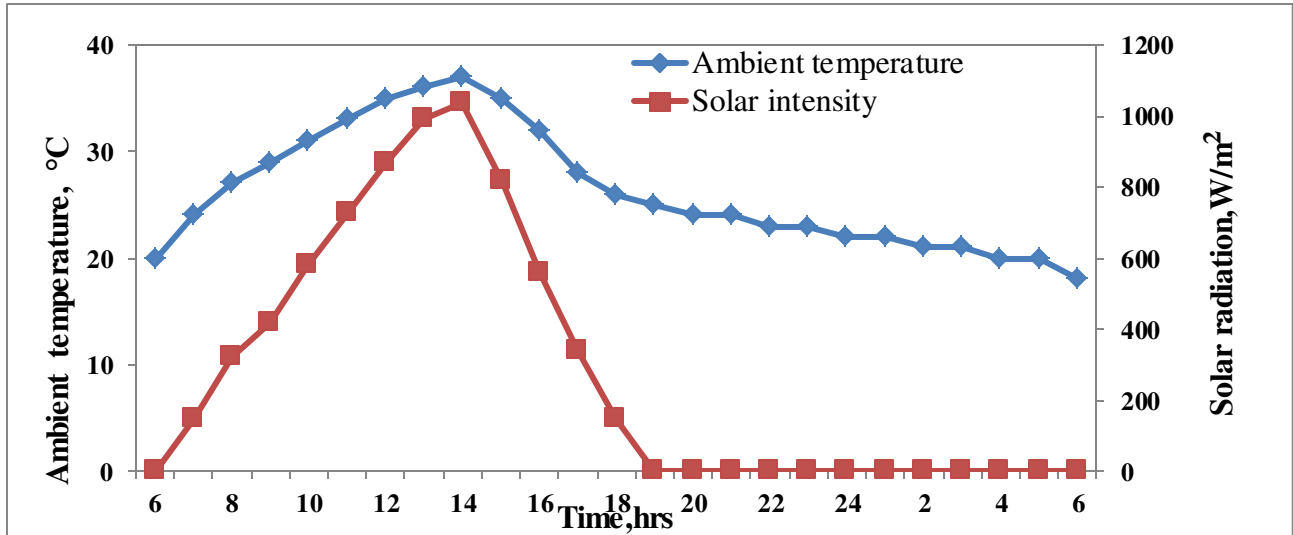


Fig.3 Variation of solar Radiation with the ambient temperature in Regular interval of time

Due to condition of temperature, at 14:00 noon solar still temperature is high. So, productivity also increases at that time. The total productivity of solar still are varies due to different conditions. The productivity of solar still without nanofluids as 1.6 liter per day, with Al₂O₃ nanofluids as 2.8 liters per day, with CuO nanofluids as 3.1 liter, with ZnO nanofluids as 2.4litre, with TiO₂nanofluids as 2 liter, with Al₂O₃+TiO₂ as 3.2 liter, With CuO+ZnO as 3.6 liter.

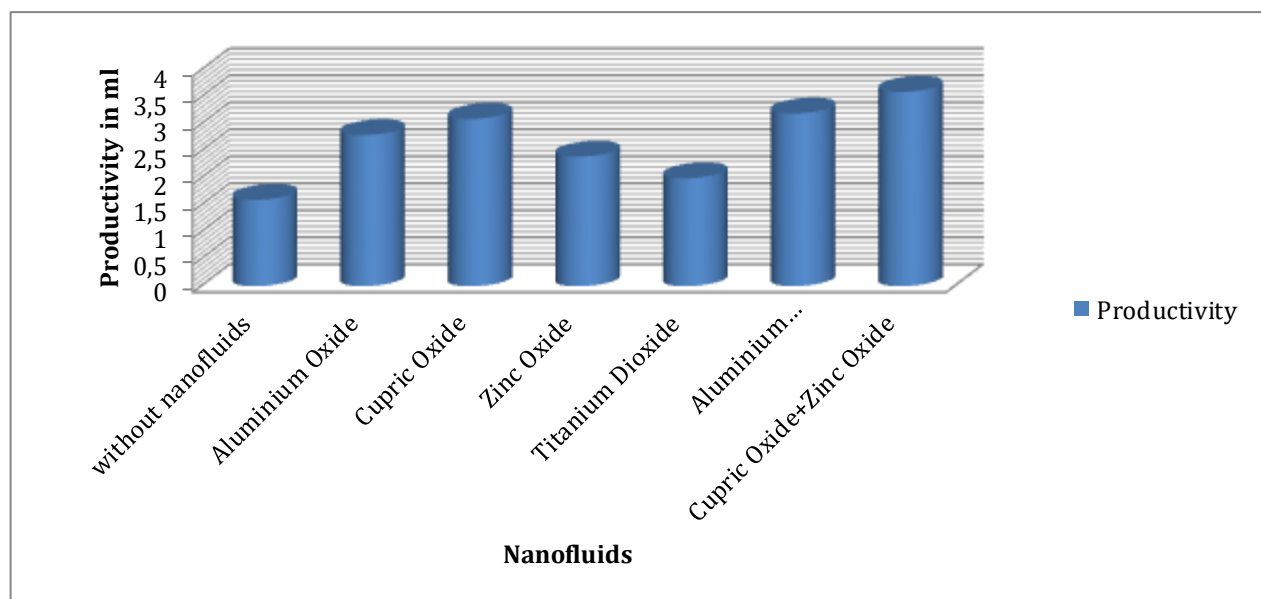


Fig.4 Variation of Productivity of solar still with different nanofluids and Hybrid nanofluids



V. CONCLUSION

The productivity of solar desalination method was increased by nanofluids is an efficient way. It produces soft water in high with limited time. The productivity of the solar still entirely depends on the climatic parameters as well as increasing the water temperature. This leads to raise the evaporative and convective heat transfer coefficients in the solar still. The nanofluids and Hybrid nanofluids plays a vital role to increase the water temperature up to 74°C compared to without nanofluids. So evaporative heat transfer is more for Cupric Oxide + Zinc Oxide hybrid nanofluids, and it is showing the maximum amount of yield. The nanofluids remains in the still are reusable. So, nanofluids used in solar still are again used.

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