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"A REVIEW ON DIRECT ABSORPTION OF SOLAR ENERGY, ANALYSIS THE HEAT TRANSFER PERFORMANCE "

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ABSTRACT

In the contemporary scenario, increment in power requirement is a daybydaygame. 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. Utilizing nanofluid as an absorber fluid is an effective approach to enhance heat transfer in solar devices. The purpose of this review is to summarize the research done on the nanofluids' applications in solar thermal engineering systems in recent years. This review article provides comprehensive information for the design of a solar thermal system working at the optimum conditions. This paper identifies the opportunities for future research as well.

Key Words: *Nanofluid (CuO-H2O), Nanoparticle (CuO), DASC.*

I. INTRODUCTION

Over recent decades, the escalating energy demands have paralleled technological and industrial advancements [1]. This surge has led to an increased reliance on fossil fuels as the primary energy source across various industries [2]. Besides their finite availability, fossil fuels have significantly contributed to carbon emissions, totaling 37.5 $GtCO_2$ in 2022, thereby exacerbating global warming [3]. In response, ongoing research efforts aim to identify renewable energy alternatives to replace traditional commercial fuels.

Among the several renewable energy sources, including hydropower, bioenergy, geothermal, and wind energy, solar energy, harnessed through photovoltaic (PV) technology, has emerged as a leading solution in renewable energy development [4]. Annually, the solar energy potential is approximately four million exajoules, positioning it as a superior energy alternative due to its abundance and reduced greenhouse gas emissions [5]. According to the International Renewable Energy Agency [6], photovoltaics rank as the second most installed renewable energy source, trailing only hydropower (excluding pumped storage). In 2022, the installed PV capacity reached 31.2%, marking a 3% increase from the previous year [6]. As depicted in Figure 1, electricity production via PV technology has been on an upward trajectory in every region, highlighting the growing public interest and the anticipated continual rise in demand. The versatility of PV technology, evident in its applications ranging from personal wearable devices to transportation and building systems, further fuels its demand [7].

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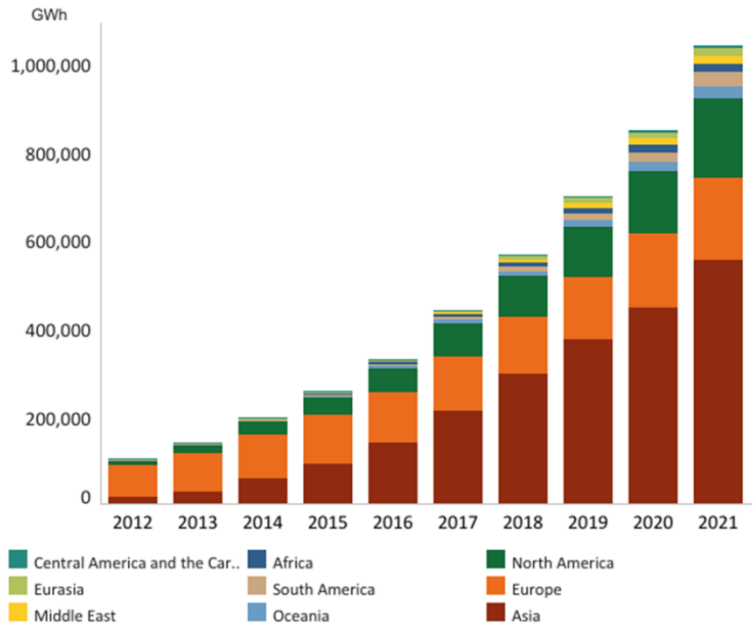

Figure 1. Rising global electricity generation by photovoltaic technology

II. LITERATURE REVIEW

HanZ. Heat exchange liquids have naturally low thermal conductivity that extraordinarily constrains the heat exchange efficiency. Liquid dispersion of particles possessing nanometric size, given the name “nanofluids”, exhibit quantitively large thermal conductivities when contrasted with that of their base fluids. A nano - emulsification technique have been studied and developed to synthesize nanofluids. The thermal transport properties of nanofluids, including thermal conductivity, viscosity, heat capacity and heat transfer coefficient in convective condition were portrayed and demonstrated.Up to 126% and 20% increase in the impact of heat capacity were experimentally evaluated in water-in-FC72 nano emulsions and indium-in-PAO nanofluids, respectively. The reason such results to be obtained was because in the transition phase, latent heat in great volume was absorbed from nanoparticles to nanodroplets and was then in reversed transition released. It can be easily deduced from the results obtained that good thermal transport properties and phenomenon is possessed by nano fluids and there exists a strong believe that nanofluids can cater the need sof next- generation advanced heat transfer fluids.

Zhou.K*etal*. This paper is about the assembling and portrayal methods of Copper Oxide – nanocrystals with various shapes. CuO-nano-crystals e.g. CuO nano particles, nano belts and nano platelets can be blended by administering a few parameters. To research the qualities of the important particles diverse systems are utilized e.g. XRD, BET, TEM, SEM, HRTEM and so on. XRD (X-Ray Diffraction) gives the affirmation of the CuO nanoparticles and decide the gem structure. Wager examination gives the shape and surface zone of nanoparticles. Transmission Electron Microscopy (TEM) gives data about the normal size and the condition of the nanoparticles. Filtering Electron Microscopy (SEM) is utilized to anticipate the surface geology of the nanoparticles.

Wang.X.Q.*et al*. This paper is a review of the latest research on fluid flow and heat transfer values of nano-fluids in ced and free convection flows. It was found in the paper that there can be a passive enhancement in convection heat transfer by employing a change in geometry off low, boundary conditions and when there is an augmentation in thermal conductivity of the fluid. By enhancing the thermalconductivity, heat transfer in thenanoparticles increase. Wang et al.measured the relativeviscosity Al2O3 – water and Al2O3 – ethylene glycol nanofluids, results gave the same trend of augmentation in relative viscosity with increased solid volume fractionthe two nanofluids. So, in turn, heat transfer of nanofluid increases. Also, past experiments show the higher value of convective heat transfer nanofluids

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Kalogirou.S.A. This paper is a report on the grouping of different sun powered collectors and their applications and this is trailed by an optical, thermal and thermodynamic investigation of collectors furthermore, a depiction of the techniques used to assess their performance.
The fundamental utilizations of sun-oriented collectors in corporate sun-oriented water warming, sun-based air heating, space heating and cooling, refrigeration, heat power frameworks, sunlight- based heaters, desalination, steam age frameworks, mechanical process heating and science applications.

Lenert.A. Since, receivers on the surface possess low energy conversion efficiency, resulting in high losses at high temperatures, whereas volumetric receivers show performance increment because solar radiation can be transmitted in the fluid medium directly.
Here, modelling and experiment were concentrated to explore the productivity of nanofluid-based solar recievers is presented. Impact of nanoparticle qualities e.g. dispersion and selectivity, and additionally authority parameters (like engrossingtallnes sand fixation proportion),is assessed. This investigation demonstrates that volumetric beneficiaries sun-oriented collectors are extraordinarily productive at expanded focus and can acquire power generation efficiencies up to 55% in these sections.

Abid.et. al Employed parabolic trough collector and parabolic dish solar collector and integrated them separately with the Rankine Cycle and analysis of electrolyser was done power and hydrogen production. They used Al2O3 and Fe2O3 based nanofluids and molten salts of LiCl-RbCl and NaNO3. It was noted that net power obtained from parabolic dish collector was higher thanparabolic trough collector which proved that nanofluids produce better power in comparison tosalts

Gorji etal. An exploratory investigation was embraced scrutinizing the reaction and outcome of operating conditions using graphite, silver and magnetite nanoparticles suspended in de-ionized water. numerous nanoparticle concentrations and volume flow rates experimentation was done. The result showed that magnetitedispersions gainedhighest thermal efficiencyand energyefficiencyfollowed by graphite and silver.

Yousefi.T,et al. Efficiency of flat plate solar collector was investigated, having Al2O3 nanofluid as a working fluid, by Yousefi.T*et al*. The weight fraction of nanoparticles used was 0.2 % and 0.4 %. Thenanoparticle size was 15nm. Yousefi.T*et al* also this experiment with and without surfactant(TritonX–100), and mass flow rate was1to3lit/min. There sultshowsthatbyusing0.2 %weight fraction nanofluid collector efficiency enhanced by 28.3%, additionally the surfactant causes an upgrade in heat transfer, by utilizing surfactant the most extreme improved productivityis 15.63 %.

Kasaeinet al. Here a solar direct absorption parabolic trough collector was studied. Borosilicate glass was used to fabricate the tube present in the absorber. The glass-glass tube had high transmissivity long wave radiation and increasing the performance of collector.Theresult showed that thermal efficiency0.3% carbon nanotube- ethyl glycol solution had the highest value and was 17.1% higher than base fluid.

Karamietal. Here the proposal was laid downa DASC which would make use of apt nanofluid on the basis of optical and heat transfer propertiesthe use in absorbing medium. Different concentrations of volume fractions of CuO nanoparticles in water and ethylene glycol mixture as base fluid were prepared. The experiment showed a 17% enhancement in thermal efficiency at different flow rates ranging from 54lit/hr to 90 lit/hri.e (0.015-0.025kg/s).

III. CONCLUSION

Nanofluids have been utilized to improve the efficiency of several solar thermal applications. Theoretical and experimental studies on solar systems proved that the system performance enhances noticeably by using nanofluids. A number of investigations presented the existence of an optimum concentration for nanoparticles in the base fluid. Adding nanoparticles beyond the optimum level no longer enhances the efficiency of the solar system.

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