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Study of the Solar Collectors with Evacuated Tubes

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ABSTRACT- Solar thermal collector systems allow solar energy to be used for cooling and heating. A heat transfer fluid is utilized in these collectors to transmit collected solar energy to applications that need it. Scientists have proposed various collector designs and better collection materials to enhance the solar collector's conversion efficiency. The use of Nano fluids to study solar collectors utilizing evacuated tubes is discussed in this article. The researchers used a two-step method to prepare Nano fluids, which improved nano fluid stability. Swasco laboratories in Mumbai provided the nanoparticles. Nanoparticles were mixed in distilled water and well blended before being used in the heat pipes. In this work, the Nano fluids were made in two stages, which enhanced nano fluid stability. Before being put in the heat tubing, the nanoparticle was well mixed with distilled water. Most solar collectors may be able to enhance their overall performance by using nano fluids. However, unless a few issues about nano fluid stability, overall performance, and hysteresis expectedness are addressed, the full potential of Nano fluids in heat transfer applications will not be realized.

KEYWORDS- Collector, Heat, Nanoparticle, Solar, Water.

I. INTRODUCTION

Renewable energy is replacing fossil fuels in the production of electricity and other applications. From an economic perspective, renewable energies are the least costly per unit of energy. Solar energy is one of the greatest alternatives to fossil fuels, and research on solar collectors has lately gotten a lot of attention in the energy sector. Using significant temperature differences between the absorber and its surroundings, evacuated tubes collectors have also reached great efficiency since then. There is a need for further study on evacuated tube solar water collectors [1].Solar thermal energy may be harnessed in medium, high, and low temperature regions. Low-temperature systems usually utilize tiny flat plate collectors to store and capture thermal energy for the purpose of supplying and heating hot water to dwellings, which are typically small. A vacuum tube or trough collector is used in mid-temperature systems to supply supplementary heat sources for building cooling and heating, as well as industrial production operations. High-temperature structures make comprise solar power plants. Essentially, a steam turbine is used to drive numerous generators with capacities of up to twenty-five kilowatts, resulting in power production [2].

Solar collectors concentrate and absorb the Sun's solar energy. Due to the variety of weather conditions they are subjected to, these collectors are often placed on roofs and must be very robust. On the basis of axis, as illustrated in Figure 1, there are many different kinds of collectors. Nano additives are used in food to enhance the dispensability of water-insoluble additives including flavors, colors, vitamins, and preservatives without the need of a surfactant. These nanoadditives enhance nutritional value, taste, and component absorption into the body due to their large surface area. Nano additives include antioxidants, vitamins, spices, preservatives, and colors, which are presently available. Nano sized iron, silver, magnesium, calcium, silica, and selenium are utilized as Nano additives in the food business. Figure 2 shows a few examples of nano additives[3,4].

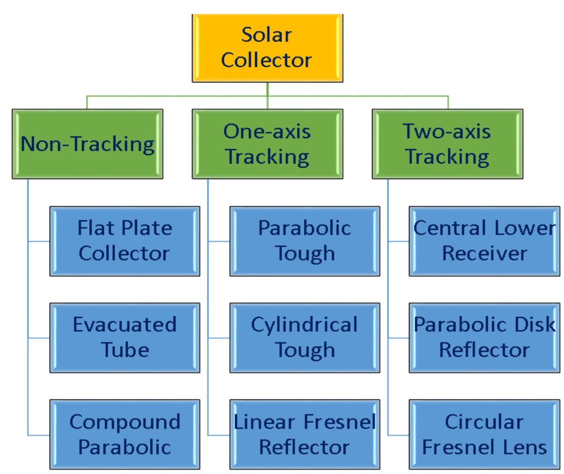

Figure 1: Types of Solar Collectors on the Basis of the Axis: Non-tracking, One-axis Tracking and Two-axis Tracking

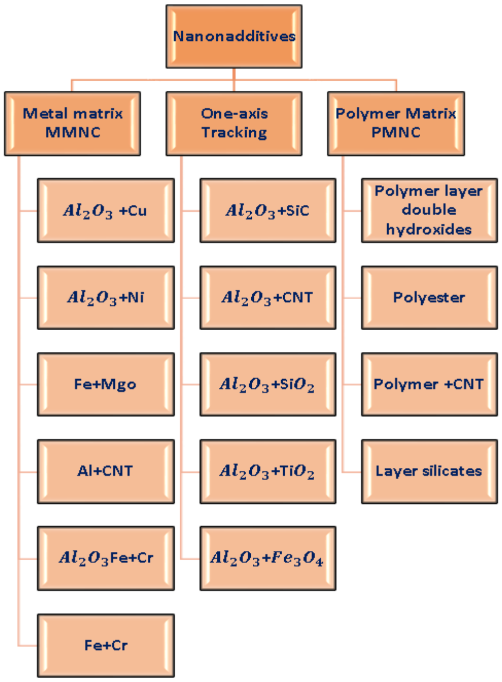

Figure 2: The Different Types Of Nano additives :(Metal Matrix Non Composites) MMNC,One-Axis Tracking, and (Polymer Matrix Non Composites) PMNC.

Nano fluid is a fluid that includes nanoparticles, which are particles that are just a few nanometers in size. These liquids are colloidal nanoparticle suspensions in specially tailored base fluids. As nanoparticles, oxides, metals, carbon, and carbides nanotubes are often found in Nano fluids. Oil, ethylene glycol, and water are all popular base fluids. Nano fluids have unique properties that could make them useful in a variety of heat transfer applications, such as fuel cell, microelectronic, pharmaceutical process, including hybrid driven engines, engine cooling, household refrigerator, heat exchangers, chillers in, the machining grindings, and the boiler flues gas temperatures reduction.As compared to the base fluid, they have higher thermals conductivity and a lowers convective heat transfer coefficient. Understanding the rheological activity of Nano fluids has been found to be critical in evaluating their appropriateness for convective heat transfer applications. The impact of extra shear wave rededication of incoming tectonic wave in ultrasonic field becomes more pronounced as the concentration increases in Nano fluids[5,7]. Figure 3 depicts the many types of nanofludis, such as metallic, oxide, and carbon.

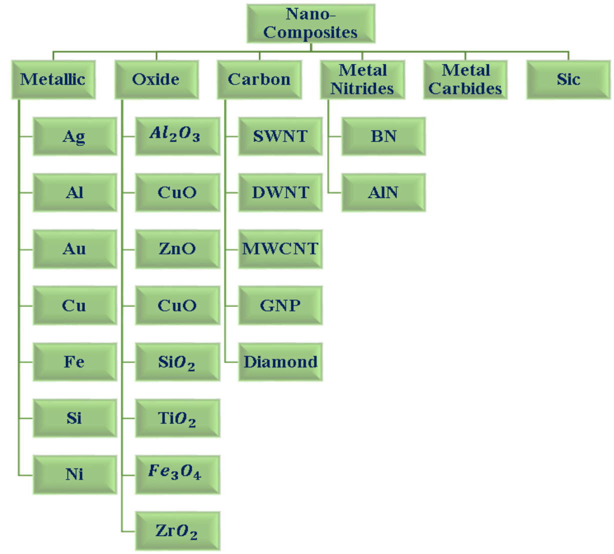

Figure3: The Different Type of the Nano fluids Such As Metallic, Oxide, Carbonic

ETCs are available in a range of forms and sizes, as illustrated on the left side of Figure 4. ETCs are typically made up of parallel rows of twin glass tubes with a metal heat pipe connecting each inner glass tube to an absorber fin. The air between the two glass tubes is removed (or evacuated) to produce a vacuum, which reduces conductive and convective heat loss. Single-walled ETCs are also common. In this design, all of the air inside the tube is evacuated. The double-walled design is superior at maintaining vacuum since it does not need a metal-to-glass seal, but the single-walled design collects more light and therefore has better thermal performance. There are also direct flow collectors, which are the most prevalent in China. With this design, which utilizes a double-walled tube, water flows directly into the inner tube. There is no heat pipe in this design. A design of an ETC with a heater just on right-hand side is shown in Figure 4.

Inside the heat pipe, liquid heat exchange fluid vaporizes and rises to the top, where it condenses. The heat is then transferred to flowing water through a manifold, and the condensed fluid falls to the bottom of the heat pipe, where the cycle starts all over again. Common applications include residential and commercial water heating, space heating and cooling, and industrial process heat. Efficiencies in the overall operation are frequent. ETCs outperform flat - plate solar collectors in colder climates because their efficiency does not decrease as quickly as flat plate collectors' if the outside atmospheric temperature lowers.

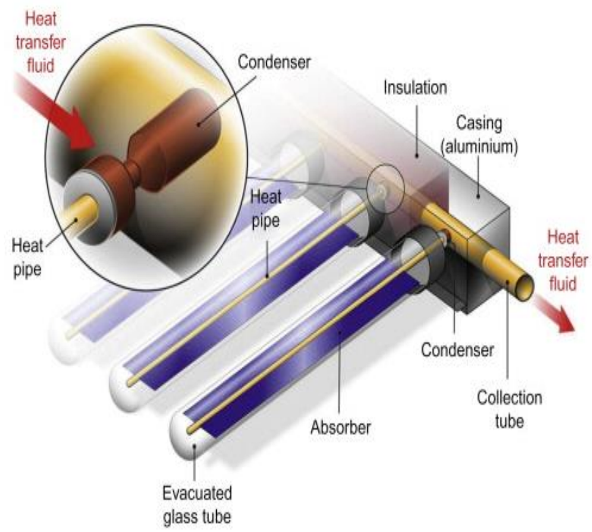

Figure 4: A Schematic of an ETC with a Heat Pipe

II. LITERATURE REVIEW

Several research on solar collectors using evacuated tubes and Nano fluids have been carried out, some of which are mentioned below: According to the size of the CuO nanoparticles and the quantities of CuO Nano fluids, Martinez-Rodríguez et al. measured and evaluated the output of an evacuated solar tube collector. The efficiency of solar collectors using CuO Nano fluids as the working fluid was compared to that of a solar collector using water. When a result, the evacuation collector's effectiveness improves as the concentration of CuO Nano fluids rises. Additionally, solar collectors with evacuated tubes performed better at 600 kg/s m2 than at 421 kg/s m2. The Solars collector had the best performance with 41 nanometer CuO Nano fluids, which was a 3% increase over the 81 nanometer CuO Nano fluids. The optimum concentration of 40 nanometer CuO Nano fluids was 0.6 volume percent, which improved thermal efficiency by 7.3 percent over water. Furthermore, as compared to concentrations of 0.1 volume percent, 0.3 volume percent, and 0.7 volume percent, performance improved by 2.3 percent, 4.4 percent, and 0.3 percent at this concentration. CuO Nano fluids may be used in evacuated tube solar collectors to assist maintain and improve performance[8].

Ozsoy, Ahmetet al. studied solar energy to see whether the need for fossil fuels might be reduced. They tested the performance of the Parallel Type Evacuated Tubes Solar Collector using Al2O3 nano fluid (ETSC). During both peak and off-peak hours, the solar collector was utilized. As a result, the ETSC's effectiveness was tested by changing the Al2O3 nanoparticle particle concentrations in the base fluids. 065 and 0. 0.035 kg/sec were used to circulate the fluid. Salem Algarni et al. look at a new design for evacuate tube solar collectors that uses nano enhanced phases change material as a thermal energy storage device for latent heats, which may improve the performance of conventional evacuate tube collectors. This ingenious device submerges ETSC U pipes and combines them into a single element to generate heat when solar power is absent or inadequate. The new device functions as a thermal booster, storing heat in a PCM to extend the length of hot water production and minimize temperature variations in water through heat absorption and thermal insulation of the evacuation tube[9].

Solar crew systems, according to Jafarkazemi, Farzadet al. readings, have increased in prominence as a renewable energy source throughout time. Their study focused at utilizing Nano fluids with three different alumina concentrations to enhance the performance of working fluids in a solar thermal system. The temperature changes in an experimental collector device were monitored using a pyrometer, and the UV, electrical conductivity, absorbance, and thermal characteristics of Nano fluids were studied. Electronic conductivity, thermal conductivity, and UV absorbance were all enhanced by increasing the alumina content. Furthermore, the temperatures of the Nano fluids increased quicker than distilled water under sun irradiation. As a consequence, the solar energy are absorbed more efficiently by alumina nano fluid than by water. The findings of the research show that alumina nanoparticles and Nano fluids may be used in thermal solar power. This article discusses the use of Nano fluids in solar collectors using evacuated tubes. The two-step nano fluid foundation methods enhanced nano fluid consistency in the experiment. The nanoparticles were supplied by the Swasco Research Laboratory in Mumbai. Before being utilized in heat pipes, the nanoparticles were thoroughly mixed with distilled water. This study used a two-step method for making Nano fluids, which improved nano fluid stability. The nanoparticle was well mixed with distilled water before being put in the heat pipes. The relative humidity value, which shows the change in relative humidity over time, as well as the variation of different types of nano fluid over time, are also discussed in this article. The value of relative humidity rises at a particular time and then lowers at a specified time, the value of water declines with time, and the value of Nano fluids increases at a specific time and then drops significantly, according to this article[10].

III. DISCUSSION

The topic of this article is the in the generation of electricity and other uses, renewable energy is replacing fossil fuels. Renewable energies are the least expensive per unit of energy from an economic standpoint. Solar energy is one of the most promising alternatives to fossil fuels, and solar collector research has recently received a lot of attention in the energy industry. Since then, evacuated tube collectors have achieved high efficiency by using large temperature variations between the absorber and its surroundings. Further research on evacuated tube solar water collectors is required. Nano fluid is a fluid that contains nanoparticles, which are tiny particles with a diameter of a few nanometers. Colloidal nanoparticle suspensions in precisely designed base fluids make up these liquids. Nanotubes are often found in Nano fluids as nanoparticles, oxides, metals, carbon, and carbides. Oil, ethylene glycol, and water are common base fluids. Nano fluids have unique properties that could make them useful in a variety of heat transfer applications, such as fuel cells, microelectronics, pharmaceutical processes, hybrid driven engines, engine cooling, household refrigerators, heat exchangers, chillers, machining grindings, and boiler flue gas temperature reduction. They have a lower convective heat transfer coefficient and higher thermal conductivity than the base fluid. It has been discovered that understanding the rheological activity of Nano fluids is important in determining their suitability for convective heat transfer applications. As the concentration of ultrasonic wave's increases, the effect of additional shear wave rededication of entering tectonic waves becomes more apparent. Nano fluids have distinct acoustic properties, including extra shear wave rededication of incoming tectonic waves in the ultrasonic field. Solar collectors concentrate and absorb solar energy from the Sun. Due to the variety of weather conditions they are subjected to, these collectors are often placed on roofs and must be very robust.

IV. CONCLUSION

This article demonstrates that sun collectors can provide active heating as well as water heating for various kinds of solar fluids used in this experiment. This collector is placed on the roof and must be very durable since it is exposed to a variety of weather conditions. The value of relative humidity rises at a particular time and then drops at a specific time, the value of water decreases with time, and the value of Nano fluids increases at a specific time and then drastically reduces by utilizing the solar collector, according to this research. Most solar collectors can use Nano fluids to improve overall performance; however, the full potential of Nano fluids in heat transfer applications will not be realized until a few questions about stability, overall, and hysteresis expectedness of Nano fluids are studied or visualized using solar collectors. The value of relative humidity rises at a particular time and then lowers at a specified time, the value of water declines with time, and the value of Nano fluids increases at a specific time and then drops significantly, according to this article.

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