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Performance of heat pipe at different elevations by using TiO as a nanofluid

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ABSTRACT

Nanofluid subjected to intensive study worldwide. This paper presents the result of an experimental investigation regarding the use of TiO. Using Nano fluid as an innovative kind of liquid blend including trival volume fraction of millimeter or nanometer size powdered particles with base fluids is fairly a novel idea. The objective of this presented review paper is to inspect the performance of Heat Pipe at different elevations by using TiO as a nanofluids. Nanofluids are the fluids that are shown various development in the thermal properties over the past decades.

Keywords: Nanofluids, Nanoparticles, heat pipe, inclination angles

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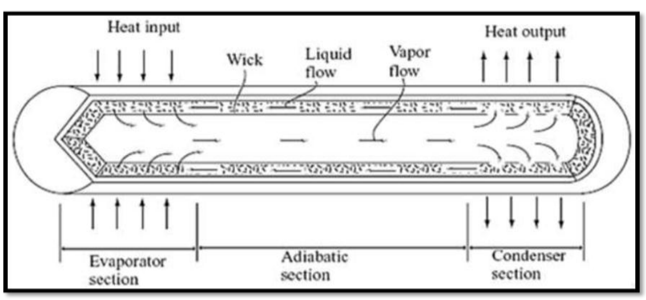
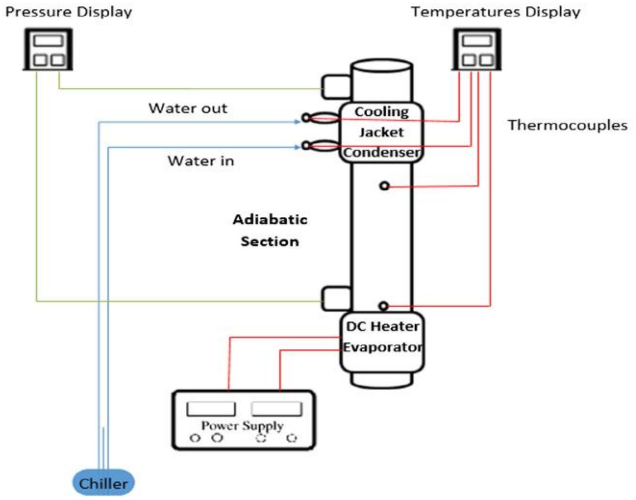
I. INTRODUCTION

The interest in the use of heat pipes for thermal management is recognized in many industrial applications. For example the thermal management of electronic equipment has become an important issue because of increasing power levels along with the miniaturization of the devices. With the advent of denser device packaging and faster intrinsic speeds, cost, reliability and size have been improved, but it requires new cooling solutions often based on liquid/vapour phase change systems.[6] the performance of heat pipe is depends on numerous factors. As a first approach, the thermal performance of a heat pipe can be characterized by both its overall thermal resistance and its maximum power in horizontal and vertical positions.[8] these characteristics depend mainly on the capillary structure, which is usually made of grooves, meshes, powder or a combination of them. Wick structure used for capillary action for returning the working fluid from condenser to evaporator.[6] the heat pipe consist of evaporator section, adiabatic section and condenser section. In many applications, heat pipes are circular and are used to transport heat from one heat source to one heat sink, which can be any cooling system.[7] planar heat pipes, also called flat plate heat pipes have the same components, but offer a wide cross- section, which allows reducing their thickness without reducing their thermal performance. Furthermore, several heat sources can be located on them, which is interesting to cool electronic cards, with many electronic components. The interest in the use of heat pipes for thermal management is recognized in many industrial applications. For example the thermal management of electronic equipment has become an important issue because of increasing power levels along with the miniaturization of the devices. The field of electronics is the fast developing science and in the present scenario, its contribution to the technology is growing rapidly. Continuous usage of these devices generates high heat. This induces thermal stresses in the electronic circuits, leading to the failure in the components. The generated large heat flux is not removed effectively and it leads to deterioration in the effective functioning of the electronic devices. Also, the effective thermal management becomes one of the major serious challenges in many technologies because of constant demands for faster speed and continuous reduction of device dimensions. Heat pipe is a special type of heat exchanger that transfers large amount of heat due to the effect of capillary action and phase change heat transfer principle. It is a simple device with no moving parts that can transfer large quantities of heat over fairly large distances without requiring any power input.[12]





II. SELECTION OF WORKING FLUID

Each heat pipe application has a particular temperature range in which the heat pipe needs to operate. Therefore, the design of heat pipe must account for the intended temperature range by specifying the proper working fluid. Within the approximate temperature band several possible working fluids may exist, and variety of characteristics must be examined in order to determine the most acceptable of these fluids for the application being considered. The prime requirements are:

(i) Compatibility with wick and wall materials

(ii) Good thermal conductivity

(iii) Wettability of wick and wall materials

(iv) Vapor pressure not too high or low over the operating temperature range

(v) High latent heat

(vi) High thermal conductivity

(vii) Low liquid and vapor viscosities

(viii) High surface tension

(ix) Acceptable freezing or pour point

The selection of the working fluid must be based on thermodynamic considerations which are concerned with the various limitations to heat flow occurring within the heat pipe. In heat pipe design a high value of surface tension is desirable in order to enable the heat pipe to operate against gravity and to generate high capillary driving force.

A vapor pressure over the operating temperature range must be sufficiently higher to avoid high vapor velocities which tend to set up a large temperature gradient, entrain the refluxing condensate in the counter current flow, or cause flow instabilities associated with compressibility. However, the pressure must not be too high because this necessitates a thick-walled container. High latent heat of vaporization is desirable in order to transfer large amounts of heat with a minimum fluid flow, and hence maintains low pressure drops within the heat pipe. The thermal conductivity of working fluid should also preferably be high in order to minimize the radial temperature gradient to reduce the possibility of nucleate boiling at the wall interface.

III. NANOFLUID

nanofluids are engineered colloidal suspensions of nanoparticles in a base fluid. In general the size of these nanoparticles varies from 1-100nm.the type of nano particle used is directly dependent on the enhancement of a required property of the base fluid. All physical mechanisms have a critical length scale, below which the physical properties of materials are changed. Therefore particles <100nm exhibit properties that are considerably different from those of conventional solids. The noble properties of nano phase materials come from the relatively high surface area to volume ratio that is due to the high proportion of constituent atoms residing at the grain boundaries.

Nanofluids have unique properties it covers the area like hybrid powered engine, management of heat in vehicles, heat transfer, pharmacy, engine cooling, chiller, refrigerator, nuclear reactor, heat exchanger, space, ships defense, grinding that make them possibly useful in many applications in heat transfer, including microelectronics, fuel cells, pharmgas temp reduction in boiler etc. Nanofluid have large convective heat transfer coefficient and high thermal conductivity. Advanced research gives outcome that 15 to 40% of heat transfer enhancement can be possible by nanofluid. Automotive car radiator can reduce size and weight makes superior without affecting performance of heat transfer. This translates into a better smooth feature for design of an automotive car for area. Coefficient of drag can be minimized and fuel consumption efficiency can be improved. Nanofluid has a caliber to increase the cooling rate of heavy duty engine also. Nanofluid is a solid-liquid composite material which consists of 1-100nmwith size of nanoparticles of nanofibers which will be added to the base fluid in order to obtain the thermal conductivity. There were two type material that can be used to prepare the nanofluid which is: (1) metallic solid and (2) nonmetallic solid.

As a theoretically, all solid nanoparticles with high thermal conductivity can be used as additives of nanofluids. Metallic solid or particles such as cu, al, fe, au and ag. Same as metallic particles, nonmetallic solid also can be an additives of nanofluid in enhancement of thermal conductivities in energy transfer. There were al_2o_3, tio, fe_2o_4, tio_2, sic, carbon nanotube and nanodroplet. The thermal conductivities of each nonmetallic particle. Generally the thermal conductivity of the metallic solid is much higher than nonmetallic solid.

IV. EXPERIMENTAL SETUP

The heat pipe is placed in the position as shown in the experimental setup. The degree of inclination is then set by moving the water jacket in an inclined way. The angle is set on frame 30^0 45^0. The two thermocouples are fixed to the two ends of the heat pipe (i.e. one at evaporator section and other at condenser section) with the help of locking screw. The heater is placed at evaporator section and the heat input is given by switch on in the heater. The amount of heat input can be varied the varied provided on the setup. Water is being pumped continuously at condenser section through a water jacket to take away the heat from condenser. The temperatures at evaporator and condenser sections are measured using thermocouple which is displayed on the setup. The temperatures are noted once the system reaches the steady state. The mass of water flow rate is calculated using rota meter. The same procedure is conducted by varying the inclination and readings are noted.

Base Fluids

To be able to formulate and use type of base fluid to be added with nanoparticles, the properties of the base fluids have to be well known. Base fluid properties that will influence the formulation could divide into two groups which are physical and chemical properties. In this study, properties from all of these groups are investigated to improve the understanding on their influence on base fluid overall performance whereby could divided into different groups, mineral, synthetic, or ester, and are classified in various ways. Researchers have also tried to increase the thermal conductivities of base fluid by suspending micro or nano-size solid particles in fluids since the thermal conductivity of solid is typically higher than that of liquids. Apart from that, liquid lubricants or based fluids may be characterized in many different ways. One of the most common ways is by the type of based fluids used.

Following Are The Common Types:

1. Water
2. Mineral Oil
3. Vegetable Oil (Natural Oil)
4. Synthetic Oils
5. Others

V. **CONCLUSION**

From the experimental setup we come to know that the work done (water) for the 90º is more than any other angle from the table & also the heat transfer for the 90º is more. Which tells that as we go on increasing the angle the work done & Heat transfer rate goes on increases & we get the maximum workdone & heat transfer rate at 90ºwhere the Heat pipe is vertical in which Condenser section is at top side & evaporater section is at bottom side.

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