"Experimental Study of Close Loop Pulsating Heat Pipe Using Thermic Fluid(HP-Hytherm-500) "A Review

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Abstract- *Thermic fluid have found a very crucial role in heat transfer than available fluid like water and oil. The heat pipe has been used to transfer heat from one region to another region of any system. The heat pipe have an extremely high thermal conductance in steady state operation as compared to other device of heat transfer. Heat pipes are widely used in various applications to remove the heat and control the temperature of various electronics components due to many advantages such as least operating and maintenance cost, accuracy, long service life and environmentally safe. With the decrease in size of electronics components, it becomes necessary to increase the performance of heat pipes. - Closed loop pulsating heat pipes (CLPHPs) are complex heat transfer devices having a strong thermo hydrodynamic coupling governing the thermal performance.*

Keywords- Thermic fluid, Close loop pulsating heat pipe , Thermal performance

I. INTRODUCTION

Heat pipes are widely used in the field of electronics cooling due to extremely high effective thermal conductivity as it involves two phase heat transfer. Due to its simplicity in operation and reliability, it has been widely used in other applications such as space, medical and health undertakings, and domestic appliances. Now-a-days various types of heat pipes are available. Their application in various fields mainly depends upon the range of temperature control, heat flux removal, space available, reliability etc. The most commonly used heat pipes are flat heat pipe (rectangular shaped and/or disc shaped), thermosyphon heat pipe (vertically oriented cylindrical heat pipe), cylindrical heat pipe, rotating heat pipe, oscillating heat pipe, loop heat pipe, pulsating heat pipe, closed loop pulsating heat pipe, open loop pulsating heat pipe and sintered heat pipe .there had been always a great demand for having robust and promising cooling devices. For this reason pulsating heat pipe is best option due to simplicity of structure, reliability, and low manufacturing cost.

A heat pipe is simply a type of heat exchanger that is very simple in construction, easy and straight forward for use. Improvements have been done over time in Heat pipes used for heat transfer. Over the years, researchers have continuously search new methods of heat transfer augmentation. The results of employing different working fluid proved to be one effective way of improving the system's overall performance. Thermic Fluid is a new working fluid used in heat exchangers which is eco-friendly . So the Thermic fluid is used as working fluid in the pulsating heat pipe and analyzed the improvement of performance.

The heat pipe has two region i.e. evaporator and condenser. There is adiabatic region which separates condenser and evaporator as shown in figure . The heat pipe has wall, the wick structure and the space for the working fluid. The heat is transferred as latent heat energy by evaporating the working fluid in the evaporator (hot side) and condensing the vapor in the condenser (cool side), the circulation is completed by the forces, such as capillary force, gravitational force (in the thermosyphon heat pipes), electrostatic force, or other forces directly acting on the liquid flow. Adiabatic section is fully insulated. Because the middle region of the heat pipe is regarded as an adiabatic zone, the amount of heat transfer to ambient is low. Regardless of the classifications of heat pipes, which might depend on the geometries, applications, and so on, the basic principles are the same.

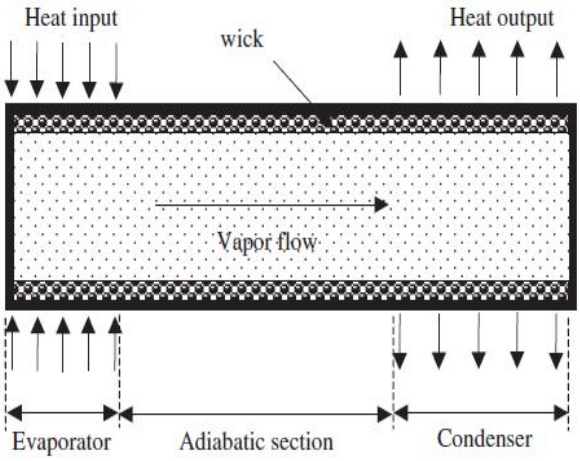

Fig. Shematic of conventional heat pipe

II. LITERATURE REVIEW

2.1 S.G. Khedkar, P. R. Pachghare,

" Effect of Working Fluid on Thermal Performance of Closed Loop Pulsating Heat Pipe" Pulsating heat Pipes are highly attractive heat transfer elements, which due to their simple design, cost effectiveness and excellent thermal performance may find wide applications. Since their invention in the early nineties, so far they have found market niches in electronics equipment cooling. The work compiled here significantly increases the understanding of the phenomena and effect of working fluids that govern the thermal performance of pulsating heat pipes. Many unsolved issues related to working fluids still exist, but continued exploration should be able to overcome these challenges.

2.2 Prof. C. B. Kothare, Prof. K. S. Raizada, Mr.Balu K. Chauhan

"Thermal Performance Of Closed Loops Pulsating Heat Pipe At Various Dimension And Heat Input" In the present work, the experimental investigation on a closed loop pulsating heat pipe is carried out. The effects of heat input, working fluid, and alternate internal diameter on the performance of CPHP are studied.

2.3 Atul N. Pote, Pramod R.Pachghare

"Experimental Analysis on Thermal Performance of Closed Loop Pulsating Heat Pipe Using ZnO/Water Nanofluid" Thermal resistance decreases with increase in mass concentration of ZnO/water nanofluid. Minimum value thermal resistance0.829oC/W is obtained for 1%w/v concentration at 72W heat input.This is 77.7% less than pure water. Thermal performance of Pulsating heat pipe strongly depends on thermo physical properties of working fluids . Thermal resistance decreases with increase heat input of PHP for both pure water and nanofluids . ZnO/water nanofluid Pulsating heat pipe gives the good thermal performance than water Pulsating heat pipe.

2.4 Ashish M. Mahalle

"Effect of pure and binary fluids on closed loop pulsating heat pipe thermal performance"A closed loop pulsating heat pipes has been experimentally investigated to study the effects of pure and binary mixture working fluid on the thermal performance. The various working fluids have been demonstrated. Different fluids are beneficial under different operating conditions. An optimum trade off of various thermo physical properties has to be achieved depending on the imposed thermo-mechanical boundary conditions.

2.5 Amir Faghri

A detailed overview of heat pipes is presented in this paper, including a historical perspective, principles of operations, types of heat pipes, heat pipe performance characteristics, heat pipe limitations, heat pipe frozen startup and shutdown, heat pipe analysis and simulations, and various applications of heat pipes. Over the last several decades, several factors have contributed to a major transformation in heat pipe science and technology . The first major contribution was the development and advances of new heat pipes, such as loop heat pipes, micro and miniature heat pipes, and pulsating heat pipes. In addition, there are now many new commercial applications that have helped contribute to the recent interest in heat pipes, especially related to the fields of electronic cooling and energy. For example, several million heat pipes are now manufactured each month since all modern laptops use heat pipes for CPU cooling. Numerical modeling, analysis, and experimental simulation of heat pipes have also significantly progressed due to a much greater understanding of various physical phenomena in heat pipes, as well as advances in computational and experimental methodologies

2.6 G. Kumaresan, S. Venkatachalapathy

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. Recent development in the heat pipe includes high thermal conductivity fluids like nanofluids, sealed inside to extract the maximum heat. This paper reviews, influence of various

factors such as heat pipe tilt angle, charged amount of working fluid, nanoparticles type, size, and mass/volume fraction and its effect on the improvement of thermal efficiency, heat transfer capacity and reduction in thermal resistance. The nanofluid preparation and the analysis of its thermal characteristics also have been reviewed.

2.7 Morteza Ghanbarpour

Investigation of Thermal Performance of Cylindrical Heat pipes Operated with Nanofluids Nanofluids as an innovative class of heat transfer fluids created by dispersing nanometre-sized metallic or non-metallic particles in conventional heat transfer fluids displayed the potential to improve the thermophysical properties of the heat transfer fluids. The main purpose of this study is to investigate the influence of the use of nanofluids on two-phase heat transfer, particularly on the thermal performance of the heat pipes. In the first stage, the properties of the nanofluids were studied, then, these nanofluids were used as the working fluids of the heat pipes. The thermal performance of the heat pipes when using different nanofluids was investigated under different operating conditions experimentally and analytically. The influences of the concentration of the nanofluids, inclination angles and heat loads on the thermal performance and maximum heat flux of the heat pipes were investigated.

2.8 Ritesh N. Patel1, Dr. N. K. Chavda

A Review on Application of Nanofluid in Enhancement of Thermal Performance of Various Types of Heat Pipes Heat pipes are widely used in various applications to remove the heat and control the temperature of various electronics components due to many advantages such as least operating and maintenance cost, accuracy, long service life and environmentally safe. With the decrease in size of electronics components, it becomes necessary to increase the performance of heat pipes. Application of nanofluid is one of the relatively recent developments employed for increasing the heat transfer rate in various heat exchanging devices. Many investigators have employed various types of nanofluids as working medium in different types of heat pipes. In the present paper, recently published literatures and available in open literature have been critically reviewed and future requirements have been identified.

2.9 **S. M. Sakhare-Chougule1, S. H. Sarje**

Nanofluids have found a very crucial role in heat transfer than available fluids like water and oil in accordance to reduce cost and size of heat exchanger. The modern nanotechnology developed nanoparticles in last few years. These nanoparticles have unique thermal and electrical properties. Due to this heat transfer rate has been enhanced. The heat pipe has been used to transfer heat from one region to another region of any system. The heat pipe have an extremely high thermal conductance in steady state operation as compared to other device of heat transfer. The nanofluids can significantly enhance heat transfer rate in heat pipe so that efficiency and thermal performance of heat pipe will be increased. This paper reviews the preparation, characterization, stability of nanofluid and concept, working, applications of heat pipe.

2.10 P M Sonawane, M D Shende, V P Baisane

Effect of Nanofluids on Heat Pipe Thermal Performance Normally conventional fluids are used in heat pipes to remove the heat based on a temperature range for its particular operating conditions [1] (see Fig.2). The addition of the nano particles to the base fluid is one of the significant issues to enhance the heat transfer of heat pipes. The purpose of this review is to summarize the research done on heat pipes using nanofluids as working fluids in recent years (2012 to 2013). This review article provides additional information for the design of heat pipes with optimum conditions regarding the heat transfer characteristics of nanofluids in heat pipes. Moreover, this paper identifies several important issues that should be considered further in future works.

III. CONCLUSION

Various types of nano particle with different base fluids has proved its potential to improve thermal properties of working medium in heat pipe. The experimental investigation needed to optimize thermal performance of heat pipe by using thermic fluid. Further research is required to obtain simplicity in the use of Thermic fluid in various applications. In the present work, an experimental study on the two turn closed loop pulsating heat pipe(CLPHP). The experiment conducted on CLPHP by using Thermic fluid oil(HP-Hytherm-500) and pure water for analyze thermal performance of closed loop pulsating heat pipe.

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