AN EXPERIMENTAL STUDY ON CYLINDRICAL HEAT PIPE USING SILVER-WATER NANOFLUID REPORT

DONTHU SUNIL KUMAR GOUD

Master of Technology

Department of Mechanical Engineering, SVR Engineering College, Nandyal.

C. Chandrudu, Associate professor, Department of Mechanical Engineering, SVR Engineering College, Nandyal.

M.Sivaram Krishnaiah, Associate Professor & HOD,, Faculty Of Engineering & technology Department of Mechanical Engineering , SVR Engineering College, Nandyal.

ABSTRACT

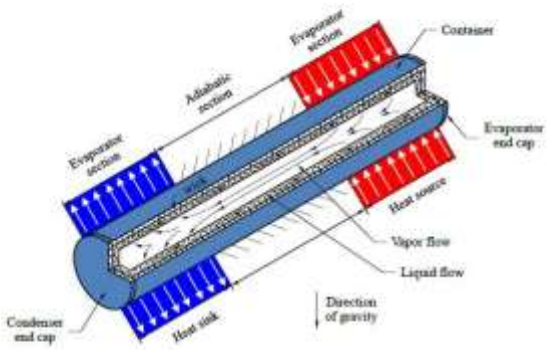
Warmth pipe is a profoundly viable detached gadget for transport heat at high rates over the extensive separations with little temperature drop, uncommon adaptability, basic development and simple control with no outer force. Scientist's, specialist's shows enthusiasm towards heat pipe science oftentimes invest impressive energy poring through authentic publications. Among the distinctive accessible cooling procedures, the utilization of warmth pipe science is progressively quickly. Warmth lines can create a low warm obstruction way for heat move inside electronic gear, with no significant weight added to the framework. A warmth pipe is warm gadget that utilizations stage change cycles and fume dispersion to move huge measure of warmth over impressive separations, with no moving parts and about at a steady temperature.

The design of the fundamental warmth pipe is appeared in the (Fig 1.1). The subject of warmth pipe science has immense significance in an extraordinary assortment of customary designing orders. The sub order of the warmth pipe science has its foundation in a few fields, for example, thermodynamics, heat move, strong mechanics and liquid mechanics. Warmth pipe innovation likewise gives a chance to architects and researchers to apply an assortment of complex physical wonders and essential laws in the warm liquids zone to a moderately straightforward framework, for example, the warmth pipe. This incorporates the consistent and temperamental power, fierce and laminar convective warmth and mass exchange, stage change marvels compressible fume impacts, two-stage stream, bubbling, buildup/dissipation, two-stage stream, pivoting streams, slim film streams, fluid stream in permeable media, tenuous, interfacial warmth and mass exchange, magneto-hydrodynamic streams

1. INTRODUCTION

By and large, heat pipe comprises of wick structure fixed co2tainer and modest quantity of working liquid which is balance with its own fume. The different kinds of working liquids, for example, water alkali CH3)2CO and methanol can be used dependent on the necessary working temperature.

The length of warmth pipe isolated into three significant parts which are condenser segment adiabatic or transport area and evaporator segment contingent upon plan and specific applications. The rule of activity of the traditional slim warmth pipe is appeared in the (Fig 1.2).



The evaporator segment of the warmth pipe is set in a hot situation or carried contact with heat source where the working liquid disintegrates and causes the ascent in the fume pressure. The weight distinction in heat pipe drives the fume through adiabatic segment to the condenser segment. The condenser segment of the warmth pipe in a cool situation and in this manner fume consolidates by delivering its idle warmth of vaporization. The fine determined power made by the menisci in the wick siphons the dense liquid back to the evaporator segment.

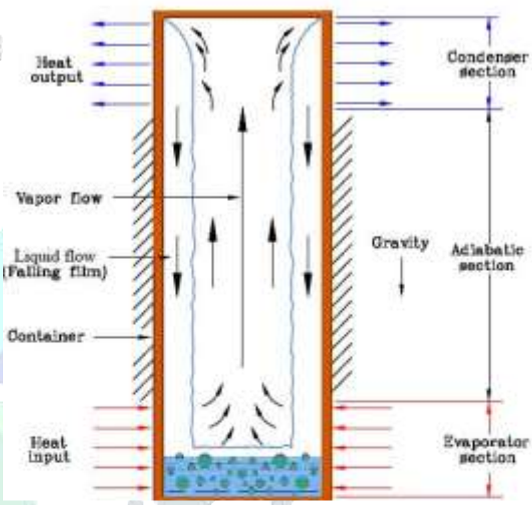
2. LITERATURE REVIEW

2.1 TYPES OF HEAT PIPES

Warmth pipes have been planned and develop with various cross-sectional territories. Warmth pipes comprise a condenser and evaporator segment, where the working liquid consolidates and vanishes, separately. Many warm pipes also have a vehicle or adiabatic area which isolates the condenser and evaporator areas by a fitting separation, intended to fulfill the warmth pipe impediments. Typically, the working liquid is circled by the narrow powers in a wick structure of the warmth pipe. Be that as it may, diffusive, electrostatic and gravitational powers can likewise impacted to return the fluid from the condenser to the evaporator. The different sorts heat pipes quickly talked about beneath

2.2 Two-Phase Closed Thermo syphon

A two-stage shut thermo symphonies a gravity assisted wickless warmth pipe (Fig). In the two stage shut thermo siphon, condenser area is situated over the evaporator so that the



The sonic and fume pressure limits are requirements to the activity of the thermo guide likewise with hair like driven warmth pipes. As far as possible is more articulated in the thermo guide than in the narrow driven warmth pipes because of the free liquid surface. The partner of as far as possible in thermo siphons is called flooding, which is the most extreme constraint in the activity of these frameworks. An abrupt waver divider temperature and fume pressure rise will happen at as far as possible. As far as possible in thermo siphons is because of film bubbling, instead of nucleate bubbling as in narrow driven warmth pipes. The activity of the thermo siphon is delicate to the working liquid fill volume. For thermo directs without wicks, it has been demonstrated tentatively that the greatest pace of warmth move increments with the measure of the stirring liquid up to a specific worth. A wick structure is now and again remembered for the plan of thermo directs to delay flooding and improve the contact between the divider and the fluid.

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3. METHODOLOGY

While this methodology has been viably associated in aircraft wing diagram, maritime applications bring additional troubles, for instance, higher stacking, more grounded fluid structure affiliation, and what's more the likely helplessness to free-surface, cavitation, and hydro elastic weaknesses. By and large, marine propulsions or hydrofoils are expected to achieve ideal execution at a single or exactly at a few arrangement centers, for instance, the projection speed, the oversaw speed, and the best speed. In any case, dependent upon the mission objectives, stacking conditions, sea states, and wind conditions, a vessel is much of the time needed to work over a broad assortment of conditions..

4. EXPERIMENTAL SETUP AND PROCEDURES

4.1Preparation Of Nano fluid

In the current work, the fragment water Nano fluid is utilized and the silver nanoparticles size of 20 nm is suspended in the base liquid water. The silver-water Nano fluid is set up by the two stage technique, wherein silver nanoparticles are arranged first. The silver nanoparticles created by utilizing a synergist substance fume testimony strategy (bought from Nano wings private restricted, Telangana). At that point, the silver nanoparticles added to the unadulterated water. Tri-sodium Citrate surfactant is utilized in the silver Nano fluid suspension. Ultrasonic homogenizer is utilized for the arrangement of Nano fluid blend.

Silver nanofluid having average particle size around 20 nm

Specification of nanofluid

Parameters	Specifications
Base fluid	DI water
Particles name	Colloidal silver
Size of particles	20 nm
Shape of particles	Spherical
Color and appearance	Yellow
Concentration of particles	0.01% w/v

5. Experimental setup

The format of trial set up to assess the warm presentation of warmth pipe is appeared in (Fig 4.3). The significant segments of the warmth pipe are wick structure, compartment and little measure of working liquid which fills in as a vehicle mode of warmth. The barrel shaped warmth pipe was made of copper material comprising 22 mm external breadth with a length of 450 mm and divider thickness of 0.5 mm. The screen work is looked into round and hollow shape and firmly appended with the inward surface of copper heat pipe. The warmth pipe loaded up with working liquid of 1.5 ml at working weight 6.5 k-dad. The tempered steel wick with 100 work size is utilized as wick structure.

heat pipe with screen mesh wick

The warmth line can be separated in to three sections: evaporator segment, adiabatic or transport segment and condenser segment. The elements of the warmth pipes are 100 mm, 250 mm and 100 mm respectively. The evaporator part of the warmth pipe is encased by warmer and warmed by Ni-Cr wire. The condenser segment of the warmth pipe is cooled by the fluid water to separates more warmth contrasted with air

Experimental setup

6. OBSERVATIONS

The experimentation on barrel shaped warmth pipe with screen work wick structure utilizing bit water nanofluid and DI water is done with various warmth input (20w,30w,40w,50W) and tendency points (45o,60o,90o). The accompanying perceptions are noted in the plain structure.

heat pipe temperatures with different heat inputs at inclination angle 45°

Heat input (w)	Water		Nano fluid	
	Temp of condenser (°C)	Temp of evaporator (°C)	Temp of condenser (°C)	Temp of evaporator (°C)
20	22.7	28.1	20.2	25.4
30	23.4	30.2	22.7	28.2
40	25.6	31.4	24	31
50	27.8	34.2	26.2	32.8

The temperatures of the warmth pipe with various warmth contributions at tendency point 45o as show in the table

Heat input (w)	Water		Nano fluid	
	Temp of condenser (°C)	Temp of evaporator (°C)	Temp of condenser (°C)	Temp of evaporator (°C)
20	24.8	32.6	22.4	27.5
30	26.4	34.2	24.3	29.5
40	28	36.3	26.7	32
50	29.8	38.1	28.4	34.6

The temperatures of the warmth pipe with various warmth contributions at tendency edge 60o as show in the table

Heat input (w)	Water		Nano fluid	
	Temp of condenser (°C)	Temp of evaporator (°C)	Temp of condenser (°C)	Temp of evaporator (°C)
20	24	32	21.6	28.8
30	26.3	33.5	24.2	31.4
40	28.5	35.8	26.6	33.1
50	32	37.5	28.9	35.6

The temperatures of the warmth pipe with various warmth contributions at tendency edge 90o as show in the table

7. RESULTS AND DISCUSSION

7.1 Thermal performance

The warm exhibition of the warmth pipe is evaluated as far as warm opposition and warmth move coefficient. The warm opposition of warmth pipe relies upon temperature distinction among evaporator and condenser and warmth input. Warm opposition is determined by the accompanying condition Mozumder et al., (2010)

$$R = \frac{Te - Tc}{Q}$$

Q = VI

The warmth move coefficient of the warmth pipe relies upon temperature contrast among evaporator and condenser, heat info and surface region of the evaporator area. Generally heat move coefficient is given by Mozumder et al., (2010):

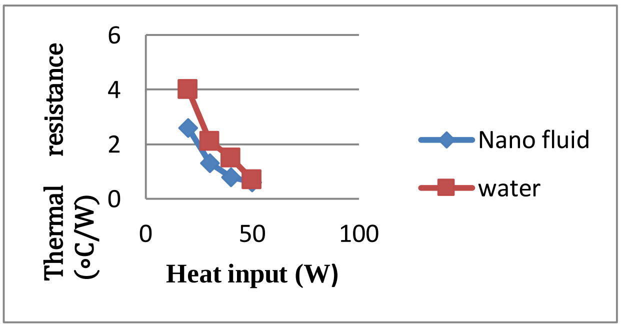
$$h = \frac{Q}{As(Te - Tc)}$$

$$A_s = \pi\, d_o\, Le$$

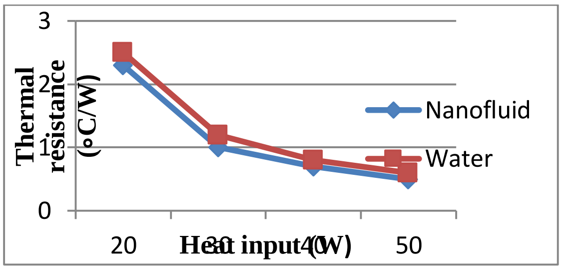
Variation in thermal resistance

The warm obstruction of the warmth line can be determined from the proportion of temperature distinction among evaporator and condenser area to the force provided. Variety in warm obstruction with the warmth sources of info and tendency edges are appeared in fig and it was seen that the warm opposition continuously diminished as warmth input expanded.

Variety in warm obstruction of warmth pipe under various warmth input and at tendency edge 45°

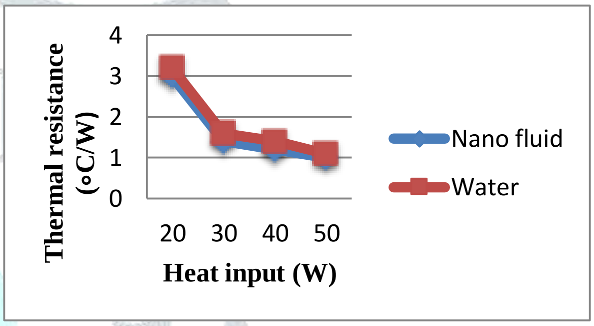


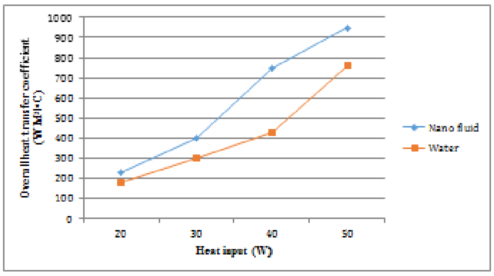
Variety in warm obstruction of warmth pipe under various warmth info and tendency edge at 600



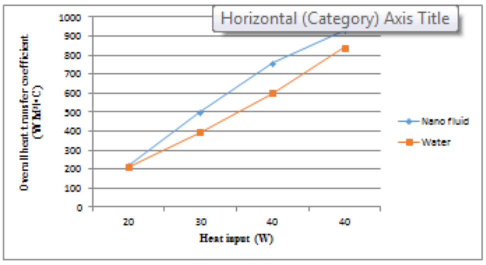
Variety in warm obstruction of warmth pipe under various warmth information and tendency edge at 90°

Variation in overall heat transfer coefficient





Variety in heat move coefficient of warmth pipe under various warmth info and tendency point 45°



Variety in heat move coefficient of warmth pipe under various warmth information and tendency point 60°

8. Conclusion

Warmth pipe science is generally creating and broadly utilized for heat move applications, for example, rocket warm administration, gadgets cooling, sunlight based warming recuperation framework and so on. The warm presentation of warmth pipe affected by the exhibition of the thermo-physical properties of working liquid. In present work, a regular warmth pipe is manufactured and a trial examination is finished with DI water and bit water Nano fluid as working liquid. From the exploratory examination, the accompanying ends are drawn.

- The heat move coefficient increments with increment in heat info and warm opposition of warmth pipe diminishes as warmth input increments.
- The nanoparticles scattered in working liquid of warmth pipe, the expansion in divider temperature of the warmth pipe is lower contrasted with DI water. Consequently, the warm exhibition of warmth pipe is improved.
- Heat move coefficient of warmth pipe increments by 6.67-16.63% and warm obstruction of warmth pipe diminishes by the 6.75-16.8% with silver-water nanofluid contrast with DI water.
- As the edge of tendency of the warmth pipe builds, the warm obstruction of warmth pipe diminishes and heat move coefficient of warmth pipe increments.

9. References

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