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Impact of water as working Fluid in Wraparound Heat Pipe Performance considering Environment

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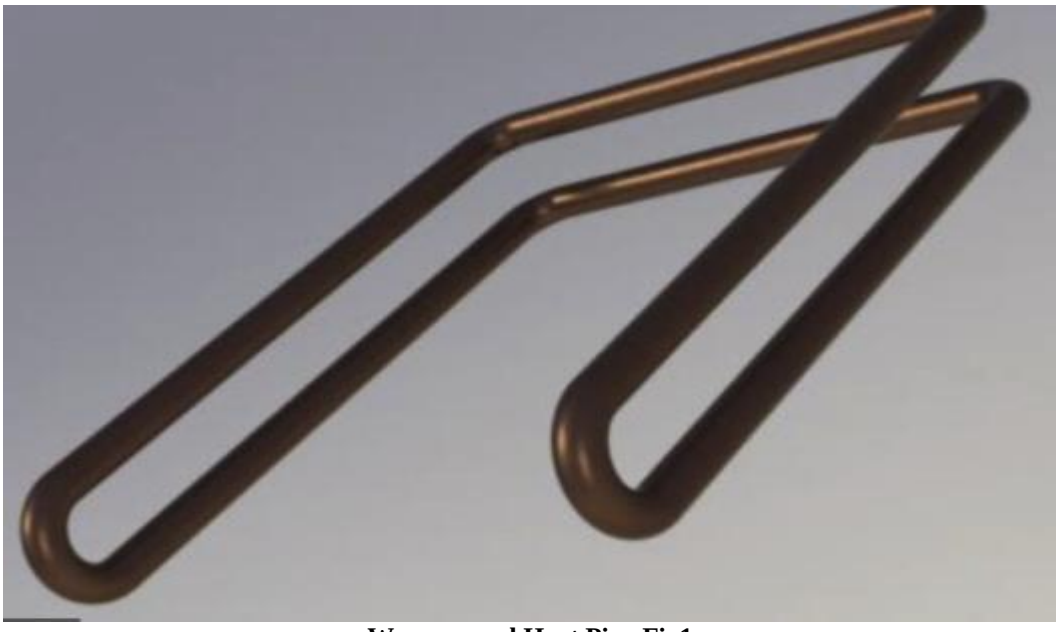
ABSTRACT
Heat pipe is a hotness move gadget that joins the standards of warm conductivity and stage progress to proficiently oversee move of hotness between two strong points of interaction. The fundamental component of hotness pipe is that it tends to be intended to move heat between the heart source and the hotness sink with tiny temperature distinction. The variables influencing the exhibitions of hotness pipe are different cutoff points, for example, viscous cutoff, sonic cutoff, Capillary cutoff, boiling limit, Entrainment limit. Improvement in Performance of hotness line should be possible based on determination of different working liquids. Refrigerant as working fluid used in heat pipe. But refrigerant has impact on Global warming and Ozone Layer Depletion. So many studied were carried out to find alternate for working fluid. In this paper discussion on Water as working fluid of wraparound heat pipe is done. As water has no impact on Global warming and Ozone Layer Depletion.

Keywords-*Wraparound Heat pipe, Effectiveness, wick structure, working fluid*

I. INTRODUCTION

A hotness pipe is a hotness move gadget that consolidates the standards of both warm conductivity and stage progress to productively deal with the exchange of hotness between two strong connection points. At the hot connection point of a hotness pipe a fluid in touch with a thermally conductive strong surface transforms into a fume by engrossing hotness from that surface. The fume then, at that point, goes along the hotness line to the chilly connection point and gathers once again into a fluid - delivering the inactive hotness. The fluid then, at that point, gets back to the hot connection point through hairlike activity, diffusive power, or gravity, and the cycle rehashes. Because of the exceptionally high hotness move coefficients for bubbling and buildup, heat pipes are profoundly powerful warm guides



Wraparound Heat Pipe Fig1

A commonplace hotness pipe comprises of a fixed line or cylinder made of a material that is viable with the functioning liquid, for example, copper for water heat lines, or copper for copper heat pipes. Commonly, a vacuum siphon is utilized to eliminate the air from the unfilled hotness pipe. The hotness pipe is to some degree loaded up with a functioning liquid and afterward fixed. The functioning liquid mass is picked with the goal that the hotness pipe contains both fume and fluid over the working temperature range. Beneath the working temperature, the fluid is excessively cold and can't disintegrate into a gas. So essentially hotness pipe is a hotness move gadget that consolidates the standards of both warm conductivity and stage change to really move heat between two strong connection points.

II. LITERATURE REVIEW

Vishnupant J, et.al[1]
Test examinations of two unique level plate heat pipes (FPHP) are introduced. The slender construction is made of a couple of screen network layers for the primary FPHP and screen network covered depressions for the second FPHP. The hotness pipes, loaded up with methanol, were tried in various designs for example with different areas of hotness sinks and hotness sources, numbers and qualities of the hotness sinks and direction. Water heat exchangers were first utilized as hotness sinks to assess the presentation of the hair like constructions. The outcomes show the interest of this answer for the proposed application. The strategy picked to gather this FPHP model with networks is extremely basic and modest. Running against the norm, the presentation of the hotness pipe acquired with the relationship of sections and networks isn't quite as high as one could anticipate. Without a doubt, on the off chance that this slim design permits working in shifted troublesome position, which is unimaginable with furrowed hotness pipe, an unmistakable nucleate bubbling impediment is noticed for rather little hotness transitions.

Gerardo Carbajal, et.al[2] A multifunctional sandwich board joining proficient underlying burden backing and warm administration qualities has been planned and tentatively surveyed. The idea depends on a shortened, square the functional guideline of the multifunctional heat pipe sandwich board and describes its transient reaction to an extraordinary confined hotness source. The frameworks measure warm reaction to a limited hotness source concurs well with that anticipated by a limited contrast technique model used to foresee the warm reaction.
B.Ch. Nookaraju,et.al[3] In this work the scientists had done the test on sintered copper underhanded hotness pipe set at various directions and note the hotness move paces of the hotness pipes at each position. The temperature at vanishing segment and buildup segment of the hotness pipe is estimated utilizing K sort thermocouple. From this trial and error we here by infer that sintered copper evil hotness pipe warm execution is extremely less impacted by gravity and point of direction due to high slim activity of the wick.
R.A. Hossain, et.al[4] An exploratory examination is done likewise to research the presentation of the MHP with various trial boundaries. These trial boundaries incorporate tendency point, coolant stream rate, working liquid and hotness input. Tendency point are fluctuated from 300 to 900, while coolant stream rate and hotness input are shifted from 0.3 lit/min to 1.0 lit/min and 0.612 W to 8.71W separately. Three unique kinds of working liquids are utilized; CH3)2CO, ethanol and methanol. For each functioning liquid, heat move attributes are resolved tentatively for various tendency point and different coolant stream rate at various hotness input. CH3)2CO is ended up being better as working liquid. A connection is additionally made for CH3)2CO to relate other test boundaries for assurance of hotness move coefficient.
Per Wallin[5] This paper centers around the choice on turning out liquid for execution upgrade of hotness pipe. Heat pipes are normal in numerous application fields for instance cooling of gadgets. The plan of a hotness pipe is fairly intricate with numerous interesting points. In this project the center is the get information regarding who to choose the functioning liquid to be utilized. Three unique sorts of working liquids are utilized; CH3)2CO, ethanol and methanol.
R.Manimaran ,et.al [6] Heat pipes are heat move gadgets that upgrades huge measure of hotness which chips away at the standard of dissipation and buildup of a functioning liquid. Disregarding wide use of hotness pipe in microelectronics cooling framework the pattern of the chips execution and power use has been expanded every year and a total comprehension of component has not yet been finished despite the fact that it can work against gravity and a more noteworthy greatest hotness transport capacity.
Tian F Z., et. al. [7]: Gravity heat pipe has been for the most part used in numerous glow move devices due to its high warm conductivity, negligible cost and test structure. In the paper, an exploratory assessment of the gravity heat pipe with cross internal helical miniature blade gravity with two kind of working fluid (water and butyl alcohol plan with 5% mass division) was presented from even and vertical position. The experimental outcomes showed that in the level position, self-rewetting fluid can basic forms quite far, decreases the warm hindrance and further develops the glow move execution. In the vertical position, gravity sway play key limits on fluid return, self-rewetting have not been exhibited to have accepted a positive part on the glow move

execution. In the vertical position, gravity sway play key limits on fluid return, self-rewetting have not been exhibited to have accepted a positive part on the glow move execution.

WORKING PRINCIPLE

A hotness pipe is a warm exchange gadget. It's essentially a fixed cylinder loaded up with refrigerant. HPT-Wrap Around Heat Pipe. It regularly ranges the stockpile air and exhaust air sides of a framework. Energy is moved - with no moving parts - from one air stream to the next (as long as there is a temperature distinction). Refrigerant is vanished on the hot side and moves to the opposite finish of the line in view of fume pressure. On the virus side refrigerant gathers and afterward streams back. It's actually basic. The fold over heat pipe is a hotness pipe folded over a cooling curl. It comprises of two segments, precool (evaporator) area put before the cooling curl and the warm (condenser segment) put after the warm loop. The precool segment is situated in the approaching air stream before the cooling loop. Whenever warm air ignores the primary segment, the fluid refrigerant disintegrates, moving hotness to the warm area (downstream from the cooling loop). As heat has been taken out from the air before the cooling curl, air going through the cooling loop drops to a lower temperature, bringing about more condensate evacuation. The over cooled air is then warmed to an agreeable temperature and a lower relative mugginess by the warm segment, utilizing a similar hotness initially consumed by the main segment.

2.1 EFFECT OF DIFFERENT WORKING FLUID

Working fluid is used in wraparound heat pipe to transport heat from evaporator section to condenser section. Different working fluid is used in wraparound heat pipe in HVAC system. We are selecting different working fliud and comparing the results obtained in terms of effectiveness.

III. PROBLEM DEFINITON

Heat pipe is a hotness move gadget utilized for cooling in numerous applications like space applications, electronic gear cooling, energy frameworks, human internal heat level cooling and so on It has exceptionally high powerful warm conductivity. From the review it is observed that upgrading the presentation of hotness pipe has become vital as a result of wide utilizations of hotness pipe.

The conventional turning out liquid for HVAC heat pipes has been a refrigerant and a substitution liquid is attractive as a short and long haul choice. From a natural point of view, water is an ideal applicant and a large number of its warm vehicle properties recommend that it ought to be practical. There are producing issues related with utilizing water which are not the worry of this paper; the's paper will probably demonstrate the feasibility of water and contrast its exhibition and that of customary refrigerants.

OBJECTIVES

To study the wraparound heat pipe performance of different working fluid

IV. MEHTHODOLOGY

The ventilation of consumed spaces subject to hot and soggy airs uses colossal measures of energy. In such regions, the sogginess load is incredibly high with external suddenness substance of up to 25 g/kg being ordinary. In order to strengthen the inside air with air at lower sogginess substance, chillers and cooling equipment should be assessed to deal with these unbelievably high lethargic weights. Heat pipes have been utilized in these applications for energy save reserves.

Heat Pipe Design: The wraparound circle heat pipes (WLHP) used economically are depicted as thermosyphons and rely upon gravity for the appearance of thick liquid rather than on thin or various powers. Wraparound type heat pipe design is most critical part. While arranging the hotness pipe we really want to think about various limits, for instance, holder material assurance, working fluid decision and wicking material decision. a) Working Fluid Material: There is no resemblance quite far as a result of the nonattendance of a wick in a thermosyphon. In any case, the temperature drop may be clear in which case the fluid should be picked to restrict this. A previously thought in the ID of a suitable working fluid is the functioning smoke temperature go. Inside the estimated temperature band a couple of potential working fluids might exist, and an arrangement of characteristics should be reviewed to choose the most satisfactory of these fluids for the application being considered. The superb necessities are as Similarity with wick and divider materials, Great warm adequacy ,Wet-ability of wick and divider materials ,Fume pressures not extremely high or low over the functioning temperature go ,High latent hotness ,High warm conductivity ,Low liquid and smoke viscosities, High surface strain, palatable freezing or pour point.

To analyze heat transfer performance:

Wraparound heat pipe execution can be depicted by suitability. This is the genuine temperature qualification across one leg of the hotness pipe parceled by the most outrageous temperature contrast between the air entering one leg of the hotness line and air entering the other leg of the hotness pipe. In light of the temperatures as the viability is equivalent to

$$\text{Ɛ} = (T1-T2)/(T1-T3) \quad \text{or} \quad \text{Ɛ} = (T4-T3)/(T1-T3)$$

T1-Temp.before condenser leg
T2-Temp.after condenser leg
T3-Temp before evaporator leg
T4-Temp after evaporator leg

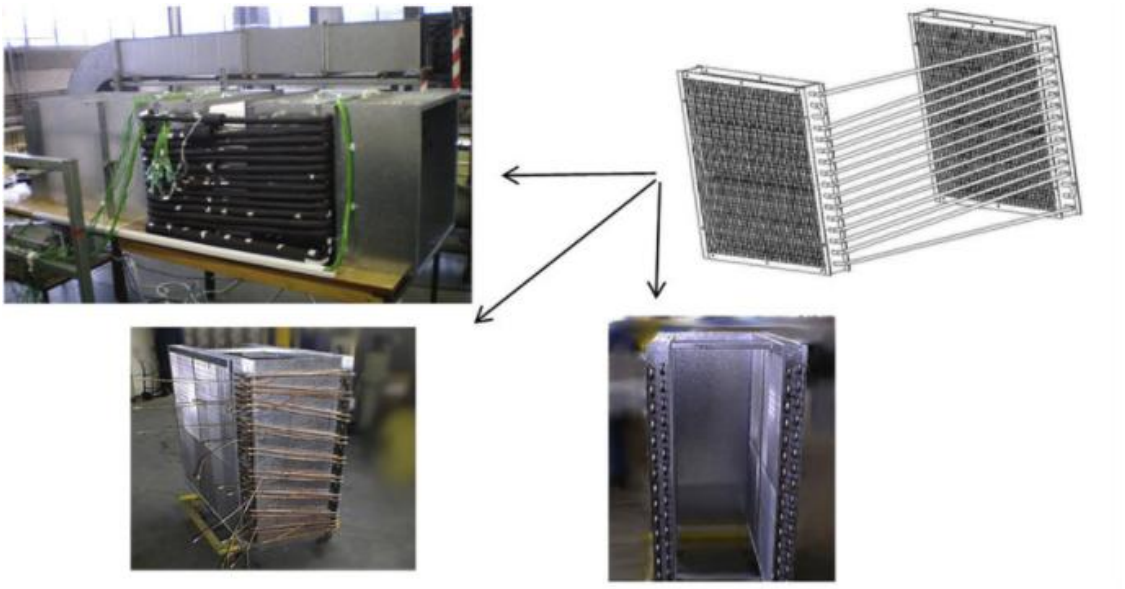


Fig No.2 Test Set Up

5.1. SPECIFICATIONS OF COMPONENTS

One of the design parameter of heat pipe is selecting the operating temperature range. In this project setting the Operating temperature range as 20-70oC, since there are many conventional application falling in this range. The boiling point of the acetone falls in the selected operating temperature. Selecting the working fluid as acetone, since useful range of acetone is 0-100oC. The compatible material for acetone is steel with high thermal conductivity. Hence, the steel is selected as pipe wall material. The larger the diameter more cross-sectional area available to allow the vapor to move from the evaporator to condenser. This allows the greater power carrying capacity. Hence, selecting the outer diameter 12mm and length 250mm, with L/D=20.83 as it will give a greater power carrying capacity and better understanding of fluid flow will be performed on it.

Specifications:

1. *Wall Material: Copper.*
2. *Working Fluid: R134a,R290,*
3. *Wick Structure: Meshing*
4. *Thermocouple: Resistance Temperature Detectors (RTDs).*
5. *1/2" rifled copper tubes for enhanced thermal performance*
6. *Aluminum fins (8-14 Fpi)*
7. *Galvanized steel casing*
8. *Up to 10 rows*
9. *Aspect ratios can be square*

For Control Panel
Ammeter: 0-5 mA
Voltmeter: 0-300 V.
4-channel Digital Temp. Indicator (0°C-500°C) with RTD Thermocouple.

V. RESULT

Working Fluid: Water
T1=42
T3=19.6
T4=26.8
Effectiveness=ℰ = (T4-T3)/ (T1-T3)
ℰ = (26.8-19.6)/ (42-19.6)
ℰ =0.32

Working Fluid: R134a
T1=41
T3=14
T4=21
Effectiveness= ℰ = (T4-T3)/ (T1-T3)
ℰ = (21-14)/ (41-14)
ℰ =0.259

Working Fluid: R600a
T1=40
T3=13
T4=20
Effectiveness= ℰ = (T4-T3)/ (T1-T3)
ℰ = (20-13)/ (40-13)
ℰ =0.2258

Result:
We found effectiveness of refrigerants
Refrigerant: Water=0.276
Refrigerant: R134a =0.259
Refrigerant: R600a=0.2258

VI. CONCLUSIONAND DISCUSSION

After observing Wraparound Heat Pipe effectiveness we found that water has higher effectiveness comparing with R134a, R600a. The conventional turning out liquid for HVAC heat pipes has been a refrigerant and a substitution liquid is alluring as a short and long haul choice. From a natural outlook, water is an ideal up-and-comer and a large number of its warm vehicle properties recommend that it ought to be viable. The utilization of wraparound heat pipes that is getting looked at depends upon explicit sizes and directions of cylinders and the finishes of the report give pointers towards additional exploration which should be attempted, or is in progress, to decide the degrees of appropriateness of water as a functioning fluid. It has been shown that water as a working fluid possesses more feasible qualifications as well as gives some per-formance upgrade in this application. When consolidated with the present status of the workmanship as far as assembling it implies that there are no further obstructions to the utilization of water as a working fluid in the application considered. Its utilization in heat pipes for other air conditioning frameworks, notwithstanding, should be painstakingly considered and tested.Hence ecofriendly working fluid water which has no effect on environment gives better results.Also water does not impact to global warming and ozone layer depletion.

REFRENCES

[1]. Vishnupant J. Sargar , Pruthveeraj D. Mali, "Design, Development and Testing of Cross flow Circular Heat Pipe For Cooling Of Oil", International Journal Of AdvancedTechnology In Engineering and Science, Vol.2,Issue No.12, pp 683-689,Dec-2014.
[2]. Gerardo Carbajal, Haydn N.G. Wadley, Douglas T. Queheillalt, "A multifunctional heat pipe sandwich panel structure", International Journal of Heat and Mass Transfer 51, pp 312-326, 2008.
[3]. B.Ch. Nookaraju, P S V Kurmarao, H.Prashanth, C.Pradeep, "Experimental Study On Behaviour Of Sintered Copper Wick Heat Pipe at Different Orientations", International Journal Of Innovative Research In Advance Engineering, Issue-5,Vol.2, pp 176-180, May-2015.
[4]. R.A. Hossain, M.A.K Chowdhuri , C. M. Feroz, "Design, Fabrication and Experimental Study Of Heat Transfer Characteristics of a Micro Heat Pipe", Jordan Journal Of Mechanical and Industrial Engineering, Volume 4, Number 5,pp 531-542, 2010.
[5]. Per Wallin, " Heat Pipe ,Selection Of Working Fluid", Project Report MVK160 Heat and Mass Transfer, ppl-7, 2012.
[6]. R.Manimaran , K.Palaniradja , N.Alagumurthi , J.Hussain, "Factors Affecting The Thermal Performance of Heat Pipe-a review", Journal Of Engineering Research and Studies, Vol. 3,Issue 2, pp 20-24, 2012.
[7]. Tian F Z, Xin G M, Hai Q, Cheng L. An investigation of heat transfer characteristic of cross internal helical microfin gravity heat pipe with self-rewetting fluid. Advanced Materials Research, 2013, 765– 767: 189–192