RESEARCHERID
THOMSON REUTERS

[NC-Rase 18]
DOI: 10.5281/zenodo.1493988

ISSN 2348 – 8034
Impact Factor- 5.070

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

A REVIEW ON WASTE HEAT RECOVERY OF BOILER PLANT USING HEAT PIPE HEAT EXCHANGER

Prof. S.P. Joshi[1] & Prof. P.B. Borakhede[2]

[1]Assistant Professor, Department of Mechanical Engineering, MGI-COET Shegaon, India
[2]Assistant Professor, Department of Mechanical Engineering, MGI-COET Shegaon, India

ABSTRACT

The consumption of hot air presents a significant part of the nation's energy consumption. And hence the cost of that energy is to regain heat from the waste warm air that is discharged to the sewer each day. The potential for economic waste air heat is recovery depends on both the quantity of heat available and whether the quality fits the requirement of the heating load. Heat pipes with heat exchanger are useful device for the recovery of waste heat. Large quantities of heat can be conveyed through a small cross-sectional area over a long distance with no extra power input to the system. Some applications of heat pipes are in the area of heat exchangers for heat recovery medicine, electrical and electronic equipment cooling and as spacecraft by replacing the conventional fluid in heat pipe with Nano fluid of the heat pipe heat exchanger enhancement in performance of heat pipe heat exchanger can be obtained. By using developed test rig, energy saving potential for heat source at various temperatures would be expected.

Keywords: *Heat pipe heat exchange, boiler plant.*

I. INTRODUCTION

A heat pipe consists of a sealed, hollow tube whose inside walls are lined with a capillary structure or wick. Thermodynamic working fluid, with higher vapour pressure at the required operating temperature, saturates the pores of the wick in a state of equilibrium between liquid and vapour. When heat is applied to the heat pipe, the liquid in the wick get heated and evaporated. When the evaporating fluid fills the heat pipe hollow centre, it diffuses throughout its length. This effective high thermal conductance will help to keep constant temperature along the length of the pipe Capillary action within the wick returns the condensate to the evaporator (heat source) and completes the operation cycle. This system transmits thermal energy at rates hundreds of times greater and with a far superior energy-to-weight ratio than can be achieved from the most efficient solid conductor. By replacing the conventional fluid in heat pipe with Nano fluid of the heat pipe heat exchanger good performance can obtained. A model of multiple type heat pipe heat exchanger panel will also develop to forecast the energy saving that would be anticipated.

Heat pipes work on a cycle of vaporization and condensation of the operational fluid, which consequences in the heat pipe's high thermal conductivity. When decide a working fluid for a heat pipe, the liquid must be able to function inside the heat pipe's in service warmth range. A incessant process is established by the capillary pumping forces within the wick arrangement, thus recurring the fluid to the evaporator part. In result, we have a perpetual motion machine with no moving parts and requiring no energy of its own. Each heat pipe has a transfer efficiency of 99.3%.

II. HEAT PIPE

A heat pipe is a novel machine that can move large quantities of heat through a small area by means of small temperature difference. Grover, Cotton and Erickson of Los Alamos National laboratory are the pioneers in construction of heat pipes. The original heat pipe was construct by them in 1964. They constructed 3 (Three) heat pipes, 1 with stream as standard and 2 with sodium. Initial efforts were directed towards space heat applications. Major factors are high reliability, its capability to work under light state in space as well as workability under isothermal conditions without the need for any outside power participation. In recent years it is realized that heat

pipes are equally chief for apply for to earth as well as space applications. It consists of a hollow tube in which annular room is craggy with wick arrangement. The empty tube is first vacuumed, then charged with working fluid and hermitically preserved. A heat pipe in principle divided into 3 parts they are Evaporator, Adiabatic section, Condenser. The driving force that transports the condensed ready liquid through the wick to the evaporator is provided by capillary pressure. Working fluids that are in employment in heat pipes have concave facing menisci (wetting liquids) as opposed to convex facing menisci (non-wetting liquids). get in touch with angle is definite as the angle between the solid and vapour region. wet fluids have angles between 0 and 90 degrees.

III. WORKING CODE

Heat pipe consists of three mechanism such as, the container, the operational fluid .and the wick. Heat applied by a heat source at the evaporator section vaporizes working fluid in that part. This also creates a pressure difference that make the vapor run from evaporator to condenser part where it condense latent heat of vaporization. This liquid proceeds to the evaporator by means of a wick (via capillary forces) so that the heat pipe can continuously transport the heat of vaporization from evaporator to condenser. This process is capable to transport the heat from hot region to a cold region. Therefore, a heat pipe transport large amount of heat with a small temperature difference. Research has been by now carried out on the theory, propose and construction of heat pipes and their applications as heat pipe heat exchangers for diminish of air pollution, energy recovery and environmental conservation. A heat pipe heat exchanger has been designed and construct for heat recovery in most clean places like hospital and laboratories, where the air must be fresh and to be replace up to 40 times per hour. In this research, the distinguishing design and limitations of heat transfer of single heat pipes for mentioned types of wick and working fluids have been investigated. Construction of heat pipes as well as wash, wick placing, void formation, fluid injection in heat pipe and installation have also been carried out. Once appropriate heat flux is obtained, the air-to-air heat pipe heat exchanger was designed, contrived and examined under low temperature in commission circumstances, using all three fluid mentioned in the literature as the working fluid The heat pipe and copper rod should be in the test section in a vertical position, similar to what is shown in the figure. Three K-type thermocouples are placed at different locations on the border for both heat pipe and copper rod. These will be used to calculate the rod surface temperatures. Place a beaker with water under test section such that 80% of evaporator section of the heat pipe as well as the bottom of the copper rod is in the water. Place the water beaker on a plate heater as shown in the figure. Orifice plates are used mainly incorporated for measuring air flow rate, velocity or Reynolds number.. The impact of number of rows of heat pipe heat exchanger and variations in the operating air conditions on the savings in cooling coil capacity.

IV. SELECTION OF WORKING FLUID

The first deliberation in the selection of the working fluid is the operating vapor temperature choice. Within the approximate temperature range, there is a number of working fluids may exist and a variety of characteristics must be examined in order to determine the most acceptable fluids for the required application. In heat pipe design, a high value of surface tension is desirable in order to operate heat pipe against gravity and to generate a high capillary driving force. The vapor pressure must be sufficiently great over the operating temperature range to avoid high vapor velocities, which cause flow instabilities due to large temperature gradients setup

V. METHOD

Actual experimentation will be conducted to Performance examination of heat recovery heat pipe heat exchanger by using Nano fluid with variable mass flow rate. An agreement will be made to calculate and diverge the heat input with the help of boiler. The hot and cold air temperatures will be measured with the help of RTD's mounted at different locations of ducts. Four RTD's are to be fixed inside of duct at inlet and outlet of hot and cold air in order to measure temperature. Heat input will be varied from different mass flow rate of tire of boiler. The manufacture of a 6 inch heat pipe involve several processes. Heat pipe proper design and construction is very intricate but the working order of a heat pipe is simple. Number of parameter like effect of fluid charge, effect of wick structure, effect of working fluid, effect of tilt angle should be restricted. We can say that experimental investigations are very

important. In this research, at the beginning material and dimensions of a heat pipe. The types of wick and working fluids compatible with the pipe material and wick structure were selected. The superiority design and heat transport limitations of heat pipes for three types of wick made of 50 mesh nickel, 250 engage nickel and 100 mesh stainless steel tested. Also working fluids like acetone, methanol and water through a computer simulation of a single heat pipe were examined. The diameters of these pipes are ½ inch. Then we cleaned these pipes in 3% HNO3 solution for 30 minutes. After cleaning in 3% HNO3 solution, we soaked these pipes in hot distilled water which is at 800 C for almost 30 minutes. After this cleaning process we fitted the end cap with copper pipe at one end. Electrical energy generation system based on renewable energy developed in this study utilizes thermo siphons to bring out stored heat as solar pond, geothermal, to expel waste heat to ambient and to collect waste heat into phase change resources. Heat pipe used for low-cost and zero greenhouse gas emission solution for these application. Usually, the heat pipe and vapor chamber are two-phase heat transfer devices. The use of energy expenditure control has become a priority for all countries in the world. This fact is due to the restriction of Earth's natural resources, the extra and more high costs of energy consumption as well as global warm. Heat revival from waste water from drains, represents a waste heat source which is untapped so far. The renewal of heat from waste water would increase the energy independence by reducing the dependency on fossil fuels, the conservatory gas emissions. For the condenser above evaporator pattern where bottom heat mode is the come again of the condensate which be aid by gravity. So it is also called as importance assist heat pipes or thermosyphons. While for the evaporator above condenser configuration where top heat mode or horizontal which evaporator and condenser at same level configuration, porous structure is wrinkled on the internal boundary of the heat pipe to promote capillary pump of the working fluid.

VI. CONCLUSION

The performance of heat pipe heat exchanger charged with BN/H20 Nanofluid increases with increase in source temperature greatest effectiveness experiential for proposed heat pipe heat exchanger is up to 0.28. The results obtained for TPCT heat exchanger charged BN/H20 Nanofluid are superior with that of TPCT charged with conventional fluid. Enhancement in effectiveness of heat exchanger for current study is about 35% compared with the available literature. Improvement in effectiveness of two phase closed thermosyphon heat exchanger charged with Nanofluid is due to thermal conductivity enhancement of Nanofluid.

REFERENCES

1. *Yodrak L., Sampan R., 'Waste Heat Recovery by Heat Pipe Air-Preheater to EnergyThrift from the Furnace in a Hot Forging Process', American Journal of Applied Sciences2010. 7 (5),pp 675-681.*
2. *Noie-Baghban, Majideian G., 'Waste heat recovery using heat pipe heat exchanger(HPHE) for surgery rooms in hospitals', Journal of Applied Thermal Engineering, 2000, pp 1271-1282,.*
3. *Wilkes G., Grant D., 'Angry Trout Cafe Kitchen Exhaust Heat RecoveryFinal Report for CARD Grant B42832', Conservation Applied Research & Development (CARD) Program, 2012.*
4. *Niu J., Zhang L., ZuoH.,'Energy savings potential of chilled ceiling combined with desiccant cooling in hot and humid climates', Energy and Buildings, 34(2002),pp 487-495.*