iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** III **Month of publication:** March 2019

DOI: http://doi.org/10.22214/ijraset.2019.3316

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue III, Mar 2019- Available at www.ijraset.com

Advancement in Triple Flow Heat Exchanger using Vibration

Mangesh R. Kamble[1], Avinash R. Mankar[2]
[1]Heat Power Engineering, Department of Mechanical Engineering, [2]Faculty of Mechanical Engineering, Gurunanak Institute Of Technology, Nagpur, Rashtrasant Tukadoij Maharaj Nagpur University, India

***Abstract:** An advancement in triple flow heat exchanger using vibration has been carried out with different flow arrangements that is hot fluid at middle of pipe where as cold fluid passed remaining two pipes with counter and cross flow types. So that surface area of heat exchanger will be increases and more heat transfer takes place. For creating theturbulence in fluid flow inside the arrangement we can use vibrator at lower side of the concentric pipe so that transfer of heat from one pipe to other are more with the turbulent flow and increase the (LMTD) logarithmic mean temperature difference. The main aim of arrangement is to increase the heat transfer using three pipes and vibrator arrangement.*
***Keywords:** vibrator, heating coil, three pipes for flow of fluid, temperature indicator, pump, motor.*

I. INTRODUCTION

A heat exchanger is a device that is used to transfer thermal energy (enthalpy) between two or more fluids, between a solid surface and a fluid, or between solid particulates and a fluid, at different temperatures and in thermal contact. In heat exchangers, there are usually no external heat and work interactions. Typical applications involve heating or cooling of a fluid stream of concern and evaporation or condensation of single- or multicomponent fluid streams. In other applications, the objective may be to recover or reject heat, or sterilize, pasteurize, fractionate, distill, concentrate, crystallize, or control a process fluid. In a few heat exchangers, the fluids exchanging heat are in direct contact.

In most heat exchangers, heat transfer between fluids takes place through a separating wall or into and out of a wall in a transient manner. In many heat exchangers, the fluids are separated by a heat transfer surface, and ideally they do not mix or leak. Such exchangers are referred to as direct transfer type, or simply recuperates. In contrast, exchangers in which there is intermittent heat exchange between the hot and cold fluids—via thermal energy storage and release through the exchanger surface or matrix— are referred to as indirect transfer type, or simply regenerators. Such exchangers usually have fluid leakage from one fluid stream to the other, due to pressure differences and matrix rotation/valve switching. Common examples of heat exchangers are shell-and-tube exchangers, automobile radiators, condensers, evaporators, air preheaters, and cooling towers. If no phase change occurs in any of the fluids in the exchanger, it is sometimes referred to as a sensible heat exchanger. There could be internal thermal energy sources in the exchangers, such as in electric heaters and nuclear fuel elements. Combustion and chemical reaction may take place within the exchanger, such as in boilers, fired heaters, and fluidized-bed exchangers. Mechanical devices may be used in some exchangers such as in scraped surface exchangers, agitated vessels, and stirred tank reactors. Heat transfer in the separating wall of a recuperator generally takes place by conduction.

However, in a heat pipe heat exchanger, the heat pipe not only acts as a separating wall, but also facilitates the transfer of heat by condensation, evaporation, and conduction of the working fluid inside the heat pipe. In general, if the fluids are immiscible, the separating wall may be eliminated, and the interface between the fluids replaces a heat transfer surface, as in a direct-contact heat exchanger. There is several application of counter flow heat exchanger using two fluids like in chemical, petrochemical, oil industry and etc. for heat exchange between the two different fluids either counter flow heat exchanger or cross flow heat exchanger are used. But to develop large temperature difference between inlet and outlet spiral heat exchanger are used. The main advantages of spiral heat exchanger it consume less area compared to other geometry for same temperature difference. Many researcher has done work on helical and spiral geometry [1, 5], some of the researcher explain triple flow heat exchanger [3] and some conducted their experiment under different frequency and vibration [10, 11 and 12]

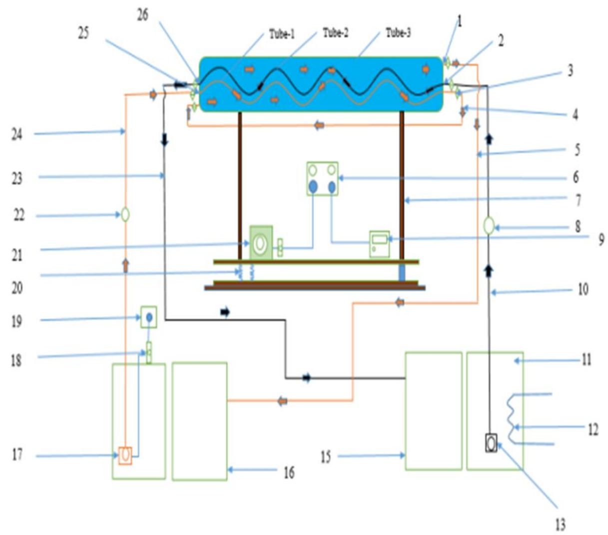


Fig.1 Schematic diagram of experimental setup

II. LITERATURE SURVEY

Cheng et al. [1] in this work it is found that the flow induced vibration at the low flow velocity can significantly increase the convective heat transfer coefficient of the nonlinear heat transfer device. Compared with the average tube outside convective heat transfer coefficient of the fixed tube bundle, the average tube outside convective heat transfer coefficient of this device is improved by more than two times, while the fouling resistance is reduced by two-third. An experimental and numerical study on the relationship between flow-induced vibration and heat transfer enhancement in a heat exchanger. It was concluded that the heat transfer could be enhanced and the fouling resistance could be decreased under the flow induced vibration condition.

Bronfenbrener et al. [2] On the basis of a dimensionless analysis, a mathematical model for the heat-transfer process was developed. It was shown that the mean heat transfer coefficient became higher as the velocity of vibration increased. The experimental results were in good agreement with the theoretical model. Concluded that the heat transfer could be increased with the increase in the oscillatory Reynolds number

Leyarovski et.al. [3] He experimented a new heat exchanger for liquefiers, it is highly efficient heat exchanger consisting of three tubes, and two are soldered on thermal contact and inserted into third. Thermal characteristic are carried out and as a result of these a Heat exchanger of two tube is less effective in the presence of second cold flow with low gas pressure and other physical parameter, because of the necessity of third tube.

SaiLavanya et. al. [4] he presented the work to design a solar water cooler of 200 liter capacity. An experimentally study of designing of absorption refrigeration for domestic purpose and carried out by calculating the basic component of the cycle and its analysis through the H-C chart.

LI Ya-xia et.al. [5] Cooperating with spiral corrugation on the inner wall is a passive heat transfer enhancement method for the smooth helical tube. The effects of the spiral corrugation parameters and Reynolds number on the flow and heat transfer were studied. The results show that the spiral corrugation can further enhance heat transfer of the smooth helical tube due to the additional swirling motion. Decrease of the pith of spiral corrugation can increases heat transfer between the tube. The results show that the spiral corrugation can further enhance heat transfer in smooth helical tube due to the additional swirling motion and decrease of the pith of spiral corrugation makes heat transfer enhance higher.

Jung-Yang San, et. al. [6] He investigated the performance of a helical heat exchanger. The heat exchanger is composed of a helical tube with rectangular cross section and two cover plates. The effectiveness-Ntu relation of the heat exchanger was obtained. In this work, the flow in the tube was considered to be mixed and the flow outside the tube (radial flow) was unmixed. In the experiment, the Darcy friction factor (f) and convective heat transfer coefficient (h) of the radial flow were measured. The radial flow was air and the helical flow was water. Four different channel spacing were individually considered. The Reynolds numbers were in the range 307-2547. In the experiment, the Darcy friction factor (f) and Nusseltnumber (Nu) of radial flow were measured respectively. The f was found to increase with the channel spacing (S) and decrease with an increase of the Re.

AniketRamchandraKalambe et.al. [7] This study is an attempt at modelling a two-phase flow for various refrigerants for the proper prediction of pressure drop and pumping power. In the present analysis, CFD analysis of two phase flow of refrigerants inside a horizontal condenser tube of inner diameter, 0.0085m and 1.2m length is carried out using homogeneous model under adiabatic.

Bo Zhang et al. [8] In this study, experiments were performed to investigate the effects of sinusoidal vibrations on the heat transfer characteristics of internal flow in a circular heated tube. Water was used as the working fluid with different Reynolds numbers. The frequencies of the mechanical vibration generator varied and by using the time domain acceleration signal was obtained using a vibration accelerometer and then transferred to the frequency domain using the fast Fourier transform method in the experiments. The results demonstrated the effect of the vibration frequency on the heat transfer enhancement was proved to be stronger than that of the vibration acceleration in the experiments. The trend of the Strengthening of the heat transfer owing to the increase in the vibration frequency reaches a peak value when the frequency is which corresponds to the resonance condition. When the frequency is much larger than that at the resonance condition, the effect of the frequency becomes less.

Barigou et al. [9] Radial heat transfer in laminar pipe flow is limited to slow thermal conduction which results in a wide temperature distribution over the pipe cross-section. This is undesirable in many industrial processes as it leads to an uneven distribution of fluid heat treatment. In this study, model is under transverse vibration motion on laminar flow which generates fluid motion which leads to considerable radial mixing. The result shows large enhancement in wall heat transfer as well as a near-uniform radial temperature field accompanied by a substantial heating of the inner region of the flow. Vibration also causes the temperature profile to develop very rapidly in the axial direction reducing the thermal entrance length by a large factor, so that much shorter pipes could in principle be used to achieve a desired temperature at the outlet.

Klaczak et al. [10] This Investigation concerns the horizontal exchanger steam-water exposed to vibrations frequency 20-120 Hz and amplitude 0:2-0:5 mm. Experiments were executed for laminar low in range of 430-2300. Vibrations with high acceleration coefficient improve in general heat transfer, but nearing the resonance frequency can be harmful to the construction of the equipment. Delivered a report concerning the influence of forced vibration on the heat transfer in a horizontal laminar-flow steam–water exchanger . It was demonstrated that a vibration with a high acceleration generally boosts the heat transfer efficiency.

Hosseinian, et. al. [11] the forced vibration on the outer surface of the heat exchanger is imposed by electro-dynamic vibrators. Result demonstrate that imposing the vibration increase the heat transfer coefficient remarkably, while decrease the Nano-particles deposition. The most effective factor on heat transfer enhancement is flow rate. Increase of flow rate causes reduce in the vibrations effects. The nanoparticles sedimentation in low flow rates is higher while the heat transfer coefficient is lower. Hence imposing the vibration for low flow rate heat exchangers is useful.

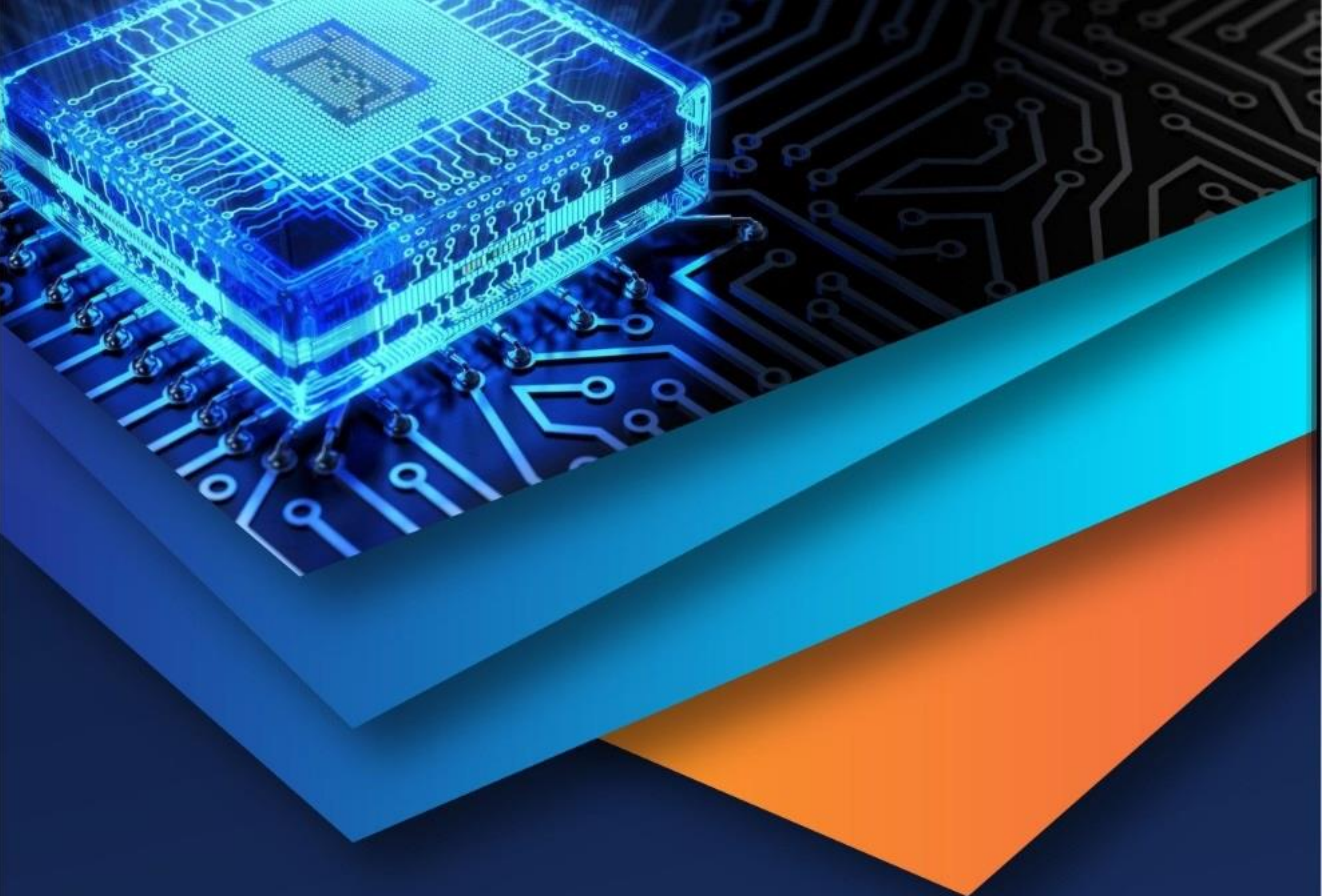
N.C. Willis et.al [12] in this the performance of the cross flow heat exchanger is determined. Effectiveness factor are determine for a wide range of operating parameters for single pass and multi pass heat exchanger The basic analysis and method of presentation of result used in this for single pass three fluid cross flow heat exchanger was extended to multiple passes. The performance for a two pass concurrent arrangement with mixed flow. This configuration is considerably less effective than the single exchanger for similar condition.

LI Ya-xia et.al. [13] Cooperating with spiral corrugation on the inner wall is a passive heat transfer enhancement method for the smooth helical tube. The effects of the spiral corrugation parameters and Reynolds number on the flow and heat transfer were studied. The results show that the spiral corrugation can further enhance heat transfer of the smooth helical tube due to the additional swirling motion. Decrease of the pith of spiral corrugation can increases heat transfer between the tube. The results show that the spiral corrugation can further enhance heat transfer in smooth helical tube due to the additional swirling motion and decrease of the pith of spiral corrugation makes heat transfer enhance higher.

REFERENCES

[1] Wenjie Liu, Zhuqiang Yang, Bo Zhang, Ping Lv" Experimental study on the effects of mechanical vibration on the heat transfer characteristics of tubular laminar flow" International Journal of Heat and Mass Transfer 115 (2017) 169–179.
[2] M. Eesa, M. Barigou, Enhancing radial temperature uniformity and boundary layer development in viscous Newtonian and non-Newtonian flow by transverse oscillations: A CFD study, Chem. Eng. Sci. 65 (6) (2010) 2199–2212.
[3] L.A. Florio, A. Harnoy, Natural convection enhancement by a discrete vibrating plate and a cross-flow opening: a numerical investigation, Heat Mass Transf. 47 (6) (2011) 655–677.
[4] Klaczak, Report from experiments on heat transfer by forced vibrations of exchangers, Heat Mass Transf. 32 (6) (1997) 477–480.
[5] L. Cheng, T. Luan, W. Du, Heat transfer enhancement by flow-induced vibration in heat exchangers, Int. J. Heat Mass Transf. 52 (3–4) (2009) 1053–1057.
[6] L. Bronfenbrener, L. Grinis, E. Korin, Experimental study of heat transfer intensification under vibration condition, Chem. Eng. Technol. 24 (4) (2001) 367–371.
[7] E.I.Leyarovski and V.T.Kowatchev"three flow, low temperature heat transfer" Bulgariya Academy of Science 337-342

[8] R SaiLavanya, Dr.B.S.RMurthy"design of solar water cooler using aqua-ammonia absorption refrigeration system" international journal of advance engineering research and studies E-ISSN2249-8974.
[9] LI Ya-xia1, WU Jian-hua1, WANG Hang1, KOU Li-ping1, TIAN Xiao-hang2" Fluid Flow and Heat Transfer Characteristics in Helical Tubes Cooperating with Spiral Corrugation" Energy Procedia 17 (2012) 791 – 800.
[10] LI Ya-xia1, WU Jian-hua1, WANG Hang1, KOU Li-ping1, TIAN Xiao-hang, "Fluid Flow and Heat Transfer Characteristics in Helical Tubes Cooperating with Spiral Corrugation", International Conference on Future Electrical Power and Energy Systems-2012
[11] Jung-Yang San, Chih-Hsiang Hsu, Shih-Hao Chen, "Heat transfer characteristics of a helical heat exchanger", Applied Thermal Engineering 39 (2012) 114e120.
[12] Hosseinian, A.H. MeghdadiIsfahani, E. Shirani, "Experimental investigation of surface vibration effects on increasing the stability and heat transfer coeffcient of MWCNTs-waternanofluid in a flexible double pipe heat exchanger", Experimental Thermal and Fluid Science -2017.
[13] N. C. Willis and A. J. Chapman, "analysis of three fluid, cross flow heat exchanger", Transaction of the ASME-1968
[14] AniketRamchandraKalambe, "Two phase flow CFD analysis of refrigerants in a condenser pipe for prediction of pressure drop and pumping power", Presented to the Faculty of the Graduate School of The University of Texas at Arlington-2015 Rahul P. Patel and Dr. R. G. Kapadia, "Performance evaluation of a vapor compression refrigeration system for simultaneous cooling and heating by using R22 and alternative refrigerants," International Journal of Engineering Research and Technology (IJERT), Vol. 02, April 2013.



10.22214/IJRASET

INDEX COPERNICUS

45.98

ISRA JIF

IMPACT FACTOR: 7.129

SJIFactor

TOGETHER WE REACH THE GOAL

IMPACT FACTOR: 7.429

ISI

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY