EFFECT OF DIFFERENT PARAMETERS ON THE HEAT TRANSFER RATE OF HEAT EXCHANGER

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Abstract
Heat exchanger is used for transferring the heat from one fluid to another fluid. One of the basic components of heat exchanger is pipe which runs the fluid in the inner pipe as well as outer pipe. Heat as well as cold water flow in opposite along with same direction in heat exchanger's simple context of a concentric tube construction. When arrangement of flow is parallel then at the same end fluid starts entering that is cold as well as hot, along with leave at the same end including flow in same direction.In this work, several literature works are taken into consideration to know about the past, present and scope for the heat exchangers in world.Different works are studied that focuses on varying the material properties, different arrangements and designs of the pipe. Also different experimental and simulation works on CFDhave been carried out. In several literatures, comparison between simulation and practical work is shown. These works are provided for the enhancement of the transfer rate of heat and efficiency of heat exchanger and further scope is looked.

Keywords: Heat Exchanger, CFD (Computational Fluid Dynamics), enhancement, heat transfer

INTRODUCTION

Any process that includes heating as well as cooling along with boiling also evaporation can be helpful in realizing its worth of usage and also might need a heat exchanger for such requirements. Usually the fluids which are processed are heated as well as cooled before it undergoes phase change and the process. As per their applications, the heat exchangers are named differently. An insight has been provided about the power requirements as well as capital cost through certain area that is needed along with Pressure drop of a heat exchanger [1]. As per their process fluids, as well as application, along with mode of heat transfer including flow, heat exchangers might be classified. Through indirect ways with fluids as well as direct contact ways, heat can be transfer in heat exchangers. Classification can also be done on the basis of kinds of baffles along with shell as well as tube passes including smooth and also baffles surfaces in addition with the arrangement of the tube such as square and triangular and so on. Classification can also be done through the flow arrangement of flowing fluid in the parallel direction along with the counter flow direction that is opposite to each other moreover with the cross flow that is normal to each other.

According to the changes in condition that occurs in the pipes: flow rates, as well as inlet temperatures, along with fluid composition, including the fluid properties and so on, changes also occur in the amount of heat transferred.A Shell as well as tube heat exchanger is a designed class of heat exchanger. In power plants as well as in large chemical processes along with oil refineries, heat exchanger are the most common which are used in it. Such kinds of heat exchangers are consisted of large vessel known as shell along

with the bundle of tubes which are inside it.Heat exchanger is used for transferring the heat from one fluid to another fluid. Gasketed plate and frame heat exchanger can be seen in figure 1.

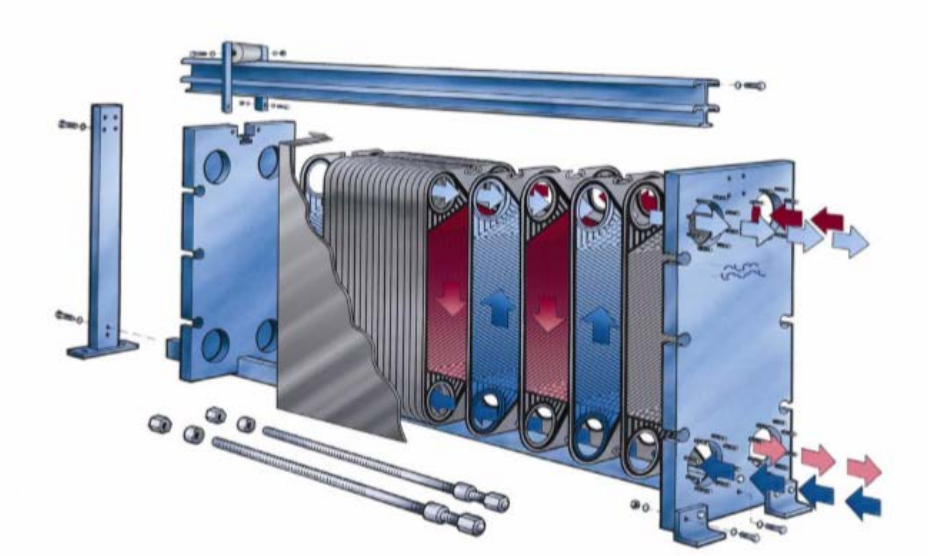

Figure 1: Gasketed plate and frame heat exchanger

One of the basic components of heat exchanger is pipe which runs the fluid in the inner pipe as well as outer pipe. Heat as well as cold water flow in opposite along with same direction in heat exchanger's simple context of a concentric tube construction.As compared to the double pipe heat exchanger, triple pipe heat exchanger performs way better as shown in Figure 2. One of the main function of third pipe is to enhance the transfer rate of heat with the help of larger transfer per unit exchanger length and an additional flow passage [2].

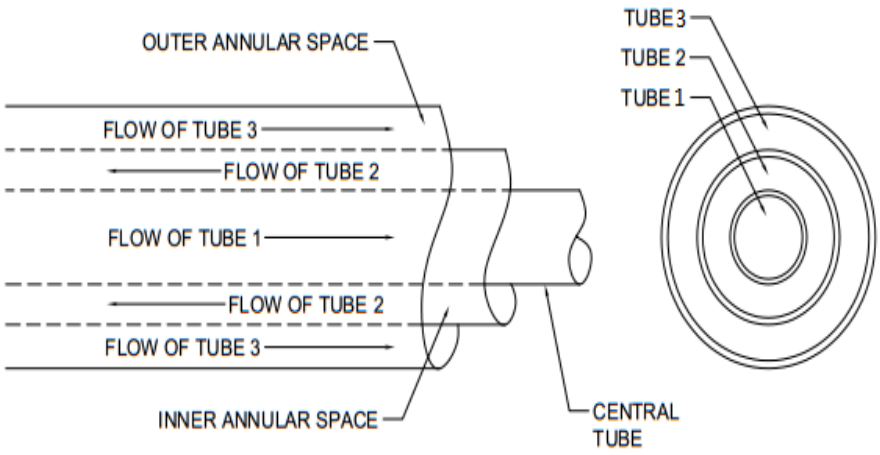

Figure 2: Triple concentric tubes

Applications of Heat Exchangers

A separate study would be required for covering each and every aspect of the vast topic of applications of heat exchangers. Amid the common applications are their which are taken in usage in mechanical equipment's industry as well asprocess industry along with home appliances. Now days, for heating district systems, heat exchangers are taken in usage for employment in abundance. For evaporation as well as condense the fluids, heat exchangers are being installed in refrigerators along with Air conditioners. Furthermore, for pasteurization, it is also taken in usage for processing units of milk.Application of heat exchanger has been provided in details along with different industries in the below Table 1.

Table 1: Heat Exchanger Applications in Different Industries

Industries	Applications
Food and Beverages	Ovens, cookers, Food processing and pre-heating, Milk pasteurization, beer cooling and pasteurization, juices and syrup pasteurization, cooling or chilling the final product to desired temperatures.
Petroleum	Brine cooling, crude oil pre-heating, crude oil heat treatment, Fluid interchanger cooling, acid gas condenser.
Hydro carbon processing	Preheating of methanol, liquid hydrocarbon product cooling, feed pre-heaters, Recovery or removal of carbon dioxide, production of ammonia.
Polymer	Production of polypropylene, Reactor jacket cooling for the production of polyvinyl chloride.
Pharmaceutical	Purification of water and steam, For point of use cooling on Water For Injection ring.
Automotive	Pickling, Rinsing, Priming, Painting.
Power	Cooling circuit, Radiators, Oil coolers, air conditioners and heaters, energy recovery.
Marine	Marine cooling systems, Fresh water distiller, Diesel fuel pre-heating, central cooling, Cooling of lubrication oil.

LITERATURE REVIEW

(Touatit&Bougriou, 2018) [3]calculation has been taken in usage to determine the temperature profiles of various heat transfer coefficients along with three fluids, as well as the total frictional power expenditure in a triple concentric-tube heat exchanger in steady state. The system has been composed of three concentric tubes, as well as hydrogen flows into the central tube, nitrogen passes through the inner annulus along with oxygen flows into the outer annulus passage in counter-current flows including concurrent flows. In this study, the thermophysical properties which have been taken in usage are supposed variables with the temperature. In this study, to optimize the heat exchanger, a techno-economic method has been used to determine the optimal diameter which is corresponding to the minimal total cost of the heat exchanger that is functioning as well as investment. only one optimum tube diameter has been remained for every single heat exchanger which corresponds to the minimum total cost of the heat exchanger that is total frictional power expenditure along with the fabrication of the heat exchanger, unlike the literature's previous studies where only two optimal tube diameters were provided: the first corresponds to the maximal heat exchanger efficiency and the last one to the minimal energy consumption required to overcome the pressure drop in the heat exchanger.

(Dhanush, E, &Meganathan, 2018)[4]research has been carried out on nanofluids flow for numerical simulation in a double pipe heat exchanger.An economical choice has taken in specification of double pipe heat exchangers which was for closed cycle cooling systems. With the usage of experimental setup different kinds of flow of have been done by Design, as well as Analysis along with Comparative study. For the evaluation of the workability analysis with the help of CFD has been done with overall effectiveness. With the usage of baffles on double pipe heat exchanger to check its workability is the main motive of this paper. With the usage of baffles along with twisted pipes enhance the transfer of heat through inducing the turbulent flow in the inner pipe, thus by increasing the effective flow length along with allowing good mixing within fluid of the channel. In many cases, the overall performance gets beneficial through the increase in pressure drop. A major role has been played by these efficiencies in budget nominal operations. The optimum values have been yield by the problem's solution of outer pipe diameter, including the utility of flow rate along with inner pipe diameter of a given effective length. Consequently, well designed as well as appropriate heat exchanger might have positive as well as significant influence on the plant profitability along with workability.

(Subramanian, Justin, &Sebastin, 2018) The work is investigating the convective transferer of heat along with the characteristics of friction factors in a plane plus ellipsoidal that is concentrating on the both side of tubes namely zigzag dimple tubes along with dimples tubes with constant heat flux under the turbulent flow where water has been used as a working fluid. Without causing any effect on the overall workability of the system, different methods have been taken in usage to increase the heat transfer rate that has been referred by heat transfer techniques. In past few decades, on passive techniques of heat transfer, numerous studies have been reported. With the usage of dimple tube the inner tube has been modified in the present study of concentric tube heat exchanger. For different Reynolds number with a fully developed turbulent flow, thermal performance as well as the friction factor of the effects on dimples has been determined. The results that are brought out from this analysis and experiment states that the utilization of

water in ellipsoidal along with the both tubes namely dimpled tubes are showing an increment in the transfer of heat but that rate of increment is very low in comparison to the plain tube under friction factors.

(kumarHotta, Nanda Sajja, TejaSigireddy, &SaiMugala, 2018) [5]pivotal parts is an SI engine. For the combustion of the fuel, on such principle SI engines have been operated. For the production of such useful work, this phenomenon has been partly utilized due to the production of heat energy. In the form of convection as well as conduction in atmosphere a part of the thermal energy has been dissipated. Changes of sharp temperature have been experienced by engine materials because of internal combustion. Efficiently as well as quickly heat dissipation needs to be carried out for the improvement of efficiency along with sustainability of the engine. For heat dissipation, exposure in the atmosphere of the engine's surface area was critical. Fins are known extended surfaces that help for the increase in surface area along with taking away the produced heat to the atmosphere of the combustion chamber. Characteristics of heat transfer of the fins have been vastly improved due to the advent of new alloys without any compromise on the other structural parameters. The parameters are the geometry as well as pitch along with height including the materials of the fins that can be altered for the optimization of the heat transfer from the engine. Thermal properties has been analyzed in this project of the engine cylinder through varying geometry of fins as well as size of fins along with size of fins including the material of fins at different operational speeds has been done. For commercial engine fins, standard materials have been taken in usage that Aluminium alloys A204 with the thermal conductivity of 120 W/m-k. Analysis has been done with the usage of materials such as Aluminium 204 as well as Aluminium 356 along with 6061 for the heat transfer characteristics of engine fins. With the help of SOLIDWORKS software as well as thermal analysis along with thermal properties are utilized with ANSYS Fluent Version 16.0 , the parametric model of the engine along with dissimilar fins are designed also the data fit software shows the results in the form of graphs.

(Taamneh, 2017) [6]combination of conventional air cooling technique along with the rotating heat pipe might be taken in consideration as effective as well as emerging technique for cooling for gas turbine disk. Consequently, numerical investigation has been taken of heat pipes along with simplified turbines including the analysis of transient as well as the thermal steady. For several parameters such as for heat as well as air pipes, the convection heat transfer coefficient along with thermal conductivity including the number of heat pipes together with the dimension of the disk, investigation has been taken place in the absence of heat pipes along with presence of transient as well as steady temperature variations. With the usage of finite element (FE) modeling software ANSYS-17.2, the thermal analysis has been performed. More than 100 degree, the temperature can be decreased at disk edge from the maximum temperature when number of heat pipes were equal to 32 and the extensive numerical simulations has been shown. Furthermore, with the increase in the working fluid of convective heat transfer coefficient which is inside the heat pipes up to 10,000 W/m2.°C, along with the maximum temperature at the disk rim could be decreased with more than 280 degree. The observation has been taken that the required time for achieving the minimum steady-state temperature has been more sensitive to the air convective heat transfer coefficient.

(Naveen &Bhuvaneshwaran, 2017)[7] Three dimensional CFD modeling has been studied in this paper on friction factor along with heat transfer including the thermal workability of concentric tube heat exchanger with the usage of twisted tapes that are Jagged V-cut as well as V-cut including Plain, V-cut along with several twist ratios that are y=4.0, 2.0 have been taken in usage. By creating turbulence in the fluid flow,twisted tapes have been taken in usage to augment the heat transfer. For increasing the thermal performance several methods have been applied on heat transfer devices like rough surface as well as treated surface including coiled tubes together with surface tension devices and also swirling flow devices. For an increase in the thermal workability from many of these methods, twisted method has been taken in usage. For several Reynolds Number effectiveness has been analyzed of heat exchanger by inserting twisted tape. With the

help of Jagged V-cut twisted tape that is H=50, maximum thermal performance factors have been obtained by inserting as compared to other twisted tapes. Consecutively analysis has been done on the friction factor.

(Yadav et al., 2017)[8] Lower energy consumption rate has been seen due to the development of heat transfer rate that leads to the enhanced efficiency as well as performance of heat exchanger along with that it also produces lower adverse effects effect on environment. TCPHE has been analyzed by its heat transfer rate as well as modeled along with the efficiency together with the performance as instead of conventional heat exchanger. Double pipe heat exchanger has been modified as well as improved and became a new version known as the triple pipe heat exchanger. For compact size of heat exchanger of triple concentric tube heat exchanger with the analytical analysis has been compared to the double pipe heat exchanger. Design with compact size length has been calculated of triple concentric heat exchanger in this research work, with the help of overall heat transfer coefficient along with the log mean temperature differences. Through analytical analysis, has been calculated with the length of 1.2 meter of heat exchanger. The result of theoretical analysis of this TCTHE has shown the improved workability along with the increased heat transfer coefficient rate in compact size heat exchanger.

(Hossain&Uddin, 2017)[9]fabricated as well as designed in this experiment which consists of three lengths of the tubes that are 580 mm, as well as 740 mm along with 857 mm including the diameter of three copper tubes that are 41.2 mm, as well as 25.35 mm along with 12.6 mm. The thickness of the outer tube is 1.25 mm. The thickness of middle tubes is 0.94 mm. The thickness of inner tube is 0.80 mm. To decrease the cost of materials along with the length including with the increase in the heat transfer surface area with the addition of intermediate tube in DCTHE is the main objective of this study. Analyzing and estimation has been done of the mass flow rates along with the different inlet temperature on the workability of the heat exchanger. It has been found from the study of experimental that when there is an increase in the mass flow rate the overall heat transfer coefficient is also increased for cold fluid as well as hot fluid. Along with the overall heat transfer coefficient of the equivalent DCTHE has been compared with that of the TCTHE and found better performance. The length of the heat exchanger for the same heat transfer area was 65.17% has been reduced as compared to the DTHE.

(SRIDHAR & 1, 2017)[10]heat exchanger has been affected by the flow pattern through a heat exchanger. Lowest transfer surface area has been required by the heat exchanger for counter flow. Higher value has been given for the log mean TEMPERATURE difference as compared to the heat exchanger of parallel flow along with the heat exchanger of cross flow. Numerous different types of flow patterns could be provided from the heat exchangers. Some common types of heat exchangers are cross flow as well as parallel flow along with counter flow. The most efficient heat exchanger with flow pattern out of three is the counter flow heat exchanger. It has been indicated that the surface area with lowest needed heat exchanger due to the log mean TEMPERATURE drop has been the maximum for a counter flow heat exchanger. Analysis has been done in this research for the comparison of heat transfer rates among the basic two flow arrangements: (i) the unidirectional parallel flow also known as parallel flow as well as co-current flow. (ii) Bidirectional flow also known as the counter flow as well as counter-current flow. For various fluids, thermal analysis as well as CFD analysis has been done on the heat exchanger by taking refrigerants R134A, as well as R22, along with R600A including hot water together with various materials of heat exchangers. In Pro/Engineer, 3D models have been done along with the Ansys done by the analysis.

(Dubey, Singh, Yadav, Pal, & Thakur, 2017) [11] Fins have been lengthy surfaces that help to dissipate the heat which is generated in the engine. On the other hand such types of lengthy surface length have been restricted that bound the rate of heat dissipation. Several industries of automobiles have worked on the rate of heat dissipation for increase through which the efficiency of the engine could also be increased.

(1Sagar Jagtap, 2017) [12]inner tube of the threaded pipe with dimple in the middle of the horizontal THE, the characteristics of heat transfer has been investigated in this study. The effect on heat transfer through triple pipe has been lead to finding of this research. Through this research it has been expected that outcome of experimental as well as application of CFD

were equal to the TTHE with the providence of turbulence in inner tube along with the spiral movement of the fluid of triple heat exchanger intermediate tube.

(Paul, Mathew, &Shripad, 2017)[13] Most popular illumination sources that are the advantage of LEDs are its higher efficiency as well as its compact size along with long life and so on. One of the highest energy saving source are the usage of lamp that are LED. Thermal analysis of honeycomb heat sink has been taken in usage in street lighting for high power LED application that has been presented in this paper. Three structure which are single cell, as well as two cell along with three cell honeycomb heat sink for high power LED lamps have been modelled in Solidworks. In ANSYS software, similar thermal analysis has been performed. One of the better configuration has been selected from the three models has been based on the outcomes from the thermal analysis along with the consideration amount and the cost of the heat sink materials. The reliability as well as the life of the heat sink would be increased of the properly designed heat sink of the LED lamp.

(P, Khond, &Lele, 2016) [14]concentric triple tube heat exchanger has been involved in the present study which includes heat transfer CFD analysis. For evaluation as well as numerical simulation of heat transfer theoretical studies have been carried out. The workability of TCTHE at variable operating conditions has to be evaluated. For C-H-N as well as N-H-C configuration experimental along with studies has been carried out already in TTHE. For various operating conditions, numerical investigation has been also carried out already. In present study, for N-H-C configuration, CFD analysis has been taken in usage to validate the experimental data.

(Ali, Krishna, Reddy, & Ali, 2015) [15]exchange heat between two fluids a device has been taken in usage that is Heat Exchanger through which the efficiency of operating has been increased. A major role has been played by such efficiencies in process industries for cost effective operations. In the meantime when the fluids are flowing through the heat exchanger, temperature would start exchanging with the fluids. To deal with the double pipe heat exchanger workability rate is the main aim of this paper through exchanging the materials that are used to recover the waste through heat input in refinery process of steam. By GAMBIT as well as CATIA, the design of Double pipe heat exchangers has been implemented. With the usage of ANSYS, the analysis of CFD has been done. Through three different kinds of materials such as copper as well as aluminium along with steel the Final Results have been obtained.

(Johnson &Shani, 2015)[16]recovering the heat among two process fluids, heat exchangers are taken in usage for the processes of industries. The designs of all the heat exchangers are based on the fulfillment of a functions process. The equations which are necessary for pressure drop as well as heat transfer has been available in a double pipe heat exchanger, with the usage of such equation, validation of the design becomes laborious. On the basis of the result obtained from the CFD analysis, the analytic design has been validated of the exchanger in this paper. The standard k- ε modeling is the basis of the CFD analysis in this paper. The optimum value has been yield of the problem through solution of the outer pipe diameter as well as utility flow rate along with the inner pipe diameter has been taken in usage for the provided length of the double pipe heat exchanger along with the definite flow rate of process stream that needs to be treated for the provided outlet temperature.

(Quadir, Badruddin, & Salman Ahmed, 2014) [17]usage of finite element method, workability of TCPHE has been carried out numerically under the steady state condition for arrangement of different flow along with non-insulated as well as insulated conditions of the heat exchanger. Three fluids have been taken in considerations which are cold water, as well as normal tap water including hot water. The outcomes have been presented for three fluids including their length for their different flow rates in the form of the dimensionless temperature variations of the heat exchanger. It has been found through the three fluids of temperature variation with the help of numerical predictions by using FEM follow closely to those obtained from experiments both in magnitude as well as trend provided correct overall heat transfer coefficients have been taken in usage. Studies of Parametric have been also carried out to show the effect of the individual design parameter on the workability of the heat exchanger.

(Peigné, Inard, &Druette, 2013) [18] energy-efficient dwellings a new wood based air heating system has been presented in this paper for conducting the experimental test. To evaluate the resulting outlet temperatures along with the recovered amount of heat by the ventilation air in order to assess feasibility including the workability of the coupling a mechanical ventilation heat-recovery unit along with the TCTHE which was integrated into the chimney of a room-sealed wood-pellet stove foe providing heat to the entire house was the main objective of this paper.

(Quadir, Jarallah, Ahmed, &Anjum, 2013) [19] Experimental study has been performed on the TCPHE under the condition of steady state for NHC as well as CHN two different flow arrangements, along with insulated including non-insulated conditions of the heat exchanger. Normal tap water as well as cold water along with hot water has been considered as three fluids. In the innermost pipe normal water has been flown under the NHC arrangement and in the inner annulus hot water has been flown along with the outer annulus hot water has been flown. Parallel are fluids are being flown with each other. By keeping the water being unchanged in the CHN arrangement, normal as well as cold water has been interchanged. In the form temperature variation the results has been presented of three fluids including the different flow rates of the heat exchanger together with their length. For two arrangements, temperature variation has been found including the length of the pipe which substantially differs. In the non-insulated condition, the temperature of cold water has been rapidly increased of NHC arrangement. In NHC arrangement has been found for cross over points for three fluids with higher volume flow rates.

(Wafelkar&Kamble, 2011) [20]double tube heat exchanger analysis of experimental workability has been presented of triple concentric heat exchanger with reference. The main issue which is equivalent to the double tube heat exchanger is that large length for tube as well as space has been consumed by it. A modification has been done to overcome from such problems in double tube heat exchanger which is later became a new version and known as triple tube heat exchanger. In the comparison of the double tube heat exchanger a large amount of heat has been provided by Triple tube heat exchanger, area per unit length of heat exchanger. On the middle tube, dimples have been made to improve the effectiveness. Water is the fluid that has been taken in usage. Though inner tube annular space as well as outer tube annular space cold fluid will be flown on the other hand in the middle annular space Hot water will flow. With dimple tubing, the effectiveness of triple tube heat exchanger has been carried out in study to determine. For different flow rate of hot fluid as well as cold fluid experimental investigation has been carried out. Relationship between different performance parameters such as Prandtls number, as well as Nusselt number, along with friction factor including the Heat exchanger effectiveness has also been presented.

CONCLUSIONS

This study is highlights a number of literature reviews which works on the principle of heat exchanger with different types of approaches. These are focused on design, material, types of fluid used in radiant cooling/heating etc. The findings in this review paper are from the above mention 20 literature reviews. In these literatures, different types of heat exchanger are observed and the work is typically done on improving the efficiency of heat exchanger by various feasible means. Some are the works that have compares between different types of material. In some other cases, fluid properties and fluids used are different. Design parameter is also seen to be varying in the above literature. From this review, it is concluded that there is a sufficient gap in the material properties to be enhanced. So addition in the material properties of pipe can be taken forward.

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