A Review- investigation of different process parameters and methods used in different heat exchanger

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Abstract: The increased demand of energy in domestic applications necessitates the development of innovative engineering solutions in building heating, ventilating, and air conditioning (HVAC) systems. As the largest energy intensive sector is domestic buildings, more focus is currently directed to reduce air conditioning energy consumption. Double-pipe heat exchangers are considered one of the practical solutions in today's HVAC industry. Here in this work it investigate the different process parameters of heat exchanger on which the performance of heat exchanger depends.

1. Introduction

The aircraft speed has increased from subsonic to supersonic over the last decades because of the advent and improvement of the aircraft jet engine. In recent times, the technologic study on the aerospace plane made a greater demand of speed (up to 5 Mach) and as the outcome, the engine for hypersonic aircraft come to be a challenge of 21st century. As new gas turbine utilized in aero engines, to attain greater thermal efficiency, the inlet temperature of turbine increases and increasing pressure ratio inside the compressor are most frequently used methods. With the improvement of engine technology, inlet temperature of current turbine is extreme outside the allowable metal temperature ranges, which is impending near about 2000 K. As the material properties development lagged behind the demand of practical application, turbine inlet temperature increased further by using highly sophisticated cooling techniques. Fin-tube compact heat exchangers show potential applications in aero engines for their great efficiency. As associated with the conventional heat exchangers utilized on the ground, those utilized in aero engines are more compact and undergo higher temperatures and larger difference in temperature. The change in temperature over the exchanger depth and the slope of temperature in the adjacent wall area are more exposed, they may reach a number of hundred degrees.

Heat exchangers are device that eases the heat exchange between two fluids that are at different temperature while possessing them from mixing with each other. heat exchanger are normally utilized in practice in a wide variety of application, from heating as well as air conditioning systems in a domestic, to chemical processing as well as power production in large plant. A heat exchanger in which two fluids exchange heat by coming into straight interaction called direct contact heat exchanger. Example of such kind is open feed water heaters, desuperheaters and jet condensers. Recuperators are heat exchangers in which the fluids are divided by a wall. The wall may be an easy level wall or tube or a complex arrangement comprising fins, baffles and tubes multiple passes.

2. Existing Research work

Many researchers perform different work to increases the heat transfer rate in a small heat exchanger. Much researcher work on the different types of fins used to increase heat transfer rate from the heat exchanger. Some of the work is conclude in the below section.

Lingdong Gu Yang et.al [1] (2017) Conducted Numerical analysis to examine the airside thermal-hydraulic individualities of bare tube bank as well as plain finned tube heat exchangers envisioned for aero-engine cooling purpose. The exchangers have insignificant diameter tubes (3.0 mm) with compact tube arrangement and functioning at high temperatures with huge changes in temperature above the exchanger depth. Evaluation are achieved for frontal air velocities between 4 and 18 m/s, airside transfer of heat and loss in pressure characteristics of bare tube bank as well as heat exchangers with plain finned tube are mathematically projected with attention of the air possessions disparities due to the air temperature change.

Erika et al [2] the analysis is about the use of dynamic evaluation of fluid studied about the plate heat exchanger which is at constant wall temperature and laminar steady flow of the non-Newtonian fluid and with as well as without use of one pass heat exchangers of U-type plate with several flat plates. They investigated about the transfer of heat and drop in pressure dissimilarity on quantity and the space amongst plates and by the improved Sieder–Tate expressions and initiate as the requirement of the Nusselt number on the Peclet number may be explained. The results has been generated from CFD are exactly fitted to an experiential relationship of the friction factors as an analysis of the comprehensive Reynolds number as well as the ratio among the friction individual, length and the length of the movement path.

Khoshkhoo et al [3] They performed experimental and numerical study and investigated that the effect of particle size on deposition in compact heat exchanger. The CFD modelled solved with the use of Reynolds-Averaged Navier-Stokes (RANS) equations, and discrete particle model (DPM) use for calculating particle motions with user define flow model deposition. The particle size varies from 1μm to 4mm for conducting experimental study and for numerical investigation they used particle size from 1μm to 100μm which is stored in A1 particle category of experiment. Numerical study results show that increases up to 50μm of particle size the particle deposition. Experimental results demonstrate enhancement of particle deposition pressure drop increases with increase of particle size.

Selma et al [4] In this present study deals with the investigation of the two-phase distribution and flow streams in a vertical compact heat exchanger placed at the bottom of the cold flow pilot plant and perform experimental and CFD simulation. 3-D volume of Fluid (VOF) model is taken for simulations are performed and results are compared with the experimental constraint. Water and air are taken as working fluids for simulation, and the velocities are varies at inside the distributor for air is 0.9–8.8 m/s and for water is 0.35–0.8 m/s.

Karel et al [5] This paper performed a comparative study of a numerical simulation with a experimental results. In the simulation work measured device is situated at a heat exchanger with a Centrifugal fan because of a fan the geometrical arrangement and stream flow is relative odd and so the heat transfer is difficult to calculate and also simulation is required time and cost affordable, so a standard k-ε turbulence model is use for the CFD. They suggested that similar flow conditions the model could disclose new construction improvements to increase or decrease the heat transfer, depends on the requirement.

Zhang et al [6] Investigated the instruments for heat transfer upgrade in parallel plate fin heat exchangers including the inline and stunned varieties of OSFs. They have likewise considered the impact of fin thickness and the time subordinate flow conduct because of the vortex shedding by solving the flimsy force and vitality condition. The impact of vortices, which are produced at the leading edge of the fins and travel downstream along the fin surface, was likewise considered. From that point think about they found that lone the surface interruptions increase the heat transfer since they cause the limit layers to begin intermittently on fin surfaces and lessen the warm protection from transfer heat between the fin surfaces and liquid. However, after a basic Reynolds number the flow ends up plainly shaky and in this administration the vortices assume a noteworthy part to increase the heat transfer by bringing the new liquids continuously from the main stream towards the fin surface.

Chunxin et al [7] Have investigated heat transfer normal for compact heat exchanger using test Information. Their outcomes demonstrate that utilized exploratory information would much be able to enhance the effectiveness of the framework plan and improvement to compact air-air heat exchangers qualities in every single working condition this papers shows a CAAHXs (common heat transfer) model. ECS ground simulation test-bed, the CAAHXs were tested with the use of results and shows that the general heat transfer model is analyse the heat transfer characteristic of CAAHXs in variable thermodynamic parameters and improve the system efficiency and design optimization.

Camilleri et al [8] They have investigated the flow dissemination in compact parallel flow heat exchangers and Results of their examination gives information about that the tube to header territory proportion is a dominant all inclusive factor for controlling mal-dispersion this paper provides the thermal designer with the time to simulate the stream separation in heat exchangers at a primary stage of design and examine the effects of different boundary condition, geometric condition and operational condition. With the help of many simulations find out the major causes of stream mal-distribution and heat exchanger parameters and performance are investigates.

Hossain et al [9] Have contemplated on plan and streamlining of compact heat exchangers to be retrofitted into a vehicle for heat recuperation from a diesel engine. The creators have done to improve the plan of the heat exchangers with computational liquid elements and ascertain the extra power this paper shows that of the current research was to design heat exchangers which needed to be pancake-shaped to be retrofitted into a vehicle. The as shell and U-tube type heat exchanger is selected for the simulation numerical simulations were performed out to improve the design of the heat exchangers and compute the added power that might be attainable by using these pancake-shaped heat exchangers to be optimized.

Hassan et al [10] Have ideally composed a plate fin heat exchanger using molecule swarm improvement calculation. In their work, the improvement was performed for the distinctive hot stream inlet temperatures for obtained sum up the outcomes. They have determined in their investigation that when the hot side inlet temperature is increased, add up to early cost increases. The author has chosen the reasonable number of segments in heat exchanger to calculate the details variation of properties and the optimized results are compared with traditional method and optimum results shows effectiveness reduced while total annual cost increases

Adina et al [11] They propose a performance assessment method for compact type transfer surfaces which consist of size of a cross flow heat exchanger for given fluids, temperature and flow rate values and the entropy generation rate observe is caused completely by changing the heat transfer surface and there is no other parameter is modified. The increase entropy number generation is selected to assess and re-examine the proposed procedure. They were discovered that the strategy proposed predicts likewise the Re esteem for which an inversion in the grouping happens.

Baghdar et al [12] Author investigated experimental and numerically method on compact heat exchanger and see the effect due to deposition particle size and to visualize the particle deposition to create an experimental setup and calculate the pressure drop across heat exchanger. Numerical study was performs on five fin straits. The fluent flow modelled is solved through Reynolds-Averaged Navier-Stokes equations, and particle motions was simulates by discrete phase model (DPM) with user defined function to model deposition. They conduct an Experiments on particle size over a range from 1x10-6 m to 4 mm and numerical investigation were done for particle size from (1 μm - 100 μm). Experimental and numerical results shows increase of particle size with pressure drop rises.

Lee et al. [13] The impacts caused in the general heat transfer coefficient, as an outcome of the adjustments in the separation amongst dimples and it was demonstrated tentatively that the separations between the dimples diminishes as much as the general heat transfer coefficient increases. For calculation the Reynolds number are varied for channel section is about to 30000 to 50000 and for heat transfer measurement transient liquid crystal technique is used. Proposed that the thermal performance and heat transfer coefficient factors are higher for the lower channel.

Tang et al [14] In the present paper they did investigation through experimentally on fin-and-tube heat exchangers with the Reynolds number varies from 4000 to 10000,and the optimization of heat exchanger with vortex generator(VGs) is also addressed and at high Reynolds numbers, best heat transfer performance achieved by slit fin heat exchanger. The high angle of attack, low height and higher length of vortex generators will lead to better overall performance of heat exchangers with VGs. The optimized vortex-generator fin can provide better heat transfer performance than slit fin.

Anurjew et al. [15] investigated different micro structure cross flow heat exchangers and thought about their warm exhibitions. The power transfer per unit volume is directly proportional to the function of heat source and heat sink for better heat transfer lesser will be the distance. They found that heat transfer can be upgraded by decreasing the pressure driven distance across of the micro channels and in their work also emphasize on the electrically heated micro channel.

Hasan et al. [16] Investigated the counter flow of micro channel heat exchanger with various channel cross-segments, for example, round, rectangular, square, trapezoidal and iso-triangular. They found that for a similar volume of a heat exchanger, increasing the number of channels prompt increase in both viability and weight drop. They additionally found that roundabout channels give the best execution (Thermal and water powered) among other channel shapes.

Mirkovic et. al [17] investigated the heat transfer and weight drop in an eight-push profound stunned tube package for the two tube measurements 38.1mm and 50.8 mm with steady transverse and longitudinal tube pitches. The tube breadth just was changed while different parameters, for example, the fin tallness and fin spacing were kept steady in his investigation. Creator reasoned that when the tube distance across increases, the wake locale behind the tube will increase and the air-side weight drop will rise

Peterson et. al [18] performed trial investigations in rectangular micro channel. They found that that cross-sectional viewpoint proportion had critical influence on the convective heat transfer and weight drop in laminar and turbulent flows.

Sopian et al. [19] It examined the entropy age in outside fluid moves over a surface of parallel microchannel. They generate the amount of entropy age dependably diminishes with increasing slip length. For inline collection, the extreme significance of Nusselt number for the first row about the surface of the tube is more than that for the flabbergasted arrangement; there are two confined limits for rows 2-4, For a flabbergasted arrangement, two dimensional prototype for a simple tube package overvalues the ordinary Nusselt number, although, for an inline arrangement, the reverse tendency is correct. It is as well originated as the number of tube row has a slight impact on the normal coefficient of heat transfer as the row numbers are more than four.

Abbassi et. al [20] investigated the entropy age in a consistently heated micro channel heat sink. They utilized Darcy condition (a permeable medium model) for liquid flow and two-condition demonstrate for heat transfer. They found an ideal incentive for porosity at which entropy age achieves its minimum esteem.

Hwan et. al [21] investigated that the execution loss of microchannel during frosting and defrosting cycles. They likewise discovered uniform ice development between the front and back side of microchannel and give better warm execution.

3. Conclusion

After going through the literature survey it is observed that performance of heat exchanger depends on the different parameters. Many of the researchers have optimized the different parameters. Heat exchangers used in the aerospace industry are mainly small and highly efficient. It is very important to consider the size of heat exchanger while using it in the airplane industries. Following conclusion drawn from the survey

- Heat transfer rate depends on the flow pattern of heat exchanger.
- Performance of heat exchanger also depends on the heat transfer through the fins and mass flow rate inside the tube in the shell and tube type heat exchanger.
- Heat exchanger used in aerospace industry uses the different pitch distance in between the tube row to increase heat transfer many of the researcher have done some work but no one have find the optimize distance on which heat transfer get better.
- In addition, some of the researcher has changed the shape of fins to enhance the heat transfer rate but no one has analyzed the thickness of fins.

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