A REVIEW ON DIFFERENT METHODS AND OPTIMIZATION OF DIFFERENT PROCESS PARAMETERS OF HEAT EXCHANGER

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***Abstract*: Economic reasons (material and energy saving) leads to make efforts for making more efficient heat exchange. The heat transfer enhancement techniques are widely used in many applications in the heating process to make possible reduction in weight and size or enhance the performance of heat exchangers. The use of Process Integration in heat transfer enhancement has many benefits. First, enhanced heat exchangers require less heat transfer area for a given heat duty because of higher heat transfer coefficients. Second, the heat transfer capacity for the given heat exchanger can be increased without changing physical size of the exchanger. This paper provides some methods for increasing shell and tube and compact exchanger's performance. These techniques are classified as active and passive techniques. The active technique required external power while the passive technique does not need any external power.**

1. Introduction

Heat exchangers are actually the crucial engineering units that has enormous array of applications incorporating nuclear reactors, cement producing factories, refrigeration and air-conditioning related systems, power plants, systems concerning heat recovery, chemical handling and food sectors. Helical coil arrangement is certainly incredibly competent for chemical reactors and simply heat exchangerssince they can certainly deal with a significant heat transfer area through a compact space, with enormous heat transfer coefficients. Heat exchange is definitely a vital unit operation which usually leads to efficiency and so essential safety concerning various techniques. A heat exchanger is usually a device employed to transfer heat amongst a solid object and simply a fluid or between two or even more fluids. The fluids could possibly be segregated by a solid wall to eliminate mixing or they may possibly be in direct contact. The rate by which heat transfers is reliant on the conductivity concerning the separating wall and then convective heat transfer coefficient between the wall and simply fluids. The heat transfer rate likewise deviates reckoning on the boundary circumstances that include adiabatic as well as insulated wall conditions.

2. Turbulator

A turbulator is equipment which usually spins a laminar flow towards a turbulent flow. Turbulent flow can easily be preferred on hardware associated with surface of an aircraft wing (air foil) or in commercial functions including heat exchangers and so the mixing of fluids. The terminology "turbulator" is utilized to an assortment of tasks and is employed as a offshoot of the phrase turbulent. Turbulators are actually engineered to generate and simply preserve turbulent flow and then support to strengthen the tube-region heat transfer effectiveness. A turbulator is a gadget which in turn is introduced upon the tube region of fire tube boilers, shell Along with tube heat exchangers and several other versions of heat transfer hardware or equipment.

3. Uses of Turbulators

A turbulator breaches up, retards and then diverts laminar key concerning fluids (whatever the circumstance might be) and so assists that can strengthen heat transfer efficiency. In actual fact, a turbulator will certainly enable all of us which can perform the comparable task employing reduced energy source.

- Angular turbulators attain which can strengthen heat transfer effectiveness for fire-tube boilers and as well, several other identical heat exchange apparatus.
- Coiled Rod or simply Spring Turbulators Strengthen heat transfer functionality through tubular heat exchange accessories.
- Would not affect central heating boiler or simply heat exchangers.
- It eradicates laminar flow and then encourages turbulence.
- It rises up heat transfer effectiveness.
- Cost effective.
- The key tasks of a baffle in shell and simply tube heat exchanger are actually to keep tubes in position (controlling sagging), simultaneously in production as well as, operation.

4. Existing Research

Many researchers have performed different work on heat transfer and optimize the different process parameters of heat exchanger. People optimize the different process parameters of heat exchanger; some of the research work is conclude here.

1. Patidar et.al (2018) Heat transfer rate in a heat exchange may also be increased with the aid of some effective or passive technique of enhancement of heat level since it gives a essential role in a number of industries. The motive from this paper is usually to examine the outcome of baffled twisted tape inserts and change in heat transfer rate in a heat exchanger. Twisted tape can be

utilized as the passive methods to improve the functionality of a heat exchanger and now era there exists a scope of even more in this field for the improvement of heat transfer and that of pressure drop with different selection of Nusselt number, Prandtl number. Modified triangular baffled twist-straight turbulators support in the improvement of heat exchanger's efficiency.

2. Singh et.al (2018) Energy is definitely primary input necessary to sustain the development of any nation. Usage of solar technology to replace it all into heat energy by solar air flow heater is usually one of these. But the thermal effectiveness of a solar air-flow heater is available to be considerably low. Thus, to be able to enhance the effectiveness of a solar air-flow heater, the technique of using artificial roughness on heat transfer plate is recognized as effective strategy to improve the thermal efficiency. The goal associated with this paper is normally to examine various studies where different artificial roughness is accustomed to improve the level of heat transfer and thermal effectiveness of the solar air-flow heater.

3. Qiao Yan et.al (2018) through this paper, the startup and heat transfer features of a gravity-actuated individual heat pipe (GASHP) system had been experimentally investigated, including its evaporator section. Two lightweight aluminum microchannel evaporators that has different channel size had been studied and the charging ratio involved with this paper was primarily 60%. The outcomes showed that heat load on evaporator, the total outcomes showed that heat load on evaporator, the air temp and air velocity moving over condenser experienced significant influences on the startup characteristics, stability of procedure and heat transfer overall performance. According to the top features of startup procedure, it was split into three stages. It had been discovered that there existed entrainment phenomenon at lower heat loads, which led to a short-term fluctuation of pressure difference between evaporator and condenser, which led to a short-term fluctuation of pressure difference between condenser and evaporator, which effect will be weakened at higher high loads. The evaluation of both evaporators indicated that the channel period had an important influence on heat transfer, which in turn was primarily induced by the various vapor quality within the microchannel, which was caused by the various vapor quality within the microchannel mainly. Microchannel evaporator with shorter stations showed a better functionality than that with much longer ones.

4. Surywanshi et.al (2017) Heat exchanger process in industrial in addition to application in engineering is very popular. This paper was aimed at heat transfer enhancement of heat exchanger utilizing helical strip in circular pipe with operating fluid as standard water. This geometry really helps to generates swirl movement of fluid stream and disturbs that boundary layer which will raise the effective surface area, residence time, reduce pressure drop and increase heat transfer coefficient. As compared with simple pipe and twisted pipe, heat transfer rate raises up to 50% to 70%. However in other part pressure drop also raises up to 90 % significantly because of huge turbulence stream. In the event of different twist ratio, as twist ratio increases heat transfer coefficient as well as pressure drop both increases concurrently.

5. Zhouhang Li et.al (2017) helical coils received considerably significance in the field of supercritical carbon dioxide (SCCO2) Rankine cycle. The reason for that is small structure and huge heat transfer level. Effects of coils orientations and as well inner rib roughness on heat transfer created by crucial greenhouse emission (SCCO2) are investigated in helically helical tubes with totally different dimensionless curvature d. The orientation result on performance of coiled coils was discovered with the coil axis organized in horizontal, vertically upward and downward directions, severally. The capability of horizontal coils became abundant severe than vertical coils, amongst that downward orientation became somewhat higher when compared to upward one. The gravitational buoyancy effect was more significant in horizontal coils than in vertical coils, and far smaller than that in straight tubes. The Mixed convection heat transfer of SCCO2 in coiled coils can be enhanced by approaching inner ribs, particularly within the horizontal orientation wherever buoyancy evoked degradation was enormously restrained in evaluation with the straight tubes.

6. Pawar et.al (2016) this paper specialize in the experimental investigation for shell and tube heat exchanger by working with completely different sort of baffles. The shell and simply tube heat exchanger that has segmental baffles as well as flower baffles are actually fabricated, made-up and tested. When a shell and simply tube heat exchanger compare to segmental and helical baffle, it can be seen that flower baffle provides higher thermal functionality and hydraulic performance. Additionally it is straightforward to produce flower baffles in comparison to helical baffle. The thermal functionality and hydraulic overall performance of each heat exchangers are actually be compared with same operational conditions. Heat exchanger that has flower baffle provides a lot of economical overall performance up to 25% to 32% when compared to segmental baffles. Additionally pressure drop should get minimized in flower baffle heat exchanger up to 20%-28% when compared to heat exchanger that has segmental baffles.

7. Sheikholeslami et.al (2016) hydrothermal evaluation of turbulent in a very double pipe heat exchanger is conferred through an experiment with the help of forced convection method. Perforated turbulators are used into annulus section. Hot water transfers heat to the cold air in outer tube. Numerous ranges pertaining to pitch ratio, Reynolds number and then open area ratio are actually considered. Examination of Correlations intended for Nusselt number, Darcy friction factor and then thermal functionality has been done. NSGA II is used in order to maximize the model. Physical trends are displayed by that of FVM. Outcomes reveal that thermal overall performance promotes with augment from open area ratio. Maximum significance of thermal performance attained at g = 1.59 that is appeared for Re ¼ 6000; k ¼ 0:07; PR ¼ 1:06.

8. Murthy et.al (2016) this paper has presented a review on passive ways that are utilized in order to boost the heat transfer overall performance. The convective heat transfer may be maximized by insertion of swirl flow equipment or metallic inserts because of establishment of swirl in the fluid motion and distressing the boundary layer at the tube surface because of continual changes within the surface geometry. Such devices induce turbulence and vortex motion that produces a slimmer boundary layer and hence leads

to more significant heat transfer coefficient and better Nusselt number mainly because of the variations within the twisted tape geometry. However, the pressure drop within the tube is enhanced by introducing the twisted- tape insert.

9. Serageldin et.al (2016) through this paper, the temperature distribution of moving air by using horizontal Earth-Air Heat Exchanger (EAHE) has been experimentally analyzed. A mathematical model depending on unsteady, one- dimensional and quasi-state energy conservation equation developed for flowing fluid. The outcome of pipe diameter, pipe length, pipe space, pipe material and then streaming fluid velocity are investigated. As pipe diameter increased the air temperatures decreased. This due to the increment in heat transfer surface area. As pipe length will increase, outlet air temperature will also increase. That can certainly delivered to a longer period the flowing air consumes thermal energy exchange with neighboring soil. As a result, the increment in fluid velocity decreases the heat transfer rate by soil to flowing air as the residence time necessary for thermal energy exchange proportionally minimize.

10. Roslim et.al (2015) This report accounts the analyses upon the consequences of porous twisted plate such as an insert to actually reinforce heat transfer overall performance and flow characteristic for a single fitted tube. That porous twisted plate that have three completely distinct numbers of holes (1Hole, 2Holes and 3Holes) having 4mm diameter on every phase was designed. The end results reveal the fact that making of holes modified the flow profile and so creating secondary flow and getting close to turbulence flow. Porous twisted plate in addition to larger numbers of holes enhance heat transfer rate when compared to simple plain tube and then plain twisted plate. Moreover, the rate of the flow was enhanced and permitting a lot of fluid mixture within the tube so offer a lot of heat transfer across the tube. The heat transfer constant was higher for porous extent, followed by plain twisted plate and plain tube without insert.

11. Bandos et.al (2015) a remedy to the specific cylinder-source model meant for the ground heat exchangers at distinct buried depths which usually considers the heat capacity within them and then enables arbitrary heat rate alterations is certainly proclaimed. Analytical expressions intended for usual ground temperature are actually extracted simply by integrating the precise solutions more than the cylinder-source depth just for vertical and then time-dependent alterations concerning heat rate. The impact involved with buried depth modifications on thermal response to actually a continual and then uniform mean heat rate of the cylinder-resource is analyzed by means of the essential mean temperature approach through a self-consistent methodology. Furthermore, estimated expressions intended for steady-state mean temperature are made pertaining to intermittent heat rate during the prolonged time limit.

12. Wang et.al (2015) in this investigation, a layer assignment design model and layer arrangement optimizations model for MPFHEs are established supported the synthesizing approach concerning hot as well as cold streams and therefore the equipartition entropy production methodology, severally. The temperature difference and then pressure drop are unveiled into the optimizations model of the corresponding layer arrangement ring, by means of that the influence of the pressure drop regarding the MPFHEs is taken into account with the heat transfer efficiency. In MPFHEs equi-partition created by entropy formation is unveiled into the planning involved with layer arrangement. To acquire the rate of entropy generation per unit area the boundary conditions of every single layer are calculated by dynamic fin structure, rate of flow and layer variety. Consistent with the two cases for the air separation unit, the best thermal efficiencies of MPFHEs obtained by the combined methodology projected during this paper are all beyond 98, that is usually more significant higher than that of the general industrial style.

13. Mohamed et.al (2015) Heat transfer improvement by exploitation Cu-water Nano fluid in a very horizontal rotating tube heat exchanger associated with counter flow is normally examined through an experiment. The hot fluid is water, and the cold fluid is copper nanoparticles dispersing in a very base fluid (water). The outcomes reveal that the enhancement in motion speed of inner tube led to increasing the heat transfer rate and also the effectiveness of heat exchanger. Impact of heat transfer for Nano fluid is more than base fluid (water).Consequently rate of heat transfer and then transfer number unit (NTU) increase with increasing Cu-water Nano fluid concentration.

14. Vahidifar et.al (2014) this paper studies the characteristics of heat transfer concerning double pipe horizontal tube heat exchanger and therefore the pressure drop associated with inserted wire coils and then rings. Wire coil being a swirl flow will increase turbulence and then roughness although rings speed up heat transfer being a promoter pertaining to turbulence and then roughness. When associate target is certainly positioned through a very boundary layer that influence the entire flow structure and then varies the speed and thermal profiles. In most liquids during which the density is reduced relative to the temperature, the force transfers the heated fluid from the physical phenomenon towards the tube axis that will increase the heat transfer. With reference to heat transfer and so friction, wire coils show superior performance than rings.

15. M. Hussein et.al (2014) Heat transfer features and so friction characteristics seemed to be numerically inquired, using elliptical tube to extend the heat transfer level accompanied by least boost of pressure drop. The rate of flow of the tube was during a vary of Reynolds range between 10000 and 100000. FLUENT software system is normally employed to resolve the governing equation of CFD (continuity, momentum and energy) by means of a finite volume method (FVM). Electrical heating system is linked in around elliptical tube which can incorporated consistent heat flux (3000 W/m2 seeing that boundary condition. Finally the CFD statistical outcomes reveal that the elliptical tube will certainly strengthen heat transfer and so friction concern by means of close to 9 % and 6 % when compared to the circular tube severally. The concentration of volume (1%) of TiO2 nanofluid has the finest Nusselt

number and then friction factor values. The outcomes exhibit that Nusselt number well as friction factor boost because of| reducing diameters however strengthening volume concentrations concerning nanoparticles.

16. Freidoonimeh et.al (2014) in this observe, PHAM (Predictor Homotopy Analysis Method) as a brand new analytical method became applied to resolve the hassle of MHD Jeffery–Hamel nanofluids flow with regard to non-parallel walls for the divergent and convergent channels. This carried out approach may be very powerful especially for those boundary price problems which admit more than one solutions and is also capable to calculate all branches of the solutions simultaneously. It became determined that the twin solutions existed for the convergent channel cases ($\alpha = -1$). The fluid inside the non-parallel partitions, convergent and simply divergent channels, can be the ingesting water comprising distinct nanoparticles copper oxide (CuO), silver (Ag) and copper (Cu).The results of take a look at were as compared with the numerical answer received the usage of the capturing approach, coupled with a Runge-Kutta scheme.

17. Lahiri et.al (2013) The paper has demonstrated successful application of hybrid DEACO technique for the best design concerning shell and so tube heat exchanger from economic purpose of view. The hybrid DEACO technique boosts the relevance of the de technique and converges quickly than individual DE or ACO formula. The given DEACO technique is straightforward in thought, few in parameters, and simple for implementations. The improvement procedure involves the choice of the main geometric parameters similar to tube length, tube dia, baffle spacing, baffle cut, array of tube passes, layout concerning tube, sort of head, and so on, and reduction of total annual price is taken into account as design target.

18. Patel et.al (2013) Heat exchanger associated with double pipe is one among simplest form of heat exchanger, typically used for the aim of wise heating or cooling. Heat exchanger running at industry is with fix mass rate and intention concerning this work to enhance the performance of heat exchanger. Sensible results are valid with ANSYS 14 CFX software system and it is in acceptable limits. Because the mass rate will increase, fluid velocity, Reynolds number, Nusselt number, heat transfer coefficient additionally increases, however friction factor decreases. The pressure drop will increase sharply by the spike in mass rate. Overall heat transfer additionally will increase because the mass rate will increase. When solely heat transfer capability of heat exchanger is criteria despite pressure drop and pumping power, heat exchanger with fins is a lot of superior as compared easy heat exchanger.

19. Gheorghian et.al (2013) the generation rate per unit volume related with entropy is composed of two expressions, the primary term accounts for heat conductivity because of a temperature gradient and the second accounts for viscos dissipation. The entropy generation profile along with temperature and velocity profiles completes the thermodynamically description of heat transfer through convention within circular tubes. The entropy generation within the tube axis is zero as a total result concerning temperature and so velocity gradients are zero within the center of the tube. On the opposite hand, the interior tube surface acts as a robust entropy generator. As viscosity effects intensify, most of the entropy generation profile alteration closer to tube wall. The optimum tube diameter for laminar flow should be massive enough so the rate concerning entropy generation is especially dominated by heat transfer across finite temperature variations. In the case of turbulent flow, for a given range, the optimum tube diameter decreases because the design parameter of heat exchanger will increase.

20. Martín et.al (2012) Enhancement techniques may be applied to flat-plate liquid solar collectors towards a lot of compact and economical designs. . For the standard in operation mass flow rates in flat-plate solar collectors, the foremost appropriate technique is inserted devices. This inserted device delivers higher leads to transitional, laminar and low turbulence fluid flow regimes. To check the improved solar collector and then compare by way of typical one, a solution side-by-side solar collector workplace was designed and created. The testing originated was absolutely designed following the necessities of EN12975-2 and permit us to execute overall performance checks beneath a similar in operation conditions (mass flow, fluid temperature inlet and weather conditions) the improved collector was changed placing spiral wire coils concerning dimensionless wire-diameter e/D=0.0717 and pitch p/D=1 and. The friction factor concerning each tube has been estimated from pressure drop checks throughout solar collectors. The thermal functionality curves concerning each solar collectors, a typical and an increased collector, are bestowed. The improved solar collector will increase the thermal efficiency by 15%.

21. Seemawute et.al (2012) creation of flow features stimulated by the way of twisted tape consisting about alternate-axis (TA) continuous to be relatively investigated to it stimulated by typical twisted tape (TT). The visual image was applied with the aid of dye injection technique. The results of twist ratios (y/W) regarding heat transfer and so fluid friction appeared to be additionally extensively examined. It is certainly found that the tube with TA provides a more robust fluid mixture within the tube than those TT that ends up in huge rate concerning heat transfer and so additionally friction factor. At an equivalent axial distance, the tape with smaller twist ratio provides a lot of swirl number and therefore longer residence time that facilitate to prolong heat transfer between tube wall and fluid.

22. Zohir et.al (2012) The impacts concerning insulating wires (behaving as turbulators simply), by the way of circular cross section involved with 2mm diameter, forming a coil of various pitches regarding heat transfer rates are actually experimentally explored. The study is started performing to get turbulent water stream during an exceedingly double-pipe associated with heat exchanger to get each parallel and counter flows associated with cold water within the shell part. The tests are performed intended for flows consisting of Reynolds numbers starting by 4,000 to 14,000. The tests outcomes demonstrate that the utilization of coiling circular wire turbulators benefits in significant increase for heat transfer over those of a smooth wall tube. The mean Nusselt number will strengthen with the enhancement of Reynolds number, also the increasing of pitch for each parallel and counter flows. The

convective heat transfer coefficient intended for the turbulent flow was found to extend with turbulators for all coiling wire pitch values with the highest improvement of regarding 450% for the counter flow whereas it had been 400th for the parallel one.

23. Ozceyhan et.al (2008) the basic objective concerning this review is to evaluate the pressure drop and so heat transfer by means of inserting circular cross sectional rings in tube. A numerical study is started performing to identify the effect of attaching the rings near the wall and the ring spacing regarding friction features and so heat transfer within the array of Reynolds number from 4475 to 43725. In this study constant pumping power criterion is used to evaluate the overall performance of five different cases (p = d/2, d, 3d/2, 2d and 3d). For all cases, Nusselt number will increase and friction factor reduces by the way of increasing Reynolds number. The very best Nusselt number along with friction factor is obtained within the case of p = d/2. The entire enhancement ratio will increase with increasing ring spacing. Therefore, the most effective overall enhancement of 18% was achieved for Re = 15,600 within which the spacing between the rings is 3d.

24.Promvonge et.al (2007) Heat transfer, friction factor and so enhancement efficiency characteristics in a circular tube built with conical-ring turbulators and a twisted-tape swirl creator are explored by using an experiment. The heat transfer evaluation section is excited electrically impacting axially and circumferentially constant wall heat flux boundary circumstances. Within the experiments, two improvement heat transfer devices are utilized. One particular is the conical-ring employed as a turbulator and then positioned within the proven tube and also the different is that twisted-tape swirl generator positioned in the core of the conical-ring. Air since the analyzed fluid is exceeded throughout each enhancement devices in a very Reynolds number ranging from 6000 to 26,000. Two twisted-tapes of altered twist ratios, Y = 3.75, and 7.5 are unveiled through each individual run.

5. Conclusion

- It is found that the value of heat transfer depends on different parameters of heat exchanger.
- Different types of baffles were used to increase the performance of heat exchanger.
- Heat transfer rate depends on the mass flow rate of working fluid and it also depends on the temperature of working fluid at the inlet of heat exchanger.
- Heat transfer also depends on the type of flow behavior of working fluid inside the heat exchanger, different types of baffles were used to enhance the flow of working fluid so that heat transfer get enhance.

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