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Investigation of Improve The Performance Analysed In Heat Transfer Enhancement Methods and Techniques With Optimization Utilized In Espresso Machine –Review

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Abstract

In these review paper different types, position, design of heat exchanger Espresso Coffee machine in food processing industry. In this causes were apply numerical analysis techniques of Heat transfer system belonging Heat exchanger consider quality suggested in of espresso coffee (EC) depends upon certain technical Forms, Like as the Heat transfer process are considering it reviewed. The Heat transfer system was study is decide Espresso machine while applied computational fluid dynamic analysis which one reduces a large amount of heat transfer level and back pressure ,velocity of heat exchanger design was analysed Finite-element approaches and experimentally are considered in the time and heat frequency domains validated in our main scope . In muffler designing are imported the different analysed tools with techniques find it, There is different operating parameter which has to taken in to the consideration from numerically and experimentally. These operating parameters affect the muffler efficiency was Perforated elements and sudden area changes can be studied by means of 3D analyses that incorporate both dissipative and turbulent flow and non turbulent effects are consider it. Active heat transfer systems are shown to be an effective alternative to Espresso coffee machine for the systems discussed.

Keywords: Food Industry, Espresso Coffee machine, Heat transfer, Review.

Introduction

The espresso coffee machine is intended for professional use. It is designed to prepare hot drinks such as tea, cappuccino, coffee (at various strengths and volumes) and espresso. Additional accessories are available which have been designed for optimum use of the machine. If the machine has two or more groups, it can be operated by two or more persons at the same time. These characteristics considering Figure 1.1 Espresso machine assemblies, together with the fact that the machine is capable of non-stop preparation of drinks, guarantee extensive and efficient use.

The taste and the flavour of a well-made espresso coffee represent a central issue in several countries and civilizations. The know-how which underlies this problem has been considered for some time an artistic talent belonging to few esoteric people. When it became clear that the pleasure of good coffee could not be confined within the borders of some regions of Italy, it was necessary to identify in a more objective way the secrets of this art. Then, studies were promoted in two main directions: the chemical and physical processes which occur when the hot water percolates along the coffee filter, and the optimization of the thermal design of an Espresso-Coffee Machine (ECM) which operates in very different load conditions. This latter point is the subject of the present paper. Schematically, an ECM injects hot water into the coffee filter; for best result the water temperature must be confined within a narrow range around 90°C. The water demand alternates from active phases (corresponding to the coffee percolation) to idle phases (no coffee delivery). It should be noted that the duration of the idle phases is not predictable. The system should meet the requirements of low cost and high reliability; in this perspective in most of the commercial machines the use of sophisticated sensors and actuators has been avoided.

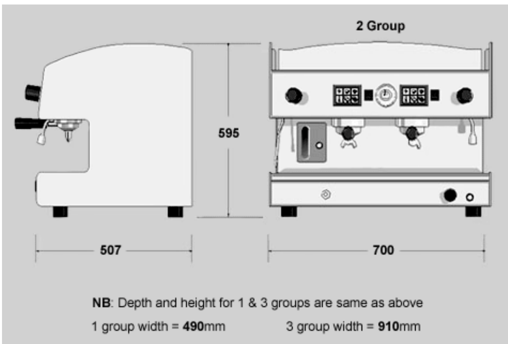

Figure 1.1: Espresso Machine Assemblies

1.Boiler level window 2.Gauge 3.Steam Gauge 4.Steam Nozzle 5.2-Cup filter Holder 6.Adjustable Foot7.Hot water Dispensing spout 8.Gas burner Dispensing Window 9.1-2cup filter 10.Gas safety 11.Gas ignition push button 12.machine main Switch 13.cup rest grille 14.machine or indicator light 15.hot water konp 16.lever group 17.manual delivery switches 18. push button manuals.

Types of Espresso Machine

Espresso machines can be broadly classified in to three types based on the boiler arrangement in the machines. Each machine has its own advantages and disadvantages based on the usage of the machines but most of the commercial machines use twin boiler system for the efficient functioning of the machine. The three types of machine are as follows,

- Single boiler
- Single boiler, heat exchanger
- Double boiler.

The differences in the operation are clearly explained below based on the preparation of both the espresso and the milk as the milk is prepared at a certain temperature higher than the temperature required brewing the coffee beans for the espresso. So it is vital to operate and maintain the required temperature for both the conditions.

Working Process Espresso Machine

This section is what could be termed the cool side of the machine; it will contain the cold water tank (or possibly mains water inlet on a plumbed machine). Its task is to provide water at the correct pressure to the rest of the espresso machine.

The pump can be either a Vibration pump or a rotary pump. Its sole purpose is to pump water at high pressure (9 or 10 bar).The water is drawn from the cold water tank, into the vibration pump, and through a device called an OPV (pressure release valve) which lowers its pressure. OPV has a tube leading back to the cold water tank, because to regulate water pressure down to 9 or 10 bar, it has to allow some of the water back to the tank rather than into the machine. The water now passes from the OPV to the rest of the machine; this water can now only exert a maximum static pressure of 9 or 10 bar. It next comes to something called an “Auto fill Solenoid”. The “Auto fill Solenoid” has two positions as shown in figure1.2.Espresso machine working process.

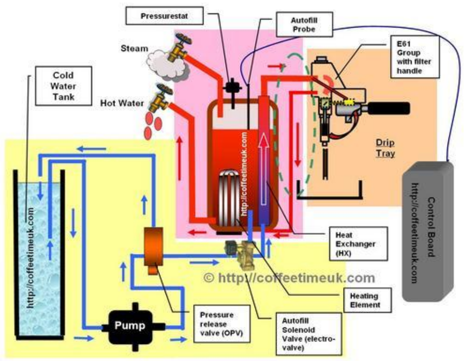

Figure 1.2: Espresso Machine Working Process

- Water is directed to the E61 group (via the HX) for making coffee (normally in this position)
- Water is directed into the main boiler to refill e.g. after steaming, or using hot water.

Techniques Handling Heat Transfer

The development of high-performance thermal systems has increased interest in heat transfer enhancement techniques. The high thermal performance enhancement of heat exchanger systems is needed to use energy source efficiently due to the sky-rocketing prices of petroleum and coal fuels. Heat exchangers are widely used in industry both for cooling and heating. Insertion of turbulators in the flow passage is one of the favorable passive heat transfer augmentation techniques due to their advantages of easy fabrication, operation as well as low maintenance. The purpose of this review presents the effect of twisted tape tabulators on the heat transfer enhancement inside heat exchanger, pressure drop, flow friction and thermal performance factor characteristics in a heat exchanger tube.

The twisted tape turbulator is a device for increasing the heat transfer rate in the heat exchanger system. The widely employed in several industrial and engineering applications of heat exchanger are automobile, refrigerators, solar collector, heat engine, air conditions, thermal power plant, electronic cooling, milk plant, chemical process industries etc. heat transfer enhancement using different type of the turbulators placed in the tube has been extensively studied for the past decade among the both passive and active technique are compile in this review.

Techniques Handling Heat Transfer Encasement Areas

Active Technique: This Technique involves some external power input for the enhancement of heat transfer; some examples of active Techniques include induced pulsation by cams and reciprocating plungers, the use of a magnetic field to disturb the seeded light particles in a flowing stream, fluid vibration, jet impingement etc.

Passive Technique: These Techniques generally use surface or geometrical modifications to the flow channel by incorporating inserts or additional devices. For example, use of inserts, use of rough surfaces, extended surface etc.

Compound Technique: When any two or more techniques employed simultaneously to obtain enhancement in heat transfer that is greater than that produced by either of them when used individually, is termed as compound enhancement .This technique involves complex design and hence has limited application.

Futilely Following Techniques Are Used Generally Used

1. Extended surface
2. Use of Additives

3. Inserts

Extended Surface
Extended or finned surfaces increase the heat transfer area which could be very effective in case of fluids with low heat transfer coefficients. This technique includes finned tube for shell & tube exchangers, plate fins for compact heat exchanger and finned heat sinks for electronic cooling. Finned surfaces enhance heat transfer in natural or forced convection which can be used for cooling of electrical and electronic devices. Plate fin or tube and plate fin type of compact heat exchangers, where the finned surfaces provide a very large surface area density, are used increasingly in many automotive, waste heat recovery, refrigeration and air conditioning , cryogenic, propulsion system and other heat recuperative applications. A variety of extended surfaces typically used include offset strip fins, louvered fins, perforated fins and wavy fins.

Use of Additives
Pressure drop in tube flow is consequence of the frictional losses with solid surface. The frictional loss occurs because of the drag force of fluid. This technique is basically concerned with reducing the drag coefficient using some additives to fluid in single phase flows. Additives when added to fluids are found to have operational benefits by lowering the frictional losses. Polymeric additives induce a viscoelastic characteristic to solution which promotes secondary circulation in bulk flow.

Inserts
Inserts refer to the additional arrangements made as an obstacle to fluid flow so as to augment heat transfer. Different types of inserts are

1. Twisted tape and wire coils
2. Ribs, Baffles, plates

Ribs & Baffles
The present paper Contributes for review of Ribs, baffle in duct and insert in tube.

Survey- Literature Review

Susana Andueza[1]The final quality of espresso coffee (EC) depends upon certain technical conditions, such as the extraction temperature used in preparing it. The aim of this work was to investigate the effects of water temperature (88, 92, 96 and 98°C) on the final quality of three types of EC (Arabica, Robusta Natural blend and Robusta Torrefacto blend) in order to select the optimal temperature. Volatile compound (analysed by Static headspace gas chromatography/mass spectrometry) and sensory flavour profiles were the most relevant parameters, whereas physicochemical, taste and mouthfeel parameters were not very useful for selecting the water temperature. For Arabica and Robusta Natural blend ECs, 92°C was the optimal water temperature. For Robusta Torrefacto blend EC the overall acceptability might lead to the selection of 88°C as the ideal water temperature, but the high percentages of key odorants related to roasty and earthy/musty flavours and the ‘not hot enough’ perception dictated the selection of 92°C in this case as well.

Giovanni Caprioli [2] The aroma profile and the final quality of espresso coffee (EC) are influenced by such technical conditions as the EC machine extraction temperature and the pressure used. The effect of these two parameters on EC quality were studied in combination by headspace solid phase micro extraction–gas chromatography– mass spectrometry (SPME-GC–MS) and sensory profile. Moreover, 10 key odorants at the best EC machine settings were examined to compare the two coffee cultivars (Arabica and Robusta) and two EC machines [Aurelia Competizione (A) and Leva Arduino (B)]. The data obtained provides important information about espresso making technique, suggesting that the usual espresso machine temperature and pressure settings (i.e. 92 C and 9 bar) are very close to those needed to obtain the best quality espresso. This confirms the traditional wisdom of coffee making, which judges 25 ml, the typical volume of a certified Italian EC, to be ideal for very strong aroma intensity.

Angelo Fabbri [3]Nowadays roasters are equipped with electric control board, thermo-regulator device, display for temperatures and on-line sensors to detect defects and/or the roasting end, depending on coffee types and blends and the desired roasting degree. It is important to have a good control of the roasting process in order to obtain a high quality final beverage. In this work a numerical model, based on a 3D digitized geometry, able to describe the heat and moisture transfer inside a coffee bean during the roasting process, was developed. The model makes reference to a rotating cylinder roaster in natural convection conditions. For the multiphysics model development heat and mass transfer equations inside the coffee bean were numerically solved using a finite element technique. To validate the numerical model, green coffee bean was singularly roasted using a rotating drum roasters prototype. The calculated moisture concentration and time-temperature curves were then compared with the observed data. The calculated temperature values, in the centre of the bean, appear to be in good agreement with those measured inserting thermocouples into the coffee bean (RMSE 6°C). Similarly the calculated volume averaged moisture was in good agreement with the experimental data (RMSE 265 mol/m3) over the entire time span. This model can be useful to optimise the roasting process control.

R. Tauscher, F. Mayinger, [4]: This paper deals with experimental and numerical investigation of the forced convective heat transfer in flat channels with rectangular cross section. To enhance the heat transfer, rib roughened surfaces are applied to the wider walls of the duct. Various rib shapes, rib spacing and rib arrangement have been investigated. Temperature fields and velocity fields in the heat exchanger channel were obtained by holographic interferometer and laser droppler anemometry, enabling measurement of the thermo hydraulic behavior of the flow without disturbing the flow pattern in the channel. By measuring the mean fluid temperature at the entrance and the exit of the test section as well as the pressure drop, the mean heat transfer and the heat exchanger performance could be judged. Simultaneously with the experimental investigations numerical calculations with a commercial code (TASCflow3D) have been performed.

Monsak Pimsarn,et al, [5]: Experiment is focused on the design of the suitable ribs used for enhancing heat transfer in a rectangular duct heat exchanger by using wall heat transfer (Nusselt number), friction loss (friction factor) and thermal performance (thermalenhancement factor) data. The Z-shaped ribs were set on the rectangular duct at 30°,45° and 60° and flat rib was set at 90° relative to the air flow direction. Reynolds numbers studied ranging from 5000 to 25,000 in the test section. The rectangular duct has aspect ratio(ratio of width to height) AR = 10 and height, H = 30 mm with the Zrib height (e), elH = 0.2 and the rib pitch (P), PIH = 3. The ribs were fitted in Z-shape (Z-rib) aligned in series on the whole area of the upper plate. The results of the Z-ribs show the significant increase in heat transfer rate and friction loss over the smooth channel. The 45° Z-rib provides the highest increase in the heat transfer rate and the best thermal performance.

Ting Maa,b, Qiu-wang Wang [6]: In this paper, the effects of inlet temperature and rib height on the fluid flow and heat transfer performances performances of the ribbed channel inside the high temperature heat exchanger are presented. The inlet temperature varies from 850 K to 1250 K and the ratio of rib height to channel height varies from 0.083 to 0.333. The results indicate that increasing the rib height can enhance the flow disturbance and hence improve the heat transfer performance. The inlet temperature has little effect on the basic structure of fluid flow and the heat transfer is enhanced due to the increased velocity. Compared to increasing the rib height, more heat can be transferred by increasing the inlet temperature with less pressure drop. The high pressure drop is more serious as the inlet temperature increases. It is proposed to use the compact heat transfer structure at the low temperature region and replace it by loose heat transfer structureat the high temperature region. It also demonstrates that the Nusselt number and friction factor are unsuitable to compare the heat transfer and pressure drop performances among different temperature conditions because the physical properties of fluid change with temperature variation.

Seyhan Uygur Onbasioglu, [7]: A liquid crystal based experimental investigation of the heat transfer enhancement supplied by ribs on a vertical plate, has been presented. Since the ribs were adiabatic, they did not work as extended heat transfer surfaces but by redirecting the flow, were used to enhance the heat transfer. Four different rib heights (H ¼ 10, 20, 30, 40 mm) and have different angles of inclination (h ¼ 0, 10, 20, 30, 45_) are considered. Local heat transfer coefficients and the mean Nusselt numbers for the considered experimental cases are compared to those of the that plate without ribs. The enhanced flow is always found to have higher heat transfer values. On the other hand, both the rib height and the angle of inclination a.ect the magnitude of the local and total heat transfer coefficients.

Giovanni Tanda, [8]: This paper deals with Repeated ribs are on heat exchanger surfaces to promote turbulence and enhance convective heat transfer. study of heat transfer from a rectangular channel (width-to-height ratio equal to five) having one surface heated at uniform heat flux and roughened by repeated ribs. The ribs, having rectangular or square sections, were deployed transverse to the main direction of flow or V-shaped with an angle of 45 or 60 deg relative to flow direction. The effect of continuous and broken ribs was also considered. Local heat transfer coefficients were obtained at various Reynolds numbers, within the turbulent flow regime. .

A.N. Mahure and V.M. Kriplani, [9]: This paper deals with experimentation with Z- shaped ribs in rectangular duct. The experimental study was to investigate the local heat transfer characteristics and friction factor in rectangular duct with flat and Z- shaped ribs. A constant surface heat flux is provided on top surface and other surfaces are maintained at adiabatic conditions. The Reynolds number was varied between 9000 to 25000.The increase in heat transfer coefficient of air found to be 14.6% higher for flat ribs,58.16% for 30˚ Z-shaped ribs, 76% for 45˚ Z-shaped ribs and 89.37 % for 60˚ Z- shaped ribs over when there is no ribs in the duct. Experimentation shows the heat transfer depend on the angle of Z- shaped ribs.

K. H. Dhanawade, [10]: - Rapid heat removal from heated surfaces and reducing material weight and cost become a major task for design of heat exchanger equipments like Cooling of I C engines. Development of super heat exchangers requires fabrication of efficient techniques to exchange great amount of heat between surface such as extended surface and ambient fluid. The present paper reports, an experimental study to investigate the heat transfer enhancement in rectangular fin arrays with circular perforation equipped on horizontal flat surface in horizontal rectangular duct. The data used in performance analyses were obtained experimentally by varying flow, different heat inputs and geometrical conditions.

Xiaokui Maa, Guoliang Ding,[11]:- The airside heat transfer and friction characteristics of 14 enhanced fin-and- tube heat exchangers with hydrophilic coating under wet conditions are experimented. The effects of number of tube rows, fin pitch and inlet relative humidity on airside performance are analyzed. The test results show that the influences of the fin pitch and the number of tube rows on the friction characteristic under wet conditions are similar to that under dry surface owing to the existence of the hydrophilic coating. The Colburn j factors decrease as the fin pitch and the number of tube rows increase. For wavy fin, the Colburn j factors increase with the increase of the inlet relative humidity, but for interrupted fin, the Colburn j factors are relatively insensitive to the change of the inlet relative humidity. The friction characteristic is independent of the inlet relative humidity. 8% higher than that with the conical-ring alone. A maximum heat transfer rate of 367% and enhancement efficiency of around 1.96 was found for using the conical-ring and the twisted-tape of Y=3.75. For all the devices used, the enhancement efficiency tends to decrease with the rise of Reynolds number and to be nearly uniform for Reynolds number over 16,000. It was found that the smaller twist ratio was, the larger the heat transfer and friction factor for all Reynolds numbers. The average heat transfer rates from using both the conical-ring and twisted-tape for Y=3.75, and 7.5, respectively, were found to be 367% and 350% over the plain tube. However, the friction factor from using both devices also increases considerably.

S. Eiamsa-ard et al. [12] have been investigated heat transfer, flow friction and thermal performance factor characteristics in a tube fitted with deltawinglet twisted tape, using water as working fluid experimentally. Influences of the oblique delta-winglet twisted tape (O-DWT) and straight delta- winglet twisted tape (S-DWT) arrangements were also described. The experiments were conducted using the tapes with three twist ratios (y/w = 3, 4 and 5) and three depth of wing cut ratios (DR = d/w = 0.11, 0.21 and 0.32) over a Reynolds number range of 3000–27,000 in a uniform wall heat flux tube. The obtained results show that mean Nusselt number and mean friction factor in the tube with the delta-winglet twisted tape increase with decreasing twisted ratio (y/w) and increasing depth of wing cut ratio (DR). It was also observed that the O-DWT was more effective turbulator giving higher heat transfer coefficient than the S-DWT. Over the range considered, Nusselt number, friction factor and thermal performance factor in a tube with the O- DWT were, respectively, 1.04– 1.64, 1.09–1.95, and 1.05–1.13 times of those in the tube with typical twisted tape (TT). Empirical correlations for predicting Nusselt number and friction factor have been employed. The predicted data were within ±10% for Nusselt number and ±10% for friction factor.

A. Durmus et al. [13] investigated the effect of propeller type turbulators which were located in the laminar pipe of co axial heat exchanger. The blade angle of propeller of turbulator between $10 \leq \theta \leq 40$ the ration of propeller diameter to pipe diameter between $0.87 \leq Dk / Db \leq 0.94$ and Reynolds number in the range of 10000and 30000.The turbulator place with 10 cm array increased the heat transfer as much as 28% and 39% the pressure loss as much as 17% and 43% compared with the turbulator placed in the arrays of 20 and 30cm. The turbulator with blade angle of 200 decrease heat transfer as far as 8%, the ones with a blade angle of 400, on the other hand, as far as 35% compared with the turbulators with a blade angle of 100. The change of blade angle affected the pressure loss between 15-40%. In the experiment was seen that heat transfer 2-4 times and pressure loses 8.5 times biggest than the values of the empty pipe heat exchanger at Reynolds number of 10000-30000 and different mass flow rate.

Anil Singh Yadav [14] has been studied the influences of the half length twisted tape insertion on heat transfer and pressure drop characteristics in a U- bend double pipe heat exchanger experimentally. In the experiments, the swirling flow was introduced by using half-length twisted tape placed inside the inner test tube of the heat exchanger. The experimental results revealed that the increase in heat transfer rate of the twisted-tape inserts was found to be strongly influenced by tape-induced swirl or vortex motion. The heat transfer coefficient was found to increase by 40% with half-length twisted tape inserts when compared with plain heat exchanger. It was also observed that the thermal performance of Plain heat exchanger was better than half length twisted tape by 1.3-1.5 times.

Piroz Zamankhan [15] has been developed a 3D mathematical model to investigate the heat transfer augmentation in a circular tube with a helical turbulator. Glycol–water blends of various concentrations were used in the inner tube, and pure water was used in the outer tube. Changes in fluid physical properties with temperature were taken into account, and k-ε; k-ω, and large eddy simulations were developed for turbulence modeling. The simulation results showed a nonlinear variation in Reynolds and Prandtl numbers for a long model of a heat exchanger even in the absence of a turbulator. The presence of the turbulator was found to increase the heat transfer, sometimes without inducing turbulence, but also increased the pressure drop. Comparing their numerical results with experimental results, it was found that the LES model predicts the behavior of real systems. Using a multi-objective optimization method such as Genetic Algorithm coupled with the GPU-LES-SPH (which is an implementation of Smoothed Particle Hydrodynamics), a set of solutions will be obtained that satisfy different levels of compromise. From this set the most suitable solution will be selected. This efficiency-enhancing tool developed will be particularly suitable for process intensification (i.e., increasing production capacity per unit volume of equipment) in the chemical process industry.

Pongjet Promvonge [16] has been presented the experimental results on heat and flow friction characteristics in a uniform heat flux tube equipped with the 5 mm wire coil of three different coil pitch ratios (CR = 4, 6 and 8) and the twisted tapes of 2 twist ratios (Y = 4 and 6) are presented in the form of Nusselt number and friction factor. The Nusselt numbers obtained under turbulent flow conditions for the twisted tape and coiled wire with the three ratios.It was worth noting that the combined wire coil and the twisted tape with CR:Y = 4:4 provides the highest heat transfer rate than those with higher CR:Y values for all Reynolds numbers. The increase in Nusselt number value was in a range of 300–685% over the smooth tube. The friction factor for CR:Y = 4:4 was found to be higher twice of that for CR:Y = 6:4 or 8:4 values while the friction factor for CR:Y = 4:6 was seen to be the mean value between those for CR:Y = 4:4 and 6:4. This means that friction loss mostly comes from using the wire coil with CR = 4. The mean increase in friction factor range of 30 to 68 times over the smooth tube. The heat transfer obtained from both the wire coil and the twisted tape inserts was around 130–250% and 180– 400% depending on the Reynolds number, CR and Y values. The increase in Nusselt number for twisted tape alone was about 20–50% while in wire coil alone was around 100–110%. The use of combined twisted tape and the wire coil inserts also shows a higher heat transfer rate around 150–300%. The friction factor value for both was around 2–4.5 times above that for the wire coil alone or about 6–12.5 times over that for the twisted tape.

Smith Eiamsa-ard and Pongjet Promvonge [17] have been conducted the experiments to investigate the heat transfer and friction factor characteristics of the fully developed turbulent airflow through a uniform heat flux tube fitted with diamond-shaped turbulators in tandem arrangements. Nusselt numbers along the tube fitted with the D-shape turbulator for cone angles θ=450 and tail length ratio TR = 1.0, for Reynolds numbers ranging from 3568 to 16,228. Nusselt number was high at the entry region (7 ≤ X/D ≤ 22) and gradually decreased but at exit region (X/D > 22) slightly increases. Heat transfer variation in terms of Nusselt number of the inserted tube for different the included cone angle (θ=150, 300 and 450) with Reynolds numbers at TR = 1.0, 1.5 and 2.0, respectively. The larger angle (θ) yields a higher heat transfer rate than the smaller angle. The use of smaller the cone angle of θ =150 and 300 leads to the decrease in Nusselt number at 16.3% and 7.4%, respectively, in comparison with θ = 450 of all range Reynolds numbers studied. The friction factor variations of using the three included cone angles (θ = 150, 300 and 450) with Reynolds number between 3500 and 16,500 for TR = 1.0, 1.5 and 2.0, respectively. The maximum increase in friction factor was seen at TR = 1.0 which was higher than TR =1.5 and 2.0 around 11.3% and 22.6%, respectively. The improvement of average heat transfer rate was respectively 32.1%, 46.5% and 57.8% higher than those the plain tube while the friction factor was 4.7, 5.25 and 5.67 times of the plain tube.

Panida Seemawute and Smith Eiamsa-Ard [18] have been conducted the experiments for heat transfer in heat exchanger tubes by means of TRs compared to that of CRs at different width and pitch ratio has been investigated for Reynolds number between 6000 and 20,000. At the same width ratio (W/D=0.15) and a given pitch ratio, only TRs with the smallest pitch ratio (p/D) of 1.0 give higher Nusselt numbers than the CRs by around 3 to 4%. TRs and CRs at p/D=1.5 yield comparable Nusselt numbers for the whole range tested. At p/D=2.0, Nusselt numbers attributed to the TRs become lower than those associated by the CRs. The Nusselt number associated by the TR at the largest width ratio (W/D=0.15), are augmented by around 35.7% and 60% over those associated by ones with W/D=0.10 and 0.05, respectively. . By the utilization of TR at the smallest pitch ratio (p/D) of 1.0, an average Nusselt number was found to be around 6.8%and 13.6% higher than those achieved by the use of the ones of larger pitch ratios of 1.5 and 2.0 respectively. Thermal performance factor results Among the TRs tested, it was found that a thermal performance factor increased with decreasing width ratio. The TRs with W/D=0.05 at p/D=1.0, 1.5 and 2.0 give thermal performance factor in the ranges of 1.02 to 1.24, 1.01 to 1.2, and 1.00 to 1.2 respectively.

Panida Seemawute et al. [19] has been investigated comparatively visualization of flow characteristics induced by twisted tape consisting of alternate-axis (TA) to that induced by typical twisted tape (TT). The visualization was carried out via a dye injection technique. The TAs were made of aluminium strips (for heat transfer setup) and acrylic sheet (for visualization setup) with thickness of 1.0 mm (δ), width of 18 mm and length of 1000 mm. Straight tapes were prepared at three desired twist lengths in 180° rotation (y/W = 3, 4 and 5) by twisting straight tapes, about their longitudinal axis, while being held under tension. The heating test tube was made of copper with thickness of 1.5 mm, inner diameter of 19 mm and length of 1000 mm. A common swirl flow was induced by TTs. with TAs, fluid stream which directly encounters a crosswise edge of the tape at an alternate point, was separated. Effect of TAs at various twist ratios, y/W = 3, 4 and 5 on the Nusselt number. This result was corresponded to the superior chaotic mixing as described above, and consequently results in more violent interruption on thermal boundary layer, and thus more efficient heat transfer though the tube wall.

P. K. Nagarajan et al. [20] have been presented experimental investigation of heat transfer and friction factor characteristics of solar trough collector fitted with full length twisted tapes inserts of twist ratio 6, 8 and 10. The transitional flow regime was selected for this study with the Reynolds number range 1192 to 2534. Friction factor decreased with increase in Reynolds number for a given twist ratio.

C. K. Pardhi[21] The various techniques for achieving improved heat transfer are usually referred to as "heat transfer augmentation" or "heat transfer enhancement" and the heat exchanger provided with heat transfer enhancement techniques as "Augmented Heat Exchanger". The objective is to reduce as many of the factors as possible: Capital Cost, Power Cost, Maintenance Cost, Space and Weight, Consistent with safety and reliability. Present work describes the principal techniques of industrial importance for the augmentation of single phase heat transfer on the inside of tubes namely twisted tapes. So twisted tape should be used in heat exchanger when high heat transfer rate is required and pressure drop is of no significance.

Naga Sarada[22] The present work shows the results obtained from experimental investigations of the augmentation of turbulent flow heat transfer in a horizontal tube by means of mesh inserts with air as the working fluid. Sixteen types of mesh inserts with screen diameters of 22mm, 18mm, 14mm and 10mm for varying distance between the screens of 50mm, 100mm, 150mm and 200mm in the porosity range of 99.73 to 99.98 are considered for experimentation. The Reynolds number is varied from 7000 to 14000. Correlations for Nusselt number and friction factor are developed for the mesh inserts from the obtained results. It is observed that the enhancement of heat transfer by using mesh inserts when compared to plain tube at the same mass flow rate is more by a factor of 2 times where as the pressure drop is only about a factor of 1.45 times

Ponnusamy Selvaraj [23] The article presents computational fluid dynamics studies on heat transfer, pres- sure drop, friction factor, Nusselt number and thermal hydraulic performance of a plain tube and tube equipped with the three types of internal grooves (circular, squareand trapezoidal).Waterwasusedasthe workingfluid. Testswereperformed for Reynolds number ranges from 5000 to 13500 for plain tube and different geom- etry inside grooved tubes. The maximum increase of pressure drop was obtained from numerical modeling 74% for circular, 38% for square, and 78% for trape- zoidal grooved tubes were compared with plain tube. Based on computational fluid dynamics analysis the average Nusselt number was increased up to 37%, 26%, and 42% for circular, square and trapezoidal grooved tubes, respectively, while com- pared with the plain tube. The thermal hydraulic performance was obtained from computational fluid dynamics analysis up to 38% for circular grooved tube, 27% for square grooved tube and 40% for trapezoidal grooved tube while compared with the plain tube.

Rajagapal Thundil Karuppa Raj[24]In this present study, attempts were made to investigate the impacts of various baf- fle inclination angles on fluid flow and the heat transfer characteristics of a shell-and-tube heat exchanger for three different baffle inclination angles namely 0°, 10°, and 20°. The simulation results for various shell and tube heat exchangers, one with segmental baffles perpendicular to fluid flow and two with segmental baf- fles inclined to the direction of fluid flow are compared for their performance. The shell side design has been investigated numerically by modeling a small shell- -and-tube heat exchanger.The studyisconcernedwitha singleshelland singleside pass parallel flow heat exchanger. The flow and temperature fields inside the shell are studied using non-commercial computational fluid dynamics software tool ANSYS CFX 12.1. For a given baffle cut of 36%,the heat exchanger performance is investigated by varying mass flow rate and baffle inclination angle. From the com- putationalfluiddynamicssimulationresults,theshellsideoutlettemperature,pres- sure drop, re-circulation near the baffles, optimal mass flow rate and the optimum baffle inclination angle for the given heat exchanger geometry are determined.

Tushar R Badule[25] Recent development in technology has led to demand for high performance lightweight, and compact heat transfer equipment. To provide accommodation with this demand, finned surface are usually used to increase rate of heat transfer. The excessive heat must be dissipated to the surrounding for smooth functioning of system. This is more important in cooling of gas turbine blade, thermal power plants, air conditioning equipment and electrical / electronic component. This component is getting more compacting size, which generates heat continuously. This excessive heat will reduce the life of component. To overcome this problem there is need of effective cooling system. Therefore now a day's industries are utilizing thermal system such as ribs, fins, baffles etc. The turbulence occurred due to these passive techniques are good enough to increase rate of heat transfer. This article is based on comprehensive review of work carried out in this technology.

MayankUniyalet al., [26]in this paper with the help passive techniques researchers had studied on forced convection for plain and dimpled surfaces to improve the heat transfer rate by comparing the two different fin surfaces with same dimensions. It has practical application for cooling of turbine airfoils. Experiments were done between plain and dimpled surface which were come on to conclusion that dimpled fin have more heat transfer coefficient than plain fin.

KenichiroTakeishi et al., [27] in this paper experiment was carried out on rectangular duct for convective heat transfer and pressure loss for enhancing the heat transfer coefficient. For improving the cooling efficiency the inclined pin-fin were used for enhancing the heat transfer coefficient and fin shape. In this experiment four kinds of pin-fin arrangement were tested. It was concluded that by using the 45 degree incline fin heat exchanger factor can be improve.

Shivdas S. Kharche et al., [28] in this paper by using the natural convection heat transfer through fin was experimentally studied to increase the heat transfer rate. The objective of this paper was to compare the effect of heat transfer coefficient for notch and without fins. This paper mainly focuses on heat transfer rate of copper fin for greater heat transfer which is needed to increase rate of modernization and extent use of copper is tested. It was observe that, the heat transfer rate in notched fins is more than the un-notched fins. It was concluded that the average heat transfer coefficient for without notched fin is 8.3887 W/m2K and for 20% notched fins it is 9.8139 W/m2K. It was concluded that the copper plate gives better heat transfer rate than aluminum plate.

Paisarn Naphon et al., [29] their aim was to experimentally investigated heat transfer and pressure drop in the different angles of corrugated upper and lower plates. The experimentation was carried out for Reynolds number in the range of 2000 to 9000 and heat flux 0.5 to 1.2Kw/m2. Experiments were conducted with various heat flux as well as flow rate of air. It was conclude that the heat transfer rate was higher as the air mass flow rate

increases. Heat transfer obtained with the corrugated channel was3.5 times higher than smooth channel, and pressure drop was 5 to 6 times greater than smooth channel.

S. Liu et al., [30] this paper reviews experimentally and numerically studies of passive method such as twisted tape, wire coil, swirl generator and ribs etc., to enhance the thermal efficiency in heat exchanger. Researcher had studied in detail about the twisted tape, wire coil, baffles, inserts and ribs. They conclude that, twisted tape inserts perform better in laminar flow. Wire coil inserts gives better performance than the other inserts. Ribs, conical nozzle were more efficient in turbulent than laminar flow.

P. Eiamsa-ard et al., [31] studied the heat transfer enhancement and friction factor in the tubes inserted with rectangular-winged twisted-tapes as working fluid water. The wing-depth ratio was varied from 0.1 to 0.3 while the tape twist ratio was kept constant at y/W = 4. Twisted tapes were used as swirl generators. Experiments were held at uniform heat flux condition for Reynolds number between 5500 and 20,200. In this experiment the modified twisted tapes used with rectangular-wings and alternate-axes. Effects of the wing depth ratio (d/W= 0.1, 0.2 and 0.3) on the heat transfer, pressure drop and thermal performance factor characteristics were also examined. It was conclude that, the proper design of the twisted tapes provides an increased heat transfer rate with a reasonable pressure drop and the use of rectangular winged twisted-tapes is more promising than the use of twistedtapes with alternate axis for energy saving purpose. In comparison with experimental data, the heat transfer rate in the heat exchanger tube can be enhanced by insertion of rectangular winged twisted tapes. Experimentally readings shows that, the thermal performance factors of the tubes equipped with rectangular winged twisted tapes considerably increase with decreasing Reynolds number and increasing wing-depth ratio.

Giovanni Tanda et al [32] researchers had studied heat transfer in rectangular channel with transverse and V- shaped broken ribs. Experiment was conducted with uniform heat flux and ribs having rectangular or square section as a working fluid air. In this paper continuous and broken ribs were also considered. In this V- shaped ribs with an angle 450 and 600 are taken for comparing, and to observe which one is better performing. It was found that, a transverse broken rib gives higher heat transfer augmentation under same mass flow rate. Broken or 600 V- shaped ribs give higher heat transfer coefficient.

SooWhanAhn et al., [33] researcher investigated the heat transfer and friction factor characteristics inside a rectangular duct. One side roughed with five different shape of rectangular duct. In this study, the effects of rib shape geometries as well as Reynolds numbers were examined. The rib height-to-duct hydraulic diameter, pitch-to-height ratio, and aspect ratio of channel width to height are fixed at e/De=0.0476, P/e=8, and W/H=2.33. They used five different shape of rib such as square, triangular, circular, arc and semicircular, these ribs were sequentially installed on bottom wall of duct. Heat transfer coefficient and centerline friction factors on the bottom ribbed wall were measured. In this experiment, Reynolds number was varied between 10,000 and 70,000. It was found that, the square rib have highest value of friction factor, while triangular type of rib have a substantially higher heat transfer performance than any other one.

MonsakPimsarn et al., [34] in this paper the researcher investigated heat transfer in rectangular duct with Z shaped ribs. These ribs were set on the rectangular duct at 30°, 45° and 60° and flat rib was set at 90° relative to the air flow direction. They observed that, Ribs and fins improved heat transfer rate, but there was high friction head loss also, the ribs and fins obstructed the fluid flow and increased friction loss.

These types of ribs created turbulence flow, vortex flow and impinging on heat transfer surface for increasing thermal performance. This paper focused on the development of Z- shaped rib for varying angle with three values (α= 30°, 45° and 60°).Experimental trial were performed in turbulent channel flows in a range of Reynolds number from 5000 - 23,000. The constant heat flux was provided to top surface only, and air is used as fluid flow. It was found that, the 45° Z-ribs can increase thermal efficiency which is more than that of smooth channel. It was observed that, the Nusselt number tends to increase with increasing Reynolds number. The 600 Z-shaped rib provided highest increase in heat transfer enhancement.

Prashanta Dutta et al., [35]in these study researchers investigated the local heat transfer characteristics and the associated frictional head loss in a rectangular channel with inclined solid and perforated baffles. Combination of two baffles of same overall size was used in this experiment. Solid and perforated baffles of same overall size were studied. The leading edges of the baffle plates are kept sharp to reduce the flow disturbance by the protruding edge. The upstream baffle was attached to the top heated surface. Position and shape of other baffle are varied for enhanced heat transfer. Reynolds number for this experimental study is varied between 12,000 and 41,000. The heat transfer coefficient calculations were done on the heated top surface, while the bottom and side surfaces are unheated. In comparison with experimental data, it was found that, the overall heat transfer coefficient is much higher with two inclined baffles than that with a single baffle. For two inclined baffle the frictional head loss is much higher than that for a single baffle arrangement.

Conclusion

From this review, various ways of enhancing the Heat transfer rate by generating the Parallel Heat exchanger and horizontal heat exchanger of various surfaces such as surface roughness, flat and wavy end wall, corrugated surface, ribs,inserts,Turblent and non Turbulent. The most efficient way to dissipate the heat effectively is by improving the surface roughness and use of Ribs. This can be done by using different surface as we can increase in different applications.

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This paper was presented as a keynote at the 2nd international conference on Espresso machine future level heat transfer analysis techniques and methodology introduced. This paper is under review for formal publication.

This paper was written with a feeling of considerable espresso machine as it is one of the last reviews of enhanced heat transfer that I will undertake. After 10 years ,it is time to put away the collection of enhanced surfaces, and focus on more techniques matters ,Such as keeping the house heating ,stabilizing, controlling etc., I am particularly grateful to Prof. **Dr. E. Palaniswamy,** Principal-Excel College of Engineering & Technology, Komarapalayam. Tamil Nadu, India. for given opportunity to undertake the study and review of enhanced heat transfer in

1996.accordingly,I must emphasize the point made above reviewing the older literature.

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