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MODELING AND COMPUTATIONAL FLUID DYNAMIC ANALYSIS OF VERTICAL TUBE WITH VARIOUS FINS USING FEM

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Abstract: This project is about a thorough study of natural convection from a heated pipe having fins of various configurations using ANSYS workbench version 16.2. The material under taken is Al and the free stream liquid is air. The heat transfer rate from the fins, external wall and the general heat transfer rate has been determined and looked at for different balance arrangements. Likewise the surface nusselt number and surface by and large heat transfer move co-efficient has been find out. Temperature forms for different blade configuration has been plotted showing the convection loops conformed to the heated pipe surface. Speed forms for different blade configurations has been plotted and the movement of heat liquid is appeared. Plots for nusselt number and heat transfer move co-efficient are appeared. The assumptions during the analysis have been considering the assembling and practical applications and working conditions. Hence the outcomes obtained can be referred to while solvling any such kind of issues in the practical field where just natural convection is getting looked at. Subsequent to contrasting it is shown that we can locate that the best configuration for this type of convective heat move of a heated pipe is a TRAPEZOIDAL fin as they have the highest total heat transfer rate.

I INTRODUCTION

Heat exchangers are generally utilized in different, transportation, mechanical, or domestic applications, for example, nuclear energy stations, methods for heating, shipping and cooling frameworks, electronic equipment , space vehicles. Taking all things together these applications improvement in the efficiency of the heat exchangers can lead The foundation of any form of heat transfer enhancement lies in the use of any external power in order to permit the mixing of working fluids, heat transfer surface rotation, heat transfer vibration The generation of electrostatic fields also involves surfaces or working fluids. The key techniques of heat transfer enhancement that have found widespread commercial use are Those which have elements for heat transfer enhancement. The same is the target of all passive strategies, namely, Higher product values of the heat transfer coefficient and the surface area of the heat transfer are obtained. In the heat transfer culture, a distinction between how the enhancement of heat transfer is done is normal. A literature-like language is adopted here in the present work, while how the heat transfer improvement is done is meaningless for realistic applications. The choice of the specific passive approach depends heavily on the convective heat transfer mode. (natural or induced convection) and on the heat transfer fluids used. When arguing about heat transfer,The thermal resistance in the direction of the heat flow needs to be taken into account. For example, It is desirable to invest in reducing thermal resistance, which is still low. It is understood that, regardless of gases,Their low thermal conductivity is characterised by much greater heat flow resistance than their low thermal conductivity of fluids. The argumentation measures should therefore generally be in gas-liquid heat exchangers,On the gas side, applied. Fins should be used as components for heat transfer to accomplish the most efficient heat transfer enhancement. Extension of Surface Area. A broad number of fins have been used for these purposes in the past, leading to a wide range of Quite compact heat exchangers with only the working media being gas or gas and liquid. Rotary Plate Fin Compact heat exchangers are commonly used in the industry as regenerators and tube fin. Here, The tubular fin structure is a field of concern. These are formed as a mixture of pipes with distinct cross-sections. Outside and inside the tubes, parts of fins are present. The generic shape of the cross-section of the tube is also found are circular or rectangular, but elliptical cross-sections. Generally, fins are connected by way of tight mechanical suit, adhesive bonding, forging, brazing, and extrusion or welding. Based on the The tubes may be defined as individual tubes with regular fins, individual fins, and the shape and orientation of the fins.Tubes with longitudinal fins or clusters of tubes with internal fins, smooth, wavy or interrupted.

AIM OF THE WORK:

There are virtually no commercial areas where heat exchangers are not used. The composition of the heat exchangers have a significant impact on the architecture of the whole system or mechanism in which they are introduced. Most individuals Factors affect a heat exchanger's architecture, but the heat transfer rate is the most critical one.With with an exception for a few situations is normally a high heat transfer rate and a minor pressure drop in a small amount. Necessary in all kinds of normal processes. In three simple types, heat is typically transferred: conduction, convection, radiation. The heat level Conduct is not a difficult problem and can usually be controlled by the material chosen to create the System. Additional radiation is of much less importance when the method of heat transfer takes place in mild Temperatures. The intensity of heat transferred by convection is the dominant aspect in this kind of analysis as compared to that by conduction and radiation.

Convective heat transfer can be measured as the result of heat transfer, based on Newton's cooling law. The coefficient, the surface area of heat transfer and the temperature difference between the wall of the tube and the fluid flowing inside the walls. Usually, the wall to fluid temperature difference is modified on the basis of it cannot be used to increase the heat transfer rate and therefore the working conditions. The surface area of heat transfer or the coefficient of heat transfer, or any of them simultaneously. But, as with the heat,the transfer coefficient at specific temperatures for a given substance is constant, thus the only means of Changing the heat transfer rate would affect the area of the heat transfer surface.

Interrupted fins in the form of stripes or louvred fins have an improvement in both the heat transfer surface area and The Effective Heat Transfer coefficient is also increasing. These are therefore particularly efficient in obtaining High transmission rates of heat. The process leading to high coefficients of heat transfer of such fins is the Periodic disturbance of the boundary layer across the fins and hence easier mixing of them. Similar fluid stream temperatures.

Heat energy exchange is analysed on a tube with a circular cross-section and a particular inner and inner tube. Outer radius and disc-shaped outer fins. The shape and scale of the fins attached to the tube can be variable. Three specific types of fins and the transfer of heat energy from a pipe with such a fin are considered. Configurations is estimated.

The design calculations of the tube and the dimensions of the fin are based on equations suitable for the tube. Maximum transfer rate of heat at a low cost of output. It is considered that the substance used for the measurements is ALUMINIUM to be. Both the tube and fins are considered to be made up of Aluminium and the fluid inside the tube is Water.

For all simulation operations, the ANSYS 16.2 WORKBENCH variant is used. The Experimental Values of Working temperatures and sufficient properties for the substance of the fin and tube together with water

TYPES OF CONVECTION:

NATURAL CONVECTION:

Natural convection is a heat transfer process or form in which no fluid motion is generated by any fluid motion. External sources like pumps, fans, suction devices, etc., but only because of fluid density changes Occurring due to the gradient of temperature. Buoyancy, a result of fluid density variations, is the driving force of natural convection. For Because of This is the presence of a proper acceleration that would provide sufficient gravity or gravity resistance. For natural convection, equivalent force is essential.

FORCED CONVECTION:

Forced convection is a heat transfer mechanism or type in which fluid motion is generated by a fluid motion. It is called the primary method of useful heat, like pumps, fans, suction devices etc. transfer as significant amount of heat energy can be transferred by this process.In forced convection. Transfer as significant amount of heat energy can be transformed the forced convention In such cases some amount of natural convention is always present. This type of convections is called as MIXED CONVECTION.

GRAVITATIONAL OR BYUOYANT CONVECTION:

Natural buoyancy causes this form of convection (a kind of NATURAL CONVECTION)

Variation that comes from properties of substance other than temperature. This is usually induced by Variable fluid composition, or gradient of concentration (SOLUTAL CONVECTION)

THERMO-MAGNETIC CONVECTION:

Thermo magnetic convection can occur when an external magnetic field is imposed on a Ferro fluid of varying magnetic susceptibility. In the presence of temperature gradient this results in a non-uniform magnetic body force which leads to fluid movement. (Ferro fluid: liquid which becomes strongly magnetized when subjected to magnetic field) This type of convection is useful in miniature micro-scale devices.

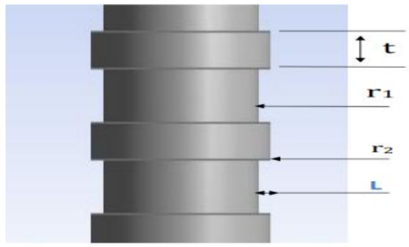

Figure 1 crossection of centrifugal fin

FINS OF MINIMUM WEIGHT:

For designing of cooling devices on vehicles, especially air crafts, the problem for exchanging maximum amount of heat with the least weight addition arises.Reducing the weight also reduces the cost of the finned heat exchanger mechanism. For a rectangular annular fin the fin cross section should be rectangular,

MESS STATISTICS AND PARAMETERS ASSUMED DURING ANALYSIS:

PHYSICAL PARAMETERS	VALUES
Type of fin	Without fins
Cross section of the tube	Circular
External diameter of the pipe	50mm
Length of the pipe	150mm
Free stream fluid	Air
Material for tubs and fins	Aluminium
Model for convention	Bousinessq
Tube wall temperature	380 k
Free stream air temperature	300 k
Convection heat transfer coff	10 W/m2k
MESH PARAMETERS	VALUES
Messing methods	Trapezoid
Relevance sizing centre	Fine
Element size	0.0001m
Initial size seed	Active assembly
Smoothing	High
Transition	Slow
Span angle centre	Fine
Number of nodes	1794
Number of elements	1474
Orthogonalityquality	7.32e-01
Aspect ratio	1.55e01

Table 2 Mess Statastics and parameters

TEMPERATURE CONTOURS

FIG shows the temperature forms for different investigations with different balance arrangements. These figures show the variation between the most maximum and minimum temperature values across the whole length of the pipe area consideration. Likewise these shapes shows the convection circles conformed to the pipe cross area.

MAXIMUM TEMPERATURE = 380 K (near the pipe) MINIMUM TEMPERATURE = 300 K (ambient air temperature)

PLOTS FOR SURFACE NUSSELT NUMBER AND SURFACE HEAT TRANSFER CO-EFFICIENT

These layers show the variation of the nusslet number along the length of the pipe. Surface values the nusslet number shows the amount of heat loss from the paddle surfaces and the outer wall heat pipe. Similarly it shows the plot values for the surface heat transfer coefficient against the length of the pipeSurface heat transfer coff. At various points adjacent to the outer wall of the pipe and the fin surfaces.

Maximum surface nusslet number and heat transfer cuff: PIPE WITHOUT FINS :nusslet number: 3.4 e 2 Heat transfer coff: 4.25 W/m2 -K , PIPE WITH CONICAL FINS: nusslet ,PIPE WITH CYLINDRICAL FINS: nusslet number: 3 e 2 Heat transfer coff 4.8 W/m2 –K

HEAT TRANSFER RATE:

PIPE WITHOUT FINS: heat transfer rate at the tube walls = 14.0589 Watts

PIPE WITH CONICAL FINS: heat transfer rate at the tube walls = 3.511642 Watts

heat transfer rate at the tube walls = 11.9164733 Watts

Total heat transfer rate = 15.42911 watts

PIPE WITH TRAPEZOIDAL FINS: heat transfer rate at the tube walls = 6.18310 Watts , heat transfer rate at the tube walls = 14.453860 Watts ,Total heat transfer rate = 20.63697 watts, PIPE WITH TRAPEZOIDAL FINS: heat transfer rate at the tube walls = 4.16301 Watts , Heat transfer rate at the tube walls = 11.45617 Watts , Total heat transfer rate = 15.61918 watts

CONCLUSION:

The best configuration for this type of convection can be seen from the values calculated above the heat exchanger is a TRAPEZOIDAL paddle because they have the highest overall heat transfer rate, and Excellent surface nusslet number with very high surface heat transfer coefficient.All assumptions are made taking into account the practical manufacturing of fins and the real working conditions. Therefore the result obtained in the whole project can be specified when dealing with heat transfer releated problems where only natural convection can be considered.

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