A Review on Enhancement of Heat Transfer through Fins

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Abstract-The cooling performance of electronic device, engine etc is a biggest challenge and an area of concern. As the poor cooling performance is observed from the conventional method of cooling. There are various researches which are happening in this field to improve the performance of fins and to enhance the heat transfer. In this paper an attempt is made to summarize the various researches that were conducted on the fins. The main aim of this review paper is to analyse the thermal properties of fin by varying its certain parameters like geometry of fins, material used, number of fins, thickness of fins etc. From this review it is observed that the heat transfer performance of fins obtained from the experimental method is in close approximation with the finite element analysis and the method of numerical solution.

Index- Fins, Fin material, Geometry of fins, Heat transfer enhancement.

INTRODUCTION

Heat transfer by convection between a surface and the fluid surrounding can be increased by attaching to the surface thin strips of metal called fins. Fins are the extended surfaces purposely provided at a place from where heat is to be removed. The fin increases the effective area of a surface there by increasing the heat transfer by convection. A fin is a type of heat exchanger that transfers the heat generated by a mechanical or an electronic device to a fluid medium, often air or a liquid coolant, where it is dissipated away from the device, there by allowing regulation of the device's temperature at optimum levels. Fins are extended surfaces used for dissipating heat from the hot surfaces. The ability to dissipate heat from the surfaces greatly affects the device efficiency. As fins are widely used for cooling, the main objective of this review paper is to obtain the optimum design of fin for heat transfer by varying certain parameters.

LITERATURE REVIEW

Pankaj Rao et al [1] has studied to improve the heat transfer characteristics and to investigate the performance of fin efficiency by using fin of different materials in pin fin apparatus for both natural and forced convection. From the experimental analysis, the heat transfer of fin for different materials is analysed and experimental results shows that the efficiency of aluminium is greater than brass and mild steel fin.

P Moorthy et al [2] The aim of this paper is to investigate the effect of fin shapes on the performance of compact finned flat tube heat exchangers. The three fin shapes considered are plain, wavy and rectangular grooved fins. From this study, it was found that the rectangular fin has the highest heat transfer performance compared to wavy and plain fin. The highest efficiency was achieved by plain fin with the least heat transfer performance. It is observed that the rectangular fin is suited for application which priorities thermal performance over hydraulic performance or efficiency.

M.Vara Prasad et al [3] The fabrication of trapezoidal and rectangular fins of variable fin cross section is done. With the help of the experimental set up made under different heat input conditions the temperature variation along the length of fin is measured. From the experiment it is found that the heat transfer coefficient is more in forced convection than in natural convection in both the fins. It is also observed that when compared to both the fins the heat transfer coefficient is twice in trapezoidal fin than the heat transfer coefficient in rectangular fin in both the natural and forced convection.

P.Kaviyarasu et al[4] In this experiment ,an aluminium 6063 rod for three various surface roughness has been fabricated and tested for the heat transfer coefficient and heat transfer rate. Comparing the smooth surface rod, rough surfaced aluminium 6063 rod is having the high heat transfer coefficient and heat transfer rate. Also compared with the free, the forced convective transfer can replace more amount of heat from the pin fin material.

Laxmi Narayana Pidda et al [5] In this study an attempt is made to fabricate cylindrical pin fin made of brass, aluminium, copper, mild steel and composite bar and analysed their performance in terms of temperature distribution along the fin. The main objective is to compare the different type material with composite material. The study of variable thermal conductivity with its resultant impact on the performance of fins becomes imperative. Both increase and decrease of thermal conductivity of

metals with temperature occurs in practice depends upon the material and the range of temperature involved. Further experimental investigation and thermal analysis on nano particle copper coating over aluminium cylindrical pin fin is done.

Zaharaddeen Aminu Bello et al [6] Experimental analysis is done to determine the effectiveness, efficiency, heat transfer rate and heat transfer coefficient for three pin fins with different shapes of the same aluminium material length is done. The theoretical values of temperature for all three fins are slightly greater than the practical values because of heat lost by radiation. The heat transfer rate for free convection has greatest value in case of circular fin, followed by triangular fins and the least is square fin, but in case of froced convection circular fin has the greatest value followed by square fin and the last is triangular fin. The triangular fin has the highest effectiveness in both free and forced convection.

N. Sethuraman et al [7] The performance analysis is carried out using simulation and experimental method. Experiment carried out for different geometry by using different heat inputs. The results show that the rate of heat transfer is high, for with insulated triangular fin followed by without insulated triangular fin, the results also show that the rate of heat transfer is high for tapered pin fin followed by pin fin. For all the conditions the temperature at the tip of the fin has to be the same as that of the air. But in reality, the temperature of the fin is not same as that of ambient temperature this shows that heat transfer is enhanced.

G. Kiran Kumar [8] Heat transfers from the condensers (heat exchangers) can be increased by extended surfaces called fins. The rate of heat transfer through condenser depends on fin material, spacing between the fins, geometry of the fin and its thermal conductivity. This experimental work focuses on effect of condenser fin geometry on the performance of the condenser. Heat transfer rate through the condenser is calculated for different fin geometries. The rate of heat transfer through the condenser is maximum for rectangular fin geometry compared to circular fin geometry of the condenser. Heat transfer rate is increased for the rectangular fin geometry, because rectangular fins have more surface area.

Devendra J waghulde et al [9] Experimental investigation and Finite element analysis is carried out on the thermal behaviour of cylinder with different fins of varying fin thickness and geometry. Results obtained from Finite element analysis are in close approximation with the results of experimental method. FEA and Experimental results shows that the temperature distribution is maximum for the cylinder with rectangular fin of 3.5 mm fin thickness for aluminium alloy 6061 and minimum for triangular fin of 2.5 mm thickness for aluminium alloy 6061.

G.Babu , M. LavaKumar [10] The main aim of the project is to analyse the thermal properties by varying geometry, material and thickness of cylindrical fins. Model is created using pro/Engineer and the analysis is done using ANSYS. The materials and geometry used for analysis are aluminium alloy 204, aluminium alloy 6061 and magnesium alloy with rectangular, circular and curved shapes. By observing the analysis result it is clear that aluminium alloy 6061 with thickness of 2.5 mm, circular fin is better because the heat transfer is more. Theoretical calculation shows that using circular fins the heat lost is more, efficiency and effectiveness is also more.

Sandhya Mirapalli, Kishore. P.S [11] Heat transfer analysis is carried out by placing rectangular and then triangular fins. Analysis is carried out by varying the temperatures on the surface of the cylinder from 200^{o}C to 600^{o}C and varying length from 6cm to 14 cm. output parameters such as rate of heat flow, heat flow per unit mass, efficiency and effectiveness are determined. Comparisons are presented with rectangular fins. By varying the length of fin from 6cm to 14cm and maintaining base temperature at 600^{o}C, the results obtained are Heat flow from triangular fin is increased compared to rectangular fin, Rate of heat flow per unit mass of rectangular fin is decreased compared to triangular fin. Efficiency of triangular fin is decreased and effectiveness of triangular fin is increased compared to rectangular fin. By varying base temperature of fin from 200^{o}C to 600^{o}C keeping the length fixed at 10 cm, the results obtained are Heat flow from triangular fin is increased compared to rectangular fin, Rate of heat flow per unit mass of triangular fin is increased compared to rectangular fin, Efficiency of triangular fin is decreased and effectiveness of triangular fin is decreased compared to rectangular fin.

Mayank Jain et al [12] The main aim of the project is to analyse the thermal heat dissipation of fins by varying its geometry. The main objective is to increase the heat transfer rate of fin which could be achieved by modifying certain parameters and geometry of the same. The modelling software used is CREO parametric 2.0. The analysis is done using ANSYS14.5. By observing the analysis results it is found that triangular fin with aluminium alloy 6061 as material is better since the temperature drop and the heat transfer rate in a triangular fin is much more compared to others. The theoretical calculations done to determine the heat lost, effectiveness and efficiency of the fins are well supported by the practical results obtained using the software.

L. Natrayan et al [13] The main aim is to analyse the thermal properties by varying geometry of cylinder fins. The 3D model of the geometries is created using SOLIDWORKS 2016 and its thermal properties are analysed using Ansys Workbench R 2016.The variation of temperature distribution over time is of interest in many applications such as in cooling. Analysis is carried out for cylinder fins using Aluminium alloy 6061 material. Design of fin plays an important role in heat transfer. There is a scope of improvement in heat transfer of air cooled engine cylinder fin if mounted fin's shape varied from conventional

one. Wavy fin shaped cylinder block can be used for increasing the heat transfer from the fins by creating turbulence for upcoming air. Improvements in heat transfer can be compare with all the four models of the engine fins geometry by CFD analysis and its flow characteristics are studied for all the geometries it is found that the curved fins provide better result when compared with all the other geometries.

Mukesh Didwania et al [14] This paper presents the result of study and analysis of rate of heat transfer and pressure loss for different shape fins with rectangular duct when surface area is same for all. Rectangular, Cylindrical(Circular) are the two shape fins used for analysis. The purpose of this study is to determine the optimum dimensions and shapes for rectangular longitudinal fins and cylindrical pin fins by including transverse heat conduction. Further the present study investigates the effect of a variable heat transfer coefficient on the optimum dimensions of the aforementioned fins. It is found from the results that the heat transfer rate is maximum for circular fin and minimum for rectangular fin. Pressure loss is minimum for circular fin and maximum for rectangular fin in the duct, From the above it can be concluded that circular fin is optimum fin for maximum heat transfer.

Subodh Kr. Sharma et al [15] The main emphasis of the work is to find the best suitable geometry and material for the fins. By reviewing the literature survey, the selection of the geometry and material for fabrication is done. The fabricated models are mounted on a base plate and are heated by heaters for a certain period of time. The temperature is then noted down at various points with the help of infrared gun and the best geometry and the material for the fins is found out. From the experiment it can be concluded that triangular geometry is more suitable as the heat dissipation from the triangular fin is more, and copper is the most suitable material as the heat dissipation from copper is more. But for manufacturing purpose, the factors to be considered are cost, weldability, density, machinability of material etc. If the parameters like costs, weight are considered, then Aluminium can be used as a substitute material instead of copper as heat transfer rate differs only by a small amount.

CONCLUSION

From the literature review, it is clear that the design of fin plays an important role in heat transfer. The thermal analysis of fins is studied by modifying certain parameters such as geometry, material, thickness etc. The heat lost, effectiveness and efficiency of the fins can be determined. We can observe that the results obtained from the finite element analysis are in close approximation with the results of experimental method and numerical solution.

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