Optimum heat transfer performance using heat sink -A Review

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ABSTRACT

Heat sinks are used to dissipate heat to the surrounding by method of convection. Generally two types of convection process are used, they are natural convection and forced convection. In natural convection, increases surface areas are employed. This surface area further increased by adding fins to achieve high rate of heat transfer. Heat transfer depends on many factors such as shape and size of the fins, spacing between fins, number of fins, thermal conductivity and temperature difference between heat sink and the fluid. In forced convection, some external agent is used for heat dissipation such as fans. Heat Sinks with fins are generally used in Automobile, Telecommunication, Electrical devices, Power electronic Components etc. Fins of different shapes and size are used in industry depending upon the shape and weight of the equipment. Today heat sink becomes vital component in electronic devices. For effective cooling the fluid flow movement around fins should increased, result in fast cooling rate. Now days, Heat sink with fan are best solution for high heat dissipation with low cost, small in size and easy to install. The main objective of this paper is to present the literature review on heat sink for effective cooling of vital component.

Keywords: Heat sink, natural convection, forced convection, fins, heat dissipation

1. INTRODUCTION

Heat generation is a series problem in all engineering devices which depend upon its operating condition. Sometime this heat cause series problem leading to deformation and failure of components. Heat must be removed for proper functioning and working of components. Different methods are employed for heat rejection. Due to limitation of space and for light weight in some component many method cannot be employed so for this type fins are widely used. It rapidly removes heat to its surrounding atmosphere by method of convection. Fins are extensively used in cooling of computer processors, air craft engines, air cooled automobile engines, cooling of generators, motors, transformers, refrigerators and other electronic devices etc. The general design of a heat sink is a metal device attached with many no of fins. The thermal conductivity of the metal as well as fins should be high enough for fast rate of heat transfer to the surrounding environment. In many components the transfer of thermal energy from the heat sink to the air is generally done by using the fan. With the increase in heat dissipation from the electronic devices and the reduction in overall form factors, it became an essential practice to optimize heat sink designs with least trade-offs in material and Manufacturing costs With best fan orientation. Number of experimental and numerical works has been carried out to study the effect and performance of fin parameters like perforation shape, perforation size etc. In this paper different work carried by researcher are discussed in detail

2 DIFFERENT TYPES OF COOLING SYSTEM

2.1Natural convection process: In this process power are not used. Natural cooling methods are widely used for electronic devices because they are noiseless, low-price and trouble free solutions. Some natural Convection methods used are air cooling, heat pipes and thermal storage using phase change materials. Using fins is one of the best inexpensive and common ways to remove unwanted heat and it has been successfully used for many engineering applications. Fins are made of various shapes, such as circular, rectangular, pin fin rectangular etc. which depending on the application. In natural convection, it is necessary to optimize the parameters of the heat sink geometry in an application independent manner.

2.2 Forced convection process: In this process external energy is required for increased in heat transfer. The forced heat transfer techniques have not found commercial interest because of operating and capital cost of devices. Augmentation of heat transfer is of vital importance in many industrial applications. There are various specimens of forced methods which produces effect pulsating by cams, reciprocating pump-piston etc.

3. REVIEW OF PAST WORK

Harahap and McManus [1] carried out experiment with different geometry and concluded that array with shorter fin length showed higher average convection coefficient when compared with two series of rectangular fin arrays having same spacing and height because single chimney flow pattern is obtained in small length fin array. Senol et al. [2] carried out parametric study to find effect of fin height, fin length, fin spacing and concluded that overall heat transfer is enhanced with increasing in height of fin and decrease in length of fin dimensions. Square perforations of inclined type are best for low fin thickness and parallel type for high fin thickness. With emphases on lower thermal resistance with increasing flow mixing and reducing flow maldistribution brought back this geometry to the focus of thermal experiments on micro-channel heat sinks. Heat transfer and pressure drop effects were investigated and a concise/basic empirical relationship for thermal resistance was proposed with experimental confirmation. It was concluded that Pin fin heat sink can lead to very lower values of thermal resistance in a system. It was also observed that most effective heat transfer mode is the forced convection over the Pin Fin Heat sinks as compared the conventional channels. The experimental data acquired for both the air and water as working fluid.

Sparrow et al. [3] to address the two constraints of Heat removal and pressure plummet. The investigations disclosed that staggered Pin arrangements are superior to inline geometry both in-terms of heat removal as well as pressure gradient across the sink. In the said investigation the experimental data for inline Pin Fin arrangement regarding the heat transfer and pressure drop was collected. Mass transfer coefficient for each row of the specimen was calculated. It was observed that for fully developed flow conditions, row heat (mass) transfer coefficient as well as the pressure drop is inferior in case of in-line arrays as compared with the existed data of staggered arrays. Also, for same pumping power and heat transfer area, more heat transfer is observed in case of inline pin fin arrays. Another outcome of the research was the supremacy of staggered arrays in requiring the lesser heat transfer area as compared with the in-line arrays under monotonous heat load and mass flow rate.

Amer et al. [4] investigated Pin-Fin Heat sinks with solitary rectangular-slotted/notched holes by employing CFD domain to extend the previous work of [5]. It was observed that heat transfer change is directly proportional to perforation size while pressure drop is inversely proportional to the rectangular contained by these arrangements. It was concluded that for a particular quantity and size, the perforations have a positive effect on the heat transfer as compared to the solid fins. Also, staggered arrays have more promising results over the in-line arrays for heat dissipation approach. On the other hand, pressure drop related inversely to the increase in number and size of the perforations. It was summed up that perforated geometries have better heat transfer rate, need less pumping power and enhanced thermal performance Enhanced thermal performance of about 40.5% was found to be achieved for perforated pin fins compared with the solid pin fin arrangements heat transfer of the walls was established. Another innovative study was conducted by Chandra et al. [6] in which the effects of varying periodic cross-section of micro channel were presented. A convergent-divergent micro-channel flow was examined for numerical simulation and heat transfer enhancements were observed for different cases of varying cross-section. It was concluded that proposed varying cross-section micro channels exhibit large pressure drop but with remarkable enhancement in heat transfer. It was observed that average Nusselt- Number was increased 1.5–2 times in such sections when compared with the conventional consistent sized micro-channels.

Lu et al. [7] experimentally investigated the effect of using then-eicosane as PCM for the cooling of a personal- digital –assistant (PDA). A heat storage unit filled with n-eicosane (PCM) considerably absorbed the dissipated heat from the device keeping the chip temperature with in working limits. It was experimentally proved that orientation of heat storage unit greatly influences the temperature-distribution.

4. CONCLUSION

From the past research following conclusion may be drawn

1) Extended surfaces are the better method of augmenting heat transfer.
2) Perforated fin may dissipate about 40% more heat.
3) Perforated fins are light in weight, so decrease the manufacturing cost.
4) Fluid flow pattern is sliding chimney in case of perforated fins.
5) Material of perforated fin may have better strength.

5. ACKNOWLEDGEMENT

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