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A review on Heat Transfer from Different types of Notch Fin Arrays under Forced Convection to increase heat energy transfer

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Abstract: Use of fin for heat transfer enhancement is becoming increasing trend. It is observed that in many applications use of fin is proved to be helpful for heat transfer enhancement. Now for further heat transfer enhancement for energy saving in heat transfer processes, one has to increase efficiency of fins this can be achieved through application of notches in fins. This paper provides review on application of notches with different size and shape in heat transfer fin to achieve further enhancement in heat transfer.

Keywords: *Fins, Notch, Heat transfer enhancement, Forced convection*

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I. INTRODUCTION

Fins are used to Enhanced convective heat transfer in a wide range of engineering applications, and offer a practical means of achieving a large total heat transfer surface area without the use of an excessive amount of primary surface area. Fins are commonly applied for heat management in electrical appliances such as computer power supplies or substation transformers. Other application include internal Combustion Engine cooling, such as in a car radiator. It is important to predict the temperature distribution within the fin in order to choose the configuration that offers maximum effectiveness.

Natural convection in enclosures is an important topic in heat transfer and has been widely used in engineering applications such as double-pane windows, solar heating, cooling of electronic packages, heat transfer in rooms and buildings and nuclear reactor cooling.

The heat transfer can be increased by the three different augmentation techniques such as Passive techniques, Active techniques and Compound techniques. The active heat transfer enhancement techniques have not found commercial interest because of the capital and operating cost of the enhancement devices, also external power is required. A compound technique involves complex design. The majority of passive techniques employ special surface geometry or fluid additives for enhancement i.e. no direct application of external power. Practically useful, augmentation techniques are mostly passive ones. Passive techniques are treated, structured surfaces, rough surfaces, extended surfaces, displaced enhancement devices, swirl flow devices, additives for liquids and gases, etc. Extended surfaces are widely used passive techniques to enhance heat transfer. Whenever it is difficult to increase the rate of heat transfer either by increasing heat transfer coefficient or by increasing the temperature difference between the surfaces and surrounding fluid, the fins are commonly used. Natural convection heat transfer is often augmented by provision of rectangular fins on horizontal or vertical surfaces in many electronic applications, motors and transformers. The current trend in the electronic industry is miniaturization, making the overheating problem more acute due to the reduction in surface area available for heat dissipation. Fins come in various shapes; such as rectangular, circular, pin fin rectangular, pin fin triangular etc. Rectangular fins are the most popular fin type because of their low production costs and high thermal effectiveness. Study of influence of geometric parameters viz. fin length, fin height, fin spacing over heat dissipation found important.

Further enhancement in heat transfer can be obtained by proper selection of form of extended surface or by making some modifications in the geometry of surfaces like dent marks, grooved or different types of notches, etc. The fin which gives single chimney flow pattern that fin will good for heat transfer rate. Fins are of two types without notch fins and with notch fins. It can be shown that notch fins gives more heat transfer rate than without notch fins.

II. LITERATURE REVIEW

Sane et al [1] did the study of heat transfers through without notch & notch fins. They use fin material was Aluminium. They use the length of fin was 150 mm and height of fin 75 mm both was fixed. They take number of fins from 9 to15 and notched portion from 10% to 40%.They used three different types of arrays by varying the depth of notch. Their set up consist Aluminium fin flats cut with the help of foot shear from Aluminium sheet of 2 mm thickness. In case of notched array, notch was machined with the help of hacksaw and then filed. The fin flats were tied together using tie rods. Spacing was adjusted using Aluminium spacers. Cartridge type rod heaters of 14 mm diameter were used for heating.

Yazicioglu et al [2] performed experiments over thirty different fin configurations with 250 and 340 mm fin length.

Optimum fin spacing of aluminum rectangular fins on vertical base was examined. It was found that optimum fin spacing varies for each fin height which is between 6.1 and 11.9mm.

Yuncu et al [3] investigated natural convection heat transfer for 15 sets of rectangular fin array with horizontal base. Fin spacing and fin height was varied from 6mm to 26mm and 6.2 to 83mm, respectively. For fin height 16 and 26mm, optimum fin spacing found 11.6 and 10.4mm, respectively.

Barhatte et al [4] did computational analysis of notched fins and studied heat transfer rate through different types of notches in the fin. They used different notch such as rectangular, circular, triangular and trapezoidal. They compare without notch and notch fin array by supplying different heat inputs. The dimensions of fin were fixed. They concluded that more heat is transferred through triangular notch fin.

Wange et al [5] investigate natural convection heat transfer in four different cases of inverted notch fin array .It was found that the average heat transfer coefficient for inverted notch fin arrays is higher as compared with normal fin arry

Wankhede et al [6] did study the heat transfer through horizontal Rectangular inverted notch fin arrays. They used rectangular notch of 10%, 20%, 30%, 40%..They take number of fin from 6 to 10.They concluded that the 40% notched configuration yield 55-75% higher values of heat transfer and coefficient of heat transfer compare with the unnotched fin for both natural and force convection.

III. CONCLUSIONS

It can be concluded that several studies have been reported that the use of different shapes, sizes, materials and spacing in fins enhances the heat transfer rate in many applications. To the authors knowledge less work has been reported on the effect of inverted notch with various shapes in heat transfer enhancement in forced convection. Hence by applying notches in the fins heat transfer from surface can be enhanced.

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