Theoretical Study of Oblique Fin Heat Exchanger for Replacement of Radiator in Automobiles

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Abstract *Heat transfer enhancement techniques are used to increase rate of heat transfer without affecting much the overall performance of the system. Boilers and condensers in thermal power plants are examples of large industrial heat exchangers. There are heat exchangers in our automobiles in the form of radiators and oil coolers. We are using oblique fins heat exchanger instead of radiator in automobiles. This paper contains study of enhancement techniques in heat transfer using fins. In this paper we are taking rectangular fins that are arranged in an oblique pattern through which we can get a larger surface area for heat transfer as we are using a forced convection so a larger amount of heat dissipation can take place. Hence, the overall heat transfer coefficient increases.*
The angle between the main channel and oblique channel which is known as oblique angle is set as ~15^0-30^0[9]. Main cause of using the oblique fin heat exchanger is to reduce the size and cost. We are comparing heat transfer rate of oblique fins and straight fins.

Index Terms-*Heat transfer enhancement, Heat exchanger, Rectangular fins, Oblique angle, Overall heat transfer coefficient.*

1.INTRODUCTION

Heat exchangers are devices used to transfer heat energy from one fluid to another. Typical heat exchangers experienced by us in our daily lives include condensers and evaporators used in air conditioning units and refrigerators. There are heat exchangers in our automobiles in the form of radiators and oil coolers. Heat exchangers are also abundant in chemical and process industries.
A fin is a surface that extends from an object to increase the rate of heat transfer to or from the environment by increasing convection. Extensions on the finned surfaces is used to increase the surface area of the fin in contact with the fluid flowing around it. In this paper we are taking rectangular fins that are arranged in an oblique pattern through which we can get a larger surface area for heat transfer as we are using a forced convection so a larger amount of heat dissipation can take place. The oblique angle that denotes the angle between the main channel and oblique channel is set as ~15^0-30^0[9]. Oblique fins have a much higher heat transfer surface area to fluid volume ratio. As the hydraulic diameter decreases, the heat transfer coefficient increases, providing an excellent cooling mechanism.

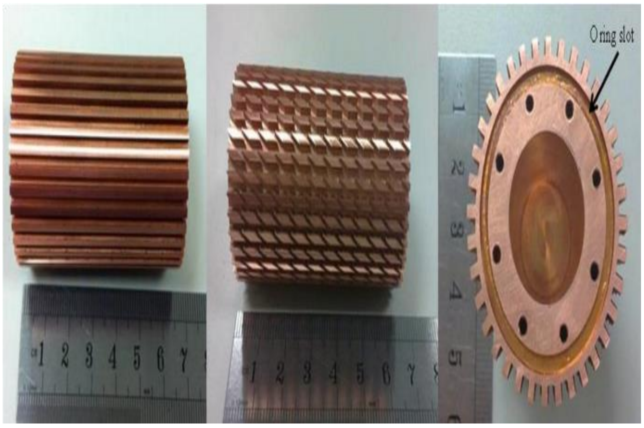

Fig..Experimental Test Pieces of Conventional Straight Fin and Cylindrical Oblique Fin Heat Sinks[10]

The surface area of oblique fin which comes in contact of air is more than the straight fin. So the due to larger the surface area of oblique fin due to ~15^0-30^0[9] oblique angle, greater the heat transfer rate. They offer several advantages such as high convective heat transfer coefficient, ease of implementation, compactness, light weight, higher surface area to volume ratio and small coolant inventory requirement. So, as the surface area increase the more fluid contact to increase the rate of heat transfers from the base surface as compare to fin without the extensions provided to it.

2. LITERATURE REVIEW

- Steinke and Kandlikar[1] reviewed convectional heat transfer enhancement techniques. They identified several techniques that can be used in fins to improve the heat transfer. The present work develops the concept of breaking up the developing flow profile. The result is a continually developing flow that maintains a very high heat transfer coefficient.

- Steinke and Kandlikar[3] reviewed the available literature for single phase liquid heat transfer in oblique fins. Following the same procedure, they identified improved agreement with conventional heat transfer theory when the previously mentioned parameters are accounted for. Therefore, the conventional Nusselt number and heat transfer coefficients should be applied.

- They attributed the reported discrepancies to improperly accounting for oblique fin geometry, entry and exit losses, entrance lengths, and experimental uncertainties. When the authors properly accounted for these parameters, the conventional fluid flow theory provides strong agreement with experiment data. Therefore, the flow physics can be described with the traditional Reynolds number and friction factor.

- Abdullah, H. Alessa [9]. had studied the natural convection heat transfer enhancement from a horizontal rectangular fin embedded with equilateral triangular perforations. The heat dissipation rate from the perforated fin is compared to that of the equivalent solid one. The effect of geometrical dimensions of the perforated fin and thermal properties of the fin was studied in detail. They concluded that concluded that, for certain values of triangular dimensions, the perforated fin can result in heat transfer enhancement. The magnitude of enhancement is proportional to the fin thickness and its thermal conductivity. The perforation of fins enhances heat dissipation rates and at the same time decreases the expenditure of the fin material.

- Sable[6] ,had investigated for natural convection adjacent to a vertical heated plate with a multiple v-type partition plates (fins) in ambient air surrounding. As compared to conventional vertical fins, this v- type partition plate's works not only as extended surface but also as flow turbulator. In order to enhance the heat transfer, v-shaped partition plates(fins) with edges faced upstream were attached to the two identical vertical plates. They observed that among the three different fin array configuration on vertical heated plate, V-type fin array design performs better than rectangular vertical fin array and v-fin array with bottom spacing design. The performance was observed to improve further, with increase in the of the V-plates (fin height).

- Golnoosh Mostafavi[7] had investigated the steady state external natural convectional heat transfer from vertically mounted rectangular interrupted finned heatsinks. After regenerating and validating the existing analytical results for continuous fins, a systematic numerical, experimental, and analytical study is conducted on the effect of the fin array and single wall interruption. Ansys software is used in order to develop a two dimensional numerical model for investigation of fin interruption effects. Results show that adding interruptions to vertical rectangular fins enhances the thermal performance of fins and reduces the weight of the fin array, which in turn, can lead to lower manufacturing costs.

- B. Ramdas Pradip[8] had studied the many industries are utilizing thermal systems wherein overheating can damage the system components and lead to failure of the system. In order to overcome this problem, thermal systems with effective emitters such as ribs, fins, baffles etc. are desirable. The need to increase the thermal performance of the system, thereby affecting energy, material and cost saving has led to development and use of many techniques termed as "Heat Transfer Agumentation". This technique is also termed as "Heat Transfer Enhancement" or"Intensification".Agumentation techniques increase convective heat transfer by reducing the thermal resistance in a heat exchangers.

3. CONCLUSION AND FUTURE SCOPE

- Here in this paper the cylindrical oblique fin heat exchanger is used in place of Radiator which would result in reduction in cost, would make it cheaper.
- Oblique fins increases the heat transfer coefficient by increasing the surface area to volume ratio.
- Because of its ease of compactness it can be implemented where less space is available.
- Using the 3D printing complicated shapes of fins can be easily produced.
- From this survey it is observed that more experimental and numerical study is required to enhance the performance with oblique fins for cooling system.
- This heat exchanger can be used in radiators of automobiles, transformers, condensers, generators etc.

4. REFERENCES

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