REVIEW ON HEAT TRANSFER ENHANCEMENT OF COMPACT HEAT EXCHANGER WITH DIFFERENT SHAPES OF FINNED SURFACES

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Abstract-

Heat transfer enhancement techniques -(passive, active or a combination of passive and active methods) are commonly used in areas such as process industries, heating and cooling in evaporators, thermal power plants, air-conditioning equipment, refrigerators, radiators for space vehicles, automobiles (in tracked vehicle it plays very important roll), etc. Passive techniques, where insrets, extended surfaces like fins of different shapes and sizes are used in the flow passage to enhance the heat transfer rate, are advantageous compared with active techniques, because the insert manufacturing process is simple and these techniques can be easily employed in an existing heat exchanger. In design of compact heat exchangers, passive techniques of heat transfer enhancement can play an important role if a proper passive insert configuration/combinations can be selected according to the heat exchanger working condition (both flow and heat transfer conditions).

Key Words: *Heat transfer enhancement,Rectangular Offset Serrated Plate Fins, Wavy fins, Pressure Drop ,Ejector cooling system*

1.INTRODUCTION

Heat transfer enhancement techniques are powerful tools to increase heat transfer rate and thermal performance. Heat transfer enhancement in thermal systems can be carried out either by

A. **Active method:** In active methods, there is need of supplying external power source to the fluid or the equipment and surface vibration-using Piezoelectric Device; some examples of active methods include induced pulsation by cams and reciprocating plungers, by using a electro magnetic field , fluid vibration technique, jet impingement method,Injection ,Suction etc.

B. Passive method: In passive methods, heat transfer enhancement is done without using any direct external power source For example , use of turbulent promoter, fluid additives, using rough surfaces, extended surface like fins etc.

C. Compound method: Combination of above two methods using simultaneously to obtain enhancement in heat transfer that is greater than that produced by either of them when used individually, is known as compound enhancement .This technique contains complex design and hence has limited applications.

Passive heat transfer Enhancement methods

Passive heat transfer enhancement is done without using external power source. In the convective heat transfer one of the ways to enhance heat transfer rate is to increase the effective surface area and residence time of the heat transfer fluids. The passive methods are based on the same principle.

Following Methods are used generally used -

- (a) Coated surfaces
- (b) Rough surfaces
- (c) Extended surfaces
- (d) Displaced insert
- (e) Swirl flow
- (f) Coiled tubes
- (g) Surface tension
- (h) Additives for liquids
- (i) Additives for gases

1) **Extended Surface /Fins**

Extended or finned surfaces increases the heat transfer area which is very effective in case of fluids with low heat transfer coefficients. This technique includes finned tube for shell & tube exchangers, plate fins for compact heat exchanger and finned heat sinks for electronic cooling. Finned surfaces enhance heat transfer in natural or forced convection which can be used for cooling devices. A variety of extended surfaces typically used include rectangular offset strip fins, angular fins,louvered fins, perforated fins and wavy fins.

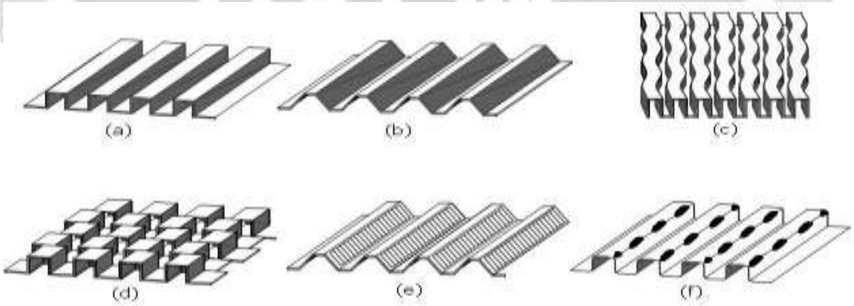

Figure 1: Types of plate fin surfaces: (a) Plain rectangular (b) Plain trapezoidal (c) Wavy (d) Serrated or offset strip fin (e) Louvered (f) Perforated

Plate Fin Heat Exchanger-

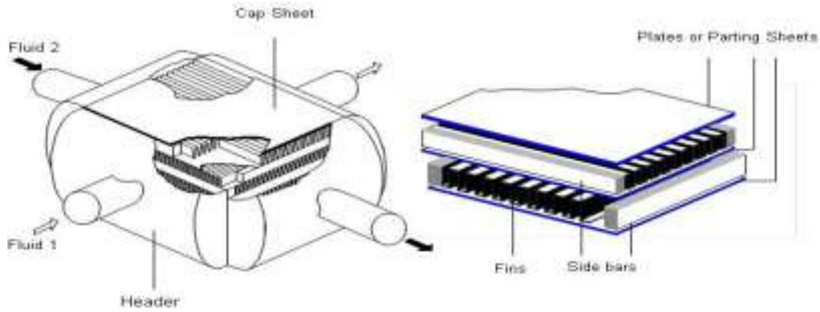

Figure 2: Plate fin heat exchanger assembly and details with cross flow of fluids.

Advantages and disadvantages -
Plate fin type heat exchangers has advantages over the other types of heat exchanger:
i) **Compactness:** Large heat transfer surface area per unit volume (typically 1000 m2/m3), is usually provided by plate fin heat exchangers. Small passage size produces a high overall heat transfer coefficient because of the heat transfer associated with the narrow passages and corrugated surfaces.
ii) **Effectiveness:** Very high thermal effectiveness more than 95% can be obtained.
iii**) Great Temperature control :** The plate fin heat exchanger can operate with small temperature differences. A close temperature approach (temperature approach as low as 3K) is obtained for a heat exchanger exchanging heat with single phase fluid streams. This is an advantage when high temperatures need be avoided.
iv) **Flexibility:** Changes can be made to heat exchanger performance by utilizing a wide range of fluids and conditions that can be modified to adapt to various design specifications.

The main disadvantages of a plate fin heat exchanger are:
i) The rectangular geometry used puts a limit on operating range of pressure and temperatures .
ii) Difficult for cleaning of passages, which limits its application to clean and relatively non-corrosive fluids,
iii) Difficulty of repair and maintenance in case of failure or leakage between passages.

Ii. Review Of Heat Tranfer Enhancement Of Compact Heat Exchanger.

The developments are being carried out continuously in the field of radiator design, coolant used in engine, material of radiator, materials of fins on air side, shape of radiator etc. according to various applications. Numbers of studies have been carried out on thermal performance of various radiators, effects of various parameters on performance of radiator, and found more increase in thermal efficiency than previous design.The studies include use of various types of antifreeze liquids, circular shape of radiator for refrigeration and air conditioning as well as automotive applications.

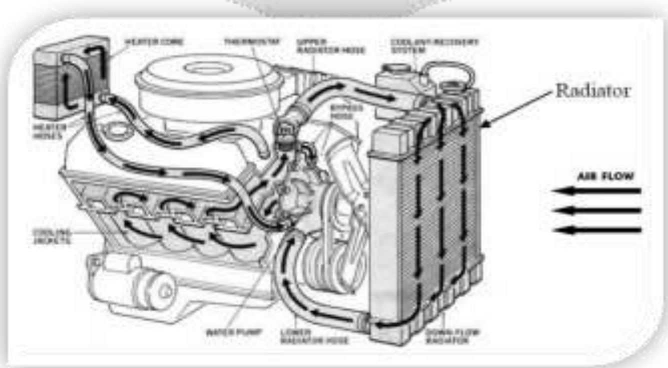

Fig. : Working of Radiator

Matthew Carl et al. [6] In this paper heat transfer process involved in operation of an automotive radiator has been analyzed. The analysis of radiator includes nearly all of the fundamentals discussed in heat transfer class, including the internal and external fluid flow through the heat exchanger and the design and analysis of heat sinks and exchangers.

III. ONGOING EFFORT

Author is working on above sponsored project from VRDE, Ahmednagar. Main Problem is the Overheating of Engine Observed In peak summer during operation at Rajstan. Temperature of cooling system goes beyond 120 degree celcius and vehicle is to stopped until the temperature of cooling system goes down. (up to app. 110 to 115 degree celcius) Hence there is the requirement to design & Development of Improved Cooling System for BMP 2(300 HP Engine) tracked vehicle. For that we have the specifications of engine required for radiator and available space for the radiator i.e. this is rating form of problem.

IV. CONCLUSION

From literature survey I have concluded that: the easiest and accurate method for heat exchanger design among all the methods is the effectiveness-NTU method; the most preferred shape of heat exchanger fins is rectangular,wavy or combined which are better than circular shape. The Main Advantage of the rectangular,wavy offset strip fin is one of the most widely used finned surfaces, particularly in high effectiveness heat exchangers employed in automobile applications especially in tracked vehicles.The fluid flow is thus periodically interrupted, leading to creation of fresh boundary layers and results in better heat transfer enhancement. Interruption of flow also leads to greater viscous pressure drop, manifested by a higher value of effective friction factor.

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