# Enhance the Heat Transfer Rate of Finned Tube Heat Exchanger: A Review

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***Abstract*** - Heat exchangers are popular used in industrial and engineering applications. The design procedure of heat exchangers is quite complicated, as it needs exact analysis of heat transfer rate, efficiency and pressure drop apart from issues such as long-term performance and the economic aspect of the equipment. Whenever inserts technologies are used for the heat transfer enhancement, along with the improvement in the heat transfer rate, the pressure drop also increases, which induces the higher pumping cost. Therefore any augmentation device or methods utilized into the heat exchanger should be optimized between the benefits of heat transfer coefficient and the higher pumping cost owing to the increased frictional losses. So, if we provided fins rectangular or circular type on internal periphery of the tube type heat exchanger than the heat transfer rate will going to be increased.

**Key Words:** Heat Exchanger, Finned Tube, Cylindrical Fin, Augmentation,

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## 1. Introduction

Heat exchangers are popular used in industrial and engineering applications. The design procedure of heat exchangers is quite complicated, as it needs exact analysis of heat transfer rate, efficiency and pressure drop apart from issues such as long- term performance and the economic aspect of the equipment. Whenever inserts technologies are used for the heat transfer enhancement, along with the improvement in the heat transfer rate, the pressure drop also increases, which induces the higher pumping cost. Therefore any augmentation device or methods utilized into the heat exchanger should be optimized between the benefits of heat transfer coefficient and the higher pumping cost owing to the increased frictional losses. In general, heat transfer augmentation methods are classified into three broad categories:

1) Active method 2) Passive method
3) Compound Method

## 2. Fin Tubes

The best combination of coil materials is the one that delivers maximum heat transfer and service life. Tubes, regardless of material, contribute little to heat transfer in extended-surface coils. It is the fins, fully exposed to the Fluid Stream, that provide the greatest contribution to heat transfer. Therefore, choose tube material on the basis of application.

1) Key fin 2) L Fin 3) Overlap L Fin

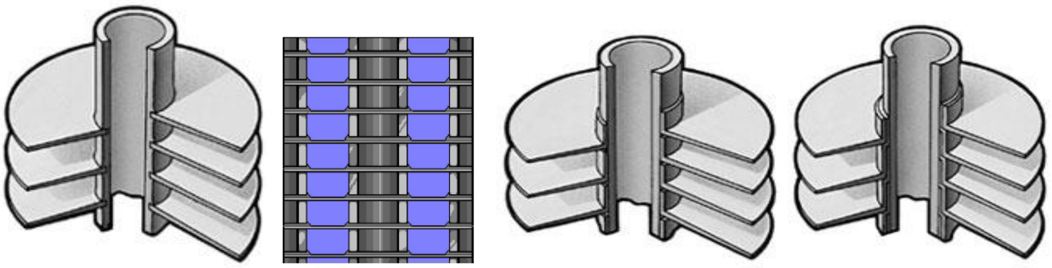

Fig. 1 Common Types of Fins Provided on the Tubular Heat Exchanger

a) Key Fin b) L Fin c) Overlap L Fin

Round Tubular type heat Exchanger will used to transfer the heat from Surrounding to the System or system to surrounding. It works on temperature difference between system and surrounding, and

ISSN: 2321-8169
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between fluid to fluid heat transfers. Fins are used to transfer better heat transfer rate between fluid to fluid and system to surrounding. Fins used to absorb or reject the heat with higher rate of heat transfer. This type of heat exchangers used in condenser, Evaporator, Solar Flat plate absorber, etc.

## 3. Literature Survey

**Karthik Pooranachandran et al. " Experimental And Numerical Investigation Of A Louvered Fin And Elliptical Tube Compact Heat Exchanger"** carried out an experimental investigation to analyze the heat transfer characteristics of a louvered fin and elliptical tube compact heat exchanger used as a radiator in an internal combustion engine. Experiments were conducted by positioning the radiator in an open loop wind tunnel.

A total of 24 sets of air, water flow rate combinations are tested, and the temperature drops of air and water were acquired. A Numerical analysis has been carried out using fluent software (general purpose Computational fluid dynamics simulation tool) for three chosen data from the experiments. The numerical air-side temperature drop was compared with those of the experimental values. A good agreement between the experimental and numerical results validates the present computational methodology. [1]

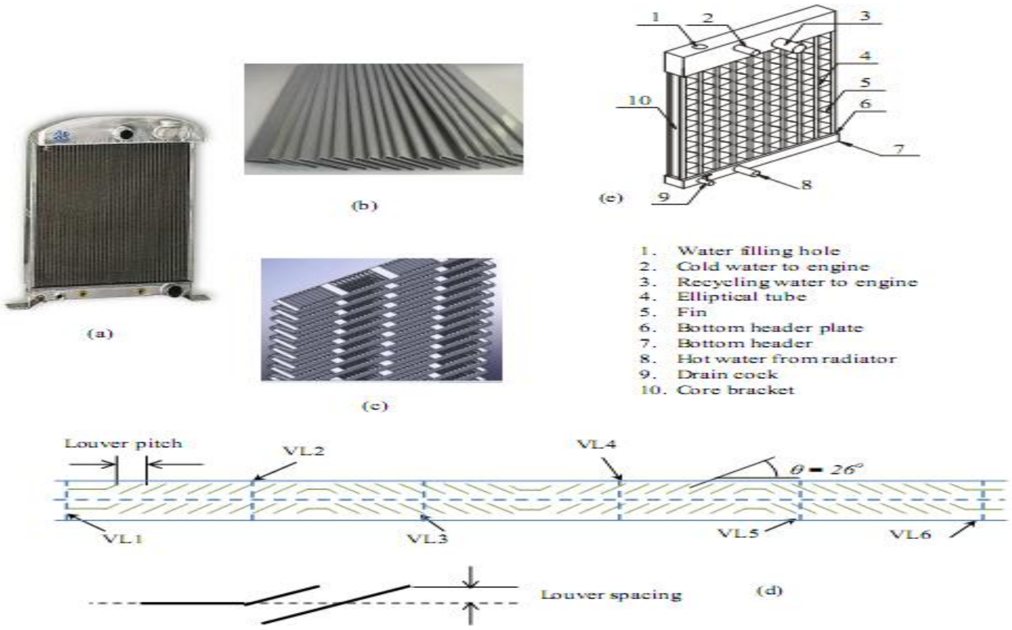


Fig.2. Details of radiator test unit [1]
(a) Photographic view of radiator (b) Elliptical tubes (c) Corrugated louvered fin (d) Details of louver
(e) Schematic sketch of radiator with parts identified

**Pega Hrnjak Et Al. "Effect of Louver Angle On Performance Of Heat Exchanger With Serpentine Fins And Flat Tubes In Frosting"** Measured an Effect of louver angle on performance of heat exchanger with serpentine fins and flat tubes in frosting. The results of an experimental study on the air-side pressure drop and overall heat transfer coefficient characteristics for serpentine-louvered-fin, micro-channel heat exchanger in periodic frosting. It focuses on quantification of the effects of louver angle on heat transfer and pressure drop and on defrost and refrost times. Nine heat exchangers differing in louver angle and fin pitch (i.e. louver angle 15º to 39º and fin pitch 15 to 18 fpi) were studied. The face velocity was 3.5 ms/ and inlet air relative humidity of 70% and 80%. Effect of fin pitch and louver pitch on initial Colburn j0 factor and Fanning friction f0 factor during the start of the first frosting cycle are reported, and compared to the prediction by the Chang and Wang (1997). [2]

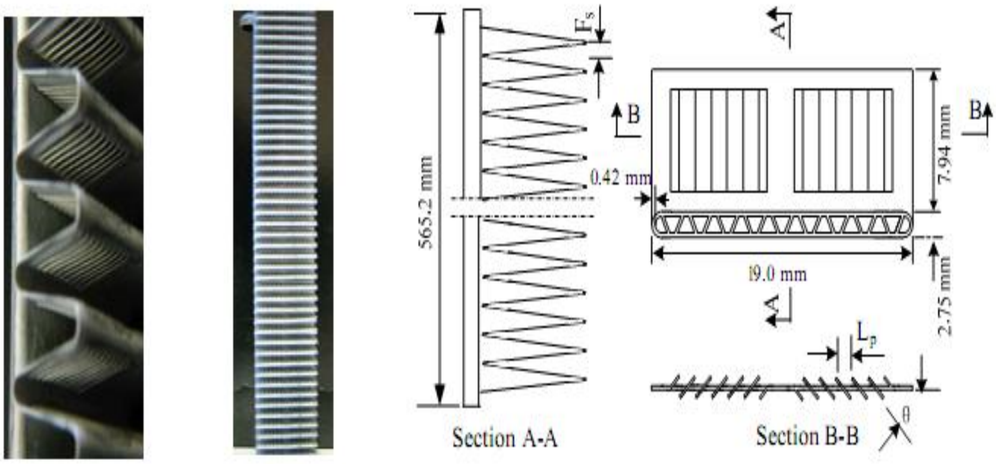


Fig.3. Structure of the test heat exchanger [2]

**R.Borrajo-Peláez et al. "A three-dimensional numerical study and comparison between the air side model and theair/water side model of a plain fin-and-tube heat exchanger"** Work based on CFD air flow models assuming constant temperature of fin-and-tube surface. The purpose of this work to present an enhanced model, whose innovation lies in considering additionally the water flow in the tubes and the conduction heat transfer through the fin and tubes, to demonstrate that the neglect of these two phenomena causes a simulation result accuracy reduction. 3-D Numerical simulations were accomplished to compare both an air side and an air/water side model. The influence of Reynolds number, fin pitch, tube diameter, fin length and fin thickness was studied. The exchanger performance was evaluated through two non-dimensional parameters: the air side Nusselt number and a friction factor. It was found that the influence of the five parameters over the mechanical and thermal efficiencies can be well reported using these non-dimensional coefficients. The results from the improved model showed more real temperature contours, with regard to those of the simplified model. Therefore, a higher accuracy of the heat transfer was achieved, yielding better predictions on the exchanger performance. [3]

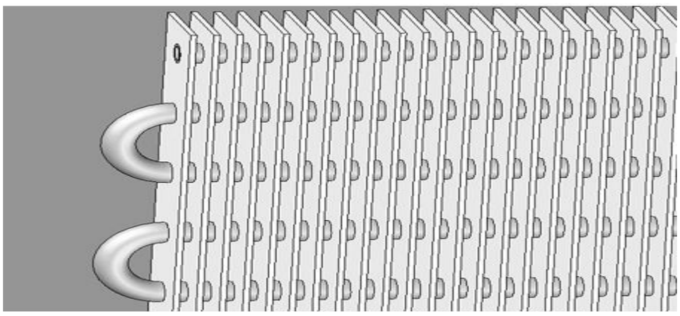

Fig.4. View of a single row fin-and-tube heat exchanger [3]

**Y.-G. Park and A. M. Jacobi "Air-Side Performance Characteristics of Round- and Flat-Tube Heat Exchangers: A Literature Review, Analysis and Comparison"** work on the air-side thermal-hydraulic performance of serpentine-fin, flat-tube heat exchangers. And it compared to that of conventional plate-fin, round-tube designs for various fin geometries and surface conditions. Heat exchanger performance correlations are obtained through a critical review of literature and complementary analyses. The result shows a clear advantage of lattube design under dry, low-Reynolds-number conditions in comparison to round-tube heat exchangers. The parametric effects on heat exchanger performance reported in the literature, the reasons of discrepancies, and the practical ranges of geometrical and operational parameters in applications are identified and summarized in this study. [4]

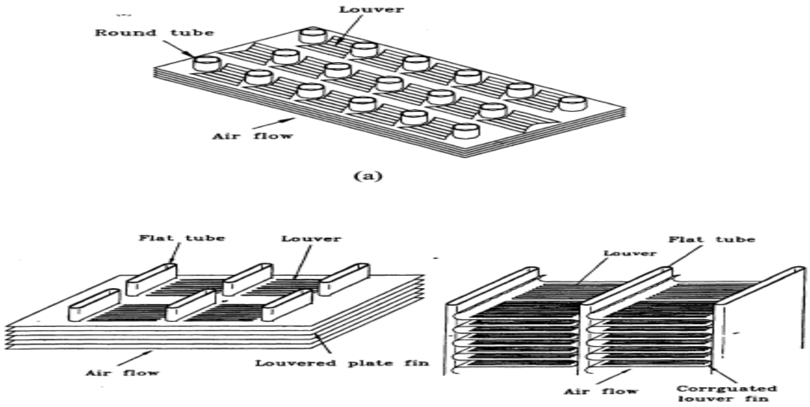


Fig.5 Typical fin-and-tube heat exchangers (From Wang et al., 1999) [4]
(a) Round-tube heat exchanger, (b) flat-tube heat exchanger

**Hamid Nabati "Optimal Pin Fin Heat Exchanger Surface"** represents the results of numerical study of heat transfer and pressure drop in a heat exchanger that was designed with different shape pin fins. The heat exchanger used for this research consists of a rectangular duct fitted with different shape pin fins, and was heated from the lower plate. The pin shape and the compact heat exchanger (CHE) configuration were numerically studied to maximize the heat transfer and minimize the pressure drop across the heat exchanger. A three dimensional finite volume based numerical model using FLUENT© was used to analyze the heat transfer characteristics of various pin fin heat exchangers. [5]

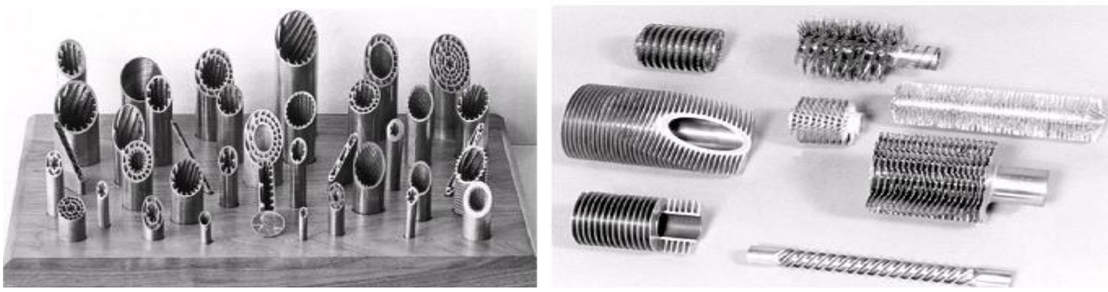

Fig.6. some of the many varieties of finned tubes [5]

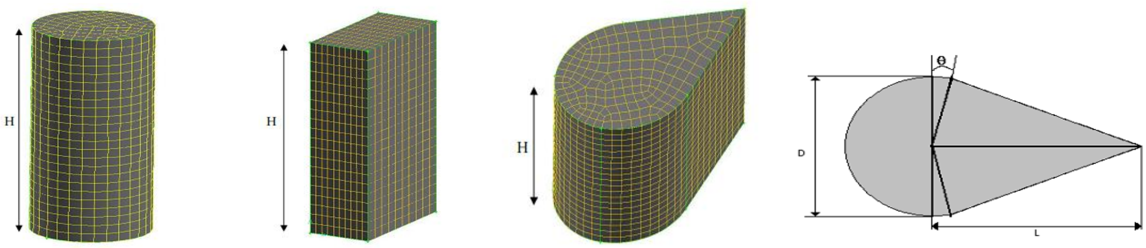


Fig.7. Studied morphologies: Cylindrical, Rectangular, and Drop-Shaped [5]

**Pankaj N. Shrirao et al. "Convective Heat Transfer Analysis in a Circular Tube with Different Types of Internal Threads of Constant Pitch"** Work on Convective Heat Transfer Analysis in a Circular Tube with Different Types of Internal Threads of Constant Pitch. This work presents an experimental

ISSN: 2321-8169
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study on the mean Nusselt number, friction factor and thermal enhancement factor characteristics in a circular tube with different types of Internal threads of 120 mm pitch under uniform wall heat flux boundary conditions. In the experiments, measured data are taken at Reynolds number in range of 7,000 to 14,000 with air as the test fluid. The experiments were conducted on circular tube with three different types of internal threads viz. acme, buttress and knuckle threads of constant pitch. The heat transfer and friction factor data obtained was compared with the data obtained from a plain circular tube under similar geometric and flow conditions. The variations of heat transfer and pressure loss in the form of Nusselt number (Nu) and friction factor (f) respectively is determined and depicted graphically. They observed that at all Reynolds number, the Nusselt number and thermal performance increases for a circular tube with buttress threads as compared with a circular tube with acme and knuckle threads. These because of increase in strength and intensity of vortices ejected from the buttress threads. Subsequently an empirical correlation is also formulated to match with experimental results with ± 8% and ± 9%, variation respectively for Nusselt number and friction factor. [6]

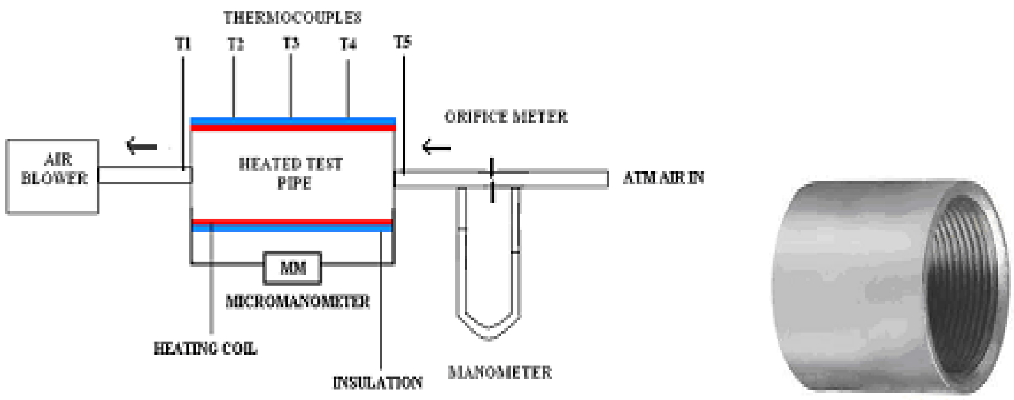


Fig.8 Line Diagram of Experimental setup [6]

## 4. Future Scope

- Fins are widely used to increase the heat transfer rate in the heat exchanger.
- Generally they are using for air flow as z fluid medium.
- Internal threads are also helpful to increases the heat transfer rate in the heat exchanger.
- So that, if we use An Internal Fin, than it will helpful to Increase the Heat Transfer Rate.
- The Parameters affecting on the heat exchangers are heat transfer effective area, inlet temperature of fluid, heat supplied in the heat exchanger, insulation material provided outside the boundary.

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