



## Increasing The Efficiency Of The Heat Exchanger Using Aluminium Alloy 7075

Mr.B.Sakthivel<sup>1</sup>, S.Gowthaman<sup>2</sup>, M.Karthik<sup>2</sup>, K.Karthikraja<sup>2</sup>, R.Vikkas<sup>2</sup>

<sup>1</sup>Assistant Professor, <sup>2</sup>UG Students,  
Department of Mechanical Engineering, Nandha Engineering College, Erode-52,  
Tamil Nadu, India.

sakthivelme1990@gmail.com, gowthamansthaman@gmail.com,  
gowthaman.dme23@ymail.com

**Abstract** In present day fin and tube heat exchanger is the most common type heat exchanger widely use in sugar cane industry and other large chemical process. The process in solving simulation consists of modeling and meshing the basic geometry of fin and tube heat exchanger using CFD package in SOLID WORKS 14.0. The aim of the project is design of fin and tube heat exchanger with varying materials. The heat exchanger has 74 tubes, 1300 mm length and diameter 45 mm. In simulation will expression how the heat varies in fin and tube with respect to material changes This results in a significant increase in heat transfer coefficient per unit area in the heat exchanger.

**Index words:**

**Fin, Tube, Heat Exchanger, Aluminium alloy, Cfd, Solid works.**

### I. INTRODUCTION

Now a day cost production of an energy is high. Respective emission is high. So that we can reduce cost and emission by increasing efficiency of an system. The heat exchanger wider role to increase efficiency of an thermal system. A heat exchanger is a device that is used to transfer thermal energy between two or more fluids, between a solid surface and a fluid, at different temperatures and in thermal contact. Heat exchangers are important engineering devices in many process industries since the efficiency and economy of the process largely depend on the performance of the heat exchangers. They are widely used in which increasing due to their respective in application such as refrigeration, air conditioning, power stations, chemical plants, sugar cane plants, natural-gas processing, and sewage treatment. The classic example of a heat exchanger is found in an internal combustion engine in which a circulating fluid known as coolant flows through radiator coils an air flows past the coils, which cools the coolant and heats the incoming air. Due to the many variables involved,

selecting optimal heat exchangers is challenging. Hand calculations are possible, but much iteration are typically needed. As such, heat exchangers are most often selected via computer programs like CFD analysis, either by system designers, who are typically engineers, or by equipment vendors. To select an appropriate heat exchanger, the system designers would firstly consider the design limitations for each heat exchanger type. Though cost is often the primary criterion, several other selection criteria are important, High/low pressure limits, Thermal performance, Temperature ranges, Product mix (liquid/liquid, particulates or high-solids liquid), Pressure drops across the exchanger, Fluid flow capacity, Clean ability, maintenance and repair, Materials required for construction, Ability and ease of future expansion Material selection, such as copper, aluminum, carbon steel, stainless steel, nickel alloys, ceramic, polymer, and titanium. In modern air conditioning and refrigeration systems material of the fin is play major role to increasing the efficiency of heat exchanger, because they have better rates of heat transfer than conventional sized condenser and evaporator coils with round copper tubes and aluminum or copper fin that have been the standard in the industry. Heat exchangers can be classified in a number of ways, depending on their construction, different type of application or on how fluid move relative to each other through the device.

### II. FIN AND TUBE HEAT EXCHANGERS

Finned tube heat exchanger for heat transfer between air, gas and liquids or steam. Finned tube heat exchangers are designed to transfer heat from clean air and gases with high efficiency on liquids or

MATERIAL	THERMAL PROPERTIES W/m-K
STAINLESS STEEL-304	16.2
ALUMINIUM ALLOY -7075	130

vapors. In this way the media can be heated, cooled or condensed, in a closely space.

(a)DETAILS OF EXPERIMENT

Experimental analysis was done on the heat exchanger (Finned tube heat exchanger) model, inside and outside convection heat transfer coefficients are estimated by passing preheated air through the tube and over the tube by the help of draught fan.

Specifications of Finned Tube HeatExchanger

Outer diameter of tube: 19mm

Tube length :1300mm

Tube material: Aluminum alloy

Length of Intercooler: 1300mm

No. of fins: 74

Fin material: Aluminum alloy

Thickness of each fin: 2.75 m

Type of fins: Radial fins of rectangular cross section

Lenth of fin: 45mm

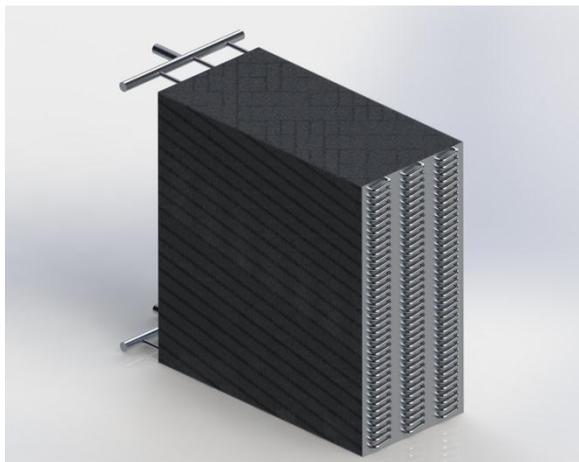


Fig 1: 3D Modelling of heat exchanger

III. MATERIALS & METHODS

(a)MATERIALS

General 7075 characteristics and uses very high strength material used for highly stressed structural parts and heat exchangers. The improved stress corrosion cracking resistance and high thermal conductivity. In original experimental heat exchanger fin and tube material was stainless steel 304 [table1]. Here were changing aluminium alloy 7075material for fin and tube of the heat exchanger.

TABLE1: Materials

(b)METHODS

The design parameters of the ceramic heat exchanger was considered from the paper "analysis and cfd simulation on the aluminium alloy 7075 heat exchanger" modeling of aluminium alloy 7075 heat exchanger by using SOLID WORKS 14.0 software. Create finite volume mesh for 3D model of ceramic heat exchanger by using CFD software. Perform flow analysis of ceramic heat exchanger using SOLID WORKS Fluent software to determine the flow rate.

CFD is useful for studying fluid flow, heat transfer; chemical reactions by solving mathematical equations with the help of numerical analysis. CFD resolve the entire system in small cells and apply governing equations on these discrete elements to find numerical solutions regarding pressure distribution, temperature gradients. This software can also build a virtual prototype of the system or device before can be apply to real-world physics to the model, and the software will provide with images and data, which predict the performance of that design [fig2].

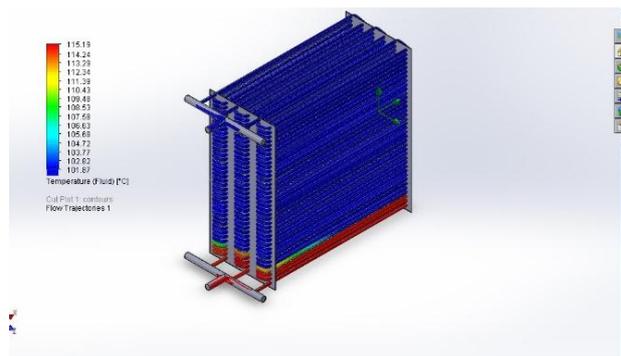


Fig 2: Water flow diagram in CFD analysis

IV. SOLUTIONS  
EXPERIMENTAL OBSERVATION

Temperatures at different materials of fin are measured by using infrared thermocouple.

TABLE 2: Temperature of fins in (°c)

SI.NO	Temp (°c)
1	85
2	90
3	95
4	100

5	115
6	120

Estimation of inside convective heat Transfer coefficient Mean temperature of air inside the intercooler = 115 °C

## V. RESULT AND DISCUSSION

The heat exchange optimization function is defined as the amount of dissipated heat to the heat exchanger weight for a one row heat exchanger. The material of the fin is changed to calculate heat transfer, reduce the total mass that refers to the cost of the whole heat exchanger. The performance of the heat transfer process in a given heat exchanger is determined for different fin material, considering the fluid flow. Fin geometry affects the heat transfer phenomenon between the plate itself and the air. Changing the fin material, the fluid streamline can be modified in a way that it affects the temperature changes on the fin surface and heat convection conditions. Numerical analyses are carried out to examine a modified finned tube heat exchanger. No changes are done to the inlet and outlet temperature and pressure values. The material of the fin and tube is modified to calculate heat transfer for different conditions, reduce the total mass that refers to the cost of the whole heat exchanger. The temperature difference is found numerically and the solid volume and temperature is calculated for different fin and tube material.

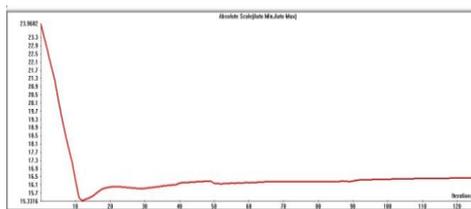


Fig:3 Temperature Result

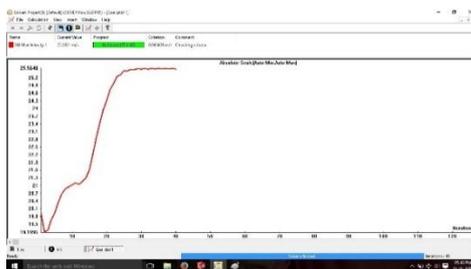


Fig 4: Air velocity result diagram

## VI. CONCLUSION

The Simulation work is successful and the work is validated in the thesis. We find the more heat transfer rate when we used aluminium alloy 7075 material.

The various conclusions drawn from the thesis work are

Temperature variations has been analyzed by performing fluid flow analysis of stainless steel 304 heat exchanger is 90° c for outlet temperature boundary conditions.

And for aluminium alloy 7075 heat exchanger is 98° c. Effectiveness for stainless steel 304 heat exchanger is 51%, and for aluminium alloy 7075 heat exchanger is 56%.

Hence optimization has been done to improve the efficiency. From the above results we observed that the changing the material aluminium alloy 7075 heat exchanger is more efficient than original experimental model.

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