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Design And Analysis of Circular Radiator

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Abstract

Radiators are utilized to transfer heat energy from one appliance to additional for cooling & heating purposes. The radiator is used to cool internal combustion engines, especially in cars but also on piston-powered aircraft, in train cars, in a stationary production plant, or in similar use of such an engine. The flow behavior and temperature profile forecast in radiator tubes are very useful and very important information for the designer. The automotive engine cooling system absorbs excess heat generated during engine operation. The car cooling system controls the engine temperature to make it more efficient. Also, reducing fuel consumption and controlling engine emissions reduce pollution processes. This paper sheds light on parameters that affect radiator performance and reviews some of the most common and modern ways to improve radiator performance.

This paper is mainly focused on the change of design from the existing radiator to increase the efficiency of water cooling in automobile radiators. The model is creating in CREO parametric software, both existing & proposed models (circular radiator). Furthermore, analysis both the model created on CFD in ANSYS software. Towards check both the model temperature difference and choose the better radiator model with the help of ANSYS software.

Keywords: *Radiator, Increase Efficiency, Temperature difference, Creo parametric, & ANSYS software*

I. INTRODUCTION

The term "radiator" refers to a form of the heat exchanger. It is designed to transfer heat from a heat exchanger to a fan. Many modern cars use aluminum radiators. These radiators are made by tying small aluminum wings to aluminum tube tubes. The coolant flows from the inlet to the stop in a series of tubes arranged in the same manner. The wings carry heat from the tubes & transmission it to the air flowing over the radiator.

Radiators are cooling devices installed in cars. These devices primarily store the engine temperature at the right level. Car radiators should not be confused with home radiators used for heating homes. Radiators are usually made of aluminum or copper and consist of a series of pipes around the cooling circuit (water or artificial cooling). Generally, a radiator is a heat transfer device used to transfer heat energy from one person to another for cooling and heating purposes. Radiators contain a large amount of cooling area and use an air stream to remove ambient heat. With easy access to cooling temperatures, effective cooling is available.

A. TYPES OF RADIATOR

Tubular Type Core

The top and bottom tanks are interconnected by a series of tubes that allow water to flow between them in the tubular form. To enhance heat transfer, wings are mounted across the tubes. The air circulates along the outside of the tubes but between the wings, collecting heat from the passing water. Since water flows through all of the tubes in a tubular radiator, if one is closed, the entire tube loses its cooling impact.

Cellular Type Core

Air moves across tubes while the water goes through the spaces between them in a cell-type method. The heart consists of a large number of independent air cells that are encased in water. The honeycomb radiator is a common name for this cell type because of its design, particularly when the front cells are triangular.

II. LITERATURE REVIEW

Chavan & Tasgaonkar's low-lying areas and high-temperature areas (regions with low heat transfer areas) are identified in the corners. We see that the velocity increases with the rpm of the radiator fan. For optimal performance, it eliminates corners and improves the radius of the Circular mode. The low power consumption of the fan works well because the cost savings of the equipment is 24%, the cost savings on the production of large scale will be about 20% when the operation is done. **Chavan et al.,** Hydraulic actuators such as pumps and motors were selected to obtain the required force of gravity. The calculation and temperature of the same temperature are calculated. To eliminate temperature growth, a cooling radiator is performed using the standard LMTD method. The wings have been shown solely to give a sense of proportion. The design has been successfully adapted to the available environment. Radiator analysis was performed using CFD in ANSYS Fluent.

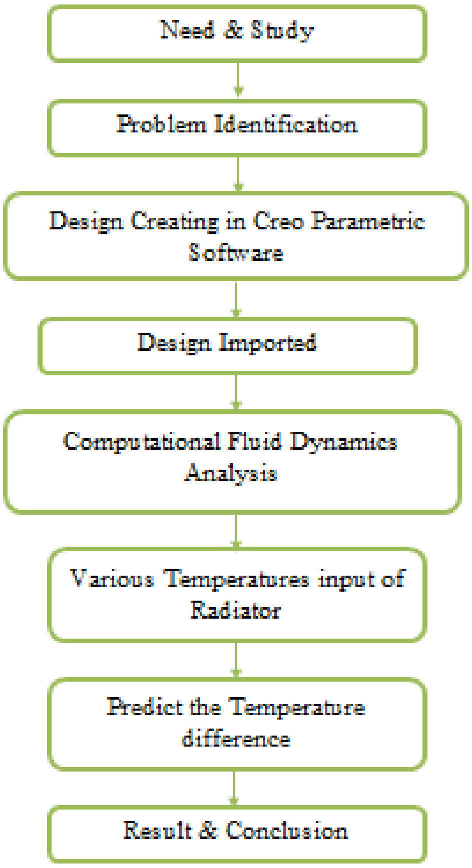
Hardikkumar Patel & Deepu Dinesan using CFD were identified by comparing the heat transfer and pressure reduction of the heat exchanger with different performance parameters. Reduction of **Vishwa Deepak Dwivedi and Ranjeet Rai** in the cooling capacity of the incoming air temperature while the cooling capacity rises with the rise of the incoming cooling temperature. Decreased pressure also increases with increasing air pressure and with a decrease in the ratio of weight to the radiator. Approximately 6% increase in cooling capacity using a hot-duty louver fin with Nanofluid compared to a standard cooler with the same model.

Channankaiah & Arunpandiyan, various types of engine cooling arrangement, have been considered by investigators through experimental & statistical analysis. The Fluid & air-cooling processes are two significant features of the cooling method. In an air conditioning process, by changing the wings & position of the radiator, the radiator cooling volume can be better. While you are in the process of cooling fluid by adjusting radiator tube, wings, spine, fan & coolant (Nano fluid), radiant cooling capacity can be enhanced. **Dhanunjaiah** the efficiency of the internal combustion engine cooling process depends largely on the presentation of its elements. The key element in this process is radiator. It is described that radiator works better compared to aluminium radiator outstanding to the high temperature decrease. Though, aluminium radiator is considerable inexpensive. It is suggested to use radiator over aluminium radiator due to the high temperature decrease.

Pratibha Radhakrishna Walunj & Nitin Korde has 16% to 24% thermal conductivity while transferring heat from coolant to air; in this case the other heat transfer loss is due to the heat transfer to the atmosphere and the remaining heat transfer loss is not expected to heat transfer loss. As the temperature of the cooling penetration increases the temperature of the wall also rises. **Sandeep Patell & Deshmukh** engine reduction and under package space are major challenges in designing an engine cooling system. The process of performing an industrial design analysis of a car radiator system provides a cumbersome estimate of core size but to make it larger we need to use simulation systems. Cooling system simulation helps design engineers simplify design work using different configurations.

Urvi Tushar Nagar and Bharatkumar Manharlal Trivedi the main advantage is that the circular section has a small rotation between all other mixed parts and the pressure compression problem is also removed. Various types such as rectangular have a high stress concentration, which is why it is solved here. And the production of a round shape is much easier. **Ram Jatan Yadav et al.,** Radiator performance is calculated on the basis of the structure and selection of the materials discussed above by selecting specific parameters. Various materials such as Aluminum 6061 T6 and copper alloy are recognized on the basis of their thermal conductivity and thermal conductivity. Considering the parameter structure and materials of the selected radiator is built.

III. WORKING METHODOLOGY



A. PROBLEM IDENTIFICATION

The rectangular radiator heat transfer method has provided better results and is suitable for a few cars in the automotive industry. Therefore, current work has been considered under this area to improve the efficiency of heat transfer with the help of a circular radiator.

B. OBJECTIVE

In our project is heat transfer with help of circular radiator method. It's useful to the more space available. So mainly focused in improve the efficiency. The design is creating in Creo parametric software & analysis based on computational fluid dynamics in Ansys software check the performance.

IV. DESIGN & ANALYSIS OF CIRCULAR RADIATOR

CAD will be defined as the use of systems to facilitate the design, modification, testing or simplification of a project. Computer systems include a hardware and software program to perform the specific construction tasks required using a user firm. CAD computer hardware usually includes a computer, single or large image embedded in display terminals, keyboards, and an additional border system.

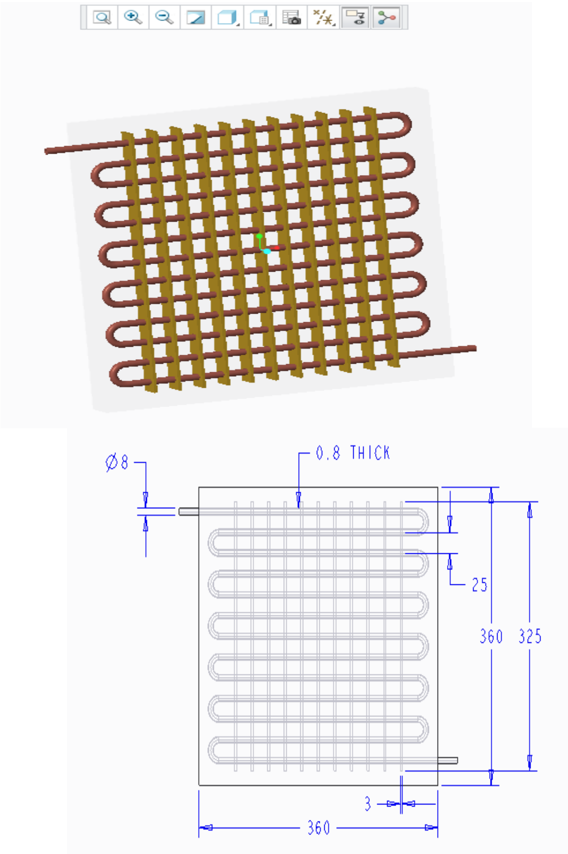


Fig. 1 Rectangular Radiator Heat Transfer Arrangement with Dimension

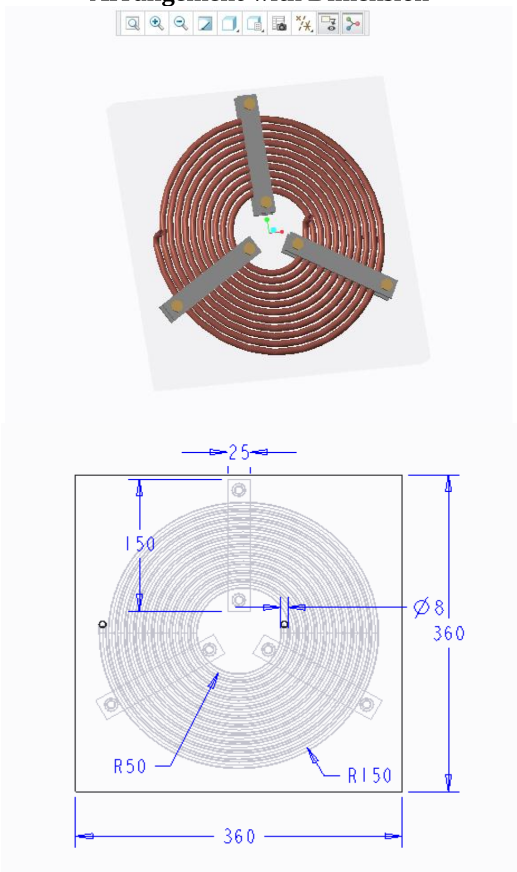


Fig. 2 Circular Radiator Heat Transfer Arrangement with Dimension

A. INTRODUCTION OF FEM

FEM is a mathematical application of the result of experimental solutions that are close to different areas of calculation. Price analysis performed using FEM is often referred to as Finite Element Analysis (FEA). General FEA applications have field, thermal, electrical and water problems. Engineers use it to minimize models and physical tests and use certain materials in their construction component to make better, faster products.

Analysis Procedure

Step: 1 Model should create in creo parametric software, furthermore part file converted to IGES file.
Step: 2 Analysis using computational fluid dynamics (fluid flow fluent) in ANSYS software
Step: 3 Geometry – double click – file – import geometry file (IGES file) – generate
Step: 4 Mesh – double click – mesh right-clicks – generate mesh – model faces one by one right-clicks to create named selection – mesh update.
Step: 5 Setup – double click – double-precision tick
Step: 6 Model – energy on & viscous standard k-e, standard wall function.
Step: 7 Materials – fluid – edit – fluid database – choose (Water Liquid) – to change the properties (Various degree C) – solid – edit – fluid database – change solid – choose the material (Copper).
Step: 8 Cell zone condition – include properties (Copper tube)
Step: 9 Boundary condition – input and output apply (Water Flow & Air Flow)
Step: 10 Solution initialization – hybrid initialization
Step: 11 Run calculation – Number of iteration– calculate
Step: 12 Results – report – surface integral – set up – report type (area-weighted average) – field variable (temperature) – surface select (inlet & outlets) – compute.

B. COMPUTATIONAL FLUID DYNAMICS

CFD is the analysis of fluid flow values, heat transfer, & related conditions. CFD solvers encompass a difficult set of algorithms utilized to model & simulation the flow of liquids, gases, heat, & electric currents. Many technological advances in space, automobiles, and space would not have been possible without CFD. Applications such as aerofoil design in aeronautics pull simulations in automotive construction, jet and hot flow in engine construction, and air conditioning

Table 1 Water Properties

Description	Units	Water			Air
		50	75	100	30
Density	kg/m^3	988	974	958	1.245
Specific Heat	J/ kgK	4180	4192	4217	1006
Thermal Conductivity	W/m K	0.644	0.667	0.679	0.024
Viscosity $x10^{-3}$	kg/ms	0.547	0.378	0.282	0.017

Table 2 Temperature Difference in Conventional Radiator Model

Water			Air		
Mass flow rate	Inlet Tem.	Outlet Tem.	Mass flow rate	Inlet Tem.	Outlet Tem.
kg/s	℃	℃	kg/s	℃	℃
0.01589	50	48.00	0.07931	30	32.09
	75	71.62		30	35.10
	100	96.65		30	36.87

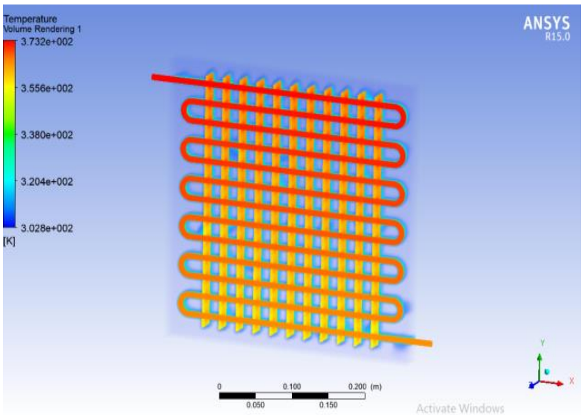


Fig. 3 Conventional Radiator Temperature Difference of Water at 100℃

Table 3 Temperature Difference in Proposed Radiator Model

Water			Air		
Mass flow rate	Inlet Tem.	Outlet Tem.	Mass flow rate	Inlet Tem.	Outlet Tem.
kg/s	℃	℃	kg/s	℃	℃
0.01589	50	47.74	0.07931	30	32.18
	75	69.92		30	35.14
	100	92.20		30	37.36

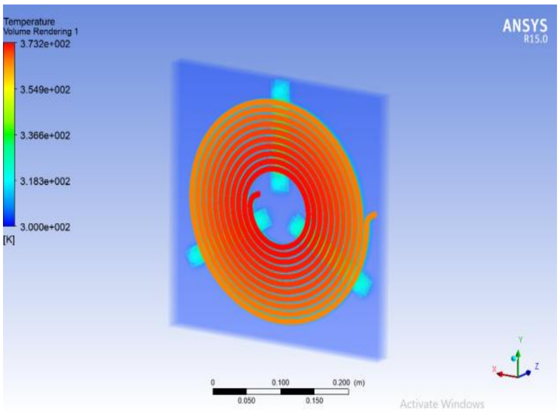


Fig. 4 Proposed Radiator Temperature Difference of Water at 100℃

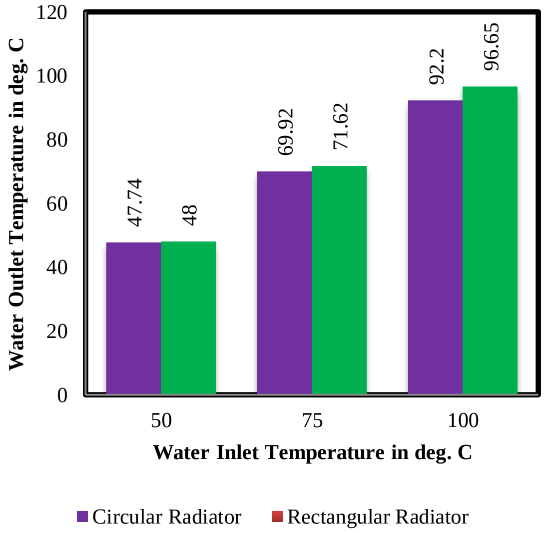


Fig. 5 Comparison of Radiator Temperature Difference

ADVANTAGE

- It has a high heat dissipation rate. It is self-evident that it saves both material & resources.
- Oxidation corrosion resistance is excellent.
- They are extremely quick to react.
- They are less polluting because they are produced in an environmentally friendly manner.
- Radiators have the advantage of retaining heat due to the ceramic, cast iron, as well as other materials in use in their construction.

APPLICATION

- Automatic transmission fluid
- Air conditioner
- Automobiles

V. CONCLUSION

The efficiency of an IC engine cooling process is largely subject to the routine of its elements. The key element in this process is the radiator. It is described that the copper radiator is working well, but our project is more focused on the radiator model. Circular & Rectangular type radiator with different temperatures, we concluded that circular type radiator works much better compared to rectangular type radiator.

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