Thermal analysis and optimal design of an automotive radiator

Science - Technology and Innovation

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Abstract

The objective of the project is to make a design proposal for a car radiator with which can reduce the weight of the automotive radiator so that the car is lighter and at the same time consume less gasoline, in order to reduce CO_2 emissions emitted by automobiles into the environment The radiator is an elementary system in the car to help control engine temperature but it is a component heavy and that occupies a large space in the car, so a study of a Tsuru radiator to study its characteristics and efficiencies in order to make the improvements proposals but reducing the weight and size maintaining the same performance of cooling required to control engine temperatures.

Efficiencies, Objective, Reduced, Component, Proposed, Reducing, Elemental, Contribute, Improvements, Maintaining

Introduction

In modern internal combustion engines between 20% and 40% of the heat released by the fuel is dissipated as heat through the cooling system. If the engine's cooling system is liquid, cross-flow heat exchangers are generally used to transfer the heat from the coolant to the air encountered by the vehicle and driven, according to coolant temperature control, by a fan. Radiators present various design parameters and the relationships between these and performance constitute complex, non-linear expressions with numerous experimental adjustment parameters. An engine generates high rates of heat that needs to be cooled and dissipated, that's where the radiator comes in, a fundamental part of a vehicle's cooling system. If an engine does not dissipate its heat properly, it overheats and the consequences in certain cases can be fatal for the car. So in this project it will be about optimizing the performance of the radiator where a model of a Tsuru radiator was developed for its study and design in SolidWorks and based on this, develop a different arrangement in the tubes because we consider that it is a part of the radiator that influences when it comes to dissipating as much heat as possible and seeking to reduce its weight, thus lightening the weight of the car to reduce gasoline consumption and CO_2 emissions. Therefore, the problem to be solved in this project will be to arrange the tubes to dissipate the heat produced by the engine and be able to carry out our objectives.

Materials and methods

Development of the configuration, analysis and design of tubes for a car radiator

Once the parameters for the study have been established, the simulation is run to obtain the required data and start the design of the radiator tube, varying its dimensions such as width, length and thickness. The radiator model will be carried out through analysis by the SOLIDWORKS Flow Simulation tool and prepare the radiator to perform the calculations and define the boundary conditions.

Study parameters:	Units:
- Fluid velocity.	0.43m/s
- Water temperatura.	86.5 C
- Air temperatura.	**20** C
- Heat transfer coefficient.	168.35 [W/m2-K]
- Pressure taken for the radiator pipe to which it may be subjected.	103 kpa

Table 1 Parameters for the simulation

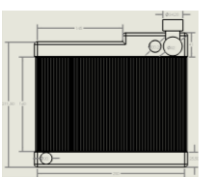
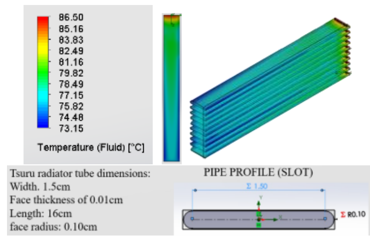


Figure 1 Automotive radiator dimensions

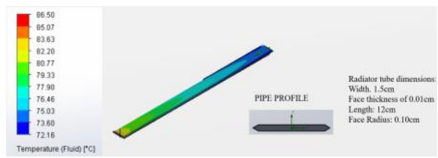
For this study, a radiator tube will be analyzed in particular, which must comply with the specification of being a closed volume and define its inlets and outlets before analyzing the flow, for which all the openings of the model must be closed by adding caps.

Results

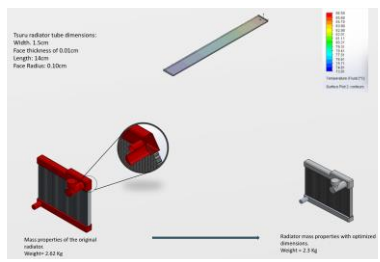
According to the compilation of the data obtained by SOLIDWORKS Flow Simulation on the radiator we were able to see the temperature flows, and in this way start with our design of the tube with dimensions that will favor reducing its size but at the same time offering the same decrease in temperature.



In the results of the Tsuru radiator with the respective dimensions, it offers us a cooling of the fluid at the inlet of 86.5 and a temperature reduction at the end of the tube of 73.15. In the following design, the same parameters will be followed for the analysis but considering a square tube with triangular corners. And it turned out to be very favorable for us since this design offers us a better cooling in the fluid and with less material use for the radiator.



In the results of the Tsuru radiator with the respective dimensions when changing, it offers us a cooling of the fluid at the inlet of 86.5 and a temperature reduction at the end of the tube of 73.91, which is ideal for its operation, helping us to meet the proposed objective, since the amount of material used was less since when we observed we could see that there was material to spare.



Conclusions

The results were as expected, we were able to complete the analysis of the radiator and also design different radiator tube profiles that helped us reduce material to meet our goal of reducing CO_2 emissions while offering a good cooling system.

Future of research

Focus the development of the project on the reduction of weight and size, testing different configurations in the arrangement of radiator tubes for cooling.

Acknowledgments

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