

Modeling and Fluid Flow Analysis of Wavy Fin Based Automotive Radiator

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Highlights

- ✓ Modeling of Wavy fin based Heavy vehicle automotive radiator.
- ✓ CFD simulation of cross flow heat transfer of nanofluids in circular tubes.
- ✓ Compare the cooling capacity by estimating temperature distribution of nanofluid as coolant to water/EG as base fluid alone.

Abstract:

In continuous technological development, an automotive industry has increased the demand for high efficiency engines. A high efficiency engine is not only based on its performance but also for better fuel economy and less emission rate.

Radiator is one of the important parts of the internal combustion engine cooling system. The manufacturing cost of the radiator is 20 percent of the whole cost of the engine. So improving the performance and reducing cost of radiators are necessary research. For higher cooling capacity of radiator, addition of fins is one of the approaches to increase the cooling rate of the radiator. In addition, heat transfer fluids at air and fluid side such as water and ethylene glycol exhibit very low thermal conductivity. As a result there is a need for new and innovative heat transfer fluids, known as "Nanofluid" for improving heat transfer rate in an automotive radiator. Recently there have been considerable research findings highlighting superior heat transfer performance of nanofluids about 15-25% of heat transfer enhancement can be achieved by using types of nanofluids. With these specific characteristics, the size and weight of an automotive car radiator can be reduced without affecting its heat transfer performance.

An automotive radiator (Wavy fin type) model is modeled on modeling software CATIA V5 and performance evaluation is done on pre-processing software ANSYS 14.0. The temperature and velocity distribution of coolant and air are analyzed by using Computational fluid dynamics environment software CFD. Results have shown that the rate of heat transfer is better when water fluid (ie C + water) is used as coolant, than the conventional coolant.

Keywords: Automotive radiator, Nanofluid, Wavy fin and circular tube geometry, performance parameters.

1. Introduction

As a type of compact heat exchangers, plate fin heat exchangers are used in a wide variety of applications. Typical among these are automobile radiators, air conditioning evaporators and condensers, charge air coolers, electronic cooling devices and cryogenic exchangers to meet the demand for saving energy and resources. To reduce the size and weight of heat exchangers, various augmented surfaces have been developed to improve the air side heat transfer performances. Typical fin geometries are plain fins, wavy fins, offset fins, perforated fins, pin fins and louvered fins. For the complex geometries, which are usually set up in a cross flow arrangement, with wavy fin geometry in a compact automotive radiator, heat exchangers are used either individually or as components of a large thermal system, in a wide variety of commercial, industrial and household applications, e.g. power

generation, refrigeration, ventilating and air-conditioning systems, process, manufacturing, aerospace industries, electronic chip cooling as well as in environmental engineering. The improvements in the performance of the heat exchangers have attracted many researchers for a long time as they are of great technical, economical, and not the least, ecological importance.

Recent technological development in automotive industries has required for high efficiency engines. A high efficiency engine is not only based on the performance of radiator but also depends on better fuel economy and less emission rate. Reducing the vehicle weight by optimizing design and size of a radiator is a capital feature. Addition of fins is one of the approaches to increase the heat transfer rate of radiator, provides greater heat transfer area and enhances the air convective heat transfer coefficient. The typical tube geometry used in the compact

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Fluid Mechanics and Fluid Power, Volume 1 Krishna Mohan Singh, Sushanta Dutta, Sudhakar Subudhi, Nikhil Kumar Singh, 2024-01-06 This book comprises select peer reviewed proceedings of the 9th International and 49th National Conference on Fluid Mechanics and Fluid Power FMFP 2022 This book brings together scientific ideas and engineering solutions put forth by researchers and practitioners from academia and industry in the important and ubiquitous field of fluid mechanics The contents of this book focus on fundamental issues and perspective in fluid mechanics measurement techniques in fluid mechanics computational fluid and gas dynamics instability transition and turbulence fluid structure interaction multiphase flows microfluidics bio inspired fluid mechanics aerodynamics turbomachinery propulsion and power and other miscellaneous topics in the broad domain of fluid mechanics This book is a useful reference to researchers and professionals working in the broad field of mechanics

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Energy Management and Conservation Handbook Frank Kreith,D. Yogi Goswami,2007-07-06

While researchers work overtime to create new technologies and methods of providing energy it is critical that modern industry makes the most efficient use of the energy that is currently available The Energy Management and Conservation Handbook offers expert guidance on the planning and design of green technologies It focuses on management strategies for better utilization of energy in buildings and industry as well as ways of improving energy efficiency at the end use Renowned authorities from around the globe share insights and modern points of view on a broad spectrum of topics Summarizing proven energy efficient technologies in the building sector the book includes examples that highlight the cost effectiveness of some of these technologies It introduces basic methods for designing and sizing cost effective systems and determining whether it is economically efficient to invest in specific energy efficiency or renewable energy projects It provides guidance for computing measures of economic performance for relatively simple investment choices and the fundamentals for dealing with complex investment decisions The book also describes energy audit producers commonly used to improve the energy efficiency of residential and commercial buildings as well as industrial facilities After developing the basics of HVAC control the book explores operational needs for successfully maintained operations It describes the essentials of control systems for heating ventilating and air conditioning of buildings designed for energy conserving operation The book also defines demand side management covers its role in integrated resource planning and delineates the main elements of its programs The book demonstrates these concepts with case studies of successful demand side management programs These features and more provide the tools necessary to improve energy management leading to higher energy efficiencies

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