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DESIGN, FABRICATION AND PERFORMANCE EVALUATION OF NANO TECHNOLOGY INTEGRATED NEXT GENERATION AUTOMOTIVE RADIATOR

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ABSTRACT

Automotive radiator is a key component of engine cooling system. The demand for more powerful engines in smaller hood spaces has created a problem of insufficient rates of heat dissipation in automotive radiators. As a result, many radiators must be redesigned to be more compact while still having sufficient cooling capabilities. Radiator size mainly depends on core for heat rejection requirement. Conventional radiator fins are limited to aluminium, one of our approach is replacing the fin material with MWCNT (Multi wall carbon Nanotube) composite to improve heat dissipation and also reduce the overall size of the radiator.

KEYWORDS: Radiator core, MWCNT, Nano fluid, Heat dissipation.

INTRODUCTION

Cooling is one of the top technical challenges to obtain the best automotive design in multiple aspects (performance, fuel consumption, etc.). Automotive radiator is an important part of the engine cooling system. Radiator is a heat exchanger that removes heat from engine coolant passing through it. Heat is transferred from hot coolant to outside air. Radiator assembly consists of three main parts core, inlet tank and outlet tank as shown in fig.1. Core has two sets of passage, a set of tubes and a set of fins. Coolant flows through tubes and air flows between fins. The hot coolant sends heat through tubes to fins. Outside air passing between fins pickups and carries away heat as shown in fig 2. Due to limited space at the front of the engine, the size of the radiator is restricted and cannot be essentially increased. Therefore, it is necessary to increase the heat transfer capabilities of working fluids such as water and ethylene glycol in radiators because of their low thermal conductivity and also the area of heat transfer is increased by utilizing the extended surfaces in the form of fins attached to walls and surfaces.

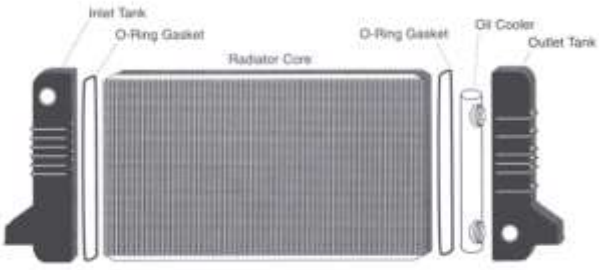

Fig-1: Radiator assembly

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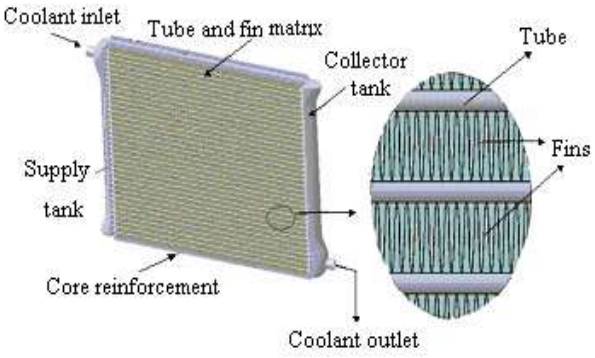

Fig 2:Radiator flow circuit

PROBLEM DESCRIPTION

The Design for an automotive radiator offers challenges in terms of determining the best configuration of the selecting the Material, recommending the type of layout of the tubes with addition of fins (if any), choosing the type of coolant and the flow rate of the coolant, etc. The present work will explore concepts of next-generation radiators that can adopt the high performance carbon Nanotubes (CNT) which will enhance the heat transfer due to its thermal conductivity. Also, the work utilizes the Nano fluid as heat absorbing medium. The development of Nano fluids, which have better conduction and convection thermal properties, has presented a new opportunity to design a high energy efficient, light-weight automobile radiator. Our new design concept is similar to current radiators, but replacing aluminium with carbon Nanotubes (CNT) and Nano fluids used to enhance heat dissipation

LITERATURE SURVEY

Today the Nano Technology Integrated next generation Automotive Radiator is one of the most active areas in automobile cooling system. Most of the early investigations are reviewed by Choi & Eastman have tried to suspend various metal and metal oxide nanoparticles in different fluids. Putnam et al. have observed that the effective static thermal conductivities of Al based nano fluids were independent of part loading. Experiments on convection heat transfer of nano fluids were conducted by several research groups. The experimental results show significant improvements in heat transfer rates of nano fluids. Robert et al. started a project in 2008 that employed Nano fluids for industrial cooling that could result in energy savings & resulting emission reductions. Singh et al. have investigated that the use of high thermal conductivity Nano fluids in radiators can lead to reduction in the frontal area of the radiator by up to 10%. The fuel efficiency and also vehicle performance will increase by reducing the size of the components. Vasu et al. have used aqueous alumina as a coolant on automobile flat tube plain fin compact heat exchanger. Tzeng et al. investigated the temperature distribution of rotary blade coupling transmission used in four wheel drive vehicles. They concluded that use of nano fluids in the transmission has a clear advantage from the thermal performance view point. Ravikanth et al. used the nano fluids in radiator to study the heat transfer performance. They used the CuO and Al_2O_3 for their study.

From the literature survey it is observed that a systematic study of carbon Nanotube CNT based radiator has not yet carried out. In addition, current radiator designs are extremely limited and have not experienced any major advancement in recent years. As described above, the main problem the current radiators experience is a large resistance to heat transfer caused by air flowing over the radiator. Current radiators also experience head resistance, are very bulky, and impose limitations on the design of the vehicle.

OBJECTIVE

Following are the objectives of the Project Work

1. To reduce the overall size of the radiator while simultaneously increasing the surface area exposed to the air, thus reducing the air side resistance.
2. The project will explore the concepts of next-generation radiators that can adopt the high performance Nano fluids.
3. Replacing the fin material with CNT composite to improve heat dissipation.
4. Improved engine performance due to compact and effective cooling system.

METHODOLOGY

1. Literature review of different types of radiators and Nano fluids.
2. Presently radiator fins are limited to aluminum, one of our approach is to choose a new fin material.
3. Fabricating the radiator core with Aluminum and CNT integrated fins.
4. Selection and preparation of the Nano fluid used as the heat transfer medium.
5. Testing the CNT integrated radiator with the Nano working fluid in a standard test Rig.

EXPERIMENTAL SETUP

For this thesis work, the Radiator core integrated with Aluminium and CNT fins will be tested for Maruti 800 engine. The final results obtained from the experimental method will be compare with conventional radiator.

POSSIBLE OUTCOME

The outcome would be to develop a new concept automotive radiator involving Nano Technology which is required to reject enhanced amount of heat compared to the conventional radiator designs while lowering the fluid inlet temperature. Also, the proposed design might reduce the size and the weight of the radiator thus enhancing the overall performance of the automobile.

REFERENCES

[1] Witry, M.H. Al-Hajeri, Ali A. Bondok, "Thermal performance of automotive aluminum plate radiator" Applied Thermal Engineering, Volume 25, Issues 8–9, June 2005, Pages 1207-1218.
[2] J. A. Eastman, S. U. S. Choi, S. Li1, W. Yu, and L. J. Thompson, "Anomalously increased effective thermal conductivities of ethylene glycol-based Nano fluids containing copper nanoparticles." Applied Physics Letters / Appl. Phys. Lett. 78, 718 (2001).
[3] Oliet, A. Oliva, J. Castro, C.D. Pérez-Segarra , "Parametric studies on automotive radiators" Applied Thermal Engineering, Volume 27, Issues 11–12, August 2007,
[4] S. Zeinali Heris, S.Gh. Etemad Nasr Esfahany , "Experimental investigation of oxide nanofluids laminar flow convective heat transfer"
[5] S.M. Peyghambarzadeh, S.H. Hashemabadi, M. Seifi Jamnani, S.M. Hoseini , "Improving the cooling performance of automobile radiator with Al2O3/water nanofluid"
[6] Q. Yu, A.Straatman, and B. Thompson, "Carbon-Foam Finned Tubes in Air-Water Heat Exchangers," Applied Thermal Engineering, 26 (2006) pp. 131-143.
[7] C. Harris, M. Despa, and K. Kelly, "Design and Fabrication of a Cross Flow Micro Heat Exchanger," Journal of Microelectromechanical Systems, vol. 9, no. 4, pp. 502-508, December 2004.
[8] JP Yadav and Bharat Raj Singh, "Study on Performance Evaluation of Automotive Radiator" S-JPSET : ISSN : 2229-7111, Vol. 2, Issue 2
[9] Salvio Chacko, Dr. Biswadip Shome, and Vinod Kumar A.K. Agarwal , D.R. Katkar, "Numerical Simulation for Improving Radiator Efficiency by Air Flow Optimization"
[10] Yang, Z., Bozeman, J., Shen, F.Z., Turner, D., Vemuri, S., and Acre, J., "CFRM concept for vehicle thermal systems", SAE-01-1207, 2002.
[11] Prof. D. K. Chavan, Prof. Dr. G. S. Tasgaonkar, "Thermal Optimization of Fan assisted Heat Exchanger (Radiator) by Design Improvements" IJMER, Vol.1, Issue1, pp- 225-228.
[12] S.M. Peyghambarzadeh, S.H. Hashemabadi, S.M. Hoseini, M. Seifi Jamnani, "Experimental study of heat transfer enhancement using water/ethylene glycol based nanofluids as a new coolant for car radiators" International Communications in Heat and Mass Transfer, Volume 38, Issue 9, November 2011, Pages 1283-1290
[13] Qijun Yu a, Anthony G. Straatman a, Brian E. Thompson, "Carbon-foam finned tubes in air–water heat exchangers" Applied Thermal Engineering 26 (2006) 131–143.
[14] Q. Yu, Thermal engineering model for air–water heat exchangers made of carbon foam finned tubes, M.E.Sc. Thesis, The University of Western Ontario, London, Canada, 2004.
[15] C.N. Gallego, W.J. Klett, Carbon foams for thermal management, Carbon 41 (2003) 1461–1466.
[16] S.N. Sridhara, S.R. Shankapal and V. Umesh Babu, "International Conference on Mechanical Engineering 2005" (ICME2005) 28- 30 December 2005,
[17] Al-Hajeri and Ali A. Bondac, 2003, "CFD analysis of fluid flow and heat transfer in patterned roll bonded aluminium radiator", 3rd International conference on CFD, CSIRO, Melborne, Australia, pp. 12-19.
[18] J A Chen, D F Wang and L Z Zheng, 2001, "Experimental study of operating performance of a tube-and-fin radiator for vehicles", Proceedings of Institution of Mechanical Engineers, Republic of China, 215: pp. 2-8.

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Impact Factor: 4.116
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[19] Changhua Lin and Jeffrey Saunders, 2000, "The Effect of Changes in Ambient and Coolant Radiator Inlet Temperatures and Coolant Flowrate on Specific Dissipation", SAE Technical Papers, 2000-01-0579.

[20] Peyghambarzadeh, S.H. Hashemabadi, S.M. Hoseini, M. Seifi Jamnani, "Experimental study of heat transfer enhancement using water/ethylene glycol based nanofluids as a new coolant for car radiators" International Communications in Heat and Mass Transfer, Volume 38, Issue 9, November 2011, Pages 1283-1290.