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To improve thermal performance of radiator as a cooler for domestic application

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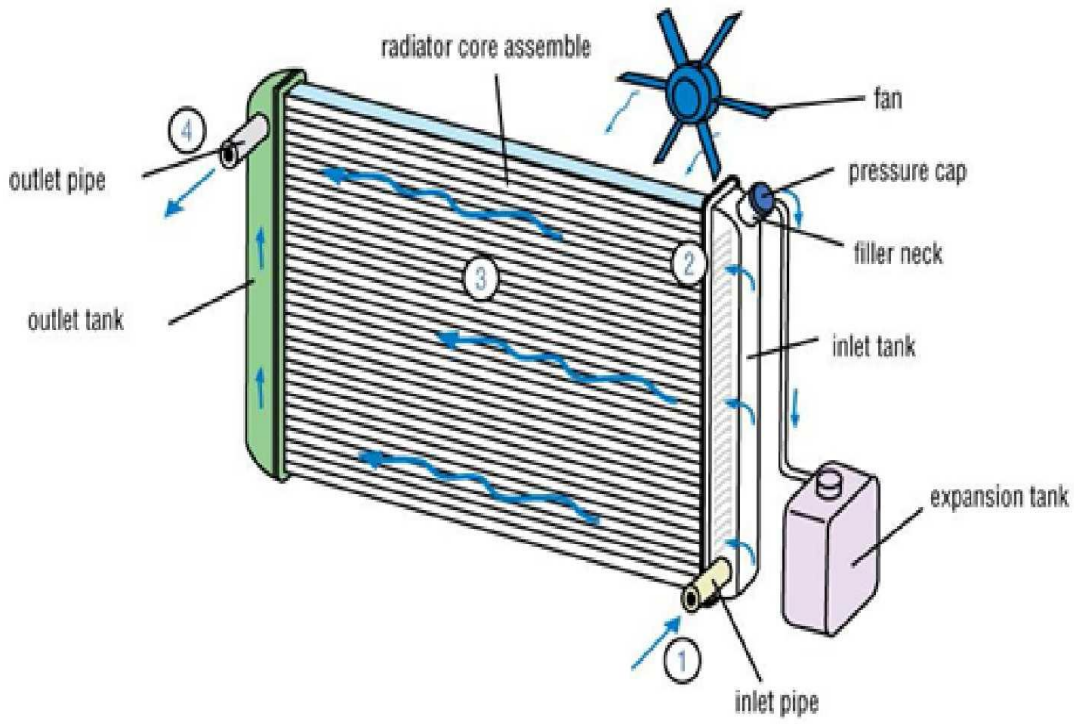
Abstract — *We all know that the temperature of our atmosphere is increasing day by day. So the requirement of coolers is necessary in our life. But because of high cost air conditioners poor people cannot take the benefit of cool air. So we decided to make a low cost cooler using radiator. Radiators are heat exchangers which are used to transfer heat from one medium to another medium for the purpose of cooling or heating. The heat exchangers or radiators used in automobiles/IC engines are either rectangular or square in shape, but because it is heat exchanger it can also be used as moist free cooler. In the present work we are using scrap radiators as a moisture free cooler for domestic applications. In this work the cold water will allow to pass to the copper pipes due to which it will cool down and so afterwards when air blows over it the cold air can be achieved and temperature can be measured with the help of k type thermocouples.*

Keywords- *Radiator; Copper tubes; Fan; Submersible pump; PVC Pipes; Water tank*

I. INTRODUCTION

Radiators are heat exchanger used to transfer thermal energy from one medium to another for the purpose of cooling and heating. The majority of radiators are constructed to function in automobiles, buildings, and electronics. The radiator is always a source of heat to its environment, although this may be for either the purpose of heating this environment, or for cooling the fluid or coolant supplied to it, as for engine cooling. To get a specific room temperature, radiators, in which warm water streams, are introduced to give this temperature. For the procurement of the radiators, the planner characterizes the required warmth stream rate, room temperature, warming water mass stream rate and temperature. In light of these information, the radiator providers make their offers. Is the outlined radiator surface too little, temperature will be too low, the proprietor of the room won't be fulfilled and the radiator must be supplanted. If the radiator surface too extensive, the room temperature will be too high. Radiators are made up of copper tubes and when the water is passed it reduce the temperature of water and we get cold air when air blows over it. In the present paper we have done the detailed study of various literature regarding radiators.



II. LITERATURE REVIEW

J.R. Patel, A.M. Mavani has done a comprehensive study of the geometric & operating parameters that affects the heat transfer rate as well as performance of radiator. The fluid flow & heat transfer analysis of single tube fin Arrangement of automobile radiator is successfully carried out using numerical simulation built in commercial software FLUENT. Significant increases of the total heat transfer rates have been observed with the nano particles and its increases overall heat transfer rate. Optimizing the values of mass flow rates and the power rating of the vehicles by generating CFD codes. So many operational & geometric parameters plays an important role in the performance of radiator but the mass flow rate of air one of the operational parameter is play significant effect as the vehicle speed must be controlled by vehicle speed and it feasible to vary the parameter of mass flow rate of air. Pitch of tube for radiator is feasible to air – volume ratio constant. coolants are easily available and coolants as nano fluids give much higher heat transfer rate than base fluid. It has fluid flow heat transfer characteristics. Most of researchers have investigated on the performance of radiator by different parameter study under CFD analysis for improves its efficiency [1].

Matthew Carl, Dana Guy, Brett Leyendecker, Austin Miller have analyzed the heat transfer process involved in the operation of an automotive radiator. The heat sink design of the radiator must then be analyzed using the Effectiveness-NTU method to find the theoretical effectiveness, overall heat transfer rate of the radiator, and outlet temperatures of both air and water[2].

C.-O. Olsson, B. Sundent done the thermal and hydraulic performance of ten radiator tubes has been investigated. The tubes tested are one smooth tube, two rib-roughened tubes, five dimpled tubes and two offset strip fin tubes. The tubes are representative of flat tube geometries applied in automotive heat exchangers, for example radiators. Isothermal pressure drop data were taken for Reynolds numbers in the range of SOMOOO. These data are presented as Fanning friction factors and inlet loss coefficients. Heat transfer data were taken in the same Reynolds number range and the results are presented as Colburn j factors, as well as Nusselt numbers. The tubes are compared by considering the flow area goodness factor and the volume goodness factor. The rib-roughened tubes showed the best performance. The offset strip fin tube results could be correlated within 20% by correlations available in the literature [3].

Long Xu, Shuyu Lin Wenxu Hu presents a new high power ultrasonic (HPU) radiator, which consists of a transducer, an ultrasonic horn, and a metal circular ring. Both the transducer and horn in longitudinal vibrations are used to drive a metal circular ring in a radial–axial coupled vibration. This coupled vibration cannot only generate ultrasound in both the radial and axial directions, but also focus the ultrasound inside the circular ring. Except for the radial–axial coupled vibration mode, the third longitudinal harmonic vibration mode with relative large vibration amplitude is also detected, which can be used as another operation mode. Overall, the HPU with these two vibration modes should have good potential to be applied in liquid processing, such as sono chemistry, ultrasonic cleaning, and Chinese herbal medicine extraction [4].

Parashurama M, Dr. Dhananjaya D, Naveena Kumar R R done the experimental study of the thermal behavior of the single phase flow through a automobile radiator. The radiator is an important accessory of vehicle engine. Normally, it is used as a cooling system of the engine and generally water is the heat transfer medium. For this liquid-cooled system, the waste heat is removed via the circulating coolant surrounding the devices or entering the cooling channels in devices. Nano fluids have attracted attention as a new generation of heat transfer fluids in building in automotive cooling applications, because of their excellent thermal performance. This study attempts to investigate the heat transfer characteristics of an automobile radiator using water combination based CuO nano fluids as coolants. Thermal performance of an automobile radiator operated with nano fluids is compared with a radiator using conventional coolants [5].

Shuyu Lin, Long Xu done the exact analytical theory, the radial vibration of an isotropic circular ring is studied and its electro-mechanical equivalent circuit is obtained. By means of the equivalent circuit model, the resonance frequency equation is derived; the relationship between the radial resonance frequency, the radial displacement amplitude magnification and the geometrical dimensions, the material property is analyzed. For comparison, numerical method is used to simulate the radial vibration of isotropic circular rings. The resonance frequency and the radial vibrational displacement distribution are obtained, and the radial radiation acoustic field of the circular ring in radial vibration is simulated. It is illustrated that the radial resonance frequencies from the analytical method and the numerical method are in good agreement when the height is much less than the radius. When the height becomes large relative to the radius, the frequency deviation from the two methods becomes large. The reason is that the exact analytical theory is limited to thin circular ring whose height must be much less than its radius [6].

Jijun Zhang, Dejian Zhou & Tianshou Liang has done through this article in view of the high power 3D-Sip system encapsulate water-cooled radiator design and optimization, we get the following main conclusions: (1) within the scope of a certain velocity, fluid outlet temperature with the increase of flow velocity increasing trends: the greater the 1449

flow velocity, the higher outlet temperature. (2) the fin height and velocity of certain premise condition, with the increase of fin spacing, the outlet temperature of the fluid as also increases, but the rate of change of temperature is tend to flat trend; With the increase of fin thickness, fluid outlet temperature as also increase, but the tendency of increase with the temperature change rate is tend to (3) based on the concept of Pareto optimal solution computation of individual fitness method, with the aid of the level of the Pareto solutions and the corresponding population selection operator in the optimization process between China and the DPRK Pareto optimal solution in the direction of evolution can quickly get optimal solution set, and have a good optimization effect. When to exit temperature as the main target can choose close to y reference points, when the inlet pressure as the main target can choose near the x axis reference point, as far as possible in the actual decision, finally also according to the actual situation in the choice of preference solution and multiple attribute decision making method to determine the final solution set [7].

JP Yadav and Bharat Raj Singh has done a complete set of numerical parametric studies on automotive radiator has been presented in detail in this study. The modeling of radiator has been described by two methods, one is finite difference method & the other is thermal resistance concept. By a detailed literature survey a number of recommendations have been provided for the development of a more effective & compact radiator. All these recommendations are listed in the future scope section. These recommendations demand changes from the range of the geometrical parameters to the extent of coolant composition. In the performance evaluation of the radiator, a radiator is installed into a test-setup and the various parameters including mass flow rate of coolant, inlet coolant temperature etc. are varied. Then the corresponding value of the effectiveness and outlet coolant temperature are reversed. These values are then plotted in the 3-axis graphs and their behavior is studied [8].

Rashmi Rekha Sahoo has done the experimental impact of an alternative heat transfer fluids for overall performance improvement for radiators. Water and water mixed with anti-freezing agents such as ethylene glycol (EG) and propylene glycol (PG) are the traditional coolants for an automotive radiator. Comparison of experimental and numerical analysis of optimum brine solution, that is 25% of propylene glycol and water as coolant for the rectangular fin radiator, has been well discussed. A closed loop test rig was designed, and fabricated with a wind tunnel section to achieve uniform velocity at the test section of the rectangular radiator and was tested for performance. Experimental runs were conducted at varying operating temperatures which included the runs for water, and an optimum propylene glycol brine solutions at 70 °C and 80 °C with various flow rates. Results show the energy performance of an optimum brine solution was nearly similar to that of water at high temperatures. The Nusselt number, heat transfer coefficient, and heat transfer rate for an optimum propylene glycol brine is nearly the same as water at 80 °C with a maximum deviation of 15%, 5.7%, and 6.6%, respectively, for theoretical and experimental result comparisons. Air side and coolant side pressure drops had a maximum deviation of 3.66% and 6.6%, respectively. Air and coolant exit temperatures had a deviation of 5% and 3.5%, respectively, with an air frontal velocity of 4.6 m/s in a rectangular fin radiator for an optimum brine solution used as coolant for the automotive radiator. The optimum propylene glycol brine may be environmentally beneficial [9].

R. Ravisankar, N. Alagumurthy has done this research work of the heat transfer improvement in a tractor radiator with nano sized particles of CuO with water as base fluid. The nano materials and its suspension in fluids as particles have been the subject of intensive study worldwide recently since pioneering researchers recently discovered the anomalous thermal behavior of these fluids. The engine cooling in heavy vehicles is an important factor for their performance in the intended application. Here, the tractor engine radiator cooling is enhanced by the nano fluid mechanism of heat transfer for its improved performance in agricultural work. Through the improvement of tractor engine cooling through the radiator a greater area can be ploughed and cultivated within a short time span. Heat transfer in automobiles is achieved through radiators. In this research work an experimental and numerical investigation for the improved heat transfer characteristics of a radiator using CuO/water nano fluid for 0.025 and 0.05% volume fraction is done with an inlet temp of 50 °C to 60 °C under the turbulent flow regime ($8000 \leq Re \leq 25000$). The overall heat transfer coefficient decreases with an increase in nano fluid inlet temperature of 50 °C to 60°C. The experimental results of the heat transfer using the CuO nano fluid is compared with the numerical values. The results in this work suggest that the best heat transfer enhancement can be obtained compared with the base fluid by using a system with CuO/ water nano fluid-cooled radiators [10].

III. CONCLUSION

After the detailed study of the literature we infer that radiator as a cooler is a gadget which will give all the more cooling with less cost contrasted with evaporative coolers and air conditioners. As radiators are great heat exchangers we will get additionally cooling with less water utilized. We also conclude from the above listed literatures that radiator can be modified according to its design, size, fluid used in it. We have also studied from the literature about how to improve thermal efficiency of an automobile radiator. This literature survey can be further modified, like we are using submersible pump to pass water to pipes which has many disadvantages and can be replaced.

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