A Review Paper on Performance evaluation of Nano fluids using Radiator effectiveness

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Abstract - *Newly emerging technologies due to their compactness are not being effectively served by the conventional heat transfer fluids. To serve these emerging technologies, Nano fluids are found to be better alternatives to the conventional heat transfer fluids. The heat transfer enhancement for many industrial applications by adding solid Nano particles to liquids is significant topics in the last few years. In this Paper, an attempt is made to review literature related to radiator effectiveness and its efficiency improvement techniques. Finely good technique is selected for further study.*

***Key Words*: Radiator Effectiveness, nanofluids, efficiency improvement techniques.**

1. INTRODUCTION

The performance of the conventional engine-cooling system has always been constrained by the passive nature of the system and the need to provide the required heat-rejection capability at high power conditions. This leads to considerable losses in the cooling system at part-load conditions where vehicles operate most of the time. A set of design and operating features from advanced engine-cooling systems is reviewed and evaluated for their potential to provide improved engine protection while improving fuel efficiency and emissions output. Although these features demonstrate significant potential to improve engine performance, their full potential is limited by the need to balance between satisfying the engine-cooling requirement under all operating ambient conditions and the system effectiveness, as with any conventional engine-cooling system. The introduction of controllable elements allows limits to be placed on the operating envelop of the cooling system without restricting the benefits offered by adopting these features. The integration of split cooling and precision cooling with controllable elements has been identified as the most promising set of concepts to be adopted in a modern engine-cooling system. We know that in case of Internal Combustion engines, combustion of air and fuel takes place inside the engine cylinder and hot gases are generated. The temperature of gases will be around 2300-2500°C. This is a very high temperature and may result into burning of oil film between the moving parts and may result into seizing or welding of the same. So, this temperature must be reduced to about 150-200°C at which the engine will work most efficiently. Too much cooling is also not desirable since it reduces the thermal efficiency. So, the object of cooling system is to keep the engine running at its most efficient operating temperature. It is to be noted that the engine is quite inefficient when it is cold and hence the cooling system is designed in such a way that it prevents cooling when the engine is warming up and till it attains to maximum efficient operating temperature, then it starts cooling.

1.2 Air Cooling System

Air cooled system is generally used in small engines say up to 15-20 kW and in aero plane engines. In this system fins or extended surfaces are provided on the cylinder walls, cylinder head, etc. Heat generated due to combustion in the engine cylinder will be conducted to the fins and when the air flows over the fins, heat will be dissipated to air.

1.2 Water Cooling System

In this method, cooling water jackets are provided around the cylinder, cylinder head, valve seats etc. The water when circulated through the jackets, it absorbs heat of combustion. This hot water will then be cooling in the radiator partially by a fan and partially by the flow developed by the forward motion of the vehicle. The cooled water is again recirculating through the water jackets.

2. LITERATURE REVIEW

Das et al. [1] investigated the increase of thermal conductivity with temperature for Nano fluids with water as base fluid and particles of Al2O3 or CuO as suspension material. It has been observed that the enhancement is considerably increased for Nano fluids with Al2O3 as well.

Wang et al. [2] reviewed summarizes recent research on fluid flow and heat transfer characteristics of Nano fluids in forced and free convection flows and identifies opportunities for future research. Among the nanoparticle, alumina (Al2O3) is one of the most common and inexpensive nanoparticle used by many researchers in their experimental investigations.

Nasiruddin et al. [3] presented heat transfer enhancement in a heat exchanger tube by installing a baffle. The effect of baffle size and orientation on the heat transfer enhancement was studied in detail. Three different baffle arrangements were considered. The results show that for the vertical baffle, an increase in the baffle height causes a substantial increase in the Nusselt number. For the inclined baffles, the results show that the Nusselt number enhancement is almost independent of the baffle inclination angle, with the maximum and average Nusselt number 120% and 70% higher than that for the case of no baffle, respectively. Results suggest that a significant heat transfer enhancement in a heat exchanger tube can be achieved by introducing a baffle inclined towards the downstream side, with the minimum pressure loss.

Peyghambarzadeh et al. [4,5] conducted experiment on forced convective heat transfer in a water based Nano fluids, has been experimentally compared to that of pure water in an automobile radiator with different concentrations of Nano fluids. Additionally, the effect of fluid inlet temperature to the radiator on heat transfer coefficient has also been analyzed by varying the temperature. Results demonstrate that increasing the fluid circulating rate can improve the heat transfer performance while the fluid inlet temperature to the radiator has trivial effects. Meanwhile, application of Nano fluid with low concentrations can enhance heat transfer efficiency up to 45% in comparison with pure water.

Chandrasekhar et al. [6] Experimental investigations on thermophysical properties and forced convective heat transfer characteristics of various Nano fluids are reviewed and the mechanisms proposed for the alteration in their values or characteristics due to the addition of nanoparticles are summarized in this review.

Pang et al. [7] studied the vehicles cooling system extensively numerically and experimentally. The research covers many individual topics which include numerical modeling of engine cooling system, under hood air flow, heat transfer at water jacket, heat transfer at radiator and coolants.

Peyghambarzadeh et al. [8] has presented heat transfer of coolant flow through the automobile radiators is of great importance for the optimization of fuel consumption. In this study, the heat transfer performance of the automobile radiator is evaluated experimentally by calculating the overall heat transfer coefficient (U) according to the conventional -NTU technique. Results demonstrate that Nano fluids show greater overall heat transfer coefficient in comparison with water. Furthermore, increasing the nanoparticle concentration, air velocity, and Nano fluid velocity enhances the overall heat transfer coefficient.

L.D. Tijing, B.C. Pak, B.J. Baek, D.H. Lee [9] They study on heat transfer enhancement using straight and twisted internal fin inserts. They found that The heat transfer characteristics and pressure drop results of the horizontal double tubes with coil-wire insert are presented. The heat transfer rate and heat transfer coefficient depend directly on the mass flow rates of hot and cold water. Effect of coil-wire insert on the enhancement of heat transfer tends to decrease as Reynolds number increases.

P. Naphon et al. [10] He studied the Effect of coil-wire insert on heat transfer enhancement and pressure drop of the horizontal concentric tubes. They Found That The overall heat transfer coefficient in a concentric-tube heat exchanger was enhanced with a star-shape fin insert by as much as 51% at a constant pumping power. This can be attributed to the increased heat transfer surface associated with the fin insert. The percentage increase in the pressure drop was larger than the percentage increase in the heat transfer rate, in general.

Khalid Faisal Sultan et al. [11] They investigated Thermal enhancement of car radiators performance with nanofluids (Cu (30nm) + DW) and (Al (50nm) + DW), as working fluid. The two types of nanoparticles are used in investigation with four particle concentration ratios (i.e. 15, 20, 25 and 35 wt %) and the based working fluid was distilled water.

Z. Zhnegguo, X. Tao, F. Xiaoming [12] They Performed Experimental study on heat transfer enhancement of a helically baffled heat exchanger combined with three-dimensional finned tubes. Their study has been performed with a new strategy to obtain the heat transfer and pressure loss for helically baffled heat exchanger combined with petal-shaped finned tubes. Both the shell side heat transfers coefficient based on the actual outside surface area of tube bundle and pressure drop increase with increasing volumetric flow rate of oil.

M.Y. Wen, C.Y. Ho [13] They Investigated Heat-transfer enhancement in fin-and-tube heat exchanger with improved fin design. They Found That, flow visualization study not only shows the salient features of a horseshoe vortex around the tube bundles, and the velocity fluctuations and the acceleration effect around the fins, but also provides qualitative information concerning convective transport. Comparison of the heat transfer coefficients with respect to the plate fin type at the same experimental conditions for the wavy fin type and the compounded fin type is about 1.11–1.32-fold and 1.34–1.63-fold, respectively. The friction pressure drops for the wavy fin and compounded fin is about 0.5–2.7% and 9.4–13.2% larger as compared to that for the plate fin.

S.H. Hashemabadi, S.Gh. Etemad [14] They studied the Effect of rounded corners on the secondary flow of viscoelastic fluids through non-circular ducts. They found that, the presence of Al2O3 nanoparticle in water can enhance the heat transfer rate of the automobile radiator. The degree of the heat transfer enhancement depends on the amount of nanoparticle added to pure water. Ultimately, at the concentration of 1 vol.%, the heat transfer enhancement of

45% compared to pure water was recorded. Increasing the flow rate of working fluid enhances the heat transfer coefficient for both pure water and Nanofluids considerably while the variation of fluid inlet temperature to the radiator slightly changes the heat transfer performance.

K. Yakut, B. Sahin [15] They Studied Flow induced vibration analysis of conical rings used for heat transfer enhancement in heat exchangers. They found that, the conical-ring tabulators increase the heat transfer and friction factor, and also produce vortices in the flow. Despite an increase in the friction factor, the tabulators can be used effectively in places where pumping power is unimportant and, the dimension and weight are important. However, dominant vortex shedding frequencies from the conical-rings should not be equal to the natural frequency or its overtones of the tube used. Otherwise, the system may experience resonance and will be damaged. The resonance conditions should be analyzed and resonance avoided by adjusting the operating conditions and controlling the vortex-shedding frequency (fv) or natural frequency (fa) of the system.

S. Laohalertdecha, S. Wongwises [16] They Studied the Effects of EHD on heat transfer enhancement and pressure drop during two-phase condensation of pure R-134a at high mass flux in a horizontal micro-fin tube. They found that, the heat transfers enhancement increases with increasing heat flux but decreases with increasing mass flux, saturated temperature and inlet quality. Pressure drop results indicate that the application of an EHD voltage of 2.5 kV slightly increases the pressure drop across the range of tested conditions.

J.S. Paschkewitz, D.M. Pratt [17] They Investigated the influence of fluid properties on electro- hydrodynamic heat transfer enhancement in liquids under viscous and electrically dominated flow conditions. The role of fluid properties on EHD enhanced heat transfer behavior has been experimentally investigated. In agreement with predictions from the EHD pumping literature, decreasing viscosity reduces both the electrical and pressure drop penalty for a desired heat transfer enhancement via secondary flow. ECO-C and Beta, which have large charge relaxation times, yielded greater heat transfer enhancement for a given forced flow Reynolds number and electrical power input than PAO, which has a small charge relaxation time.

N. Umeda, M. Takahashi [18] They investigated Numerical analysis for heat transfer enhancement of a lithium flow under a transverse magnetic field. A laminar lithium flow in a conducting rectangular channel in the presence of a transverse magnetic field was analyzed numerically, and they obtained conclusions that, the jets appeared adjacent to side walls that were parallel to the direction of an applied magnetic field. The ratio of peak velocity in the jets to average velocity increased with an increase in the Hartmann number, and reached about six at the Hartmann number of 1900.

D. Wen, Y. Ding [19] they investigated into convective heat transfer of nanofluids at the entrance region under laminar flow conditions. They found that, the use of Al2O3 nanoparticles as the dispersed phase in water can significantly enhance the convective heat transfer in the laminar flow regime, and the enhancement increases with Reynolds number, as well as particle concentration under the conditions of this work. The enhancement is particularly significant in the entrance region, and decreases with axial distance. The thermal developing length of nanofluids is greater than that of pure base liquid, and is increasing with an increase in particle concentration. The enhancement of the convective heat transfer could not be solely attributed to the enhancement of the effective thermal conductivity. Particle migration is proposed to be a reason for the enhancement, which results a non-uniform distribution of thermal conductivity and viscosity field and reduces the thermal boundary layer thickness.

3. CONCLUSIONS

From Literature Review it is observed that, by using Different Technics We can improve the radiator effectiveness using twisted tape inserts, by using Nano fluids etc. Nano Fluids can be used to improve the heat exchanger effectiveness with mixing the conventional lubricants in different percentage. Nano Fluids have high surface area therefore it gives more heat transfer surface between particles and fluids.

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