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Empirical Review on Car Radiator Using H_2O and Al_2O_3

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ABSTRACT*:* In case, pure water is used in an automotive radiator and its performance was studied. Al_2O_3 nano particles are mixed in water in 0.025%, 0.05%, 0.1% and the performance of nanofluid is tested. The performance comparison will be made between pure water and nanofluids tested in an automotive radiator. Finally the recommendations are made and conclusions are drawn based on the improved performance of nanofluids in an automotive radiator.

KEYWORDS: Al_2O_3, Automotive Radiator, Nanofluid, Nanoparticles.

I.INTRODUCTION

A quick look at the history and progress of nanofluids is examine in this section. The selection of nanofluids based on properties, suitability and cost effective was emphasized. The various measuring techniques used for preparation and measurement of nanofluids were also discussed. The use of nanofluids is one of the most effective mechanisms of increasing the amount of heat transfer in heat exchangers. The worn of flat tubes, in that the fluid flow has a lower thermal resistance, is another way of improving the rate of heat transfer in tubes. The subject of the present paper is increase of heat transfer . The nanofluid refers to a mixture in which solid particles of (generally less than 90 nm) are added to a base fluid and cause the increase of heat transfer in that mixture nanofluids particles instead of traditional liquids which include water, ethylene glycol etc. Use of such nanoparticles in the base fluids gain their thermal conductivity and heat transfer achievement of nanofluids. Nanofluids are modern generation heat transfer fluids and can be worn for heat transfer enrichment. Nanofluids are used in micro channel cooling without any clogging and sedimentation problems. The nanofluids can also be engaged in huge heat flux applications where single phase plain fluids are not skillful of transferring the heat at desired rate.

II. PRODUCTION MODE OF NANOPARTICLES

Before talking about nanofluids production methods, is recommendable mention different ways nanoparticles are produced and materials worn to make nanofluids. Metals like Ag, Au, Cu, Fe; or ceramic oxides such as CuO, Al2O3, CeO2; semiconductors like TiO2; and single-, double- or multi-walled carbon nanotubes are the often worn particles. But each time there are more and more new materials employed for the purpose of recognise exotic properties while testing various new nanofluids.
According to the literature there are two general methods:

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Physical methods: mechanical grinding and inert-gas condensation.
Chemical methods: chemical precipitation, chemical vapor deposition, micro- emulsions, spray pyrolysis and thermal spraying. Furthermore, nanoparticles in powder form, are easier to disperse in base fluids and, in this way, get a homogeneous concotion will be not crucial. Another question is the shape of nanoparticles, which usually are spherical, cubic, ellipsoidal, nanotubes and sometimes can be unified into arrays. Despite of this variety, the most common shape are spheres.
Once nanoparticles preparation methods have been seen, it is time to go further and talk about nanofluids manufacture methods, which are mainly two: one and two steps course. However, there are more methods, but this aspect will be treated later.

1. **One Step System**

The change between this method and the earlier one is that, while in two- step system first nanoparticles are composed and after that these particles are disslove into the base fluid, in the case of one-step system both phase are done at the twin time.A great point of this approach is that the operation of drying, storage, transportation, and dispersion of nanoparticles are avoided, so, the agglomeration of nanoparticles is minimized and the stability of fluids is elevated. On the other hand, this method is also used because prevents oxidation of metallic particles when huge-conductivity metals are worn.

But, for this purpose, there is not only one way to do it, there are different tested approach that can be engaged lean on the materials properties and limitations.

Figure 1: Preparation of base fluid and Al_2O_3 nanofluids

For instance, direct evaporation (under vacuum conditions) has been used to produce nanofluids with metal nanoparticles. Whereas it presents the advantage of aggregation effect is reduced, this technique is only accurate for low vapor pressure fluids.

2. **Two Steps System**

As the name of the approach shows, it has two steps, the first one is when nanoparticles are prepared, and the second one consists of the nanoparticles consuming into a base fluid. Depending on the kind of nanoparticles are going to be used, first step is often put on by chemical vapor degradation. An favor of the next process is that has before been scaled up to economic nano-powder production, so it is low-priced to produce nanofluids by this method; yet that is not the only reason, since particle concentration and size distribution can be controlled as well.

For the second step, namely, the scattering of nanoparticles into the preferred base fluid, clean techniques such as adding of surfactants to the fluids, altering nanofluids' pH value and both mechanical and ultrasonic agitation are needed in order to obtain stable samples, since minimization of particle gathering and distribution improvement will be obtain.

III. SCOPE OF PRESENT WORK

In this, forced convection heat transfer coefficients are reported for pure water and H_2O/Al_2O_3 nanopowder mixtures under turbulent conditions. The practical case is made up with a typical automobile radiator, and the effects

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of the operating conditions on its heat transfer performance are analyzed at different flow rates and at various inlet temperatures.

FIGURE 2 : Radiator used for fabrication

IV. RESULTS AND DISSCUSION

In this section the calculations for pure water (base fluid) and different percentages of nanofluids are discussed. The obtained results are tabulated and the graphs are between outlet temperature, and flow rate. The fabricated model of car radiator was run at three different flow rates (4 liters/min, 6 liters/min and 8 liters/min) at an inlet fluid temperature of 60ºC, 70ºC, 80°C. A temperature difference (*ΔT*) was recorded for each flow rate, respectively. These obtained results are drawn graphically.

Performance of outlet temperature at Different Flow Rates

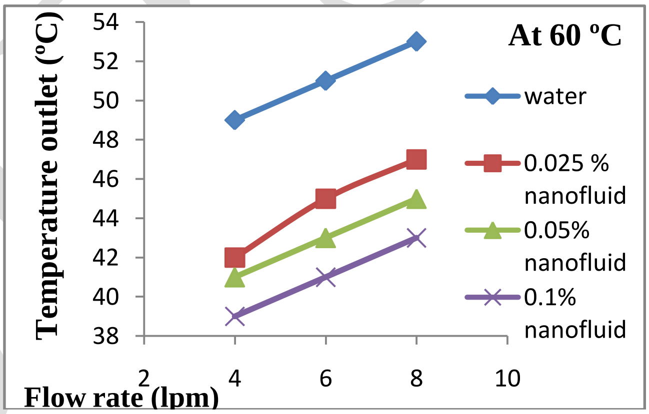

Figure 4.1: Variation of outlet temperature for different flow rates at 60ºC

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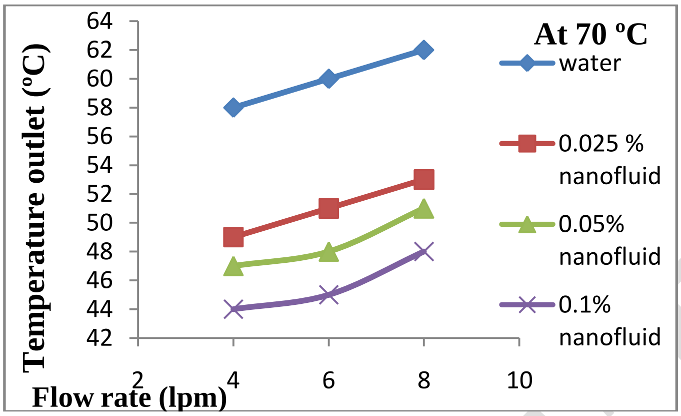

Figure 4.2: Variation of outlet temperature for different flow rates at 70ºC

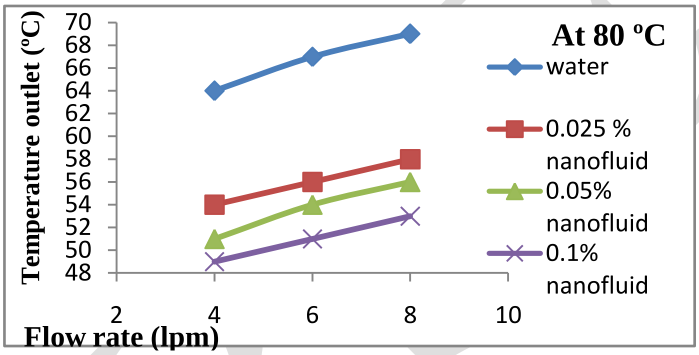

Figure 4.3: Variation of outlet temperature for different flow rates at 80ºC

The above figures show the outlet temperature of the radiator (T_{out}) with different volume flow rate circulating and nanofluid volume concentrations. It seems that the outlet temperature increases with increasing in the volume flow rate and decreasing in nanofluid volume concentration. The outlet temperature at pure water is the highest which referred the heat transfer increasing from the radiator. It should be noted that all the data in Fig. 4.3.a-c obtained when the radiator inlet temperatures were 60, 70 and 80ºC, respectively. It also showed that the outlet temperature increases with increasing of inlet temperature and the difference between inlet and outlet temperature for each run. This means the heat transfer increases with increasing of inlet temperature too.

V. CONCLUSION

The convective heat transfer performance and flow characteristics of Al_2O_3 nanofluid flowing in an automotive radiator have been experimentally inspected. Significant increase in heat transfer was observed with the used different volume concentrations of nanoparticles blended with water.

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