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Increasing the Efficiency of Automobile by Using Nanocolant

Ashok Rinwa[1], Arvind Mahla[2], Sourabh Soni[3]*
Department Of Mechanical Engineering, Sobhasaria Engineering Collage Sikar, Rajasthan, India

Abstract

In the developing world there is demand of efficiency and for the better efficiency of the automobile, cooling system play an important role. From the birth of an automobile, we are using air or water for cooling and have many demerits. Now a days we are adding a host component i.e. nanofluids which have higher thermal conductivity. Addition of nanofluid the heat transfer capacity increases by 50–65%. The research is to improve the thermal conductivity of nanofluid is mostly focused. These results, improvement in thermal conductivity, increase in heat transfer coefficient, increase in the surface volume ratio etc. presented in this paper, application of nanofluids as engine radiator cooling, challenges and future scopes of nanofluids have been reviewed.

Keywords: cooling system, heat transfer capacity, surface volume ratio

****Corresponding Author***
E-mail: ashokrinwa94@gmail.com

INTRODUCTION

In the automobiles, the power was generated by combustion of composite air fuel mixture inside engine only. The power sends to the automobile for useful work, but a part of power not used by automobiles and dissipates by exhaust or heat. Heat is not easily removed, so it cause increase in engine temperature, overheating, viscosity breakdown of the lubricating oil, increase in engine component wear.

To overcome these reversers provided the air cooling fan and radiator and the coolant be air or water. But these not much efficient. As the thermal conductivity of the metal, non-metal and liquid shown Figure 1 the coolant such as air, water, oil, Ethylene glycol are the less heat transfer capacity and the thermal conductivity of the solid is greater than the liquid so, dispersion of solid particle in a given base fluid is bounded to increase the thermal conductivity.[4] Then nanofluids project is to reduce the size and weight of HV(heavy vehicle) cooling system by >10% there by increases the fuel efficiency by >5%[1] but it is not enough to increase efficiency. So, USA based research laboratory started to prepare special kind of the fluid by suspending the particle size of 1-100 nm in base fluid i.e. "Nano fluid" named by choi in 1995[2]

After the choi's concept presented, the researches move toward the nano field further goes through characteristics like mechanism, structure, application, function, environment impact etc. choi and Eastman have tried for the various metal and their oxide at nano particles size suspended into various based fluid.[2-5] Eastman et al.[4] reported that with base fluid ethylene glycol nanofluids 0.3% concentration of cooper particle can enhanced up to 40% respect to the base fluid. Xie et al.[6] nm sized Al_2O_3 then observed higher thermal conductivity enhanced for longer nano particles in

Ethylene glycol base fluid. Wang et al.[7] used Al_2O_3 particles of size 28 nm in base fluid Ethylene glycol & water at different % concentration i.e. enhanced thermal conductivity 16% for 5.5% concentration & 12% for 3% concentration . Also, used CuO particle of size 23 nm in base fluid Ethylene glycol water at different % concentration i.e. enhanced thermal conductivity 55% for 15% concentration & 35% for 10% concentration respectively. Yu et al. Obtained about 26.5% enhancement of thermal conductivity by adding 5% volume fraction of zinc dioxide nanoparticles in Ethylene glycol and also conducted heat transfer experiments of nanofluids containing 170 nm silicon carbide particles at 3.7% concentration & enhanced thermal conductivity by 50-60%.

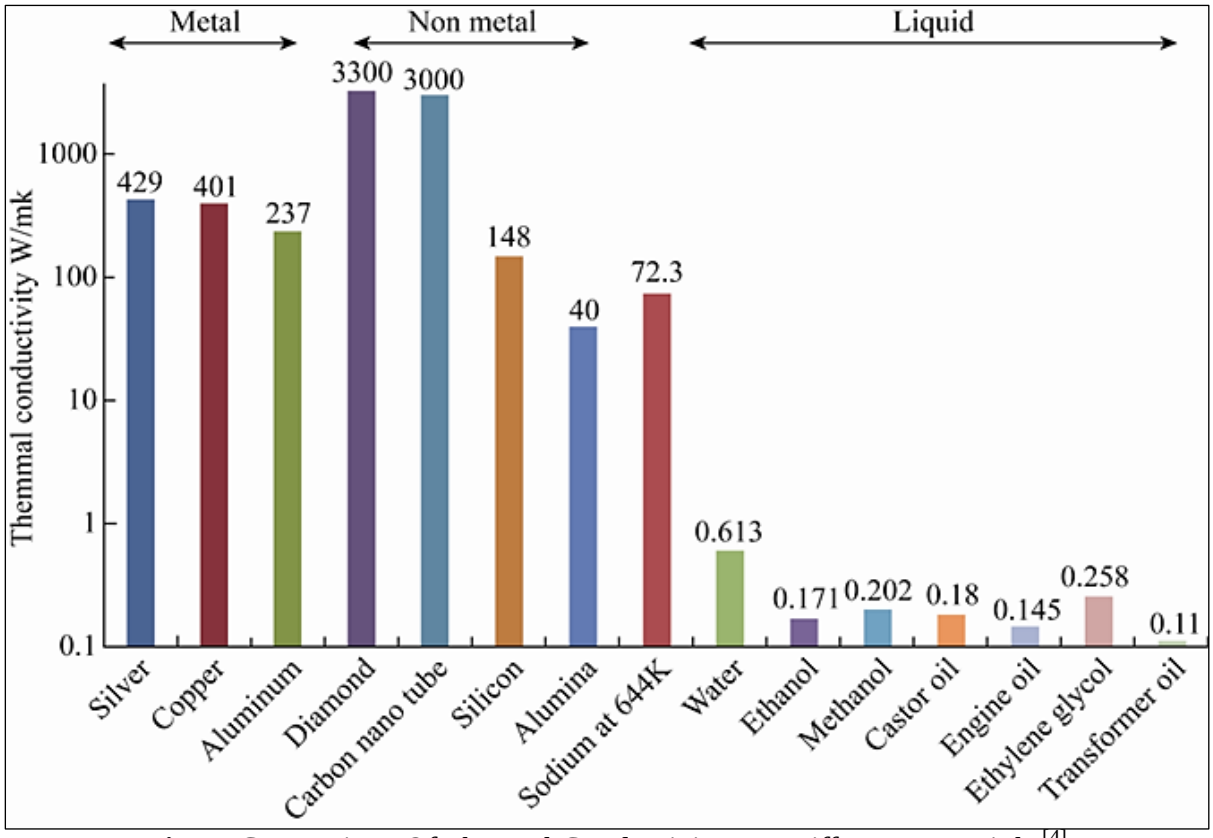

Fig. 1. *Comparison Of Thermal Conductivity For Different Materials.*[4]

Table 1. *Variation of Thermal Conductivity by Change in % Concentration (by Volume) of Nanofluid.*

Researchers	Base fluids	Nano Particle	Particle size (in nm)	% Concentration	Enhance Thermal conductivity	Reference
Eastman et al	Ethylene glycol(EG)	CuO	<10	0.3	40%	[4]
Lee et al	EG	Al_2O_3	24.4	5	20%	[5]
Xie et al	EG	Al_2O_3	60	5	26.5%	[6]
Wang et al	EG	Al_2O_3	28	8	40%	[7]
Lee et al	EG	CuO	18.6	4	20%	[5]
Wang et al	EG	CuO	23	15	55%	[7]
Liu et al	EG	CuO	25	5	22.4%	[8]
Yu et al	EG	ZnO	-	5	26.5%	[9]
Eastman et al	water	Al_2O_3	33	5	30%	[4]

Lee et al	water	Cu	24.4	4.3	10.67%	[5]
Xie et al	water	Al_2O_3	60	5	30%	[6]
Wang et al	water	Al_2O_3	28	4.5	14%	[7]
Lee et al	water	CuO	18.6	4.3	10%	[5]
Wang et al	water	CuO	23	10	35%	[7]
Yu et al	water	SiC	170	3.7	55%	[9]

Namburu et al.[10-13] researches that turbulent flow of the nanofluids named copper oxide (CuO), alumina(Al_2O_3), and silicon oxide (SiO_2) with ethylene glycol or water, following through circular tube under constant heat flux then produce higher viscosity and Nusselt number. As numerically observed that at a constant heat flux (50 W/cm^2) and Reynolds number (20,000) with 6 % concentration of CuO nanofluids has enhanced 40% heat transfer rate. By the NSF (Nano science & foundation) research taken the conclusion that nano technology product & service will exceed $ 1 trillion in the US alone by 2015[3] had a great approach.

APPLICATION

All the automobile industries working for the high efficiency model and best cost at market. Their challenges to face poor thermal conductivity of their heat transfer fluid the major problem with regarded to radiator cooling system, also with the cooling in microelectronics, transportation, manufacturing industries.

As the traditional process using air as base coolant for all the field. As air cooling consists of heat sink and a fan is most common method for cooling electronics some new techniques have immersed to extend to useful range of air cooling such as piezofans (acikalin et al.)[11] & synthetic jet cooling (glezer & mahalingum).[12] A goal of nanofluid is to achieve the highest possible thermal properties at the smallest possible concentration (preferably<1% by volume) by uniform dispersion and stable suspension of nanoparticles (preferably<10 nm)in host fluids.[10]

PARTICIPATE OF NANOFLUIDS IN AUTOMOBILE

Nanofluids As Nanocoolant

Nanoparticles have a sustainability than the base fluids. So, it easily dispersed as coolant in radiator. So, that the radiator lead to reduce in frontal area upto10% and the saving of fluids upto 5%.[15] As nanofluids having greater boiling point, they increase mean coolant operating temperature so, remove higher amount of heat through existing system.[14]

Nanofluids As Fuel Additives

As known fact that, the fossil fuel combusting daily leads to the emptiness of energy sources. So, to overcome these scientist improving the performance of automobile by thousands experiments such as better design, reducing weight, smart control and better engine performance etc. Modern nanotechnology founds that fuel additives can increase in efficiency, by combustion stability. The scientists of in nano science and technology council in USA have achieved to increase 10-25% of aluminum nanopartical to a rocket solid fuel.[16]. Arul Mozhi seleven[17] reported that to improve the performance and emission characteristics of C.I. engine using cerinum oxide nanofluids with diesel and biodiesel mixed fuel. Nanopartical act as catalyst in combustion of diesel so, it completely burn research by Yanan Gan et al.[18]

Nanofluids As Lubricant

Now-a-day automobiles field researchers focusing their interest to enhancement of tri-biological properties(load carrying

capacity, wear resistance and friction reduction between two moving part) of nanoparticle suspended lubricant. As for lubrication of nanoparticles dispersed with mineral oil to be effective for enhancing load caring capacity and reducing wear resistance. As reported to reduce the friction between two pieces of cast iron used TiO_2 nanoparticles by Mu-Jung Kao et al.[19] They concluded that the nanoparticles could fill rough cracks in a metal wall surface to reduce the coefficient of friction.[20]

Properties

Nanoparticles carry unique properties:

a. a.Smallest size (1-100 nm) nanoparticle.
b. b.Larger surface area (due to smaller in size).
c. c.Highdensity.

Nanofluids have higher thermal conductivities than the base fluids. Thermal conductivity of the Nanofluids depends on both the properties of base fluids and particles (hamliton & crosser). Not only the shape but the size are considering in enhancing the thermal conductivity of Nanofluids. Expected that effective thermal conductivities of nanofluids under flow conditions might be higher than those in rest conditions.

CHALLENGES

Smaller the size greater the stability of colloidal dispersion, greater the stability of colloidal dispersion greater is the probability of interaction & collision among particles in fluid and with fluid so due this particle interact with each other then settle down due to gravity & tends to agglomerate.

Due to agglomeration, blocking of fins as well as properties of nanofluids are decreased. In order to reduce agglomeration addition of surfactants is the only option. But addition of surfactants causes widespread problem as they may produce foams in alternate cooling-heating process.

Cost

Nanofluids are prepared by following process

1. 2 step- in 2 step first nano powder is produced then secondly powder is dispersed into liquid coolant.
2. 1 step- in 1 step process both production of nano powder & dispersed into liquid are simultaneously done by one chemical process Both these process have their own limitations & require advanced and sophisticated equipments Panzali ey al stressed that high cost of nanofluids is among the drawback of nanofluids applications.

Specific Heat

Nano coolants actually possess lower specific heat than base fluid but ideal coolant should possess highest specific heat value as function of coolant is to draw more heat from engine. But specific heat possess a great challenge to researchers. Namburu et al. revealed that Al2O3/ ethylene glycol nanofluids exhibit lower specific heat compared to base fluids.

Viscosity

Due to agglomeration at higher concentration of nano particles in coolants results in higher viscosity of nanofluids. As a result of this, heat transfer rate is decreased and clogging of fins is major problem. So article mass fraction has to be increased in limited manner. Lee reported that the viscosity increased so rapidally with increasing particle concentration that volume% of CNT_S are limited to less than 0.2% in practical systems.

Pressure Drop & Pumping Power

Increased flow rate increases pumping power and as pressure drop is closely associated with pumping power so there is effect on pressure drop also. The major properties of nanofluids that influences the coolant pressure drop are

1. Density
2. Viscosity

The coolants with higher density and viscosity experiences higher pressure drop. So this caused the real disadvantage of nanofluids as liquid coolant. Lee and Mudawar revealed that single phase pressure drop of Al_2O_3 nanofluids in microchannel heat sink increases with nanoparticles concentration. Vasu et al studied the thermal design of compact heat exchanger using nanofluids. In this study, it is found that the pressure drop of 4%. Al_2O_3 + H_2O nanofluids is almost double of the base fluid.

FUTURE WORK

a. Study is required to identify the reason for and effects of particle deposition.
b. Study in use of nanofluids as refrigerants.
c. Exact mechanism of heat transfer for nano fluids is still unclear as reported by many researchers.
d. Nanofluids stability & its production cost are major factors that hinders the commercialization of nanofluids.
e. in contrast to traditional unilateral approach, researchers need to examine the following factors:- such as synthesis, characterization, thermo-physical properties, heat and mass transport, modeling and device as well as system level applications of nanofluids.

CONCLUSION

Nanotechnogy provided a great chance to produce a higher thermal conductive crystalline solid of size average 50 nm. i.e. the world most advance heat transfer fluids.It has been found that nanofluid have much a higher and strongly temperature depend thermal conductivity at very low particle concentration there base fluid. In comparison to base fluid nanofluids are superior to dispersions' of nanometers size particle by virtue of their high colloidal stability and high surface volume ratio. Base fluid as oil, water and ethylene glycol mix are poor heat transfer fluid. Nano technology based heat transfer fluid that are derived by stably suspending nanometer sized particles (with typical length scale of 1 to 100 nm).Immersed and increase the heat transfer coefficient. It also concluded that when the size of nano fluid decreases the heat transfer rate increased also by increase in volume ratio. By the research of this property the better efficiency of automobile by nano fluid are:

a. Performance of engine radiator cooling system increased by 10%.
b. Performance of vehicle life time were increased (such as wear resistance, load carrying capacity etc.).

REFERENCES

1. Steve Choi Energy Systems Division Heavy Vehicle Systems Review Argonne National Laboratory.
2. Kluwer Academic Publ., J. Nanopart. Res. 3, 353 (2001). doi:10.1023/A:1013248621015
3. Senthilraja S., Karthikeyan M., Gangadevi R. Nanofluid applications in future automobiles: comprehensive review of existing data. *Nano-Micro Lett.* 2010; 2: 306–10p.
4. Lee J-H, Hwang K.S, Jang S.P. *et al.* Effective viscosities and thermal conductivities of aqueous nanofluids containing low volume concentrations of Al2O3 nanoparticles. *Int J Heat Mass Transfer*. 2008; 51(11–12):2651–6p.
5. Xie H, Wang J., Xi T. *et al.* Thermal conductivity enhancement of suspensions containing nanosized alumna particles. *J Appl Phys*. 2002; 91: 4568–72p.
6. Wang X., Xu X., Choi S.U.S. Thermal conductivity of nanoparticle-fluid mixture. *J Thermophys Heat trans*. 1999; 13: 474–80p.

7. Liu M.S., Lin M.C.-C., Tsai C.Y. *et al.* Enhancement of thermal conductivity with Cu for nanofluids using chemical reduction method. *Int J Heat Mass Transfer*. 2006; 49(17–18): 3028–33p.
8. Yu W., Xie H., Chen L. *et al.* Investigation of thermal conductivity and viscosity of ethylene glycol based ZnO nanofluid, Thermochimica Act a 491. 2009; 92–6p.
9. Acikalin, T., S. M. Wait, S. V. Garimella, and A. Raman (2004). Experimental investigation of the thermal performance of piezoelectric fans, *Heat Transfer Eng*. 25(1): 4–14.
10. Glezer, A., Mahalingam R. System and method for thermal management by synthetic jet ejector channel cooling techniques. U.S. patent 6,588. 2003; 497.
11. Namburu P.K., Das D.K., Tanguturi K.M. *et al.* Numerical study of turbulent flow and heat transfer characteristics of nanofluids considering variable properties. *Int J Therm Sci*. 2009; 48: 290–302p.
12. Yu W., Xie H. A review on nanofluids: preparation, stability mechanisms and applications.
13. Lee S., Choi S. U. S., Li S. *et al.* Eastman. *J. Heat Transf*. 1999; 121: 280p.
14. *Interagency Working Group On Nano Science, National Nano Technology Initiative: Leading To The Next Industrial Revolution.* Technology National Science and Technology Council, USA. 2000.
15. Selvan V.A.M., Anand R. B., Udayakumar M. *J. Eng.Appl. Sci*. 2009; 4: 1p.
16. Gan Y., Qiao L. Combustion and Flame. 2011; 158: 354.
17. Jung J-Y, Kwak H-Y. Forced convective heat transfer of Nanofluids in micro channels. *Int J Heat Mass Transfer*. 2009; 52(1-2); 466-72p.
18. Kao M.J., Lin C.R. *Alloy J. Compd*. 2009; 483: 456.
19. Lee J-H, Hwang K.S., Jang S.P. *et al.* Effective viscosities and thermal conductivities of aqueous nanofluids containing low volume concentrations of Al2O3 nanoparticles. *Int J Heat Mass Transfer*. 2008; 51(11–12): 2651–6p.
20. Ahuja A.S. Augmentation of Heat Transport in Larninar Flow of Polystyrene Suspensions. 1. Experiments and Results. *Journal of Applied Physics*, 1975; 46(8): 3408–16p.