Heat Transfer in Nanofluids

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Abstract— Suspended nanoparticles in basic fluids, called Nano fluids. Nano fluid will enhance the thermal conductivity of fluid. This increase of thermal conductivity of fluid was surprising and cannot be determine by existing theories. Nano -sized particle-fluid suspensions exhibit no such drastically increase in thermal efficiency. This article presents review of these studies and suggests a direction for future development. The review and suggestions will be useful because the material in this area is sprinkled over a wide range of branches.

Key words: Nano Fluid, Heat Transfer, Thermal Conductivity

I. INTRODUCTION

A nanofluid is a fluid containing nm -sized particles, called nanoparticles. These fluids are implemented colloidal suspensions of nanoparticles in a base fluid. These particles used in nanofluids are typically made of metals, oxides or carbides. Common base fluids include base fluids.

Nanofluids have novel properties that make them potentially useful in many applications in heat transfer, [7]including pharmaceutical microelectronics, fuel cells, microelectronics processes, and hybrid-powered engines, [8] engine radiators thermal management, domestic refrigerator, chiller and in boiler flue gas temperature reduction. They shows increased thermal conductivity and the convective heat transfer coefficient compared to the base fluid.[6] Knowledge of the flow of matter is found to be very critical in deciding their suitability for convective heat transfer applications [4][5]

In analysis such as computational fluid dynamics (CFD), nanofluids can be considered to be single phase fluids but now a days two-phase assumption are used in paper. single phase fluid theory can be used, where physical characteristics of nanofluid is taken as a function of properties of both constituents and their concentrations.[9]

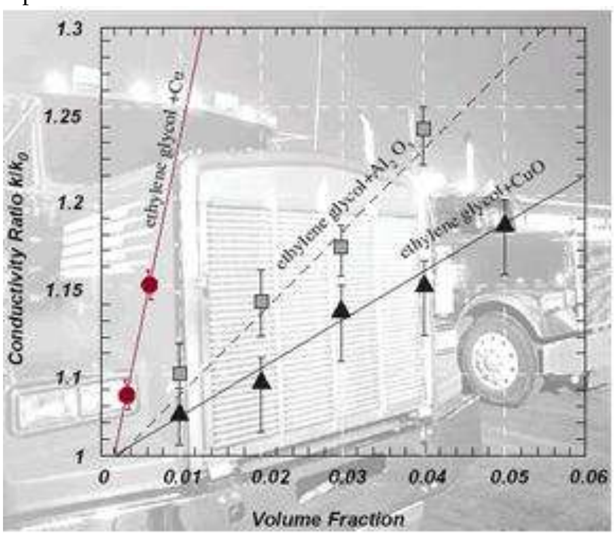

Fig. 1: Graph

II. SYNTHESIS

Many fluids including water, ethylene glycol, and oils are used as base fluids. Nano-materials used in nanofluid synthesis include metallic particles, carbon nanotubes, graphene and ceramic particles.[18][19]

Conventional heat transfer fluids have very poor thermal conductivity compared to solids. Conventional fluids having mm- or mm-sized particles do not work with the emerging "miniaturized" technologies because they can cause the clogging of tiny channels of the system. Modern nanotechnology provides opportunities to produce nanoparticles. Argonne National Lab (Dr. Choi's team) developed the novel concept of nanofluids. Nanofluids are a new trade of advanced heat-transfer fluids solids have more thermal conductivity then conventional which can be seen in graph

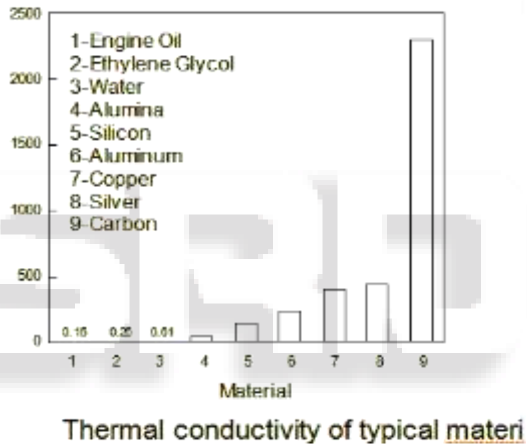

Fig. 2: Graph

III. USES OF NANOFLUIDS AS A COOLANT IN RADIATOR

Nanofluids have great potentials to improve automotive and heavy-duty engine cooling rates by increasing the efficiency, decreasing the size and made it simple design of thermal management systems. The increase cooling rates for bulky engines can be used to remove more heat from higher horsepower engines with the same size of cooling system. Alternatively, it is easy in design for more compact cooling system with smaller and lighter radiators. It is in turn benefiting the high efficient and high fuel economy of heavy automobiles. Ethylene glycol based nanofluids have attracted much attention in the application as engine coolant [13-14], due to the low pressure operation compared with a 50/50 mixture of ethylene glycol and water, which is the the most commonly used coolant. The nanofluids has a high thermal conductivity, and it can be used to increase the normal coolant operating temperature and then reject more heat through the existing coolant system [16]. Argonne researchers, Singh et al. [15], have determined that the use of high-thermal conductive nanofluids in radiators can lead to a reduction in the frontal area of the radiator by up to 10%. This reduction in aerodynamic drag can lead to a fuel savings of up to 5%. The application of nanofluid also contributed to a reduction of friction and wear, reducing dimension losses, operation of components such as pumps and compressors, and subsequently increasing to more than 6% fuel savings. It can be considered that greater improvement of savings would be obtained in the future.

Choi [17] reported that in US a project was initiated to target fuel savings for the HV industry through the development of energy efficient nanofluids and compact and lighter radiators. A major target of the nanofluids project is to compact the size and weight of the HV cooling systems by >10% thereby increasing fuel efficiency by >5%, despite the cooling demands of higher power engines and EGR. Nanofluids enable the capacity to allow higher temperature coolants and higher heat rejection in HVs. A greater heat transfer can reduce the radiator size by perhaps 30%. This results into reduced aerodynamic drag and fluid pumping and fan requirements, leading to perhaps a 10% fuel savings. The developed radiator design can be used in new general motors hybrid vehicles. The popularity of these hybrid vehicles is on the rise due to the decreasing fossil fuel supply, multiple cooling systems can be replaced by increasing the importance of a new radiator design. These properties would be very beneficial to allow for an increased amount of heat to be removed from the engine. This is important because it will allow for a greater load to be placed on the fluid for cooling. However, these nanofluids do not show considerable improvement in heat transfer when used with current radiator designs. This is because there are several demerits to current radiator designs.

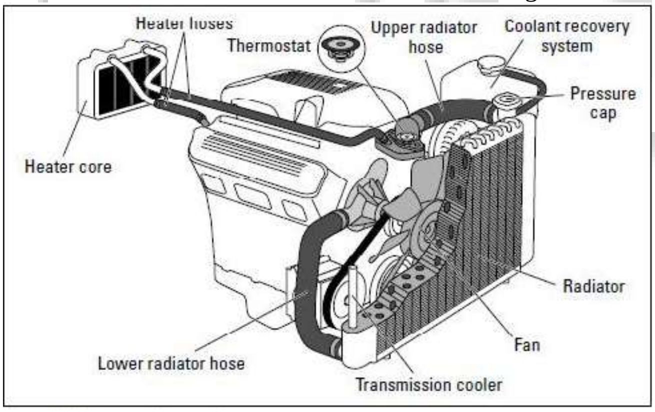

Fig. 3: The Cooling System

A. Advantages

1) Good Thermal Conductivity:

Nano fluid has greater thermal conductivity as compared to base fluid. By increasing surface area of nano fluid will increase rate of heat transfer between base fluid and nano particles. Though the nano fluid particles are small in size bt owing great thermal conductivity.

2) Prevention of Clogging:

Nano particles are from 1nm to 1000nm. They mix with base fluid very easily n do not causes clogging problems so it can be used for micro channels to.

3) Reduction in Size of Radiator:

Due to greater thermal conductivity the size of radiator will be reduces up to 10% so aero dynamic drag in heavy vehicle will be less, so fuel consumption will be less.

B. Limitation:

Nanofluids have some physical and chemical limitation. It cannot be stable physically or chemically. the boiling characteristics of nano fluids are poor.

IV. Conclusion

The increased thermal conductivity of nanofluids makes it a good prospect in the future technology.it can be used as smart fluid. There are various problems of nanoparticles li8ke agglomeration settling and erosion potential .But these problems can be resolved by further research and development in nano technology.

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