National Conference on "Advanced Technologies in Computing and Networking"-ATCON-2015
Special Issue of International Journal of Electronics, Communication & Soft Computing Science and Engineering, ISSN: 2277-9477

Synthesis and Characterization of Water Based Silver Nanofluids

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Abstract — **The present research is focus to synthesis water based silver nanofluids by chemical reduction which increase the thermal conductivity to enhance the rate of heat transfer also to characterize the thermal properties and heat transfer performance of nanofluids over heat exchangers to enhance the efficiency and overall heat transfer coefficient of heat exchanger with simultaneous reduction in the area of heat exchanger. As noted above the basic concept of dispersing solids in fluids to enhance thermal conductivity. Solid particles are added because they conduct heat much better than do liquids. Compared with micro particles, nanoparticles stay suspended much longer and possess a much higher surface area. The surface/volume ratio of nanoparticles is 1000 times larger than that of microparticles. The high surface area of nanoparticles enhances the heat conduction of nanofluids since heat transfer occurs on the surface of the particle. The number of atoms present on the surface of nanoparticles, as opposed to the interior, is very large. Therefore, these unique properties of nanoparticles can be exploited to develop nanofluids.**

Keywords **—chemical reduction, heat exchanger, nanofluids, thermal conductivity.**

I. INTRODUCTION

Cooling is one of the most important challenges facing numerous industrial sectors. Despite the considerable amount of research and development focusing on industrial heat transfer requirements, major improvements in cooling capabilities have been lacking because conventional heat transfer fluids have poor heat transfer properties. One of the usual methods used to overcome this problem is to increase the surface area available for heat exchange, which usually leads to impractical or unacceptable increases in the size of the heat management system. Thus there is a current need to improve the heat transfer capabilities of conventional heat transfer fluids. Crystalline solids have thermal conductivities that are typically larger than those of fluids by 1-3 orders of magnitude. Therefore, fluids containing suspended solid particles can be expected to display significantly enhanced thermal conductivities relative to those of pure fluids. Choi of Argonne National Laboratory of USA in 1995 proposed a novel concept of ''nanofluid" by applying nanotechnology to thermal engineering to meet the cooling challenges (Bergles et al., 1988). This new class of heat transfer fluids (nanofluids) is engineered by dispersing nanometer-sized (one billionth of a meter) solid particles, rods or tubes in traditional heat transfer fluids. From the investigations in the past decade, nanofluids were found to exhibit significantly higher thermal properties, in particular, thermal conductivity, than those of base fluids. Thus, nanofluids have attracted great interest from the research community due to their potential benefits and applications in numerous important fields such as microelectronics, transportation, manufacturing, medical and heating, ventilating and air conditioning (HVAC). The impact of nanofluid technology is expected to be great considering the heat transfer performance of heat exchangers or cooling devices, which is vital in numerous industries. For example, the transport industry has a need to reduce the size and weight of vehicle thermal management systems and nanofluids can increase the thermal transport efficiency of coolants and lubricants. When crystalline solids with nanometer dimensions are suspended in a suitable base fluid to form stable homogeneous suspensions, and there is an increase in the thermal conductivity relative to the base fluid, the resulting suspensions are called nanofluids, as opposed to nanofluidics, which is concerned with flow in nanoscale channels.

II. BACKGROUND

The crystalline solid can be either spherical nanoparticles, or micrometer long nanotubes. Nanofluids can be prepared by a one-step or a two-step method. In the two-step method, the preparation of the nanofluid is isolated from the synthesis of the nanoparticles. However, this approach may result in the formation of larger nanoparticles due to agglomeration which can occur during drying, storage, transportation and re-dispersion of nanoparticles. As a result, the thermal conductivity may be affected negatively. Hence the current interest is to develop one-step methods where nanoparticles are synthesized directly in the heat transfer fluid. Different methods have been used for the preparation of nanofluids, namely, thermal decomposition pathways, microwave and laser radiation, chemical reduction and 'direct-evaporation' techniques. Nanofluids containing metals such as Cu, Ag and Au have shown an increase in the effective thermal conductivities of the heat transfer fluid compared with the base fluid. The large intrinsic thermal conductivity of carbon-based nanostructures, combined with their low densities compared with metals, make them attractive candidates for use in nanofluids. Until recently, there have been a limited number of studies on the characteristics of dispersion and rheological properties of nanofluids. Since nanofluids are expected to be used under flow conditions, the study of the rheological properties of the nanofluid is essential. Also, to understand the mechanism of heat transfer enhancement, it is crucial to have knowledge on the fluid-particle and particle-particle interactions within the fluid. Stability of the suspensions is a crucial issue for both scientific research and practical applications. Particle aggregation and the formation of extended structures of linked nanoparticles will affect stability, and may be responsible for much of the disagreement between experimental results and the predictions of effective medium theory. Simultaneous studies of thermal conductivity and viscosity may give additional insight.

III. Previous Work Done

When the nanoparticles are properly dispersed, nanofluids can offer numerous benefits. For example 0.3 vol% copper nanoparticles dispersed in ethylene glycol is reported to increase its inherently poor thermal conductivity by 40% (Eastman et al., 2001). This observation was further confirmed from our previous study where the thermal conductivity of copper nanofluid obtained by novel one step method was found to be higher than that of the base fluid ethylene glycol (Wang et al., 1999). About 10–30% increase in thermal conductivity of alumina/water nanofluids was observed with the incorporation of 1–4 vol % of alumina (Das et al., 2003). Nanofluids are generally prepared by step-by-step method by dispersing metallic nanoparticles in the base fluid (Xuan et al., 2003). This involves agglomeration of nanoparticles that takes place during the process of drying, storage and transportation resulting in settlement and clogging of the micro channels leading to a decreased thermal conductivity. There are several other methods like the one-step physical method, in which the metal vapour is directly condensed into nanoparticles by contact with a flowing low vapor pressure liquid (Eastman et al., 2001) but this method appears to be cost ineffective. By polyol process (Das et al., 2003), mono dispersed and non-agglomerated metal nanoparticles are obtained. However, the major drawback of this method is that solution of the metallic salt should be heated to its boiling point and kept under refluxing conditions for a long time (Zhu et al.2004; Kulihara et al.,2005). In the aqueous chemical reduction method, though the rate of the reaction is high, the agglomeration problem exists, and as a consequence, a decrease in the thermal conductivity of the nanofluid is observed in most cases. Hence the development of a new and novel method for the preparation of nanofluids is inevitable. In the previous study carried out by the authors, the synthesis of copper nanofluids was done, by optimizing various process parameters and nanofluids of desired properties were obtained. Hence as an extension of our work, in the quest to develop heat transfer fluids of superior properties the synthesis of silver nanofluids was carried out. Silver was chosen as it has high thermal conductivity and is therefore expected to have good heat transfer properties ideally suitable for thermal engineering applications.

IV. Existing Methodology

A) Two step method

Two step method is widely used for preparing nanofluids. Nanoparticles, nanofibers, nanotubes or other nanomaterials used in this method are first produced as dry powder by chemical or physical methods then the nano size powder will be dispersed into a fluid in the second processing step with the help of intensive magnetic force agitation, ultrasonic agitation, high-shear mixing homogenizing and ball milling .

B) One step method

Two reduce the agglomeration of nano particles,choi I developed a one step physical vapor condensation method to prepare Cu/ethylene glycol nanofluid the one step process consists of simultaneously making and dispersing the particles in the fluid

V. Analysis And Discussion

The main objective of this project is to prepare silver nanofluids that are stable and investigate the effect of suspended Nanoparticles on the thermal conductivity, the viscosity of the produced nanofluids. Based on the results, a recommendation will be given towards the potential application of the nanofluids.

The methods used to prepare the nanofluids should be economically attractive, simple and reproducible. Amongst the various nanofluids proportions, one proportion nanofluid should be optimized with significant application.

Enhance the efficiency & overall heat transfer coefficient of heat exchanger, with simultaneous reduction in area of heat exchanger. Characterize the thermal properties and heat transfer performance of nanofluids over heat exchanger.

VI. Proposed Methodology

Synthesis of water based silver nanofluid. characterizations of silver Nanofluid optimizations of the concentrations of raw materials.

Design and construction of double pipe heat exchanger.

calculation of Temperature distribution, Log Mean Temperature difference, Efficiency, of the constructed double pipe heat exchanger by using Water, Nanofluid, and commercially available coolant. Comparison of the data obtained from the experimental analysis. Conclusion

MATERIALS/CHEMICALS

125-Ml Borosilicate beaker Silver nitrate ($AgNO_3$) Sodium borohydride ($NaBH_4$) Water (H_2O)

There are various methods available for preparation of nanofliuds on laboratory as well on large scale. In this project we select chemical reduction method for preparation of nanofluids. We found that there is various advantage of chemical reduction method over other one step as well as two step method of nanofluids preparation.

It gives good dispersion of nano-particles. Fluid will forms in one step In this method the processes of drying, storage, transportation and dispersion of nanoparticles are avoided.

Unique size (10-100nm) & spherical shape particles obtained by this method. Simplicity low cost of production.

CONCLUSION

Most systems/processes whose performance is affected by heat generation could benefit from nanofluid coolants. Nanofluids have great potential for thermal management and control involved in a variety of applications such as electronics cooling, micro electro mechanical system(MEMS) and spacecraft thermal management. By changing the various parameters , reaction condition of AgNo3, NaBH4 and PVA as stabilizer which will give optimum result for synthesis of nanofluids.

REFERENCES

1.Sarit K. Das Nanofluid (Science & Tech.), Wiley publications (Page No:1-39, 145-187)
2.M. N. Ozisik, Heat Transfer: A Basic Approach, McGraw-Hill
Preparation, Thermal and Rheological Properties of Propylene Glycol and Water Mixture Based Fe_3O_4 Nanofluids
3.*L. Syam Sundar, E. V. Ramana, Manoj K. Singh, Jose Gracio, and Antonio C. M. Sousa* J. Nanofluids 3, 200-209 (2014)
4.Choi, S. Enhancing thermal conductivity of fluids with nanoparticles. *In* Development and applications of non-newtonian flows, edited by D.A. Siginer and H.P. Wang, New York: ASME, 1995,
5.Phelan, P.E.; Bhattacharya, P. & Prasher, R.S. Nanofluids for heat transfer applications. *Annu. Rev. Heat Transfer*, 2005,
6.Xuan, Y. & Le, Q. Heat transfer enhancement of nanofluids. *Int. J. Heat Fluid Flow*, 2000,
7.Keblinski, P.; Phillpot, S. R.; Choi, S. U. S. & Eastman, J. A. Mechanisms of heat flow in suspensions of nanosized particles nanofluids. *Int. J. Heat Mass transfer*, 2002,
8.Chopkar, M.; Kumar, S.; Bhandar, D.R.; Das, P.K. & Manna, I. Development and characterization of *Al*2*O*3 and *Ag*2*Al* nanoparticle dispersed water and ethylene glycol based nanofluid., *Mat. Sci. Engg. B*, 2007,
9.Zhang, X. Effective thermal conductivity and thermal diffusivity of nanofluids containing spherical and cylindrical nanoparticles. *J. Appl. Phys.*, 2006,

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