INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN ENGINEERING, SCIENCE & MANAGEMENT

REVIEW PAPER ON NANOFLUID AND ITS APPLICATION AT LOWER TEMPERATURE.

Smit Naik[1], Ratnadeep Mishra[2], Ashutosh Joshi[3], Prof Ashish Desai[4]
U.G student, FETR, Isroli-Bardoli, Gujarat, India[1]
U.G student, FETR, Isroli-Bardoli, Gujarat, India[2]
U.G student, FETR, Isroli-Bardoli, Gujarat, India[3]
Assi. Prof., FETR, Isroli-Bardoli, Gujarat, India[4]

Abstract: Nano-fluids are a new class of nanotechnology-based heat transfer fluids engineered by dispersing nano-particles into conventional heat transfer fluids such as water, ethylene glycol, and engine oil. Many researchers have been trying to create new kinds of heat transfer fluids in order to enhance the heat transfer performance of the base fluids. Cooling is one of the major requirements in the industries today. However, the thermal conductivity and heat transfer rate are the major concerns and limitations of the conventional fluids used in the brine solution of ice plant. Thus, Nano-fluids are developed as an alternative of the conventional fluids by suspending the Nano-particles in the base fluids and experiments have shown that utilizing these nano-fluids in place of the conventional fluids as heat transfer mediums enhances the thermal conductivity and thereby, the heat transfer rate significantly. The experimentation will be carried out for secondary refrigerant used in ice plant, water and ethylene glycol is used with nano-particles to enhance the efficiency of system and also decrease the time rate to achieve the lower temperature of secondary refrigerant in ice plant.

Key words: **Nano-particles, Nanofluids, Stability, Surfactants.**

1. INTRODUCTION

1.1 Fluid: A substance, as a liquid or gas, that is capable of flowing and that changes its shape at a steady rate when acted upon by a force tending to change its shape is called as fluid. Fluids display properties such as not resisting deformation or resisting it only lightly (viscosity), and the ability to flow (also described as the ability to take on the shape of the container).Ideal fluids can only be subjected to normal, compressive stress which is called pressure. Real fluids display viscosity and thus are capable of being subjected to low levels of shear stress.

1.2 Conventional fluids: Conventional heat transfer fluids include oil, water, and ethylene glycol mixture. These conventional fluids are being used since years. Due to the increasing demands and number of future applications, these fluids do not meet the requirement of quicker heat transfer rate at the present. Thus, nano-fluids are designed as a substitute for these conventional fluids which overall provide quite good heat transfer property.

1.3 Nano-particles: Nano-particles are the extremely small particles of the order of around 1-100 nm. This increases their surface area and thus, more the contact area (surface area), better is the reaction with any external agent (which is not possible in the milli meter or micro meter sized particles). Due to this property, nano-particles are the key area of interest in fields like biomedical, optical, electronic industries, etc. Nano-particles used in nano-fluids have been made out of many materials by physical and chemical synthesis processes. Typical physical methods include the mechanical grinding method and the inert-gas-condensation technique.

1.4 **Nano-fluids:**Nano-fluids are described as the fluids which are prepared by suspending the nano-particles in the conventional fluids (base fluids) such as water, oil, ethylene glycol, etc. which leads to the significant change of thermal properties of the base fluid. Some examples of nano-fluids: Various metallic and non-metallic oxides such as Al_2O_3, CuO, Fe_2O_3, SiO, and TiO2 can serve as nano-fluid. The thermal conductivity of the particle materials, metallic or non-metallic such as Al_2O_3,CuO, Cu, SiO, TiO, are typically order-of-magnitude higher than the base fluids even at low concentrations, result in significant increases in the heat transfer coefficient.

2. PREPARATION OF NANO FLUID.

There are two fundamental methods to prepare nano-fluid:

1. Single step direct evaporation method.
2. Two step method.

2.1Single-step direct evaporation method: The direct evaporation and condensation process of the nano-particles in the base fluid are obtained to produce the stable nano-fluids. It consists of a cylinder containing a fluid which is rotated. In the middle of the cylinder, a source material is vaporized. The vapour condenses once it comes into contact with the cooled liquid (Figure 1). The drawbacks of this technique however, are that the use of low vapour pressure liquids are essential and only limited quantities can be produced.

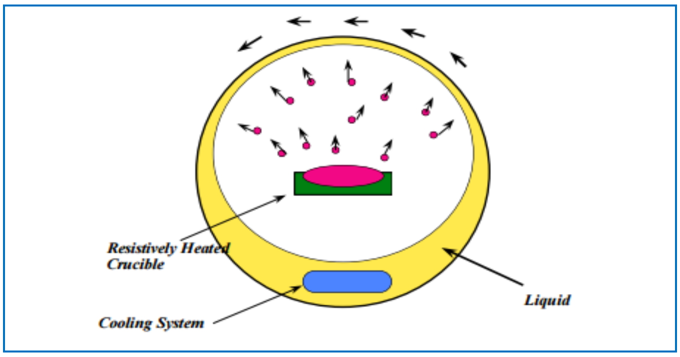

Figure 1 One Step Method

2.2 Two-step method: This process includes two stages. During first stage, nano-particles are obtained by various techniques and in the later stage; those nano-particles are dispersed into the base fluids. To get a uniform dispersion and stable suspension, which determines the final properties of nano-fluids were kept under ultrasonic vibration continuously for 4-5 hours.

3. The Stability of Nanofluid: The agglomeration of nanoparticles results in not only the settlement and clogging of micro channels but also the decreasing of thermal conductivity of nanofluids. So, the investigation on stability is also a key issue that influences the properties of nanofluids for application, and it is necessary to study and analyse influencing factors to the dispersion stability of nano fluids.

 ISSN : 2394-1766

4. Surfactants used with Nanofluids: Surfactants used in nanofluids are also called dispersants. Adding dispersants in the two-phase systems is an easy and economic method to enhance the stability of nanofluids. Dispersants can markedly affect the surface characteristics of a system in small quantity. Dispersants consists of a hydrophobic tail portion, usually a long-chain hydrocarbon, and a hydrophilic polar head group. Dispersants are employed to increase the contact of two materials, sometimes known as wettability. In a two-phase system, a dispersant tends to locate at the interface of the two phases, where it introduces a degree of continuity between the nanoparticles and fluids. According to the composition of the head, surfactants are divided into four classes: non-ionic surfactants without charge groups in its head (include polyethylene oxide, alcohols, and other polar groups), anionic surfactants with negatively charged head groups (anionic head groups include long-chain fatty acids, sulfosuccinates, alkyl sulphates, phosphates, and suffocates), cationic surfactants with positively charged head groups (cationic surfactants may be protonated long-chain amines and long-chain quaternary ammonium compounds), and amphoteric surfactants with zwitterion head groups (charge depends on ph. The class of amphoteric surfactants is represented by betaines and certain lecithins). How to select suitable dispersants is a key issue. For nonionic surfactants, we can evaluate the solubility through the term hydrophilic/lipophilic balance (HLB) value. The lower the HLB number, the more oil-soluble the surfactants, and in turn, the higher the HLB number, the more water-soluble the surfactants is. The HLB value can be obtained easily by many handbooks. Although surfactant addition is an effective way to enhance the dispersibility of nanoparticles, surfactants might cause several problems. For example, the addition of surfactants may contaminate the heat transfer media. Surfactants may produce foams when heating, while heating and cooling are routine processes in heat exchange systems. Furthermore, surfactant molecules attaching on the surfaces of nanoparticles may enlarge the thermal resistance between the nanoparticles and the base fluid, which may limit the enhancement of the effective thermal conductivity.

At lower temperature application Ethylene Glycol can be used as surfactants with nanofluid.

4.1 Ethylene Glycol as Surfactants: The major use of ethylene glycol is as a medium for convective heat transfer in, for example, automobiles and liquid cooled computers. Ethylene glycol is also commonly used in chilled water air conditioning systems that place either the chiller or air handlers outside or systems that must cool below the freezing temperature of water. In geothermal heating/cooling systems, ethylene glycol is the fluid that transports heat through the use of a geothermal heat pump. The ethylene glycol either gains energy from the source (lake, ocean, water well) or dissipates heat to the sink, depending if the system is being used for heating or cooling. Pure ethylene glycol has a specific heat capacity about one half that of water. So, while providing freeze protection and an increased boiling point, ethylene glycol lowers the specific heat capacity of water mixtures relative to pure water. A 50/50 mix by mass has a specific heat capacity of about 3140 J/kg C three quarters that of pure water, thus requiring increased flow rates in same system comparisons with water. Additionally, the increase in boiling point over pure water inhibits nucleate boiling on heat transfer surfaces thus reducing heat transfer efficiency in some cases, such as gasoline engine cylinder walls. Therefore, pure ethylene glycol should not be used as an engine coolant in most cases.

 ISSN : 2394-1766

5. CONCLUSION

- By adding nanofluids in the base-fluids like water, ethylene glycol, etc. the conventional heat transfer fluids like water, oil, ethylene glycol, etc.is increase.
- Nano-fluids prepared by the addition of nano-particles in these base fluids increases the heat transfer rate to a considerable amount.
- The time for reaching the freezing temperature of substance is drastically reduce by adding the nanofluids in brine solution and it increases the productivity.

REFERENCES

[01] Ching-Song Jwo1 and Tun-Ping Teng2 Experimental study on thermal properties of brines containing nanoparticles. 1 Department of Air-Conditioning and Refrigeration Engineering, National Taipei University of Technology, Taipei, Taiwan, R.O.C. 2 Graduate Institute of Mechanical and Electrical Engineering, National Taipei University of Technology, Taipei, Taiwan, R.O.C.

[02] Dossat, Roy J. (2004). Principles of Refrigeration. 4th Ed. ND: Pearson Education Pvt. Ltd. pp 102-105,118-125.

[03] Jordan, Richard C. &Priester, Gayle B. (1966). Refrigeration & AirConditioning.2nd Ed. ND: Prientice-Hall of India Pvt. Ltd. pp 16-23,423-429.

[04] Xuan and Li Heat transfer enhancement of nanofluids, International Journal of Heat and Fluid Flow.

[05] WeiYu and HuaqingXie. A Review on Nanofluids: Preparation, Stability Mechanisms, and Applications.School of Urban Development and Environmental Engineering, Shanghai Second Polytechnic University, Shanghai 201209, China.

[06] Sayantan Mukherjee Somjit Paria1.Preparation and Stability of Nanofluids-A Review. IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) 10/2013; 9(2(Sep. - Oct. 2013)):63-69. DOI: 10.9790/1684-0926369.