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Nano Fluid in Heat Transfer

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ABSTRACT

Almost all industries need an efficient transfer of heat energy. Nanoscale industries are expanding and proving themselves in many fields of engineering. Fluid is an essential part of all industries, but how do we enhance their application? We have the fluid at Nanoscale and heat transfer to think about and come down to some essential conclusions on how it can enhance the current industries heat transfer.

Keywords: Nanofluid, Heat transfer, Industry, Efficiency

INTRODUCTION

The 21st century comes demanding promising technologies to make an impact to the human race. The concept of using Nanofluid in Heat transfer is safer and cost efficient and hence a promising piece of technology for tomorrow.

What is heat transfer: Heat transfer is energy in transit due to the temperature difference. Whenever there exists a temperature difference in a medium or between media, heat transfer must occur. The basic requirement for heat transfer is the presence of temperature difference. There can be no net heat transfer between two mediums that are at the same temperature

Thermodynamics tells us:

- How much heat is transferred (δQ)
- How much work is done (δW)
- Final state of the system

Heat transfer tells us:

- How (with what modes) δQ is transferred
- At what rate δQ is transferred
- Temperature distribution inside the body

Applications

1. Energy production and conversion
2. Energy production and conversion - steam power plant, solar energy conversion etc.
3. Refrigeration and air-conditioning
4. Domestic applications - ovens, stoves, toaster
5. Cooling of electronic equipment
6. Manufacturing/materials processing - welding, casting, soldering, laser machining
7. Automobiles/aircraft design

8. Nature (weather, climate etc.) (Figure 1)

Industry	Examples of Application
Food	Meat & poultry further processing, snack foods
Chemicals	Batch reactors, continuous processes
Plastics, rubbers, and composites	Molding, blow molding, extrusion
Petrochemicals	Catalysis, distillation, synthesis
Oil and gas	Gas processing, refineries
Converting	Presses, rolls, laminating, printing
Asphalt and concrete	Concrete heating, hot-mix paving
Building materials	Engineered woods, roofing materials
Die casting	Die temperature control
Industrial laundry	Flat work ironers, steam generators

Figure 1: Industrial Applications of heat transfer table.

Industry that relies on heat transfer:

1. Automotive industry (radiator, cooling circuits, lamps)
2. Aerospace (de-icing system, cooling systems)
3. Chemical Process Industry (heat recovery systems, heat exchangers)
4. Energy (kilns, boiler, cross flow heat exchangers, solar panels)
5. Home appliance (ovens, household heaters)

There have been many experimental pieces of evidence in the last decade that confirms that the technology is quite suitable [1] and needs attention.

Industries today: Today's world cannot be imagined without industries. Industries are the backbone of development of the human race. Industries include a wide variety of industrial processes. Many of which needs to transfer heat energy from one location to another with a great efficiency.

There is an emerging and promising concept of using Nanofluids in heat transfer for industries. They are small and hence expected to have a greater efficiency in doing the job.

Nanofluid: The term Nanofluids was first coined by Sir Stephen Choi at Argonne National Laboratory in 1995, U.S.A .They suspend various metal and metal oxides nanoparticles in several different fluids which led to this amazing discovery.

Since the discovery, nanofluid have been expected to be used as heat transfer fluids

Nanofluid is a new type of medium for heat transfer, which contains nanoparticles in them which are about 1-100 nm and are uniformly distributed in a base fluid [2]. The nanoparticles, which are mostly a metal or metal oxide increase the thermal conductivity of the nanofluid and increases conduction and convection coefficients, allowing for more heat transfer (Figure 2).

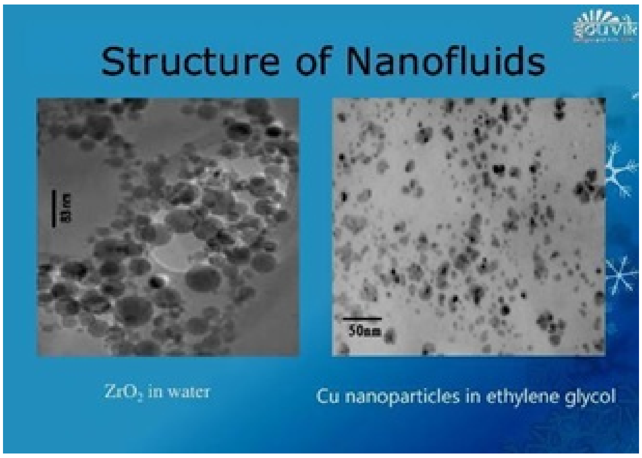

Figure 2: Suspended nano particles in liquid.

Experiment on the rate of heat transfer by nanofluid: The experiment states that the rate of heat transfer of the Nanofluids using a shell and tube heat exchanger in single and multi-tubes under turbulent flow condition by a forced convection mode. Alumina Nanoparticles are prepared by using the Sol-Gel method. The transfer rate increases with decreasing particle size. In this particular experiment, the Alumina Nanoparticles of the metal concentration of 0.13%, 0.40%, 0.27%, etc. are used, with water as a base fluid using ultra-sonicator. It have been conducted on shell and tube heat exchanger for the above concentrations on parallel and counter flow conditions by keeping constant inlet temperatures and mass flow rate [3]. The result shows that the heat transfer rate is good compared to conventional fluids (Figure 3).

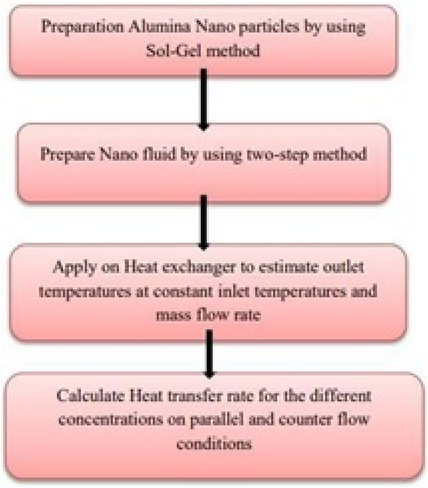

Figure 3: Experiment on the rate of heat transfer by nanofluid.

CONCLUSION

This article gives a brief description of nanofluid and its benefits for usage in industries for a better tomorrow. But the method is still under development and needs attention. The preparation of nanofluid is a challenge itself but on better research and wider acceptance of the technology, engineers can eliminate some of the harsh and dangerous technology used in today's world for heat transfer. But there exists a lot of controversy and inconsistency among the reported results. The results of all heat transfer work utilizing nanofluids showed that our current understanding of nanofluids is still quite limited. There are many challenges that are faced by the nanofluids community ranging from the formulation, practical application to mechanism understanding. Engineering nanofluids with controlled particle size for heat transfer applications is still a big challenge. Future research should consider other properties, such as viscosity and wettability, and examine systematically their influence on flow and heat transfer. A better understanding of the interactions of stabilizers, particles, the suspending liquid and the heating surface will be important for future applications of nanofluid as a medium of heat transfer in industries.

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