Thermal Analysis of Shell and Tube Heat Exchanger by using Al_2O_3 Nanofluid having Different Concentration in Different based Fluid - A Review

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Abstract— This paper offers the transient plan concerning the heat transfer enhancement in numerous applications by use of various nanofluid. It offers however heat transfer enhances victimization Nanofluid and its application in varied fields like heat exchangers, heat pipes, medical, etc. The papers focuses one explaining the essential mechanisms of improvement in heat transfer by adding completely different concentration of nanoparticle in base fluid like water, glycol and flow into the fluid in device shell. It's a scientific survey that studied the quality of nanofluid systems and advances the understanding of nanoparticle contributions to body, thermal physical phenomenon, effectiveness and overall heat transfer constant of nanofluid.

Key words: Nanomaterial's, Nano Fluids, Properties, Heat Transfer Enhancement

I. INTRODUCTION

Nanofluid is outlined as terribly little particles suspension in saturated liquids like water, glycol and engine oil. It's terribly fascinating different fluid for advanced thermal applications. It's been determined that heat transfer enhancement is also achieved by victimization nanofluid compared to the employment of typical fluids. Chemical compound nanoparticles have superb dispersion properties in ancient cooling liquids like water hymenopter glycol. Scientists are terribly interested from past few decades within the search of novel approaches to extend heat transfer rate of varied cooling devices like device, cooling towers.

II. TYPES OF NANOFLUIDS

The range of potentially useful combinations of nanoparticle and base fluids is gigantic. Nanofluid may be classified loosely by the kind of particles into four groups: ceramic, pure auriferous, alloy, and a few allotropes of carbon or carbon-based nanofluid.

III. PREPARATION OF NANOFLUIDS

Nanofluids are ready by victimization metals, oxides, carbides and carbon nanotubes may be mixed in heat transfer fluids, like water, glycol, hydrocarbons, and fluorocarbons with the addition of helpful agents. Nano particles may be made from many processes, like gas condensation, mechanical attrition or chemical precipitation. The particles may be made below cleaner conditions and their surface may be protected against undesirable coatings throughout the gas condensation method. There are 2 primary ways to arrange Nanofluids: A ballroom dancing method during which nanoparticles or nanotubes are 1st made as a dry powder. Chemical vapour deposition method is employed to supply materials to be used in nanofluids. During this method nanoparticles are mixed into a fluid with surfactants.

Fig. 1: Nanoparticle Storage

IV. WHAT ARE NANO FLUIDS?

A Nanofluid could be a dilute liquid suspension of particles with a minimum of one vital dimension smaller than ~100 nm. A Nanofluid is that the promising heat and mass transfer medium during which nano particles are spread. It's famous that the thermal physical phenomenon of the nanofluids is significantly above that of the corresponding base fluids. The enhancement depends on many factors like particle form, particle size, volume fraction of particles, and thermal properties of solid and liquid. Researches to this point recommend that nano fluids supply wonderful heat transfer enhancement over typical base fluids. But thanks to the wide selection and also the quality of the nano fluid.

V. THERMAL CONDUCTIVITY OF NANO FLUIDS

Thermo physical properties of varied materials at 25oC a considerable increase in liquid thermal physical phenomenon, liquid body, and heat transfer constant, are the distinctive options of nano fluids. It's standard that at temperature, metals in solid section have higher thermal conductivities than those of fluids. As an example, the thermal physical phenomenon of copper at temperature is concerning 700 times larger than that of water and concerning 3000 times larger than that of engine oil. The thermal physical phenomenon of auriferous liquids is way larger than that of non-metallic liquids.

Material	Density Kg/m^3	Thermal conductivity W/mk	Specific heat J/kgK
Silver	10490	429	710
Copper	8950	380	390
Aluminium	2700	237	910
Titanium Dioxide (TiO2)	4175	8.4	692
Alumina (Al2O3)	3380	36	773
Silica (SiO2)	2220	1.4	745

Water	998.9	0.613	4181
Ethylene glycol	1110	0.253	2200

Table 1: Properties of base metals and nano particles

VI. ENHANCEMENT OF THERMAL CONDUCTIVITY

Eastmann et al. showed that Cu–ethylene glycol (nanoparticles coated with thioglycolic acid) with w = zero.3% gave a four-hundredth increase in thermal physical phenomenon. Recently, an effort at the Gandhi Centre for Atomic analysis (IGCAR) was created, to align magnetic nanoparticles (Fe3O4 coated with Oleic acid) in a very base fluid (hexadecane) in a very linear chain employing a magnetic flux, that was applied to extend the thermal physical phenomenon by three hundredth.

Sidi El Becaye Maıga, Samy Joseph Palm, Cong cap Nguyen, Gilles Roy, Nicolas Galanis[2]. Investigated that the current paper, the matter of laminal forced convection flow of nanofluids has been completely investigated for 2 specific geometrical configurations, specifically a uniformly heated tube and a system of parallel, concentric and heated disks. Numerical results, as obtained for water–cAl2O3 and alkene Glycol–cAl2O3 mixtures, have clearly shown that the inclusion of nanoparticles into the bottom fluids has made a substantial augmentation of the heat transfer constant that clearly will increase with a rise of the particle concentration.

Yimin Xuan, Tibeto-Burman language Li [2]. Showed that the paper presents a procedure for getting ready a nanofluid that could be a suspension consisting of nanophase powders and a base liquid. By means that of the procedure, some sample nanofluids ar ready. Their TEM images ar given maybe the steadiness and evenness of suspension. The theoretical study of the thermal physical phenomenon of nanofluids is introduced. The start up equipment is employed to live the thermal physical phenomenon of nanofluids with suspended copper nanophase powders. Some factors like the amount fraction, dimensions, shapes and properties of the nanoparticles ar mentioned.

S. Bhanuteja, D.Azad [3]. Paper reports the thermal performance of a Counter-flow Shell and Tube device victimisation nanofluids because the operating fluids. Finite volume technique was wont to solve the 3 dimensional steady, turbulent developing flow and conjugate heat transfer in a very Shell and tube device. The nanofluids used were conductor, Al2O3, CuO, SiO2, and TiO2 and also the performance was compared with water. The thermal performance and flow of the Shell and tube device was analyzed victimisation completely different nanofluids. Temperature profile, heat transfer constant, pressure profile, was obtained from the simulations. The results ar evaluated in terms of effectiveness, heat transfer rate, and Overall heat transfer constant.

Andre L.H. Costa, Eduardo M. Queiroz [4]. Studied that the planning improvement of shell-and-tube heat exchangers. The developed downside consists of the diminution of the thermal expanse for a definite service, involving separate call variables. extra constraints represent geometrical options and speed conditions that should be complied so as to succeed in a a lot of realistic resolution for the method task

B. Farajollahi, S.Gh. Etemad, M. Hojjat [5] by experimentation investigated that the heat transfer characteristics of Al2O3/water and TiO2/water nanofluids were measured in a very shell and tube device below flow condition. supported the results, adding of naoparticles to the bottom fluid causes the many enhancement of heat transfer characteristics. For both nanofluids, 2 completely different optimum nanoparticle concentrations exist. Comparison of the heat.

Enhancement of heat transfer by nanofluid in various applications

1) *Enhancement of heat transfer in parallel & counter flow heat exchanger*
2) *Enhancement of heat transfer sheel and tube heat exchanger*

A. Enhancement of heat transfer in parallel & counter flow plate heat exchanger

Heat transfer processes are wide employed in varied areas as well as device, cooling processes, heating and chemical processes. The poor heat transfer properties of common fluids (such as water, oil and alkene glycol) compared to most solids could be a primary obstacle to effectiveness of heat processes. However, impeding within the method is also found within the tube once the fluid with massive particles is used. With awareness of this downside, the nanofluid is a gorgeous resolution that provides not solely the improved thermal physical phenomenon however additionally future stability and depression drop oxide (TiO2) is one in all promising materials for heat transfer enhancement purpose thanks to its wonderful chemical and physical stability. Additionally, TiO2 particles ar low cost and commercially accessible. TiO2 nanoparticles suspended in typical fluids were extensively used in varied styles of heat exchangers, as well as circular tube, a double tube and a shell and tube another different technique to boost heat transfer is to insert twisted tape into a core tube. This approach induces secondary recirculation to the axial flow, resulting in a rise in tangential and radial turbulent fluctuation and therefore reducing a thickness of the physical phenomenon.

Using nanofluid at the side of twisted taped for heat transfer enhancement was reportable in varied analysis works like twisted tape inserts with Al2O3/water nanofluid, turbinate twist tape inserts with Al2O3/water nanofluid, twisted tape with alternate axis inserts with CuO/water nanofluid, twisted tape inserts with CuO/water nanofluid in furrowed tube, twin twisted tape inserts with CuO/water nanofluid in micro-fin tube, turbinate screw tape inserts with Al2O3/water nanofluids turbinate screw tape inserts victimisation CuO/water nano-fluids, and propellor inserts with TiO2/water nanofluid the worth of overall heat transfer constant will increase just in case of nanofluid having completely different volume concentrations as compared to water for parallel flow yet as counter flow arrangement for double pipe device. the rise in sensible price of outer and inner overall heat transfer constant is found to fifty four attempt to fifty six during case of CuO nanofluid having volume concentration of zero.004 anticipating parallel flow and also the same is found to be twenty five attempt to thirteen in case of CuO nanofluid having volume

concentration of zero.004 anticipating counter flow arrangement [3].

B. Enhancement of heat transfer shell and tube heat exchanger

Heat exchangers play associate progressively vital role within the field of energy conservation. the necessity for higher economical heat exchanging system is needed for brand spanking new technological and industrial development. Therefore, the scientific attention is concentrating each on rising the instrumentation style and on enhancing the thermal potential of the operating fluid. a considerable reduction in energy consumption may be created attainable by rising the performance of heat money handler systems. thanks to inadequacy of typical fuel, optimizations in energy consumption in varied industrial processes become vital. Heat transfer rate in a very device ar hooked in to the thermo physical properties of the fluids collaborating within the device, the fabric of the heat money handler and additionally the areas of the surfaces.

Base fluid	Nano Particle	Size of nano particle	Maximum concentration in Volume	Enhancement of thermal conductivity
water	AL2O3	13 nm	4.3	30 %
Water	AL2O3	28 nm	4.5	14%
Ethylene glycol	AL2O3	28nm	8	40%
Pump oil	AL2O3	28nm	7	20%
Engine oil	AL2O3	28nm	7.5	30%
water	CuO	23 nm	10	35%
Ethylene glycol	CuO	23nm	15	55%
Pump oil	CuO	18.6 nm	4	20%
Water	TiO2	15nm	5	33%

Table 2: Nanofluids

The performance of shell and tube device is presented for Al2O3 nanoparticle. Nanoparticle volume fraction was extend from 0.5% to 3% for water based Al2O3 nanofluid. The inlet temperature of nanofluid 270C and water has been taken as 900C. The flow rates of both nanofluid and water were kept constant at 0.18 and 0.36 kg/s, respectively. The diameter of nanoparticle is taken as 44 n. However, the heat transfer coefficient increases compared to base fluids due to increase in transport properties viscosity and thermal conductivity of nanofluids. Higher thermal conductivity of nanofluid probably is the main reason contributing to heat transfer enhancement n heat exchanger.

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