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Performance of Heat Transfer and Friction Factor of Heat Exchanger with Al_2o_3/ Water Nano Fluids

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Abstract: This paper summary of heat transfer characteristics and nano fluids mechanics by using single phase convection techniques. Gas having less thermal conductivity compare than the liquids having high thermal conductivity. The heat transfer enhancement improved by using nano fluids Al_2O_3 compared with base water. The heat transfer enhancement was analysed with plain tube and twisted tape inserts with nano fluids. The experimental investigation was analysed and reading was taken to improve the heat transfer and friction flow characteristics. The Reynolds number varies from different ranges with plain water and Nano fluids. The experimental record of nano fluid heat transfer value was increased with 2.89 percentage compare with the experimental record of plain water. The nano fluids has more concentration than the plain water.

Keywords: Heat transfer, Nanofluids, Twisted tape, Reyolds number

I. INTRODUCTION

Heat is a form of energy is known as heat energy is due to primarily motion of molecules within medium. Heat transfer is the transfer of heat due to a temperature difference. The flow of heat is always from a warm surface to a cold surface.Scientists and engineers who are interested in heat transfer are often interested in the heat transfer rate.The amount of heat transfer is increased by using Nanofluids. Nanotechnology is the science andengineering of working at the Nanoscale, where the each particle size in the range of 1-100 nanometers. It"s hard to imagine the size of nanoparticles, but there are about 2,54,00,000 nanometers in an inch(2.54 cm). Nanofluids are a new class of heat transfer fluids provided by adding solid particles (in nanoscale) to a base fluid They are utilized in many types of equipment such as transportation, micro-electronics, defense. weaponry, nuclear reactors, heat exchangers, utilization of solar energy for power generation, and so on. Both thermal conductivity and viscosity of nanofluids would increase by adding nanoparticles, which cause the enhancement of energy demand for pumping power in the systems. Therefore, other effective parameters in the enhancement of the heat transfer coefficient and decreasing viscosity of the nanofluids must be studied. One of the effective parameters is the nanoparticle shape. In most studies, the spherical nanoparticles have been used in the base fluid, whereas at least 70% of the raw materials consist of non-spherical particles in modern industries. Consequently, this explains the importance of studying the nanoparticle shape effect. Several studies have been conducted on the effect of nanoparticle shape, both numerically and experimentally. S K Das et al has been presented the experimental analysis of the heat transfer characteristics in nano fluids used [1]. Eastman et al was presented the nano fluids heat transfer enhancement by using ethylene glycol containing copper based nano fluids [2]. Choi et al have been studied about the nanoparticle properties with enhancement of heat transfer characteristics [3]. Youlong ding et al has been identified the heat transfer enhancement of nano fluids and improvement of thermal conductivity of heat transfer[4]. AK singh presented the recent work of heat transfer examination with nano fluid materials and intensification heat transfer characteristics [5]. Yimin Xuan and Qiang Li they presented a paper on procedure for preparing Nanofluids which is a suspension consisting of anophase powders and a base liquid. By means of the procedure, some sample Nanofluids are prepared[6]. Sivakumar K et al has been examined the heat transfer analysis with experimentally along twisted tape insert[7]. Godson et. al. the heat transfer coefficient of Nanofluids is much higher than that of the common base fluid and gives little or no penalty in pressure drop[8].

Sivakumar was introduced the heat transfer enhancement with swirl motion of twisted tape insert and enhanced the heat transfer and friction factor characteristics [9].

II. EXPERIMENTAL INVESTIGATION

A geometry arrangement of pipe by means of width (t) of 0.075 cm, distance end to end (L) of 200 cm use experimental examination. In double tube heat exchanging device, the primary heat move test segment is used, which is protect to reduce heat defeat to nearby area.

It comprises of two pipes which temperate wet flows from side to side the internal tube and cold water flows through the external tube.

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The external tube is complete of CI with inside and surface diameter 27 mm & 37 mm respectively.

The middle tube is made of AL surrounded by and outer surface diameters of 20 mm & 18 mm correspondingly. Water is complete to pipe from the water circle, the electrical furnace is prohibited with the voltage regulation agitator and the flow meters are located in pathway of irrigate provide. The organization consists of twin pipe heat exchanger. The inside pipe is made of copper and the exterior tube is shaped of stainless steel. It consists of a water warmer and temperature dimension scheme. The hotness dimension system include located cove and opening of tubes, in that order.

A experimental set of connections comprises

Geyser
Stress gage
Indicator of temperature
Flow meter
Unit
Display Unit
Double pipe heat exchanger with twisted
Hot water.
Line of Cold Water

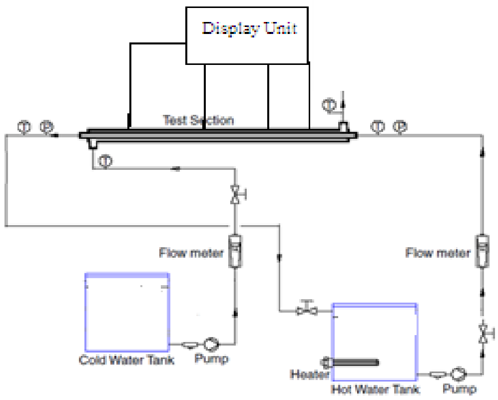

Figure 1 Experimental setup

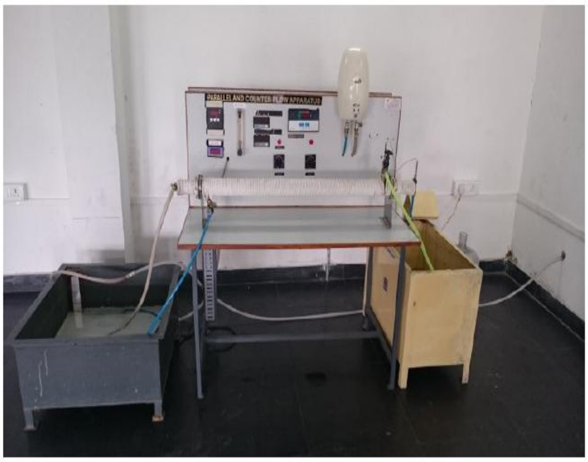

Figure 1 (a) Photographic view of double tube heat exchanging device

Heat flow rate be considered as a result of

$$Q = m \; Cp \; (T_2 - T_1) \quad \text{---- (1)}$$

Everywhere

Q - heat rate
m - mass flow
Cp specific heat
T - temperature inlet and outlet

Heat transfer coefficient be able to be considered with

$$H = q \; / \; (T_w - T_b) \quad \text{---- (2)}$$

Where

h - heat transfer coefficient
q - heat flux
T_w- surface temperature

Reynolds number considered

$$Re = UD/_v \quad \text{---- (3)}$$

Where

Re - Reynolds number
U - velocity
D - Diameter of the tube

Nusselt number be capable of obtain

$$Nu = h\,D / K \quad \text{---- (4)}$$

Where

Nu - Nusselt number
K - thermal conductivity

III. RESULT AND DISCUSSION

The experimental investigation of heat transfer, heat transfer coefficient, Nusselt number and friction factor characteristics of the double pipe heat exchanger with twisted tape inserts was analyzed and indicates the enhancement results. The Reynolds varied from the 90000 to 170000. The experimental setup was conducted and the reading with plain water and nano fluid concentration (0.2% & 0.4% volume). The heat transfer characteristics of nanofluids were compared based on Re. Al2O3 nanofluid was attributed to the Brownian particle motion; therefore, a further increase for the heat tranfer capability of Al2O3 nano particles. Al2O3 nanoparticles present a large surface area which enhances the heat transfer characteristics of the nanofluid. The presenting of the Nu as a function of the Re indicates enhancement in the convection heat transfer. Typically, the nanofluids obtain higher Nu than water with an equal Re. The Nu from Fig.2 was compared when subjected to the same Re in 90000 to 170000 ranges. The experimental results indicated that due to the low thermal conductivity of Al2O3 nanofluid, Nu is higher than that of other nanofluids. An increase in Re leads to increase in Nu. The Nu was enhanced with 0.4% volume of nanofluids compared with 0.2% and plain water, because due to 0.4% having more concentration with the other two fluids. The nusselt number increased 1.4% to 1.9 % compare with the 0.2% and plain water. The Nusselt number improvement as shown in the figure 2.

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As Figure 3 shows the express variation of Re and h the analog the Nano fluid heat flow coefficient augmented by means of add to Reynolds and give superior standards than plain water transfer coefficient.

Due to swirl stream shaped through warped tape, the heat periphery level with the enhanced integration among center and pipe partition were liable the tapering stream. The assessment of heat flow coefficient Nano fluids augmented 1.06 to 1.45 times improved with plain water. With an increase in Re, the importance of thermal conductivity in heat transfer enhancement becomes less considerable. At 0.2% and 0.4% volume concentration of Al2O3 nanofluid, the heat transfer coefficient of both concentrations of the nanofluids is 6.2 % and 7.2 % greater than the basefluid in annulus tube side, respectively; while this value is 4.3 % and 1.5 % in inner tube side. This behavior is probably due to the wall effect, which leads to the turbulent flow. Due to an increase in heat transfer coefficient by using Al2O3 and therefore an improvement in the heat transfer characteristics in both concentration of the nanofluids, these nanofluids were recommended to be used in heat exchangers. The possible explanation behind this phenomena is the fact that at 0.2% concentration and 0.4% concentration of Al2O3, these two nanofluids show similar behavior in the figure.

The experimental investigation of heat transfer characteristics of nano fluids with various concentrations with 0.25% and 0.4% of Al2O3 as shown in figure 4. The figure 4 shows the Reynolds number and heat transfer. The results indicates the Reynolds number increases with increases of heat transfer. The heat transfer enhancement was improved 12.4% with 0.4% of nano fluid concentration as compared with the other fluid like water and nano fluid 0.2% concentrations. The figure 5 has shown the comparison of the Reynolds number and friction factor. The friction factor was continuously decreased with increases of the Reynolds number.

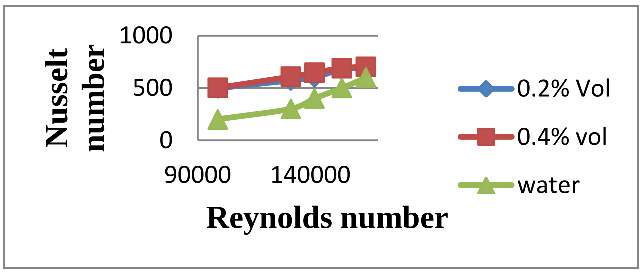

Figure 2 Reynolds number with Nusselt number variations

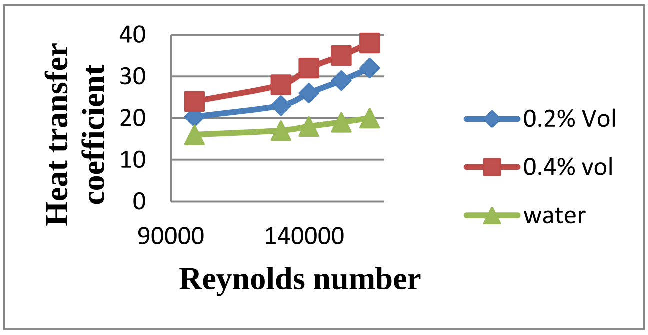

Figure 3 variation of Reynolds number and Heat transfer coefficient

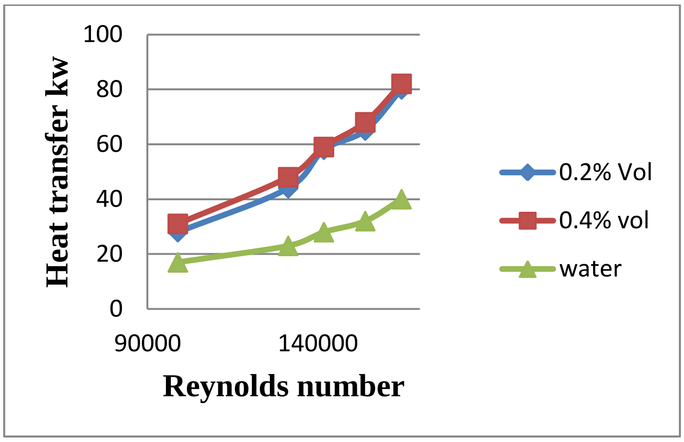

Figure 4 Reynolds number and Heat transfer

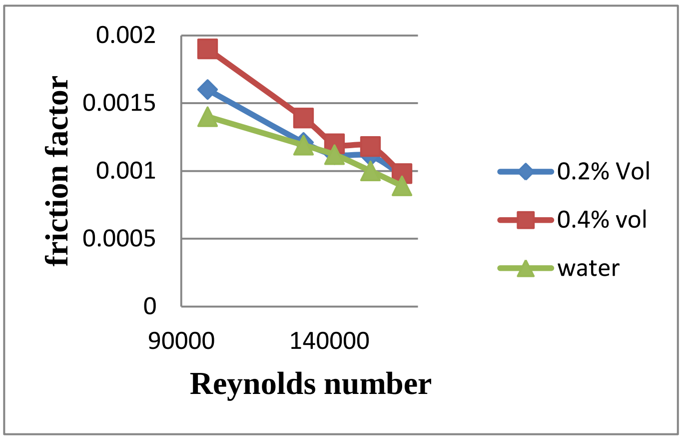

Figure 5 shows the Reynolds number and friction factor

IV. CONCLUSION

In this article the characteristics of heat transfer and friction factor was investigated with Al2O3 nanofluid with different concentration of 0.2% and 0.4% following assessment was made.

- The experimental analysis was taken with double pipe heat exchanger with twisted tape inserts as working fluids is nano fluids with 0.2% and 0.4% concentrations.
- The changes in f and Nu against Re for Al2O3 nanofluids at 0.2 % and 0.4% concentration was also assessed. The results obtained from the simulation of Al2O3 indicate a good agreement with that of reported with different concentrations. The heat transfer coefficient for Al2O3 nanofluids at 0.4 % concentration was enhanced more performance than the in a separate manner demonstrated a better result than that of water.
- The experimental analysis of heat transfer characteristics of the 0.4% concentration volume of nano fluids increased with Al2O3 nano fluids. The heat transfer enhanced 3.2 times than the other working fluids.

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