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PERFORMANCE ENHANCEMENT OF SHELL & TUBE TYPE HEAT EXCHANGER USING NANOFLUID

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ABSTRACT

Heat exchanger is a universal device and plays a critical role in the design of a chemical engineering process. The heat exchangers are designed for many applications in chemical engineering and for many other industrial and non-industrial purposes where the device is used for transferring of internal thermal energy between the two or more fluids/ gases at different temperature levels. In heat exchangers the fluids are segregated by the heat transfer surface and ideally they do not mix with each other. The heat exchangers run on the principle of conductive and convective heat transfer and are design for the where high pressure difference between the two phases are required.

Keywords- Nano fluid, Heat transfer, Heat exchanger.

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I. INTRODUCTION

One of the most innovative science segments of today is nanotechnology, in view of its ability to impact across the board and significant production chain. Nanoscience enables the suggestions on initiatives and programs to develop competitive industrial, and seek consensus on opportunities and challenges and set goals and actions for sustainable development and the production chains in various industry segments. A remarkable characteristic of nanofluids is that by the addition of small amount of nanoparticle, they show anomalous enhancement in thermal conductivity over 10 times more than the theoretically predicted. According to Eastman et al (Eastman et al. 2001) a 40% thermal conductivity increase in ethylene glycol is observed by adding only 0.3 vol.% of copper nano particles with a diameter smaller than 10 nm. A better understanding of the heat transfer process is crucial to improve efficiency in the industrial activities. Since Maxwell (1873) there have been registers of dispersed solid particles are used in the liquid but, was possible to use nano particles dispersed in the liquid. The particle size is important for stability and for increasing the thermal conductivity of the fluid.

Types of Nanofluids-

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There are several types of the Nanofluids Important among them are as follows-

- Metallic Oxides (Al_2O_3,CuO)
- Nitride Ceramics(AIN,SiN)
- Carbide Ceramics(SiC,TiC)
- Metals(Cu,Ag,Au)
- SWCNT,DWCNT
- Semiconductors(TiO_2,Sic)

Objective:-

A remarkable characteristic of nanofluids is that by the addition of small amount of nanoparticle, they show anomalous enhancement in thermal conductivity over 10 times more than the theoretically predicted.

- To increase the heat transfer rate.
- To increase the overall efficiency of the heat exchanger.
- To reduce the time required for heat transfer.

II. LITERATURE REVIEW

L.B mapa et al,[1] Measured enhanced thermal conductivity of Cu- Water based Nano fluid using a shell and tube heat exchanger. Where the dimensions of heat exchanger is 240X24X0.25mm, using 37 tubes. The outcome of analysis is rate of heat transfer is increases with increasing flow rate and also its concentration. By nanoparticle dispersed into de-ionized base fluid a better enhancement is achieved.

J. Koo et al,[2] Investigated the nano particle collision and deposition in the surface wall with the help of micro channel heat sink. Which has the dimensio of 1cm 100micrometerX300micrometer; water-Cu and Cu-ethylene nanofluid are through micro channel heat sink. They are investigated the base fluid should posses high prandtle number and get enhanced heat transfer rate by minimize particle particle, particle-wall collision. Viscous dissipation is important of narrow channel because Nusselt number high for high aspect ratio.

S.J Kim et al,[3] Investigated formation of porous layer and wet ability of nanofluid using critical heat flux experiment and SEM images. They are used three different types of nanoparticles with different diameters such as Al_2O_3 (110-220nm) SiO_2(20-40nm) Zno(110-210nm). They are showed boiling is main factor to affect the heat transfer rate of nanofluid. Due to nucleate boiling nanoparticle deposited on wall, so the porous layer is formed on the wall. Porous layer directly consequence for creating wettablity, cavity and roughness of surface wall. So heat transfer rate decreased due to boiling of nanofluid .

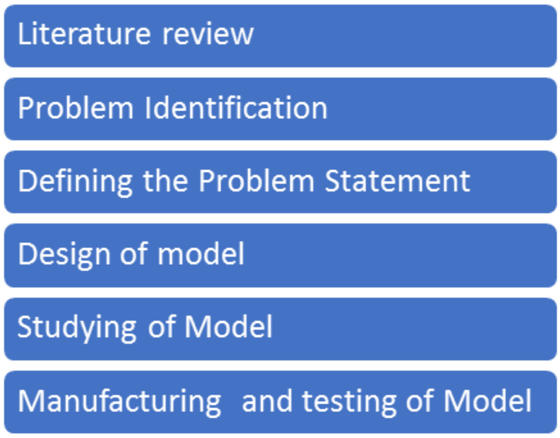
Anilkumar et al [4]. : Studied the heat transfer enhancement of fin, using Al_2o_3- water nano fluid analyzed using CFD. Reyleigh number increases due to Brownain motion, ballistic phonon transport, and clustering and dispersion effect of nanoparticle. At high Rayleigh number flow rate at center circulation is increasing, so temperature is drop from center of fin. Volume of the circulation increases the velocity at centre is increases as the result of increasing the solid fluid heat transportation. Low aspect ratio fin is suitable for heat transfer enhancement, because heat affected zone is less

Eed Abdel Hafez Abdel-hadi et al [5]: Investigate the heat transfer analysis of vapour compression system using Cuo-R134a Nano fluid, test section made of copper horizontal tube and heat is applied
10-40 Kw/m Heat flux concentration and size particle is important factor to enhance the heat transfer rate of nanofluid. Heat transfer rate increases with increasing heat flux, upto 55% of concentration of nanofluid and upto2.5nm sized particles.

Yu-Tung Chen[6]: Investigated the thermal resistance of heat pipe using Al_2O_3 water nanofluid, heat pipe made as 200cmX3mm length and thickness respectively. Heat resistance is increases with increasing concentration of nano fluid up to 50ppm. Due to wet ability of nano particle various geometry wick is created on heat pipe.

Shung-Wen Kang et al[7]: Studied about the relation between thermal resistance- size of nanoparticle with the help of 211 micrometer X 2187 micrometer sized and deep grooved circular pipe and heat pipe maintain 40 temperature. They are finalized thermal resistance is directly proportional to the size of the nanparticle. Maximum reduction of the thermal resistance by using 10nm sized particle. Because particle size is increasing the wall temperature also increases. So small sized particle suitable for enhanced heat.

III. METHODOLOGY

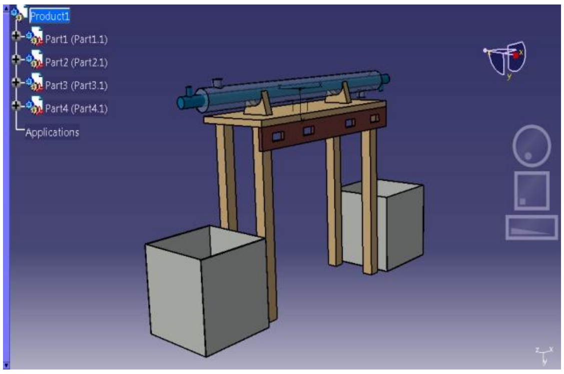


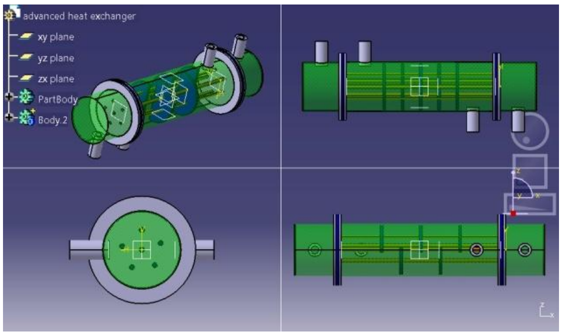
IV. SHELL AND TUBE TYPE HEAT EXCHANGER

Shell and tube heat exchangers consist of series of tubes. One set of these tubes contains the fluid that must be either heated or cooled. The second fluid runs over the tubes that are being heated or cooled so that it can either provide the heat or absorb the heat required. A set of tubes is called the tube bundle and can be made up of several types of tubes: plain, longitudinally finned, etc. Shell and tube heat exchangers are typically used for high-pressure applications (with pressures greater than 30 bar and temperatures greater than 260 °C). This is because the shell and tube heat exchangers are robust due to their shape. Several thermal design features must be considered when designing the tubes in the shell and tube heat exchangers: There can be many variations on the shell and tube design. Typically, the ends of each tube are connected to plenums (sometimes called water boxes) through holes in tubesheets. The tubes may be straight or bent in the shape of a U, called U-tubes. These fluids have deficiencies among which include the low evaporation temperature, as water, and low thermal conductivity in the case of oils and ethylene glycol. The addition of nanoparticles in the fluid changes the flow structure, so that besides increasing the thermal conductivity, chaotic motion, dispersion and fluctuation of the nanoparticles especially near the tube wall of a heat exchanger leads to an increase in the rate of energy exchange and increases heat transfer between the fluid and the tube wall. Furthermore, at high flow rates, the effects on dispersion and chaotic motion of nanoparticles enhance mixing fluctuations and changes in temperature profile to a flatter profile similar to turbulent flow and cause an increase in the heat transfer.

V. MODEL OF THE HEAT EXCHANGER

The shell and tube type heat exchanger is designed in CATIA software. The parts in the assembly are heat exchanger , tubes , Tank. The CATIA model is as shown in following fig.





VI. FUTURE SCOPE

In Future, the next steps in the nano fluid research are to concentrate on the heat transfer enhancement and its physical mechanisms, taking into consideration such items as the optimum particle size and shape, particle volume concentration, fluid additives, particle coating and base fluid. Important features for commercialization must be addressed, including particle settling, particle agglomeration, surface erosion, and large scale nanofluid production at acceptable cost. We are using this type of heat exchanger in automobile radiator, industry purpose, oil cooler of heat engine, In west heat recovery system.

Applications:-

1. Milk chillers of pasteurizing plant
2. Oil coolers of heat engines
3. Automobile radiators
4. Regenerators
5. Condensers and evaporators in refrigeration plants
6. Condensers and boilers in steam plants
7. Intercoolers and pre heaters

VII. CONCLUSION

This study aimed to present a new fluid, and the feasibility of its use. The nanofluid is revolutionizing the concept of heat exchange, making researchers teams from around the world to rethink about this concept to enable their use in industrial equipment such as: refrigerators, heaters, among others. The methods used in this work, been conventional methods, however, a study that has to check if in fact the conventional methods are suitable for the use of this novel class of fluid. The nanofluids of high particle concentration have shown higher thermal conductivity as is evident from the and . Both particle loading and Nanofluid temperature are dependent on thermal conductivity of AL_2O_3 Nanofluids. The propylene glycol based nanofluids have low thermal conductivity compared to water based Nanofluids. A significant modification of thermo physical properties due to emulsion nano structured particles in the fluid based, in this case water and ethylene glycol, provided a significant decrease in the dimensioning of the heat exchanger. In fact this new technology demonstrate future commitments, however, makes clear the need to study more deeply about this, because without doubt is a kind of fluid, which will provide a revolution, making the heat exchangers in ever smaller dimensions.

VIII. ACKNOWLEDGMENT

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REFERENCES

[1] Pramod S. Purandare, Mandar M. Lele, Raj Kumar Gupta "Experimental investigation on heat analysis of conical coil heat exchanger with 90 degree cone angle", Heat Mass Transfer 46 (2014)

[2] M. Ghazikhani, I. Khazaee S. M, S. Monazzam, J. Taghipour "Experimental Investigation of the Vortex Generator Effects on a Gas Liquid Finned Tube Heat Exchanger Using Irreversibility Analysis" Arab J Sci Eng (2013) pp 2107–2116.

[3] Dillip Kumar Mohanty and PravinMadanraoSingru. "Numerical method for heat transfer and fouling analysis of a shell and tube heat exchanger using statistical analysis" Korean J. Chem. Eng., (2012) pp 1144-1150

[4] A. I. Zinkevich, V. N. Sharifullin , A. V. Sharifullin. "Analyzing the Effect on Heat Transfer due to Non uniform Distribution of Liquid Flow among the Tubes of a Shell and Tube Heat Exchanger" Thermal Engineering, (2010) pp 807

[5] LIU Wei, LIU ZhiChun, WANG Ying Shuang& HUANG SuYi. "Flow mechanism and heat transfer enhancement in longitudinal flow tube bundle of shell and tube heat exchanger." Sci China Ser E-Tech Sci (2009) pp 2952-2959.

[6] Seong-YeonYoo, Jin-Hyuck Kim2, and Kyu-Hyun Han, 2010. "Thermal performance analysis of heat exchanger for closed wet cooling towerusing heat and mass transfer analogy", Journal of Mechanical Science and Technology,pp:

[7] Andre L.H. Costa, Eduardo M. Queiroz, 2008. ''Design optimization of shell-and-tube heat exchangers", Applied Thermal Engineering 28, pp: 1798–1805.

[8] G. Ferrara et al. "CFD analysis of gas explosions vented through relief pipes", Journal of Hazardous Materials A137, pp. 654-665, 2006. IntCommun Heat Mass Transfer (2002) pp 84–92.

[12]]Naphon P "Study on the heat transfer and flow characteristics in a spiral-coil tube." Int J Heat Mass Transfer (2002) pp 69–74.
[13] SwapnaneelSarma, D.H.Das, 2012. ''CFD Analysis of Shell and Tube Heat Exchanger using triangular fins for waste heat recovery processes", IRACST – Engineering Science and Technology: An International Journal (ESTIJ), pp: 2250-3498.
[14] Sanjay Kumar Sharma and Vikas Sharma, 2013. ''Maximizing The Heat Transfer Through Fins Using Cfd As A Tool", International Journal of Recent advances in Mechanical Engineering (IJMECH) Vol.2, No.3, pp: 13 28.
[15] Avinash D Jadhav, Tushar A Koli, 2014. ''CFD Analysis of Shell and Tube Heat Exchanger

