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A Study on Heat Exchanger Using Various Arrangement of Baffle

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Abstract- *A heat exchanger is a device that allows heat from a fluid (a liquid or a gas) to pass to a second one (another liquid or gas) without their mixing or direct contact. The efficiency of the heat exchanger depends directly on the heat transfer coefficient of the material. In tubes under laminar or turbulent flow conditions with a variety of nanofluids, high heating transfer rates were routinely observed in investigations. The increase in the thermal transfer of the nanofluid depends on particle content, the thermal conductivity of Nano in particular and the mass flow rate. In numerous heat exchangers, the scientists discussed various aspects of nanofluids and various methods for using nano-fluids to increase heat transfer rates. In several research papers, the study focused on increasing the efficacy of nanofluids. However, certain papers are concerned with nanofluid and its effect, performance, thermal transport and overall heat transfer coefficient. Now a day's mostly research done on helical baffle arrangement which gives better performance compared to segmental baffle and researcher gives some more design arrangement of baffles like trefoil-hole baffles, plate baffles, ladder-type fold baffle etc which gives better overall performance of shell and tube heat exchanger.*

Keywords:- Shell and tube heat exchanger, baffle, segmental baffle, helical baffle.

I. Introduction

A device whose primary purpose is the transfer of heat energy between two fluids at different temperature is named a heat exchanger. A heat exchanger may be defined as equipment which transfers the energy from a hot fluid to a cold fluid, with maximum rate and minimum investment and running costs. There are various types of heat exchangers available in the industry, however the Shell and Tube Type heat exchanger is probably the most used and widespread type of the heat exchanger's classification. It is used most widely in various fields such as oil refineries, thermal power plants, chemical industries and many more. This high degree of acceptance is due to the comparatively large ratio of heat transfer area to volume and weight, easy cleaning methods, easily replaceable parts etc. Shell and tube type heat exchanger consists of a number of tubes through which one fluid flows. Another fluid flows through the shell which encloses the tubes and other supporting items like baffles, tube header sheets, gaskets etc. The heat exchange between the two fluids takes through the wall of the tubes.

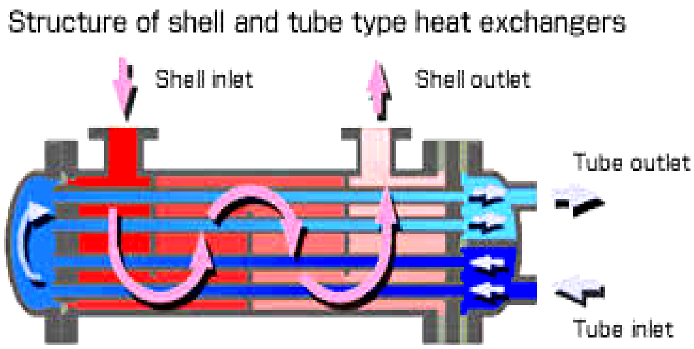

Fig. 1: Heat Exchanger.

II. Design Methods

Shell and tube heat exchangers are designed normally by using either Kern's method or Bell-Delaware method. Kern's method is mostly used for the preliminary design and provides conservative results whereas; the Bell-Delaware method is more accurate method and can provide detailed results. It can predict and estimate pressure drop and heat transfer coefficient with better accuracy. In this paper we have described Kern's method of designing in detail. The steps of designing are described as follows:

1) To find out the values of some unknown temperature first we consider the energy balance. In this energy balance certain some inputs like hot fluid inlet and outlet temperatures, cold fluid inlet temperature, mass flow rates of the two fluids are needed to serve the purpose. The equation may be given as :
Some contents under this heading have been cited from Wolverine Tube Heat Transfer Data Book.

$$Q = m\,h\,C_{ph}\,(Th_1 - Th_2) = mc\,C_{pc}\,(Tc_2 - Tc_1)$$

2) Then we consider the LMTD equation to find its value:

$$LMTD = \frac{(\Delta T1 - \Delta T2)}{\ln\left(\frac{\Delta T1}{\Delta T2}\right)}$$

Where, $\Delta T1 = T_{h1} - T_{c2}$ and $\Delta T2 = T_{h2} - T_{c1}$

III. Review Works

While reviewing the works of renowned scholars it has been seen that significant amount of works has been done in field of STHE. Some important works have been described in detail as under:
The properties of 'nanoparticles' for heat transfer have resulted from the idea of using nanoparticles in the fields concerned to increase the performance of heating delivery of natural liquids in industries such as solar synthesis, gas sensing, biological sensing, pharmaceutical industries, nuclear reactors and the oil industry.

As shown by **Choi et al. (2001)** [1], addition of nanoparticles increases thermal conductivity. Masuda et al., (1993) and Minsta et al. (2009) [2, 3] have proved that small amounts of nanoparticles are smaller than 5%, 10-50% of the total thermal conductivity in single fluids [2, 3].

Kim et al. (2007) the essential role of nanofluids in nuclear physics has been studied. The effectiveness of any water cooled nuclear devices would be improved by proven nano-fluids. Possible applications include water reactor pressurized, primary refrigerant, standby systems, acceleration targets, plasma diverters etc. [4, 5].

Kim et al. (2017) usage of nanofluids by way of coolants in emergency cooling systems could be investigated where the surface heating could quickly be cooled and the safety on the power plant could be improved [6].

From **Jackson's (2007)** from a crucial heat flow point of view, a regulated nanofluid-deposit surface can be increased. Nanofluid use improves nuclear reactors' in-ship retention capacity by as much as 40% [7].

Suresh et al. (2011) Prepared by thermochemical process nano-crystalline nanocomposite Al2O3-Cu hybrid. "Copper nitrate Cu (NO_3)2•3H2O and aluminium nitrate Al (NO3)3•9H2O" are formed by mixing the solution with water. Due to proportions of nano-composite aluminium and copper mixture the proportions of these precursory sales are chosen. For the extraction of Al2O3-Cu, the solution formulated is sprayed to 180 ° C. The powder is stored for a solid alumina and copper oxide combination at 900 ° C in still air for 1 hour. This mixture is heated to CuO to Cu intended for In a tubular furnace at 400 ° C 1 hour in the hydrogen setting. During this reduction process, the aluminium composition remains unchanged. This is then milled in 400 rpm to handle homogenous nanocomposite Al2O3-Cu in experiments. [11].

Sunder et al. (2014) Produced insitu process MWCNT- Fe3O4 nanocomposite. In the beginning, the MWCNT is carboxylated by dispersing the MWCNTs into heavy hydrochloric and nitric acids (1:3 polar ratios). The MWCNTs shall be drying at 80 ° C and dried for 24 hours with acetone and filtered water. The carboxylate-MWCNT is distributed in distilled water, combining with Fecl3+, and Fecl2+. A watery solution of sodium hydroxide is applied progressively until the iron chlorides are evenly distributed to the reaction where the colour suggests. This solution is continually withdrawn and pH is retained at 12. After this solution has been carried out. Nanocomposites are then washed with acetone and dried with purified water at 80 ° C for 24 hours [12].

Batmunkh et al. (2014) in the first position hybrid TiO2 nanocomposites are manufactured by pulse wire evaporation, the Ag-nanoparticle's with the global ball moulds are ground besides TiO2 particulates with Ag-particulates are then mixed to produce Ag-TiO2 nanocomposites. A mechanical agitating process for preparing Ag- TiO2 hybrid nanocomposites [13].

Nine et al. (2013) Cu / Cu2O nanocomposite produced using a method of wet ball milling. 99 percent of pure copper nanoparticles 200 nm in size are wet-filled pellets in order to generate Cu2O nanoparticles. Planetary ball-milling used to grind the desired type and shape of nanocomposites. By feeding the particles of 0.5 gram of Copper into the ball mill with 20 milli Litre of Distilled water and spinned for 90 minutes at 500 RPM, keeping the temperature below 50 °C. The synthesized material is oven-dried at 60 °C [14].

Chandrasekhar et al. (2017) The behaviour of Al2O3 / water nanofluid prepared by chemical precipitation method was experimentally investigated and tested theoretically. Al2O3 / water at varying concentrations of volume was examined for their inquiry. They concluded that the growth in nanofluid viscidness is greater than the upsurge in thermal conductivity. While both viscosity and thermal conductivity rise in volume concentrations, thermal conductivity is dominated by an increase in viscosity. Several other theoretical models were also suggested in their paper [15].

Hady et al. (2017) the effect of alumina water (Al2O3 / H2O) in a cold water air-conditioning device has been experimentally investigated. They used different amounts alternating from 0.1% to 1% weight and supplied nanofluid at diff. degrees of discharge. Studies have shown that it takes less time than pure water to obtain the requested chilled fluid. There was also a decline in power consumption indicating an increase in the unit's cooling capability. In comparison, the unit's COP has been increased through 5% with a vol. of 0.1% and by 17% with a vol. of 1% [16].

Rohit S. Khedkar et al. (2017) Experimental works with nano-nano-fluids as working liquids with numerous nanoparticles with double tube heat exchanger for hot transition water from nano-fluids to simple fluids. The cumulative heat transfer coefficient has been experimentally measured and results are compared to pure water for a fixed surface of heat transfer with different volume percentages of Al2O3 nanoparticles in single fluids. 3% of nanofluids with an average coefficient of heat transfer 16% higher than water demonstrate acceptable performance in their findings [17].

Akyürek et al. (2018) in a double tube heat exchanger with turbulators within the internal tubes, experimentally examined effects of Al2O3 / Water nanofluids at different concentrations. Comparisons were made with and without nanofluid and turbulators in the device and without. Results were collected and the results found were the basis for a variety of heat transfer parameters. Various heat properties have been explored including change in Nu number and dynamic viscosity w.r.t. Reynold's no., nanofluid behaviours at altered volume sizes, variations in heat coefficients, influence of turbulator pitch variations on nanofluid thermal transfer etc. They concluded that there is a correlation entre the various pitches and instability in the flow induced by more instability when the pitch is less and vice versa [18].

IV. Conclusion

After the study and above discussion it is to be said that the shell and tube heat exchanger has been given the great respect among all the classes of heat exchanger due to their virtues like comparatively large ratios of heat transfer area to volume and weight and many more. And in this work An model will be developed to evaluate analysis of a Helical and Segmental Baffle Heat Exchanger as well as the Comparative analysis between the thermal Parameters between the Segmental and helical angle has been showed.

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