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DESIGN,FABRICATION AND EXPREMENTAL ANALYSIS OF SHELL AND HELICAL COILED HEAT EXCHANGER USING NANO FLUIDS

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ABSTRACT

Heat exchangers are the important engineering equipment's used for transferring heat from one fluid to another. Heat exchangers are widely used in various kinds of application such as power plants, nuclear reactors, refrigeration and air-conditioning systems, and heat recovery systems, petrochemical, mechanical and biomedical industries. Now day's helical coiled heat exchangers are used in many large thermal industries because it can give high heat transfer coefficient in small footprint of surface area.This project focuses on the designing of shell and helical coiled heat exchanger and its thermal evaluation with cross flow configuration. In this project work, analysis will be carried out by considering the various parameters such as flow rate of cold water, flow rate of hot water, temperature, effectiveness and overall heat transfer coefficient etc. In this work, copper material is used for tube pass in helical coiled heat exchanger because of copper has good thermal conductivity (K) is 385w/m.k. So that it can give better results for improving overall performance of helical coiled heat exchanger. Finally result will be evaluated by varying mass flow rate of cold medium with different concentration of Nano fluids.
KEYWORDS: Shell and helical coiled heat exchanger, Copper, Thermal conductivity,Nano fluids.

Introduction

Heat Exchanger

A heat exchanger is a device that is used for transfer of thermal energy (enthalpy) between two or more fluids, between a solid surface and a fluid, or between solid particulates and a fluid, at differing temperatures and in thermal contact, usually without external heat and work interactions.
The heat exchangers classified based on the type of heat transfer as

- Direct transfer type (or) recuperators
- Indirect transfer type (or) regenerators

LITERATURE SURVEY

Amol Andhare,et al. has studied the Heat exchangers have significant applications in refrigeration & air-conditioning systems, heat recovery processes, chemical reactors, food processing, power engineering and other energy intensive industries. The design of an efficient heat exchanger had always been significant to equipment designers. Due to their compact structure and high heat transfer coefficient, helical coils as one of the passive heat transfer enhancement technique is widely used in various industrial applications. The centrifugal force induced due to the curvature of the tube results in the secondary flow development which enhances the heat transfer. Numerous studies have been carried out by researchers to investigate the fluid flow and heat transfer characteristics in the coiled tubes. Dravid et al. in the fully developed region and the thermal entrance region studied the effect of secondary flow on laminar flow heat transfer in helically coiled tubes. The results obtained from predictions were validated with those obtained from experiments in the range in which they overlapped. Patankar et al. has studied the effect of the Dean number on friction factor and heat transfer in the developing and fully developed regions of helically coiled pipes. Good agreements were obtained from comparisons between the developing and fully developed velocity profiles, the wall temperature for the case of axially uniform heat flux with an isothermal periphery obtained from calculation and those obtained from experiments. In the model mentioned above, the effects of the torsion and the Prandtl number were not taken into account. Rennie et al investigated performance of a double pipe helical heat exchanger. The overall heat transfer coefficients were calculated and heat transfer coefficients in the inner tube and annulus were determined using Wilson plots. Results revealed that there was significant increase in Nusselt number in the entrance region and also heat transfer rates in counter flow configuration. Ghorbani,et al has studied the experimentally investigated the mixed convection in helically coiled heat exchanger for various Reynolds numbers, Rayleigh's number, various tube-to-coil diameter ratios and different dimensionless coil pitch for both laminar and turbulent flow inside coil. The mass flow rate of tube side to shell side ratio (Rm) was found to be effective on the axial temperature profile of heat exchanger. Parinya pongsoi,et al ,has concluded the present study, an attempt has been made to summarize and analyze the results of an examination of the air-side performance of spiral (or helical) fin-and-tube heat exchangers. Currently, the spiral fin and tube heat exchanger is a favored type of heat exchanger for the waste heat recovery unit (WHRU), a kind of economizer system. The present paper is broadly divided into an experimental section and numerical and simulation sections. A significant fraction of the papers herein reviewed pertains to the effect of fin configurations, tube arrangements, operating conditions, and other factors on the air-side performance of the spiral fin-and-tube heat exchangers. Approximately 40 published articles related to spiral fin-and-tube heat exchangers are briefly described. Moreover, the air-side performance correlations of spiral fin and circular fin-and-tube heat exchangers are compiled into this work for practical industrial applications. The results of the helical tube heat exchanger are compared with the straight tube heat exchanger in both parallel and counter flow by varying parameters like temperature, flow rate of cold water and number of turns of helical coil. Dravid et al. has shown that the intensity of secondary flow developed in the tube is the function of tube diameter (Di) and coil diameter (Dc). Naphon investigated the thermal performance and pressure drop of a shell and helical coiled tube heat exchanger with and without helical crimped fins. Naphon et al .summarized the phenomenon of heat transfer and flow characteristics of single-phase and two- phase flow in curved tubes including helically coiled tubes and spirally coiled tubes. The design procedure adopted gives sizing and rating analysis of helical coil heat exchanger and results are found in good agreement with the experimental results. By increasing mass flow rate of hot water the effectiveness increases at constant cold water mass flow rate. When mass flow rate of cold water is maintained at lower value the effectiveness is maximum but, when mass flow rates of cold water increases effectiveness decreases correspondingly. The overall heat transfer coefficient and Heat transfer rate increases with increase in mass flow rate of hot water. The overall heat transfer coefficient and heat transfer rate increases with minimum amount when mass flow rate of cold water is kept 0.86 whereas it is increases with maximum amount when mass flow rate is 1.71. Also temperature of hot water at outlet increases with increase in hot water flow rate in the tube.

Nanoparticles

From the literature survey we have find that aluminium are have high Thermal conductivity with small particles size. Even though copper has high Thermal conductivity the particles size of aluminium and zinc nanoparticles is very high than other nano particles. It is observed that aluminium nano particle is having high thermal conductivity compared to other Nano fluid. aluminium nanoparticle increases the thermal conductivity of water by maximum. The experimental analysis the thermal conductivity coefficient is found to increase with the increase of the volume concentration of the Nano fluid and decrease of the particle size. From our literature survey we have chosen aluminium as a Nano material to enhance the thermal conductivity of paraffin. Nano materials are being applied in more and more fields within engineering and technology. One of the key benefits of Nano materials is that their properties differ from bulk material of the same composition. The properties of nanoparticles, for example, can be easily altered by varying their size, shape, and chemical environment.

Aluminium is a Block P, Period 3 element. It is a ductile metal with very high thermal and electrical conductivity. The morphology of copper nanoparticles is round, and they appear as a brown to black powder.

Manufacturing Process

Aluminium nanoparticles can be manufactured using numerous methods. The electro deposition method is considered by many as one of the most suitable and easiest. The electrolyte used for the process is an acidified aqueous solution of copper sulphate with specific additives. A spongy layer of aluminium particles is deposited on the cathode surface when the input DC voltage is varied with a constant current. The particles are typically characterized and assessed by XRD and UV-Vis. The surface morphological characterization is done using scanning electron microscopy (SEM) and transmission electron microscopy (TEM). Damp reunion tends to affect

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the dispersion performance and usable properties of aluminium nanoparticles; hence this material has to be sealed under vacuum and stored in a cool and dry room. It should not be exposed to air, and should not be under stress.

Experimental Setup

Figure 1 shows dimensional and operating parameters of helical coil heat exchanger.

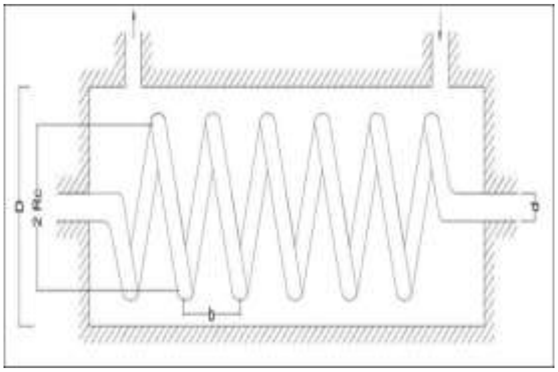

Fig 1 Geometrical Procedure of proposed helical coiled heat exchanger

Table 1 Dimensional parameters of proposed helical coiled heat exchanger.

Si.no	**Dimensional parameters**	**Dimensions**
1.	Outer diameter of mild steel cylinder(d_o)	210mm
2.	Inner diameter of mild steel cylinder(d_i)	198mm
3.	Thickness of shell (t)	2mm
4.	Outer diameter of tube (d_o)	10mm
5.	Inner diameter of tube (d_i)	8mm
6.	Thickness of tube (t)	1mm
7.	Length of tube	470mm
8.	Curvature radius (r_c)	65mm

Table 2 Reading With Nano Particles

S.NO	Mass flow rate	Cold water inlet(t1)	Cold water outlet(t2)	Hot water inlet(T1)	Hot water outlet(T2)
1	m/20	31	58	80	47
2	m/15	30	45	81	57.2
3	m/10	31	39.7	80	63

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