Simulation of Helical Coil Double Tube Heat Exchanger with Baffles by Numerical Investigation –A Review

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Abstract-The project aims to study the comparison of nusselt number on the behalf of Reynolds number and baffles in spiral coil tube in tube device. A spiral coil tube in tube device with variety of turns adequate to two and that accommodates three ring formed baffles that area unit placed in annular space between these two spiral tubes is taken into account for study. The most aim of providing baffle is to extend the turbulence so that it increase the convection and the baffles are also provides to support and helps to keep up two coils concentric . The design was modeled exploitation Ansys 16. The hot fluid flows through the tube and cold fluid flows through annular space. The fluid considered is water. The analysis is completed exploitation Ansys fluent. The heat transfer in spiral coil device is analyzed by varied the rate of hot fluid and rate of cold fluid is kept constant.

The laminar and turbulent flows are considered for study. K–ε model is employed to model the turbulence within the flow and also the flow is analyzed for counter flow device setup. The variation of Nusselt number with the amendment in Reynolds number of hot fluid is studied. The coil diameter of the spiraling coil is additionally varied to check the result for each laminar and turbulent flow. The D/d magnitude relation is varied from ten to twenty five in steps of five

Keywords-Helical coil heat exchanger, Baffles, Nusselt number

I. INTRODUCTION

1.1. Heat Exchangers

Heat exchanger is that devices that square measure used for the transferring heat between totally different temperature fluids which can be directly in grips or could also be flowing severally in two tubes or in two channels. various applications of heat exchangers are often determined in our day these days life, to mention a number of square measure condensers and evaporators employed in refrigerators and air conditioners and just in case of thermal station heat exchangers square measure employed in, condenser, boilers, air coolers and chilling towers. Just in case of cars heat exchangers square measure within the sort of radiators or within the sort of oil coolers in engine. Giant scale method industries and chemical industries use heat exchangers for the transferring heat between totally different temperature fluids that square measure single section or two section.

1.2. Types of Heat Exchangers:

Based on Heat transfer method

*1. Direct Contact heat exchange*r

In direct contact heat exchangers two unmixable fluids are directly mixed and heat transfer happens between two fluids. The specialty of this kind of heat exchangers are the absence of wall separating the hot fluid stream and cold fluid stream. the appliance of this sort of heat exchangers are often found in several places like in air conditioners, water cooling, humidifiers, industrial predicament heating and compressing plants.

2. Transfer type of device

In Transfer style of device two fluid at the same time flows through two tubes separated by walls. This are the foremost usually used sort device owing to simplicity in its construction

3. Regenerators type device

A regenerative device is that style of device within which hot fluid heat is intermittently keeps during a thermal medium so it'll be transferred to the cold fluid. To realize this initial the new fluid is allowed to return in grips with the thermal medium that is sometimes the wall of heat transfer so the fluid is replaced with the cold fluid which can absorb the warmth from the medium.

Based on Constructional options

1. Tubular device

This type of heat exchangers contains two coaxial tubes within which one in all the fluid flows through the tubing and also the second fluid flows through the annulated area. Each the fluids square measure separated by the wall and heat transfer happens through the walls

2. Shell and Tube device

This type of heat transfer contains tube bundles that are ready of tubes and a shell. The fluid that is to be heated or cooled is contained in one set of those tubes. The second fluid flows over the tubes that have to be heated or cooled

during this manner fluid are often either heated or absorb the warmth needed.

3. Finned tube device

The principle that is in cooperated during this style of heat exchanger are that with the introduction of fin within the heat money handler the heat transfer capability of the heat exchanger are often improved. This is often principally employed in gas to liquid style of device and whereas victimization this fin is employed in gas aspect.

4. Compact device

A compact device are often outlined as device that has space density (The magnitude relation of the heat transfer area of a device to its volume) for gas worth larger than 700 m2/m3 and for liquid or two-phase stream operation it's greater than 300 m2/m3. Compact device square measure usually cross flow sort wherever two fluid flow perpendicular to every different.

Based on flow arrangement

1. Parallel Flow

In parallel flow heat exchangers the new and cold fluid flows parallel to every different which means within the same direction.

2. Counter Flow

In counter flow heat exchangers each the fluids flows in wrong way.

3. Cross Flow

In cross flow heat exchangers the two fluid flow perpendicular with relevance each other

1.3. Helical Coil Heat Exchangers

Helical coil device are recent development that has several blessings compared with straight tube heat exchangers.

Advantages:

a. Heat transfer rate of whorled coil is giant compared thereupon of straight tube device.

b. It's a compact structure and needs less floor space compared to different heat exchangers.

c. Self-cleaning.

d. surface area for heat transfer is massive

The application of warmth exchanger covers following areas

1. Air conditioning

2. Power generation

3. Crude oil industry

4. Chilling towers in Thermal station

5. Refrigeration

6. for warmth recovery

II. LITERATURE REVIEW

Kumar et al. (2006) investigated heat transfer characteristics and fluid mechanics of tube in tube whorled coil heat exchanger the experimental work was done on counter flow setup of warmth exchanger and overall heat transfer coefficients was evaluated. The Nusselt selection and friction constant for outer tube conjointly as conduit was calculated thus it's compared with numerical values got from CFD code package FLUENT. The observation created by them is that overall heat transfer constant increase with inner coil dean selection for constant flow in annulus region.

Jayakumar et al. (2008) has done each numerical and experimental study on whorled coil device and he has thought of fluid to fluid heat transfer. the various boundary conditions into account wherever constant heat flux, constant wall temperature and constant heat transfer constant .The observation created was constant values of transport properties and thermal properties of warmth transfer medium ends up in inaccurate heat transfer constant and conjointly in several sensible applications like heat transfer in fluid to fluid heat exchangers discretionary boundary conditions like constant heat flux and constant wall temperature are much not applicable. Supported numerical analysis and experimental work conducted and development of correlations was done to calculate the inner heat transfer constant of whorled coil among bound error limit.

Kharat et al. (2009) has done experiment on concentric whorled coil device to review the warmth transfer rate and develop the warmth transfer constant correlations. The impact of assorted operational variables like diameter of tube, gap between the concentric coils and coil diameter. The gap between concentric coils and tube diameter affects the warmth transfer constants and results obtained by them suggests that with increase in coil gap ends up in the decrease of warmth transfer constant and once tube diameter increase the warmth transfer coefficient will increase.

Jayakumar et al. (2010) has done each experimental and numerical analysis thus on establish the native Nusselt variety variation on circumference and conjointly on length of whorled coil. Variations were created on pitch circle diameter, pipe diameter and tube pitch and the way they have an effect on heat transfer rate was acknowledged. Within the literature Nusselt variety prediction was conjointly done. The variation of Nusselt variety admire angular location of purpose position was conjointly foreseen. The conclusion created by them counsel that heat transfer constant and thus on the bound

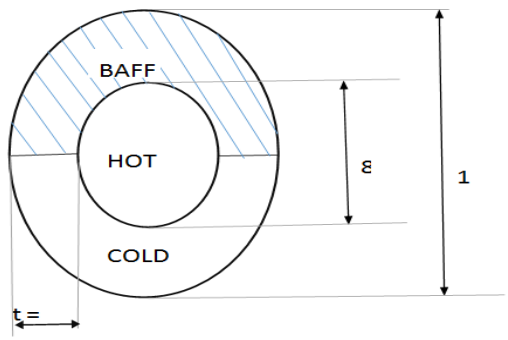
of whorled coil Nusselt variety isn't uniform and that they have derived associate expression for conniving the Nusselt variety at completely different points on the bound of the whorled coil within the totally developed region. The impact of pipe diameter was conjointly studied and results suggests that for low pipe diameter, the secondary flow is weak and fluid mix is a smaller amount

When the diameter of the coil will increase the warmth transfer at the outer surface is highest. The PCD influence the force of fluid flowing within the tube that successively affects the secondary flow. Once the PCD is exaggerated, the curvature impact on flow pattern decreases and therefore the force plays a lesser role in flow characteristics.

Heat transfer and flow characteristics in a very spiral-coil tube was studied by Naphon (2011).Both experimental and numerical study on horizontal spiral-coil tube was applied to predict the flow characteristics. To model the turbulence the quality k–ε two equation model was used. He acknowledged that heat transfer constant was full of force and conjointly the Nusselt variety and pressure drop obtained from the spiral-coil tube are nearly one and half times more than that of straight tube device because of the impact of force Pawar et al. (2014) has done the experimental analysis by considering equal steady state also as non-isothermal unsteady state conditions for laminal also as flow conditions in whorled coils by considering Newtonian as well as non-Newtonian fluid because the operating fluid. The Newtonian fluid thought-about is Glycerol-water mixture (10 and 20 the troubles glycerol) and Non-Newtonian fluid. thought-about is 0.5–1% (w/w) dilute liquid chemical compound solutions of sodium Carboxy alkyl polysaccharide and metal Alginate is taken into account as Correlation was observed between Nusselt number, coil curvature quantitative relation and Prandtl range.

Lu et al. (2014) has done each numerical and experimental work on shell-side thermal hydraulic performance of multilayer spiral wound heat exchangers subjected to totally different thermal boundary conditions for the wall.

III. SYSTEM MODEL



Cross section of helical coil tube in tube heat exchanger at the baffle

The thickness of the baffle along the radius in the annular region is varied to study the effect of thickness. The values chosen for the study are t= 3.5, 4, 4.5 mm. and helical coil heat exchanger without baffle is also considered for the study.

IV. PROPOSED METHODOLOGY

The project aims to study the comparison of nusselt number on the behalf of Reynolds number and baffles in spiral coil tube in tube device. A spiral coil tube in tube device with variety of turns adequate to two and that accommodates three ring formed baffles that area unit placed in annular space between these two spiral tubes is taken into account for study.

V. CONCLUSION

Numerical simulation of helical coil tube in tube heat exchanger has been done with Ansys fluent and the variation of Nusselt number with different baffle thickness and for various D/d ratio and different flow rate of hot fluid has been plotted.

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