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Thermal Analysis of Concentric Tube Heat Exchanger Using Louvered Strip Inserts

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Abstract

Heat exchangers are most explored and routinely propelled strategies in investigation (research) industries. This project is endeavor on numerical investigation by utilizing ANSYS fluent CFD programming. In this paper heat transfer, and pressure drop are numerically studied by utilizing louvered strips implanted in a concentric tube heat exchanger. The louvered strip was embedded into a tube to produce turbulent stream which aided to increase heat transfer rate of tube, the Reynolds number utilized is 6000. The turbulent stream devices comprised of

(1) Louvered strips with an angle of inclination ($\Theta = 15^0$).

(2) Louvered strips with forward and backward arrangements. Hot water was made to move through inward tube and cold through annulus.

By numerical exploration pressure drop and heat transfer rate are calculated and compared with plain tube.

Keywords: *Author Guide, Article, Camera-Ready Format, Paper Specifications, Paper Submission.*

1. Introduction

Heat exchanger, a device which is utilized to exchange heat starting with one liquid then onto the next which are on distinctive temperature by mixing one another

Heat exchangers are classified by stream arrangement. One is parallel-stream heat exchanger in this two fluid flows inside exchanger with same side then flows in a similar direction to one another to opposite side. Second is counter-stream heat exchanger in this fluid flows over heat exchanger since reverse direction. Third is counter flow heat exchanger in this type of exchanger the heat is moved from heat transfer intermediate per unit mass because of its mean temperature difference along its length.

To obtain higher efficiency, the heat exchangers are planned to design that the resistance to the fluid stream is reduced whereas surface area of wall between two fluids is increased. By adding strips, fins, or any corrugations in any directions it creates a turbulent flow and the surface area is increased so that it can achieve the heat transfer performance.

For engineering researchers, designers and manufacturers heat exchanger is the main field of interest towards research. In conventional applications, for example, chemical processing, general manufacturing, energy devices and gas turbines of higher performance a huge effort has been given to research. Along with this, a major number of documents tells about the research and applications of micro-channel flows, electronics cooling, semiconductors and bio-heat transfer

2. Literature survey

Cengizyildiz et.al [1] proposed the effect of heat transfer and pressure drop using metallic twisted strips with certain angle using hot air and cold water as working fluid and they observed the result that Nusselt number increased up to 100% at around 130% expansion in pressure drop and heat transfer rate increased upto100%.

Experimentation was directed for an unfilled internal tube. Outcomes were confirmed with Dittus-Boelter expression specified for Nusselt number. It was witnessed that Nu number could increment up to 100% at an expense of around 130% expansion in pressure drop for tube with warped strips inside [1].

A.S. Dalkilic, S. Wongwises [2] paper presents an evaluation of exploration work on in-tube condensation because of its importance in refrigeration, air-cooling system and heat pump applications. In many applications In-tube condensation of refrigerants is vital experience. At this point of time, condenser makers have been attempting to change working fluids and to utilize improved

geometries in procedure of considering energy effectiveness [2].

Yonghua You, Aiwu Fan et al [3], their work was on the thermo-water driven execution of laminar stream numerically furthermore about impacts of some geometrical parameters
The outcomes demonstrated that, the incline angle relies on size of Reynolds number and it is shown Nusselt number, friction factor are delicate toward geometry angle, while strip pitch is most delicate feature of PEC [3].

V. C. Todkari A. B. Dhekale S. S. Kale [4] describes the computational examination of heat transmission augmentation and stream characteristics because of louvered strips that has been done out for different velocities and temperatures by FLUENT. It is important to have ideal presentation of heat exchanger, by decreasing size of system and to make system more compressed.
In this way it has been realized that high rate of heat transfer is necessary since it decreases fuel utilization, size of heat exchangers and time needed to accomplish required temperature of fluid
In this manner expansion procedure ought to be checked for optimization of heat transfer rate and pumping price. The augmentation method utilized is louvered strips as turbulators are arranged on copper bars and are introduced in the internal tube midway [4].

3. Objectives

1. To find out the rate of heat transfer enhancement by the effect of louvered strips at 15^0 angle of inclinations with forward and backward flow arrangement

2. To investigate the pressure drop-in concentric tube heat exchanger

4. Detail study of the project.

In the present work the louvered strip with different angle of inclinations is used to find out rate of heat transfer and variation in pressure levels. Louvered strips are placed on outside surface of internal tube (material is copper) with respect to the horizontal axis of the tube. This louvered strips are made up of aluminium because of its high thermal conductivity and it is placed on the outside surface of internal tube with 45 mm apart along the length of the tube at 15^0 angle of inclination with forward and backward flow arrangement. The inner and outer pipe is made up of copper whose diameters are 19.6mm and 38mm respectively. This analysis is carried out for the hot mass flow rate of 0.092kg/s and cold mass flow rate of 0.03 kg/s. The inlet temperature of cold water is given value 298K and the inlet temperature of hot water is given value 353K

The rate of heat transfer is improved by using louvered strips in double tube heat exchanger. As the strips are placed on outer surface of inner tube and placed in an outer tube it generates a turbulent flow which increases the heat transfer rate of tube.

Analysis is done by taking water as a working fluid with its standard properties and by taking the heat pipe without louvered strips as a reference and the same is analyzed by using ANSYS fluent15 software with and without louvered strip inserts.

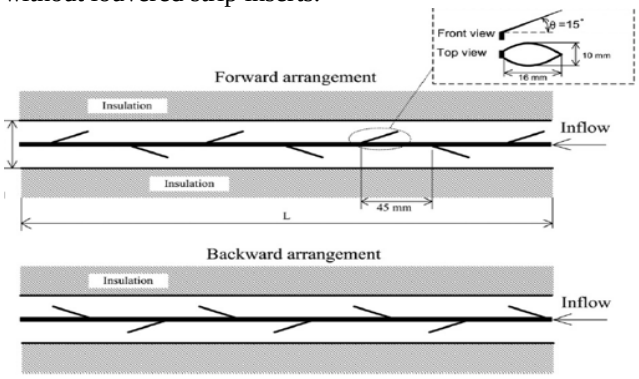

Image of strip with an angle of 15^0 forward and backward arrangement

Formulae used

Heat transfer in cold side

$$Q_{C=}m_cC_{p,w}(T_{c,out} - T_{c,in})$$

Heat transfer in hot side

$$Q_{h=}\, m_h\, Cp_{,w}(T_{h,in} - T_{h,out})$$

Mass flow rate

$$R_e=\frac{\rho v d}{\mu}$$

$$m_{h\,=}\rho AV$$

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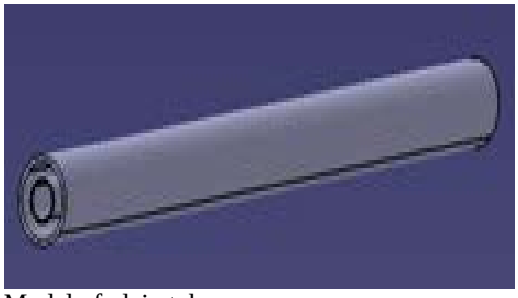
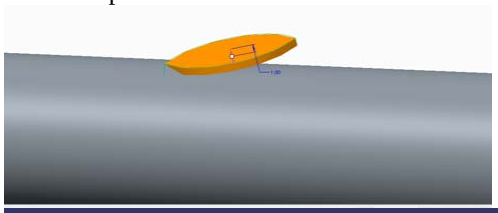
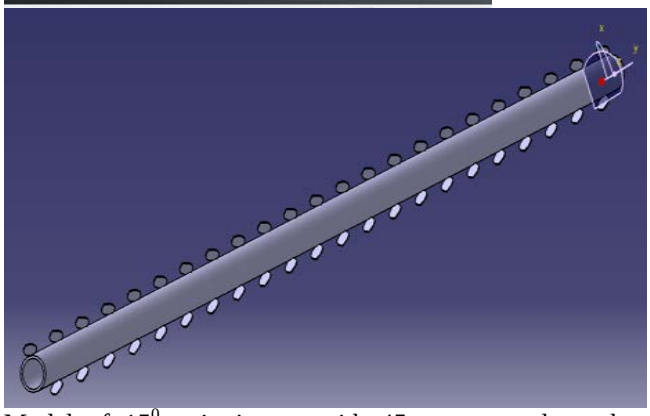
5. Results and discussion

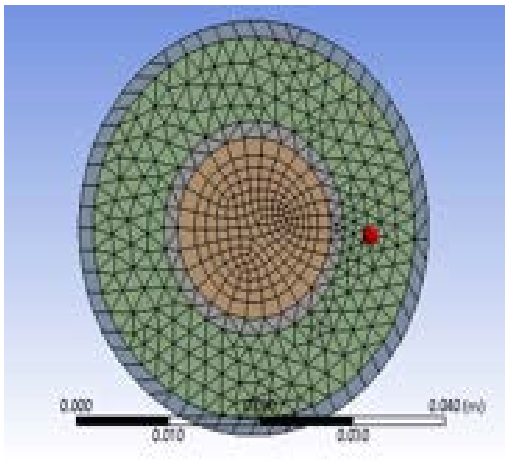


Model of plain tube

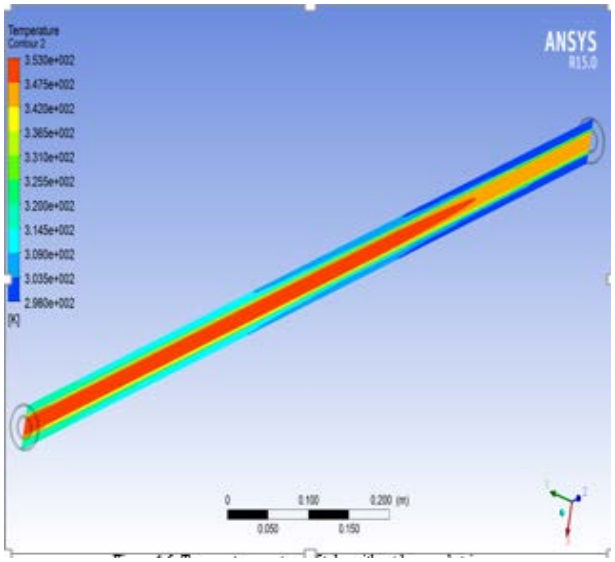




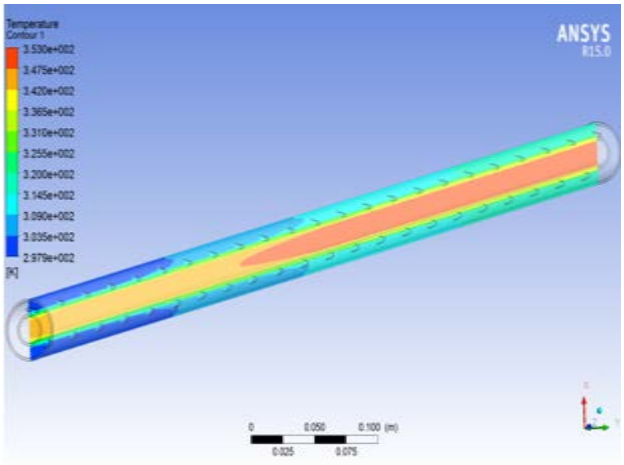
Model of 15^0 strip inserts with 45mm apart along the length of the tube



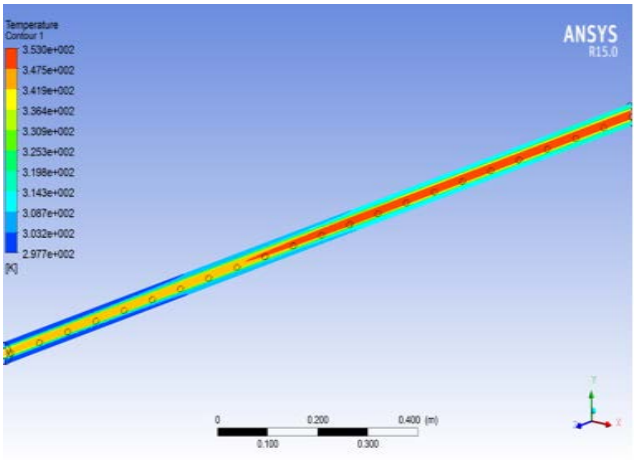
Meshing of the model



Temperature contour of plain tube



Temperature contour of 15^0 forward arrangement



Temperature contour of 15^0 backward arrangement

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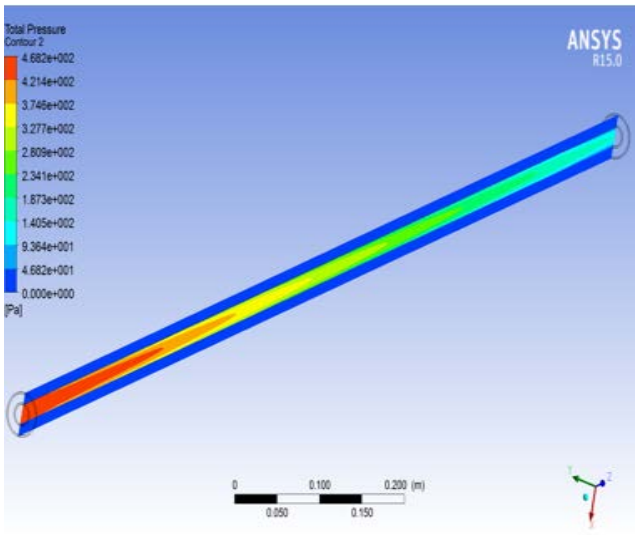
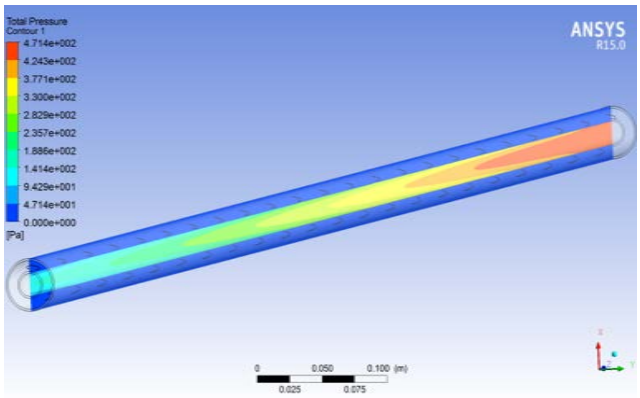
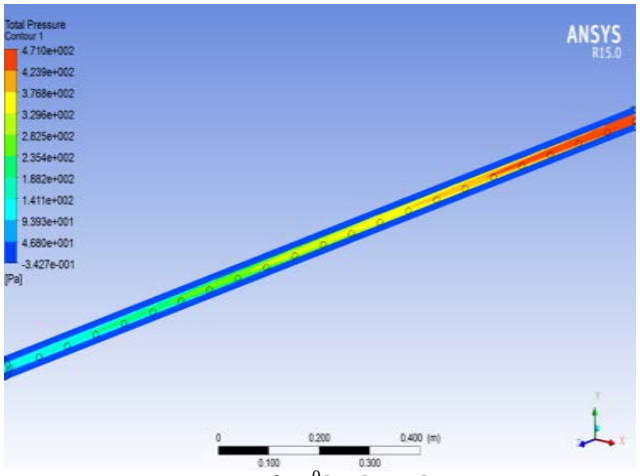


Pressure contour of plain tube



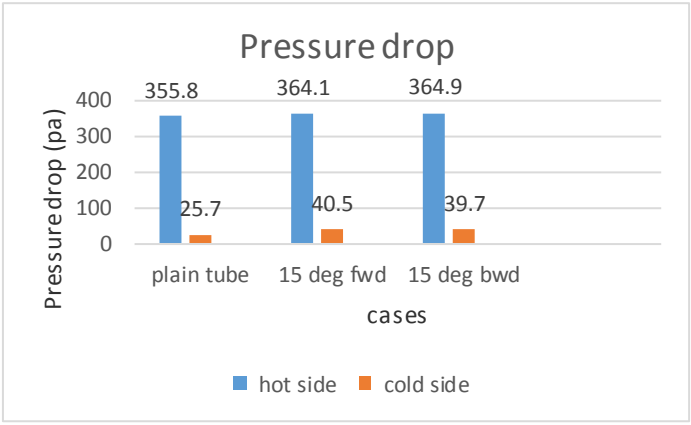
Pressure contour of 15^0 forward arrangement

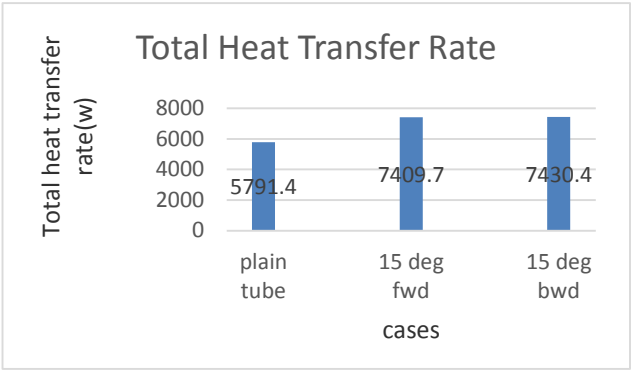


Pressure contour of 15^0 backward arrangement

Table1: Pressure drop and heat transfer for different cases

cases	*Pressure drop(pa) hot side*	*Pressure drop(pa) Cold side*	*Heat Transfer (w)*
Plain tube	355.8	25.7	5791.4
15^0fwd arrangement	364.1	40.5	7409.7
15^0fwd arrangement	364.9	39.7	7430.4





6. Conclusions

Heat transfer can be in augmented by utilizing strip insertions. Louvered strip insertions can be utilized effectively to expand heat transfer rate as a result of

turbulence intensity actuated could enrich the heat transfer so in this investigation strips were placed in 45mm apart along the length of the tube at different angle of inclinations.

Heat transfer and pressure drop are numerically investigated for plain tube and by inserting 15^0 louvered strips with forward and backward flow arrangements and the values are tabulated and compared with that of plain tube.

1. The increase of pressure drop is 56 to 60%more than the plain tube.
2. The increase of heat transfer enhancement is 28 to 30%more than the plain tube.

Reference

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