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Numerical Comparison of Tube and Shell Heat Exchanger Performance and Operations with different Flow Patterns

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Abstract: ***Parallel and Counter stream heat exchangers are the two sorts of expectedly utilized heat exchangers in Industries. In flow work, water is taken as a heat exchange liquid. The majority of the examinations on heat exchange coefficients are for steady divider temperature or consistent heat motion. The viability, general heat exchange coefficient, impact of cool water stream rate on adequacy when high temp water mass stream rate is kept steady and impact of boiling water stream rate on viability when cold water stream rate kept consistent are contemplated and looked at for parallel stream, counter stream and proposed blended stream course of action of shell and tube heat exchanger. All readings are taken at consistent state of heat exchanger. The outcome demonstrates that the heat exchange coefficient got for proposed blended stream H.E. is influenced by the geometry of the heat exchanger and it lies amongst parallel and counter stream arrangements. The CFD investigation is performed in ANSYSFLUENT.***

Keywords: ***CFD, Heat Exchanger, Flow pattern, Comparative study, RNG, k-ε model***

I. INTRODUCTION

Heat exchangers are a standout amongst the above all utilized gadgets to exchange heat vitality between at least two liquid streams at various temperatures. In heat exchangers, there are normally no outside heat and work cooperation's. Run of the mill applications include heating or cooling of a liquid stream of concern and vanishing or build-up of single or multi-part liquid streams. In view of their use that any procedure which includes cooling, heating, build-up, bubbling or vanishing will require a heat exchanger for these reasons. Process liquids, as a rule are heated or cooled before the procedure or experience a stage change. Diverse heat exchangers are named by their application. For instance, heat exchangers being utilized to gather is known as condensers, also heat exchanger for bubbling designs are called boilers.

II. CURRENT PRACTICE

The execution of heat exchangers can be enhanced to play out a specific heat exchange obligation by heat exchange improvement procedures. The heat exchange improvement empowers the extent of the heat exchanger to be impressively diminished. Parallel stream and Counter stream heat exchangers are ordinarily utilized heat exchangers in Industries, handling plants, control era and so forth. Normally parallel stream heat exchangers are utilized for high mass stream rates and counter stream heat exchangers are for minimization in size and its high adequacy. Henceforth in this work a blended stream heat exchanger (blend of parallel and counter stream) is proposed and its execution is contrasted and regular parallel and counter stream heat exchanger. The shell liquid enters at the center of the shell so the heat exchanger encounters half of the liquid as counter stream and staying half as parallel stream. The present work indicates how the heat move qualities in proposed blended stream are fluctuated from traditional parallel and counter stream heat exchange attributes. The majority of the examinations on heat exchange coefficients improved the situation steady divider temperature or consistent heat transition. The circumstance of consistent divider temperature is admired in heat exchangers with stage change, for example, condensers. The limit state of consistent heat motion discovers application in electrically heated tubes and atomic fuel components. In current work the liquid to liquid heat trade is mulled over and investigated stream. Water is taken as heat exchange liquid. Constrained convection and Tube side heat exchange coefficients are thought about for investigation of heat exchanger.

III.PROBLEM IDENTIFICATION

In Parallel stream and counter stream H.E are utilized as a part of ventures all the more by and large. The got information and applications likewise demonstrated for their reality. Because of need data about a mix of parallel and counter stream heat exchanger

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in a solitary model is the inspiration for this venture. A proposed blended stream (mix of parallel and counter streams) heat exchanger is taken for concentrate and how its execution differs from regular parallel stream and counter stream H.E. Execution bends are plotted for another blended stream H.E.

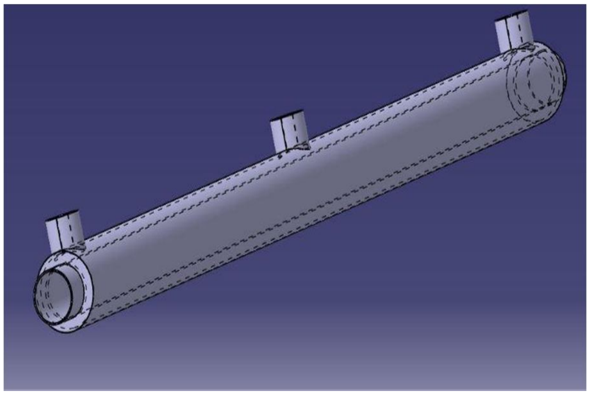

Fig.1 Proposed mixed flow heat exchanger

IV. METHODOLOGY

A. Boundary Conditions

1) *Inlet conditions:* At the inlet, pressure inlet condition with atmospheric 1.01325 bar pressure is specified.
2) *Outlet conditions:* At the outlet, pressure outlet condition with 1 bar pressure is specified.
3) *Walls:* The wall boundary conditions implemented states that there is no slip between the wall and the fluid and wall act as insulator.

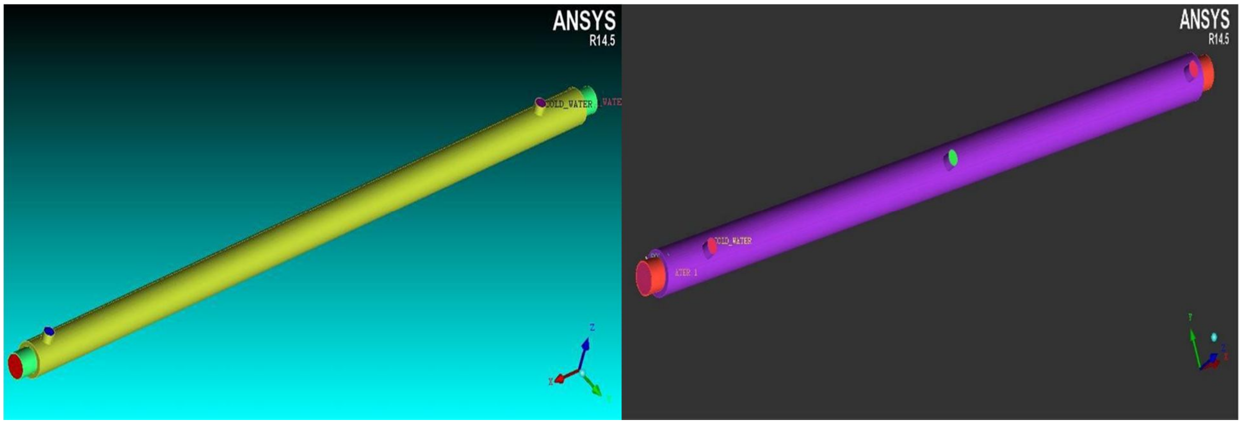

Fig.2 (1) Parallel and counter flow heat exchanger model, (2) Proposed mixed flow heat exchanger

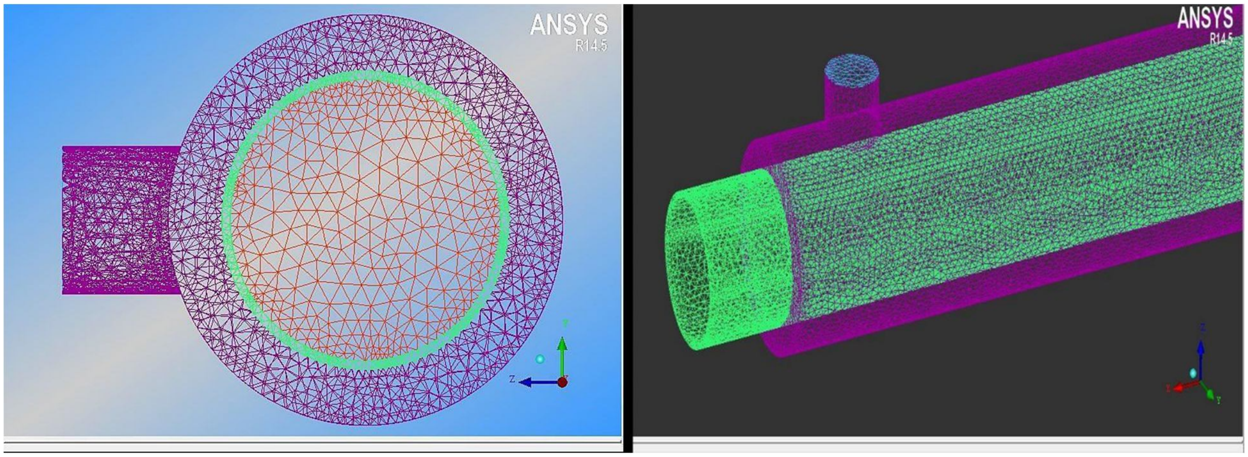

Fig.3 (1) Unstructured mesh from side view of H.E., (2) Unstructured mesh throughout length of H.E

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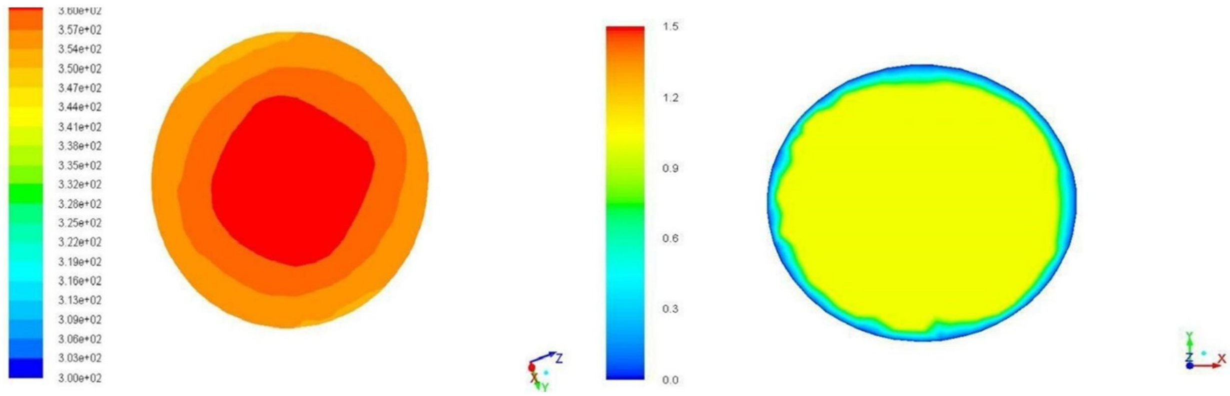

Fig.4 (1) Temperature contour, (2) Velocity contour

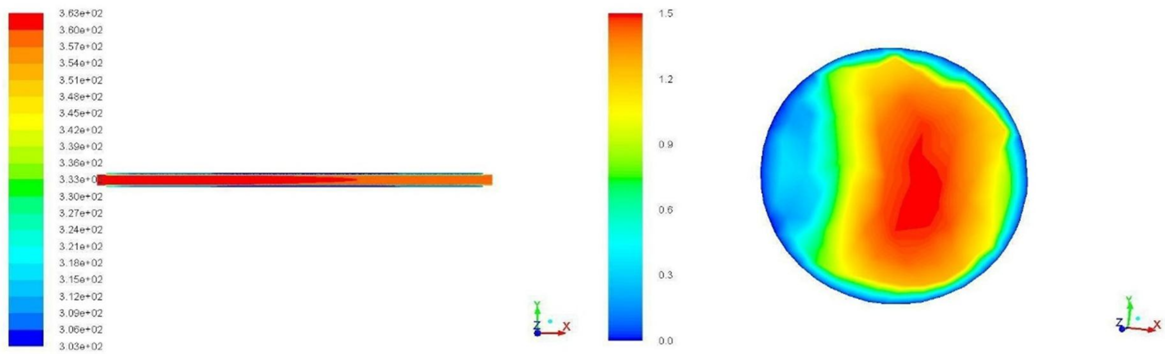

Fig.3 (1) Temperature contour of Proposed mixed flow, (2) Velocity contour of cold outlet in Proposed mixed flow

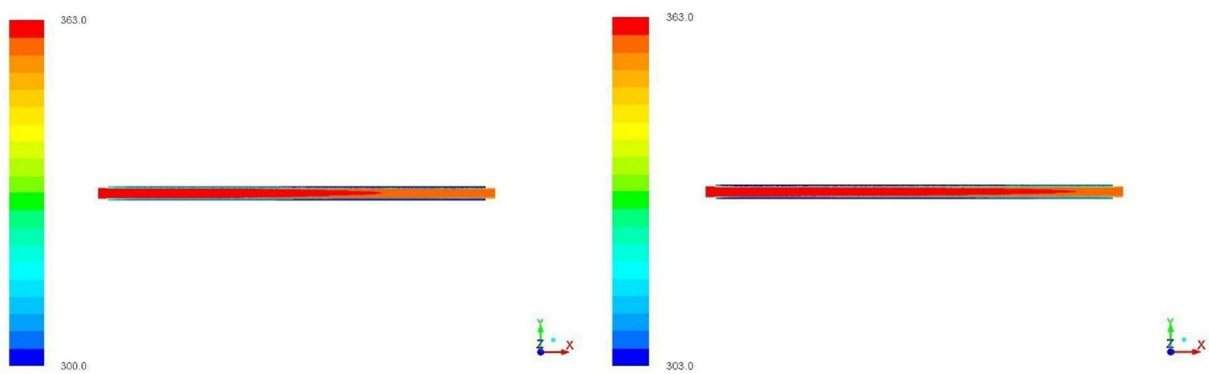

Fig.4 (1) Temperature contour of counter flow H.E., (2) Temperature contour of parallel flow H.E.

V. RESULT AND DISCUSSIONS

This section manages the outcomes acquired from scientific and CFD investigation. This Chapter covers the adequacy, general heat exchange coefficient variety concerning icy and heated water mass stream rates. In this section three heat exchangers are analysed those are parallel stream H.E, counter stream H.E and proposed blended stream H.E. In these heat exchangers, execution of proposed H.E lies in the middle of Parallel stream H.E and Counter stream H.E. Impact of mass stream rates of heated water and cold water on viability (E) are examined.

VI. CONCLUSIONS AND FUTURE SCOPE

An investigation of shell and tube heat exchanger with various stream courses of action i.e., parallel stream, counter stream and proposed blended stream are dissected through numerical recreation and approved through scientific outcomes. All the three heat

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exchangers are of same measurements and same heat stream region of shell and tube. The mass stream rates in the internal tube and in the annulus are fluctuated, parallel stream, counter stream and proposed blended stream arrangements are tried.

A. *Momentum Equations*

B. *Effectiveness*

$$\varepsilon = \frac{Q_{act}}{Q_{max}} = \frac{m_c C_{pc}(T_{co} - T_{ci})}{(mc_{p_{min}})(T_{hi} - T_{ci})} = \frac{m_h c_{ph}(T_{hi} - T_{ho})}{(mc_{p_{min}})(T_{hi} - T_{ci})}$$

C. *Overall Heat Transfer Coefficient*

$$U_i = \frac{1}{\frac{d_i}{d_o h_o} + \frac{d_i}{2k} ln \frac{d_o}{d_i} + \frac{1}{h_i}}$$

D. *General Transport Equation*

$$\frac{\partial(\rho\emptyset)}{\partial t} + div(\rho\emptyset\bar{u}) = div(grad\emptyset) + S_\emptyset$$

E. *Continuity equation*

$$\frac{\partial\rho}{\partial t} + \frac{\partial(\rho u)}{\partial x} + \frac{\partial(\rho v)}{\partial y} = 0$$

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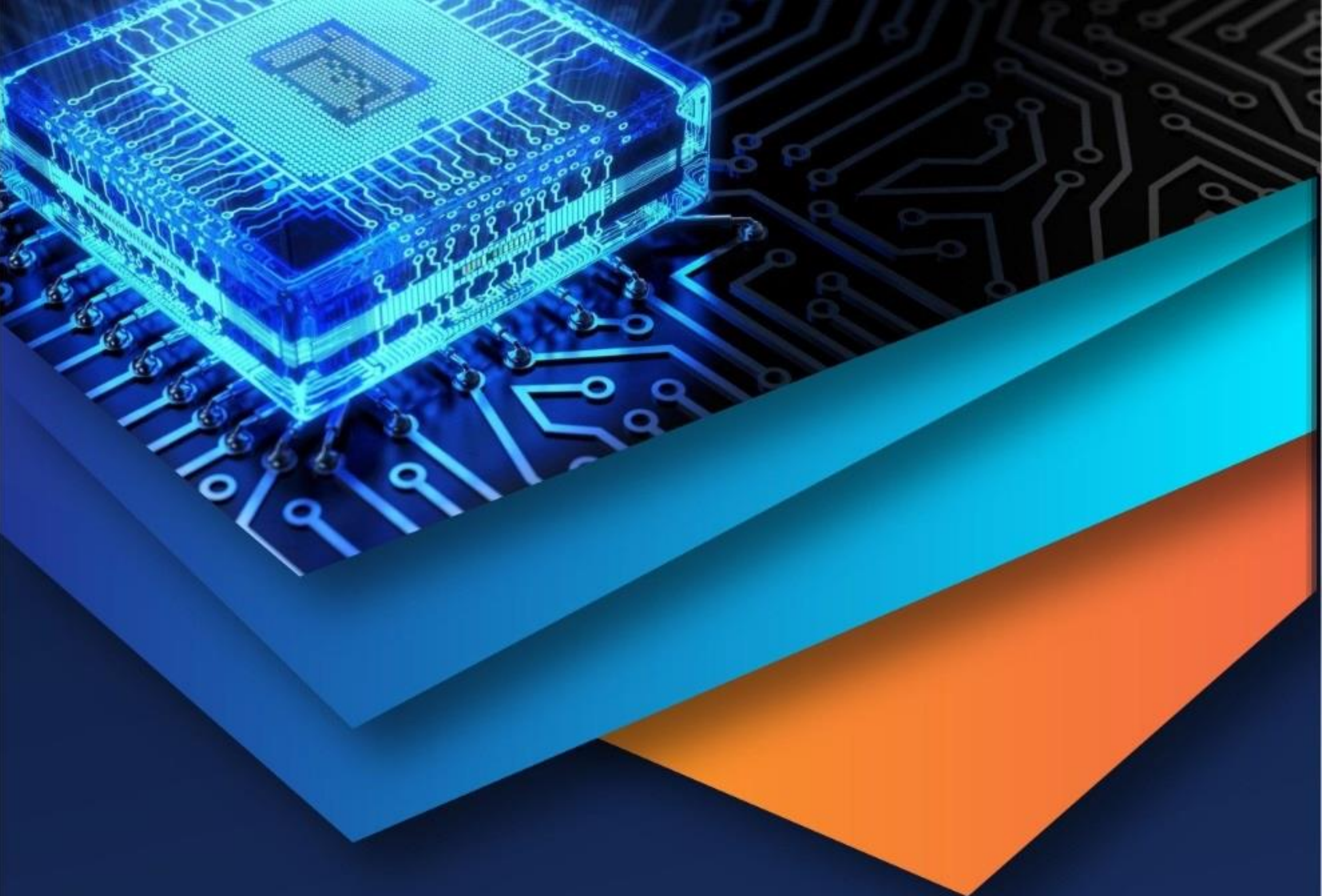

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