"SHELL SIDE CFD ANALYSIS OF SMALL SHELL AND TUBE HEAT EXCHANGER"

SIDDHARTH MISHRA[1], AMOL TRIPATHI[2]

[1]Research Scholar, Dept. of Mechanical Engineering, Rewa Institute of Technology, Rewa, Madhya Pradesh, India.
[2]Asst.Professor, Dept. of Mechanical Engineering, Rewa Institute of Technology, Rewa, Madhya Pradesh, India.

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Abstract: *In present day shell and cylinder heat exchanger is the most well-known sort heat exchanger generally use in petroleum treatment facility and other enormous compound cycle, since it suits high pressing factor application. The cycle in tackling reproduction comprises of demonstrating and lattice the essential math of shell and cylinder heat exchanger utilizing CFD bundle ANSYS 13.0. The target of the venture is plan of shell and cylinder heat exchanger with helical perplex and study the stream and temperature field inside the shell utilizing ANSYS programming apparatuses. The warmth exchanger contains 7 cylinders and 600 mm length shell distance across 90 mm. The helix point of helical confound will be fluctuated from 00 to 200. In recreation will show how the pressing factor shift in shell because of various helix point and stream rate. The stream design in the shell side of the warmth exchanger with consistent helical puzzles had to be rotational and helical because of the math of the ceaseless helical bewilders, which brings about a huge expansion in heat move coefficient per unit pressure drop in the warmth exchanger.*

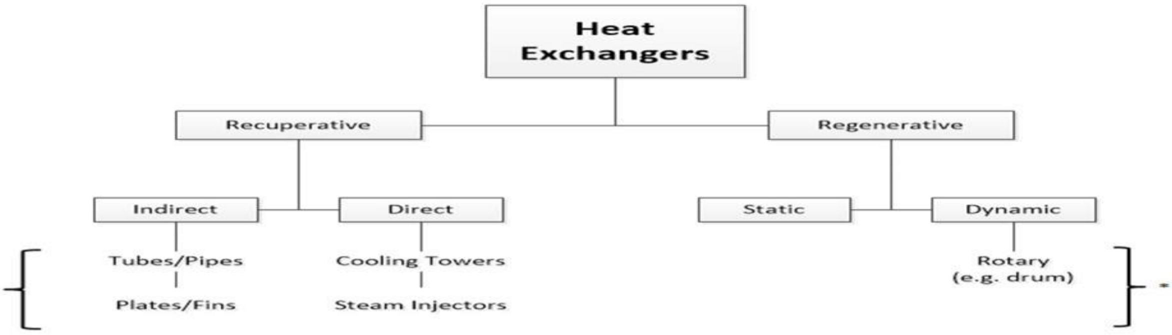
Keywords: Computational Fluid Dynamics(CFD), Analysis of System(ANSYS).

1. INTRODUCTION

Heat exchanger is system used to transfer heat from one fluid to another fluid or more. Heat exchangers is used in both cooling and heating processes. Fluids can be separated from a solid wall to prevent mixing or in direct contact. They are broadly utilized in Space Warming,

Refrigeration, Cooling, Power Stations, Compound Plants, Petrochemical Plants, Petrol Treatment Facilities, Petroleum gas Handling, and Sewage Treatment. Heat exchangers mostly used equipment in the process industries. Heat exchangers are utilized to move heat between two interacting streams. One can understand their utilization that any interaction which include cooling, warming, buildup, bubbling or vanishing will require a Heat exchanger for these reason. Heat exchangers are gadgets intended to move heat between at least two liquids i.e., fluids, fumes, or gases of various temperatures. Contingent upon the sort of Heat exchanger utilized, the heat moving cycle can be gas to gas, fluid to gas or fluid to fluid and happen through a strong separator, which forestalls blending of the liquids, or direct liquid contact. Other plan qualities, including development materials and parts, heat move components, and stream designs, additionally help to order and classify the kinds of Heat exchangers accessible. Discovering application across a wide scope of ventures, an assorted determination of these Heat trading gadgets are planned and made for use in both warming and cooling measures. In view of the plan qualities showed above, there are a few distinct variations of Heat exchangers accessible. A portion of the more normal variations utilized all through industry include:

- Shell and tube heat exchangers
- Double pipe heat exchangers
- Plate heat exchangers
- Condensers, evaporators, and boilers



2. PROPOSED WORK

Reason for helical bewilder to give improvement. Bewilder was first evolved by Lutcha and Nemcansky. Researched the stream designs delivered by such helical bewilder math with various helix points. Tracked down that the stream designs were near plug stream condition, which was relied upon to decrease shell-Side Pressure drop and further develop Heat Transfer execution. Stehlik et al. thought about heat move and pressing factor drop amendment components of warmth exchanger with enhanced segmental astound dependent on Bell–Delaware technique, with those for a warmth exchanger with helical confuses.

Computational model of a trial tried Shell and Tube Heat Exchanger with helix point and the calculation boundaries, Simulated STHX has six patterns of puzzles in shell side bearing with all out number of seven cylinder . Entire calculation space is limited by internal side of shell and everything in the shell contained in area delta and outlet of the space are associated with relating tubes. To improve on mathematical reproduction, some fundamental attributes of the interaction following supposition that are made :

1. The shell side fluid is constant thermal properties.
2. The fluid flow and heat transfer processes are turbulent and in steady state.
3. The leak flows between tube and baffle and that between baffles and shell are neglected.
4. The natural convection induced by the fluid density variation is neglected.
5. The tube wall temperature kept constant in the whole shell side.
6. The heat exchanger is well insulated hence the heat loss to the environment is totally neglected.

3. SIMULATION IMPLEMENTATION

Named after Claude-Louis Navier and Gabriel Stokes, They portrayed the development of fluid substances. Moreover a focal condition being used by ANSYS and shockingly in the flow work. These condition rise out of applying second law of Newton for smooth development, The assumption that the fluid pressing factor is measure of a diffusing term ,notwithstanding a squeezing factor term. Derivation of Navier Stokes condition begins with usage of second law of Newton for instance security of energy. In an inertial edge reference, the general sort of the conditions for smooth development .

TUBULAR EXCHANGER

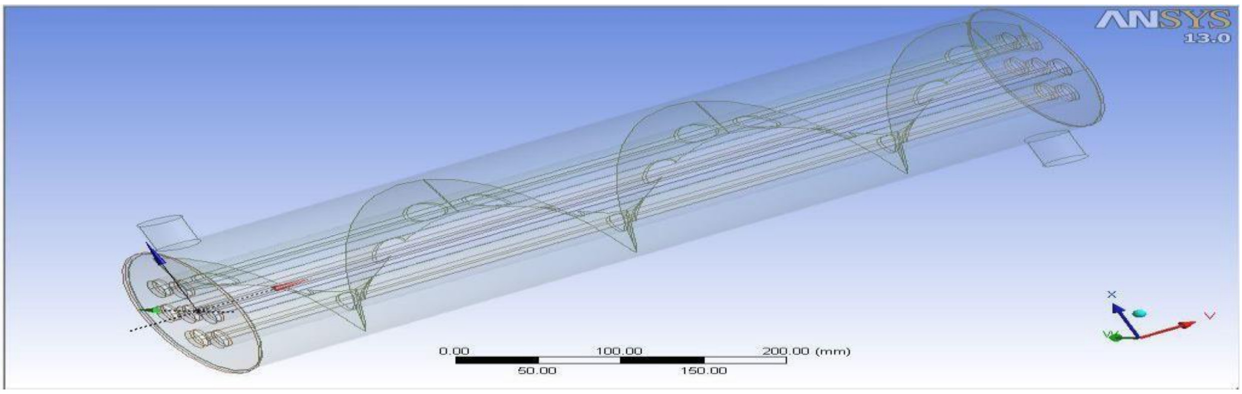


Figure 1. Isometric view of arrangement of baffles and tubes of shell and tube heat

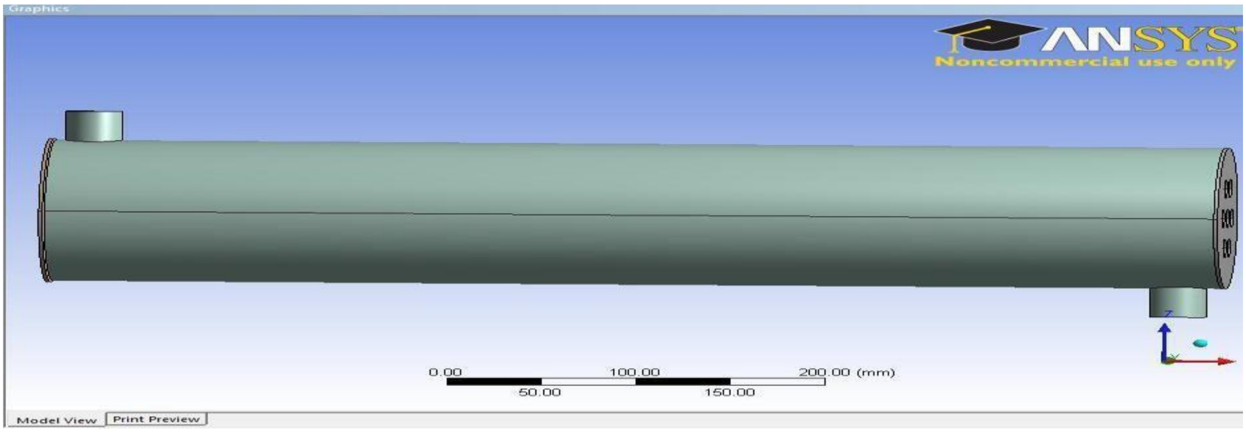


Figure 2. Complete model of shell and tube heat exchanger

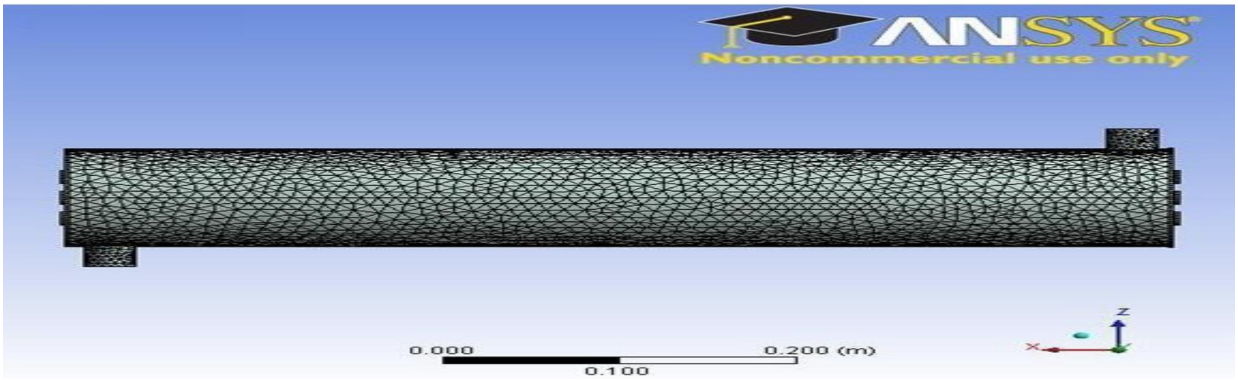


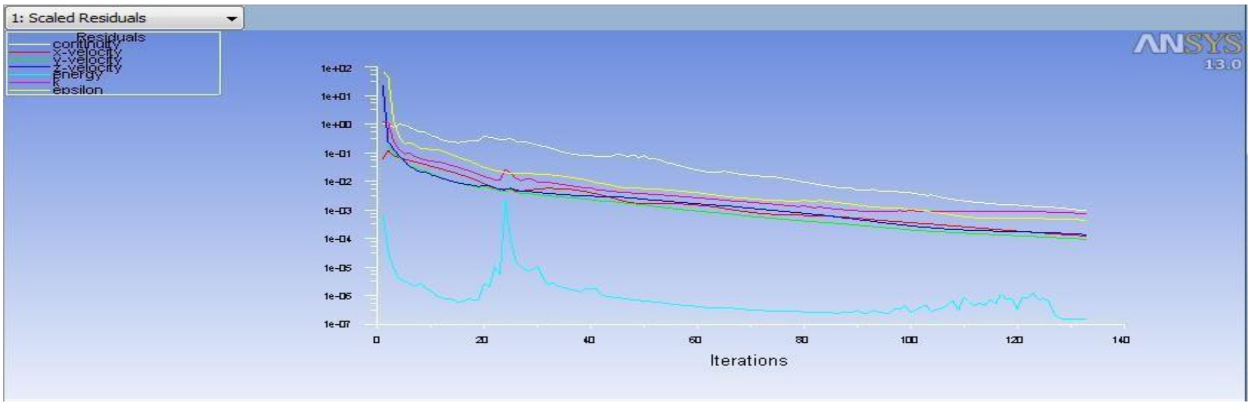
Figure 3. Meshing diagram of shell and tube heat exchanger

4. RESULTS AND DISCUSSION CONVERGENCE OF SIMULATION

The intermingling Simulation is needed for getting boundaries of the shell and cylinder heat exchanger for outlet. It gives exact worth of boundaries for the necessity of warmth move rate.

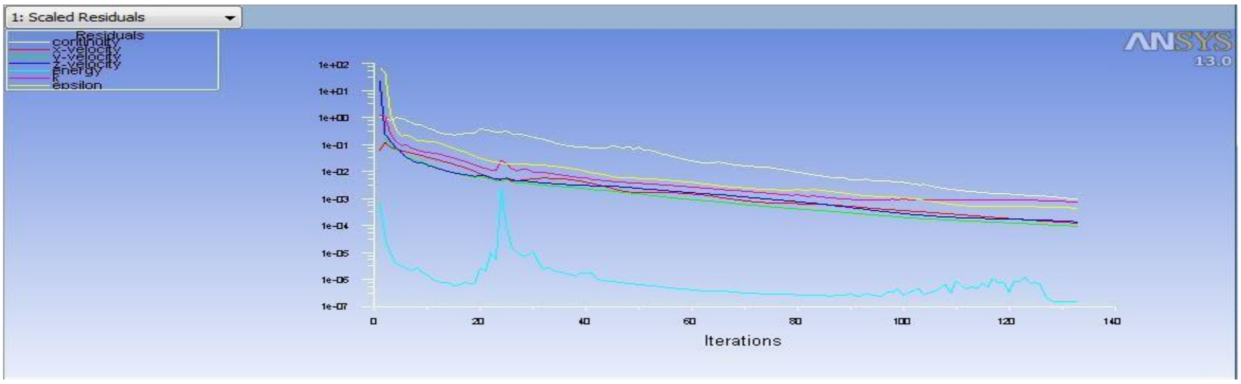
Coherence, X-speed, Y-speed, Z-speed, Energy, k, Epsilion as the piece of scaled lingering which should have been joined in explicit locale. For the coherence of X-speed ,Y-speed, Zspeed , k, Epsilion ought to be under 10-4 and Energy ought to be under 10-7. In the event that these qualities are same, arrangement will meet.

Zero degree baffle inclination converged at 170th Iteration. Figure shows the residual plot for above iterations.



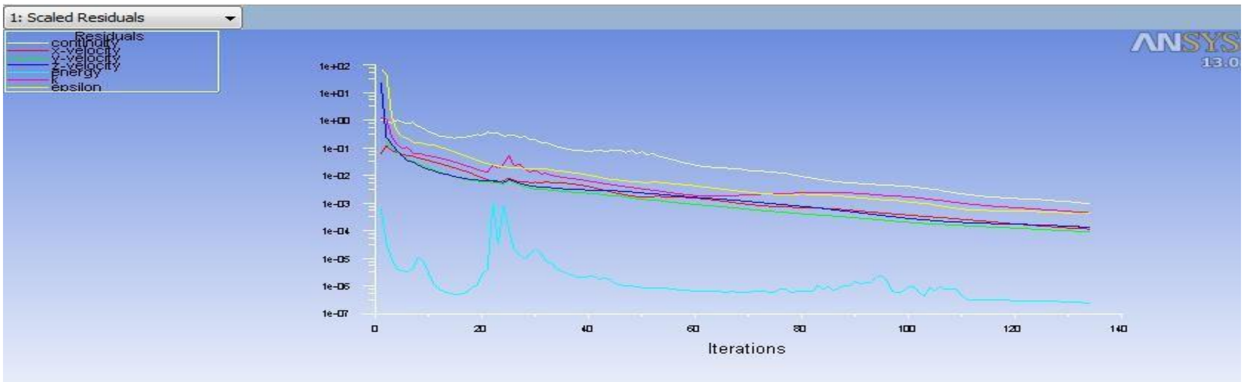
Conversion of 0^0 Baffle inclination after 170th iteration

Simulation of 10^0 Baffle inclination converged at 133th iteration. Figure shows residual plot



Converge simulation of 10^0 baffle inclination at 133th iteration

Simulation of 20^0 baffle inclination converged at 138th iteration. Figure shows the residual plot



Convergence of 20^0 baffle inclination at 138th iteration

Table 4.1 Outlet Temperature of the Shell side And Tube Side

Baffle Inclination Angle (Degree)	Outlet Temperature Of Shell side	Outlet Temperature Of Tube side
0	346	317
10	347.5	319
20	349	320

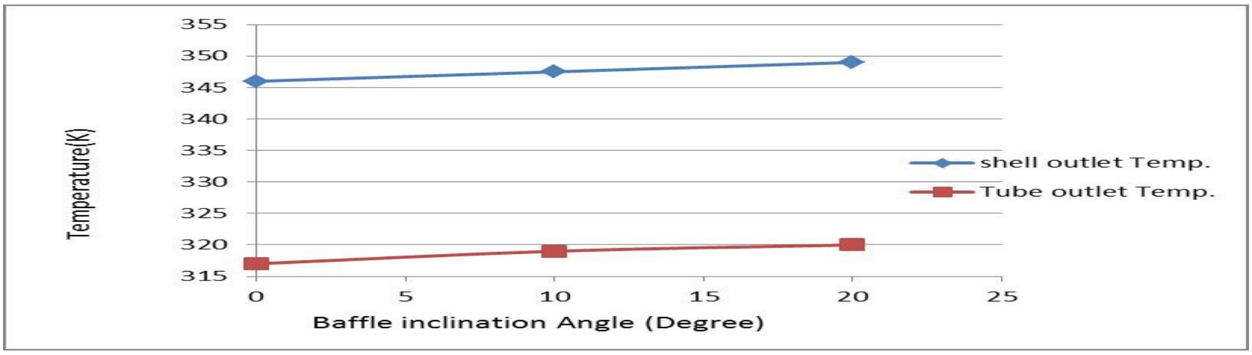


Table 4.2 Pressure Drop inside Shell

Baffle Inclination Angle (Degree)	Pressure Drop Inside Shell (kPA)
0	230.992
10	229.015
20	228.943

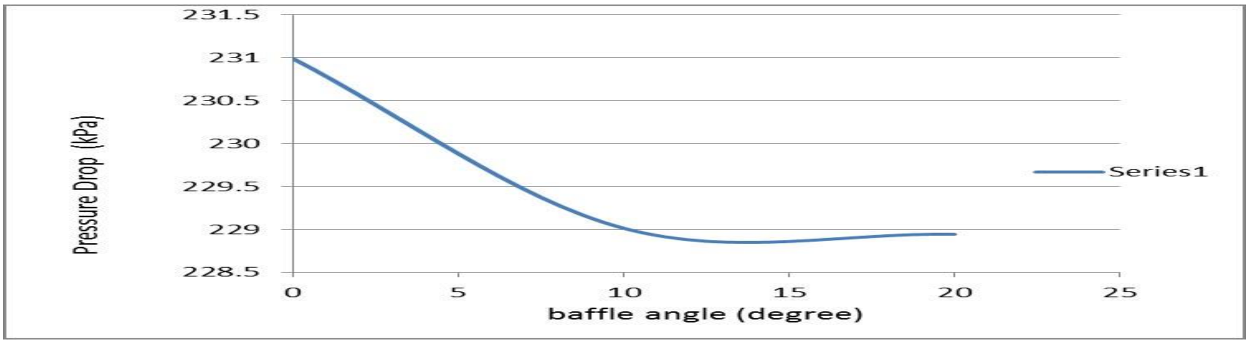


Table 4.3 Velocity inside Shell

Baffle Inclination Angle (Degree)	Velocity inside shell (m/sec)
0	4.2
10	5.8
20	6.2

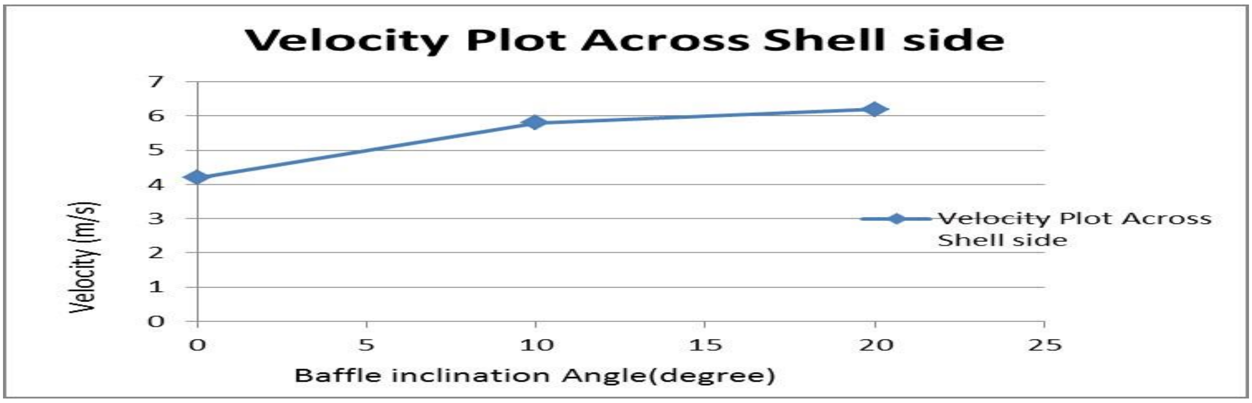


Table 4.4 Heat Transfer Rate Across Tube side

Baffle Inclination Angle (Degree)	Heat Transfer Rate Across Tube side (w/m2)
0	3557.7

10	3972.9
20	4182

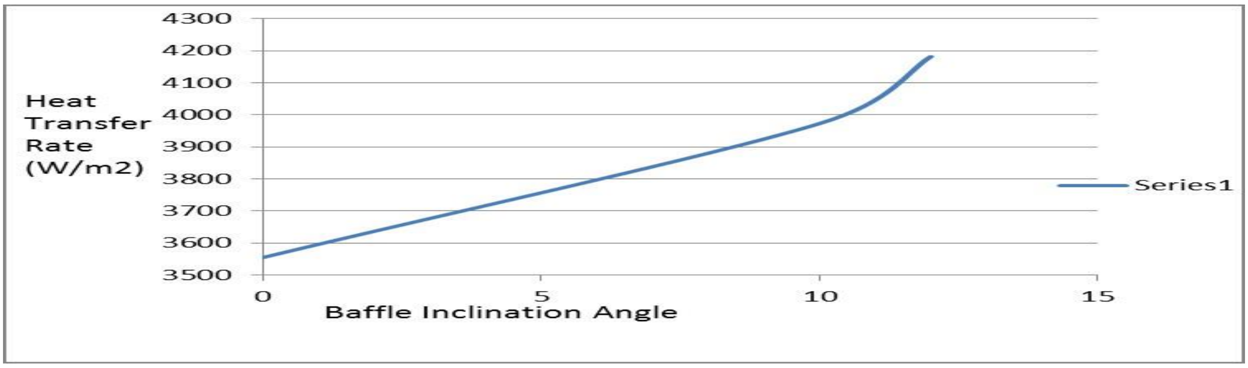


Table 4.5 Overall Calculated value in Shell and Tube heat exchanger in this simulation.

Baffle inclination (in Degree)	Shell Outlet Temperature	Tube Outlet Temperature	Pressure Drop	Heat Transfer Rate(Q) (in W/m2)	Outlet Velocity (m/s)
00	346	317	230.992	3554.7	4.2
100	347.5	319	229.015	3972.9	5.8
200	349	320	228.943	4182	6.2

Shell side of small shell-and-tube heat exchanger is modeled with sufficient detail to resolve the flow and temperature fields. Pressure drop decreases with increase in Baffle Inclination. Rate of Heat transfer is very slow this model so that it affect the outlet temperature of the shell and tube side.

5. CONCLUSION

The model predicts the warmth move and pressing factor drop with a normal of 20%. Accordingly the model can be improved. The supposition functioned admirably in this calculation and lattice expect the power source and bay area where quick blending and shift in stream. Accordingly improvement is normal if the helical bewilder utilized in the model ought to have total contact with the outside of the shell, it will help in more choppiness across shell side and the warmth move rate will increment. In the event that diverse stream rate is taken, it very well may be help to improve heat move and to improve temperature distinction among bay and outlet. Also the model has given the solid outcomes by considering the standard k-e and standard divider work model, yet this model over predicts the disturbance in areas with enormous typical strain. Hence this model can likewise be improved by utilizing Nusselt number and Reynolds stress model, yet with higher computational hypothesis. Besides the upgrade divider work are not use in this undertaking, however they can be extremely helpful. The Heat move rate is poor on the grounds that a large portion of the liquid passes without the association with perplexes. In this way the plan can be changed for better warmth move in two different ways either the diminishing the shell measurement, It is on the grounds that the Heat move region isn't used proficiently. Hence the plan can additionally be improved by making cross-stream locale so as to not stay corresponding to the cylinders. This will permit the external shell liquid to have contact with the inward shell liquid, along these lines heat move rate will increment.

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