PERFORMANCE OF SHELL AND TUBE HEAT EXCHANGER BY VARYING THE NANOFLUID MEDIUM USING CFD

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ABSTRACT: *Heat transfer is a phenomenon that occurs with respect to change in temperatures of working fluids or medium. Heat transfer can be seen in many applications in various forms and by using various methods. One such common method is by using heat exchangers. Heat exchangers are widely used in automobiles, thermal appliances and some parts of food industries.*

The efficiency of the heat exchanger is based on the amount of temperature difference of the working fluids. Meanwhile the efficiency of the heat exchanger also depends on the quality and property of the working and supporting fluids. Based on these criteria, this project deals with the efficiency optimization of the heat exchanger by varying the parameters like supporting fluid's property and modification of the design of the heat exchanger.

For this purpose, a shell and tube heat exchanger is selected along with working fluids of water and ammonia. The water will enter the heat exchanger in cold state and exits as hot water, whereas the ammonia will enter in vapour state and then condenses into liquid form. In this project, the heat exchanger will be modelled using solid works software and then analysed using solid works flow simulation. Then this setup will be analysed under optimized conditions. The operating conditions of the heat exchanger will be collected from a diary factory, where heat exchangers are used to maintain their products.

For the optimization purpose, the heat transfer medium is changed as aluminium oxide from ammonia. Then for further optimization, the design of the heat exchanger like adding baffles along the path of water tubes and then increase of inner volume toward the water outlet, replacing straight pipes with U type pipes and applying coatings on the tube will also be evaluated using CFD software. The results will be tabulated and then the better solution will be suggested.

Keywords: heat exchanger, shell and tube type, efficiency optimization, CFD

INTRODUCTION

Heat exchangers are widely used in various thermal and thermal related industries for the purpose of maintaining a desired temperature in the system. Heat transfer occurs in many forms, one of this is convection, which is also known as convective heat transfer. This type of heat transfer is widely used in all types of heat exchangers. Among various types of heat exchangers, shell and tube type heat exchangers are widely used because of this simple construction and less maintenance. This type of heat exchangers run under parallel and counter flow modes.

In this project, a shell and tube heat exchanger is taken for analysis purpose. The model of the heat exchanger is done using solid works software and for future CFD analysis, the same package will be used, because this package is capable of integrating the model between the modelling and simulation. The datas for the simulation will be collected from a nearer diary factory, as they use heat exchangers for maintaining the temperature in their system. Initially the existing setup will be subjected to CFD analysis and then the results are noted. Then, the working fluid is replaced from ammonia to titanium oxide hence attempting to increase the heat transfer from gas to liquid. Later, the system will be analysed under modified design. For the terms of modification, baffles are added along the pipe lines inside the shell. Also, since the baffles are added, the outlet region of water

is made wide along with baffles, so that more heat can be transferred accordingly and this slope helps in draining of condensed fluid. Also, the straight pipe are replaced by U type pipes, this reduced the space and increases the heat transfer rate. An attempt will also be made to increase the heat transfer by applying coatings over the tubes inside the shells. Moreover, the flow of a heat exchange also determines the efficiency of the system. To validate this statement, in this project, an analysis will also be conducted for parallel and counter flow of fluids inside the shell and tube heat exchanger. Then the CFD results will be tabulated and compared accordingly.

a) Shell and Tube heat exchanger with Condenser tank

b) Cooling tower

c) Accumulator tank

d) compressor

FUTURE WORK

- Collecting datas regarding the inlet conditions of the heat exchanger and fluids.
- CFD analysis of the system for existing fluids
- CFD analysis for proposed fluids
- Discussions and conclusion

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