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Heat Exchanger Design Modification for Performance Optimization Using CFD Tools

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Abstract

Heat exchangers are used in the thermal system to maintain the temperature of the working liquid. Among the various types of heat exchanger, the shell and tube heat exchanger is the most commonly used heat exchanger based on its simple design and performance aspects. Even though these shell and tube heat exchangers operates at its designed point, it can be even effectively designed to achieve better heat transfer rate.

Since most of the shell and tube heat exchangers are designed based on the traditional design concepts, in this paper, we have planned to modify the design of the heat exchanger. For this purpose, we have selected a reference heat exchanger with its practical performance results. Using the design data from the existing heat exchanger, the CAD model was generated using solid works software and it was analysed using the CFD software under the actual operating conditions.

Then, the design modifications was carried out in the inner tubes and baffles accordingly. Initially we have changed the design of baffles and based on the analysis results, the cross section of the tube was modified. These modified design was analysed using the CFD tools under the same operating conditions and the results was compared with the actual and modified designs.

By this, we will be justifying the application of CFD tools in the design of heat exchangers to predict its performance in the early design stage. Due to this, the time and money invested on the man and equipments will be reduced to the industry for developing an efficient heat exchanger.

Keywords: Heat exchangers – CFD tools – performance analysis – design optimization.

INTRODUCTION

Heat exchangers are widely used in the thermal systems where there are requirement of maintaining the system temperature in order to get the quality product. The quality of the final product is directly associated with the efficiency and effectiveness of the heat exchanger. The efficiency of the heat exchanger is based on the quantitative values of the inlet and exit temperature difference.

The efficiency of this type of heat exchanger is determined by the amount of heat transferred from hot to cold mediums and in vice versa. Also in some peculiar cases, for the customized purposes, the flow inside the heat exchangers are changes from counter flow to parallel flow. This is purely based on the application where it is been used. In most of the cases, the type of fluid flowing in the shell and in the tubes are also changed to get better efficiency.

Based on the above, this project is based on the performance study of a shell and tube heat exchanger using a CFD tool. This study is carried out with respect to the available practical data. The practical data are taken from the reference paper and the design of the heat exchanger is also taken from the reference paper. The reference paper contains the practical experimental data. This study is to justify the application of CFD tools in the design of the heat exchanger system. The analysis will be carried under varied conditions as per the reference paper.

The first phase of this project deals with the study and analysis of the heat exchangers along with the selection of reference paper continued by the modelling of the heat exchanger system. The second phase of this project will be contained with the CFD analysis of the system using the solid works flow simulation tools. Then the experimental and CFD results will be compared to justify the effective application of the CFD tools in thermal system design.

METHODOLOGY

Methodology is the basic requirement for a project, because it defines the proper start and end conditions of the works to be done. Proper planning and execution of the workflow decides the successful completion of the project. The methodology of this project is as follows.

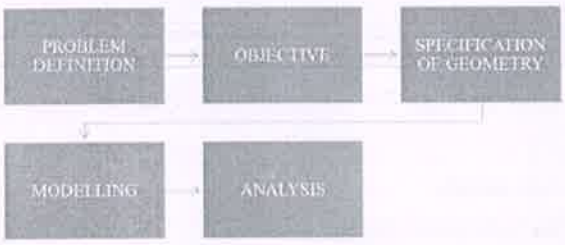

Figure 1: The strategic planning process