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Design modification for the improvement of Heat-Exchanger efficiency

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Abstract: It is time to focus on heat exchanger design as high cost to build heat exchangers and to made improving operation in order to increase their outlets. In this paper a shell and tube heat exchanger with simple baffle has been replaced by modified curved baffle. Field of flow and temperature were analysed inside the shell and tubes using software. Further investigation shall be carried out on turbulence model, the k-Ψ SST model for better results. Profiles of temperature and velocity profiles will be compared with the experimental data. It will be seen that flow due to their existence of conventional baffle will be improved by modified curved baffle, As a result the heat transfer level improves and thus the heat transfer increases.

Key words: Heat Exchanger, baffles, tubes, headers.

1. Introduction

Heat exchangers are one of the mostly used equipment in the process industries. Heat exchangers are used to transfer heat between two process streams. One can realize their usage that any process which involve cooling, heating, condensation, boiling or evaporation will require a heat exchanger for these purpose. Process fluids, usually are heated or cooled before the process or undergo a phase change **[4].**

A better presentation of its efficiency is done by calculating over all heat transfer coefficient. Pressure drop and area required for a certain amount of heat transfer, provides an insight about the capital cost and power requirements (Running cost) of a heat ex changer.
Heat exchangers are of two types:-

1) Where both media between which heat is exchanged are in direct contact with each other is direct contact heat exchanger,

2) Where both media are separated by a wall through which heat is transferred so that they never mix, indirect contact heat exchanger **[1].**

Most of the researches now a day are carried on curved baffles, which give better performance than single segmental baffles but they involve high manufacturing cost, installation cost and maintenance cost. The effectiveness and cost are two important parameters in heat exchanger design. So, in order to improve the thermal performance at a reasonable cost of the Shell and tube heat exchanger, baffles in the present study are provided with some inclination in order to maintain a reasonable pressure drop across the exchanger.
The complexity with experimental techniques involves quantitative description of flow phenomena using measurements dealing with one quantity at a time for a limited range of problem and operating conditions. Computational Fluid Dynamics is now an established industrial design tool, offering obvious advantages **[2].**

2. Heat Exchanger Design and Benefits

Purpose is to provide design change for the improvement of efficiency. It can be performed by innovative design with the help of Ansys CFD.
It will help to design for simple construction, minimize Gasketted joints, less leakage possibility, no limitation on number of tube side passes, cleanse mechanically tubes, and no limitation on number of tube side passes.

3. Problem Identification

There are many design baffles' design in heat exchanger but somehow all have advantages as well as disadvantages. Some have high efficiency on other side they need more maintenance so baffles which need less maintenance and gives higher efficiency .Many tries has been done for different types of baffles in an experiment but at the time of compilation but there the baffles and shell of heat exchanger property can't be matched, but what should be the curviness of the plate which helps for a maximum flow of fluid by which maximum efficiency of heat exchanger can be obtained.

4. Problem Solving Techniques & Methods

Design is an activity aimed at providing complete descriptions of an engineering system, part of a system, or just of a single system component design methodology for a heat exchanger as a component must be consistent with the life-cycle design of a system. There are two main designs for this paper even for general design of shell and tube heat exchanger**.**

4.1 Thermal Design Heat exchanger thermal/hydraulic design procedures top in involve exchanger rating (quantitative heat transfer and pressure drop evaluation) and/or exchanger sizing. Only two important relationships constitute the entire thermal design. Two of the simplest (and most important) problems are referred to as the rating and sizing problems**.**

4.2 Rating Problem Determination of heat transfer and pressure drop performance of either an existing exchanger or an already sized exchanger (to check vendor's design) is referred to as a rating problem.

4.3 Sizing Problem In a broad sense, the design of a new heat exchanger means the determination/selection of an exchanger construction type, flow arrangement, tube/plate and fin material, and the physical size of an exchanger to meet the specified heat transfer and pressure drops within all specified constraints **[5].**

5. Heat Exchanger Parts

Shell: It is the main body of heat exchanger enclosing tubes, baffles (only for supporting), and impingement plate, with inlet and outlet connections for working fluid**.**

Headers/Channel dished ends: It forms the tube side of the shell and contains pass partition plates in multiple pass heat exchangers with inlet and outlet connections for working fluid, and a drain nozzle.

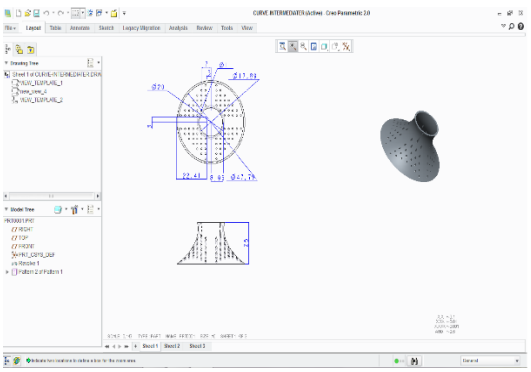
Tube patterns:

Square pattern: In removable bundle units when mechanical cleaning of tubes is specified. Tube lanes should be continuous.

Tube sheets (TS): Tube sheets are used to support the tubes of heat exchanger at extreme ends. TS are made from round plate piece of metal. Holes are drilled for the tube ends at precise locations and pattern relative to one another **[3].**

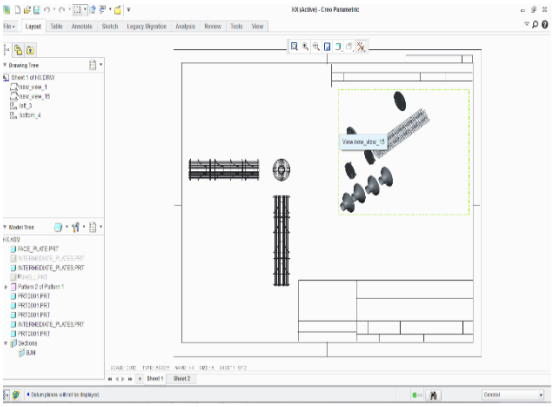
6. Steps for Analysis

Many design has been done but they are not sufficient enough to increase the efficiency in present heat exchanger finally the design is ready to apply

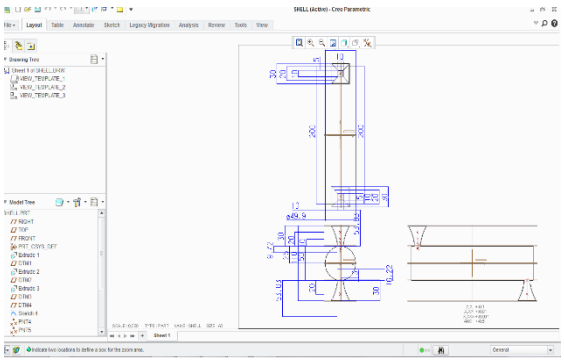


As the curve of the baffles is already given in the picture it will increase the flow path of fluid which directly affects the efficiency.

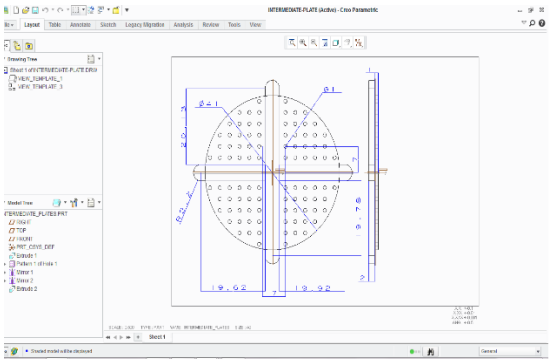
1. Cross sectional view of heat exchanger



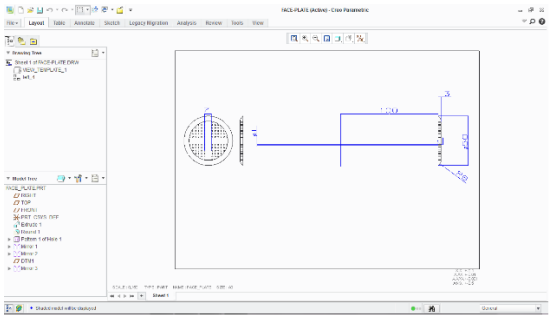
2. Shell



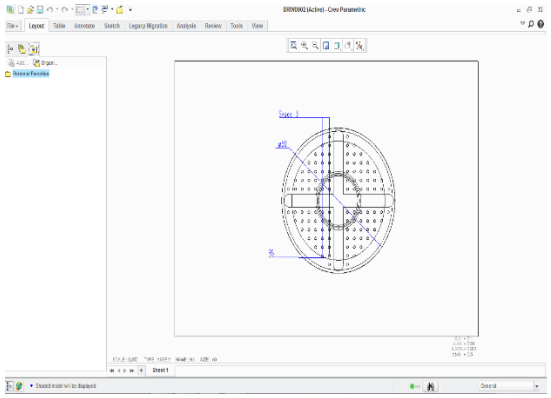
3. Intermediate Plate



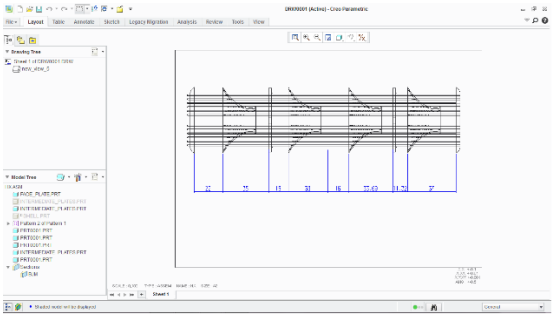
4. Face Plate



5. Front View



6. Side View



7. Conclusion

After analysing heat exchangers defects, the design of heat exchanger is replaced by the conventional flat baffles to curved baffles, to increase its efficiency and to decrease the maintenance cost as such it will directly affect the usage of the heat exchanger. Therefore to determine the heat exchanger designs efficiency of improved heat exchanger. All the data of improved heat exchanger is shown in the figure.

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