An Analysis of the use of Heat Exchangers in Industry

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Aim of the Project

Aim

- Review of heat exchangers using a literature review
- Conduct interview to gain field knowledge.
- Compare effectiveness and efficiencies

Background

The process of transferring heat from one medium to another without the two mediums mixing is achieved using a heat exchanger. Heat exchangers vary is size, design and material used to make them. Heat exchangers are not a modern concept as the first patent was received in 1878 by a German man named Albreacht Dracke. Heat exchangers deal with liquids, solids and gases. Types include shell and tube, plate and fin, economisers, helical coil, finned tube, printed circuit and double pipe. Although certain heat exchangers are prominent in their own systems heat exchangers are very much interchangeable. Factors effecting the types of heat exchanger used include the liquids/gases/solids they are required to heat/cool, fouling factor (how dirty a process is), what pressure is in the system and the temperature they will be operating at.

3 Heat Exchangers working side by side

Figure 1: Three Shell and Tube Heat Exchangers

Designs

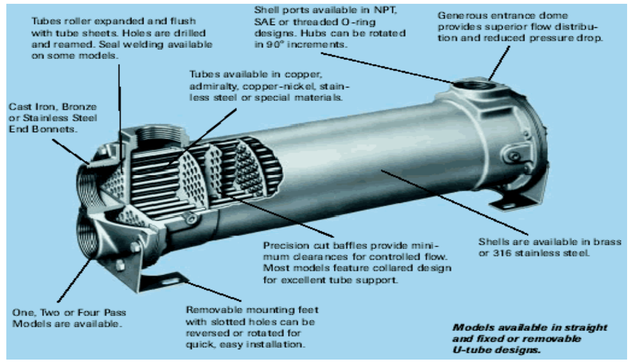

Figure 2: Diagram of a Shell and Tube Design

Shell and Tube – Shell and Tube was one variant of heat exchanger explored throughout the dissertation. As can be seen from the diagram above the shell and tube consists of an outer shell housing multiple tubes within. One fluid or gas travels through the shell from one end to the other while another fluid or gas travels through the tubes. The tubes are configurated to guide the medium back and forth through the shell before exit. Shell and Tubes can be configurated in two ways, parallel and counterflow. Counterflow sees the two mediums travelling in opposite directions aiding maximum heat transfer while parallel flow sees both fluids travelling in the one direction meaning more controlled heat transfer can be achieved. Shell and Tubes are commonly used in heating systems.

Figure 3: The internals of a shell and tube heat exchanger.

Topic

Figure 4: Photo of Industrial sized plate and fin

Plate and Fin – Plate and Fin was a second variant of heat exchanger studied during the dissertation. Plate and Fin heat exchangers are made up of corrugated sheets separated by flat metal plates, typically made of aluminum to create finned chambers. Separate hot and cold streams flow through alternating layers of the heat exchangers which are enclosed at the edges via side bars. A high degree of flexibility is present in plate and fin heat exchangers as they can operate with any combination of gas liquids and two-phase fluids.

Advantages include

- ⊡ High Thermal Effectiveness
- ⊡ Large Heat Transfer Area per unit volume
- ⊡ Low Weight

Plate and Fin – Diagram

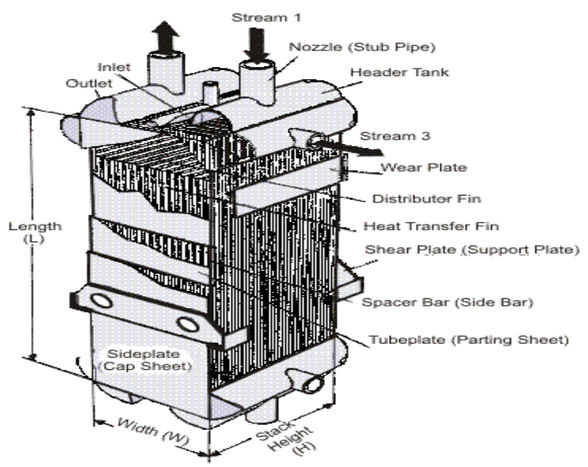

Figure 5: Diagram explaining the workings of a Plate and Fin Heat Exchanger

Conclusion

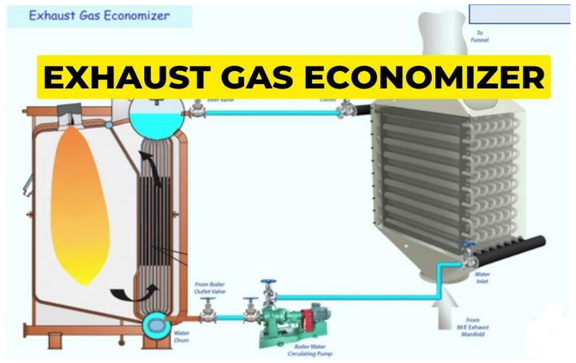

Figure 5: Economiser Design

Heat Exchangers are a tool used in every area of industry including in boilers, in refrigeration, in process, in automotive, in agriculture and in energy applications. Heat exchangers come in many forms Reasons for including heat exchangers include increased productivity, energy saving costs, heat dissipation, lower emissions and as a method to meet emission laws.

References

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