

Heat Exchanger Applications in Chemical Industry

Heat exchangers are the basic Heat transfer equipment used in Chemical Process industries for wide range of applications. Varying temperature requirements of streams in a chemical process facilitates the use of heat exchanger.

Heat Exchanger application in a Chemical industry is outlined as follows.

Heat Exchangers

This type of Heat Exchanger is generic form which uses the process stream in both shell side and tube side. They may be classified into two types depending on the phase change.

Heat Exchangers without Phase Change

Liquid – Liquid, Gas- Gas, Liquid – Gas exchangers are the examples of this type. An example for this Application includes Methanator Feed Product exchanger in a Hydrogen plant where Gas-Gas heat transfer occurs.

Heat Exchangers with Phase Change

Phase change occurs in this type of Heat exchangers by vaporization. An example for this is Reactor Effluent and Fractionator feed exchanger where in feed is vaporized to aid phase change with the help of the reactor effluent.

Reboiler

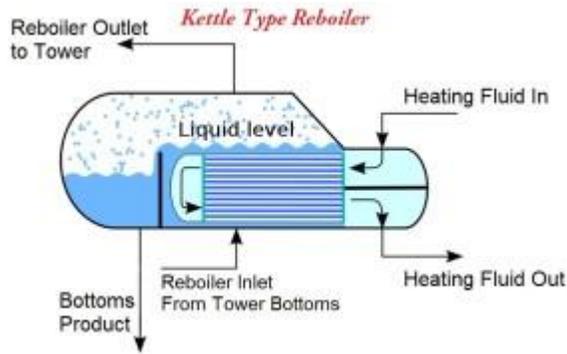
Reboilers provide latent heat of vaporization to the liquid to produce vapor from it. Reboilers are classified into three types as follows

A. Thermosiphon Reboiler

Thermosiphon reboiler operates based on static head of the liquid available at the stripping column bottom. Normally heating medium is passed through tube side due to pressure drop limitation in shell side. Horizontal thermosiphon reboilers are mostly used in Refinery and petrochemical plants. Vertical thermosiphon reboilers with tube side vaporization are adopted by chemical plants.

B. Kettle Type Reboiler

Kettle type reboilers are employed where vaporization rate is high. This type provides large diameter shell for vapor for accommodating vapors. Here also heating fluid is passed through tube side.



C. Forced Circulation Reboiler

A pump is provided in the liquid line to reboiler in this type. Fouling or plugging fluids will offer more pressure drop and this type helps to increase the driving force with the aid of the pump.

Evaporator

Evaporators are used to concentrate the solutions by vaporizing water from it. They are used in desalination processes and other chemical plants.

Chiller

Chillers are used to cool the fluid to a temperature below the ambient temperature by vaporization of refrigerants like Ammonia, Propane, Ethylene etc. Chillers are used to cool the liquid stream or to condense the vapors which are normally sent through tube side. The refrigerant is vaporized in a shell side of a heat exchanger which is similar to a Kettle type reboiler. Shell side provides vapor disengaging space for the refrigerants.

Condensers

Hydrocarbon Condensers

Hydrocarbon condensers are used in distillation columns to condense the hydrocarbon vapors.

Surface Condensers

Surface condensers are used to produce vacuum in the exhaust of Steam turbines by condensing the steam using cooling water or air. The efficiency of the steam turbines is greatly affected by the performance of surface condensers.

Coolers

Coolers are used for transferring heat from process stream to utility stream like water or air.

After cooler

Shell and tube Heat exchangers are normally employed as after coolers in Compressors to cool the process gas. The aim is to remove the heat generated due to compression in order to remove condensable vapors or to reduce the gas volume for enabling storage or as per downstream process requirement for example absorber feed.

Inter cooler

Similar to after coolers compressor intercoolers are used for removing compression heat to increase the volumetric efficiency of the compressors. Thus it helps to avoid the compressor discharge temperature in next stage to go beyond the design limits.

Compressor Recycle Cooler/ Surge Cooler

As discussed in Chemical Engineering Site already about Anti Surge Flow in compressors, it is necessary to remove the compression heat from the discharge stream before recycling it to the suction to maintain surge flow in centrifugal compressors. Shell and Tube Heat exchangers with Cooling water as a cooling medium is selected for this application.

Liquid Coolers

Liquid coolers are normally product coolers used in Refinery and petrochemical applications. They cool the flammable and volatile liquids before sending them to storage tanks. Cooler outlet temperatures are to be carefully maintained as high temperature will lead to high vaporization and loss in storage tanks.

Other Applications of Heat Exchangers

Economizers

Economizers help to preheat the feed water to boiler using the flue gas from it to increase the efficiency of boilers

Super heaters

Super heaters are the heat transfer equipment in a boiler which is employed to superheat the saturated steam which is produced in the steam drum.

Steam Generators

Kettle type heat exchangers are used for this purpose where the hot process fluid is passed through tube side and water is passed through shell side to produce steam

Preheaters

Thermic Fluid Heaters are example for this type. It is employed Cement industry where feed limestone to crusher is heated with the help of Dowtherm to reduce moisture.

Miscellaneous Applications

Heat exchangers are used in other miscellaneous applications. Lube oil coolers in Rotating Equipments, Jacketing Water coolers in IC engines and Reciprocating Compressors, Tank Heaters to decrease the viscosity of the Fuel oil, Lube oil reservoir heaters to avoid freezing are the typical applications

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