HEAT EXCHANGERS

Definition of Heat Exchanger

Heat exchangers are devices that transmit heat between two fluids across a dividing wall or by direct mixing, with conduction, convection, and radiation as the three acknowledged ways of heat transfer. **A heat exchanger is a device that allows heat to be transferred from one fluid to another.** In both cooling and heating processes, heat exchangers are used. To avoid mixing, the fluids might be separated by a solid wall, or they could be in direct contact.

Classification of Heat Exchanger

Heat exchangers are typically categorized based on their flow configuration and construction type. The most basic heat exchanger has hot and cold fluids moving in the same or opposing directions. Heat Transfer Equipment can be classified into the following types based on its functionality:

- Recuperative
- Regenerative or Storage Type
- Direct Mixing Type

Recuperative

This is the most common type, in which heat is transferred between fluids separated by a barrier.

Regenerative or Storage Type

In this case, some material is heated by a hot fluid. Then the hot fluid flow is stopped. Cold fluid now flows over the hot solid and gets heated. This type is used for air heating in steam plants. This type is also used in solar heating homes.

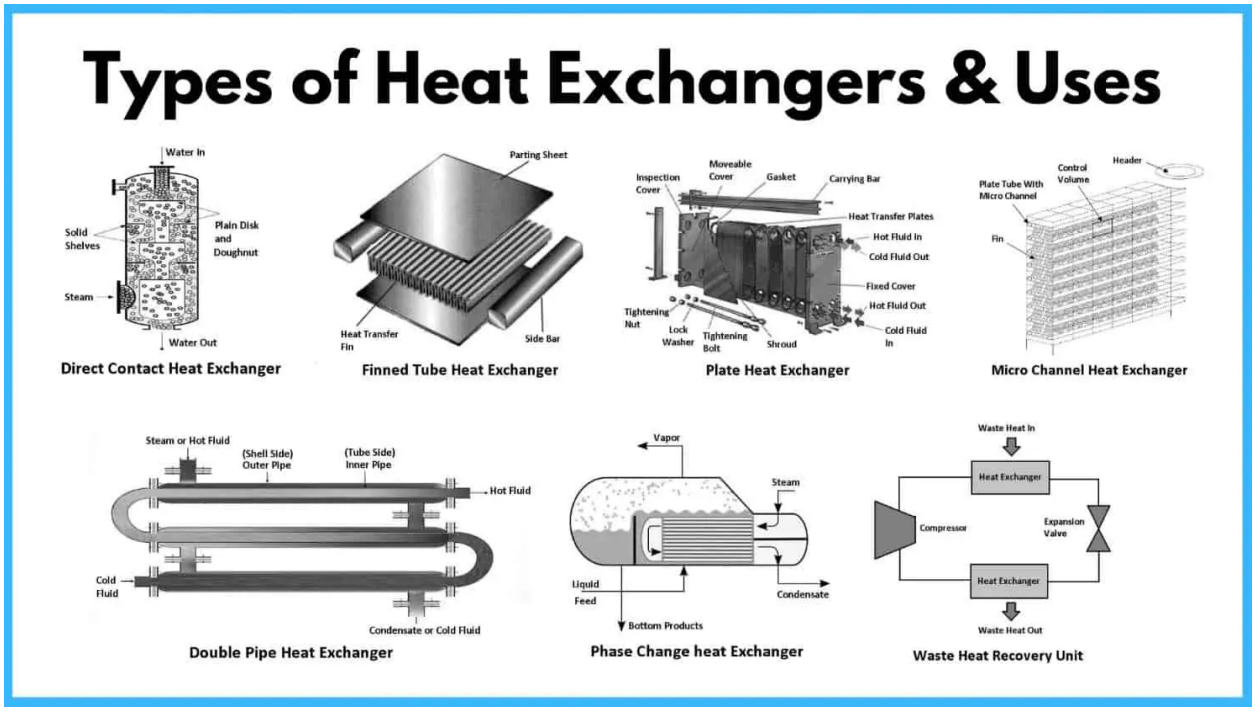
Direct Mixing Type

In this case, the fluids mix and reach a common temperature. This type is rarely used.

Types of Heat Exchangers

Heat exchangers are available in various designs, depending on the design characteristics. The following are some of the more popular variations used in the industry:

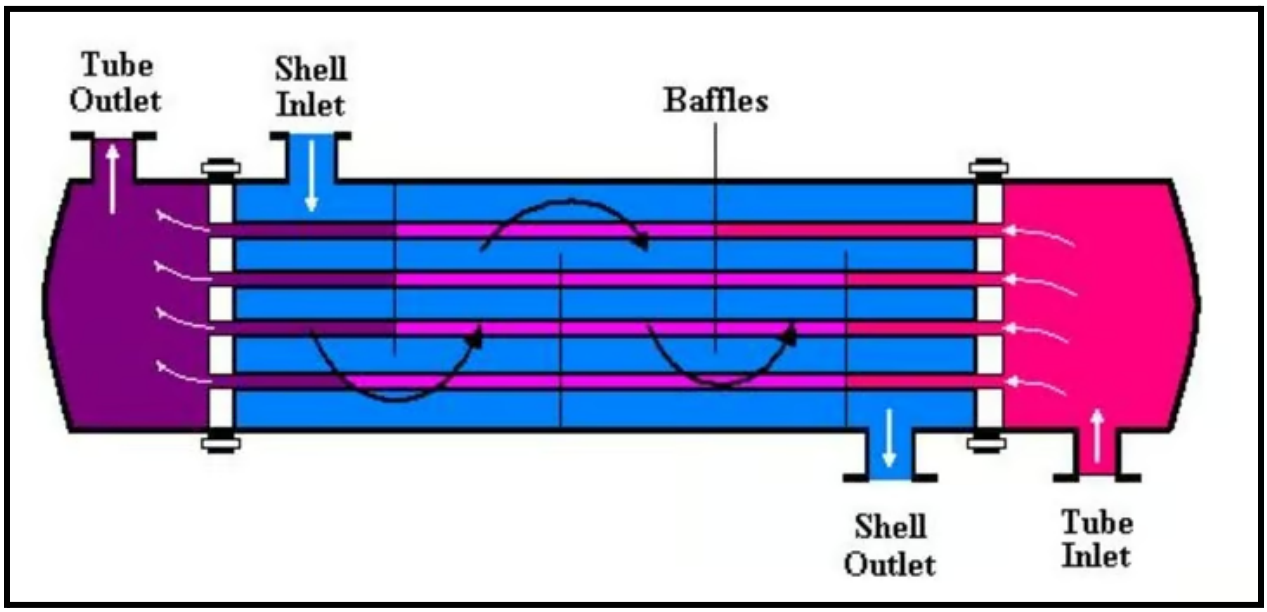
- Shell and tube heat exchanger
- Double pipe heat exchanger
- Plate heat exchanger
- Condensers, evaporators, and boilers

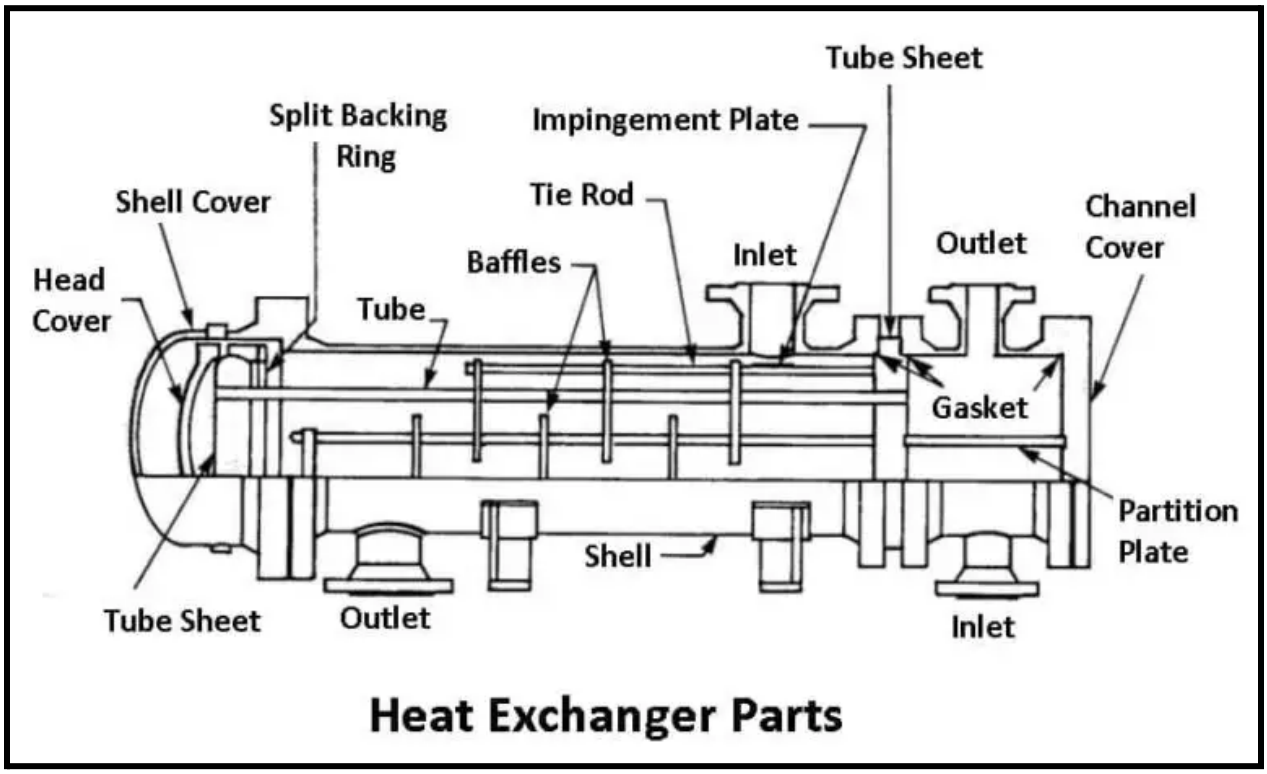


Shell and Tube Heat Exchanger

A single tube or a sequence of parallel tubes is encased within a sealed, cylindrical pressure vessel in a shell and tube heat exchanger. One fluid travels through the smaller tube(s), while the other flows around its/their outsides and between them within the sealed shell. Finned tubes, single- or two-phase heat transfer, countercurrent flow, co-current flow, or crossflow

arrangements, and single, two, or multiple pass configurations are some of the other design features available for this type of heat exchanger.





Double Pipe Heat Exchanger

Heat exchangers with two or more concentric, cylindrical pipes or tubes are known as double pipe heat exchangers (one larger tube and one or smaller tube). One fluid goes through the smaller tube(s) while the other fluid flows around the smaller tube(s) within the bigger tube, according to the shell and tube heat exchanger's design. Because the fluids remain separated and flow via their channels throughout the heat transfer process, the design requirements of a double pipe heat exchanger contain characteristics from the recuperative and indirect contact types.

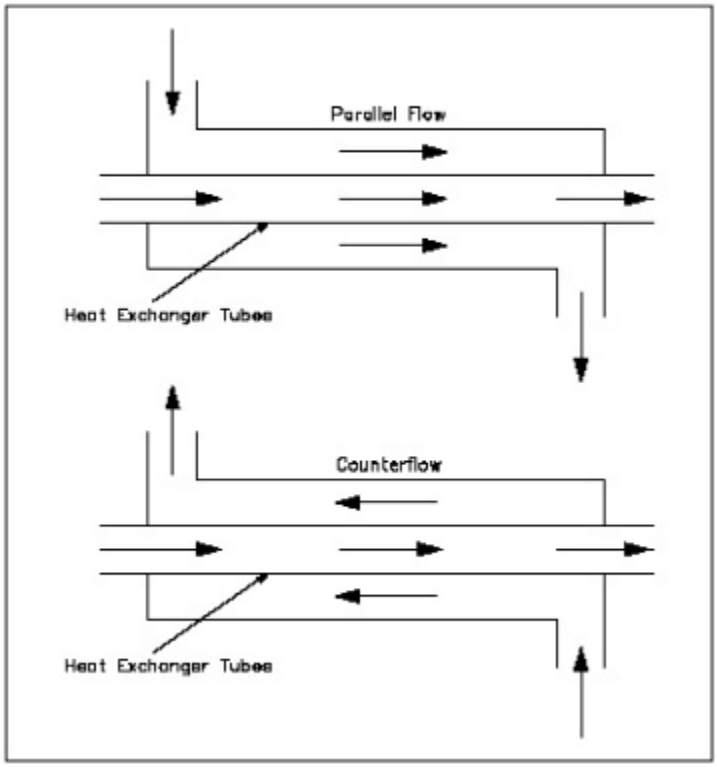


Plate Heat Type Heat Exchanger

Plate heat exchangers are made up of several thin, corrugated plates that have been grouped. Each pair of plates produces a channel for one fluid to flow through, and the pairs are stacked and connected (by bolting, brazing, or welding) to create a second passage for the other fluid to flow through. There are some modifications to the typical plate design, such as plate-fin or pillow plate heat exchanger. Fins or spacers between

plates in plate-fin exchangers allow for different flow configurations and more than two fluid streams to pass through the device.

Condensers, Evaporators, and Boilers

Heat exchangers that use a two-phase heat transfer mechanism include boilers, condensers, and evaporators. During the heat transfer process, one or more fluids in two-phase heat exchanger change phase, either from liquid to gas or from gas to liquid. Condensers are heat-exchanging devices that take a hot gas or vapour and cool it down to the point of condensation, converting it to a liquid. In evaporators and boilers, on the other hand, the heat transfer process converts the fluids from liquid to gas or vapour.

Advantages of Heat Exchanger

There are various advantages of using a heat exchanger such as they are not very expensive. All the advantages of a heat exchanger are listed below:

- Heat exchangers are typically less expensive to maintain.
- These are subjected to extreme working pressures and temperatures.
- You may get an efficiency of roughly 80% with the right-sized heat exchanger.
- They are basic, low-maintenance, small in size, and easy to clean.
- When dismantling, there is no need for additional space.
- Heat exchangers made of shell and tube are less expensive than plate-type heat exchangers.

Disadvantages of Heat Exchanger

Apart from advantages, there are some disadvantages to using a heat exchanger. All the disadvantages of the heat exchanger are provided below:

- Leakage and pressure decrease in the system are the main downsides.
- The initial cost of the plate type is expensive due to the high cost of titanium plates.
- When disassembling and assembling, the operator must be cautious.
- The pressure in the cooler is increased by over-tightening the clamping bolts.
- The tube cooler's capacity cannot be increased, which is also a disadvantage.

Applications of Heat Exchanger

Heat exchangers can be used in various places as they can be used to warm a cold fluid entering a hot process system by transferring heat from the system's hot fluid. Check out some applications of the heat exchanger shown below:

- Heat exchangers are most commonly used to transfer heat from one medium to another.
- Heat exchangers of the shell and tube types are utilized in a wide range of industries.
- The spiral heat exchanger is used for digester heating, heat recovery, and effluent cooling, among other things.
- These are commonly used to heat and cool food and beverages.

References - https://byjusexamprep.com/heat-exchanger-i
https://www.theengineerspost.com/types-of-heat-exchanger/