What is Plate Heat Exchanger

A plate heat exchanger is used to transfer heat energy from one fluid to another. These fluids never encounter each other due to being separated by the heat exchanger. Typically, a plate heat exchanger will consist of several parallel plates positioned above each other, thus creating a passage in which the fluid can flow between. The spacing between two opposite plates provides a channel for the fluid to flow through.

Plate Heat Exchanger Constructed?

A plate exchanger consists of a series of parallel plates that are placed one above the other so as to allow the formation of a series of channels for fluids to flow between them. The space between two adjacent plates forms the channel in which the fluid flows.

Inlet and outlet holes at the corners of the plates allow hot and cold fluids through alternating channels in the exchanger so that a plate is always in contact on one side with the hot fluid and the other with the cold.

The size of a plate varies from a few square centimeters (100 mm x 300 mm side) up to 2 or 3 square meters (1000 mm x 2500 mm side). The number of plates in a single exchanger ranges from just ten to several hundred, so reaching surface exchange areas up to thousands of square meters.

The plates are often spaced by rubber sealing gaskets which are cemented into a section around the edge of the plates. The plates are pressed to form troughs at right angles to the direction of flow of the liquid which runs through the channels in the heat exchanger. These are arranged so that they interlink with the other plates which forms the channel with gaps of 1.3–1.5 mm between the plates.

Plate Heat Exchanger Working Principle?

The purpose of a plate heat exchanger is to transfer thermal energy between two fluids, without the fluids mixing together. For example, in building services, you might want to transfer heat from a primary loop connected to a boiler over to a separate secondary loop, maybe in a district heating network. In manufacturing, you may want to cool down some oil using water, but obviously you don’t want to mix the oil and the water together.

The liquid to be heated or the liquid heats, are totally separated from each other with plates. In standard plate heat exchangers, there are 4 in-out ports and two of them

are for heater liquid and two of them for heated liquid. With special production, it is possible to produce heat exchangers which have more than one heater or heated liquids. In Plate Heat Exchangers, the flow is diagonal. When the hot liquid enters in the top portion and leaves from the bottom, the cold liquid enters in the bottom and leaves from top. So, efficiency reaches maximum level.

Different Types of Plate Heat Exchanger?

1. **Brazed Plate Heat Exchangers**: These are used largely for refrigeration & industrial applications. The main benefit of brazed plate heat exchangers is that they are highly resistant to corrosion. This is due to them being made from a combination of stainless steel and a copper brazing.
2. **Gasketed Plate Heat Exchangers:** These heat exchangers are suitable for a number of industries such as HVAC, Food, Brewing and Pharmaceutical. The heat exchangers make use of gaskets which seal the plates together in the process preventing leaks. Reduced maintenance costs are involved due to the plate easily being removed for replacement and cleaning purposes.
3. **Welded Plate Heat Exchangers:** These heat exchangers are mainly used in the oil, gas and chemical industries. An advantage of these heat exchangers is that they are highly durable and ideal for transferring corrosive fluids or fluids which reach high temperatures. The only issue of these plate heat exchangers is their cost which is accentuated by the fact that the plates are welded together. This means that replacing the plates is difficult and that cleaning the plates is also an issue unlike the removable plates in a gasketed plate heat exchanger.
4. **Semi-Welded Plate Heat Exchangers:** This variety of plate heat exchanger combines the use of welded and gasketed plates. The heat exchanger contains twin sets of plates which have been welded together. These have then been gasketed to other sets, thus making one of the fluid passages welded and another gasketed. The main benefit of a semi-welded plate heat exchanger is that high temperature, corrodible fluids can be transferred on one side while the other side allows for easy servicing.

Objectives of pasteurization

- To make the product safe for human consumption by destroying the pathogenicorganism, which may be present.
- Improves preservation quality by destroying almost all spoilage organisms.
- Helps to retain good flavor over a longer period of time.

Pasteurization requirements for milk

Pasteurization by heating and time treatments are a compromise among bacterial killing along with a number of other factors such as taste, phosphate inactivation, cream line reduction, etc. The target microorganism for milk processing is Micobacterium tuberculosis (TB germ). The following Table 5.1 shows how the pasteurization process has been standardized considering these factors. Accordingly, the methods of pasteurization can be given as in Table 5.2.

Table 5.1. Standardization of pasteurization requirements for milk

Requirement	30 min	15 sec
Kill TB germ	138°F	158°F
Phosphate inactivation	142°F	160°F
Pasteurization requirement	145°F (63°C)	161°F (72°C)
Creamline reduction	146°F	162°F

Table 5.2. Methods of pasteurization for milk

Methods	Treatment
Long hold batch type / Vat pasteurization	63°C-30 min
High temperature short time (HTST) pasteurization	72°C-15 s

Ultra high temperature (UHT) pasteurization	88°C-3 s

However, the time and temperature combination maintained in a dairy plant may vary from the above Table values depending on the initial microbial load and other considerations.

LONG HOLD OR VAT PASTEURIZATION

The long hold or vat pasteurization is a batch type method where the pasteurization is carried out at 63°C for 30 min. The basic operations involved in a vat pasteurizer are given in Fig. 5.1.

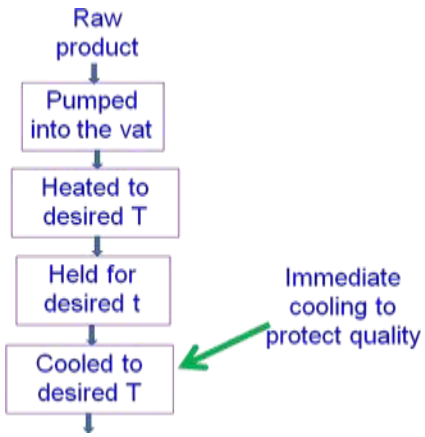


Fig. 5.1 Basic operations in a vat

pasteuriser Types of vat pasteurizers (Classification based on flow of heating medium)

1. Spray type
2. Flooded type
3. High velocity flooded type

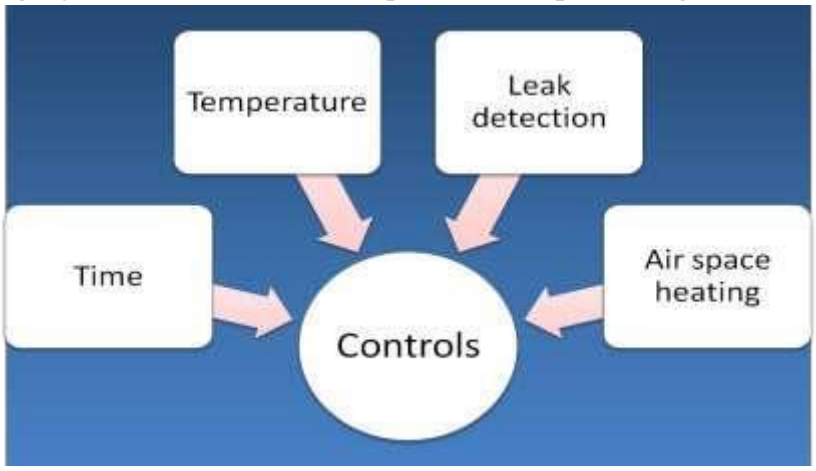
General requirements

The following are the requirements for a successful batch pasteurization process.

- Rapid heating: Generally the circulation of heating medium is started as soon as filling of the vat is begun, thus shortening the heating time.
- Immediate cooling: In some designs the cold water is circulated over the outside of the inner lines as soon as the holding period is completed, so a part of cooling can be done in the vat itself.

- Heating medium should be only a few degrees warmer than milk to prevent formation of milk stones on heating surfaces and cause minimum injury to cream line or flavour.
- ***Agitation*.** Agitation of milk within a certain degree helps in improving the heat transfer.
    - Agitation is easier in case of hot fluid than cold ones.
    - Agitation should not develop foam and it should not injure the cream line.
    - Viscosity of the fluid greatly affects the type of agitator.

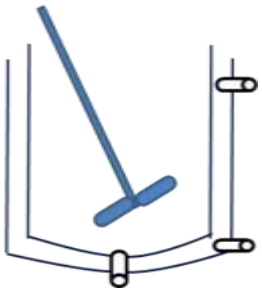
- Less viscous materials require small diameter high speed agitator. Highly viscousmaterials require slow speed large surface blade type



agitators.

Fig. 5.2 Pasteurizer Controls

For vat pasteurizers, an electric or air operated control can be connected with a timing clock so that the heat is shut off when the proper milk temperature has been reached and a bell rings when the proper length of holding time has elapsed.



Also temperature of heating water can be controlled during the holding period.

Fig. 5.3 Schematic representation of a long hold batch type

pasteurizerAdvantages

- Well suited for small plants, low volume products
- Variety of products can be handled.
- Well suited for cultured products such as bottle milk, sour cream, etc.
- Simple controls
- Low installation cost

Disadvantages

- Batch type
- Slow process

- As the controls are mostly manual, it requires constant attention.
- Both heating and cooling are relatively expensive (as we do not have heat regeneration).