Regeneration in HTST Pasteurizer

Regeneration section

Typically, the regeneration section is that part of the HTST unit where the cold raw product is warmed by hot pasteurized product flowing in a counter current direction on the opposite sides of thin stainless steel plates. The pasteurized product will in turn, be partially cooled.

Basic criteria for the regeneration section:

- Has free draining capability
- Has proper pressure relationship between the raw and pasteurized product in all the modes of operation (forward flow, diverted flow and shutdown)
- Is clean and in good condition, with no cracks or pinholes

General conditions

Since the physical distance between the various liquids in the pasteurization plates is extremely small, the liquids have the potential to move through the plates and cross-contaminate the product if pin holes exist.

- Ensure plates are of sanitary design, constructed of stainless steel or other corrosion resistant material, and are without pin holes.
- Ensure plates are clean with no presence of milk remnants, milk-stone, mineral scale build-up, or foreign materials.
- Equip plate gaskets with leakage grooves
- Ensure plate gaskets are in good condition and are not compressed or otherwise showing signs of wear.
- Verify during operation the pasteurizer does not leak at the plate gaskets.
- Establish a routine program to monitor the condition of plates (pin holes in plates, gasket condition, cracks, etc.), taking into consideration the design specifications, operating conditions and hours of operation, wear and the history of the plates and gaskets.
- Check the integrity of all food contact heat exchange surfaces at least once per year (for example by dye recirculation, dye check, pressure retention, etc.).
    - If there are problems with heat exchanger integrity (plate or gasket issues), implement a more frequent inspection program to verify that the problem has been remedied.

    - If pin holes are found in any plate in any section, check all plates in the same section.
    - Document the cause of any failure (for example, age, compression, metal fatigue, etc.).
- Keep records to show testing has occurred.

Shut-down capability

When the system is shut down, the raw milk flows back to the constant level tank.

- Locate the raw product inlet to the regenerator at the lowest point of the raw regeneration section.
    - Second regenerators of a dual regeneration system may have inlet at the top or bottom.
    - The outlet could also be at the lowest point as long as it is free draining to the balance tank.
- Have drain holes in the raw product deflector plates to allow for free drainage of the raw product in the regenerator back to the constant level tank in the event of a shut down.
    - Ensure each deflector plate which carries raw product in the regeneration section has a hole at least 1.59 mm (0.0625 inch) in size at the bottom of the plate.
    - If two deflector plates are back to back, ensure the upstream hole is large enough to allow for CIP cleaning.
    - Vent holes may also be drilled in the upper corners of the deflector plates to assist drainage of the raw product.
- Ensure no valves or pumps block the flow in the shutdown mode.
- Check the second stage regenerator in a dual regeneration system also drains freely during shutdown.
    - Accomplish this by draining the system from the second stage regenerator inlet or outlet.
- Ensure any flow control valve located between the booster pump and the inlet to the raw regenerator:
    - If pneumatically operated, is normally open.
    - If manually operated, is modified to prevent full closure.

Pressure differentials

- Ensure systems without a booster pump have an appropriate system layout (for example system where milk is drawn through the raw regenerator by the positive displacement pump and pushed under pressure through the remainder of the system) to assure the proper pressure differential.
    - Verify the raw side of the regenerator is under lower pressure (at least 14 kPa or 2 psi) than the pasteurized milk at all times.
        - In the event of metal or gasket leakage, pasteurized milk will leak into raw milk passages, and not vice-versa.
    - Ensure the maintenance of this pressure relationship is safeguarded during periods of start-up operation and shutdown.

Failure to maintain the required pressure differential in any section of the regenerator causes all flow promoting devices upstream of any raw regeneration section to be de-energized or isolated from the system.

- In milk-to-heat transfer medium-to-milk type regenerators, ensure the pasteurized milk section is under greater pressure (at least 14 kPa (2 psi)) than the heat transfer medium at all times.
    - In the event of regenerator plate or tubular failures, pasteurized product will leak into the heat transfer medium.
    - Ensure the heat transfer medium (for example hot water) is from a safe source.
    - Locate the pressure sensors for these controls at the heat transfer medium inlet on the pasteurized side of the regenerator and at the pasteurized product outlet of the regenerator.

Failure to maintain the required pressure differential in the pasteurized milk section of the regenerator causes all flow promoting devices upstream of any raw regeneration section to be de-energized or isolated from the system and vented to the atmosphere.

Thermal regeneration is a technique devised to reduce service loads and thus improve energy usage. Percentage regeneration may be defined in several ways and due to these different methods; heat exchangers having identical thermal performance may have, seemingly, different regeneration efficiencies
One definition of Regeneration efficiency is “The temperature range through which the product is heated by regeneration, expressed as a percentage of the total heating range”.

A simple heat exchanger is considered where a product is to be heated from 5°C to 85°C by 80% regeneration and then finally in a heating section. Having heated the product to 85°C it is held in holding tubes and returned to the regeneration section at 85°C.

The total temperature heating range is 85 -5 = 80°C

The temperature range through which the product is heating by regeneration must be 80% of 80°C = 64°C.

Thus the incoming product will be raised in temperature from 5°C to 69°C by regeneration and will be heated from 69°C to 85°C in the heating section. The heated product is then returned to the regeneration section at 85°C where it is cooled regeneratively by the cold incoming product at 5°C. This can be depicted as follows

Preventive Maintenance of HTST Pasteurizer

The plant should be inspected externally for leakage of all kinds. It should be monitored continuously throughout the process and any abnormalities noted be investigated and rectified. The flow rate of milk and media should be checked by measuring the time to process a known quantity of milk.

Plates

1. The Pasteurizer should be CIP cleaned regularly after day's operations.
2. The plates have to be cleaned manually periodically. It should be done with nylon or fiber brush or coir. It should never be cleaned with metal wire brushes.
3. The proper tightening and dismantling procedures have to be followed. Care should be taken not to tighten beyond the mark, provided by the manufacturer. The tightening has to be done such a way that plates move parallel to each other and the measurement of length at the top of the plate pack should be same as at the bottom.

Gaskets

Gaskets must be of nitrile rubber which can with stand up to 120ºC. Use of aggressive acid solutions during CIP cleaning might damage the gaskets. They should be replaced as a set instead of one at a time, to prevent misalignment of

plates. New gaskets should be tightened to the minimum. As gaskets get older, tightening should be increased just to avoid leakage. While replacing the old gaskets with new gaskets, the remnants of old gaskets should be carefully removed from the gasket groove. Old adhesive, grease, dirt etc. should be removed by acetone and the plate groove thoroughly cleaned and dried. The new gaskets for replacement should be slightly sand papered at the back and should be cleaned and dried. A thin coat of adhesive should be applied to the gasket groove and back of the gasket with a small brush for even distribution. While the adhesive is still sticky, the gasket should be fitted in to the gasket groove. A slight pressure on plate for some minutes will help in the fixing of the gaskets. Excess of adhesive should be removed if any still present.

Frame

The frame having threads and spindle should be lightly coated with grease, to help easy movement of the plates.

Filter

Filter cloth should be checked from time to time for any tear or worn out patches. It should be washed after dismantling. Cloth should be replaced if any damage is observed. So is the case with wire gauge filter screen protecting the filter cloth.

Instruments

All thermometers should be checked periodically for accuracy. All air operated instruments should be supplied with clear dry air. The air filters should be inspected periodically, cleaned or changed when required. The components of controlling instruments should be replaced when ever damaged or functioning inaccurately. Leakages in the control instruments of steam supply should be checked, as they are susceptible for corrosion because of higher temperatures.

Pumps and motors

The pumps and motors should be thoroughly overhauled once in a year. The shaft seals if leaking should be replaced immediately. Motors if noisy should be

checked for damaged bearings. Misalignment is one of the most common sources of pump troubles. Scales in hot water pump should be removed