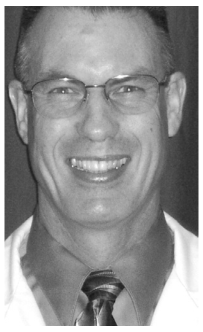
Cheesemaking Practice

HTST vs. Batch:

The Ongoing Pasteurizer Debate



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Batch: Batch Pasteurizer
HTST: High Temperature Short Time Pasteurizer

Before any cheese maker makes his or her first pound of cheese he or she will make this decision: raw or pasteurized. The next decision will be HTST or Batch. The debate is ongoing so I will attempt to explain without bias how the two systems differ.

Batch pasteurizers are commonly used by smaller cheese makers and the number one criteria that carries the most weight is capital cost; a batch pasteurizer may cost less than an HTST. In many cases the model that is emulated in the US is one that may mirror the small farmstead operator in Europe who used to make raw milk cheese and has been forced by regulation to first pasteurize their milk before making cheese.

On this scale a batch pasteurizer can likely be introduced into their operation with the least amount of modification to the existing infrastructure.

Principle Of Heat Transfer

A batch pasteurizer is in essence a tank surrounded by a cavity of water or a tank with very small film of water being pumped across the surface.

In the case of cavity vessels hot water may be heated with an electric element, steam or the hot water maybe circulated. The temperature of the water in these systems is unlikely to be greater than 212° F and is typically between 180° F and 200° F.

The water heats the stainless steel liner of the batch pasteurizer which in turn heats the milk. The temperature differential across the stainless steel wall ranges from 150° F when the milk is cold to 40° F when the milk is at 145° F in the pasteurizer at the end of heating.

In one installation viewed recently I observed that this particular batch pasteurizer was being heated with steam above the condensate causing extensive burn on the wall of the tank at the milk to air interface; this is because the temperature on the stainless steel wall of the vessel was being exposed to a temperature approaching 300° F.

I believe this to be an incorrect use of steam and changes will be made. The Delta T in this situation ranged from 260° F to 150° F. Low Delta T is better.

This difference in temperature across the stainless steel wall is referred to as the Delta T. Delta T is the driving force for the energy transfer and the reduction in Delta T as the milk temperature rises is the reason why the rate of temperature increase slows as you get closer to the temperature of the heating medium.

The batch is constantly agitated during the heating and cooling cycles designed to limit the amount of laminar flow but this still has a less efficient rate of heat transfer and higher localized temperatures than can occur in the HTST.

In an HTST the milk is not placed inside a vessel like the batch but pumped through in a very controlled manner between closely spaced and matched plates. The milk enters the HTST first passing through a series of stainless steel plates called the regenerative section; flowing on the other side of these plates is milk returning from the heating sections.

To pasteurize a fixed volume of milk in one hour a batch system requires double the heating energy of an HTST; add to this the energy to cool and you see that the operational cost to operate a batch pasteurizer is two to three times, not a green option.

The plates are placed very close to each other, creating a thin film of milk millimeters thick. In addition the plates are not flat but ribbed, causing the milk to remain in very close contact with the plate and causing very efficient heat transfer.

The milk entering the regenerative section at 35° F will be exposed to milk on other side of the plate at approximately 140° F, a Delta T of 105° F. This milk then enters the heating section where it will likely be exposed to a plate backed by counter flowing hot water at a temperature of between 5 and 10 degrees above the desired temperature of the milk.

Where the desired temperature is 162° F the water temperature may be as low as 167° F but for this exercise let us assume 163° F is the desired temperature and 169° F is the water temperature, a Delta T of 6° F for not less than 16 seconds.

In an HTST there are three brief temperature treatments given to the milk, warming up, final heating and cooling down. The milk is cooled down to the desired temperature required for culture and coagulation in the cheese vat.

In an HTST the milk is exposed to less elevated temperature for less time than a batch system. The consequences of this are less denaturation of the whey proteins when milk is treated with an HTST than a batch.

The negative consequences of protein denaturation are: poor coagulation in sweet curd cheeses and poor drainage characteristics for acid drained curd such as Quark, Chevre and ladled acid curds. When milk is heated whey proteins form an attachment to the casein in the milk in such a way as to interfere with the action of rennet on the casein and prevent it from forming a good set.

In the batch system the milk then has to be cooled down to the desired temperature for arrival at the cheese vat. This step, unlike the HTST, requires additional equipment in the form of a source of cool water.

Initial cooling may be done with cool ground water and finished with a chilled water source which will have required the use of refrigeration chiller or ice bank system. If this step is completed in the batch it will be quite slow and energy intensive.

A good modification for cooling milk after batch pasteurizing is to run it through a dedicated cooling plate en route to the cheese vat and counter flow cold water from an ice bank or chiller. Through correct sizing it is possible to have the milk in the cheese vat in say 10 minutes at the desired temperature.

Many operators of batch pasteurizers fail to add the cooling equipment necessary to get the temperature down quickly. They save some capital cost but have a milk that is more damaged (denatured) by heat than an HTST, have milk that often has an elevated sweetness and lightly caramelized flavor due to mild breakdown of the sugar and mild Maillard reaction, a reaction between lactose and milk protein, and have an increased energy cost in the form of gas or electricity, and considerably more labor cost.

All systems have their pros and cons, and HTST may cost more but not much more than a good batch system setup with appropriate cooling. To pasteurize a fixed volume of milk in one hour a batch system requires double the heating energy of an HTST; add to this the energy to cool and you see that the operational cost to operate a batch pasteurizer is two to three times, not a green option.

The hidden capital cost in a batch system is the greater size of the steam or hot water heating system which must be twice as large as that for an HTST.

One further comment that should be made is a comment on milk handling. There is a trend in HTST design to move away from positive pumps and use two centrifugal pumps and a Mag Meter (a flow control device); the combination of these two pumps can have a negative impact on milk and its components which can negatively impact cheese quality. My preference is to use a positive pump as the timing pump and a fine tolerance, low sheer centrifugal as the booster pump to minimize damage.

Pumping is also an issue with batch systems; the use of centrifugal pumps for pumping cold raw milk causes churning and fat damage which can lead to off flavors in the cheese. This situation would arise when transferring cold milk to the batch system from a bulk tank or silo. The answer is to use a positive pump; these are available and affordable.

The Bottom Line

An HTST gives you milk that is more like the raw milk you started with than a batch, for me this is the overwhelming reason to use an HTST.

Final Comment

Myth: Batch Pasteurizers are more gentle on the milk because they only heat to 145° F.

Simply, technically not true: 145° F for 30 minutes is equal to 162° F for 15 seconds. The heating damage done on the shoulders of the heating and cooling cycle is many magnitudes greater with a batch system than an HTST.

Closing comment: Tera Johnson, CEO of the new whey plant being constructed in Reedsburg, WI, said they cannot use the whey from cheese plants where batch pasteurizers are used as the whey had undergone too much denaturation. CR

FROM OUR ARCHIVES

50 YEARS AGO

Feb. 13, 1959: **St. Paul, MN**—Some important clues in studies on "cold storage" bacteria called "psychrophiles" – the kind that cause milk, cottage cheese and other dairy products to spoil even though refrigerated, were recently reported by the University of Minnesota.

Madison—Bacteria used for cheese starter can be spray-dried effectively, according to UW-Madison bacteriologists. This would be a simpler and less expensive process than the freeze-drying methods now used for making dried lactic starters.

25 YEARS AGO

Feb. 17, 1984: **Alexandria, VA**—Dairy industry representatives from across the US gathered here this