

# CHEESE – CHEESE VAT

Solutions Sales Training Reference

Receiving

Pasteurization

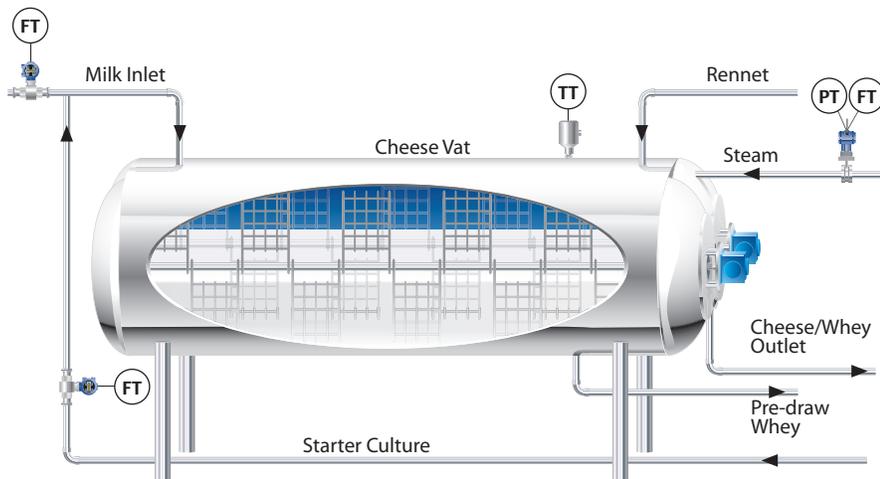
Standardization

**Cheese Vat**

Starter Room

Finishing

CIP



## Key Objectives:

- Maximize curd production, yield
- Maximize whey expulsion and removal
- Minimize fines/losses
- Optimize moisture quality

## Cheese Vat Process Description

After milk has been pasteurized, standardized and cooled to the right temperature, it is sent to the cheese vat for curd production through a series of tubing. Most dairies have 4-8 cheese vats and a PLC coordinates the filling cycles through discrete valve control. The pasteurized milk (often called cheese milk at this point) is added to the vats based on a pre-set target using a flowmeter to measure the total pounds (the density of milk at this point is assumed constant). A starter culture is introduced into the milk just before the cheese vat and an enzyme known as rennet is added during one of the cycles. The enzyme causes the milk to coagulate into a solid gel; calcium chloride may also be added to aid coagulation. The starter culture facilitates curd production and whey removal by producing lactic acid. As acidity increases whey proteins are released and can be

removed. The starter also gives cheese its unique flavor.

The cheese vat goes through a 3 hour cycle of stirring, cooking, setting, cutting and whey removal with the purpose of producing lactic acid to develop curds and remove whey. Between 30% and 40% of the whey is removed in this process unit, which typically can handle between 30,000 and 45,000 pounds of cheese milk. Whey removal is important to minimize energy consumption, since the vat is carefully controlled to 88oF during inoculation and then at 100oF during cooking. Removing the same amount of whey for each batch keeps the batches consistent; this is typically a manual procedure.

The cheese vat has blades that turn in both directions, so the blades used for stirring the curds are the same as those used for cutting, when rotation is

in the other direction. Cutting the curd facilitates whey removal, as does careful temperature control of the vat. Cutting also has a significant impact on final yield, as well as the moisture of the final product, which is an important quality parameter. Excessive cutting results in fines that contain fat and are lost during whey removal. The curds are cooked and gently stirred until they achieve the proper consistency and pH, and are then sent downstream for further whey removal, forming or molding, and packaging. With proper measurement and control plants have moved from 10% yield to 14%. The huge volume of whey was once seen as waste, but now is a valuable by-product. Whey stream processing is commonly done in a separate building next to the dairy.

## Select Measurement and Control Points in the Cheese Vat

### Pasteurized Milk to Cheese Vat

The pasteurized milk to the cheese vat is carefully measured to meet production requirements, to calculate yield and to ratio the appropriate amount of starter and rennet.

### Cheese Vat Temperature

The temperature of the cheese vat is controlled by adding steam to the jacketed vessel (some types of cheese use hot water either added directly or indirectly). Heat treatment is required to regulate the size and acidification of the curd, both of which facilitate whey removal.

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### Pasteurized Milk To Cheese Vat

#### Control Point Challenge:

The amount of milk added to the cheese vat must be carefully measured to achieve the appropriate production as well as to calculate yield and identify product loss (known as product shrinkage). It also is used to ratio the proper amount of starter and rennet, which are critical to curd production and whey removal. Fill time can take 20 minutes to 1 hour.

#### Solution:

The pasteurized milk flow into the cheese vat is controlled by a magnetic flowmeter that carefully measures the total volume of milk added. If a weight basis is required for starter and rennet addition, a constant density of milk is assumed from the point of reception (the original lab analysis).



#### Rosemount 8721 Magmeter

- 3A and EHEDG approved
- 0.25% accuracy
- Full diameter; no pressure drop
- Isolated electronics and LOI for long term reliability

### Cheese Vat Temperature

#### Control Point Challenge:

Heat treatment is critical in regulating curd size and acidification, both of which facilitate whey removal.

#### Solution:

The temperature of the cheese vat for cheddar is automatically controlled by adding steam to the jacketed vessel based on the temperature measurement. Some types of cheese use hot water either added directly or indirectly. Since careful agitation keeps the cheese milk and curds fairly uniform, only one temperature measurement is typically applied.



#### Rosemount 644 Temperature Transmitter & 68Q Hygienic Sensor

- 3-A and EHEDG sensors
- Sensor matching for best accuracy
- Sensor drift alerts

### Starter Addition

#### Control Point Challenge:

Starter must be carefully metered into the cheese milk to facilitate lactic acid production, which develops the curd and separates the whey. The starter is also responsible to give cheese its unique flavor.

#### Solution:

Starter is added on a weight basis directly into the cheese milk line just before the vat to promote a homogenous mixture. A magmeter or load cells are used to carefully measure the volume or weight of starter so the ratio to cheese milk is optimized for curd production (density is carefully controlled in starter production so it doesn't change). Magmeters are a more durable, cleaner application than load cells because there is less area for bacteria build-up, they are less intrusive and not as likely to be bumped. Line size is typically 1.5"; 350lbs of starter for 45,000lbs of cheese milk is common.



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### Steam to Cheese Vat

#### Control Point Challenge:

Steam used for heating cycles in the cheese vat is monitored to detect anomalies in energy use, and for overall plant energy management.

#### Solution:

A mass flow measurement provides steam use for the cheese vat based on cycle, product or day. Trending of steam flow rate provides visibility to exceptions where steam use is out of line, indicating a problem with the equipment. It also provides information for total plant energy management.



#### Rosemount 3095 MF Mass Flow Meter

- Multivariable: flow, P, T, DP
- 1% mass flow accuracy with up to 10:1 turndown
- Pressure and temperature compensation



#### Rosemount 8800MV Mass Flow Vortex

- Multivariable: flow and T
- 2% accuracy with up to 30:1 turndown
- Temperature compensation for saturated steam
- Process isolated removable temperature sensor

#### Typically Not Measured:

- Rennet Addition - measured by hand; only ounces of rennet are weighed on a small scale and mixed with water for 45,000 lbs of cheese milk.
- Whey flow out of the vat: MMI - ask Tom Belling for whey protein concentrate
- Cheese vat level
- Curd "flow" out of the cheese vat