

Continuous Butter Making

INTRODUCTION:

Continuous butter making, introduced after World War II, increased the efficiency and output of butter manufacture. To overcome the disadvantage of batch method of production continuous method is evolved and it has the following advantages.

- i. **Highly economical:** Due to reduced labour cost, reduced power consumption.
- ii. **More hygienic:** Because it is processed under closed system, no manual handling is necessary and no chance for air borne contamination.
- iii. **Quicker:** Butter can be produced in a span of few minutes from cream.
- iv. **Large volume can be easily produced.**
- v. **Can be connected directly to packaging lines.**

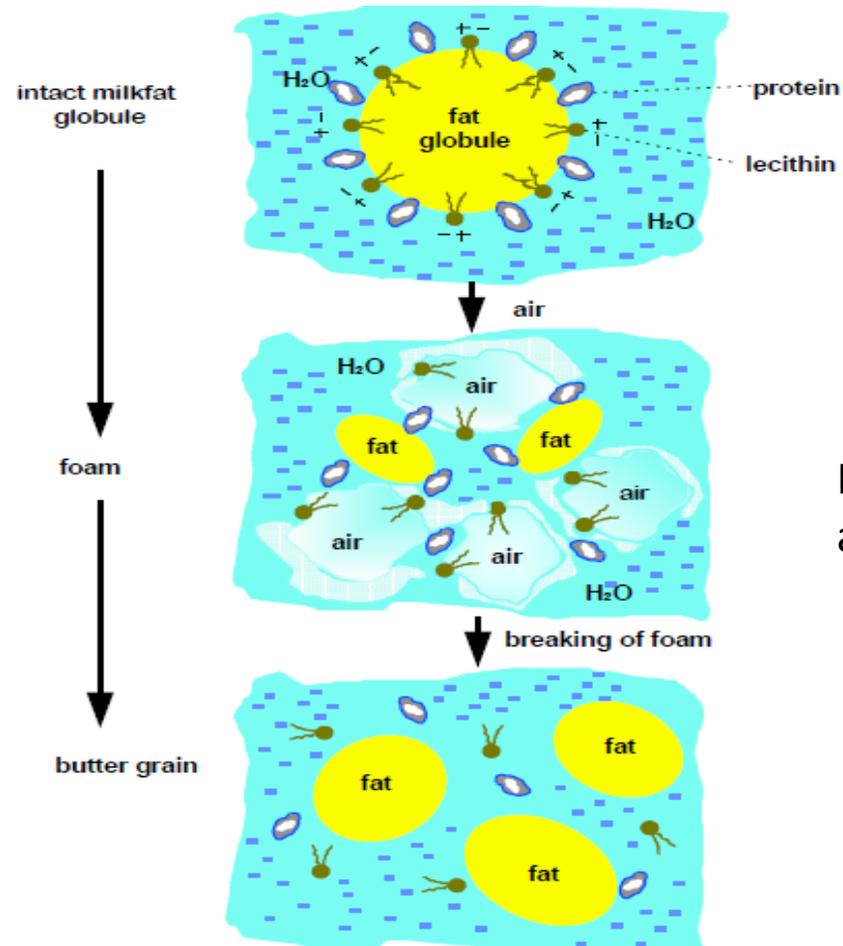
CONTINUOUS BUTTER MAKING PROCESS DEPENDS ON THREE PRINCIPLES

I. Churning or frothing:

- In this method butter grain is formed by aggregation of the fat globules under the action of air present in the cream.
- During churning, air is beaten into the cream and is dispersed into small bubbles.
- The fat globules touch these bubbles, often spread part of their membrane substances and some of their liquid fat over the air–water interface, and become attached to the bubbles.
- One bubble can catch several globules.
- This resembles flotation, although in true flotation the foam is collected.
- In the churning process, however, the air bubbles keep moving through the liquid and collide with each other due to the rotation of beater.

CONTINUOUS BUTTER MAKING PROCESS DEPENDS ON THREE PRINCIPLES

- They thus coalesce and adhering together.
- In this way small fat clumps are formed. Mechanism is shown in fig.



Formation of butter granules according frothing principle

- This involves the use of high-speed beaters to destabilize the fat emulsion in chilled cream, and cause the formation of grains of butter in few seconds.
- The buttermilk is then drained out and butter granules are worked in kneading section consists of screw type kneader.
- The proportion of solid fat is crucial, if the globules contain very little solid fat, then the cream does not churn.
- Higher the proportion of solid fat, the slower the churning, and the lower the fat content in the buttermilk.
- The temperature will therefore have a considerable effect on the churning.

ii. Concentration and phase Reversal:

In this method the concentrated cream will be subjected to combined effects of cooling and working and bring about a direct conversion of cream to butter. Thus it by-passes the butter grain stage.

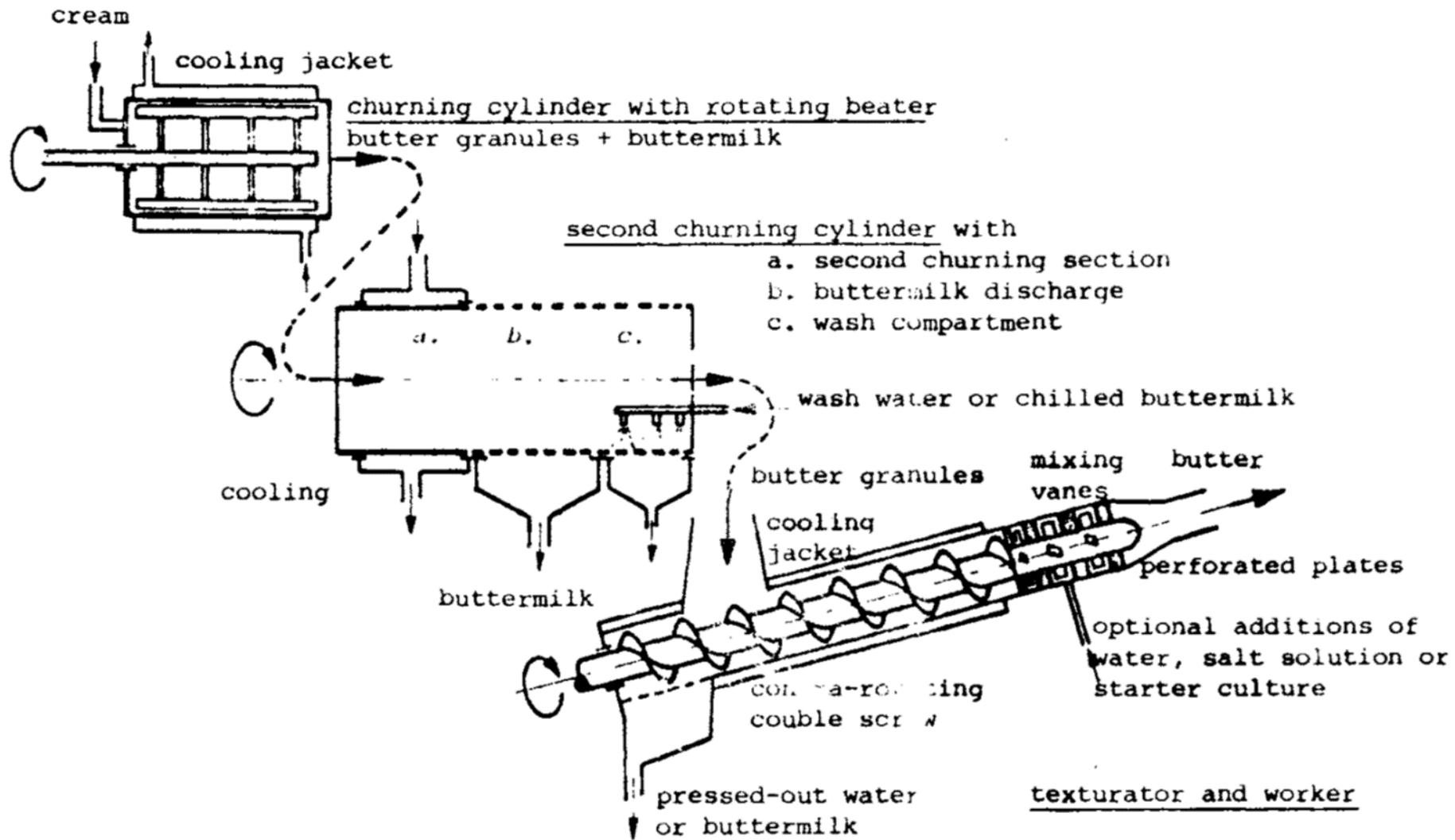
iii. Emulsification: In this process, liquid butter fat and serum are emulsified and emulsion is cooled and worked to form butter.

FRITZ-EISENRICH PROCESS:

- Fritz butter making machine; it contains only one **churning cylinder and twin screw working device.**
- This was only suitable for **sweet cream of 40-50% fat.**
- The second churning cylinder was developed by Eisenrich which basically have second churning section, buttermilk discharge section and wash compartment. This allow, churning of ripened cream as well.

First Churning Section:

It is cylindrical in shape with cooling jacket. It contains beater whose battens are at a distance of 2-3 mm from the wall(Fig.)



Fritz process of continuous butter manufacturing

- Beater rotates at a high speed (600-2800 rpm) which can be adjusted according to the requirement.
- Cream containing 40-50% fat is passed to this section at a temperature of 7-10°C. Butter granules are formed here within 3-5 seconds.
- Cream is set into the rapid motion in the form of a thin film. Fine cream froth is produced.
- Through the breaking of these froth bubbles and through the action of the very vigorous mechanical action the cream is churned to butter granules and buttermilk.

- 30% fat cream can also be churned by increasing the unevenness of the inner surface (by inserting perforated cylinder).
- Mixture of butter granules and buttermilk is displaced from the cylinder by the incoming cream.
- The beater speed is adjusted accurately to yield butter grains of correct size.
- If the size is too small it causes difficulty in drainage of buttermilk. Thus, fat loss in buttermilk increases.
- On the other hand, if the size is too big it will entrap more buttermilk resulting in unsatisfactory drainage of buttermilk.

Second Churning Section:

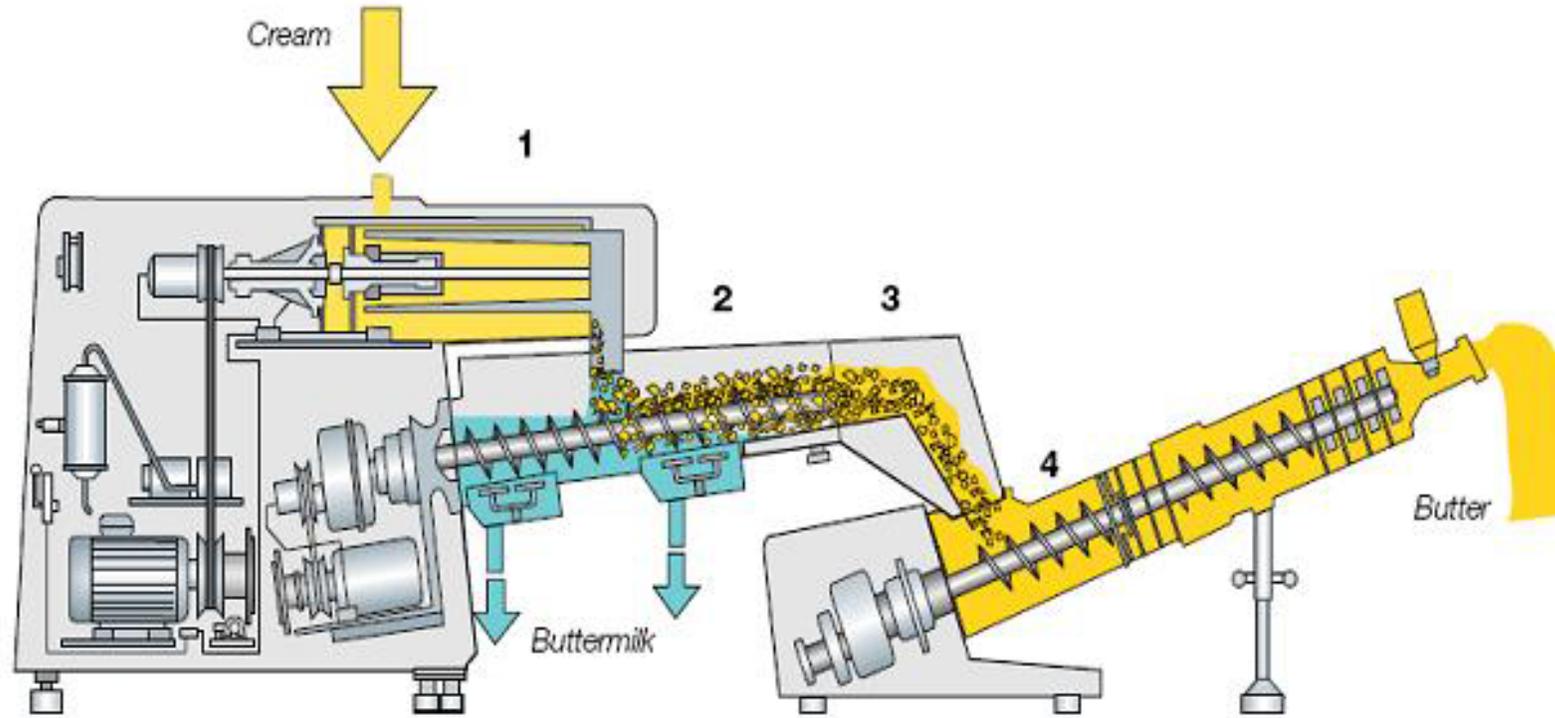
- This is also in cylinder shape and rotates at **10-25 rpm**.
- In this section cylinder is cooled and butter granules are able to form loose agglomerates.
- Metal rods are attached to this cylinder so they rotate at the same speed loosen the mass and prevent the formation of lumps.
- In the buttermilk discharge section major part of the buttermilk is drawn off through a wire mesh which covers the perforated cylinder.
- Removal of buttermilk is almost complete and water is in very fine state of dispersion.
- Washing of butter granules can be done in wash compartment but it is hardly necessary.

Twin Screw Working Device

- Butter granules are collected by two rotating screws and worked intensively.
- Buttermilk is pressed out here, to reduce the moisture content of butter. Screws force the butter through a number of perforated plates arranged in series.
- This treatment serves to produce a fine dispersion of water in the butter. Process is assisted by mixing vanes which are assisted between the plates and attached to the shaft.
- In this working section water or salt solution may be added through an opening immediately in front of the perforated plates to adjust moisture or salt.
- Modern butter making machine have vacuum compartments to reduce the air content of the butter and improve the spreadability to some extent.

CONTIMAB PROCESS

- In this method, cream churns into butter granules in **1-2 seconds**, churning cylinder rotates at **600 – 800rpm**.
- Two major working sections are provided, one is wet and another one is dry(Fig.).
- In wet working section washing and cooling of butter granules and removal of buttermilk takes place.
- In dry working section, butter is further worked and reduces the moisture content to **13 to 14%**. Further butter travels to dosing section, where adjustment of salt and moisture will be happen.
- At the end vacuum chamber is provided to reduce the air content of the butter.



Schematic diagram of contimob process of continuous butter manufacturing

1. Churning cylinder
2. Separation section
3. Squeeze-drying section
4. Second working section

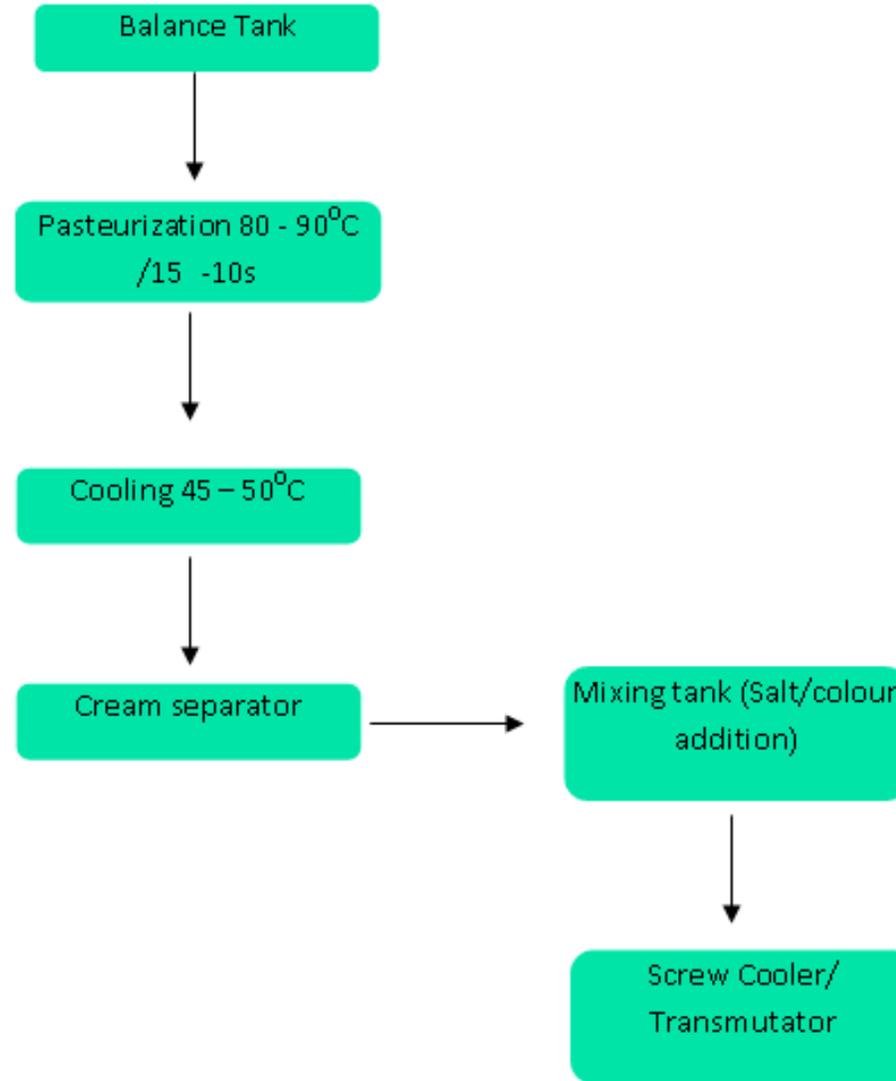
ALFA PROCESS:

- Cream of 30% fat is pasteurized at 90°C, degassed, cooled to 45 – 50°C and separated at this temperature in a cream separator to 82% fat.
- The cream, which is still in the form of oil in water emulsion, but it is almost the composition of butter.
- In this cream fat globules are so closely packed that their fat globule membranes are in contact with each other.
- As fat crystallizes and fat crystals perforate the fat globule membrane and free fat is released out.
- Rubbing together of the fat globules helps this process as they move in the cooler.

ALFA PROCESS:

- Thus phase inversion takes place and water-in-oil emulsion (butter) is formed.
- It contains all the fat globule membrane material, thus it has high phospholipids content and **no buttermilk is produced in this process.**

Process flow diagram for Alfa process is given below.



Alfa Process flow diagram of continuous butter making

- **Salting in Continuous Butter making:**
- Salt is added only after removal of buttermilk and preferably entry is in between 1st & 2nd perforated plates.
- Salt is commonly injected in the form of **50:50** water salt slurry.
- Only 26% salt is soluble, so half the salt remain undissolved in slurry.

CHERRY-BURRELL GOLD'N FLOW PROCESS:

This process essentially includes following steps;

1. Destabilizing cream and separating it to 88-90% fat
2. Pasteurizing the high fat concentrate
3. Standardizing to the composition of butter
4. Chilling and working into butter

CHERRY-BURRELL GOLD'N FLOW PROCESS:

- The process starts with 18⁰C cream that is pumped through a high-speed destabilizing unit and then to a cream separator, from which a 90% fat plastic cream is discharged.
- Destabilization is a process of packing small fat globules together to form large ones.
- Destabilizing unit consists of a perforated blade travelling at high speed, beating chamber, an adjustable hold back valve and an air inlet valve.
- The blade travelling at high speed packs the fat globules together by mechanical force.
- The adjustable hold-back valve insures that the cream is held in beating chamber long enough.

CHERRY-BURRELL GOLD'N FLOW PROCESS:

- It is then vacuum pasteurized and held in agitated tanks, wherein color and salt are added.
- Now, product is in the form of 80% fat-water emulsion, which is maintained at 49⁰C, is cooled to 4⁰C by use of scraped surface-heat exchangers.
- It then passes through a crystallizing tube and then a perforated plate that works the butter.
- Before chilling, 5% nitrogen gas is injected into the emulsion.
- It is possible to manufacture butter from high-fat cream (>82% milk fat) on a continuous basis.

SALT QUALITY & SLURRY PREPARATION:

- If the butter is to be salted, salt is spread over the surface in batch production, or added in slurry form during the working stage in continuous butter making.
- Very finely grounded salt to be used and which is of high quality (TBC <10/g) and Purity (99.5 – 99.8% Sod. Chloride).
- Salt grain should be fine, all pass through IS: Sieve-85(aperture 8424). Salt slurry should be made before 30min and vigorously agitated.
- Need a proper working after salting otherwise —loose moisture or mottling defect may happen.

Determination of salt in butter

- There are several ways of determining the salt content of butter.
- The analysis can most conveniently be carried out with a 10-gram sample that has already been used for determination of the moisture content of the butter.
- The butter is melted and poured into a 150 ml beaker.
- The butter residue is washed into the beaker by means of 50- 100 ml of water at 70°C.
- After addition of 10 drops of saturated potassium chromate solution, titration takes place with the use of a 0.17 n silver nitrate solution (AgNO_3), added gradually until the colour changes from yellow to brownish.
- The salt content is then determined in accordance with the following equation:

$$\text{Salt \%} = \text{ml of silver nitrate solution used} \times 0.1$$