

that was used for cream. Only filtered water of approved purity should be used.

If the churn is equipped with several speeds for working, the low speeds can be used at the beginning until most of the loose moisture has been eliminated. Moistened salt is then added and the churn barrel, with the vents closed, is revolved at the next higher speeds until the brine has been finally incorporated with the butter. An analysis for moisture is then made. If this is less than desired, a calculated amount of water is added, and the butter is finished at the top working speed.

It is important that the butter be thoroughly worked so that there will be no visible brine droplets on the cut surface of the butter after it has been kept in a refrigerator for some time. Leakiness means that (a) there is an economic loss to the butter distributor, (b) the keeping quality of the butter is less satisfactory, or (c) the consumers think the butter contains an excessive amount of moisture.

Butter should have a close texture and a waxy body. It must not be greasy, salty, sticky, or crumbly.

The average composition of American creamery butter in percent is:

Fat	Moisture	Salt	Curd, etc.
80.5	16.5	2.2	0.8

REMOVING THE BUTTER FROM THE CHURN

The butter should be removed from the churn by mechanical means. One of these consists of dumping the butter out of the churn onto aluminum or stainless steel trays or boats rolled under the churn. The butter is stored in these trays in the refrigerator until time of printing. A hydraulic lifter may be used for lifting the tray with butter to the level of the hopper of the butter printer. A tilting mechanism dumps the butter into the hopper.

Another method of removing butter which is now used by many creameries in Denmark consists of pumping the butter from the outlet gate of the stainless steel churn by means of a specially designed pump through stainless steel pipes direct to either the bulk butter containers or to butter printer.

PRINTING BUTTER

Automatic equipment for efficient forming and wrapping prints of butter is now available. Some machines are designed for handling butter direct from the churn; others will handle butter after it has been firmed in a refrigerator. Machines will automatically print, wrap, carton, and overwrap butter. The hourly output may vary from about 500 to 5000 lb.

When bulk butter from a refrigerator is printed, it is necessary to use a precutter. The printer and wrapping machine automatically forms butter into prints of the exact size and wraps each print with parchment or parchment-coated foil.

From the printer the prints are conveyed to an automatic cartoning machine. Cartons or paper-wrapped prints may be automatically overwrapped with either cellophane, foil, or glassine and may be heat-sealed in a final machine.

A demand by restaurants, hotels and institutions for butter patties has led to automatic machines having an output of 400 to 1200 lb of patties per hr. Bulk butter is placed in an extruder and is formed into slabs. These slabs are cut into patties, embossed, and wrapped with parchment paper. It is possible to make 60, 72, or 90 patties per lb of butter.

CONTINUOUS BUTTERMILKING

Two patented processes for continuous butter-making have been developed in the United States.

The following description of one of the processes has been given by Rishoi.¹

The process consists of the four following steps:

1. Destabilizing cream and separating it to 88 percent fat or higher.
2. Pasteurizing the high-fat concentrate.
3. Standardizing in batches to the composition of butter.
4. Chilling and working into butter.

The equipment used for the manufacture of butter can also be used for the manufacture of anhydrous milk fat.

Destabilizing and Separating

The cream in the holding vats is brought to a temperature of from 60 to 70 F. At this temperature, the raw unneutralized cream is delivered by a pump through a pressure cream filter to a high-speed centrifugal destabilizing unit. The filter is a new, all-stainless steel unit equipped with perforated stainless steel screens and O ring seals that positively prevent by-passing of product. The destabilizing unit discharges the cream in a partially destabilized condition. Such destabilization of the cream before separation enables the separator to deliver a fat concentrate testing as high as 88 percent fat or higher and to separate with low fat losses. The fat loss in separating is less than that usually had in the buttermilk when churning with conventional churns.

The destabilizing unit delivers the cream to a centrifugal heater where it is heated to a separating temperature of between 120 and 130 F. The centrifugal heater is quite similar in design and principle of operation to a continuous pasteurizer. Cream enters at the bottom and is forced upward through the heater by the lifting action of a stainless steel agitator. By means of curved blades operating as a centrifugal pump in the top of the heater, the cream is delivered directly to the separator where it is separated to a concentrate having 88 percent fat or higher.

The separator is a special industrial type machine designed to handle sweet or sour cream without clogging. One of the important differences between this separator and a standard machine is that there are orifices in the periphery of the bowl which permit the curd or heavy skim, that normally packs around a separator bowl, to discharge continuously.

The separator has three discharge outlets—one for the high fat concentrate, one for the skim milk and one for the heavy skim. The skim milk and heavy skim, which are discharged into a 20 gal surge tank, may be utilized for the usual skim and buttermilk products.

Pasteurizing

The fat concentrate is discharged into a second surge tank from which it is pumped to a vacuum pasteurizer in which it is continuously pasteurized at 200 F. Feed, weed and other volatile off-flavors are removed in the process and the concentrate is cooled by evaporation in vacuum to approximately 110 F. At this temperature it is discharged into composition control units where the fat concentrate is standardized for acidity and to the desired butter composition.

Composition Control

The composition control units may be either 300 or 600 gal capacity. These vats are equipped with special agitators and baffles designed to produce the thorough mixing necessary to obtain representative samples, to uniformly incorporate the standardizing materials and to maintain uniform composition while being emptied.

The tests employed in standardizing are those commonly used in creameries. The number of pounds of fat concentrate

in a composition control unit is determined by measuring with a calibrated stainless steel measuring rod. An acid test of the serum is made to determine the serum acidity and the amount of neutralizer required to adjust the acidity to the desired point. The concentrate is next tested for moisture, fat and curd. Knowing the percentage of butter fat and the amount of concentrate in a vat, the number of pounds of salt and water required for the desired composition is calculated.

The required amounts of neutralizer, salt, and water are weighed and added to the concentrate in the vat. Butter color, if required, and starter distillate or butter culture, if desired, are also added at this time.

Chilling and Working into Butter

The next step in the process is to chill the standardized mix and work it into butter. This is accomplished in the butter chiller and the texturizer.

The butter chiller is similar in principle of operation to a Vogt freezer. It has two ammonia-cooled cylinders equipped with agitators which work the butter and also scrape the chilled butter from the cylinder walls. The action in the butter chiller is that of chilling the butter to a firm consistency and partially working it.

At the rated capacity of 2000 lb of butter per hr, about 12 tons of refrigeration are required to operate the butter chiller.

Since butter normally contains from four to five percent dissolved and entrained air, the butter chiller is equipped with a volume meter for metering nitrogen into the product to give it the same body and texture characteristics as batch churned butter.

The butter discharges from the chiller at a temperature of about 40 F directly into the texturizer. The function of the

texturizer is to allow time for crystallization of fat and to further work the butter. Forcing the butter through a perforated plate at the discharge end furnishes the working action required. The butter as it leaves the texturizer is firm enough for bulk packaging or for printing and wrapping.

The second patented continuous butter making process, Fig. 4, has been described by Mitten and Roahe.²

Concentration to Cream of 80 percent Fat Content

Milk may be processed the same day it is received. Either milk or sweet cream may be the starting product. Milk is first separated to yield 40 percent cream. This cream is heated in a plate type heat exchanger to a temperature of 155 to 165 F and separated by a heavy cream separator to 78 to 80 percent. The skim from both or either separation may be utilized in low temperature dried non-fat solids. The concentrated cream from the centrifugal separator enters a special balance tank and is ready for the next step.

Reversal of Fat Phase from Fat-in-Serum to Serum-in-Fat

The reversal of the fat phase is the heart of the process. It is this step which provides a means of making a quality product unavailable through any other process. The concentrated cream is removed from the balance tank by a small centrifugal pump which provides a steady supply to the Phase Reverser, a machine similar in design to a homogenizer. By careful and accurate control of the pressure used in the Phase Reverser, the cream is processed in such a way that the protein-phospholipid complex surrounding the individual fat globules is

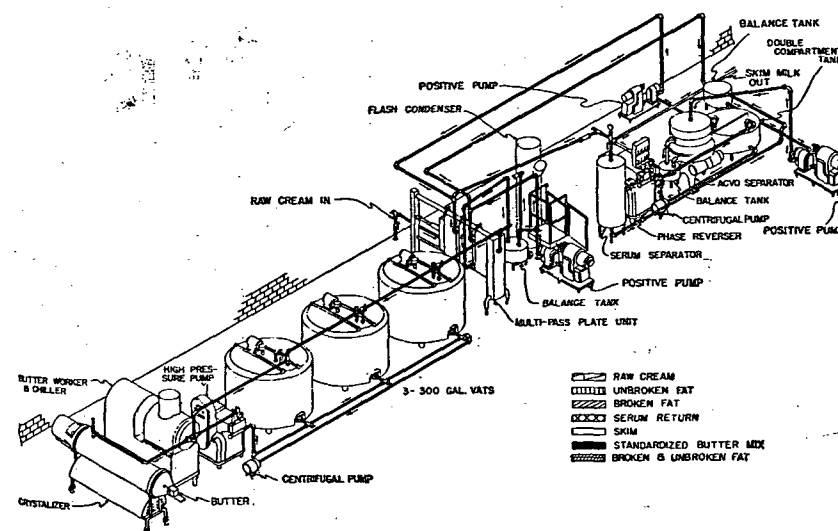


Fig. 4 . . . Continuous Butter Making Process for Sour Cream—2000 Lb per Hr.