



Butter Production - Technology and Process

White Paper

Table of Contents

Executive summary - - - - -	- 3
Introduction to SPX Flow Technology- - - - -	- 3
vision and commitment - - - - -	- 3
Customer focus - - - - -	- 3
Traditional butter manufacturing - - - - -	- 4
Butter products - - - - -	- 5
Recombined butter process - - - - -	- 5
Butter blends- - - - -	- 6
Pilot trials - - - - -	- 6
Final remarks - - - - -	- 7



EXECUTIVE SUMMARY

Food companies today are like other manufacturing businesses not only focusing on the reliability and quality of the food processing equipment but also on various services which the supplier of the processing equipment can deliver. Apart from the efficient processing lines we deliver, we can be a partner from the initial idea or project stage to the final commissioning phase, not to forget the important after-market service. SPX Flow Technology has Gerstenberg Schröder installations in more than 110 countries around the world.

SPX Flow Technology delivers complete process lines for butter and butter products. The lines can be based on the traditional continuous butter making process or on recombined butter technology involving scraped surface heat exchanger (SSHE), GS Nexus, GS Kombinator or GS Perfector, technology.

INTRODUCTION TO SPX FLOW TECHNOLOGY

VISION AND COMMITMENT

SPX's Flow Technology segment designs, manufactures and markets process engineering and automation solutions to the dairy, food, beverage, marine, pharmaceutical and personal care industries through its global operations.

We are committed to helping our customers all over the world to improve the performance and profitability of their manufacturing plant and processes. We achieve this by offering a wide range of products and solutions from engineered components to design of complete process plants supported by world-leading applications and development expertise.

We continue to help our customers optimize the performance and profitability of their plant throughout its service life with support services tailored to their individual needs through a coordinated customer service and spare parts network.

CUSTOMER FOCUS

SPX Flow Technology develops, manufactures and installs modern, high efficient and reliable processing lines for the food industry. For the production of crystallized fat products like margarine, butter, spreads and shortenings SPX offers Gerstenberg Schröder solutions which also comprise process lines for emulsified food products such as mayonnaise, sauces and dressings.

TRADITIONAL BUTTER MANUFACTURING

Traditionally, butter is defined as a plastic product derived from cream, inverted to a water-in-oil emulsion (W/O) with minimum 80% fat. The continuous fat phase in the butter is a complex matrix of liquid butter oil and fat crystals forming a network which entraps the water droplets and to a limited extent small air bubbles.

In the dairy industry today the majority of the butter is produced on continuous butter making machines using the so-called Fritz method. Initially, the milk is concentrated to cream followed by a pasteurization process. Subsequently, the cream follows a temperature treatment where crystallization takes place. The churning process involves phase inversion of the crystallized cream to butter granules and buttermilk. The butter granules are plasticized by the kneading and mixing process to form

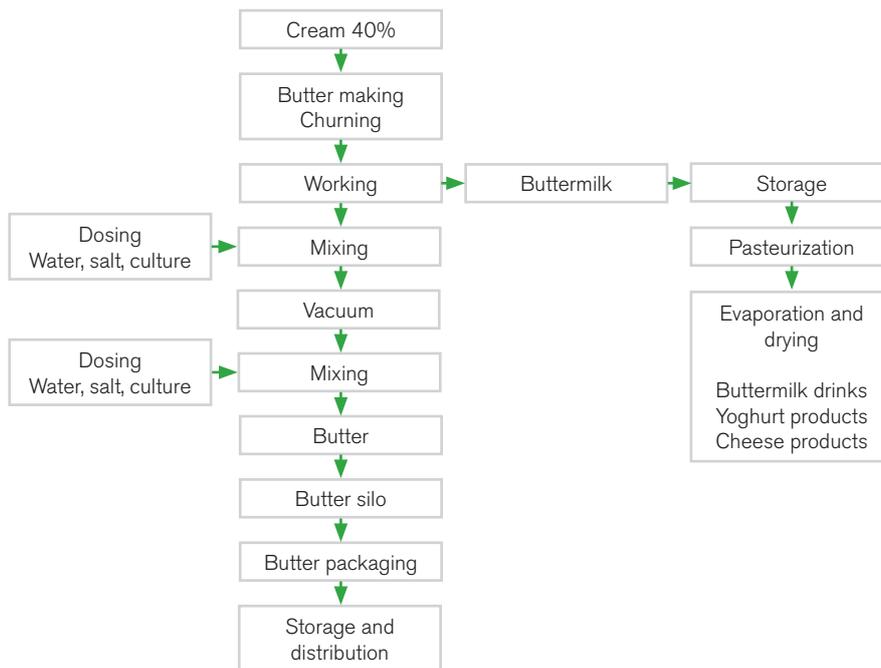


Figure 1: Butter process

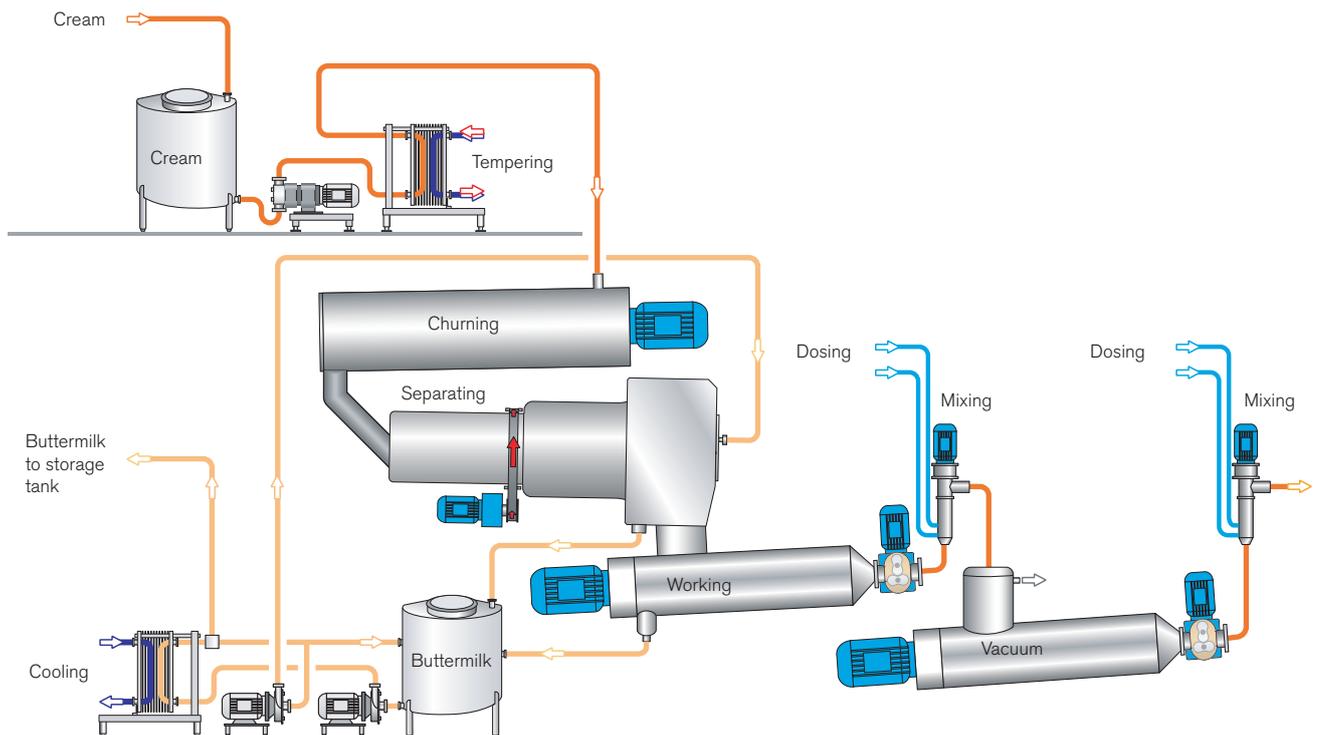


Figure 2: Principle of a butter machine

the butter. Figure 1 shows the process and figure 2 shows the principle of a butter machine.

Apart from butter yield, the consistency, moisture content including water droplet distribution and oiling out are the most important quality parameters of butter. The quality is highly affected by interrelated processing parameters during the cream treatment and the continuous butter making process. The cream can vary in fat composition depending on race and season thus in solid fat content (SFC) measured at various temperatures. The fat content of the cream can vary, and consequently, in order to be able to constantly produce butter with the same texture, the cream treatment temperature and the time of treatment will change correspondingly. In the continuous butter maker the speed of the churning cylinder where the butter granules are formed can be varied as well as the speed of the kneading and mixing units. To improve the butter quality, the system is equipped with a vacuum section in which the incorporated air is removed. Removal of air from the butter will improve the texture of the butter and increase the shelf life due to less oxidation and risk of free moisture. A denser product will also improve the efficiency at the packaging machine. Thus optimal butter quality is achieved when the numerous interrelating processing parameters have been correctly adjusted, which is the art of butter making.

BUTTER PRODUCTS

The traditional process as described above is suitable for the production of butter and butter spreads with fat content between 60 and 84% but shows limitations in respect to the production of low fat versions. However, processes which combine the traditional continuous butter making process and SSHE technology are available for the production of low fat butter products. Low fat butter tends to have a rather firm structure and lacks the nice plastic structure of traditional butter no matter which production method is used, but by adding a specific proportion of a lower melting fraction of butter oil or liquid vegetable oil a suitable fat blend is achieved for a plastic low fat butter blend. It is generally accepted that SSHE technology is the most suitable production method for low fat butter blends.

RECOMBINED BUTTER PROCESS

When producing recombined butter products, the SSHE process or margarine technology is used. The butter, butter oil (or anhydrous milk fat - AMF) or a mix of these is melted. When only butter oil is used as basis for the fat phase a suitable water phase, typically a milk phase, is added following the addition of emulsifier to the melted fat in order to form an emulsion. The emulsion is pasteurized and by the high pressure pump

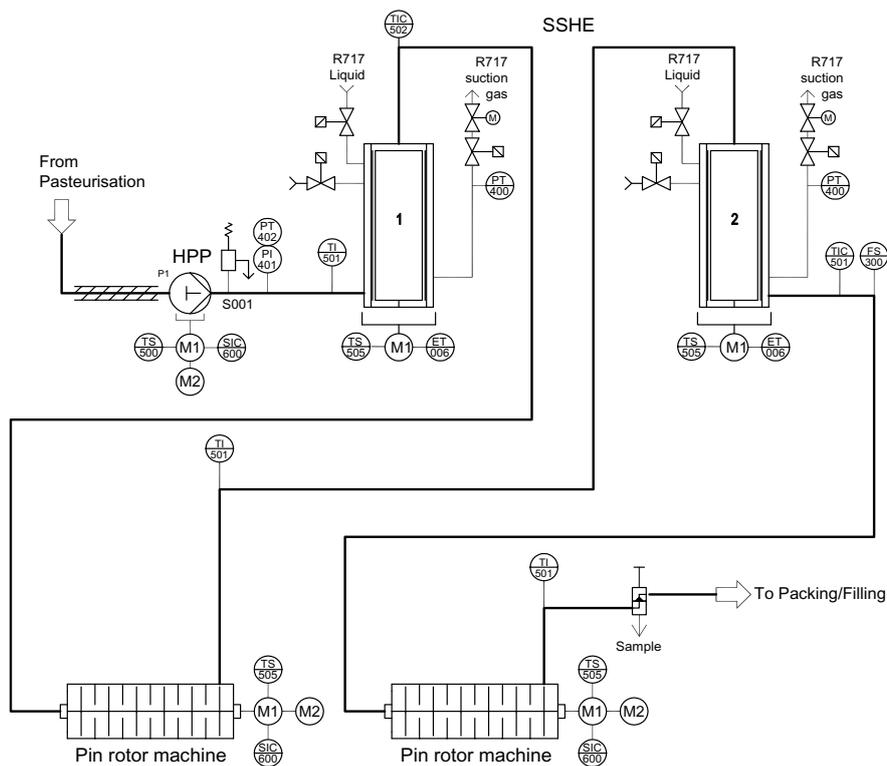


Figure 3: Process for recombined butter by SSHE technology

transferred to the SSHE for crystallization and kneading in the pin rotor machine as shown in figure 3. The butter is either wrapped in foil or paper, or filled in cup or in bulk as bag-in-box. Processing guidelines for the production of recombined butter exist and are well documented. The plastic texture of the produced butter is almost similar to that of the butter made by the traditional butter making process. However, by decreasing the flow through the line, a plastic and relatively firm butter product can be made suitable for the roll-in puff pastry application.

BUTTER BLENDS

The group of products called butter blends typically covers spreadable butter products. The SFC profile of butter is changed by adding a lower melting fraction of butter oil or vegetable oil in order to achieve a softer SFC profile. Hereby the final product is softer at low temperatures, which results in easy spreadability directly from the refrigerator. The fat content of butter blends ranges from very low fat versions with 20-25% fat content to full fat blends with 80-82% fat content. Products known on the Scandinavian market as Kærgården and Bregott are examples of high fat butter blends produced by traditional butter making process where liquid vegetable oil is added to the process in the ratio 20 parts liquid oil to 80 parts butter fat of the total 80% fat product. Other similar products on the market in Europe are Bakkedal and Lurpak Spreadable. The fat phase for these products consists of butter fat, unhydrogenated fat and liquid oil, thus these products are slightly firmer than the products only consisting of butter oil and liquid oil. The high fat butter blends produced by the traditional butter making process exhibit a softer texture than traditional butter but have the appearance of butter. When butter blends are produced by SSHE technology attention should be paid to the intensity of mechanical treatment added during processing as too much will result in a shiny, oily surface and softer texture.

PILOT TRIALS

Several trials have successfully been conducted in a GS Perfector pilot plant where cream of 38% or 50% fat content was used to produce butter blend spreads of 60%, 50% and 44% fat content. The recipes can be viewed below in table 1 and are interesting as no stabilizers or emulsifiers are added to

ensure good stability of the emulsion. The products only consist of cream, vegetable oil, salt and flavor.

RECIPES	60%	50%	44%
38% CREAM	-	80 PARTS	90 PARTS
50% CREAM	80 PARTS	-	-
LIQUID OIL	20 PARTS	20 PARTS	10 PARTS



GS butter mixer type BMX

The process is based on SSHE technology combined with a high shear mixer type BMX designed for the addition of liquid oil or other liquid phases to butter when this is produced by the traditional butter making process. The design of the BMX has proven to be suitable for the phase inversion as the initial emulsion is of the O/W type and is inverted over the mixer to a stable W/O.

The quality of the spreads after 24 hours' storage at 5°C showed a plastic texture with good spreadability and nice flavor release. Only the samples of 44% spread all showed free water when spread and a relatively harder and brittle texture than the 60% and 50% spreads. The SFC profile for the 44% spread differs due to less liquid oil in the fat phase, thus shows higher SFC values at 10-40°C than the two other products. Often lower fat spreads which exhibit a nice, fast flavor release show tendency to free water when spread on bread, however, the samples apart from the 44% product all showed relatively good stability. There is a correlation between fast flavor release and stability. A fast flavor release is often a result of an open structure in the emulsion and a slow flavor release is a result of a tight emulsion. Thus the individual spread producer can control the stability of the final spread not only by changing the recipe of the spread but also by altering the processing parameters.

FINAL REMARKS

With the Gerstenberg Schröder brand SPX Flow Technology covers all aspects of butter processing equipment, technology and service support on new and existing processing lines. The service support also covers optimization of current processes to improve production efficiency and to reduce product loss. In addition, we offer consulting and engineering support when implementing new processes.



Table 1: Recipes for various butter blend spreads



ABOUT SPX

Based in Charlotte, North Carolina, SPX Corporation (NYSE: SPW) is a global Fortune 500 multi-industry manufacturing leader. For more information, please visit www.spx.com.

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