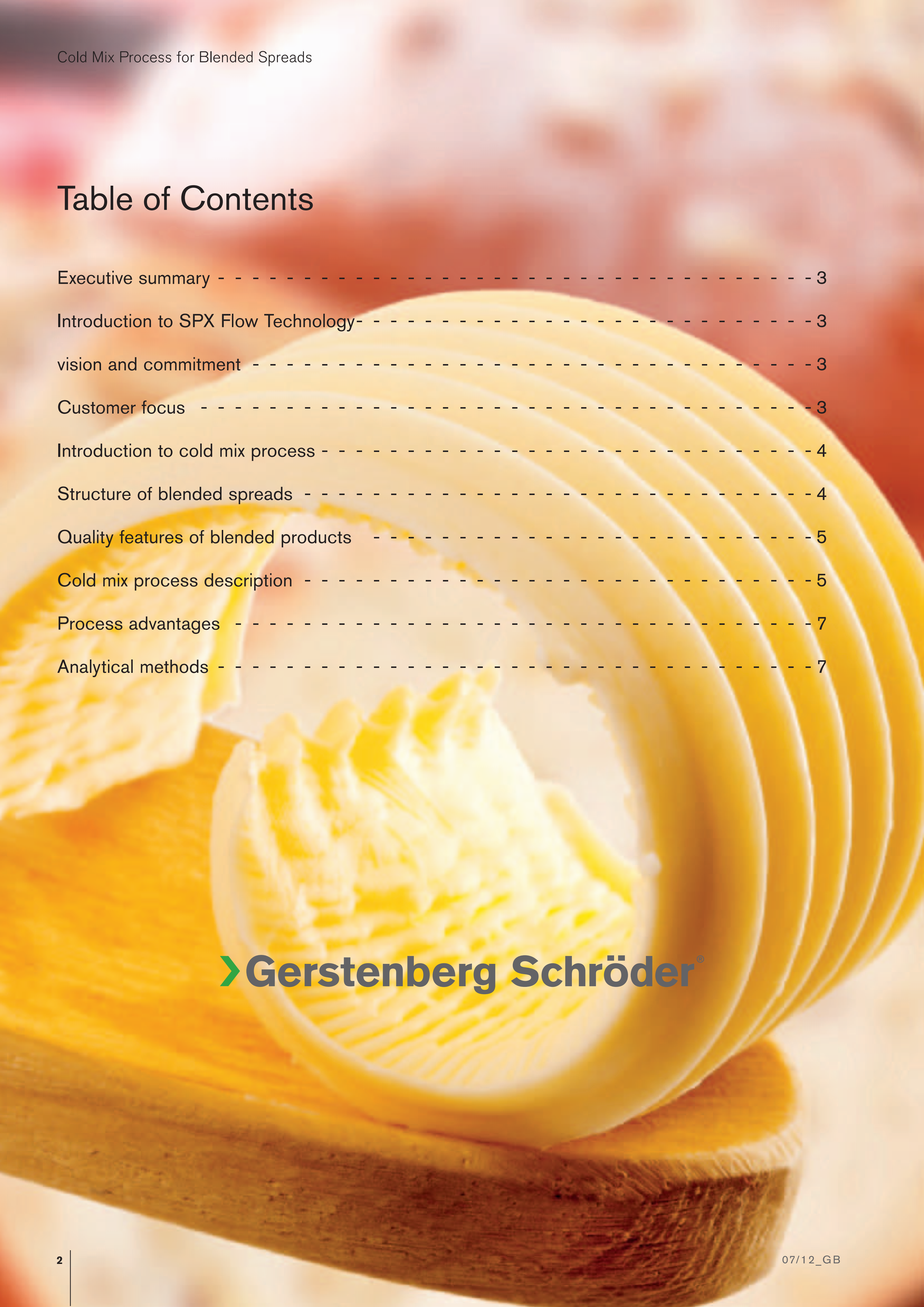
SPX®

Cold Mix Process for Blended Spreads

White Paper



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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.

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

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.

INTRODUCTION TO COLD MIX PROCESS

Different processes exist for production of spreads containing butterfat, named blended spreads. Blended spreads can be either full fat, reduced fat or low fat products and are defined as all spreads containing 15-80% milk fat. Full fat butter blends are traditionally produced batch-wise in a churn or via a continuous process in a butter making machine. In this article we will refer to these processes as products manufactured in churns. Another option is to produce blended spreads on scraped surface heat exchanger (SSHE) equipment. To come as close as possible to the sensoric properties of butter, most blended spreads are made as water-in-oil emulsions.

The butter crystal network is complex in structure. The network and structure formed in the churning process differ from the structure achieved when the butter is crystallized using the Gerstenberg Schröder (GS) SSHE technology, like Consistator®, Nexus, Kombinator or Perfector. Churned butter is characterized by exhibiting an extraordinarily plastic structure. A similar but often firmer structure can be achieved in an SSHE plant if optimal or alternative processing is implemented. E.g. it has been reported that products prepared by mixing and rapid cooling have better stability than those prepared by churning. Furthermore, it has been shown that partial or full injection of vegetable oil after the first cooling section results in blends which are softer than those manufactured by incorporating the oil in the emulsion before processing.

A combination of the two processes has been of interest to manufacturers due to the possible improved quality and stability of the blended spread products. This combination is possible with the GS technology. We call it the „Cold Mix Process“, because in this process unmelted butter is mixed with other phases in order to obtain a blended spread.

When producing blended spreads by the cold mix process, the structure of the churned butter is maintained but softened by addition of liquid oil and intensive mixing. The process also offers extensive possibilities with regard to addition of other ingredients that can be difficult or undesirable to add into the emulsion when traditional production methods are used.

STRUCTURE OF BLENDED SPREADS

When blended spreads are produced in a churn, fat globules which are intact and partly intact are created, whereas products manufactured with GS Nexus, Kombinator or Perfector technology contain no fat globules.

In the churn the crystallization of fat occurs in the globules and in the continuous fat phase. The crystals outside the fat globules make up a continuous network in which part of the water droplets (often with crystals attached to their surface) and damaged fat globules may participate. The network retains the liquid fat as a sponge. In the fat globules, fat crystals orientate themselves on the inner side of the membrane in concentric layers, which results in firmer products.

It is mainly crystallization in the continuous phase that seems to influence the consistency of the blended spread. This means that it is not necessarily the amount of crystallized fat at a given

SSHE units from the GS brand: GS Nexus and GS Consistator® MD

temperature that determines the rigidity of the product, but more where the crystallization takes place. When equally firm products manufactured by churn and by GS Nexus, Kombinator or Perfector technology are compared, products manufactured in a churn will then generally contain more solid fat at a given temperature than products produced with SSHE equipment. It appears that blended spreads produced by a GS Nexus, a GS Kombinator or a GS Perfector are composed of a continuous network structure of fat crystals or fat crystal aggregates. In contrast, blended spreads produced in a churn have a much more discontinuous structure, containing fat globules which do not interact with the rest of the matrix or only to a limited extent.

QUALITY FEATURES OF BLENDED PRODUCTS

The desired characteristics of blended spreads produced with the cold mix process are the same as for products produced in a butter churn or by traditional SSHE technology. These include a smooth consistency and appearance, good spreadability, clear and fast flavor release and a nice cooling and melting sensation in the mouth. To achieve this, appropriate crystallization and addition of a sufficient amount of mechanical work during processing are necessary.

The consistency and characteristics of butter products can be modified by adding liquid oil and/or vegetable fat as well as different functional ingredients to the fat and water phases.

In addition, the SSHE technology makes it possible to produce blended spreads with a very low fat content, which is not possible with the churn process, but still it can be difficult to create a real competitor to traditional 80% blended spreads in terms of taste, consistency and stability. However, 80% blended spreads manufactured by the cold mix process show comparable results when compared to churned products.

With low fat products it is necessary to strike the balance between stability and mouth-feel, which can be affected both by the composition and by the processing method. Some of the most important factors to have in mind are the composition of the fat blend, the type and use of emulsifier, the composition of the water phase, the stability of the pre-emulsion (in emulsion tank), the crystallization of emulsion and the mechanical treatment (kneading). Furthermore, storage conditions are important and storage should be at low temperature without fluctuations in the temperature, as the latter can have a negative impact on the products and their shelf-life.

GS butter mixer type BMX

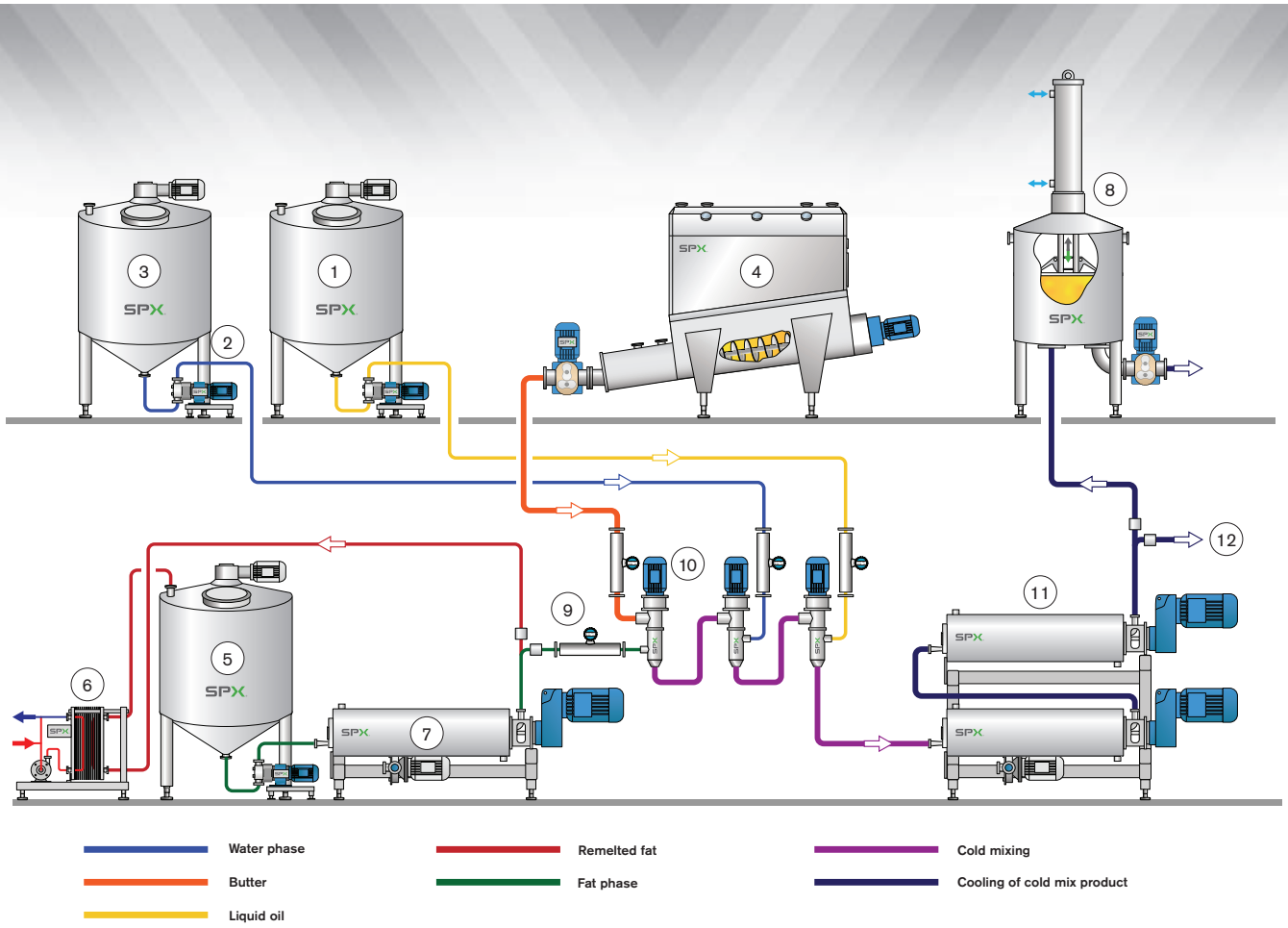
COLD MIX PROCESS DESCRIPTION

The process for continuous production of blended spreads mainly consists of the following modules:

1. Liquid oil tank
2. Displacement pump
3. Water phase preparation
4. Butter silo
5. Solid vegetable phase
6. Plate heat exchanger
7. Crystallization unit - Consistator® MD
8. Butter silo
9. Dosing system
10. Dynamic butter mixers type BMX
11. Cooling units - Consistator® MD
12. Filling of finished products

Depending on the product formulation, two to four different products are pumped to the butter mixer type BMX for mixing. Examples:

- Solid vegetable fat phase
- Liquid oil
- Water phase



The below table shows some examples of recipes for blended butter mix products. The softness is a function of the recipe and the processing parameters, thus a softer or harder version can be obtained by adding more or less liquid oil, respectively.

	80% PRODUCT	80% PRODUCT	80% PRODUCT	80% PRODUCT
BUTTER	60 PARTS	49 PARTS	38 PARTS	37 PARTS
LIQUID OIL	30 PARTS	20 PARTS	20 PARTS	10 PARTS
SOLID FAT BLEND	-	20 PARTS	30 PARTS	33 PARTS
WATER PHASE	10 PARTS	11 PARTS	12 PARTS	20 PARTS

The water phase should have a protein content of 1.5%-2%, e.g. buttermilk could be used. For the 60% product, the viscosity of the water phase has a large influence on the final consistency of the blended butter spread. When compared to the viscosity of the water phase for the 80% product, a higher viscosity is required in order to avoid a brittle and loose structure resulting in free water at spreading. Therefore, it is recommended to add a stabilizer and/or emulsifier to the water phase when 60% product is manufactured.

Before being added to the butter mixers type BMX (10), the solid vegetable fat phase (5) is crystallized and plasticized in the GS Consistator® (7). The liquid oil (1) is added directly to the butter mixer type BMX by means of a positive displacement pump (2).

The water phase is prepared by mixing of water with the water-soluble ingredients and subsequent transferred to the buffer tank (3). Depending on the product formulation (e.g. total fat content and butter content) it is possible to incorporate one or more phases simultaneously in one line.

The churned butter is stored in the butter silo tank (4) and dosed into the butter mixer type BMX by a suitable butter pump.

In the butter mixer type BMX a temperature rise of the product will occur due to the mixing process. In order to keep the fat globules in the butter intact and hereby maintain the crystal network structure of the butter, the phases are kept at low temperatures. All phases are added to the butter mixer type BMX by a dosing system. The dosing system consists of dosing units with volumetric pumps (2), frequency inverters and mass flow meters (9) which assure accurate dosing. The flow parameters are defined in the recipe.

After incorporation and cold mixing of the phases in the butter mixer type BMX, the mechanical heat is removed by cooling in

the Consistator® (11). If the filling line has a short production stop, the finished product is diverted to a butter silo of sufficient capacity (8). When the filling line is running again the finished product from the tank will be dosed into the butter mixer type BMX for incorporation into the butter blend just produced. If a longer production stop is necessary, the line is simply stopped by turning off the cooling on the Consistator® and the power for the pumps and the various motors. No draining or melting of the line is necessary and when the filling line is operational again, the power for the motors and the Consistator® is just switched on again.

It is recommended to submit the water phase to a heat treatment before incorporation in order to eliminate harmful bacteria. Heat treatment can be necessary if the water phase contains hot swelling starch, which often results in a high-viscous water phase. In this case the Consistator® is ideal for the application.

PROCESS ADVANTAGES

High quality products are achieved when butter blends are manufactured by the cold mix process. The consistency of the butter blends is similar to that of butter when compared to butter blends manufactured by traditional margarine technology. One reason could be the preservation of fat globules during the mixing process that results in products with a softer and more plastic structure.

With the modular process structure, the most flexible manufacturing process is achieved. The cold mixing process offers extensive possibilities with regard to addition of other ingredients or phases that can be difficult or undesirable to add into the emulsion when the traditional margarine process is used (e.g. due to the relatively high emulsion temperature). In addition, the stability is better for emulsions prepared by mixing and rapid cooling than those prepared by churning. The cold mixing process is especially suitable for low fat products since these products cannot be manufactured by churning.

The fully automated process ensures accurate and reproduceable product quality of different recipes. The highest hygienic standards are fulfilled and the process equipment is easy to clean by CIP.

ANALYTICAL METHODS

Various methods for analysis of the microstructure of spreads exist. These are useful tools when establishing the relation between composition, processing and final properties. Functional properties such as firmness, spreadability, mouth-feel, emulsion stability and flavour release are all linked to the product microstructure. At the SPX Innovation Center close to Copenhagen, Denmark, we have facilities for pilot plant trials as well as a broad range of new equipment for measurement of product quality, and we can therefore offer our customers assistance with the development of high quality products.

GS Nexus pilot plant for fat crystallization. The GS Nexus uses CO_2 as cooling medium.

SPX®

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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ISSUED 07/2012 GB