MILK POWDER

Outstanding solutions for milk powder production.

GEA Engineering for a better world.

GEA.com

SOLUTIONS TO SUPPORT YOUR BUSINESS.

GEA offers decades of experience as a technology partner supplying complete turnkey plants to the dairy and milk powder industries. We design and install end-to-end processing lines for all kinds of milk powder products. Our role is to use years of expertise and engineering know-how to configure the best systems for handling and processing all the ingredients in your products.

GEA's experience in designing and delivering modern dairy plants means that we can offer state-of-the-art technologies as well as process and plant optimization know-how to ensure seamless delivery of your new plant. Our solutions are designed to maximize plant flexibility and to improve traceability and overall operational efficiency. Our complete process offering means that you can be assured of the safety of the finished product, enabling you to deliver brand confidence to consumers.

Our customer relationship model provides continued support long after delivery of your new plant. With experience gained from hundreds of dairy projects we are able to continually improve plant and technology design to meet the changing needs of the industry. These benefits are passed on to you through plant upgrades, optimization projects and further training, so that your plant continues to meet your processing needs.

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MILK POWDER PROCESS.

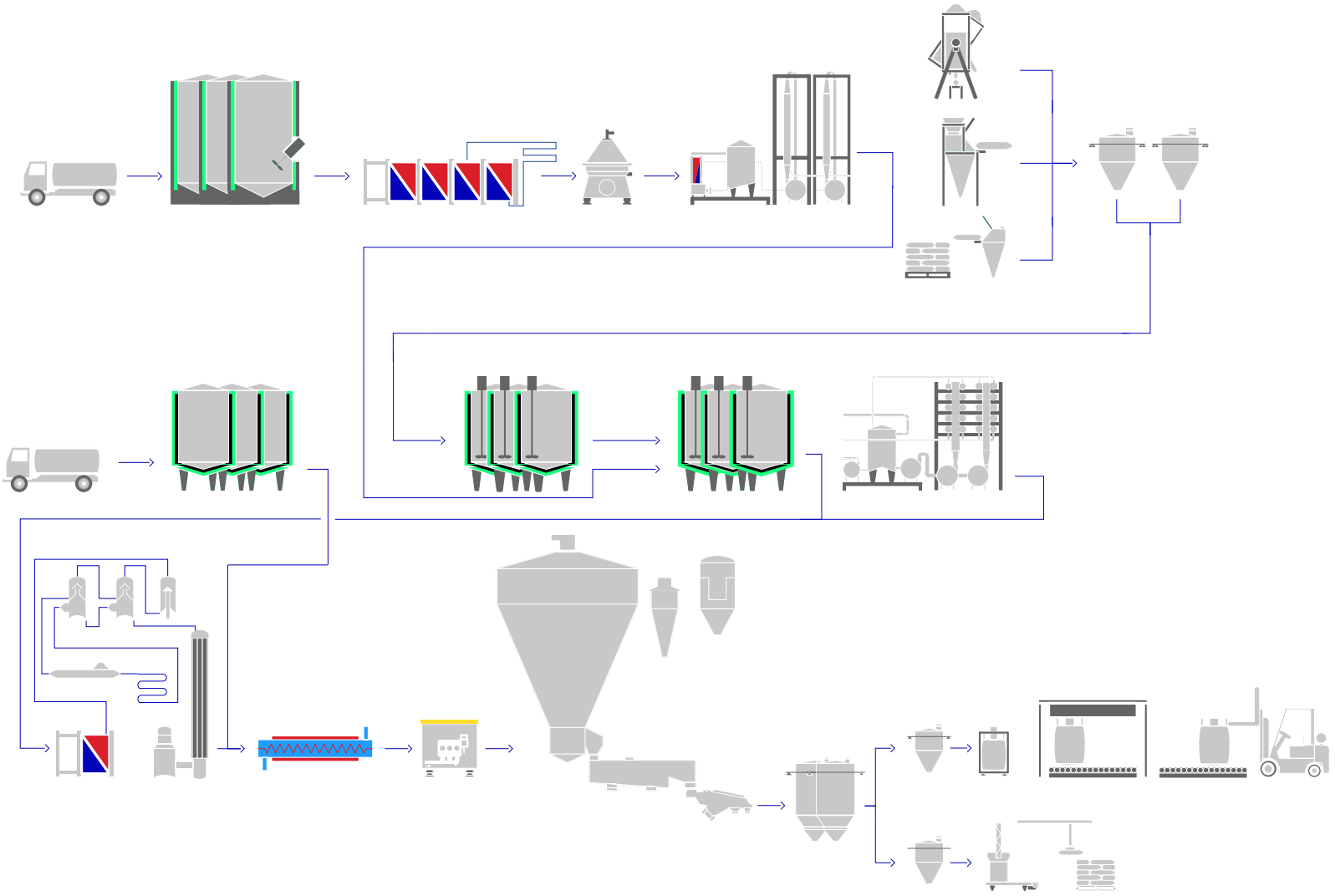
Even though milk powders are well-defined products, we recognize that every manufacturer has specific process requirements. We add value to your business by delivering application, process and plant design expertise and solutions that are tailored to your needs, and which will also meet consumer demands for final product quality.

Process design and the selection of appropriate technologies will vary, dependent upon your final products. Work with GEA and you will have the benefit of working with an experienced partner who can design a plant that is safe, flexible, and can handle every ingredient for your recipes.

As the primary ingredient for milk powders, milk is typically pasteurized after reception. The protein and fat content is also standardized according to the product recipe. Solutions of lactose, milk permeate and vegetable oil can be added prior to pasteurization, if required.
Vegetable oil can, alternatively, be added before drying. The standardized milk is heat treated according to the process specifications, and then the bulk of the water is removed using an evaporator. After evaporation the concentrated mix is spray dried to obtain a powder with defined chemical, microbiological and physical properties.

In this brochure we will briefly describe key aspects of the different sub-processes for milk powder manufacture – from raw material reception to the packaged end product – and suggest how our solutions can support your production process and help to address possible challenges. An overview of the basic production process is shown below.

TYPICAL MILK POWDER PROCESS.



RECEPTION, HANDLING, STORAGE AND TREATMENT.

Milk and liquid ingredients
The core milk ingredient is received as a liquid. Milk UF permeate that may be used for protein standardization is also commonly received in liquid form. Raw milk must undergo pasteurization and either partial or total separation of cream before it can be concentrated and dried.

During the protein standardization process either milk permeate or solubilized lactose is also added to standardize the protein content. Alternatively, fat standardization of whole milk can be achieved by adding cream in line or in tank. Cream separation can be carried out using a skimming separator, type MSE/MSI. We develop equipment that will handle milk gently so that all of its nutritional properties are retained. Our separators are designed to minimize product losses, optimize energy consumption, and maximize product quality.
Every milk powder producer must guarantee maximum hygiene and microbiological safety. To optimize the control of bacteria and spores, we offer either bacteria removal separators or ceramic microfiltration equipment, which are ideally suited to removing micro-organisms in milk, including heat resistant bacteria and spores that can survive pasteurization. Rather than just inactivate the micro-organisms our technologies physically remove bacteria and spores from the milk. This can eliminate the need for high heat treatment and thus help to improve both the nutritional value and the powder properties of the end product.

Buffer storage should generally be kept to a minimum to reduce CAPEX and OPEX. Fewer storage tanks means lower capital expenditure, and less equipment equates to reduced overall operating and maintenance costs. However, we realize that flexibility is needed for practical production, so we also offer cost-effective tank designs and valve clusters.

MSI skimming separator

RECEPTION, HANDLING, STORAGE AND TREATMENT.

Dry ingredients
Either lactose or milk permeate can be used to standardize the protein content in the final milk powder. Lactose is typically delivered to the plant as powder. To help you maintain flexibility in your plant we offer equipment that can handle powders received in different formats, such as 25 kg bag, FIBC and Rigid IBC.

The powders are emptied from their transport containers and conveyed to hoppers, or silos that are typically equipped with weight control. Powder lactose is dissolved in water before it is added to the milk during the standardization process. Transferring the dry ingredients from their transport packaging to the process line is always carried out using equipment that safeguards hygiene and product safety.
We offer dense phase vacuum conveying systems to transfer dry ingredients to the powder storage units.
Our technologies reduce dust generation during the transfer to the powder mixing and liquid blending plants.

Oil
Skim milk can be enriched by the addition of vegetable oil to replace the milk fat, although the amount of vegetable fat added may not necessarily match the total milk fat composition of whole milk powder. Oils are received in tankers and are usually pressurized with inert gas to limit oxidation – and thus off flavor – during storage. We configure oil storage tanks with a hot water jacket so that the oils can be kept above their nominal melting point, without heating too intensively. To avoid cross mixing different oils, we can either supply individual reception/dosing lines for different oil types, configure free-draining pipes, or install a pigging system. Oils can be dosed into the skim milk or milk-based ingredients at different stages in the process. The oil/milk mix should always undergo homogenization after oil has been added to the milk-based mix.

Microfiltration plant

VITAMIN HANDLING AND DOSING.

When manufacturing vitamin-enriched milk powders, the vitamins need to be prepared for inclusion in the manufacturing process. When deciding at which point the vitamins will be dosed, it is important to consider that:

- Dosing must be accurate, to ensure that the right amount has been added
- Dosing should occur at a point in the process that will allow the vitamins to undergo subsequent pasteurization, if appropriate
- The vitamins should not be negatively affected, for example by reduction or oxidation, either at dosing or during subsequent processing

Vitamins introduced into the liquid mix are normally dissolved in water prior to dosing. How the dry vitamins are handled will depend on the quantities required in the recipe.

For small amounts weighing and dosing could be carried out as manual operations, whereas larger quantities of vitamins may be handled using a semi-automatic or automatic system.

We can configure either or both types of handling solutions, according to your needs.

Bag unloading

EVAPORATION AND SPRAY DRYING.

Prior to evaporation the milk is heat treated to ensure microbiological safety. The final quality of the milk powder will be defined and classified according to the type of heat treatment used. After heat treatment the milk is concentrated as far as possible using an evaporation system, which is the most cost-effective method for removing water.

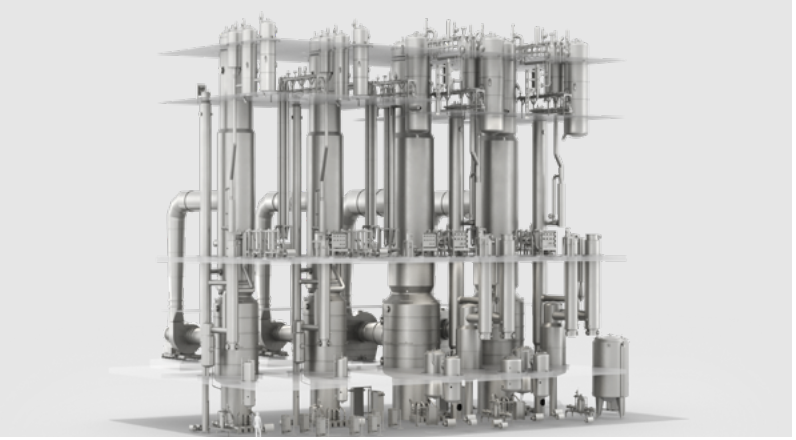
We offer both direct and indirect solutions for product heating, which can be applied for processing product mixes with different characteristics, at specified temperatures, and with defined results for bacterial control. The optimum solution will often involve a combination of indirect and direct heating.

Technologies used may include our low thermophile system or a UHT plant, direct steam injection, or steam infusion. We also recognize that your choice of evaporation system will depend on multiple product, plant and process-related considerations, including energy source and energy price, functionality, and flexibility.

GEA engineers will work with you to configure the most appropriate heat treatment system that is easy to control, flexible and convenient, and which takes into account your processes, running times and demands on the quality of the end product. We offer a wide range of solutions and will work with you to configure an evaporation system that meets your specific requirements.
All of our solutions have been designed to offer optimum hygiene and product safety, and to minimize energy consumption through the use of energy-efficient technologies and energy recovery functionality. All of our falling film evaporators are equipped with a liquid distributor, which utilizes the best hygienic design.

After evaporation, the concentrate moves via small buffer tanks to the spray dryer feed line. GEA spray dryers for milk powder are often equipped with two or more feed lines so that the dryer can remain in operation 24/7. Each of the feed lines can be cleaned individually without stopping the dryer.

Dairy evaporator for milk powder



EVAPORATION AND SPRAY DRYING.

This not only maximizes dryer utility, but also reduces the risk of scaling. The addition of vegetable oil to the milk concentrate it is typically done in the spray dryer feed line.

Each feed line includes a GEA TCM heater to preheat the concentrate. A high pressure pump generates exactly the correct pressure required for the atomization nozzles, to ensure optimized atomization. Typically, the high pressure pump is equipped with homogenizing valves, which carry out homogenization of fat/oil-containing products such as whole milk or fat-filled milk. Our high pressure pumps and homogenizers are recognized worldwide for their performance and reliability.

Spray drying is a critical stage in producing a consistent and stable powder structure and ideal density. All spray drying technology from GEA is designed to give you the assurance of optimum powder quality, consistency and stability, every batch.
Our spray dryers are equipped with air dispersers that ensure optimal air flow in the chamber and so maximize contact between the milk powder particles and drying air, which helps to prevent the wet particles from reaching the chamber wall.

We can size the spray drying chamber to match the required capacity, and tailor the equipment according to the type of atomization and the product to be dried. A typical choice for milk powder products is the MSD® chamber, which is equipped with a DDD® air disperser, a static, integrated fluid bed in the bottom and an air exhaust at the top of the chamber.

Dryer exhaust system

EVAPORATION AND SPRAY DRYING.

This configuration aids agglomeration, which is a key property that determines wettability and solubility of the final powder. Our systems can also be configured for producing non-agglomerated powders. As the atomization and agglomeration processes are key to final product quality and safety we also offer the SPRAYEYE® camera system to improve surveillance.

Where appropriate, spray dryers for milk powders may be equipped with cyclones to separate the powder fines from the chamber/fluid bed exhaust air. Our SANICIP® bag filters are often used after the cyclones to recover remaining powder fines and thus help to meet environmental goals.

The SANICIP® bag filter can also be used without cyclones. After drying, the powder is cooled in the VIBRO-FLUIDIZER® external fluid bed, and is then sifted using a vibrating sifter.

All our evaporators and spray dryers are designed with a focus on performance, maintenance and hygiene, and can be cleaned using CIP nozzle systems.

High pressure homogenizer

POWDER STORAGE, MIXING AND PRE-GASSING.

Prior to packing into containers a hopper and vacuum receiver system is used to remove oxygen (pre-gassing) and replace the atmosphere with nitrogen, which ensures a low residual oxygen level.

By removing oxygen the product becomes more shelf-stable and the flavor is preserved over a longer time – up to two years in some cases.

This is relevant when the product contains fat/oil, for example, whole milk powder or fat-filled skim milk powder.

Benefits:

- Flexible handling of tipped ingredients in bulk or small package format
- Monitoring of batch size during mixing to ensure accurate final composition
- Minimization of interstitial air in the powder to increase shelf life and stability and preserve flavor profile
- Gentle conveying to prevent breakdown of agglomerated powder prior to packing

Pre-gassing system for modified atmosphere powder packing lines (MAP)

POWDER HANDLING, POST-GASSING AND FILLING.

Powder is pneumatically conveyed to and from powder silos or hoppers, using dense phase vacuum or positive pressure transport. Both transport modes are gentle on the powder, minimizing powder attrition, and helping to preserve the physical structure and quality of the final product.

We offer two solutions for pre-gassing, the process by which interstitial air is replaced using an inert gas prior to packing:

- Vacuum pre-gassing is carried out as part of the vacuum transport system, and pulls air out of the powder vessel until a deep vacuum is reached. Nitrogen is then added until the internal pressure inside the vessel reaches atmospheric pressure.

- Gas flushing is a continuous process, whereby powder is gravity-dosed in the vessel, and the N2 gas is percolated through the lower part of the vessel before being discharged at the same rate as the infeed of fresh powder.

Depending on your project needs, we also offer post-gassing, the process of substituting interstitial air with an inert gas after the container is filled with powder, with probes for 25 kg and bulk packaging.

Powder packing

A range of powder filling solutions are available to compliment the pre- and post-gassing technologies, so that we can provide you with an integrated solution for modified atmosphere packing (MAP). Our semi-automatic and automatic powder packing solutions cover most bulk formats.

For packing in bulk 25 kg (55 lb) bags our range of multi-wall bag/sack fillers is designed to pack powdered products at rates of 4.5 t/h to 12 t/h or more, with an accuracy of 10 g (0.35 oz) or better.

RBF-800Li (Limited Intervention) powder filling system

POWDER HANDLING, POST-GASSING AND FILLING.

Our range features a bottom-up filling system, which, compared to conventional top filling systems, minimizes air displacement and dramatically reduces dust emissions. This makes our filling equipment very clean and safe to operate. Reduced product loss through better dust control means greater product yields for you.

By adding downstream equipment, we can provide you with a complete solution for automated bag filling, conditioning and quality checking, which can be combined and matched with any manual or automated palletizing system.

HYGIENIC PLANT DESIGN FOR PRODUCT SAFETY.

Overall plant design and selection of the best equipment and components will help to ensure a reliable, durable plant that can be cleaned efficiently using CIP (clean-in-place) systems. We recognize that hygienic design extends beyond that of the individual components – it is a holistic approach to overall plant design that puts your products and operator safety first. Our technologies give you peace of mind when selecting key process components. Every component and plant is designed to meet the strictest global hygienic and aseptic standards.

Using our components you can be confident of complete and efficient cleaning and drainage. Our plants are designed to be reliable and easy to maintain, so you have the assurance that they will give you optimum performance for their complete lifespan. Because we recognize hygiene as a safety issue, our component and plant designs are based on a hygienic design, which is informed by guidance coming from global standards organizations.

Liquid processing solutions are always designed to minimize bacterial growth. To reduce the contact of product directly with hot surfaces, we have developed innovative preheaters and an advanced pasteurizer with direct steam injection. This swirl heater provides fast and efficient heating for product heat treatment prior to evaporation.
The design and operation lengthens the production run between cleaning cycles, and avoids the risk of bacterial growth, including thermophiles and their spores.

Our innovative CIP solutions also meet all critical hygiene standards to guarantee product safety at every point of the process. Tailored solutions configured to meet individual requirements ensure efficient commissioning, while also reduce your total cost of ownership, for example, by optimizing the use of water and detergents.

Seamless integration of technologies, coupled with sophisticated plant automation, safeguards trouble-free operation and maintenance to deliver solid financial benefits. Optimized plant design ensures that we can match all the parameters that characterize your process. For powder handling and packing, easy access for inspection and dry cleaning is key.

For efficient evaporator CIP we have introduced a “hydro cyclone”, which collects and discharges impurities that would otherwise block the distribution plates above the calandria during CIP. Spray dryer technology from GEA is equipped with appropriate drying air filtration and CIP facilities. All surfaces in contact with the product comply with international standards, and materials are FDA approved.

Our equipment is always designed to ensure complete drainage during CIP. GEA drying plants are constructed with smooth surfaces, are designed to avoid any hollow spaces, and are equipped with CIP nozzles whenever appropriate.

ENGINEERING AND PROJECT MANAGEMENT.

We understand that delivering high-value projects requires careful planning and financial control so that key business objectives can be achieved.

We know how important it is to accomplish every deliverable, on time, and to meet all your quality expectations. A contract with us gives you the assurance of a dedicated project manager, who will work with you every step of the way.

We combine core technologies with extensive process knowhow to deliver tailored solutions across all product applications.

Your GEA project team will include experienced engineers who can configure the best design for your plant.

We will configure and tailor the optimum solutions for the core process, but also focus on making your plant environmentally sustainable, using advanced technologies that can help to reduce resource consumption and recover heat and water.

And of course, your project manager will make sure that installation and commissioning are as smooth and seamless as possible. From plant upgrades to complete large-scale green field process plants, we employ strong project, financial and resource management to ensure you get world-class solutions.

AUTOMATION.

Reliable automation systems are vital to ensure optimum process performance. We appreciate that every customer will have specific requirements, so we tailor individual automation solutions that combine proven hardware from selected suppliers with GEA Codex® software modules.
Partner with us and we can design an automation solution that will be optimized for your needs, all supplied from a single source.

Benefits for your plant will include:
- Local and centralized plant monitoring and control, as well as mobile access
- High performance human machine interface (HMI) systems based on the ISA101 standard with consistently themed, user-friendly dashboards and screens to simplify user interaction
- Recipe management, including production order handling
- Process optimization and standardization
- Process repeatability with minimal variation
- Improved plant, product and operator safety
- Product traceability
- Connection to your ERP system

By employing big data, machine learning, and advanced algorithms, our solutions can help to unlock the full potential of your production lines.

Your benefits
- Stability in operation
- Ease of planning
  - Consistent product quality
- Plant operation at maximum capacity and efficiency, with compensation for:
  - Operator skills
  - Weather
  - Feed quality
- Transparent relationship between plant operating conditions and economic output

GEA OptiPartner is one of our optimization solutions for spray dryers. You know that even the smallest deviation in quality and consistency during the drying process can lead to downstream problems, to rejected product or loss of production time. We have developed OptiPartner to help minimize these deviations, to give you precise control of residual moisture in the final powder and to optimize drying conditions in the spray dryer.

Using GEA OptiPartner you can maximize the spray dryer's capacity and increase yield while precisely regulating moisture content in the final powder.
Complementing GEA OptiPartner is our POWDEREYE® instrument, which issues out-of-specification warnings to the operator, so corrective action can be taken and costly out-of-specification production avoided.

Installed after the last drying stage, POWDEREYE® gives you key information so that you can fine-tune your process parameters. The POWDEREYE® technology measures at operator-defined intervals:

- Residual moisture in the powder
- Scorched particles (using high resolution imaging)
- Bulk density
- Tapped density

SUSTAINABLE ENERGY SOLUTIONS.

Most of the energy consumed by dairy process systems is used to meet precise cooling and heating requirements. These systems can offer a key opportunity for cost reduction. Our expertise extends to identifying every energy-saving and energy-management opportunity.

We provide measurable, innovative solutions with short payback times, which are aimed at reducing both total cost of ownership and carbon footprint. For example, our heat pump technology upcycles byproducts of the processing chain, including waste heat, back into the production cycle.

Your benefits

- Reduced expenses
- Smaller carbon footprint
- Achievement of sustainability goals
- Decrease in use of natural resources and lower
- CO2 emissions, which helps protect the planet

Engineering for a better world.

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