

# FOOD INGREDIENTS

Solutions for food ingredients processing



# Technologies for a world of food ingredients

GEA offers decades of experience as a technology partner supplying solutions for food ingredients processing.

## Our expertise

GEA has supplied state-of-the-art processing solutions to the global food ingredients industry for more than 50 years. Our portfolio of technologies range from basic units to very sophisticated plants, all designed to meet your exact needs.

We combine years of expertise and engineering know-how to configure the best, reliable systems for your food ingredients products. Our solutions are designed to maximize plant flexibility and overall efficiency, while ensuring repeatable processing and high product quality.



## Standalone units and integrated solutions

GEA expertise spans every stage of processing, from ingredients reception and bulk handling, to liquid and powder processing, control and automation systems, and packaging lines. We offer key components, standalone technologies and integrated solutions for a wide range of food ingredients.

Our industry and technical experts, and project managers will work with you at every stage of your project, from initial consulting through to installation and commissioning. Whatever the complexity or scale of your process line or plant, our goal is to deliver the right solution that will give you reliable and robust operation throughout the entire lifecycle of the plant and its equipment.

# Application overview

The right process for your product With our portfolio of technologies, and our process and application knowledge, we can help you to make the most of new opportunities across a broad spectrum of food ingredients applications.



## Starch & starch derivatives

GEA configures technologies for the efficient processing of starches, their derivatives and byproducts.

- Starch & modified starch
- Sweeteners
- Maltodextrins
- Oligosaccharides



## Proteins

We help you to develop repeatable processes for producing free-flowing and dust-free protein powders with tailored particle size distribution and excellent dispersibility attributes.

- Vegetable proteins
- Hydrolyzed fish & animal proteins
- Other proteins



## Texturants & emulsifiers

GEA offers key expertise and technologies for the concentration and solidification of a wide range of texturizers and emulsifiers, including oils, waxes, fatty acid-derived mono- and diglycerides.

- Gelatin
- Gum arabic
- Pectin
- Microcrystalline cellulose
- Ethyl cellulose



## Co-products from the food ingredients industry

The ability to process co-products represents a great opportunity to generate added value products, while optimizing industrial manufacturing processes and potentially enable zero waste. GEA offers key expertise and technologies for creating value products. Take a look at our portfolio spanning centrifugal separation, filtration, evaporation, crystallization and drying.



### Flavors

We can work with you to define solutions that could help to improve yield and optimize quality and stability of your final powdered flavors.

- Sweet flavors
- Savory flavors
- Extracts & powders



### Nutrients & colors

Our drying technologies provide controlled drying conditions for producing high quality, consistent powders.

- Dietary fibers
- Vitamin C
- Extracts & powders



### Non-dairy creamer

GEA mixing and drying technologies have been developed to gently and reliably handle the most challenging of non-dairy creamers, including those with very high oil content.



### Fermentation-derived ingredients

We can tailor versatile, hygienic lines for manufacturing almost any type of fermentation-derived food ingredient.

- Probiotics
- Cultures
- Enzymes
- Algae
- Starter cultures



### Pet food ingredients

As a recognized provider of technologies for pet food ingredients and flavors, we offer systems that are constructed to the same quality as our food plant solutions, and which are designed to help maintain organoleptic properties and stability.

- Pet food ingredients & flavors
- Freeze dried pet food

# Solutions for food ingredients manufacturing

## GEA process design and plant integration

We can supply preconfigured, standalone equipment and technologies or tailor, deliver and install integrated processing lines that match your plant infrastructure. We recognize that every manufacturer has specific process requirements, so we partner with you to tailor optimized solutions that take into account key requirements for product quality, production capacity and level of automation. GEA experts will be with you through every stage of plant design, construction and engineering, starting at inception, design and equipment purchase, through to installation, commissioning and hand-over.

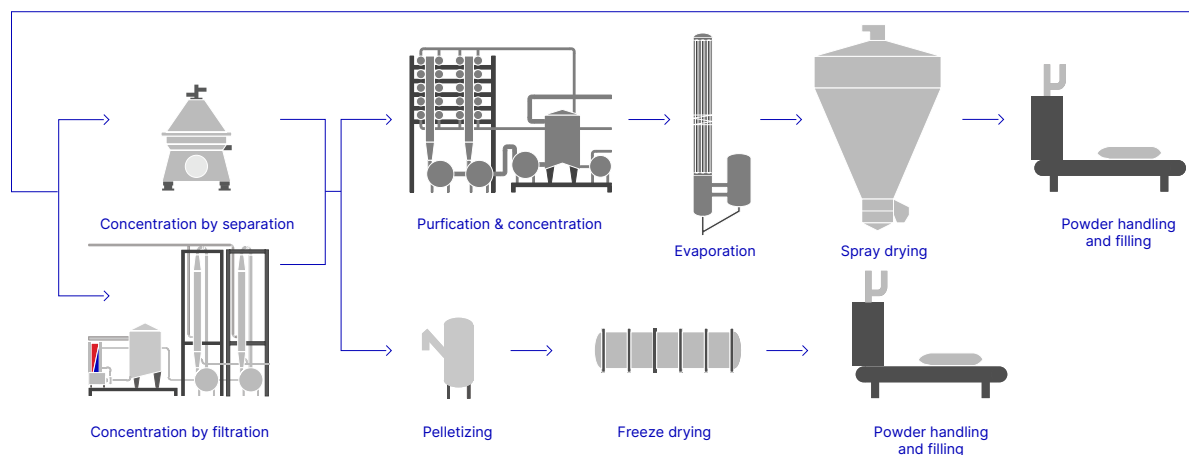
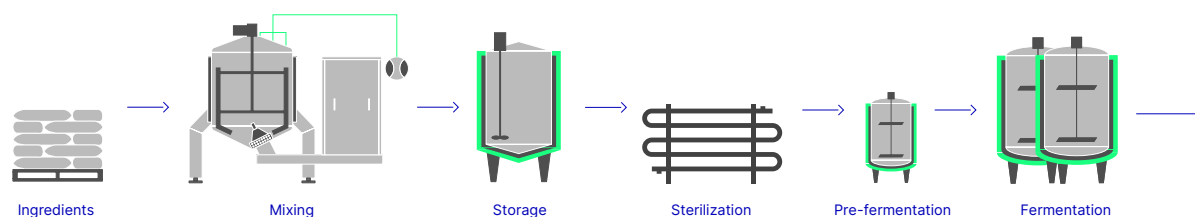
## Hygienic design and product safety

The GEA heritage includes more than 50 years' experience developing hygienic equipment for aseptic processes and microbiological safety. Our systems are constructed using the highest quality materials, and are designed to minimize the risks of contamination or carry-over. Smart clean-in-place plants mean less manual cleaning and downtime, and so reduced use of water, energy and cleaning agents.

## Training and support

GEA offers training and support, so that you can be confident that all of your equipment and process lines offer optimum throughput and reliability for the entire lifecycle of the plant. Partner with GEA and you have the security of expert support from day one, with options for flexible service, maintenance and upgrade packages.

## Example of a GEA process line



# Technology overview

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# Mixing

Faultless mixing is an essential stage for processing free-flowing, homogeneous food ingredients.

## Rethinking mixing technology

Achieving a smooth, consistent mix without lumps or fish eyes, and in the shortest possible timeframe, is a key goal for food ingredient processing. Reliable, reproducible mixing reduces waste and costs, and improves final product quality. Optimized mixing helps to safeguard final product stability and so shelf life, for both liquid and powdered final products.

To help meet these expectations GEA has developed the BATCH FORMULA® Mixer, as a state-of-the-art rethink on traditional mixing technology. Our energy-efficient system incorporates a high shear mixer that helps you to achieve homogeneous mixes fast and efficiently.

The BATCH FORMULA® Mixer doses dry ingredients into the liquid by means of vacuum. Powders are introduced below the liquid surface, which ensures instantaneous wetting and solubilization, and reduces foaming and incorporation of air.

## Multiple benefits

The highly versatile BATCH FORMULA® Mixer can be configured for mixing and cooking a wide range of products, and incorporates a heating and cooling jacket, as well as the option for direct steam injection, flash cooling and/or evaporation by vacuum. The use of vacuum helps to avoid product oxidation, and removes the need to use nitrogen. The system in addition features an agitator for blending fragile ingredients. Precisely controlled operating conditions help to ensure consistent, worry-free processing.

## Applications

- Flavors
- Vegetable proteins
- Fermentation-derived ingredients
- Non-dairy creamer
- Emulsions



GEA BATCH FORMULA® Mixer

Benefits for customers include increased production capacity and operational efficiency. The one-pot design allows for lower product losses/waste, saves time and decreases energy use all of which can contribute to improved profits, reduced environmental impact and faster return on investment.

#### **Test mixer for process development**

The BATCH FORMULA® Test Mixer from GEA lets you optimize specific production processes on a small scale before investing in a commercial production plant. Small-scale testing can clarify important timings and process parameters, including when to add ingredients, the temperature profile and run times. Optimizing key parameters can expedite scale-up and process development. The BATCH FORMULA® Test Mixer has a 25% smaller footprint than the industrial-scale technology, but is just as hygienic, flexible and efficient.

#### **GEA Homogenizers**

GEA has also developed a portfolio of versatile high-pressure homogenizers for either batch or continuous processes. A range of hygienic machines and configurations is available, including aseptic design options for specific applications.





# Heat treatment and pasteurization

Food ingredients manufacturing processes should guarantee microbiological safety, whatever the recipe, product type or process.



GEA heat treatment plant

## Versatile heat treatment options

Heat treatment may be required for processes such as enzyme deactivation, to sterilize media prior to fermentation, or just for carrying out a pasteurization or sterilization test. GEA offers a number of heat treatment methods that can be tailored to best suit your business and plant operation. Our range includes flexible, convenient UHT plants that utilize heat exchange, direct steam injection or steam infusion sterilization methods.

The GEA VARITUBE® heat exchangers are at the heart of our modular indirect sterilization units, which can be tailored to match your immediate requirements, and easily reconfigured to accommodate changes in your capacity, throughput and/or processing parameters.

We also offer sterilization systems that use steam injection or steam infusion heating. Both are direct heating systems, but whereas steam injection introduces steam directly into the product, steam infusion introduces the product into a steam atmosphere. Both methods heat the product rapidly, and require short retention times compared with indirect heating. The GEA infusion technology is a more gentle process, which helps to achieve a better product quality.

## Configured to your requirements

All of the sterilization options offered by GEA have been developed to enable full, precise control of the sterilization process. This means that holding times and temperatures can be selected to match process, product and regulatory requirements.

Our heat treatment systems are energy efficient and can be tailored to best suit plant operation, product specifications and operating requirements.

## Applications

- Fermentation-derived ingredients, e.g. cultures, probiotics, enzymes and algae
- Vegetable proteins
- Hydrolyzed fish & animal proteins
- Coconut water

# Fermentation

Manufacturers can carry out controlled fermentation of micro-organisms to create a wide range of food ingredient products, from bioengineered flavors and leavening agents, to probiotics, cultures and yeast products.

## The GEA advantage

GEA has harnessed decades of process and industry expertise to develop batch, fed-batch and continuous fermentation systems for global customers in the food ingredients sector. Our systems monitor all fermentation parameters throughout the process, from pH, pO<sub>2</sub> and temperature, to agitator speed and weight. Constructed from high-grade stainless steel, our fermenters are designed without dead spots, to help ensure complete sterility during medium or nutrient change and addition, aseptic sampling, aeration, venting or transfer.

## Keeping you in control

Our fermentation solutions give you control of your processes, so you can optimize conditions to boost output without impacting on quality, and where possible save on resources. The stirring device in our design optimizes oxygen transfer rates allowing optimal cell health and growth at maximal densities.

GEA solutions for continuous fermentation allow you to maximize feed and harvest rates, but at the same time reduce the requirement for cleaning.

We can also configure prefermenter units into your process for preparing seed cultures. This additional stage can help to reduce lag phase delays when introducing micro-organisms into a growth medium. Fully automated cleaning- and sterilization-in place plants further reduce downtime and the need for manual cleaning, and so help to cut delays and bottlenecks.

Full GMP documentation can, of course, be provided. We understand your need for full process transparency as part of regulatory compliance, so we have developed safe, secure process control software that ensures end-to-end capture and validation of input, conversion and output data, for every fermentation batch.

## Applications

- Probiotics
- Cultures
- Algae
- Yeast products



GEA fermentation tanks

# Centrifugal separation

Food ingredient manufacturers rely on versatile solutions that can switch between products quickly and adapt to scale and throughput.

GEA offers a comprehensive range of robust, versatile centrifuges for separating, purifying and concentrating a wide range of ingredients and products, from algae, animal and vegetable proteins, to starch, baker's yeast or lysine. We understand your challenges and the need to secure optimum yield and quality from valuable raw materials and innovative new processes, so our experts can tailor complete process lines and process know-how for wet separation. We can also give you the option to carry out test runs and validation trials, and will partner with you to develop separation solutions that will let you tap into new resources, such as insect processing.

GEA centrifuges are built for high separation efficiency and feature sophisticated drive systems that save on energy use.

Our industry-leading hygienic designs, and options for efficient cleaning-in-place (CIP) plants mean that all GEA units meet the most stringent requirements for safe food processing.

## Applications

- Starch & starch derivatives
- Fermentation-derived ingredients
- Vegetable proteins
- Hydrolyzed fish & animal proteins



GEA decenter centrifuge



GEA centrifugal separator

# Crystallization

The ability to control crystallization - whether that means inducing or preventing crystal formation - can impact on key characteristics of many types of food ingredient.



DTB crystallizer

GEA expertise encompasses all of the key types of crystallizer, including forced circulation (FC), and draft-tube-baffle (DTB) systems that are most commonly used in food ingredient processing. Our crystallizers remove solvent by evaporation, which increases the level of supersaturation in the process liquor and promotes crystal formation. The process is carried out under vacuum or slightly over atmospheric pressure. The evaporated solvent is condensed and removed, leaving the required crystals behind.

GEA engineers have designed and commissioned more than 1,500 plants, and can configure solutions to match your expectations for product purity, morphology and crystal size. All of our technologies are engineered to for reliable, robust operation, and to reduce energy and resource use wherever possible.

Experts at GEA R&D laboratories work with the design team to configure even the most complex crystallization system according to parameters including solubility, viscosity, density, mixed crystal formation and chemical composition.

## Applications

- Amino acids
- Ascorbic acid & derivatives
- Citric acid
- Caffeine
- Malic acid
- Succinic acid
- Tartaric acid
- Dextrose
- Fructose
- Ketogulonic acid & salts
- Isomaltulose
- Erythritol
- Xylitol

# Membrane filtration

Membrane filtration systems can be ideally suited to food ingredient processes that require a separation stage.

## Polymer or ceramic membranes

GEA offers a complete portfolio of crossflow filtration solutions for separating liquids or for concentrating solids, without the need for thermal or mechanical treatment. We can configure systems using either conventional polymer membranes, or state-of-the-art ceramic membranes that are easy to clean and have a 10 year lifespan. Our portfolio includes reverse osmosis (RO), nanofiltration, ultrafiltration and microfiltration systems.

## Retaining nutritional and physical properties

Membrane filtration can replace other separation methods, such as evaporation, rotary vacuum filters or centrifugation. Unlike some of these alternative methods our cross-flow membrane filtration systems are gentle, which reduces the risk of damaging sensitive products, and helps to preserve the nutritional value of key constituents. Using our technologies, you can expect your products to retain their physical, chemical and organoleptic properties.

## Higher yield, with less energy

Our technology experts and engineers have developed membrane filtration systems that are effective and efficient, so you can expect higher yields, reduced waste and waste disposal costs, and lower energy requirements. Every membrane filtration application is different, so we custom-design each unit, to best exploit whichever membrane filtration solution meets your needs. Working directly with you, our experts will tailor the ideal system for your existing food ingredient products. Where possible, we can build in the flexibility to work with new ingredients and recipes so that you can gain maximum value from your investment as you develop new product lines.

## From feasibility trials to commercial scale-up

Our goal is to develop technologies that will improve your processes, products and profits, and help you to meet both short- and long-term sustainability goals. We operate fully equipped process development laboratories at regional centres around the world, so we can help you with



GEA ultrafiltration unit

everything from small volume feasibility evaluations to large-scale optimization trials. A wide range of pilot plant units with different membrane configurations is also available for trials on site. We can provide both continuous and semi-automated plants for scale-up tests.

## Applications

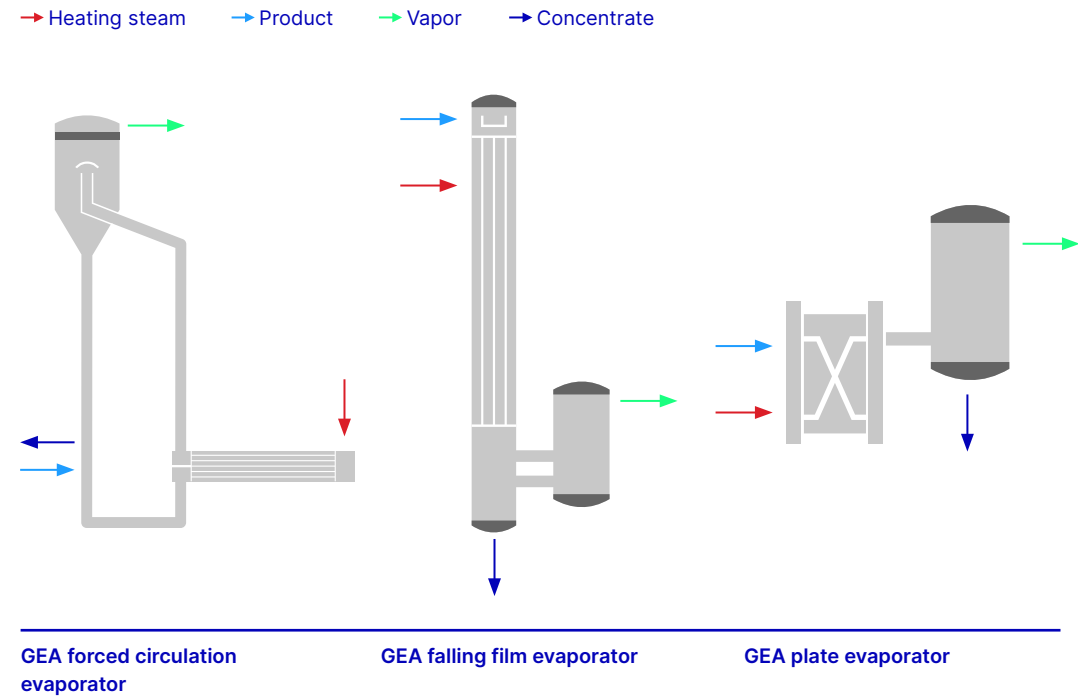
- Starch & starch derivatives
- Protein hydrolysates
- Egg protein
- Gelatin
- Animal byproducts
- Coconut water
- Herbal extracts
- Plant proteins

# Typical membrane filtration applications

Membrane type	Reverse osmosis	Nanofiltration	Ultrafiltration	Microfiltration	Particle filtration
Relative size of common materials		Flavors & fragrances Aqueous salts Sugars Amino acids Colorants	Proteins / enzymes Oil emulsions	Gelatin	Yeast cells Bacteria Red blood cells
Microns	0.00001	0.00002	0.001	0.1	1.0 10.0
Molecular weight	<100	200	10,000	1,000,000	
Pressure	300 – 1200 PSI (20 – 300 bar)	60 – 300 PSI (4 – 20 bar)	10 – 60 PSI (1 – 4 bar)	1 – 10 PSI (< 1 bar)	

# Evaporation and distillation

Process evaporation can affect product viscosity, stability, and downstream drying stages, which can then impact on the integrity of key product constituents.



## A broad portfolio for diverse applications

GEA has more than 50 years of expertise designing, building and supplying plants for a wide range of food ingredient and additive applications. Our broad portfolio includes systems that are heated by thermal or mechanical vapor recompression with live steam, or dryer vapors. The best evaporator for your products will depend on factors such as concentration ratio, evaporation rate, viscosity, the type of heating and heat recovery system required, and the fouling characteristics of the application. Typical applications in the food ingredients sector might include the concentration of gelatin, yeast, yeast extract, or pectin. We also supply combined sterilization and evaporation units for gelatin and protein hydrolysates.

## Tailored falling film evaporation plants

Falling film evaporators are typically used for low viscosity products with a moderate tendency to foul. Forced circulation evaporators can be used for higher concentration ranges and can handle much higher viscosities. Forced circulation systems also help to avoid fouling. Falling film or forced circulation evaporators represent ideal solutions for water-intensive processes, such as producing starch or yeast-based products, which generate waste water that may contain high concentrations of salts, dissolved and suspended organic components.

## Applications

- Gelatin
- Yeast
- Yeast extract
- Pectin
- Malt extract
- Whole egg
- Protein hydrolysates
- Animal byproducts
- Starch & starch derivatives

Our falling film evaporation plants are highly energy efficient and an excellent choice for temperature-sensitive products. Offering flexible operation methods, gentle evaporation – mostly under vacuum – and extremely short residence times, they have been developed to aid the highest quality processing.

#### Plate evaporators

GEA also offers plate evaporators that can be used for low-to-medium evaporation rates. Potential applications might include liquids containing only small amounts of undissolved solids, which have no fouling tendency. Product recirculation designs are typically selected for non-temperature-sensitive products, for highly viscous products or for high evaporation ratios.

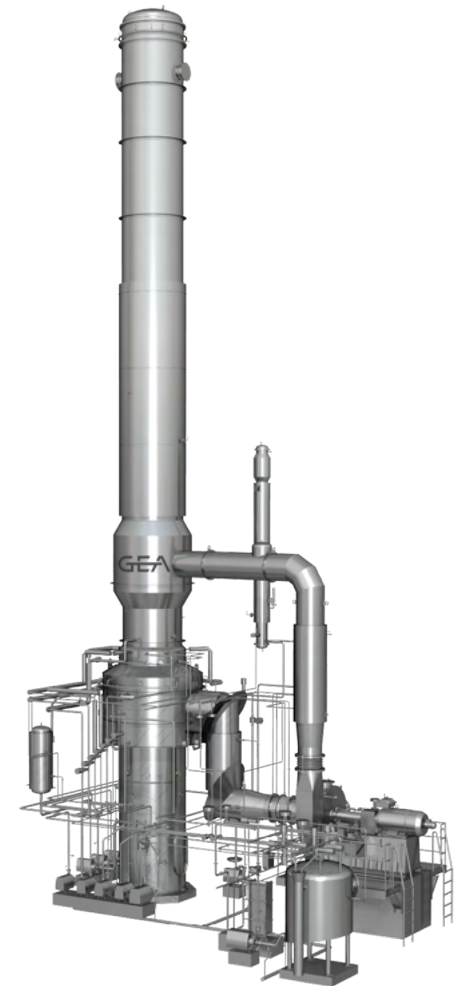
As a GEA customer you can be assured of our dedication to tailoring the optimum evaporation system for each of your food ingredient products and processes.

#### Distillation

GEA supplies a wide range of distillation technology and equipment for food ingredient applications, including aroma recovery and concentration, flavor fractionation, pectin extract concentration and refining for precipitants and solvents. We can configure plants of any size for separating compound mixtures by distillation/rectification and stripping, including gas stripping and extractive distillation. Our portfolio spans batch, MVR/TVR and multiple effect technologies, as well as reboilers and skid-mounted units. At our Karlsruhe R&D Center our experts can provide access to a variety of laboratory-scale equipment for refining process parameters and substance properties. On-site customer testing can also be arranged.

#### Applications

- Flavors & essences
- Pectin
- Xanthan
- Carrageenan
- Vinegar



GEA evaporation plant



# Spray drying

Spray drying is the most widely used industrial process for the continuous production of powders or agglomerates from liquid feeds such as solutions, emulsions and suspensions.

## Optimum powder properties

Tailored particle size distribution, free-flowing and dust-free powders and excellent dispersibility are key attributes of the spray drying process. Our design allows for gentle processing and precise control of drying conditions to preserve organoleptic and sensory properties of heat-sensitive products.

## Encapsulation of food ingredients

Spray drying is an effective method for encapsulating food ingredients. Our experts can help you to adjust drying parameters to ensure effective particle formation and encapsulation. We can also help to develop alternative encapsulation processes based on spray congealing or fluidized bed coating.

## Repeatable processing

Our systems range from basic units to very sophisticated plants for complex processes, which are all designed to conform to the highest industry standards for hygiene, energy efficiency, safety and plant performance. GEA solutions exploit plant-wide control and automation software to monitor process parameters, and make any necessary adjustments. This level of control helps to ensure process repeatability and product consistency.

The option for built-in clean-in-place plants can further speed cleaning and reduce downtime, with less use of water and cleaning agents.

## Applications

- Algae
- $\beta$ -carotene
- Chelates
- Cultures
- Emulsifiers
- Enzymes
- Fibers, (e.g. inulin, fructooligosaccharide, galactooligosaccharide)
- Flavors & encapsulated flavors
- Gelatine
- Glucose syrups
- Gum arabic
- Herb extract
- Non-dairy creamer (coffee & tea whitener)
- Probiotics
- Proteins & protein hydrolysates
- Starch & maltodextrins
- Tomatoes and fruit purees
- Whole blood & hemoglobin
- Yeast & yeast extract



GEA FSD® spray dryer

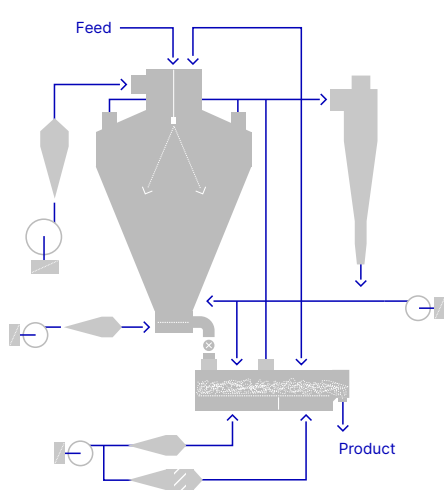
# System and chamber designs

## Broad configuration options

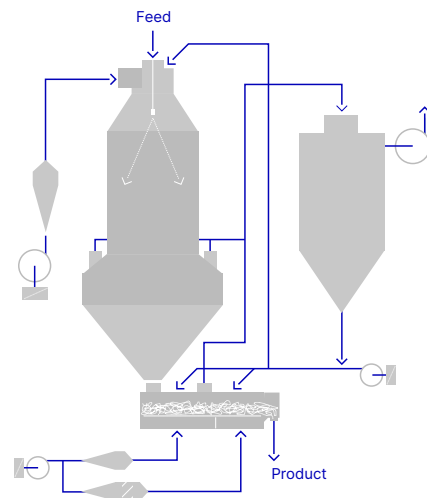
Drying characteristics and product specifications vary from product to product, so no single spray dryer design or configuration will be suitable for all applications. GEA has applied its technology and sector knowledge and expertise to develop a wide range of chamber and system designs. Among the options is a smart, single step agglomeration system that combines spray drying and fluid bed drying

technology in one solution to create ready-to-dissolve agglomerated powders directly from liquid feed.

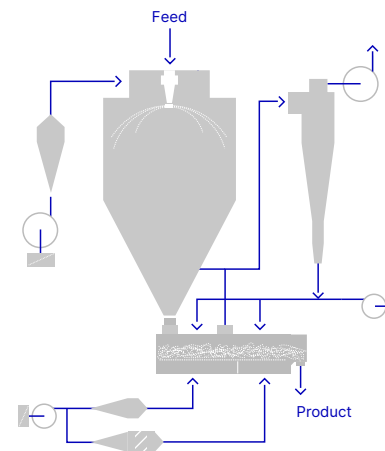
Working together we can select and tailor the drying plant that will provide you with the most cost-effective solution for your product.



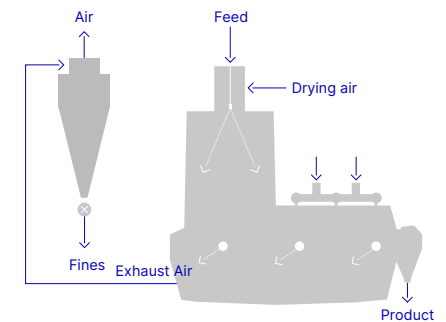
Fluidized spray dryer, GEA FSD®



GEA TALL FORM dryer



Spray dryer with GEA VIBRO-FLUIDIZER®



GEA FILTERMAT® dryer

# Fluid bed drying

Fluid bed drying can represent a critical step for removing residual water and other volatiles from powdered materials, so that the final powder retains the desired moisture content.

## Preserving key product properties

Fluid bed drying is suitable for powders, granules, agglomerates, and pellets with an average particle size between 70 microns and 2 mm. The technology is ideal for food applications in which product properties need to be preserved. Our experts can work with you to configure optimized fluid bed drying solutions that will fit in with your existing layout and process infrastructure.

Fluid beds are designed for continuous processes and are available for processing powders in open or closed-cycle operations using air, nitrogen or inert gas as the drying medium. We supply several types of fluid bed units for food and food ingredients applications, from small scale to industrial size plants.

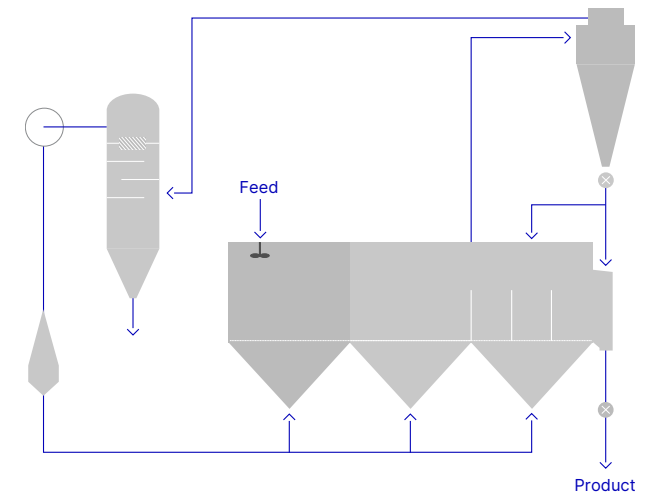
GEA fluid beds offer high thermal efficiency. The combination of back-mix and plug flow sections helps to achieve an optimized drying profile. Each GEA fluid bed is

designed to meet the strictest food industry standards and regulations. They can be delivered with integrated clean-in-place systems that aid fast, effective cleaning with reduced process downtime.

Fluid beds can be constructed as stationary or vibrating units, and we can also apply heating panel banks to stationary beds, where appropriate.

## Applications

- Vitamin C
- Fruit & vegetables
- Fish feed



GEA fluid bed dryer, closed-cycle

# Spray congealing

Spray congealing (spray cooling) is a useful technology for generating free-flowing food ingredient powders directly from melted fats, waxes, oils or emulsifiers.

## Customized plants

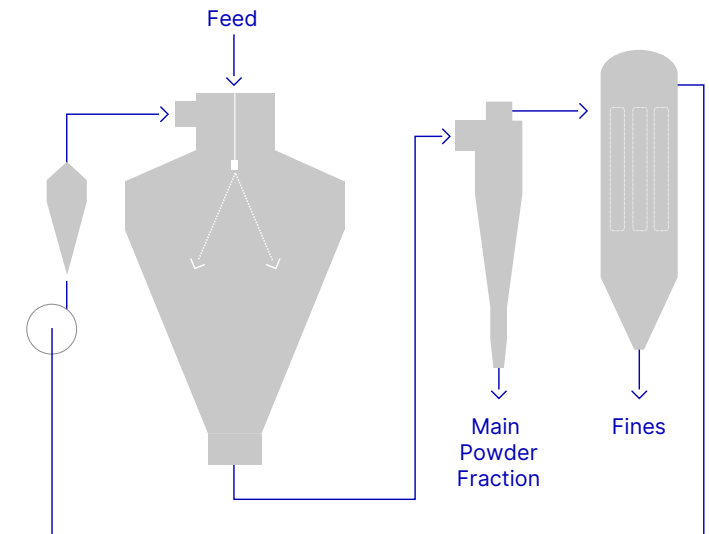
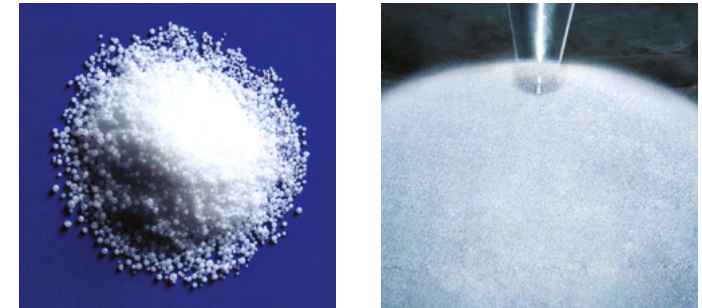
Spray congealers provide a flexible method for converting melts into powders with particle sizes of up to 500 microns. Particle sizes of up to 2000 microns can also be reliably achieved when using a low-speed atomizer.

GEA spray congealing plants are hygienically designed to meet the strictest food industry standards. The plants run continuously, can be used for the manufacture of a wide range of products, and enable rapid product changeovers.

We can configure and supply customized spray congealing plants for your bulk food ingredients or for more advanced specialist and niche applications, such as encapsulation of oxidation-sensitive materials and oils, or for controlled release products. Our designs enable efficient cleaning and maintenance, to reduce downtime.

## Applications

- Emulsifiers (distilled monoglycerides, propylene glycol ester, mono- and diglycerides)
- Encapsulated materials (e.g. carotenoids, omega-3 and -6 oils)
- Fats
- Stearic acid
- Waxes



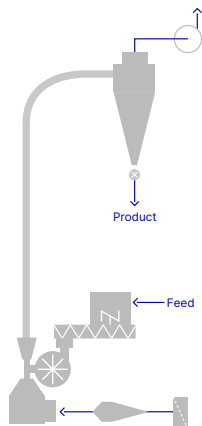
GEA closed-cycle spray congealing process

# Solid feed drying

Several solutions are available if you are looking for versatile, precisely controlled drying systems that can gently handle a wide range of food ingredients finished in powdered, flaked or other solid formats.

## GEA Flash dryers

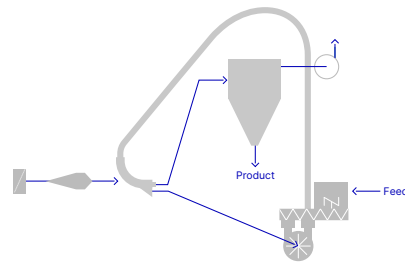
GEA offers energy-saving flash dryers to match capacity, feed and product type, including friable and non-friable wet feeds. We tailor systems for open circuit or partial gas recycle and provide solutions for processing in inert atmospheres. Constructed with a minimum number of moving parts to reduce maintenance, cleaning time and associated costs, our flash dryers work with different dewatering systems, and are designed to integrate seamlessly with your existing processes.



GEA flash dryer

## GEA Ring dryers

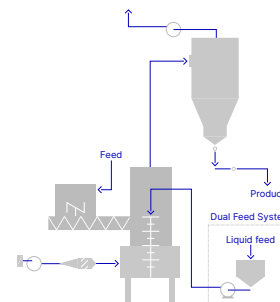
Our proprietary pneumatic-type ring dryer range includes a modified flash dryer, with the addition of a hot disintegrator and a manifold for the selective recirculation of semi-dry material. Suitable for almost any powdered product application, the ring dryer design results in lower exhaust temperatures and can increase efficiency. We can configure ring dryer solutions for handling diverse feed types, including thermally sensitive food ingredients and products such as modified starches and vegetable proteins.



GEA ring dryer

## GEA SWIRL FLUIDIZER®

The SWIRL FLUIDIZER® from GEA is suitable for producing fine and homogenous dry powders from feeds with a wide range of viscosities. Ideal for drying pastes, the unit features a patented dual feed system, and combines internal back-mix drying with the ability to precisely control product residence time, and the option of air drying at up to 700°C.



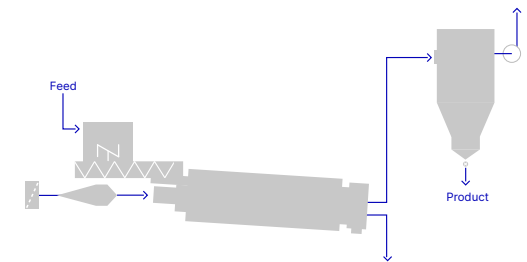
GEA SWIRL FLUIDIZER®

## GEA Rotary drying and cooling

Rotary dryers from GEA are known as robust industry workhorses that combine flexibility with reliability, whatever the product or drying temperature. They offer trouble-free operation for your valuable food ingredient applications.

### Applications

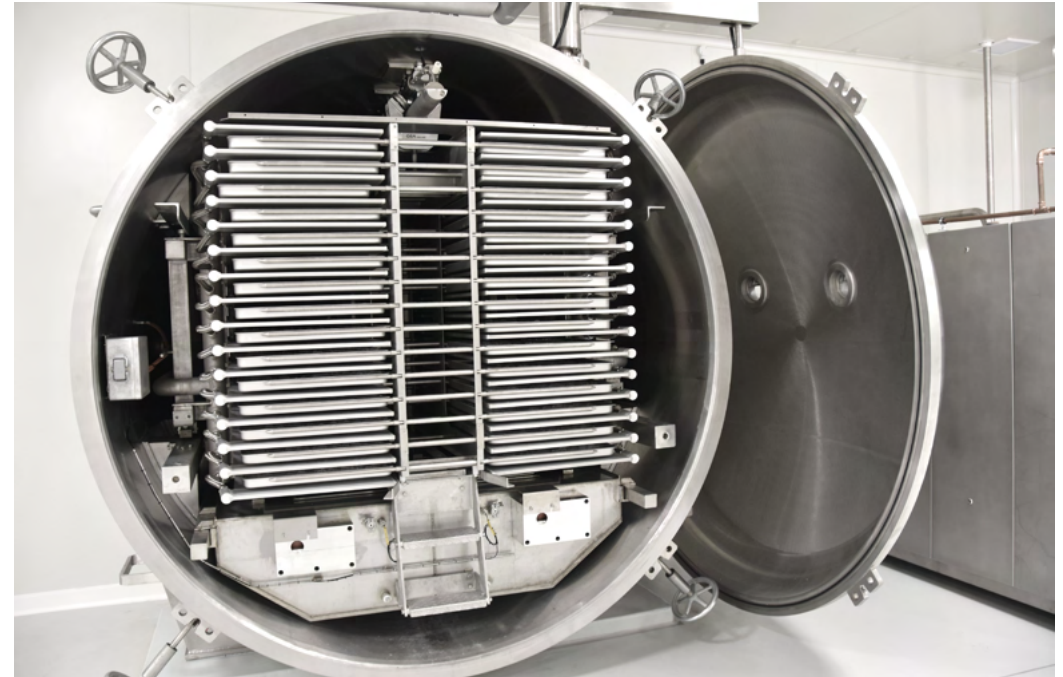
- Starch
- Fibers
- Proteins
- Algae



GEA rotary dryer

# Pelletizing and freeze drying

Freeze drying is a valuable technology for generating products that have an extended shelf life and which are easier to store and transport at ambient temperatures.



## Pelletizing

Our liquid nitrogen freezer carries out extremely fast freezing, which helps both to optimize your production process and throughput, and also to ensure the most appropriate conditions for downstream lyophilization of fermentation-derived ingredients. Liquid nitrogen freezing forms free-flowing, dust-free droplets, resulting in almost no product loss. The resulting pellets can be stored frozen and distributed as a frozen product, or transferred to a freeze dryer.

## Freeze drying

Freeze drying can help to preserve key constituents in food ingredients, and so retain quality, while offering the benefits

and convenience of a dry product. GEA offers freeze drying / lyophilization solutions for a wide range of food ingredients applications, ranging from sensitive fermentation-derived ingredients to delicate or perishable products such as strawberries, mushrooms, meat, shrimps or any form of liquids, extracts, juices etc. Frozen products are dried under deep vacuum, so the natural water in the frozen product is removed as vapor through sublimation.

Designed to deliver efficient and uniform lyophilization, and so a high-quality product, GEA freeze dryers are highly

reliable and efficient and can handle products in almost any size and shape. Freeze dried products benefit from a long shelf life, which makes storage and transportation more convenient.

Our RAY® freeze drying technology has been designed to meet the strict hygiene requirements of the food ingredients industry, and is ideal for sensitive applications such as lactic acid bacteria, enzymes, bioactive proteins and yeast.

## Applications

- Fermentation-derived ingredients
- Freeze dried fruits, vegetables, meat and seafood

# Powder filling

After processing, finished food ingredients must be safely and gently handled and packaged to help retain their desired properties, quality and shelf life.

## Safe packaging

GEA offers a portfolio of powder filling systems that can safely package your finished products into any of a broad size range of bags, boxes and drums, without impacting on product integrity and structure, and with minimal risk of contamination.

## Less stress on fragile powders

We have developed robust, multi-tasking fillers that use our unique, bottom-up filling process. This filling method helps to reduce physical stress on the powder during filling, ensuring that the quality of even fragile products isn't compromised. A range of easily interchangeable filling heads lets you quickly switch between packaging formats, without long delays for equipment reconfiguration.

## Reducing product loss

GEA fillers also feature accurate on-head weighing so you don't give away valuable product and lose profits.

Integral dust control technology further reduces losses and increases safety. And to help keep downtime to a minimum our fillers can be configured with optional CIP plants that help to minimize downtime, when cleaning between batches and product changeover.

We aim to offer solutions that can work together seamlessly so that you can maximize throughput and reduce bottlenecks. GEA powder filling systems are complemented by fully integrated solutions for closing, coding, labeling and palletizing the finished containers, so you can have confidence that your products will be delivered for storage in first-class condition.

## Applications

- Flavors
- Specialty powders
- Blended powders
- Non-dairy creamer



GEA bag-in-box filling system

# Refrigeration and heating

Processing food ingredients requires precise temperatures to maintain product quality during heating and cooling. Manufacturers aim to maximize the efficiency of their production systems and reduce their carbon footprint. GEA's sustainable energy solutions help to achieve those goals.

## Holistic approach

Cooling and heating account for up to 60% of the energy cost of food processing. GEA expertise spans both process technology and utilities, so we have developed a unique, holistic approach to address your cooling and heating challenges. Our detailed engineering knowhow means we can design tailor-made solutions that seamlessly integrate smart cooling and heating systems into your processes. With GEA solutions it may even be possible to eliminate the boiler.

## Benefits

- Increase heating performance by up to 70%
- Reduce energy usage and operational costs by 30% to 50%
- Reduce CO<sub>2</sub> and NO<sub>x</sub> emissions by up to 90%
- Reduce water consumption
- Reuse waste heat from the refrigeration plant for other heating purposes, e.g. heat treatment and pasteurization

## Reduce costs – help our planet

We provide innovative, measurable, solutions with payback terms that can reduce your total cost of ownership. Our aim is to maximize the performance of your process by implementing energy-efficient refrigeration solutions that use natural refrigerants such as ammonia and CO<sub>2</sub>. By using our technologies you may be able to achieve significant reductions in primary energy use, with no CO<sub>2</sub> emissions. This could pave the way to the ultimate goal of closed loop, carbon-neutral food processing.





# CIP/SIP

Food ingredient production plants should meet critical requirements for hygiene, and guarantee unflinching product safety.

## Meeting stringent regulatory standards

GEA offers efficient, thorough clean-in-place (CIP) systems to help ensure that your process lines satisfy the most stringent regulatory standards for hygiene, giving you the security of complete product safety at every point in your processes. We can also design and build systems with sterilize-in-place (SIP) functionality for high microbiologic control.

## Fast and effective CIP for better sustainability

We strive to develop versatile solutions that offer the flexibility to switch easily between products, while maximizing product recovery and preventing carryover to reduce loss. Fully automated CIP systems from GEA are designed to be fast and effective, so you can stay productive and keep downtime between batches or product switching to a minimum. Where possible our systems use less water and detergents, which reduces costs and improves sustainability.

All GEA solutions are tailored specifically to fit in with your infrastructure, product and process requirements, which helps to make commissioning seamless and with minimal risk of unpredicted delays. We aim to get you up and running as fast as possible.



GEA CIP Unit

# Automation and control

GEA offers a portfolio of well-proven systems for the control and collection of process data. We can tailor and supply operating systems for single plants, complete lines, or enterprise-level oversight.



## Options for every level of control

Full automation isn't necessary for every application or process plant. Sometimes it is enough to have manual operation using buttons and switches, and this is commonly the most cost-effective option. For higher levels of automated control in single or interfaced plants we configure digital solutions with easy-to-use human-machine interfaces (HMIs). And if you have more complex requirements we can tailor complete instrumentation and control (I&C) and/or batch systems that

are capable of controlling several workstations, and solutions for the fully integrated control of enterprise-wide networks. To help maintain a complete audit trail our solutions securely record and log process and formula-relevant data in real time.

At the heart of the GEA automation concept is a toolbox comprising standardized software modules for specific applications. These modules combine visualization-level and control-level functionality into a customizable supervisory control system.

## GEA Codex®

GEA Codex® is a scalable plant process control solution that combines an engineering portal, and a high-performance HMI, with standardized and structured software. The solution, which runs on Siemens, Rockwell or Wonderware platforms, is delivered with the plant, and can be extended and expanded to meet your user requirements.

## GEA Cube®

GEA Cube® is a suite of manufacturing execution system (MES) applications that can be used to build complete MES/MOM (manufacturing operations management) landscapes for projects covering a wide variety of requirements, including interfacing with ERP systems.

# Flow components

Every GEA component is designed to the highest standards of safety and hygiene, to help ensure reliable, repeatable quality for all of your food ingredient lines.

## Aseptic and hygienic valve technology

For sterile applications we offer aseptic and ultraclean valves and systems that hermetically seal process lines, which helps to ensure maximum process and product safety.

Our Aseptomag® valve range features stainless steel bellows technology, while the D-tec® valve line uses stem diaphragm technology to hermetically seal the sterile process pipe against the external atmosphere. Our aseptic VESTA® valve series is equipped with PTFE bellows and is specifically designed to meet the highest requirements for sterile processes in the pharmaceutical, biotech and cosmetics industry.

GEA also offers hygienic valves, including the VARIVENT® valves that are core components of matrix-piped process plants. Our complete range of economically designed hygienic valves for complex tasks as well as for basic functions helps producers to achieve high product quality and efficiency.

## Hygienic pump portfolio

As a full-line supplier of premium pump solutions, GEA offers a variety of hygienic pumps as part of the SMARTPUMP and VARIPUMP lines, which have been developed to match just about any application for food sector manufacturers. Our portfolio includes centrifugal pumps (end-suction, self-priming and multi-stage systems) as well as rotary lobe pumps. Clever pump design helps to make cleaning easier and faster, which saves time and reduces water and cleaning agent use. Sensibly rated high-efficiency motors help you to keep energy consumption as low as possible.

## Cleaning devices

Our goal is to design sustainable cleaning technologies, so you can save valuable resources in the cleaning process. Options include orbital, rotating or static devices, which can be installed into your fermenter, spray dryer, mixing or storage vessel units.



GEA Hilge HYGIA pump



GEA VARIVENT® mixproof valve with balancer

# Test facilities

GEA test facilities helps you to achieve greater confidence in the safe and repeatable production of your food ingredients products prior to market release.

## Global centers of excellence

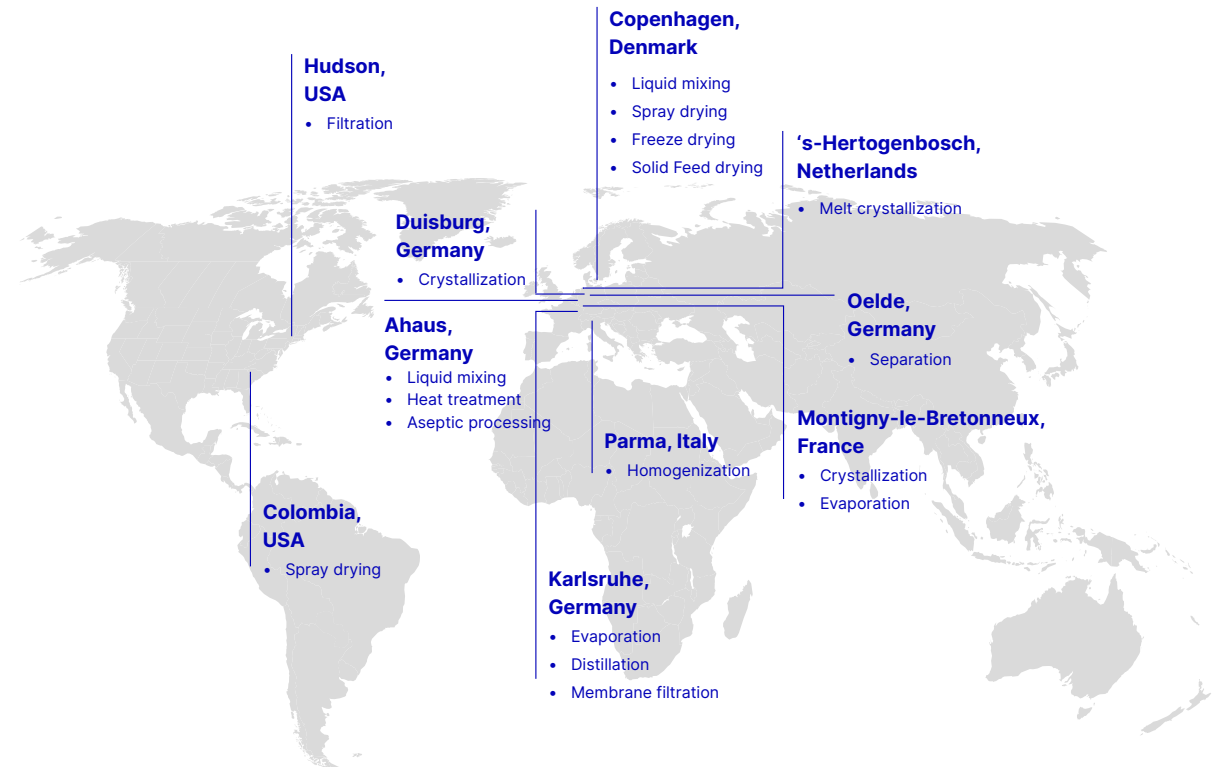
To minimize product development risk, we have established global GEA centers of excellence, where our customers can access laboratory and pilot plant facilities and a wide range of GEA equipment to try out new recipes and work on process development and validation.

## Tap into expertise

Specialists at our centers of excellence provide application, process and engineering expertise, and will work with you to help select and tailor the best components and systems for your products and business. We aim to help you optimize every process stage, from early product development through to final process refinement.

## Where you can find us

Talk to us about what our centers of excellence can offer. Our test facility for centrifugal separation is in Germany. Also in Germany we have a test center for heat treatment, liquid mixing and aseptic processing. Evaporation, distillation and membrane filtration systems and processes can be tested at sites in Germany and in the USA. For crystallization we offer facilities in Germany, France and the Netherlands. Solid feed drying and spray drying facilities are available in Denmark and spray drying can also be tested at facilities in USA. We offer homogenization expertise at our test center in Italy. Test facilities for mixing and freeze drying are also sited in Denmark.



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