GEA Group is a global engineering company with multi-billion euro sales and operations in more than 50 countries. Founded in 1881, the company is one of the largest providers of innovative equipment and process technology. GEA Group is listed in the STOXX® Europe 600 Index.

We live our values.
Excellence • Passion • Integrity • Responsibility • GEA-versity

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GEA Niro Drying and Particle Formation
Solutions for the World’s Food Industry
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A full range of services

GEA Process Engineering delivers added value on top of advanced powder technology

When you choose GEA Niro powder engineering, you benefit from more than advanced technology – you also get a long-term business partner. We offer a host of services that enable you to maximise your business opportunities by keeping pace with the evolving requirements of the food industry.

Comprehensive research and development

Our know-how is founded on comprehensive research and development and strengthened through co-operation with food organisations and universities. GEA Process Engineering offers you products that optimise plant production and process verification through laboratory and pilot plant testing, unmatched scale-up experience. The test engineers and process technologists at our GEA Niro pilot plants – which can accommodate more than 50 different process configurations – represent the largest pool of special-trained staff ever assembled for this task. Customers from all over the world test new products in our pilot test facilities, and, when required, these new developments are tested full-scale before market launch at leading powder producers.

A unique partner

With in-house project financing expertise as well as industry and technology licences, GEA Process Engineering is a unique partner at every stage of the planning, design and delivery of an industrial processing plant. We are also always available to help you comply with evolving safety, health and environmental regulations. Because food market demands change over time, you may benefit from a visit by one of our product specialists to evaluate the possibility of process modifications and optimisations.

Global presence – local after-sales service

We believe service is a local business. With GEA Niro, you never have to go far for assistance or overcome different time zones or language barriers. We’re on the spot in local markets all around the globe – not just with representatives, but with our own staff, stocks of spare parts, service engineers and training specialists.

Your GEA Niro installations also get the best possible care through our key component repairs, overhaul service and preventive maintenance programmes. So, you benefit from:

- Less unplanned downtime, greater efficiency, enhanced performance and longer plant lifetime

For more information about how GEA Process Engineering can provide total solutions for industrial drying and powder product engineering in the food industry, please visit www.niro.com.
Added value

Maintaining the highest safety and standards...

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- Extended product lifetime
- Reduced downtime
- Greater energy efficiency
- Reduced costs
- Reduced maintenance
- Improved performance
- Improved safety and health

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Quality powders for competitive products

From advanced equipment to complete plant design, from feed formulation to competitive powders, from sanitation to safety – GEA Process Engineering has the answers

No one knows more about the role of industrial drying and engineering of high-performance powder products than GEA Process Engineering. With data gathered from more than 75 years of experience and a reference list of some 10,000 GEA Niro plants, we’re equipped to engineer the properties you want into your powders – and the processes needed to produce them. Nowhere is this expertise more critical than in the food industry, where drying plants are an increasingly important key to better, safer, “greener” and more profitable food products.

Dedicated process control

A narrower powder distribution? An easier flowing granulate? An agglomerate with fewer fines? Or maybe just a more competitive process. There’s no quicker way to go from your identified request to the solution than by consulting the powder engineers at GEA Process Engineering. We supply a full spectrum of know-how and processing equipment, from raw material reception through liquid processing, concentration and drying to powder handling and storage, as well as powder packing.

Our engineering solutions range from single pieces of equipment to complete plants. Backed by more than 75 GEA Niro pilot plants worldwide, our engineers and technologists can help you design a system – including dedicated process control – to meet specific powder requirements. Additionally, GEA Process Engineering has developed “gentle processing” techniques that maintain the natural qualities of foods, guaranteeing added value to your products. We’re also one of the world’s most experienced designers and manufacturers of continuous and batch GEA Niro freeze drying plants.

Global project management

GEA Process Engineering’s global project management skills take your project smoothly all the way to completion, on schedule according to preplanned milestones. All coordinated and documented for you by an organisation that implements and completes hundreds of projects on time each year. GEA Niro equipment fully complies with FDA and/or EU regulations. Our plant designers are experts at meeting the industry’s ever-increasing demands regarding product specifications, hygiene, energy saving, environmental protection and plant safety.

Ultimately, our goal is to help you maximise competitiveness through superior product quality and high-yield processes. The food industry is dynamic, with market demands that change over time. Whether you need a new investment, process modification or optimization, it’s all part of the GEA Niro solution.
Beverages

Full range of equipment and know-how

GEA Process Engineering and its sister companies offer a wide range of process equipment, process technology and know-how for beverage production – expertise that ranges from extraction and concentration through spray drying. We supply single process units or complete factories for the production of all types of beverages. When you choose GEA Process Engineering, you choose a solution tailored to comply with precisely your product requests and demands.

Liquids and juices
The industry for beverage production is enormous and includes a huge variety of products. Some are made by blending crushed nuts and seeds with water and creating soy milk, rice milk, coconut milk and the like. Many of the products are made when liquids from natural sources are collected by squeezing the juice out of natural fruits and berries, harvesting coconut water and collecting the sap from trees. As the harvesting season is short and consumption continues throughout the year, many of the juices are concentrated and pasteurized for storage, then later dried for transport and long shelf life.

Extracts from dry ingredients
Some drinks are made by extraction from dry ingredients, which results in products such as tea, herbal tea, polyphenols, punicalagins and others.

Blended ingredients
More and more drinks are made as recipes by mixing a number of ingredients and dissolving them in water. These include soft drinks, sport drinks, nutritional drinks and health drinks. Most of these drinks are sold in bottles and cans. Several of these are made as blended powders and sold as bulk products to the beverages industry.
The range of health products is wide, and most of them require spray drying during the production process, regardless of whether the raw material comes from a chemical/pharmaceutical product or from a natural product. Health products include dextran, calcium salts (lactate, etc.), as well as various types of herbs that may contribute to good health. Plants growing wild in nature or cultivated as crops are still the prime ingredients in many drugs, beverages, flavours and cosmetics.

Health powder production
The production of health powders involves batch or continuous extraction equipment and concentration of the extract to proper solid content prior to spray drying. GEA Process Engineering's comprehensive product range covers most of the required processes and techniques for processing botanical materials, such as leaves, herbs and roots and branches – as well as for processing animal organs, glands, etc. – into extracts and then further into powders or granulates.

Health and herbal powder manufacturers worldwide have been using GEA Niro spray dryers for more than 40 years. Our technology and industrial experience guarantees the most suitable extraction, concentration and spray dryer design for health and herbal applications. These designs fulfil product requirements in relation to active components' powder particle size, particle form, plant operation safety, pollution-free drying, ease of cleaning between product changes and avoidance of cross contamination.

Vitamins
Traditionally, vitamins were produced to protect humans against diseases caused by vitamin deficiency. The steadily growing industry of vitamin manufacturing has found increasing markets in direct application in food and animal feed and as nutritional supplements. The largest vitamin manufacturers have been employing GEA Niro drying installations for four decades. The process engineering and design of drying equipment is always adapted to the requirements that our customers must meet in their own markets with respect to active components, particle size, particle form and/or encapsulation. Our equipment designs are also adapted to specific production processes for protecting the active substance or for controlled release of the active substance.
Carbohydrates

Different processing of plants for a wide range of powdered products

Carbohydrates of different origins and forms are found in most food products. Worldwide, GEA Process Engineering has supplied hundreds of conventional GEA Niro spray dryers, multistage dryers and FILTERMAT™ dryers for a variety of carbohydrate products. The type of dryer selected depends on the product properties. Carbohydrates are excellent as binding material, and agglomerated products can easily be produced if the spray drying plant is designed to suit this purpose.

Starches

Starch from corn, grain, potatoes, yams and tapioca qualifies as one of the most important ingredients in the food industry. Starches can be transformed into many important products through hydrolysis. The end products are assigned a Dextrose Equivalent value. Products with DE-values from 6 to 19 are referred to as Maltodextrins. Those with DE-values from 20 to 91 are generally termed Syrups (the most common being Corn Syrup). Products with DE-values of 92 to 99 are called Total Sugars. A value of DE-100 equals pure Glucose (Dextrose). Products with DE-values of 6 to 38 are either dried in conventional dryers for fine particle products, or in multistage dryers for coarse and agglomerated products. Products with values of DE-10 to DE-100 can be dried in a GEA Niro FILTERMAT™ dryer, which yields a coarse, agglomerated product. Many artificial sweetener products are made by spray drying mixes of maltodextrins with small amounts of aspartame. The GEA Niro dryers are available with capacities from 100-7000 kg per hour.

Malts

Malts contain a high amount of Maltose, known from the brewing of beer and malt drinks. These malts can be spray dried in various types of dryers, depending on the desired composition and thermoplasticity. Conventional spray dryers are often used for regular malts, while the GEA Niro FILTERMAT™ is ideal for the more thermoplastic products.

Sucrose and fructose

Sucrose is used in food products as a sweetener, and also to add calories in products such as baby foods and other powdered beverages. If the final sucrose content in a product must be greater than what is possible to incorporate in liquid form in the concentrate to be dried, it is possible to add sucrose in dry form into the spray dryer. This is done during the drying of the liquid feed, resulting in a blended, agglomerated, homogeneous final product. Fructose as found in all fruits is very thermoplastic.

Applications

- Carragenan
- Corn syrups
- Glucose
- Gum arabic
- Inulin
- Maltodextrins
- Malts
- Pectin
- Sorbitol
- Sugar
- Xylitol
- Others
and hygroscopic. Products like fruits therefore cannot be spray dried unless a filler – such as natural fibres or maltodextrine – is used as a carrier.

**Sugar and sweeteners**

Sugar is not normally a spray dryable product, but some low bulk density products, such as sugar for breakfast cereals, have been produced in GEA Niro dryers for special use.

The spray drying process is also used for low-calorie sweeteners like sorbitol and xylitol and other sugar alcohols because spray drying can produce excellent properties for producing tablets, as well as great solubility and handling properties. The products are normally extremely sticky and thermoplastic, and require a long process time to crystallize. The GEA Niro FILTERMAT™ drying system is the most successful industrial installation to process these products, which cannot be dried in conventional dryers.

**Pectins**

Pectins, seaweed polymers and tree-gum polymers are groups of natural carbohydrate-polymer products. The water solutions of these products have a high viscosity. They are popular gelling agents and thickeners within the food industry. The water solutions or melts are often dried by roller or drum drying, as they are difficult to atomize. It is possible under certain conditions to spray dry several of these products to achieve low dust content, improved free-flowing properties and increased wetability and solubility.

*Modern diets call for new sweeteners that provide taste without compromising health.*

*GEA Niro spray dryer.*
Proteins

Creating specific product properties

Proteins and protein products like peptides and amino acids are collected from insects, sea food, animals, plants, seeds, bacteria, yeast, mould or even created by fermentation of natural gas. GEA Process Engineering and its sister companies can supply single unit operations or complete process lines and know-how for most of the required processes and products mentioned in the following protein categories:

- Meat provides important proteins, and many meat products are preserved by spray drying to make stable products with long shelf life.
- Gelatines are mainly made from skins and bones and are important ingredients for the production of soft capsules and microencapsulations and as ingredients for viscosity adjustment. Several of these proteins can be spray dried to powders with excellent properties for the end product.
- Fish and seafood provide oils and proteins, and the protein is essential feed for domestic animals. New refined products for human consumption are now also available.
- Beans, peas and grains account for a large variety of botanical proteins, which can either be native or further converted into peptides and amino acids. Isolating native botanical proteins is complex and demands precise processing parameters. Processing accuracy dictates end-product quality. Botanical proteins are gaining preference for dietary purposes and as a supplement of amino acids for human consumption.

Proteins and spray drying

Each protein or hydrolyzed protein has a different hygroscopicity and thermoplasticity profile and therefore requires different drying parameters. GEA Process Engineering and its sister companies can supply you with complete process lines and know-how for successfully fulfilling your identified product properties, such as: dry free-flowing powders, non-dusty granuleometry, long shelf-life, easy dosing and packaging, reduced transportation costs and compliance with hygienic regulations for human and animal food.

Our comprehensive test and laboratory facilities allow you to create the required powder properties by using GEA Niro equipment to optimize process conditions and to provide samples for market analysis.
Fruits and berries

Creating high-quality powders

GEA Process Engineering is the single largest supplier of GEA Niro tomato dryers and FILTERMAT™ dryers, and has gained experience with spraying juices and paste from a variety of fruits, berries and vegetables. Drying capacity ranges between 50-800 kg final powders per hour, depending on the product. Additionally, our GEA Niro CONRAD™ freeze dryers preserve product quality and add significant value to a wide range of food products, including fruits and berries.

Strained pulp from fruits and berries is freed from skin, seeds and long fibres to create a paste which can be spray dried in this form, or with only a limited addition of carrier. Few of these powders result in reconstituted products identical to the original paste with respect to retaining natural properties like colour, flavour, taste and texture. The GEA Niro FILTERMAT™ is the most attractive dryer for production of high-quality powders from these fruit and berry pastes.

Tomatoes

Tomatoes are spray dried in large amounts from a concentrated paste. The powder is prepared from hot break paste or cold break paste. The paste used is strained free of skin, seeds and long fibres and is concentrated to a maximum of 29° Brix for hot break and 36° Brix for cold break. GEA Process Engineering has designed a special GEA Niro spray dryer to handle tomatoes. Because our spray dryer produces a superior quality powder that customers are willing to pay a premium price for, the GEA Niro solution has become the most popular tomato dryer in the world. GEA Niro technology also allows for the drying of tomato paste in the FILTERMAT™. With GEA Niro dryers, tomato powder can be produced without any additives.

Vegetables

Highly competitive products

Spray drying of vegetables is feasible when these exist as juice or paste, as described above. Due to the composition of vegetable juice, fewer carriers are required during the drying process. Filtered and concentrated juices are normally dried as flavours, mostly dried in conventional dryers and multistage dryers. The paste, free of skin and long fibres, is likely to be concentrated and fabricates great products when dried in the GEA Niro FILTERMAT™ dryer. These products can often be dried without additives, typically resulting in high-quality products which can compete with freeze-dried powders.
Oils and fats

Essential ingredients in human food

Oils and fats are essential ingredients in human food, where they are used in liquid form, soft spreads and in solid forms. Fats are collected from fish as fish oils, from animals as fats from interior fat, and from plants as oils or fats from seeds and nuts. For use in food, some oils are solidified by spray cooling or congealing and others are microencapsulated by spray drying.

Equipment, technology and know-how

Many of the fats and oils are essential ingredients of various recipes and are finally transformed to solid products such as high-fat powders (e.g., 80% butter fat) and chocolate, where the chocolate crumb can be spray dried. Some fats and oils can be solidified by spray cooling and used for different confectionaries and cosmetics.

The most volatile oils, such as flavours of different kinds, can be transformed to solid powders by microencapsulation in a spray drying process, in which a recipe and special pretreatment assures that the volatile ingredients are enclosed in particles and protected from oxygen in the air and UV light.

GEA Process Engineering and its sister companies in the GEA organisation have the process equipment, technology and know-how for transforming almost any fat or oil into dry powders – which makes life easier in the food industry and in the kitchen – and for recovering volatile flavours from a multitude of natural sources.

Applications

- Animal fats
- Botanical oils and fats
- Fish oils
- Grains
- Nuts
- Seeds
- Others

GEA Niro MOBILE MINOR™
Flavours

Recovering volatile flavours

Flavours, or aromas, are usually strong-smelling organic compounds with characteristic odours. These substances are often of plant origin, or they are synthetically produced. Since antiquity, flavour products have been used for flavouring foods and beverages or to a lesser extent for their preservative properties.

Whatever their origin and application in food, beverages or perfumed products, flavours should be used in an applicable form. This is mostly done by spray drying. In general, prior to spray drying all natural or synthetic flavouring compounds have to be formulated with soluble gums and carbohydrates. By forming a protective encapsulated surface film around each particle, the volatile flavour is retained.

Mixing of flavours/aromas

Mixing takes place in a feed with a solid content of 40-50%, after which the feed is homogenized and spray dried. GEA Process Engineering offers many different plant types – ranging from quite simple spray dryers to more advanced drying processes – to produce a free-flowing granulated product in accordance with the powdered product’s fat content, thermoplasticity and hygroscopicity.

Food ingredients such as oil, fats, flavours etc. are manufactured by having a liquid feed with the active substance encapsulated or emulsified. Correct feed formulation is essential for matching spray dried powder products of excellence.
Leading technology for the food industry

The comprehensive GEA Niro technology portfolio ensures the best solution

State-of-the-art liquid processing
GEA Process Engineering and its sister companies provide the entire range of state-of-the-art liquid processing and feed preparation technologies and know-how. Our expertise encompasses every step of liquid processing for the food industry, including: extraction, mixing processes, clarification and filtration, homogenization and pasteurization, concentration, and liquid handling and storage.

Mix and prepare liquid ingredients for further processing
Mix-processing, separation of impurities, homogenization, pasteurization and storage are key steps in preparing liquid feed for spray drying.

Produce concentrated forms of natural substances
Extraction uses solvents such as water, alcohol or another organic equivalent to treat crude material and produce concentrated forms of natural substances.

Separate and concentrate liquid components
Three different technologies are available to increase concentration of liquids: membrane filtration, thermal evaporation and freeze concentration.

The world leader in spray drying technology
GEA Process Engineering is the world leader in evaporation and spray drying technology, as well as fluid bed drying and processing. Our engineering solutions range from single pieces of GEA Niro equipment to complete plants. We also offer freeze drying plants that are ideal for the sensitive processing requirements of many food products.

Turn liquid into powder, agglomerates and granulates
Use spray drying to remove the moisture from liquid feedstocks such as solutions, emulsions and pumpable suspensions. It is ideal when your end-product must comply with precise quality standards.

Turn wet powder into dry powder, agglomerates and granulates
Use fluid bed drying for powders, granules, agglomerates and pellets with an average particle size of 50-5,000 microns. Very fine, light powders or highly elongated particles may also require vibration.

Meeting specific product requirements
GEA Process Engineering sets the trend in modern process plant design. We meet specific requirements for powder properties, while always keeping plant performance, drying economy and environmental aspects in focus. The art of achieving ideal product functionality lies in mastering processing techniques such as agglomeration and spray congealing. Our process and design expertise ensures an exact match for your product requirements.

Turn small particles into agglomerates
Agglomeration makes small particles adhere to each other to form a powder consisting of bigger conglomerates/ agglomerates, which are essential for fast and total reconstitution in water.

Turn melt into powder
Use spray congealing to transform melted feedstocks into free-flowing, spherical particulates of controlled particle size.

Expert powder handling, storage and packing
Powder handling requires great care in order to maintain the physical properties acquired during drying. GEA Process Engineering specializes in powder handling and vacuum transport systems, as well as storage and packing systems.

Retain powder properties
Careful post-production powder handling is necessary to maintain the precise powder properties acquired during drying.
The comprehensive GEA Niro technology portfolio ensures the best solution for your application.

### Feed preparation
State-of-the-art liquid handling includes a number of steps that help isolate active components and formulate desired properties. This helps ensure high standards of product quality, long shelf life and maximum production efficiency.

### Extraction
GEA Process Engineering supplies two GEA Niro extraction systems, continuous and batchwise. In true continuous extraction the solids are transported by helicoidal screws placed in a tilted trough with heating panels. The conventional column extractor uses a system of batch-operated percolator columns.

### Concentration
Membrane filtration, thermal evaporation and freeze concentration are used to remove water and isolate certain substances in order to produce highly concentrated liquids and decrease the drying cost for production of powders.

### Spray drying
Spray drying starts with the atomization of a liquid feedstock into a spray of droplets. The droplets make contact with hot air in a drying chamber, evaporate and form particles.

### Fluid bed drying and processing
Fluid bed drying achieves uniform processing conditions by passing a temperature-controlled gas (usually air) through a product layer under controlled velocity conditions to create a fluidized state, enabling liquid migration out of the product.

### Agglomeration
Modern GEA Niro spray dryers can produce powders in an agglomerated form ready to be dissolved in water. Powders from traditional spray dryers are put through a rewetting process to make single particles “glue” together.

### Spray congealing
The melt is atomized and sprayed into a cooling chamber. After contact with cool air, the atomized spray solidifies. The atomization is done either by nozzle spraying or by prilling with a rotary atomizer.

### Powder handling
Ordinary powders can be conveyed by conventional methods, including pneumatic transport. For agglomerated powders, mechanical treatment must be minimised in order to maintain product structure.
Mix and prepare liquid ingredients for further processing

GEA Process Engineering and its sister companies provide a complete range of technology, equipment and know-how for the reception, pretreatment and storage of a wide variety of food products prior to spray drying. Depending on the application, feed preparation may involve a variety of steps, including mix-processing, separation of impurities, homogenization, pasteurization and storage. Integrating each separate step into a continuous feed preparation process calls for a high level of expertise, including hygienic process design expertise. GEA Process Engineering offers tailor-made feed preparation processes to precisely match your product application requirements.

**Mix-processing**

Using batch-mixing, individual base materials from a tank farm are supplied into a load-cell tank, where they are precisely weighed and mixed to form the finished and/or semi-finished product. Frequently, a multi-component mixer is used in mix-processing. This mixing system allows an independent and fully automatic blending of two or more product streams under controlled mixing rates and temperature and viscosity conditions.

**Homogenization**

Homogenization plays a key role in most production processing in the food industry. Homogenization technology utilizes pressure to subdivide liquid particles or droplets into the smallest possible sizes (submicron) and create a stable dispersion/emulsion ideal for further processing. GEA Niro Soavi accomplishes this process with unique homogenizing valves that achieve the required degree of micronization and dispersion at the lowest possible pressure, according to application requirements.

**Pasteurization**

A top priority in food processing is to achieve long shelf-life with maximum efficiency and minimum loss of quality. Pasteurization is accomplished by thermal treatment – followed by rapid cooling – of the product in a pasteurizer. Plate or tubular heat exchangers are the best choice for heating product to the correct pasteurization temperature. GEA Process Engineering offers different types of treatment systems to match the specific requirements of your product application.
Liquid feed preparation

Feed preparation systems

- Raw material
- Feed tanks
- LSI™
- Filters
- CO2
- 4 effect TVR evaporator
- Chilled tanks
- Mixing tank 1 x 3,500 l
- Oil
- Powder
- Homogenizer
- Heat exchanger
- CIP
- Feed to spray drying plant
Produce high-solid extracts of natural substances

Different raw materials have a variety of tissues and textures, which call for different isolation methods using a range of solvents and solvent mixtures. GEA Process Engineering is a world leader in supplying GEA Niro extractors for the food industry. We have in-depth experience in the design and manufacture of extraction process equipment for a wide range of active compounds.

**Continuous extraction**

The GEA Niro continuous extraction process is the result of a dedicated research and development programme. It operates on the counter-current extraction principle and features an inclined trough, in which the inclination is adjusted to suit an exact solvent/solid retention time. The trough is surrounded by heat-transfer jackets for exact temperature profile control. Solids are transported by helicoidal screws in a gentle spiral movement, which produces ideal counter-current plug-flow extraction conditions. Hot extraction liquid flows downwards through the solids, thereby extracting the desired active component. This technology allows production of quality extracts and the highest possible yields, enabling further economical liquid processing of the extract or conversion to powders by spray drying.

The GEA Niro continuous counter-current extractor (CONTEX™) achieves:

- High yields of extractable material
- High solids content in the extract
- Uniform and controllable residence time for efficient extraction
- Easy scale-up from low to large capacity units
- Low operating costs by minimising cleaning time and maintenance costs

**Batchwise extraction**

The conventional column extractor uses a system of batch-operated percolator columns. The solids are fed into vertical percolator vessels and the extraction liquid flows downwards in a plug flow. The extraction takes place under relatively high temperature and pressure, resulting in both high yield and high quality, due to controlled residence time.

![Graphs showing actual plug flow and back mix flow, along with percentage of particles and residence time.](image)

Left graph shows the actual plug flow curve of solids flow achieved in the extractor. Right graph shows that the soluble content in the extract is low at the solids exit; soluble content is high where the solids are fed in the extractor, thus maintaining a high yield of extraction.
The GEA Niro continuous counter-current extractor (CONTEX™) is designed for controlled change of process conditions for optimization of yield and quality.
Concentration

Separate and concentrate liquid components

GEA Process Engineering and its sister companies offer a complete range of technology for concentration of many different types of food products. We are uniquely positioned to provide both customised plants and complete process lines specifically tailored to your exact product requirements.

**Thermal evaporation**
Industrial evaporation is employed for the large-scale production of concentrated solutions and plays a critical role in the manufacture of a variety of food products. Removing water in a spray dryer is more costly and requires more energy than removal through evaporation. GEA Wiegand’s thermal evaporation technology encompasses a variety of evaporators, including falling-film evaporators and rotary thin-film concentrators, for the concentration of liquid streams. The processes are used to increase solids content or to reduce volume by removing water. Thermal evaporation features either thermal or mechanical recompression of vapours, ensuring low energy consumption and short product-residence time at low temperature. The process runs under vacuum and controlled heat with low degradation of sensitive products.

**Membrane filtration**
Reverse osmosis (RO), nano-, ultra-, and microfiltration are used for special liquid separation requirements in which liquid components have to be separated or solids content increased without any product deterioration. This method is applied for separation of liquid components or concentration of solids without thermal or mechanical treatment. The filtration plants are equipped with special membranes made of organic polymer or ceramics from GEA Filtration.

**Freeze concentration**
Freeze concentration is a new technology for concentrating natural products at water’s freezing point by means of crystal formation and then separating the ice crystals in a washing column. GEA Niro PT freeze concentration technology (NFC) provides both maximum quality retention and a relatively high concentration factor. The process operates at freezing temperatures and therefore maintains the original aroma and flavour composition balance, protecting heat-sensitive components.
Concentration systems

Standard NFC system flowsheet

GEA Wiegand thermal evaporator.
Spray drying

Spray drying is the most widely used industrial process for particle formation and drying. It is extremely well-suited to the continuous production of dry solids in either powder, granulate or agglomerate form from liquid feedstocks. Feedstocks can include solutions, emulsions and pumpable suspensions. Spray drying is ideal when your end-product must comply with precise quality standards regarding particle size distribution, residual moisture content, bulk density and particle shape. GEA Process Engineering has significant expertise in the application of closed-cycle spray dryers in the food industry, and we design and supply a range of GEA Niro spray dryers in both open- and closed-cycle designs.

Spray drying starts with the atomization of a liquid feedstock into a spray of droplets. Next the droplets are placed in contact with hot air in a drying chamber. The atomization is produced by either rotary (wheel) or nozzle atomizers. Evaporation of moisture from the droplets and formation of dry particles proceed under controlled atmosphere, temperature and airflow conditions, and powder is continuously discharged from the drying chamber.

Solutions tailored to your product requirements
Every GEA Niro spray dryer consists of a feed pump, atomizer, air heater, air disperser, drying chamber and systems for exhaust air cleaning and powder recovery. Because the drying characteristics and quality requirements of the thousands of products GEA Niro spray dries vary so widely, the solution we select for you will be based on your product’s individual specifications.
GEA Niro spray dryer.
GEA Niro Spray dryer chamber designs

Since most spray drying plants operate for 30 years or more, the functionality, stability and flexibility of your plant will determine the financial soundness of your investment. Over time, many things can change – from the market, to properties requested, to ingredients and a host of factors related to energy and pollution.

GEA Process Engineering can help you select the optimal installation to cope with new challenges – by offering a wide variety of solutions and by continuously developing our products and technologies. With more than 75 years in the market and state-of-the-art pilot test facilities, GEA Process Engineering has the credentials it takes to choose the right installation, to put it into production quickly and to secure support in a changing world.

FILTERMAT™ Dryer

Counter Current

1. Co-current, with integrated belt, nozzle atomizer.

2. Co-current, conical base with rotary atomizer, for both heat-sensitive and stable products.

3. Co-current, with nozzle atomizer.

4. Mixed flow, with integrated fluid bed, rotary or nozzle atomizer for non-dusty, free-flowing products.

5. Mixed flow, with integrated filter and fluid bed, rotary or nozzle atomizer. All in one.
GEA Niro Spray drying systems

Since drying characteristics and product specifications vary from product to product, no single design is suitable for all applications. GEA Process Engineering offers a wide range of chamber and system designs. This allows us to select the type of drying plant that can provide the most cost-effective and property-preserving process for your product. The most common spray drying systems appear below. Our pilot plant facilities encompass more than 50 different plant set-ups. These test facilities and accompanying analytical laboratories allow you to establish the feasibility of using GEA Niro equipment, optimize process conditions and provide samples for market analysis.
Fluid bed drying and processing

Turn wet powder into dry powder and powder into agglomerates and granulates

GEA Process Engineering determines the drying properties of a given product from drying rate data; i.e., how volatile content changes with time in a batch fluid bed operating under controlled conditions. Other important properties are fluidization gas velocity, fluidization point (i.e., the volatile content below which fluidization without mechanical agitation or vibration is possible), equilibrium of volatile content and heat transfer coefficient for immersed heating surfaces.

We apply these and other data in a computer model of fluid bed processing, enabling us to determine the industrial drying system that best meets your needs.

GEA Process Engineering equips each GEA Niro fluid bed with a tailor-made gas disperser plate made by a GEA Niro GILL PLATE™ or a GEA Niro BUBBLE PLATE™ with gas orifices (gills) in a pattern specially designed for each product (Patented).

The GEA Niro CONTACT FLUIDIZER™ is equipped with feed spreader and contact heating/cooling surfaces. The GEA Niro CONTACT FLUIDIZER™ can be constructed with internal bag filters.

Fluid bed drying is suitable for powders, granules, agglomerates and pellets with an average particle size normally between 50 and 5,000 microns. Very fine, light powders or highly elongated particles may require vibration for successful fluid bed drying – which is possible with the GEA Niro VIBRO-FLUIDIZER™.

Benefits of fluid bed drying of solid products

- Ideal for both heat-sensitive and non-heat-sensitive products
- Higher thermal efficiency
- Prevents overheating of individual particles
- Considerably larger capacity
- Fewer moving parts for lower maintenance costs
- Greater flexibility to adjust drying conditions
- Easier material transport
- Use of low-pressure steam
- Fluid bed BARRIER GAS™ (patent pending)

GEA Niro VIBRO-FLUIDIZER™ for final drying and cooling of spray-dried powders.
There are two basic types of fluid bed designs, differentiated by the solids flow pattern in the dryer:

- **Back-mix flow design** – for feeds that require a degree of drying before fluidization is established
- **Plug flow design** – for feeds that are directly fluidizable upon entering the fluid bed

A fluid bed can be stationary or vibrating. Heating panel banks can be applied to the stationary beds.

GEA Process Engineering carefully considers the requirements of the material you are processing before selecting the ideal fluid bed.
GEA Niro Fluid bed process systems

GEA Process Engineering will recommend the process system that best meets your product’s properties, specifications and requirements regarding operational safety and environmental responsibility. Some of the most frequently used fluid bed process systems appear below.

**Open system CONTACT FLUIDIZER™**

**Closed-cycle CONTACT FLUIDIZER™**

in side-by-side double decker configuration

**Open system with Flash Dryer**

**SPRAY FLUIDIZER™**
Agglomeration

Turn small particles into agglomerates

During the spray drying process the aim is to produce particles with good wetability, fast dispersability and 100% solubility. Big single particles are easy to disperse in water but dissolve only partially, while powder consisting of small particles is difficult to disperse. Due to abundant capillary space, large powder particles made out of small single particles dissolve instantly in water. As opposed to small particles, agglomerated powders ensure quick dispersion and dissolution of the agglomerates. Furthermore, agglomeration of powders improves the product’s flowability and reduces dust problems during powder handling, which decreases machine maintenance and cleaning costs.

Rewet agglomeration

Agglomeration results when powder is submitted to controlled moisture and steam for heat – or a binder – and collides on a rotating surface inside a chamber where the atmosphere is controlled to suit the agglomeration process. The impact forms a stable agglomerate. The powder fraction that is under a given agglomeration particle size is segregated in a sieve and returned to the powder feed-in system.

Modern GEA Niro spray dryers like the MSD™/FSD™ or IFD™ can produce powders in an agglomerated form ready to be dissolved in water. Powders from traditional spray dryers producing single particles can be “made instant” in a special agglomeration plant by a combination of rewetting the surface of the particles and a mechanical treatment to make the single particles “glue” together before residual moisture adjustment and cooling. The GEA Niro REWET AGGLOMERATOR™ produces coarse, instant, free-flowing and dustless agglomerated powders.

Process mastery

Mastering agglomeration techniques is the art of modern spray drying – the art of GEA Niro. Plant operation and economics are other important parameters. Our product specialists and plant designers build these factors into the process when designing spray drying plants to meet your individual needs.
GEA Niro agglomeration systems
Spray congealing

Turn melt into powder

Various droplet formation techniques and efficient droplet/air contact make GEA Niro spray congealing ideal for transforming melted feedstocks into spherical particles of controlled size. Average particle sizes ranging from below 50 to 2,000 microns are possible. Even particles with an average size from 3 up to 50 microns can be created with one of the special patented GEA Niro two-fluid nozzles.

Depending on particle size requirements and the need for post-cooling/crystallization, most of the spray dryer concepts are applicable, including chambers equipped with fluid beds. A GEA Niro spray congealer offers you the following advantages:

- Fewer moving parts than belt coolers – less maintenance
- Only one feed line when selecting the GEA Niro prilling wheel
- High standard plant capacities
- Easy change between open- or closed-cycle to reduce energy consumption
- Water injection possible to reduce cooling station energy consumption
- Narrow, uniform particle distribution for a free-flowing product

 Spray congealing applications
- Emulsifiers
- Encapsulated materials
- Fats
- Gelatine
- Glycol ester
- Mono- and triglycerides
- Propylene
- Waxes
- Others

GEA Niro spray congealing chamber, including fluid bed.
GEA Niro spray congealing systems

Closed-cycle spray drying process

Spray atomization and final powder in spray congealing of melted fat and hydrogenated vegetable oils.
Conveying, storage and packing require great care in order to maintain the physical properties acquired during drying. The precise type of product being handled determines the solution. Ordinary powders can be conveyed by conventional methods, including pneumatic transport. If the product is an agglomerated powder, mechanical stability must be conserved in order to maintain product structure. GEA Process Engineering specialises in supplying lenient powder handling and, where needed, vacuum transport systems. The GEA Group includes a number of companies specialised in meeting your exact needs.

**Powder handling and silo storage**

GEA Colby specialises in powder handling and silo storage systems designed to meet strict hygienic standards – particularly relevant for food manufacturers, who must prevent contamination of powders during handling and storage. GEA Colby supplies a variety of conveying systems, depending on:

- type of product – agglomerated or non-agglomerated
- conveying distance – horizontal and vertical
- number of silos – vacuum or pressure systems

**Bagging off**

GEA Avapac takes hygienic design a step further in bag filling and handling by providing smart methods that enable producers to easily keep systems clean and properly serviced. GEA Avapac supplies bagging-off lines from small, semi-automated systems to large, fully automated lines filling and palletizing up to twelve 25 kg bags per minute, or 18 tons per hour.

**Complete systems for powder packaging**

The recent addition of GEA Albro, specialists in vacuum filling, to the GEA Group helps position GEA Process Engineering as the world leader in supplying complete systems for powder packaging. GEA Albro’s portfolio of powder packaging systems includes powder filling systems, capping systems and liquid systems for a wide variety of food products. Sophisticated line control technology also boosts overall equipment effectiveness and improves productivity.
Powder handling systems

Fluid bed Sieve
Pressure pots
Pressure transfer
Divert valve
Divert valve
Divert valve
Divert valve
Valve cabinet Compressor Vacuum pump
Separators

Silo 1
Silo 2
Silo 3
Silo 4

Vacuum transfer

Hopper 1
Packaging

Powder packaging

25 kg bags

Bulk
Intermediate Bulk Container
Powder re-use

Flexible Intermediate Bulk Container

Retail
Flexible containers
End users

Flexible containers
Rigid containers

Powder production
Powder packaging
GEA Niro systems comply with international health, safety and environmental regulations

GEA Process Engineering can help you address some of the food industry’s most pressing challenges: hygiene, safety and environmental compliance. All of these are addressed in every modern GEA Niro plant. All our plants meet the strictest physical, chemical and bacteriological hygienic requirements, as defined by regulations from governing bodies, and are supplied with built-in CIP systems to provide thorough, efficient cleaning of the production line.

Our expertise in explosion-control design is unequaled – an invaluable aid whether you’re looking at ATEX, other safety directives or local regulations. We examine your product and its properties, analyse the risks according to well-established safety procedures and recommend the safety concept that is best suited to your situation. Our plants are designed to eliminate possible ignition sources. When needed, we provide additional safety protection by installing explosion-relief or suppression systems that operate in combination with automatic fire extinguishing systems.

Added value

Whether you are planning a new plant or updating an existing facility, take a look at the full range of services GEA Process Engineering offers for ensuring your facilities and safety systems comply with relevant directives.
A full range of services

When you choose GEA Niro powder engineering, you benefit from more than advanced technology – you also get a long-term business partner. We offer a host of services that enable you to maximise your business opportunities by keeping pace with the evolving requirements of the food industry.

### Comprehensive research and development

Our know-how is founded on comprehensive research and development and strengthened through cooperation with food organisations and universities. GEA Process Engineering offers the world’s most popular tomato dryer.

### A full range of services

GEA Process Engineering delivers added value on top of advanced powder technology.

Drawing on years of experience and technical expertise, GEA Niro designs, supplies, installs and commissions production units and complete production plants worldwide.

When you choose GEA Niro powder engineering, you benefit from more than advanced technology – you also get a long-term business partner. We offer a host of services that enable you to maximise your business opportunities by keeping pace with the evolving requirements of the food industry.

Comprehensive research and development

Our know-how is founded on comprehensive research and development and strengthened through cooperation with food organisations and universities. GEA Process Engineering offers the world’s most popular tomato dryer.

A unique partner

With in-house project financing expertise as well as industry and technology knowledge, GEA Process Engineering is a unique partner at every stage of the planning, design and delivery of an industrial processing plant. We are also always available to help you comply with evolving safety, health and environmental regulations. Because food market demands change over time, you may benefit from a visit by one of our product specialists to evaluate the possibility of process modifications and optimisations.

Global presence – local after-sales service

We believe service is a local business. With GEA Process Engineering, you never have to go far for assistance or overcome different time zones or language barriers. We are on the spot in local markets all around the globe – not just with representatives, but with our own staff, stocks of spare parts, service engineers and training specialists.

Your GEA Niro installations also get the best possible care through our key component repair, worldwide service and preventative maintenance programme. Have you benefited? Less unplanned downtime, greater efficiency, enhanced performance and longer plant lifetime.

For more information about how GEA Process Engineering can provide total solutions for industrial drying and powder product engineering in the food industry, please visit www.niro.com.
GEA Group is a global engineering company with multi-billion euro sales and operations in more than 50 countries. Founded in 1881, the company is one of the largest providers of innovative equipment and process technology. GEA Group is listed in the STOXX® Europe 600 Index.