GEA crystallization technologies

Innovative and proven solutions

GEA engineering for a better world

Expect more

World-class industrial crystallization solutions.

The name GEA has become synonymous with innovative tailor-made process solutions in the diverse field of crystallization technology. With more than 100 patents and 2000 references worldwide, we understand that a successful business relies on its ability to adapt quickly to evolving market conditions. That's why we specialize in creating highly versatile crystallization solutions, calibrated for your applications, with the flexibility and scalability to meet your demands.

We are there when you need us

With GEA as your partner, our vast pool of crystallization knowledge, expertise and technology is entirely at your disposal. Together, we can bring your ideas to life, engineered according to your specifications.

Flexible solutions

Whether you require expert advice on starting a new project, developing a more efficient process, upgrading a plant, or building a new installation, GEA can provide an ideal solution that incorporates innovative energy reduction technologies and can reduce the environmental footprint.

Your success is our success

We are here to support you with a customized service that is designed to increase your business and your bottom line.

Innovation and test center

Experience meets innovation - turning smart ideas into process solutions.

GEA's worldwide success is based on comprehensive technology and process know-how combined with decades of engineering research, product testing and experience. GEA operates more than 40 test centers, all over the world, to support you in product development.

The centers of excellence for crystallization are located in France, the Netherlands and Germany. More than 2000 m² of testing area, equipped with laboratories and numerous pilot plants, is available for product and feasibility trials, scale-up studies, process optimization and development as well as training programs.

Chemical laboratory in a GEA test center facility

Analytical accuracy maximizes performance

The basic information for the design of crystallization plants is determined in the laboratory. This includes the chemical composition of the product, its physical properties (viscosity, density, solubility, metastable zone width [supersaturation] and desupersaturation rates) and the formation of mixed crystals.

Piloting and scale-up

Our test centers are equipped with several pilot plants that accurately represent most types of crystallizers. They are constructed according to the same design principles as industrial units and provide reliable operational data.

With products that are too sensitive to be shipped to our facility, or that require special handling (due to safety or health concerns) our team may perform the necessary tests or investigations at customer locations.

GEA test center with several pilot plants

The right technology for your product

Decades of experience, first-class application know-how and a passion for innovation have made us one of the leading specialists in crystallization technology.

Whatever your application, we will help you find and implement the optimal process solution for your product.

PRODUCTION OF BULK PRODUCTS FROM SOLUTIONS

Recovery of dissolved substances in high purity and desired granulometry.
Applications: salt; potassium, nitrogen and phosphorus fertilizers; battery linked elements like lithium, copper, magnesium, nickel and zinc salts; alloying elements like molybdenum, Vanadium, tungsten; sodium chloride in every purity and particle size; many other organic and inorganic substances

PRODUCTION OF BIOCHEMICALS

Isolation and purification of biobased chemicals after fermentation and biomass separation, as well as crystallization of the final product.
Applications: citric acid, ketogulonic acid, ascorbic acid, isomaltulose, threonine, lysine, malic acid, succinic acid, para-xylene, lactide for PLA

TREATMENT OF INDUSTRIAL WASTEWATER

Treatment of industrial waste water up to zero liquid discharge (ZLD) - savings on resources and disposal costs by recovering water and other recyclable materials.
Applications: salt containing wastewater, wastewater from minerals processing, flue gas desulfurization effluents, effluents from power plants, sulfuric acid pickling baths, hydrometallurgical wastewater

PURIFICATION OF ORGANIC CHEMICALS

Separation and purification of chemical compounds when conventional processes are difficult and complex.
Applications: monomers like MDI, TDI, DCB, xylenes, acrylic acid for producing polymers like polyurethane or PET, durene, aliphatic and carboxylic acids, benzoic acid, phosphoric acid, hydrogen peroxide, acetonitrile, alcohols and a wide variety of organic specialty chemicals

CONCENTRATION OF AQUEOUS PRODUCTS

Dewatering of aqueous solutions without thermal impact, biological degradation or loss of volatiles or solids - maintaining the original product characteristics.
Application: aqueous food products, fruit and vegetable juices, liquid coffee and tea, beer, vinegar, meat and fish extracts, herbal and vegetable extracts, dairy products, hazardous waste streams

SOLUTION CRYSTALLIZATION

Crystallization from a solution is probably one of the oldest processes that mankind has harnessed from nature. The best known application is the recovery of salt. Solution crystallization, also referred to as mass crystallization, is the formation of solid crystals from a supersaturated solution. It is a common solid-liquid separation technique. The most common solvent is water. With crystallization the dissolved substance is recovered in high purity and the desired granulometry.
Depending on the type of crystallizer, the achievable particle size ranges from microns to millimeters.

Essentially three types of crystallizers are used - forced circulation (FC) crystallizer, draft tube baffle (DTB) crystallizer, and OSLO crystallizer. GEA provides all of them, as single units as well as in combination, to achieve customers goals.

The selection of the equipment and the design of the crystallization operation is influenced by many product and process-specific factors. Laboratory tests and trials in pilot plants are the prerequisite for the correct process engineering design. Customer requirements, such as energy conditions and the overall situation on site, play an important role in the implementation of the process engineering design in an industrial plant and must be taken into account.

MELT CRYSTALLIZATION

Melt crystallization is a suspension based process providing slow crystal growth rates that allow pure crystal formation even in relatively impure melts. An ultra-high purity product can be achieved as crystallization is extremely selective. Our proven wash column technology effectively separates the value products from the impurities.

FREEZE CONCENTRATION

Freeze Concentration is the removal of water from a solution in the form of ice. When supreme quality concentrates are required, freeze concentration is the process of choice. The very gentle concentration at sub-zero temperatures allows product freshness, aroma and flavors to be maintained and practically eliminates all biological degradation.

Solution crystallization

Solution crystallization is the formation of solid crystals from a supersaturated solution. It is a common solid-liquid separation technique.

Worldwide, millions of tons of bulk products are crystallized daily from solutions - products, like sugar, salt and fertilizers. The name of the applied unit operation is mass crystallization, or single crystallization from solution. The most common solvent is water. With crystallization, the dissolved substance is recovered in high purity and the desired granulometry. Depending on the type of crystallizer, the achievable particle size ranges from microns to millimeters.

There are three basic types of crystallizers: forced circulation (FC) crystallizers; draft tube baffle (DTB) crystallizers; and, Oslo crystallizers. They can be used for:

- Cooling crystallization
- Evaporative-cooling crystallization
- Evaporative crystallization
- Reaction-crystallization

GEA can provide all of them as single units or in combination. They can be arranged in several ways:

- Single or multiple stages and effects (evaporative)
- Recompression of produced vapor (thermal or mechanical)

Additionally, as one of the largest technology supplier, GEA can provide corresponding upstream and downstream processing steps including preconcentration (evaporation and membrane filtration), debrining (thickening, filtration or centrifugation), drying, solids handling and packaging, offering a complete process line.

Application

- Agrochemicals, including potash and multinutrient fertilizers
- Table salt and inorganic salts
- Minerals and metals, including lithium, magnesium, nickel and zinc salts, and alloying elements like copper, molybdenum, vanadium and tungsten
- Inorganic acids
- Food and food related chemicals
- Organic and bio based chemicals
- Landfill leachates concentration plants
- Industrial wastewater treatment up to zero liquid discharge (ZLD) systems

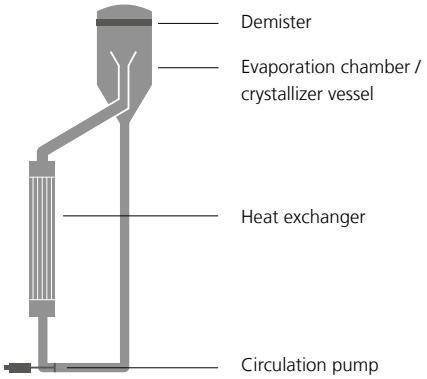
Draft tube baffle crystallizer in the fertilizer industry

BENEFITS

- Suitable for most applications, especially for large capacities
- Different crystallizer types and arrangements for every desired particle size
- Controlled residence time for optimal growth
- Continuous operation
- Energy-efficient plant concepts

Forced circulation crystallizer

The forced circulation (FC) crystallizer is the most common type of crystallizer. Simple in design and easy to operate, it is usually employed in evaporative crystallization of relatively flat or inverse solubility products, in rather viscous media and when scaling is a major issue. Its high mechanical energy input and high secondary nucleation rate make it best solution when large crystals are not required (average size <1 mm).

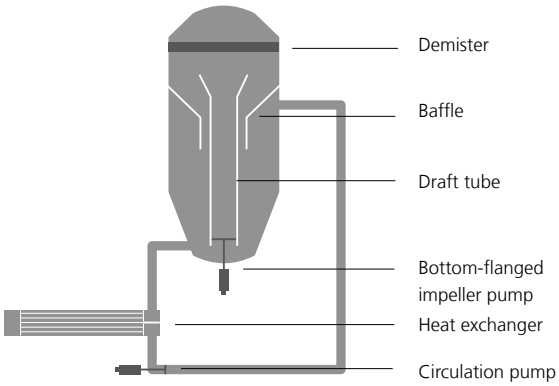


The FC evaporates solvent, thus increasing the supersaturation in the process liquor, and causing crystallization. Slurry from the crystallizer vessel is circulated through the heat exchanger, and returned to the crystallizer vessel, where its supersaturation is relieved by deposition of material on the crystals present in the slurry. The supersaturation is controlled, so as to avoid spontaneous nucleation, by sufficient circulation capacity. Most conventional FC units operate under vacuum, or slightly over atmospheric pressure.

Draft tube baffle crystallizer

The draft tube baffle (DTB) crystallizer is specially designed to produce coarse crystals with narrow size distribution. According to process requirements it can be used for evaporative, cooling or reactive crystallization, always providing steady operation under the whole capacity range due to its ability to operate at optimal supersaturation and to control crystal population inside the system. The DTB can produce large particles (up to 3 mm) because it gently agitates growing crystals. It has a controlled residence time for optimal growth and a long operating cycle with limited encrustations.

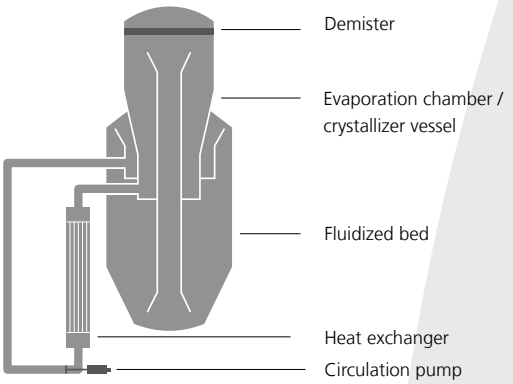
The DTB was given this name because it provides two discharge streams: the slurry that contains the product crystals, and the mother liquor (saturated solvent) with a small amount of fines.



Most conventional DTB crystallizers operate under vacuum, or slightly over atmospheric pressure. DTB crystallizers have been studied widely in crystallization theory, and can be modelled with accuracy. Its distinct zones of growth and clarified mother liquor make it possible to define in terms of kinetic parameters, and thus growth and nucleation rates can be determined. These features make the DTB crystallizer very suitable to mathematical description, and thus subject to good operating control.

OSLO crystallizer

This crystallizer type is also referred to as fluid-bed-crystallizer. GEA is the premier designer of OSLO crystallizers in the world. The primary advantage of the OSLO crystallizer is the ability to grow crystals in a fluidized bed, which is not subject to mechanical circulation methods.



Compared to other crystallizers, an OSLO crystallizer will grow the largest crystals. The slurry is then removed from the crystallizer's fluidized bed and sent to be separated.

Melt crystallization

With melt crystallization chemical compounds can be separated by cooling to a temperature range and conditions where the major compound crystallizes and the impurities stay in solution.

Melt crystallization systems remove heat and cool the liquid to create a driving force for the formation and growth of crystals. Melt crystallization provides an economic and energy-efficient alternative purification step in cases where standard distillation is unsuitable due to close boiling isomers, azeotropic systems, products that tend to polymerize, heat sensitive products, or explosive substances. The suspension based process provides slow growth rates that allow pure crystal formation even in relatively impure melts. By combining this extremely selective crystallization system with our proven washing column technology that separates the crystal from the mother liquor, an ultra-pure product can often be obtained after one step.

Economical with high product quality

In this application field, GEA's technology is known for considerable reductions in energy consumption and superior product quality. The processes' ability to split feed into two streams with adjustable purities along with its outstanding energy efficiency, make this process the technology of choice for many customers. The innovation potential of our team is reflected by more than 30 patents in this technology field.

Application

Melt crystallization is typically used in operations where high purity products are required. It also has the potential to reduce energy requirements due to phase change at a much lower latent heat level. The following products are often produced by melt crystallization:

- Substituted aromatics used in specialty polymers (pDCB, pDIB, pCT, NVP)
- Isocyanates used in the manufacture of polyurethane (MDI, TDI)
- Xylenes for the production of PET (pX and mX)
- Aliphatic and carboxylic acids (MCA, Acrylic acid, Acetic acid, Lactide)
- Benzoic acid, Phosphoric acid
- Specialty solvents (acetonitrile, alcohols)
- Wide variety of high purity organic specialty chemicals

Melt crystallization plant for benzoic acid purification

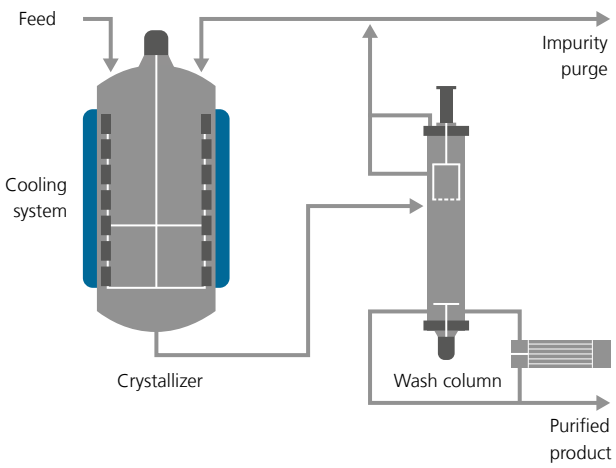
BENEFITS

- Low energy consumption as the product is typically crystallized only once
- Required heat is two to four times lower than for evaporation
- Low operation temperatures
- Separation of components with close boiling points and those difficult to distill
- Continuous operation
- No need for solvents, thus no need for solvent recovery or waste by-products

Freeze concentration

Many industries dewater aqueous solutions. The objective can be to create high-quality food and beverage concentrates or, in non-food applications, retention of special properties in the concentrate.

In principle, freeze concentration is a special form of melt crystallization. The the difference is that the liquid is a solution with water instead of a chemical and the product is the concentrate instead of the (ice) crystals. Freeze concentration converts part of the water into pure ice crystals. The complete separation of these ice crystals results in specific removal of water at very low processing temperatures. The very gentle concentration at sub-zero temperatures allows product freshness to be maintained and practically eliminates all biological degradation. Since the crystallization process is highly specific for water and no vapor phase is present, all volatile aromas and flavors will be preserved in the liquid concentrate.



The capacity range available in industrial plants is very broad. Various configurations with dewatering capacities ranging from 200 to 200,000 tons per year have been installed. The process can handle a variety of products from small volume specialty products to large scale commodities.

Application

- Aqueous food and beverages like liquid coffee and tea, fruit and vegetable juices, beer, wine and vinegar, dairy products, meat, fish and plant extracts
- Enzymes and products with functional groups that are sensitive to degradation by heat in standard concentration processes.
- Hazardous wastewater streams, for example for the concentration of wastewater before incineration and for aqueous solutions containing mixtures of volatile and non-volatile organic components. In addition to the organic components, salts containing, scaling and fouling products can be handled by specially designed scraped surface heat exchangers.

Wash column of a freeze concentration plant

BENEFITS

- No loss of volatiles or solids
- Sub-zero temperature processing
- Maintains original product characteristics
- Closed system, prevents oxidation
- Elimination of microbiological activity
- Continuous and stable operation
- No need for intermediate cleaning

Your project is in capable hands

With over 2,000 installations across virtually every industry and numerous new projects in progress every year, we offer unparalleled experience in managing your project from start to finish.

The right people

Over nine decades, we've fine-tuned our approach to maintaining the highest standards of quality and efficiency at every stage. As a key part of this, we allocate a dedicated Project Manager as your single point of contact to keep everything transparent and tightly organized. Your Project Manager will be the face for a larger team of specialists hand-picked for your specific project.

The right training

We have invested heavily in training all our Project Managers to have the right skill set, application expertise and experience to guide you seamlessly through the process. To be qualified as a GEA Project Manager, the person must have extensive exposure to accounts of all sizes, locally and globally, and have passed an international project management course. Not only does this person provide excellent technical and organizational strengths, they also possess every attribute necessary for the smooth running of your project, including strong communication skills, multiple languages and solid problem-solving abilities.

On time and on budget

This proven and trusted approach creates the basis for an on time and on budget outcome.

This includes:

- Initial meetings to get to know everyone involved and outline project expectations
- Basic Engineering Package to highlight potential technical issues and solutions
- Planning for key milestones, site management, installation, commissioning and safety audits
- 3D CAD plant design, including ERP systems, for optimization and fault-finding prior to construction
- Transparent and timely management of your plant's construction and installation
- Commissioning by the project manager, process control expert and process technologist

Finally, when everything has been thoroughly tested and your employees trained in its operation, the plant is handed over to you for production, with our on-going support if needed.

GEA Service – For your continued success

For us, service and partnership go hand-in-hand. We will provide the proactive support you need over your plant's lifecycle to keep you updated, upgraded and able to upscale as opportunities arise.

Working with GEA Service means partnering with a dedicated team of service experts. Our focus is to build, maintain, and improve customer performance throughout the entire life cycle of the plant and its equipment.

- Beginning of Life Services – Getting you started with seamless support for instant productivity and performance
- Lifetime Services – Keeping it running with the cost-efficient way, safely and reliably
- Extended Life Services – Constantly improving by sharing our knowledge to safeguard your investment
- Consulting & Enhanced Operations – Together with you, through our enduring commitment to you and your business

engineering for
a better world

We live our values.

Excellence • Passion • Integrity • Responsibility • GEA-versity

GEA is one of the largest technology suppliers for food processing and a wide range of other industries. The global group specializes in machinery, plants, as well as process technology and components. GEA provides sustainable solutions for sophisticated production processes in diverse end-user markets and offers a comprehensive service portfolio.

The company is listed on the German MDAX (G1A, WKN 660 200), the STOXX® Europe 600 Index and selected MSCIS Global Sustainability Indexes.

GEA Messo GmbH
Friedrich-Ebert-Str. 134
47229 Duisburg
Germany
Tel +49 2065 903 0
gea.com/contact

GEA Niro PT B.V.
De Beverspijken 7b
5221 EE 's-Hertogenbosch
The Netherlands
Tel +31 73 6390 390
gea.com/contact

GEA Process Engineering SAS
4, rue Jean Pierre Timbaud
78185 Montigny-le-Bretonneux
France
Tel +33 130 146 110
gea.com/contact