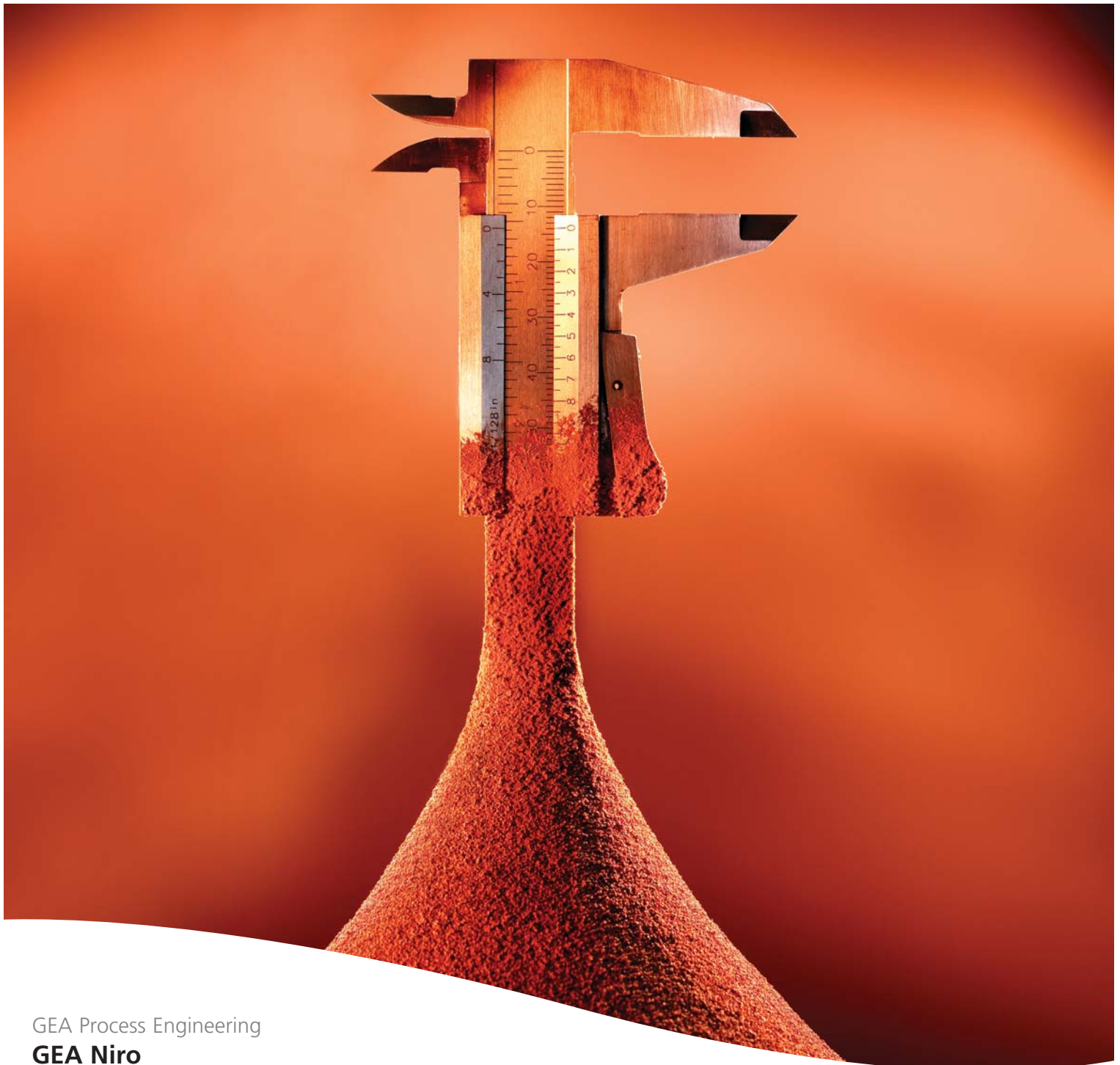


Spray drying solutions

for R&D and small-scale production



Expect more from GEA Niro

Equipment, experience, process expertise, support – it all adds to your success

Getting it right from the start

With more than 3,000 references for R&D and small production units, GEA Niro has unmatched expertise within small-scale spray drying technology. Which means that we have the know-how to help you choose exactly the right process and equipment. Many of the world's leading manufacturers and their R&D departments, independent research centers and universities work with GEA Niro and they all gain from our process and product knowledge.

Our broad range of state-of-the-art spray dryers offers the industry's best solutions for R&D and small-scale production. And when you choose GEA Niro you benefit from more than advanced technology – you also benefit from our unsurpassed level of experience. We assess each project on its individual needs and tailor the process and the spray dryer to match your specific application requirements.

Up and running, and up to date

Collaborating with GEA Niro gives you access to the greatest concentration of spray drying experts in the world. From process technologists versed in particle design, to process engineers practised in overcoming the difficulties of scale-up to commercial production and experts familiar with the intricacies of regulatory procedures. In addition to the most qualified up-front advice, you gain the long-term security of knowing that the best professionals in the business are there for you when you need technical support and service.

Picture yourself a few years from now, when research requirements or market conditions have changed. When it's time for an upgrade, GEA Niro will be right by your side.



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We offer the most in-depth support – and the most dependable pipeline of innovative ideas and technologies – of any supplier in the drying industry. We'll help you keep your plant up and running, and up to date.

There when you need us

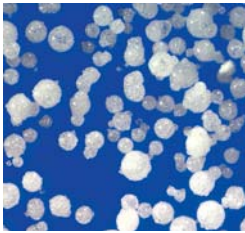
We're a truly global supplier, but we believe service is a local business. With GEA Niro, you never have to go far for assistance or overcome time or language barriers. We're there, whenever and wherever you need us. And not just with representatives, but with our own staff, stocks of spare parts and service engineers.



- TAILOR-MADE PRODUCTS
- MOST VERSATILE SPRAY DRYING SYSTEM - COVERS WIDE PRODUCT RANGE
 - HELPS LOWER ENERGY CONSUMPTION AND TOTAL PRODUCTION COST
 - MORE THAN 75 YEARS DESIGN AND OPERATION EXPERIENCE
 - WORKING WITH LOGIC AND LOGICISTS

Process and equipment expertise

GEA Niro offers the world's largest pool of talent specialised in tackling spray drying challenges



Powders



Agglomerates

GEA Niro tailors the drying process to the particulate size, structure, moisture content and other properties needed for your application.

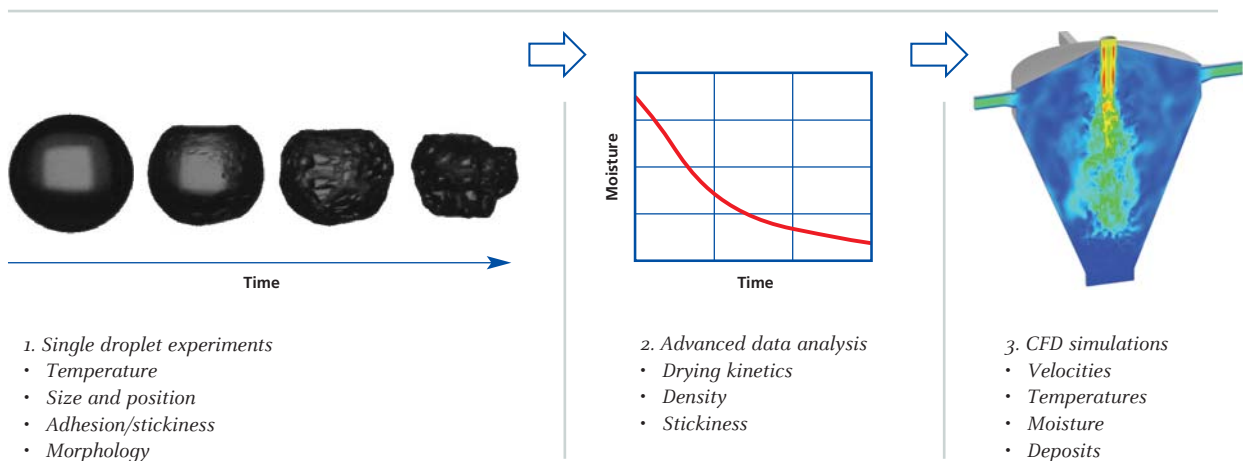
Testing and spray drying solutions

Want a drier powder? An easier flowing powder? Agglomerates with fewer fines? With more than 75 pilot plants in GEA Niro Test Centers worldwide and an international team of test engineers and process technologists, GEA Niro represents the world's largest pool of talent specialised in spray drying. We provide powder engineering expertise and process verification through laboratory and pilot plant testing. We also offer the industry's most advanced analytical capabilities, including dynamic flow modeling based on the drying properties of a single droplet.

Analytical accuracy maximises performance

In fact, GEA Niro has vastly improved the accuracy of computational fluid dynamics (CFD) simulation that is the backbone of our plant design. Our proprietary method, called DRYNETICS™, is a technological breakthrough that incorporates real-world measurements – such as drying time and stickiness of a given feed – into the CFD software. This makes it possible to predict the spray dryer performance by precisely analysing the results of small-scale experiments. DRYNETICS™ analysis can be used to investigate new designs, improve existing plants and test new products.

DRYNETICS™



R&D and small-scale spray dryers

GEA Niro's series of small-scale dryers goes from the popular MOBILE MINOR™, with a water evaporative capacity from below 1 kg/h, to the VSD-12.5, with a capacity of up to 110 kg/h. Actual capacity depends on the feed properties and temperature profile.

Different atomization modes

Atomization results from an energy source acting on a liquid. Resultant forces build up to a point where liquid breakup and disintegration occurs and individual droplets are created. Different atomization techniques apply different energy forms to the liquid feed.

Rotary atomizer

In rotary atomization, the feed is centrifugally accelerated to high velocity in the atomizer wheel before being discharged into the hot drying gas. The degree of atomization and particle morphology depends upon peripheral speed, feed rate, liquid properties and atomizer wheel design. Particle size is adjusted by change of peripheral speed. The rotary atomizer is considered the most flexible atomizing device, suitable for a wide range of products.

Two-fluid nozzle, co-current or fountain mode

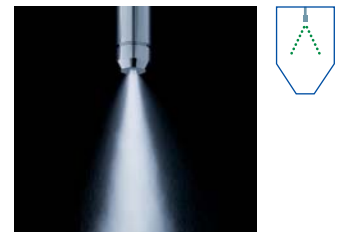
Two-fluid nozzle atomization is achieved pneumatically by high-velocity compressed air/gas impacting the liquid feed. Particle size is controlled by varying the nozzle flow ratio between atomizing gas and feed. When operating in co-current mode, the nozzle tip is placed close to the outlet of the ceiling air disperser. The co-current mode is selected when drying heat-sensitive products. When coarse particles of a non-heat sensitive feed are required, the two-fluid nozzle in fountain mode is appropriate.

Pressure nozzle, co-current or fountain mode

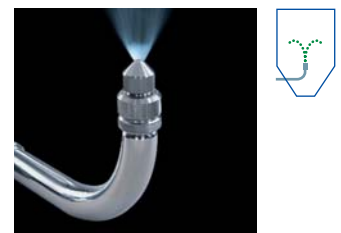
With a pressure nozzle, atomization is the result of the conversion of pressure energy within the liquid feed into kinetic energy of a moving thin liquid sheet. Pressure applied to the liquid within the nozzle forces the liquid out of the orifice creating the atomization. A pressure nozzle can be operated in co-current mode or in fountain mode. Particle size is adjusted by change of feed pressure and nozzle size. Pressure nozzles will generally deliver a narrower particle size distribution and coarser particles than other atomizer types. Selection of nozzle type depends on the feed properties and powder specification.



Rotary atomizer

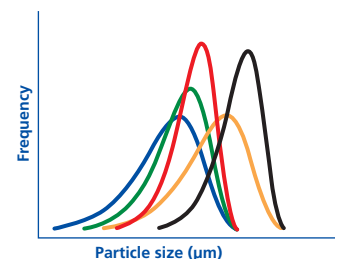


Co-current nozzle



Fountain nozzle

Particle size distribution with different atomization systems at comparable conditions



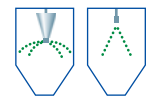
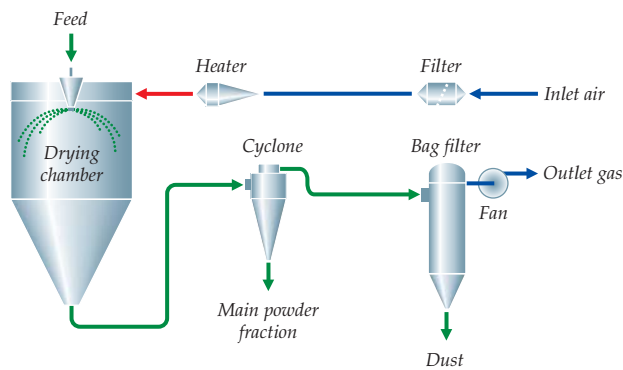
- Two-fluid nozzle, co-current
- Rotary atomizer, co-current
- Pressure nozzle, co-current
- Two-fluid nozzle, fountain mode
- Pressure nozzle, fountain mode

Configurations

Three conventional spray drying configurations

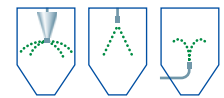
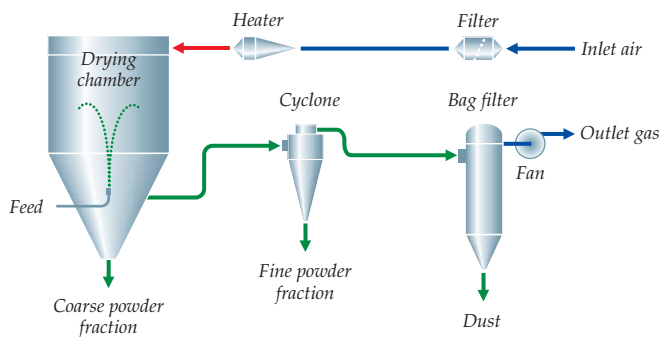
When configuring a plant, it is essential to choose the most appropriate mode of operation, equipment design and powder collection system. We offer a wide range of different solutions and configurations to meet your specific requirements.

Open-mode design with single-point powder discharge



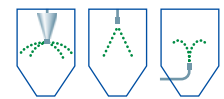
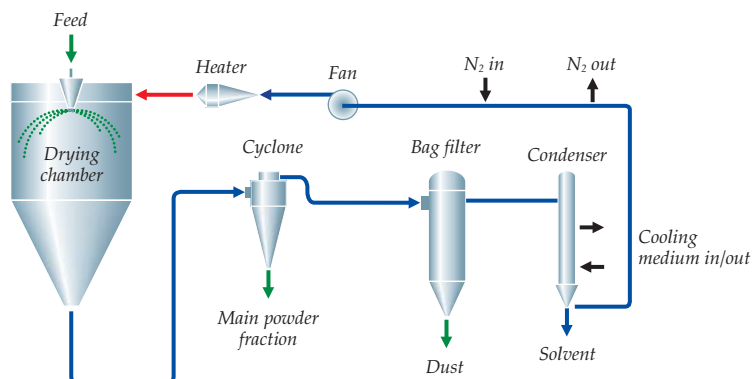
Atomization options

Open-mode design with two-point powder discharge



Atomization options

Closed-cycle design with single-point powder discharge



Atomization options

Solutions

A wide range of versatile small-scale solutions

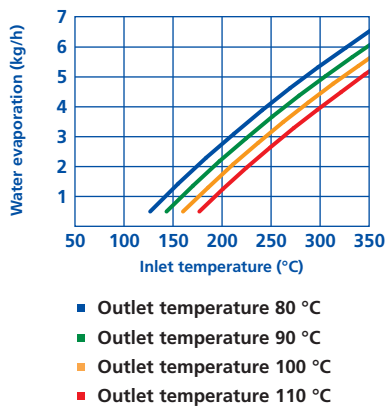
Since drying characteristics and product specification vary from product to product, there is not one process or spray dryer design suitable for all applications. By offering a full range of processes and designs, GEA Niro impartially helps you select the most suitable equipment.



Small-scale plants – process and available equipment	PLANT TYPE	MOBILE MINOR™	PRODUCTION MINOR™	VSD-6.3	VSD-12.5	FSD MINOR™	FSD™-4.0	FSD™-6.3	FSD™-12.5
CHARACTERISTICS									
Nominal main process gas flow, kg/h		80	360	630	1250	80	400	630	1250
Water evaporation capacity, kg/h		0.5-6	5-30	10-55	20-110	0.5-6	5-25	10-50	20-90
Typical mean particle size range, micron		5-80	10-90	10-130	20-140	30-300	50-300	50-300	50-300
Space requirements, LxWxH, m		2.5x2x2.3	4.4x2x2.7	5.5x4x6.3	6.5x4x6.8	3x2.5x3	6x4x5	8x4.5x6.5	9x4x7
CONFIGURATIONS									
Feed pump		X	X	X	X	X	X	X	X
Rotary atomizer, pneumatically driven		X							
Rotary atomizer, high-frequency motor			X	X	X				
Two-fluid nozzle, co-current		X	X	X	X	X	X	X	X
Two-fluid nozzle, fountain		X	X	X	X				
Pressure nozzle				X	X	X	X	X	X
Static fluid bed, single chamber						X	X	X	X
Static fluid bed, 2 or 3 chambers							X	X	X
Electrical heater		X	X	X	X	X	X	X	X
Steam heater with optional electrical booster			X	X	X		X	X	X
Combustion gas heater			X	X	X				
Drying chamber with main powder discharge		X	X	X	X				
Cyclone with main or secondary powder discharge		X	X	X	X				
Powder discharge from static fluid bed						X	X	X	X
Cartridge filter, fine powder collection		X							
Bag filter, main, secondary or fine powder discharge		X	X	X	X	X	X	X	X
Wet scrubber		X	X	X	X	X	X	X	X
Control panel / MCC panel, combined - push buttons		X							
Control panel / MCC panel, combined - PLC with LC HMI		X	X	X	X	X	X	X	X

MOBILE MINOR™

A flexible, easy-to-handle laboratory spray dryer



The MOBILE MINOR™ has a pneumatically liftable chamber roof for easy inspection and cleaning (left). It is also available in a closed-cycle version for operation with feeds based on flammable solvents (above).

GEA Niro has supplied more than 2.200 MOBILE MINOR™ units. Drying chamber size: Ø 800x620 mm, 60° cone.

The MOBILE MINOR™ is the excellent choice for making test work and exploring the possibilities of spray drying. It meets the demand for a safe, sanitary, flexible, modern and easy-to-handle laboratory spray dryer. In the MOBILE MINOR™, small quantities of solutions, suspensions or emulsions can be dried into representative powder samples, and the process data required for scale-up to industrial production can be retrieved.



The MOBILE MINOR™ Basic with limited options and a slightly different design for customers with limited requirements. Drying chamber size: Ø 800x620 mm, 60° cone.

With three alternative atomizing systems, the MOBILE MINOR™ can be equipped to provide the optimal atomization:

- **Rotary atomizer**, located in the center of the chamber roof. An air turbine drive requiring 6 bar compressed air supplies energy to the atomizer wheel.
- **Co-current two-fluid nozzle**, located in the center of the chamber roof. Atomization is created by compressed air at a pressure of 0.5-6.0 bar.
- **Fountain two-fluid nozzle**, located in the cone of the drying chamber, spraying upwards. Atomization is created by compressed air at a pressure of 0.5-6.0 bar.

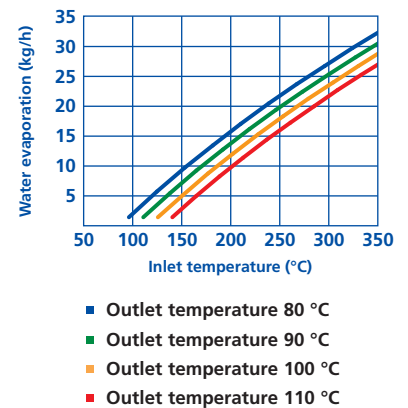
The MOBILE MINOR™ can be supplied with all three systems for flexible operation. In addition, it is available in a number of versions - all equipped and configured to meet the users' exact needs and requirements.

PRODUCTION MINOR™

The spray dryer for R&D
and small volume production



PRODUCTION MINOR™ with rotary atomizer, powder collection under the cyclone. The exhaust fan is installed in a noise attenuator box to reduce the noise level. Drying chamber size: Ø 1200x745 mm, 60° cone.



The PRODUCTION MINOR™ is a flexible spray dryer that can be applied for both R&D - where a larger capacity is required - and for small volume productions. The capacity of the PRODUCTION MINOR™ makes it suitable for a wide range of products. It is a standard spray dryer in a sanitary design with several modules and options available.

The PRODUCTION MINOR™ can be equipped with three alternative atomizing systems to provide the optimal atomization:

- **Rotary atomizer**, located in the center of the chamber roof. The atomizer is powered by a high-frequency, high-speed motor integrated in the unit (patented).
- **Co-current two-fluid nozzle**, located in the center of the chamber roof. Atomization is created by compressed air at a pressure of 1.0-6.0 bar.
- **Fountain nozzle**, located in the cone of the drying chamber, spraying upwards. Atomization is created by compressed air at a pressure of 1.0-6.0 bar.

For alternative operations and to increase its flexibility, the PRODUCTION MINOR™ can be supplied with all three atomization systems. It is available in a number of versions - all equipped and configured to meet the user's exact needs and requirements - incl. closed-cycle design for operation with organic solvents, reinforced designs for dust explosion protection and an extended drying chamber with additional height.

VERSATILE-SD™ size 6.3 and 12.5

Customized versatile production units
- based on standard modules



VSD-12.5-CC spray dryer with a rotary atomizer and bag filter. Closed-cycle design using nitrogen as drying gas. Drying chamber size: Ø 2500x1500 mm, 60° cone.

The VERSATILE-SD™ is a range of versatile production-scale spray drying units. They can be applied for production of a wide range of products - from advanced ceramics and catalysts to flavours, herbal extracts and other food ingredients. The VERSATILE-SD™ spray dryers are modular spray dryers designed to utilize the same modules and configurations for different capacity levels and product requirements. There are two sizes; the VSD-6.3 and the VSD-12.5.

The VERSATILE-SD™ spray dryers can be equipped with five types of atomization systems:

- **Rotary atomizer**, located in the center of the chamber roof. The atomizer is powered by a high-frequency, high-speed motor integrated in the unit (patented).
- **Co-current two-fluid nozzle**, located in the center of the chamber roof. Atomization is created by compressed air at a pressure of 1.0-6.0 bar.
- **Co-current pressure nozzle**, located in the center of the chamber roof. Atomization is created by pressure applied to the liquid feed.
- **Fountain two-fluid nozzle**, located in the cone of the drying chamber, spraying upwards. Atomization is created by compressed air at a pressure of 1.0-6.0 bar.

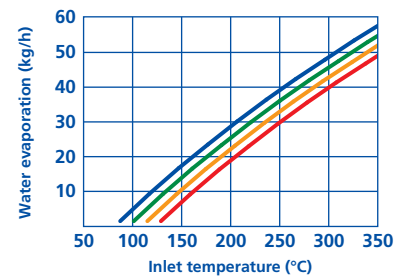
- **Fountain mode pressure nozzle**, located in the cone of the drying chamber, spraying upwards. Atomization is created by pressure applied to the liquid feed.

All VERSATILE-SD™ spray dryers can be supplied with an alternative atomization system. This allows for switching between products with different characteristics while still having the optimum atomization system. The units can also be equipped for spray congealing applications - where a melted feedstock is atomized and turned into a free-flowing powder. All units are tailored to meet the user's exact needs and requirements - incl. closed-cycle design for operation with organic solvents and reinforced designs - with venting or suppression for dust explosion protection.

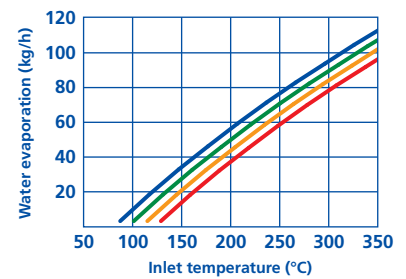
To develop the right process and select the ideal size, configuration and equipment, GEA Niro's Test Centers are available for process development and for making tests and trial productions.



VSD-6.3 co-current atomization



VSD-12.5 co-current atomization



- Outlet temperature 80 °C
- Outlet temperature 90 °C
- Outlet temperature 100 °C
- Outlet temperature 110 °C

VSD-12.5-CC installed in the GEA Niro Test Center in Copenhagen. Chamber size: Ø2500x2500

FSD™ size 0.8 to 12.5

Multi-stage drying technology



*FSD™-6.3 with triple chamber static fluid bed. Installed in GEA Niro Test Center, Copenhagen.
Drying chamber size:
Ø 1600x800 mm, 40° cone.*



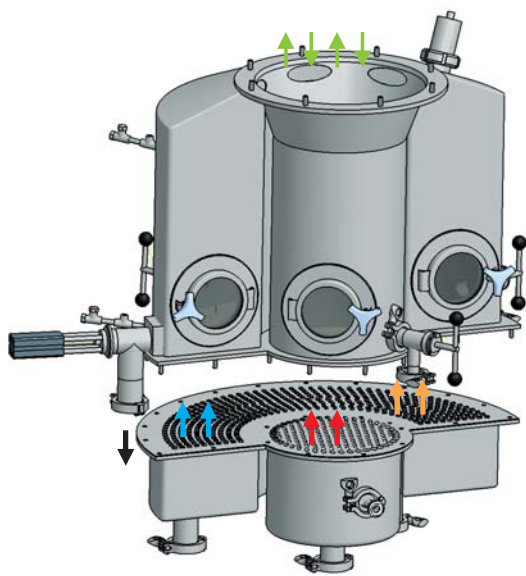
*FSD MINOR™, size 0.8.
Drying chamber size:
Ø 800x620 mm, 40° cone.*

Multi-stage drying technology

The FSD™ Fluidized Spray Dryer is a flexible and efficient multi-stage dryer for production of coarse, dustless and free-flowing agglomerates. It integrates spray and fluid bed drying technology to provide excellent drying and agglomeration in a single operation. The FSD™ can be applied for a wide range of applications - including sticky, hygroscopic, aromatic and heat sensitive products. It is available in four sizes - ranging from the lab-scale FSD MINOR™ (size 0.8 unit) to production units (size 12.5).

Agglomeration

Small single particles dissolve instantly in water. Powder consisting of small particles is, however, difficult to disperse. Large particles are easy to disperse in water, but dissolve only partially. Agglomeration optimises quick dispersion of the agglomerates as well as quick and complete dissolution of the small particles forming the agglomerate. Furthermore, agglomeration improves the product's flowability and reduces dust problems during powder handling. Agglomeration is a result of wet and/or semi-dry particle collision.



The static fluid bed - here a triple chamber - offers the possibility of post treatment of the spray dried powder in a continuous operation in a very compact system:

- 1st stage, inner bed: Final agglomeration, sizing, drying of agglomerates and de-dusting
- 2nd stage, ring bed, first chamber: Post drying and continued de-dusting
- 3rd stage, ring bed, second chamber: Cooling and final de-dusting

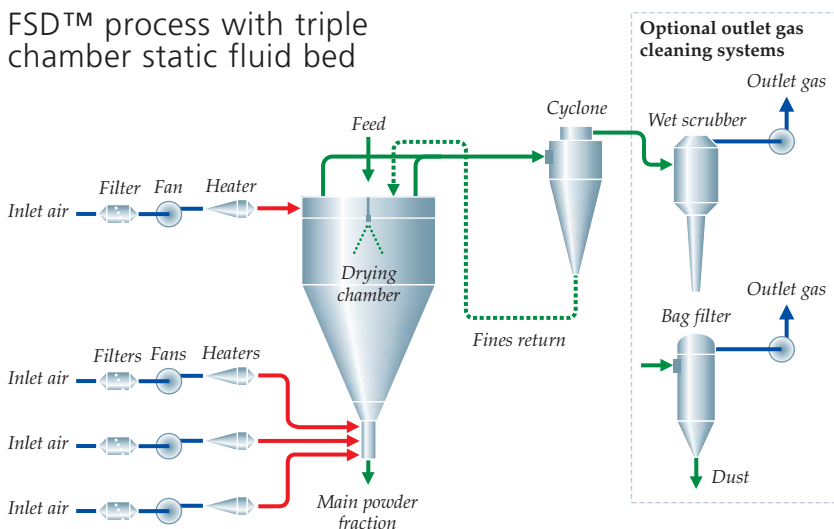
All three chambers can have separate process gas supply systems.

- Powder/fines to and from spray drying chamber
- 1st stage, main fluid bed gas
- 2nd stage, post drying fluid bed gas
- 3rd stage, cooling fluid bed gas
- Final product

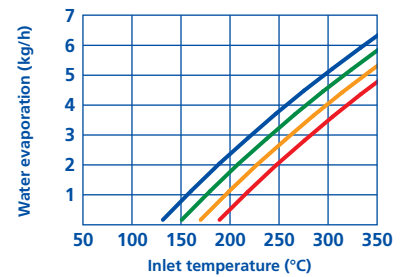
Mode of operation

In the FSD™ Fluidized Spray Dryer, the feed is sprayed from the atomization system (a two-fluid or pressure nozzle) mounted in the ceiling of the drying chamber into the hot drying air introduced through the process gas disperser. The vigorous fluidization of moist powder in the static fluid bed at the drying chamber base, and the recycling of fines from the cyclone or bag filter leads to spray drying taking place in a powder-laden atmosphere, resulting in agglomeration. Control is achieved by adjusting atomization, temperatures and fluidization velocity and the returning of dry fine powder to the wet spray.

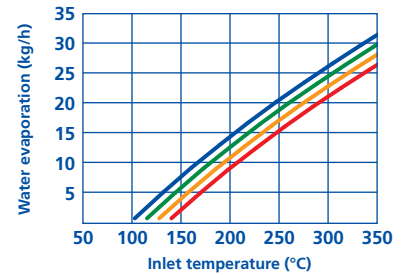
FSD™ process with triple chamber static fluid bed



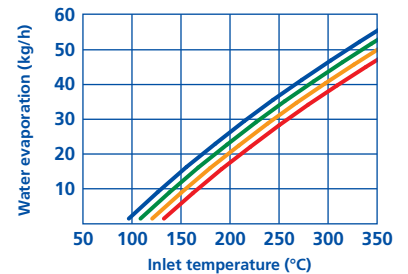
FSD MINOR™ – 0.8



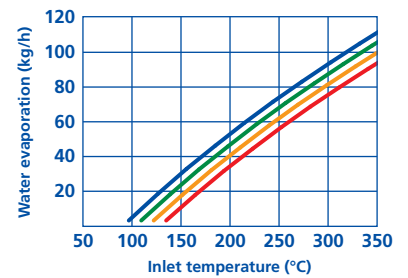
FSD™ – 4.0



FSD™ – 6.3



FSD™ – 12.5



- Outlet temperature 80 °C
- Outlet temperature 90 °C
- Outlet temperature 100 °C
- Outlet temperature 110 °C

Additional equipment

Everything you need to complete your solution

To complete the solution, GEA Niro offer a range of additional equipment - including systems for post drying and cooling, data logging, powder collection and emission control, cleaning and noise reduction - all specially designed for our range of small scale spray dryers and to meet your demands:

Post Drying and cooling



The GEA Niro VIBRO-FLUIDIZER™ is a vibrating fluid bed for post treatment of the spray dried product. It can be applied for additional drying, cooling or agglomeration, or as a powder conditioning unit.

Noise reduction



Exhaust fan installed in a noise box. This ensures a low noise level and provides a pleasant environment for the plant operators. Here the noise box also supports the powder recovery cyclone.

Powder collection and emission control



For exhaust gas cleaning and powder collection, GEA Niro offers a range of bag filter solutions.

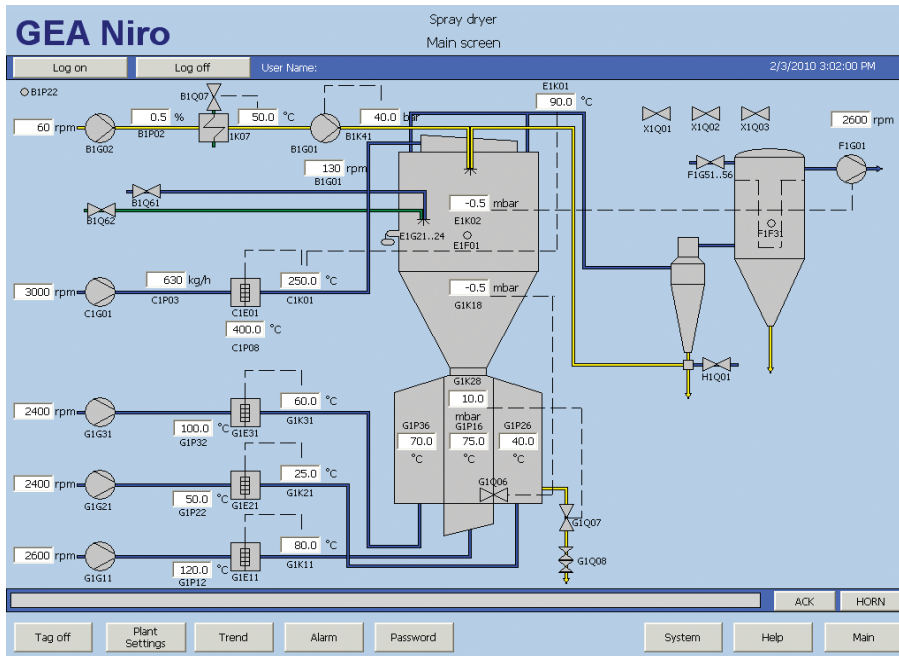


For removal of residual powder and particulates in the exhaust gas, the GEA Niro wet scrubber type SHE is an ideal solution.



For the MOBILE MINOR™ a series of cartridge filters are available for exhaust gas cleaning.

Process control



GEA Niro's stand-alone process control system with integrated touch screen interface ensures an easy and safe operation of your plant. The one screen plant overview provides a full view of all process values and - combined with multiple ways of monitoring and logging data and trends - it also provides a perfect and flexible access to all information about plant operation. The control panels are compact units with limited space requirements, and therefore ideal for installation next to the spray dryer. The GEA Niro control panels are also available in explosion protected versions for installation in classified rooms.

Cleaning Systems



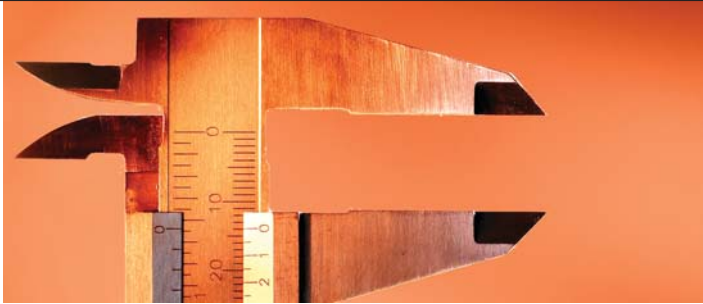
GEA Niro offers several elegant solutions for efficient cleaning of your plant after operation. The combined CIP and feed tank with integrated CIP pump provides an easy and flexible opportunity for in place cleaning. Here equipped with a water tank for feed line flushing and stand for feed pump.



Tank cleaning equipment ensures an efficient cleaning of drying chambers and feed tanks. The machine is driven by the pressure of the CIP liquid and ensures a complete cleaning of the entire inner surface (of drying chambers or tanks).



When not in use, the retractable GEA Niro CIP nozzle is flush with the inner wall. This ensures that it does not interrupt during operation. The nozzle is activated by CIP liquid under pressure and ensures an efficient cleaning (of fluid beds, ducts, tanks etc).



Experience

GEA Niro has contracted and installed more than 10,000 plants worldwide

GEA Niro is a world leader in industrial drying, with spray drying, spray cooling/congealing, flash drying, freeze drying, granulation and fluid bed processing as core technologies. Having installed more than 10,000 plants around the globe, GEA Niro is known for delivering solutions that meet customers' exact requirements. The GEA Niro companies are part of GEA Process Engineering.



GEA Process Engineering

GEA Niro

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