

# Drying and Particle Formation Technologies for the World's Chemical Industry





# Solutions

## Whatever your requirements, Niro is equipped to handle the challenge

No one knows more about the role of industrial drying and engineering of high-performance products than Niro. With data gleaned from more than 70 years of experience and a reference list of some 10,000 plants, we're equipped to engineer the properties you want into your products – and the processes needed to produce them.

### **Niro's comprehensive product range meets all your needs**

Niro specialises in the design of plants for processing liquid, particulate and solid materials. Our core technology is also used in air pollution control and waste management. Niro's comprehensive product range includes spray dryers, fluid bed systems, the SWIRL FLUIDIZER™, flash dryers, spray congealers and spray drying absorbers – each tailored to meet our customers' exact specifications.

Many of the world's leading manufacturers are Niro customers. Our plants are designed to fulfil the most demanding safety and performance requirements. We minimise manufacturers' costs through efficient energy utilisation. And we help our customers maximise competitiveness through superior product quality.

### **Niro adds value to your business across the world**

When you choose Niro powder engineering, you benefit from more than advanced technology. We offer powder property formulation and process verification through laboratory and pilot plant testing; unmatched scale-up experience; global project execution – on time and according to your specifications; and help securing maximum plant utilisation and possible plant modification to meet new market requirements. It's all part of the Niro solution.

Niro has 70 years of experience and a reference list of 10,000 plants.



*Niro masters solutions from lab testing to industrial scale production*

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Applications

Technology

Added value

# Polymers & resins

Experience since 1952



- Single unit dry product rates > 45 t/h for certain wet powders
- Single unit dry product rates > 5 t/h for some emulsions and solutions
- Minimise turnaround time
- Save energy
- Prevent dust explosion
- Minimise sticky build-up
- Prevent release of VOCs

Niro has supplied more than 500 industrial-sized polymer drying plants since 1952 – here you can see why.

## Ideal for wet powders, emulsions and solutions

If you need to dry wet powders where the particles have already been formed (such as s-PVC, c-PVC, ABS, MBS, HDPE, PP, PAN, c-PE, POM and PVA), Niro fluid bed dryers, CONTACT FLUIDIZER™, flash dryers and CYCLONE FLUIDIZER™ are ideal (see p. 18 for more info on the technology).

For emulsions and solutions in which the particles are formed during the drying process (such as e-PVC, EVA, UF, MF, PF, PMMA, PVAc, PVP, Acrylic Resins and Paraformaldehyde), Niro spray dryers are ideal. Spray drying is often followed by fluid bed post-drying or cooling (see pp. 14-19 for more info on the technology).

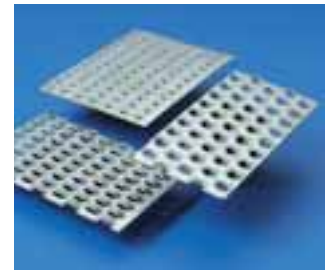
## Open- and closed-loop solutions available

If your polymers are water wet, you're probably considering an "open drying plant," where ambient air is taken in, heated, used for drying and cleaned of particles, then sent back into the atmosphere.

When the polymers are solvent wet (for example, hexane/pentane wet HDPE or PP), the concentration of oxygen must be very low to avoid explosion or fire in the dryer. Consequently, nitrogen is often used as a drying gas. To minimise your costs, Niro re-uses nitrogen in a "closed drying loop": the nitrogen is heated, used for drying and cleaned of particles; then the evaporated organic solvent is condensed and pumped away. The nitrogen gas is then re-circulated, heated and used for drying again.



Niro has supplied more than 500 industrial-sized polymer drying plants since 1952.



*The Niro CONTACT FLUIDIZER™ is a special, energy-efficient fluid bed where heating panels submerged in the fluidized product layer supply 80-85% of the evaporative energy. The overall energy savings compared to other types of dryers is 10-25%, depending on the product type and grade in question*

### **Prevent dust explosion**

Dust explosion is a potential risk when drying some products, such as ABS and PVAc. In these situations you can use open plants in Pressure Shock Resistant execution combined with Explosion Relief Panels or Explosion Suppression systems. Alternatively, a low-oxygen plant with nitrogen as the drying gas in a closed loop might be the best solution. Another option is the self-inertized plant, where a special direct-fired heater ensures sufficiently low oxygen content.

### **Avoid sticky build-up in the dryer**

Some thermoplastic polymers, such as PVAc and UF-resins, can be sticky during the drying process and require special precautions. We'll help you minimise product build-up in the dryer. Often this includes the use of the Air Broom and/or Niro JET SWEEP™ (patented).

### **Prevent the release of VOCs**

Stripping of Volatile Organic Compounds from dry polymers is a growing requirement and could well become a general processing standard due to concern about the release of VOCs during handling, storage and fabrication. Niro dryers can include both integrated and separate stripping stages. Stripping of VOCs is a special form of heat treatment/drying often performed in specially designed Stripper Fluid Beds.

# Hardmetals

More than 120 installations



- Solvent recovery
- Plant control automatic, including CIP
- Comply with EU directives (ATEX)

Niro has installed more than 120 drying plants for hardmetal powders – in both open configuration (for water-based materials) and closed-cycle configuration (for solvent-based materials).

Carbide powders for cutting and mining tools are mainly produced as ready press powder in one single operation, from a suspension in an organic solvent with binder added.

Using solvent as milling and process liquid requires a high level of safety in all steps of production. In order to operate economically and safely above the ignition temperature of the solvent used, the spray dryer has to have an inert atmosphere (see pp. 14-17 for more info on the spray drying technology). Another advantage of operating in an inert atmosphere is reduced risk of oxidation degradation of the powder and reduced emission of solvent and solids.

# Ceramics

Tailored to your specifications



- Aluminium Oxides
- Carbides
- Electroporcelain
- Ferrites
- Silicium Oxides
- Titanates

You'll find Niro offers a broad range of technical solutions and tailor-made applications to meet your exact requirements within ceramics. Spray dryer design and operating conditions match your specifications for moisture content, bulk density, particle size distribution, etc (see pp.14-17 for more info on the technology). This ensures you obtain a reproducible, free-flowing granulate for the production of ceramic press-body of high uniform quality in one single operation.

Whether you're working with traditional or advanced, high-tech ceramics for high-performance products, Niro is experienced in supplying the ideal open or closed solution. Water-based ceramic slip formulated with high solids content, binder and lubricant is transformed into a controlled droplet distribution using rotary wheel or nozzle atomization.

# Dyestuffs & pigments

## In solution, suspension or paste form

Free-flowing characteristics, powder granulometry, low dustiness and redispersion characteristics are just some of the factors Niro examines when determining your ideal drying solution. Whether your feedstocks are in solution, suspension or paste form, Niro offers the technical solutions and tailor-made applications to meet your specific product property requirements.

Niro has supplied roughly 400 plants for this industry, including spray dryers, the Fluidized Spray Dryer FSD™, the Integrated Filter Dryer IFD™, the SWIRL FLUIDIZER™ and fluid beds for agglomeration/granulation and mechanical granulation (see pp. 14-19 for more info on the technology).

### Meet safety and environmental requirements

Since many dyestuffs and pigments include hazardous organic ingredients, Niro's drying plants meet stringent requirements to prevent fire/dust explosion and environmental pollution from active emissions. Today's environmental restrictions require a sophisticated plant design tailored to your product, powder form, its activity properties and the residual moisture content in the final dried product.

### You benefit from:

- Open, environmentally friendly plants with highly effective components that ensure the exhaust of cleaned process air
- Semi-closed plants that utilise low oxygen combustion gas as process air to prevent fire/explosion and save on nitrogen costs
- Semi-closed, self-inertized plants that feature incineration of exhaust air to prevent pollution
- Closed-cycle systems with a nitrogen purged process gas circuit for high safety and low emissions

Semi- or fully automatic cleaning-in-place (CIP) systems are available for all Niro plants.



*The Integrated Filter Dryer IFD™ gives you the advantage of lower space consumption and lower CIP volumes*

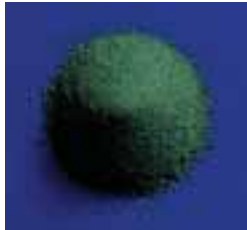


- Acid dyes
- Azoic dyes
- Barium sulphate
- Basic dyes
- Cadmium carbonate
- Cadmium sulphide
- Calcium carbonate
- Ceramic colorants
- Disperse dyes
- Dyestuff intermediates
- Iron oxide (black, red, yellow)
- Kaolin
- Lead chromate (chrome yellow)
- Lead molybdate
- Lithopone
- Phthalocyanines
- Reactive dyes
- Related fillers
- Titanium dioxide
- Zinc chromate
- Zinc potassium chromate



# Agrochemicals

## A broad range of tailor-made solutions



- Fertilizers
- Fungicides
- Herbicides
- Insecticides
- Other agrochemicals

Niro has the solution to meet your specific agrochemical product requirements. Our range of plant concepts includes spray dryers and fluid beds for agglomeration/granulation and mechanical granulation (see pp. 14-19 for more info on the technology). These plants are flexible to meet your specific requirements regarding free-flowing characteristics, powder granulometry, low dustiness and redispersion characteristics. Niro has installed nearly 100 plants in the agrochemical industry.

### Prevent risks of fire/explosion/pollution

Niro's process plants are designed to meet today's environmental restrictions and to prevent the risk of fire, dust explosion and environmental pollution from active or odorous emissions.

### Niro provides:

- Open, environmentally friendly plants with highly effective components that ensure the exhaust of cleaned process air
- Semi-closed plants that utilise low oxygen combustion gas as process air to prevent fire/explosion and save on nitrogen costs
- Semi-closed, self-inertized plants that feature incineration of exhaust air to prevent pollution
- Closed-cycle systems with a nitrogen purged process gas circuit for high safety and low emissions



*This spray drying plant in a semi-closed configuration includes incineration of exhaust bleed*

Niro plants meet the most stringent safety and environmental requirements.

# Detergents & surface active agents

## For household and industrial applications

Niro's broad range of technical solutions are specially designed to meet your agglomeration, granulation and drying needs. Our spray drying products can be designed with co-current, counter-current or mixed airflow patterns to accommodate the optimal product processing/drying needs (see p. 14 for more info on the technology). The drying chamber is designed to ensure the air flow and product residence time that is ideal for your product. Niro has installed roughly 130 plants in this industry.

The Niro Continuous High Shear Granulator HEC™ converts dusty, light powders into high-density, free-flowing granulates (see the flap on p. 19 for more info on the technology). Capable of handling a wide variety of powders, it was developed for the detergent industry to produce compact powders with densities ranging from medium to high.

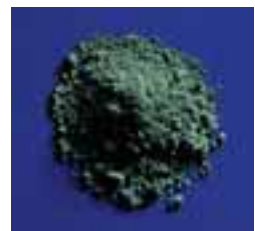


- Alkyl-Aryl sulphonates
- Dispersing agents
- Emulsifying agents
- Enzymes
- Fatty alcohol sulphonate
- Hand soap
- Mono- and dipotassium orthophosphate
- Nitrilo tri-acetic acid salts
- Optical brightener
- Phosphates
- Sodium lauryl sulphate
- Sodium perborate
- Sulphonates
- Tetra potassium polyphosphate

# Tannins

## An easy way to preserve tannin activity

Spray drying provides an easy way to preserve the activity of the tannins materials. The spray-dried powder can be re-dispersed in water for use in the tannin process. Even if your tannins are corrosive or abrasive, Niro offers a solution that protects parts in contact with the product and feed/product handling systems. This ensures your plant's durability and trouble-free operation. We have supplied the tannin industry with nearly 100 co-current flow spray dryers with a high-speed rotating atomizer wheel and nozzle towers in combination with powder conveying and agglomeration systems (see pp. 14-17 for more info on the technology).



- Synthetic tannins (phenol-based [e.g., sulphonated phenol])
- Basic chromium salts
- Natural extracts from trees, e.g., Quebracho

# Organic chemicals

## From fine crystals to coarse granulates



- Amino acids
- Ascorbic acid
- Benzoates
- Butyrates
- Chloramines
- Gluconates
- Hydrazines
- Maleic acid
- Phthalates
- Salicylates
- Salicylic acid
- Sorbates
- Stearates
- Ureas
- Waste water drying

The majority of organic chemicals that maintain solid form during atmospheric conditions can be transformed to powders or granulates. Whether you're producing organic acids, organic salts or nitrogen-containing compounds, Niro offers a broad range of technology and tailor-made applications to meet your requirements. Niro has supplied more than 100 plants to the organic chemical industry.

Your feed material can be in liquid, suspended crystal or solid form. Following the melting stage, solids such as fatty acids and waxes can be turned into prills through spray congealing. Solutions and slurries of fine crystals can be dried to free-flowing products in a spray dryer, or to coarse granulates (1- 2 mm) in a **SPRAY FLUIDIZER™**. Cakes and pastes from filters or decanters can be dried and cooled in fluid beds or the **SWIRL FLUIDIZER™** (see pp. 14-21 for more info on the technology).

Please refer to the sections in this brochure dedicated to agrochemicals, dyestuffs and polymers for details on these other organic chemicals. Niro also offers dryers that utilise waste heat for the complete drying of liquid wastes, primarily for wastewater treatment.

*Niro Integrated Filter Dryer IFD™*



*Niro SPRAY FLUIDIZER™ plant for the production of granulated food preservatives*

# Inorganic chemicals

## From aluminium to zinc compounds

Niro offers a broad range of technology and tailor-made applications to meet the various property requirements of inorganic chemicals. From aluminium to zinc, hundreds of compounds are well-suited to drying with Niro equipment.

Your feed material can be in liquid, suspended crystal or solid form. Solutions and slurries of fine crystals can be dried to free-flowing products in a spray dryer or to coarse granulates (1- 2 mm) in a **SPRAY FLUIDIZER™**. Cakes and pastes from filters or decanters can be dried and cooled in fluid beds or the **SWIRL FLUIDIZER™** (see pp. 14-21 for more info on the technology).

In addition to the hundreds of inorganic chemicals well-suited to spray drying and fluid bed processing, fluid beds are ideal for sodium bicarbonate and sodium carbonate production.

### **Sodium carbonate and bicarbonate**

Today's fluid bed technique is considered the optimum technical solution for dewatering and calcining within soda ash production (see pp. 18-20 for more info on the technology). Niro's **CONTACT FLUIDIZER™** can handle a variety of drying/calcining processes, and the process is well-suited to the production of dense soda ash.

Niro also can help you manufacture light soda ash from sodium bicarbonate (patented). The drying and calcining process uses recycled CO<sub>2</sub> as the fluidizing gas, and the released CO<sub>2</sub> from the calcining can be recovered.



- **Spray drying for solutions and slurries**
- **Fluid beds and SWIRL FLUIDIZER™ for cakes and pastes**
- **SPRAY FLUIDIZER™ and FSD-GRANULATOR™ for agglomerates and granulates**

(See the overview of technologies on p. 12)

Niro has supplied more than 500 plants to the inorganic chemical industry.



*Niro CONTACT FLUIDIZER™ with integrated filters for the production of dense soda ash*

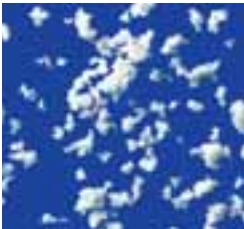
# Technology for the chemical industry

Niro's comprehensive portfolio of technology ensures you get the best



Turn liquid into powder, agglomerates and granulates

Use spray drying to extract 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.



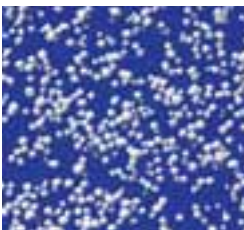
Turn paste into powder

Use the SWIRL FLUIDIZER™ to obtain a fine, homogeneous and non-agglomerated dry product from pastes, filter cakes and highly viscous liquids.



Turn melt into powder

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



Air pollution control

Use spray absorption to remove sulphur dioxide, hydrogen chloride and other acid pollutants from combustion gases. The process is suitable for coal-fired power plants and industrial boilers as well as municipal solids wastes and hazardous waste incinerators.

## solution for your applications

### 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.



P. 14

### Fluid bed drying and processing

Fluid bed drying achieves uniform processing conditions by passing a gas (usually air) through a product layer under controlled velocity conditions to create a fluidized state.



P. 18

### SWIRL FLUIDIZER™ drying

The paste or cake is fed to the compact drying chamber, where it makes contact with the warm process gas and the rotation impeller. The dried, disintegrated product exits the chamber as powder together with gas.



P. 20

### Spray congealing

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



P. 21

### Spray drying absorption

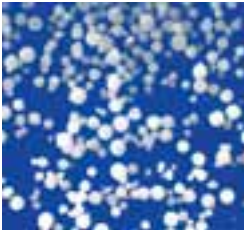
Hot flue gas acidic pollutants are mixed with a fine spray of alkaline slurry from a rotary atomizer. The acidic components are absorbed into the droplets, while the water is evaporated simultaneously.



P. 21

# Spray drying

Turn liquid into powder, agglomerates and granulates



## Spray drying applications

- Agrochemicals
- Ceramics
- Detergents & surface active agents
- Dyestuffs & pigments
- Hardmetals
- Inorganic chemicals
- Organic chemicals
- Polymers & resins
- Tannins

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.

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 sprays are produced by either rotary (wheel) or nozzle atomizers. Evaporation of moisture from the droplets and formation of dry particles proceed under controlled temperature and airflow conditions, and powder is continuously discharged from the drying chamber.

## Your product's drying characteristics and quality requirements determine operating conditions and dryer design

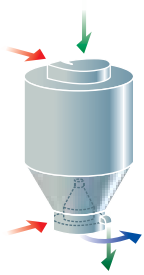
Every spray dryer consists of a feed pump, atomizer, air heater, air disperser, drying chamber and systems for exhaust air cleaning and powder recovery. Because the drying characteristics and quality requirements of the thousands of products Niro spray dries vary so widely, the solution we select for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

Niro has more than 7,500 spray dryer installations throughout the world.

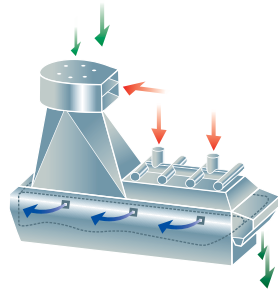




# Spray dryer chamber designs



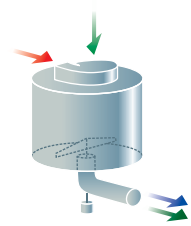
1. *Co-current, with integrated fluid bed, rotary or nozzle atomizer.*



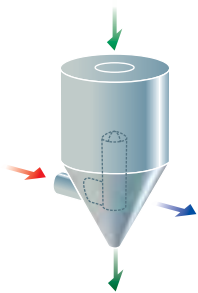
2. *Co-current, with integrated belt, nozzle atomizer.*



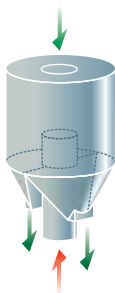
3. *Co-current, conical base with rotary atomizer, for both heat-sensitive and stable products.*



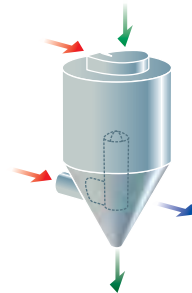
4. *Co-current, flat base with rotary atomizer, for special products. Also suitable for spray congealing.*



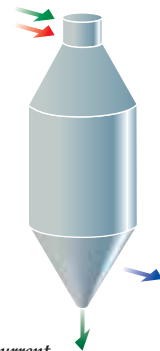
5. *Co-current, with rotary atomizer, for drying chemicals at high inlet air temperatures.*



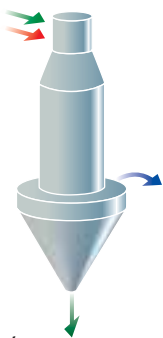
6. *Co-current, with rotary atomizer, for drying mineral concentrates at ultra high inlet air temperatures.*



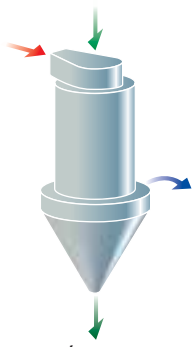
7. *Co-current, compound air disperser with rotary atomizer, for very large volumes of low inlet air temperatures.*



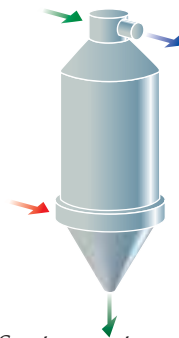
8. *Co-current, with nozzle atomizer.*



9. *Co-current, with nozzle atomizer.*



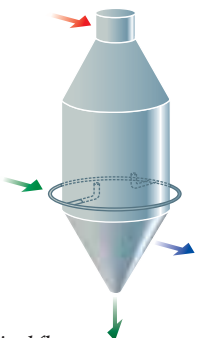
10. *Co-current, with nozzle atomizer.*



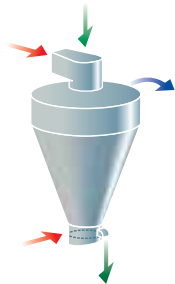
11. *Counter-current, with nozzle atomizer.*



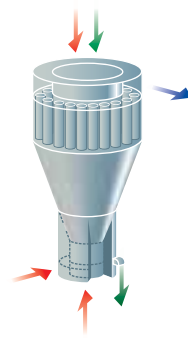
12. *Mixed flow, with nozzle atomizer for coarse powders of heat-stable products.*



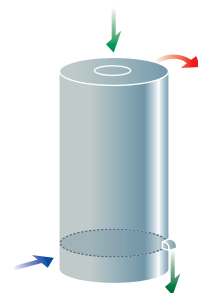
13. *Mixed flow, with nozzle atomizer.*



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



15. *Mixed flow, with integrated filter and fluid bed, rotary or nozzle atomizer. All in one.*



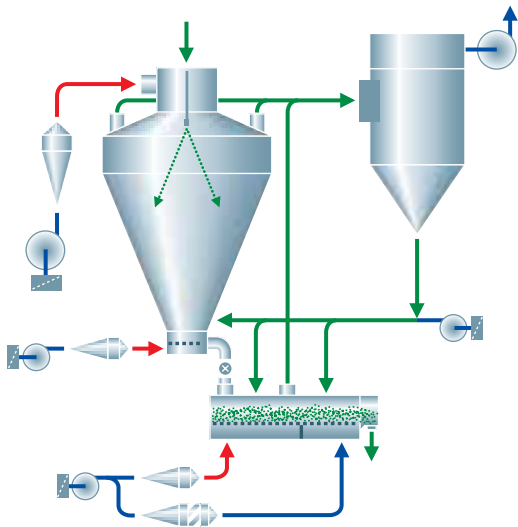
16. *Counter-current, with integrated fluid bed, rotary atomization for spray cooling/congealing.*

## Spray drying systems

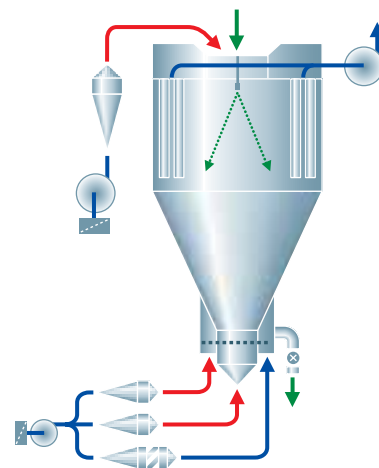
Since drying characteristics and product specifications vary from product to product, no single design is suitable for all applications. Niro offers a wide range of chamber and system designs. This allows us to select the type of plant that best meets your needs. Four of the most common spray drying systems appear below.

Our pilot plant facilities encompass more than 75 different plant set-ups. These test facilities and accompanying analytical laboratories allow you to establish the feasibility of using Niro equipment, optimise process conditions and provide samples for market analysis.

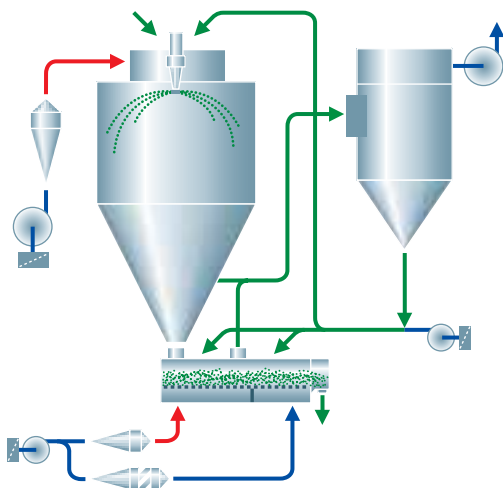
Fluidized Spray Dryer FSD™



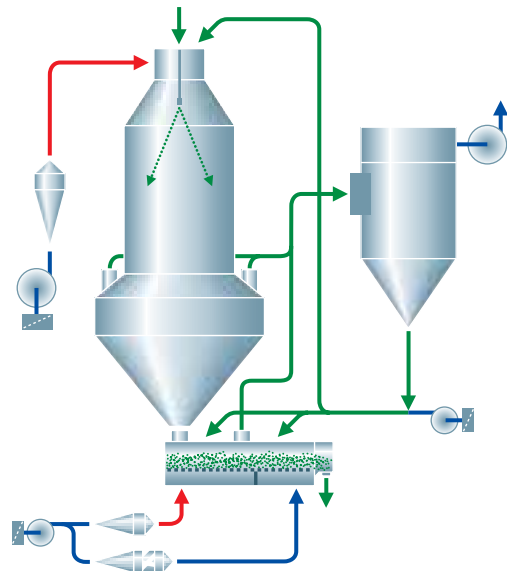
Integrated Filter Dryer IFD™



Spray Dryer with VIBRO-FLUIDIZER®



NOZZLE TOWER™



# Spray drying hardware

## The right equipment ensures quality and economy

The atomizer, which forms the spray, is the “heart” of the spray drying process. In order to produce top-quality products in the most economical manner possible, it is crucial to select the right atomizer. The choice of atomizer depends upon the properties of the feed and the desired characteristics of the dried product. We meet your needs with three types of atomizers:

- Rotary (atomization by centrifugal energy)
- Pressure nozzle (atomization by pressure energy)
- Two-fluid nozzle (atomization by kinetic energy)

In cases where more than one atomizer type is suitable, we generally recommend the rotary atomizer. The advantages of rotary atomization include:

- Great flexibility
- Ease of operation
- Ability to handle high feed rates without the need for atomizer duplication
- Ability to handle abrasive feeds
- No blockage problems
- Low-pressure feed system, which makes the atomizer simple to operate and maintain
- Ease of droplet size control through wheel speed adjustment

### Specialised equipment meets your unique needs

Depending on the specifications of your product, a specialised solution might be appropriate. Niro offers a complete range of unique equipment that spans a variety of needs. Our NARROWSPAN™ atomizer, for example, is able to produce coarse powders with a narrower particle size distribution than conventional atomizers.

#### Other specialised

##### Niro hardware

- Air Broom
- Niro JET SWEEP™ (patented)
- Pneumatic hammers
- Rotary valves
- Semi- or fully automated CIP available
- CIP-able bag filters (patented)
- WEARSERT™ inserts (patented)
- FSD-GRANULATOR™ (patent pending)
- IFD-GRANULATOR™ (patent pending)

NARROWSPAN™ atomizer wheel (patented)



Niro rotary atomizer wheel with WEARSERT™ inserts (patented)



Niro's broad range of atomizers enables us to alter certain physical characteristics of products



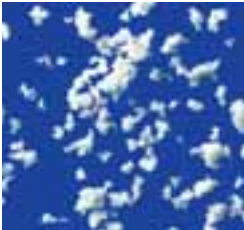
Niro atomizers, which include the world's largest rotary atomizer, cover feed rates up to 200 t/h and power requirements up to 1,000 kW.



*Rotary atomizer (top) and nozzle atomizer sprays*

# Fluid bed drying and processing

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



## Benefits of fluid bed drying over other drying methods

- 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)

Niro 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 volatile content, and heat transfer coefficient for immersed heating surfaces.

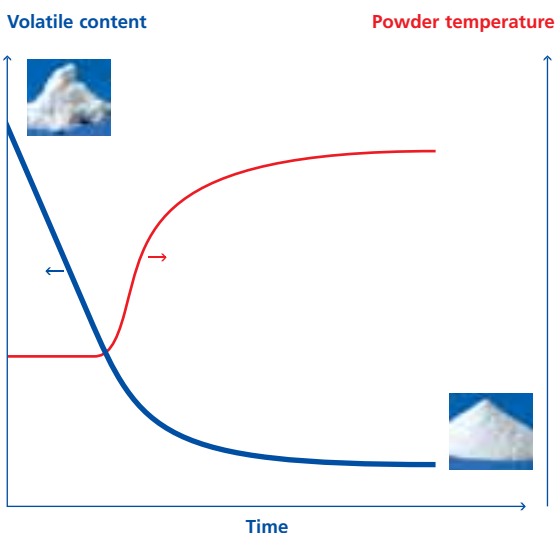
We apply these and other data in a computer model of fluid bed processing, enabling us to dimension the industrial drying system that best meets your needs.

Niro equips each fluid bed with a tailor-made GILL PLATE™ gas disperser plate with gas orifices (gills) in a pattern specially designed for each product.

The CONTACT FLUIDIZER™ is equipped with feed spreader and contact heating/cooling surfaces. The 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 Niro VIBRO-FLUIDIZER®.

## Product drying curve



Fluidization gives easy material transport and high rates of drying at high thermal efficiency while preventing overheating.



## Fluid bed types

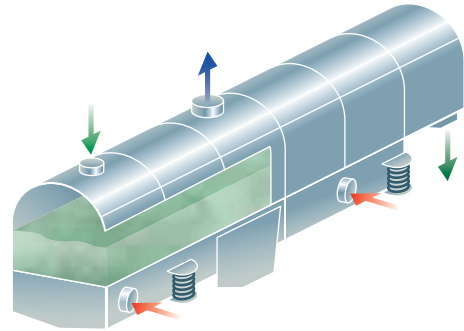
There are two basic types of fluid bed designs, differentiated by the solids flow pattern in the dryer:

- 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

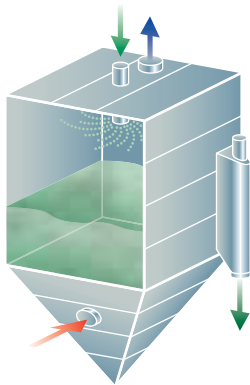
A fluid bed can be stationary or vibrating. Heating panel banks can be applied to the stationary beds.

Niro carefully considers the requirements of the material you are processing before selecting the ideal fluid bed.

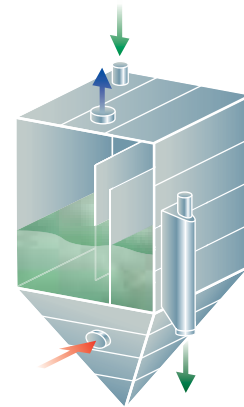
### VIBRO-FLUIDIZER®



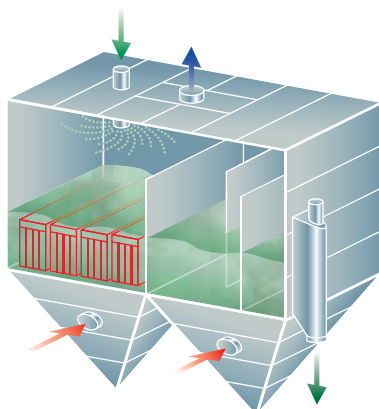
### Back-mix flow fluid bed



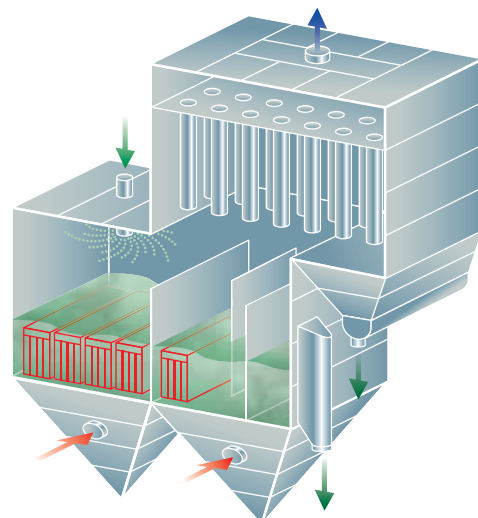
### Plug flow fluid bed



### CONTACT FLUIDIZER™



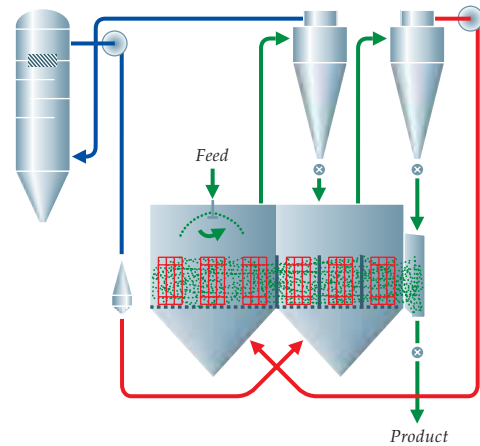
### CONTACT FLUIDIZER™ with integrated filters



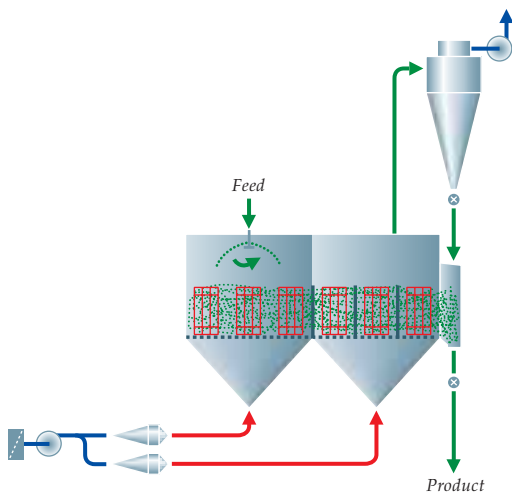
# Fluid bed process systems

Niro will recommend the process system that best meets your product's specifications and requirements regarding operational safety and environmental responsibility. Some of the most frequently used fluid bed process systems appear below.

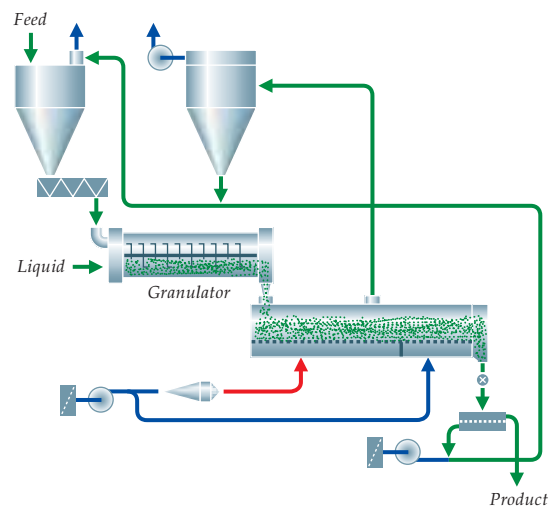
Closed cycle CONTACT FLUIDIZER™ in side-by-side double decker configuration



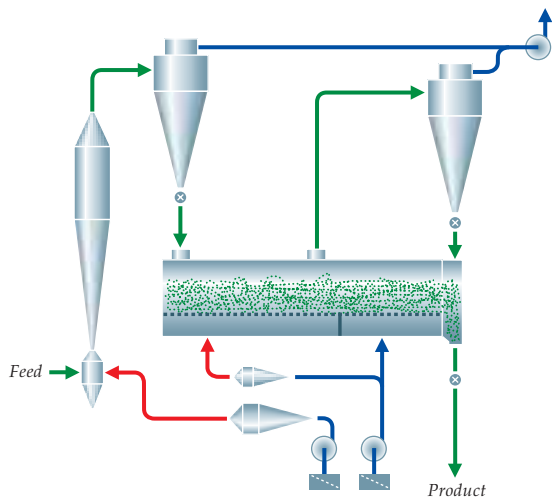
Open system CONTACT FLUIDIZER™



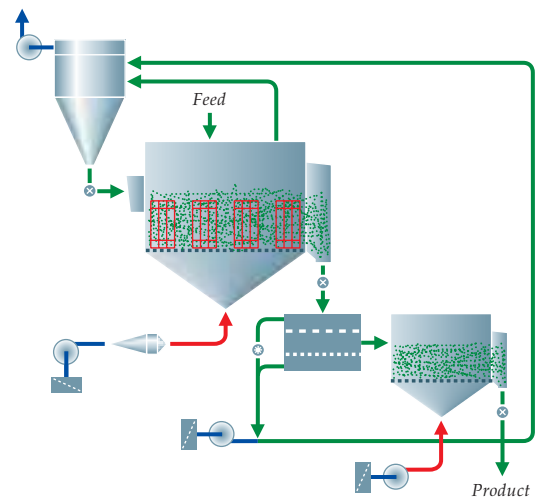
Mechanical Granulation



Open system with Flash Dryer

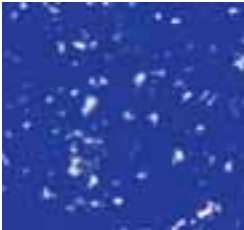


SPRAY FLUIDIZER™



# SWIRL FLUIDIZER™ drying

Turn paste into powder



## Advantages of the SWIRL FLUIDIZER™

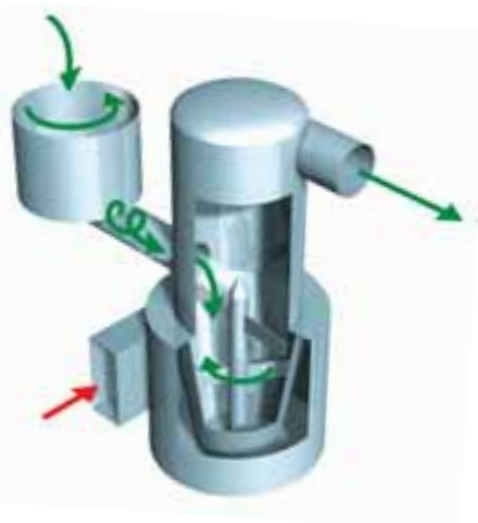
- Handles non-pumpable products
- Combined drying and product treatment
- Continuous operation
- Requires minimal space
- Effective heat and mass transfer
- Negligible heat loss
- Maintenance-friendly design
- Improved tolerance towards changes in feed properties
- Improved product load capacity
- Handles very high drying temperatures
- Dries very heat-sensitive products

The Niro SWIRL FLUIDIZER™ offers a cost-effective solution for obtaining a fine, homogeneous and non-agglomerated dry product from pastes, filter cakes and highly viscous liquids – in one compact process step. Unlike contact dryers, band dryers, drum dryers and tray dryers, the Niro SWIRL FLUIDIZER™ offers short processing time and eliminates the need for costly post-treatment such as milling.

The ability of the SWIRL FLUIDIZER™ to handle even the most viscous liquids makes it an attractive alternative to spray drying for applications where dilution is needed to obtain a pumpable and sprayable feed.

## Now suitable for an even larger range of applications

Extensive R&D work has resulted in a “new generation” SWIRL FLUIDIZER™ with an even more compact design and a number of easily implemented optional features for special applications. The new generation SWIRL FLUIDIZER™ offers the following additional process advantages: improved tolerance towards changes in feed properties; improved product load capacity; ability to handle very high drying temperatures; and drying of even very heat-sensitive products.



The SWIRL FLUIDIZER™ provides disintegration and drying in one compact step.

# Spray congealing

## Turn melt into powder

Various droplet formation techniques and efficient droplet/air contact make 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 Niro two-fluid nozzles.

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

- Fewer moving parts than belt coolers – less maintenance
- Only one feed line when selecting the 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

- Encapsulated materials
- Fats
- Glycerides
- Hydrates
- Inorganic/organic melts
- Paraformaldehyde
- Quaternary ammonium compounds
- Stearic acid/stearates
- Waxes

# Spray drying absorption

## Air pollution control

First conceived by Niro in the 1970s, spray drying absorption for the removal of acidic components from combustion gases has been quickly adopted by the industry. The Niro spray drying absorption process has since been installed at more than 130 locations, primarily at coal-fired power plants and at waste incineration facilities.

The Niro spray drying absorption process offers you the following advantages:

- High acid gas removal efficiencies
- High capacity with only one atomizer in operation
- High availability
- Low capital cost
- Low power consumption
- Low operating and maintenance cost
- Low water consumption
- Low quality of water is acceptable without negative effects



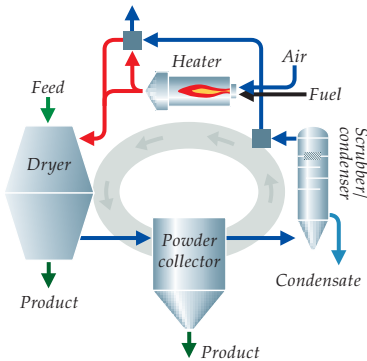
### Spray drying absorption applications

- Coal-fired power plants
- Industrial boilers
- Municipal waste incinerators
- Hazardous waste incinerators
- Metal smelters
- Other industrial off-gases

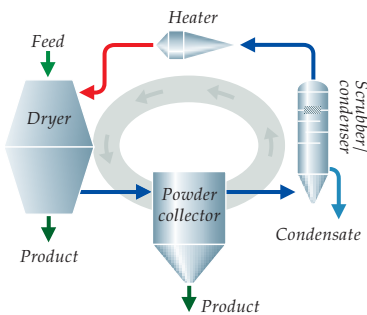
# Safety & standards

## Niro systems meet the strictest standards

### Self-inertized system



### Closed-cycle system



Because many of the materials you deal with are combustible, Niro takes the strictest safety precautions. 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 arrangements.

#### Prevent VOC emissions

If a product grade presents a high powder explosion risk, drying can be safely carried out in self-inertizing recycle layouts. Inertizing is created by use of a special direct-fired heater with venting of small volumes of exhaust drying air to maintain system equilibrium. This layout is ideal for preventing VOC emissions, since the small vent volume can be economically incinerated in an integrated heater system.

Solvent wet materials are dried in closed-cycle dryers that operate with inert gas (nitrogen) as the drying medium.

Compliance with environmental regulations is often achieved by stripping the wet feed. When this is insufficient or impractical, the exhaust air can be purified by adsorption or by catalytic or thermal incineration.

Niro analyses the risks according to well-established safety procedures and recommends the ideal safety concept.



# Services

## Niro delivers added value on top of advanced powder technology

When you choose Niro powder engineering, you benefit from a host of services that enable you to maximise your business opportunities.

### Engineering the product

We offer powder property formulation and process verification through laboratory and pilot plant testing and unmatched scale-up experience. Niro operates over 75 pilot plants worldwide. Our test engineers and process technologists represent the largest pool of specialized talent ever assembled for this task.

### Structuring the project

We also offer project financing assistance to customers planning to invest in industrial processing plants. Our financing experts have a widespread network of contacts with banks and multi- and bilateral financial institutions.

Niro's global project management skills take your project smoothly all the way to completion – coordinated and documented for you by an organisation that implements hundreds of drying projects each year.

### Extending the relationship

Maximum uptime is the focus of our spare parts programme. A ready stock supply and customized service programme is key, combined with a global network of experienced Niro service engineers. The chemical industry is dynamic, with market demands and raw materials changing over time. Whether you need a new investment, process modification or optimisation, Niro helps you perform optimally.



*Niro's test facilities and accompanying analytical laboratories allow you to establish the feasibility of using Niro equipment, optimise process conditions and provide samples for market analysis*



*Because the chemical industry is so dynamic, you'll benefit from a visit by one of our product specialists. You might need to modify or optimise your process as the years pass*

# Experience

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



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