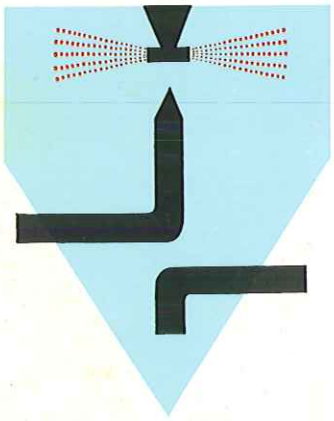
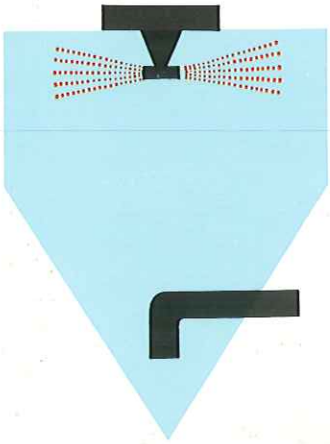
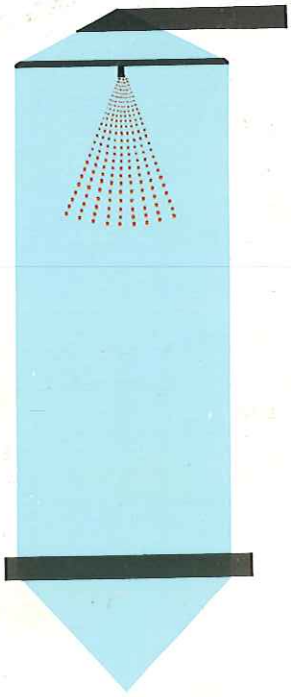
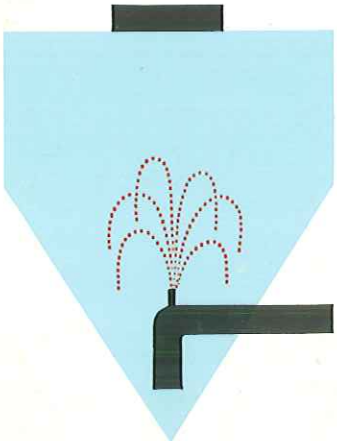
Spray Dryers

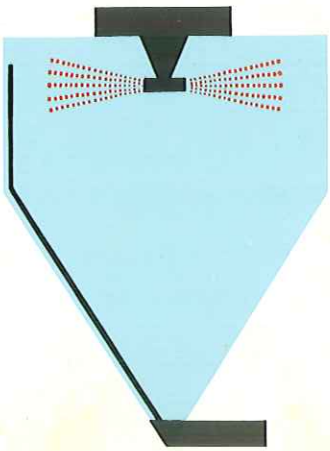
NIRO ATOMIZER









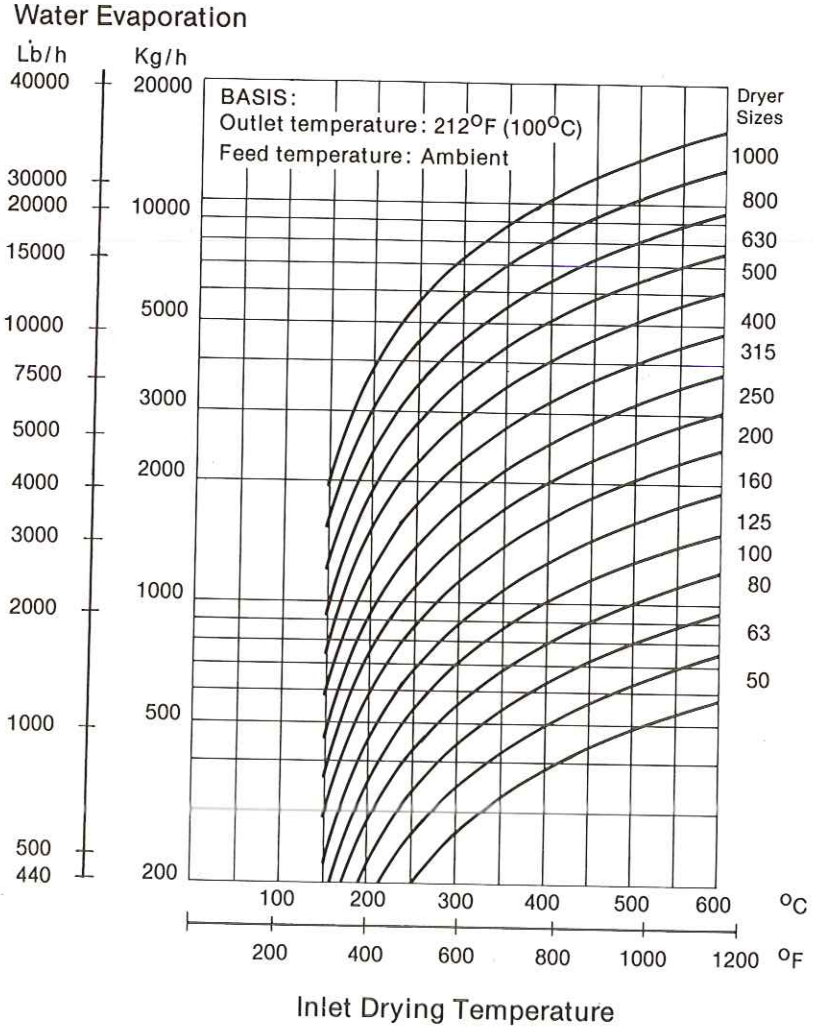


A thorough understanding of spray drying principles backed up by experience acquired from the supply of over 3000 industrial installations. This is the basis of successful applications involving NIRO ATOMIZER SPRAY DRYERS.

Spray Drying Systems

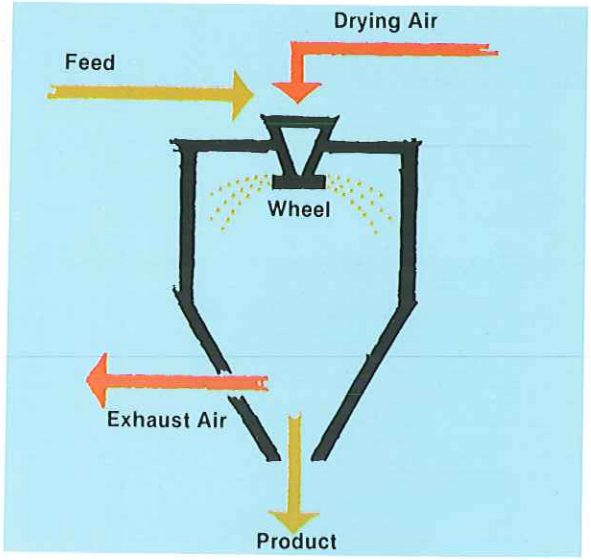
Spray drying is the transformation of a fluid feed into a dried product in one single operation. The feed is atomized using a rotating wheel or nozzles, and the spray of droplets immediately contacts a flow of hot air. The resulting rapid evaporation maintains the temperature of the sprayed droplets low, so that high drying air temperatures can be applied without affecting the product.
Spray dryer size and operating conditions are selected individually to meet each product specification.

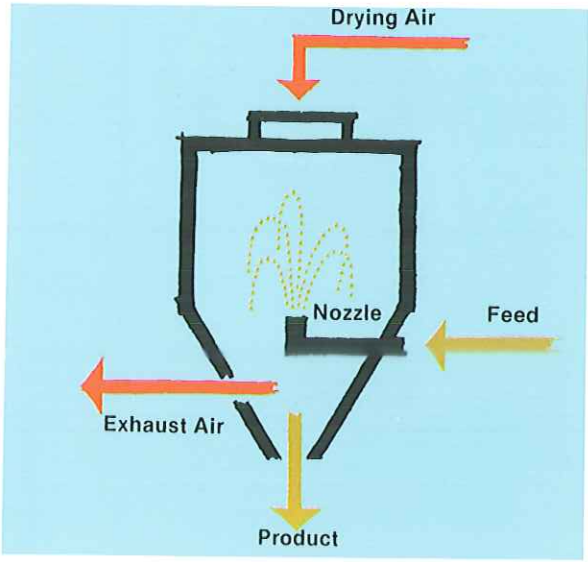
Water evaporative capacities of standard industrial Niro Atomizer spray dryers fitted with ceiling air dispersers.



Rotary Atomization

The rotary atomizer is located within the air disperser mounted on the drying chamber roof. Feed is supplied to the wheel rotating at high speed. Wheel design and operating speed depend upon capacity, feed properties, and desired particle size. Atomizer wheels are ideal for pumpable feeds, and their performance is non-sensitive to small fluctuations in feed rate and concentration.



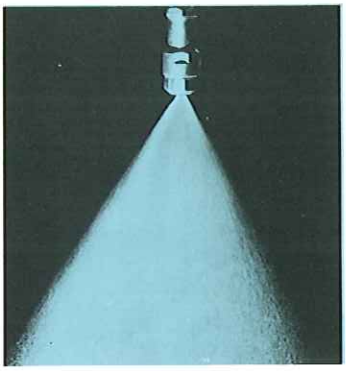


Nozzle Atomization

The nozzle atomizer can be located either within the air disperser, or positioned in the lower part of the drying chamber, as shown. This latter arrangement results in a fountain-like spray and enables coarse non-heat sensitive powders to be produced in small drying chambers.

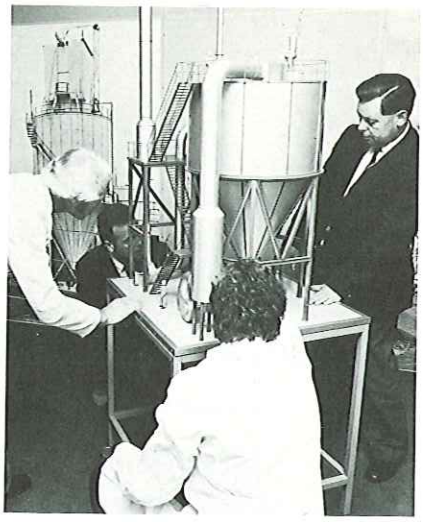
In Niro Atomizer spray dryers rotary or nozzle atomization can be employed. The diversity in fluid feed properties and in the demands upon dried product characteristics have resulted in the development of a wide range of atomizer wheel and nozzle designs.

NA rotary atomizers are available powered by motors up to 850 HP, enabling atomizer wheels to handle feed rates reaching 200 t/h.



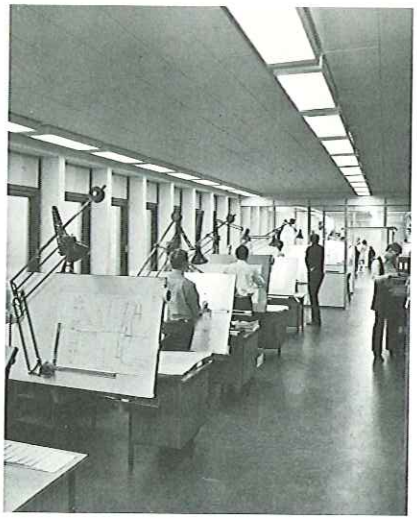
Atomizer nozzles.

Atomizer wheels.



Planning

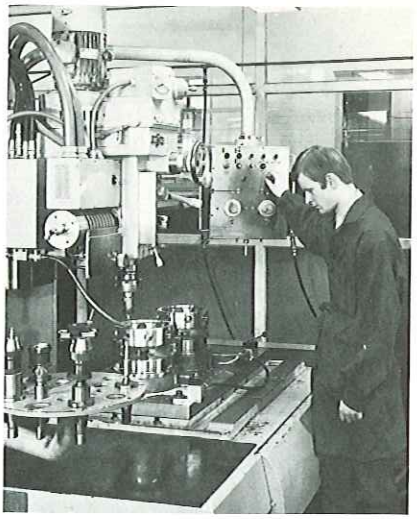
Following finalization of plant specification and order confirmation a time schedule for the individual phases of the project is drawn up so that agreed plant delivery and commissioning dates can be met. Planning ensures optimum coordination between the drawing office, workshops, testing/inspection facilities, and shipping departments.



Design

The project continues into the design stage by securing all technical data for equipment and lay-out evaluation. The final lay-out is settled, and each item of equipment is specified and the design selected based upon our latest experience from previous plant commissioning and research findings. The completed engineering drawings are checked by experienced personnel prior to delivery for workshop fabrication

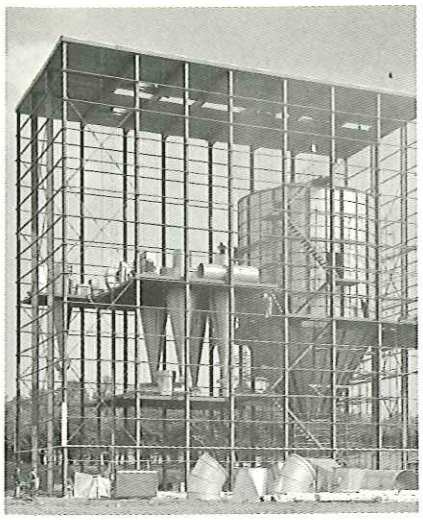
Operating and maintenance manuals are prepared to cover the main plant items.



Fabrication

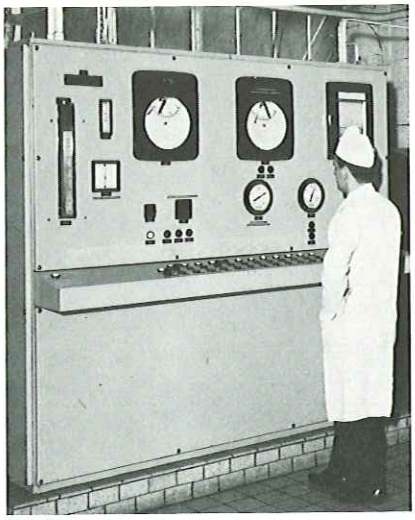
A detailed fabrication program is drawn up once the engineering drawings become available to obtain a manufacturing sequence that meets the delivery date specified in the order confirmation. The majority of drying chambers are fabricated with stainless steel product contact surfaces, but there is also extensive use of mild steel sheeting in the heavy chemical industrial field.

The Niro Atomizer engineer, responsible for the fabrication program, maintains close control over all equipment items right up to plant shipment.



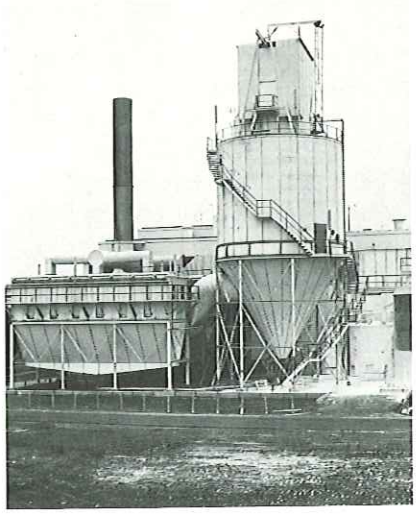
Erection

In order that the plants are erected correctly Niro Atomizer always provide an engineer to supervise the erection of the complete installation. This procedure ensures a minimum of erection time and a plant in operation as soon as possible. Usually local skilled and unskilled labor are provided by the client, but if so required, Niro Atomizer are also in the position to make available a team or just a single specialized erector for a job. To all equipment supplied by Niro Atomizer is attached a good deal of engineering »know-how« and knowledge to the benefit of the client.



Commissioning

The commissioning of the installation is also performed under the supervision of engineers from Niro Atomizer. To come into full production without delay and with no product waste is of paramount importance and we co-operate with the client in achieving this. Operation and plant attendants are trained during the commissioning period.
The commissioning involves two stages. Firstly, a mechanical start-up to check the function of all plant components. Secondly, dryer operation on water to check evaporation capacity followed by process start-up on product.
Niro Atomizer engineers ensure that the plant operates in accordance with the contract as to plant performance and product quality.



Production

Production implies the optimum use of the installation and with a Niro Atomizer plant, uninterrupted manufacturing is readily achieved yielding a high quality product for the competitive world market.
NA maintain contact with their clients, and should future technical assistance be required our company is always prepared to furnish this.

Chemicals and Ceramics

Spray drying finds wide application in these industries meeting varied product characteristics through design flexibility in choice of atomizer, air disperser, chamber size, powder recovery, and handling equipment.
There are atomizers available for all types of pumpable feeds, air dispersers to handle drying air temperatures right up to 1200°C, chamber sizes for the smallest or largest of production rates, and handling equipment to obtain optimum powder recovery with negligible losses.
Where toxic or odorous aqueous feeds are involved, special closed or semi-closed drying systems are used.
Application in the chemical industry can be grouped as follows:

- **Catalysts**
- **Detergents**
- **Dyestuffs/pigments**
- **Fertilizers**
- **Organic/inorganic chemicals**
- **Pesticides**
- **Polymers**

Examples of ceramic products processed in spray dryers:

- **Floor- and wall tile slip**
- **Electro porcelain**
- **Ferrites**
- **Tungsten carbide**
- **Steatite**
- **Alumina**
- **Titanates**

Minerals

The mining industry has much to benefit by applying the spray drying technique which is today's technology for drying the great variety of mineral products that include mineral flotation concentrates and residues from chemical and electrolytic refining.

The spray dryer is capable of producing in one single operation a »bone-dry« concentrate particularly suited for flash smelting as well as for other refining methods that require a finely divided bone-dry concentrate.

Spray dried bone-dry concentrates reduce product handling and transportation costs considerably. Simultaneously, product losses and environmental pollution are minimized.

NA spray dryers have proven duty in high tonnage mining operations, and the large rotary atomizer units particularly developed for this purpose are capable of withstanding the highly abrasive and corrosive mineral concentrates due to the use of a patented design of abrasive resistant atomizer wheel.

Examples of products handled by spray drying include:

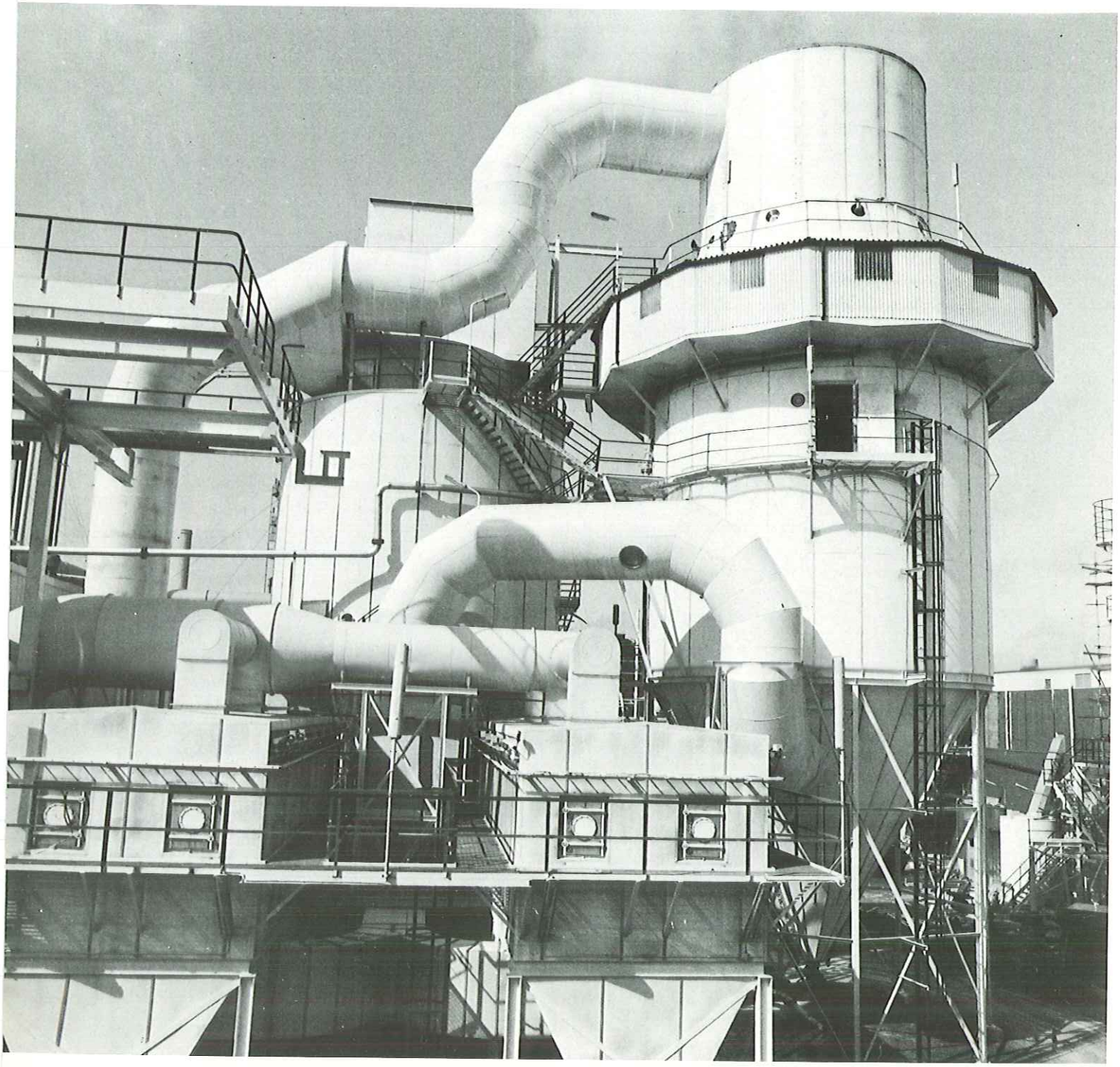
- **Copper concentrate**
- **Nickel concentrate**
- **Platinum concentrate**
- **Molybdenum concentrate**
- **Lead- and zinc concentrate**
- **Tin concentrate**
- **Cement copper precipitate**
- **Cobolt hydroxide precipitate**
- **Nickel carbonate precipitate**
- **Precious metals slimes**
- **Bentonite**
- **Cryolite**
- **Kaolin**
- **Rock phosphate**
- **Iron oxide furnace fumes**

Polymers

Niro Atomizer have installed a large number of spray dryers in the polymer processing industries.
Spray dryers for polymers often require individual design in order to meet quality specifications for the dried products. Dryer flexibility makes it possible to comply with a number of product grades.
Niro Atomizer spray dryers for polymers are characterized by an advanced and sturdy construction and a comprehensive instrumentation in order to save labour and downtime for cleaning and inspection.

For thermoplastics the dryers may be provided with a pneumatic sweep for cooling and sweeping of the chamber walls thus preventing sticking of the products.
Cyclones, wet scrubbers or bag filters are selected for efficient fines recovery from the exhaust gas.
For environment protection the gases can be recycled into the drying system through special filters and/or through scrubber-condensers. The installation can be made self-inertizing through combustion of gaseous or liquid fuels into the recycling gas stream.
When flammable solvents are to be evaporated the system operates in fully closed cycle with strictly controlled inputs and outputs from and to the surroundings and by applying nitrogen gas as drying medium.
Examples of spray dried polymer products:

- **Polyvinyl chloride**
- **Polyvinyl acetate**
- **Polyvinyl alcohol**
- **Urea formaldehyde resin**
- **Melamin formaldehyde resin**
- **Phenol formaldehyde resin**
- **Polyacrylate**
- **Polycarbonate**
- **Styrene butadiene resin**
- **Paraformaldehyde**
- **Polyformaldehyde**



Milk and milk products

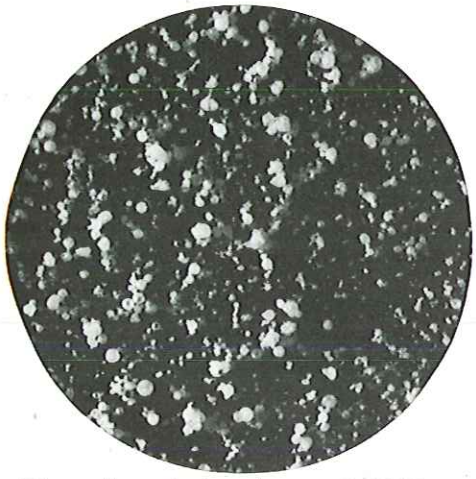
Different plant lay-outs are available to handle the various product types and to meet individual product characteristics. Microphotos demonstrate these properties.

The spray dryer with a **Pneumatic Conveying System** is suitable for the production of dried milk products such as ordinary skimmilk, whole milk, whey powder and baby foods.

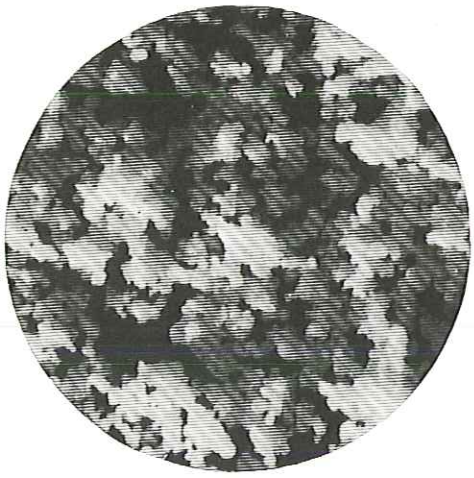
The spray dryer with a **Cooling Bed System** features the agglomeration of fines to give a slightly dusty semi-instant skimmilk powder. Fat containing products like whole milk powder gain in flowability due to low content of free fat. Products of high fat content, such as milk replacers, ice cream mix, cheese and cream powder are succesfully spray dried with this system.

The spray dryer with **Straight-through Instantizer System** produces instant milk powder directly. With some slight modification this type of plant is used for the production of non-caking whey powder, or products with high fat content.

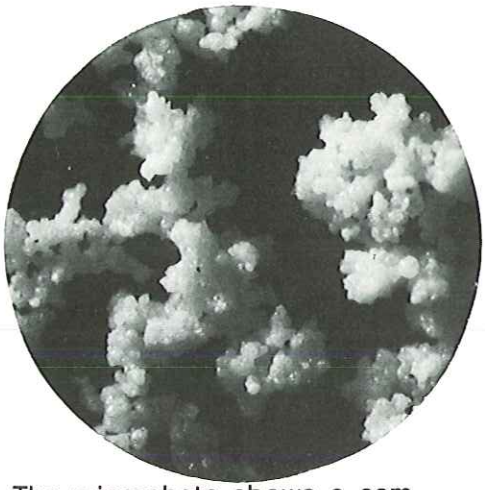
The straight-through instantizer system is a vibrated fluid bed attached to the drying chamber base.



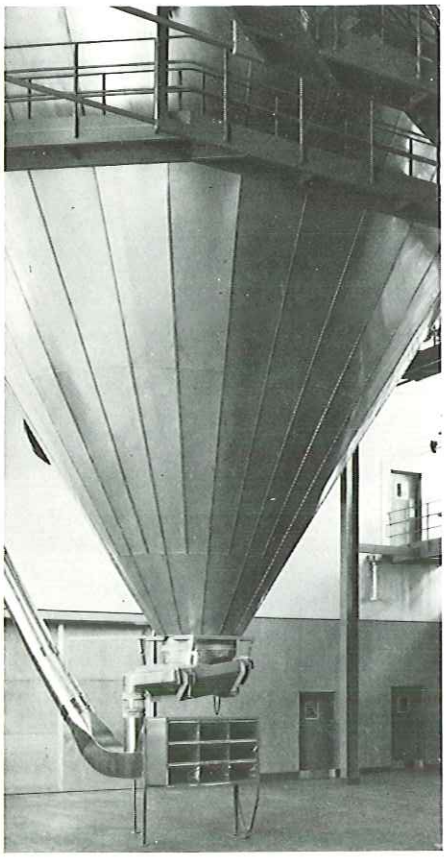
The microphoto shows a sample of ordinary skimmilk powder.

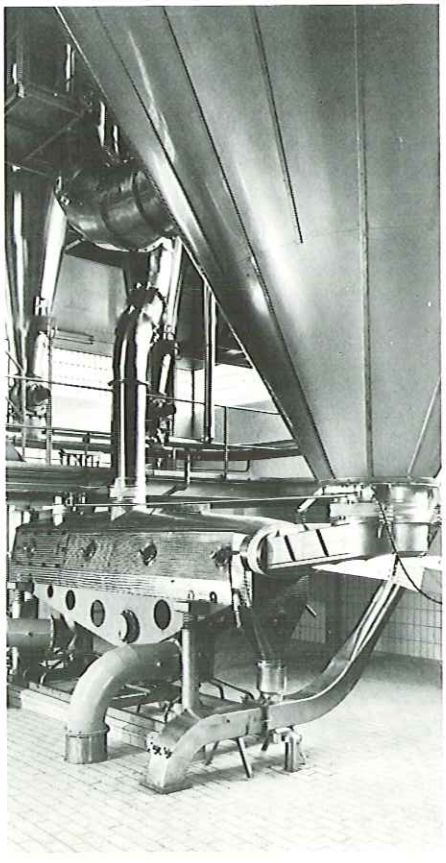


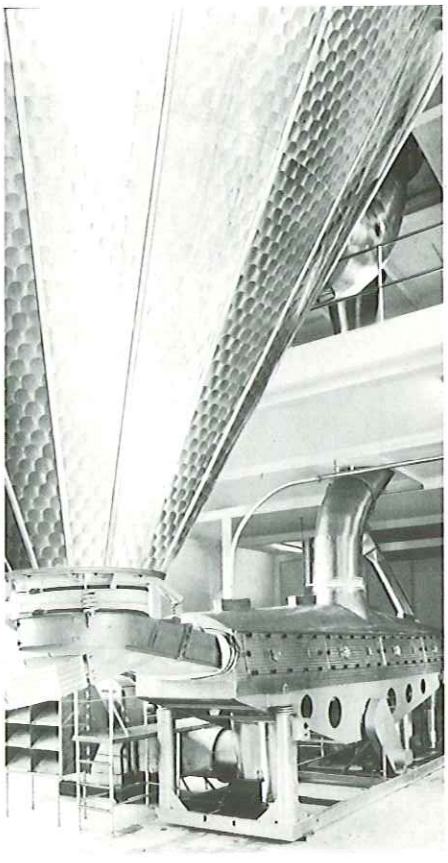
The microphoto shows a sample of semi-instant skimmilk powder.



The microphoto shows a sample of instant skimmilk powder.







Agglomerated or »instant« foodstuffs

Over the past few years, agglomeration of powdered foodstuffs has risen to new levels of importance. The trend is strong in the instant coffee, milk, and baby food industries. However, the product range is rapidly widening (see accompanying list). Such foodstuffs are produced directly in special spray dryer designs or in agglomerating equipment operating in conjunction with spray dryers.

Agglomeration improves the dispersibility of powdered products by creating a form that is wetted simultaneously and uniformly when dropped into cold or hot water. In addition, agglomeration gives the product a psychological advantage over non-agglomerated dried powder forms. Color, particle shape, and appearance are more pleasing to the eye, giving the product greater sales appeal.

Agglomerated foodstuffs include:

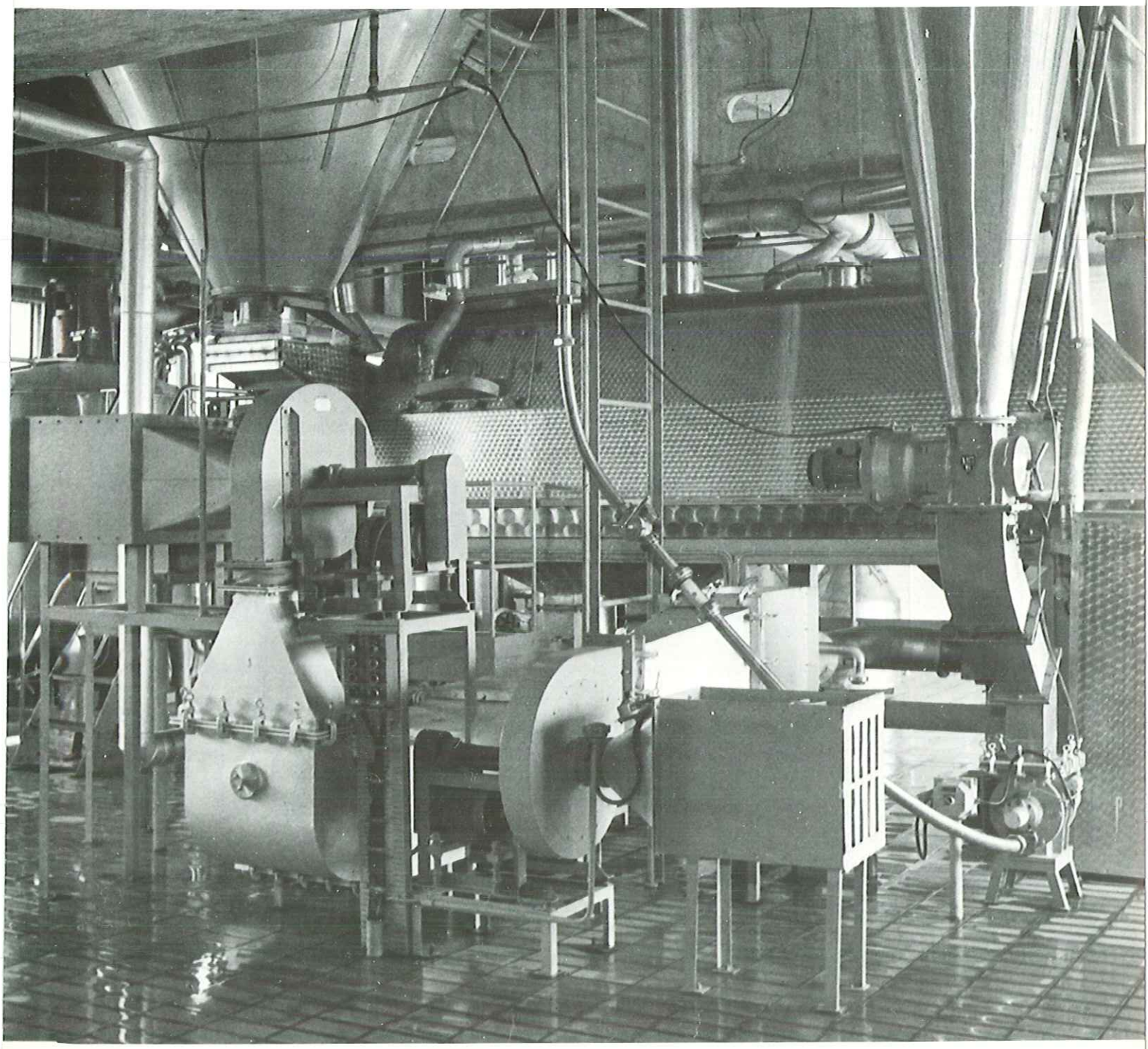
- **Alginates**
- **Baby food**
- **Banana/Sugar**
- **Beverage whiteners**
- **Cocoa/Sugar or Sugar/Milk**
- **Coffee**
- **Coffee substitute**
- **Instant Starch**
- **Milk/Starch/Flour**
- **Milk/Sugar**
- **Pineapple/Sugar**
- **Strawberry/Sugar/Milk**
- **Tomato**

Pharmaceuticals

Niro Atomizer meet the stringent demands of the pharmaceutical and biochemical industries by offering a range of spray dryers for both aseptic and sanitary processing.
Properties of pharmaceuticals and biochemicals are so diversified that special designs are selected according to whether standard, aseptic or sanitary conditions are required. All these dryer designs are featured by the method of atomization, feed and air filtering, and powder handling.
A full range of dryer sizes are offered, from small production units for antibiotics, etc. to high tonnage dryers for proteins from hydrocarbon sources.

Typical applications include:

- **Aminosalicylic acid**
- **Aspirin**
- **Bacitracin**
- **Blood plasma**
- **Chloramphenicolsuccinate**
- **Culture media**
- **Dextrans**
- **Enzymes**
- **Penicillins**
- **Proteins**
- **Streptomycin and salts**
- **Tetracyclines**
- **Vitamins**
- **Yeast**



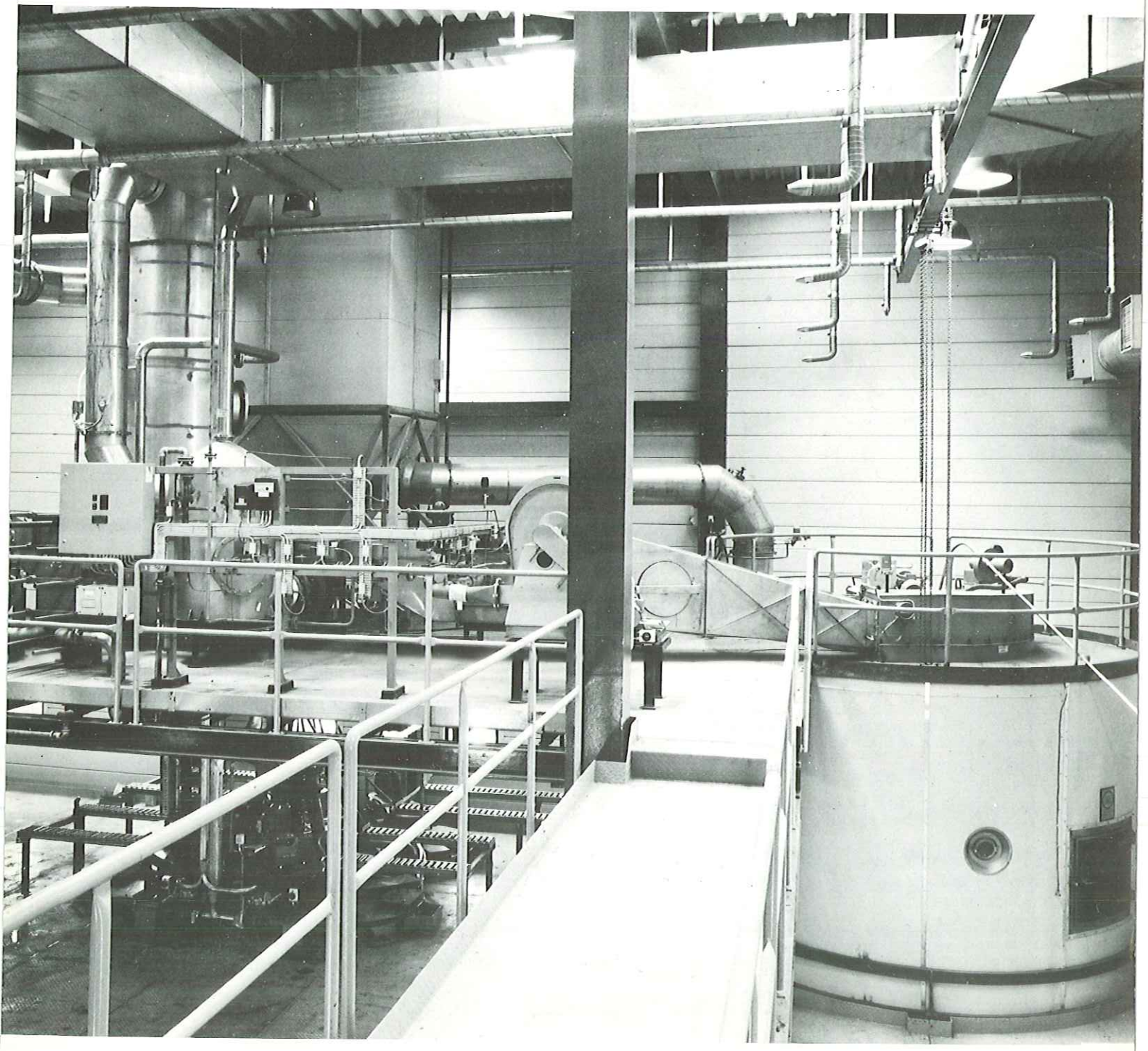
Spray drying in low oxygen atmospheres

Closed Cycle and Self-Inertizing Systems

The majority of spray dryers designed today operate with atmospheric air as the drying medium, the so-called open system. However, when feeds contain organic liquids the drying air must be substituted by inert gas to eliminate risk of explosion. For complete solvent recovery and re-use of inert gas (e. g. nitrogen) **Closed Cycle Drying Systems** are employed involving a drying chamber with indirect heater, product collector and scrubber/condenser in a closed loop.

However, if an aqueous feed is involved where the dried product must only be in contact with a reduced oxygen content due to explosive or powder oxidation tendencies a modified closed cycle system is applicable: **the Self-Inertizing System**. The formation of an inert system is accomplished by use of a direct gas or oil fired air heater. A minimum of excess combustion air is used. The low 0_2 content drying medium is created from the combustion gases.

In order to maintain the correct pressure conditions in the recycling drying medium, a small gas volume is continuously bled from the system. If required, this bleed can be de-activated.



Utility Unit

A package unit for research and semi-industrial applications

With this dryer, investigations on a small industrial scale can be achieved by covering a wider range of operating conditions.

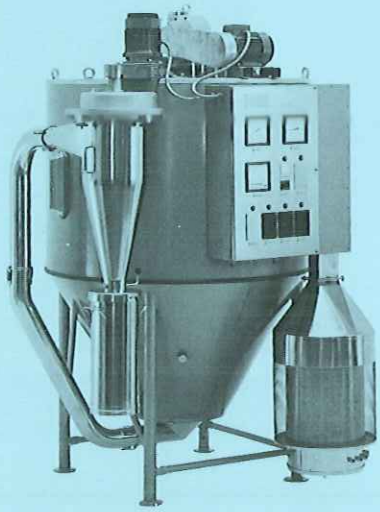
Flexibility is built-in by having a choice of atomizer and heating system. Rotary atomization (vaned wheels rotating at high speed) or nozzle atomization (pressure or two-fluid nozzle) can be used equally well in association with the gas, steam or electric air heaters offered with the unit.

The provision of a chamber wall that can be air-swept extends the range of test products to cover thermo-plastic and hygroscopic materials. The utility unit can be modified for closed cycle or sanitary applications.

Rotary atomization

Evaporative capacity:
10—25 kg/h

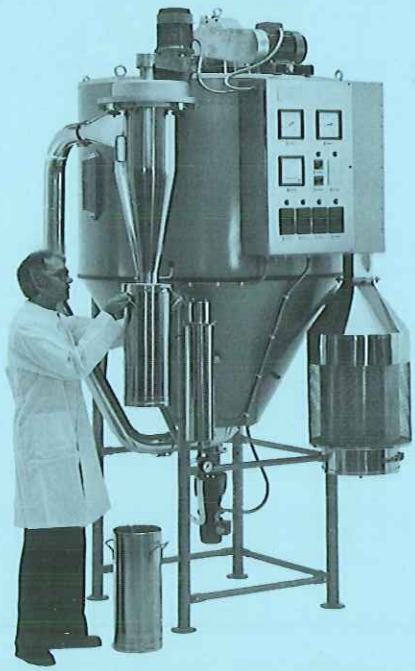
Dimensions:
Length: 1750 mm
Height: 2450 mm
Width: 1675 mm
Weight: approx. 720 kg



Rotary atomization and airbroom assembly

Evaporative capacity:
6—8 kg/h

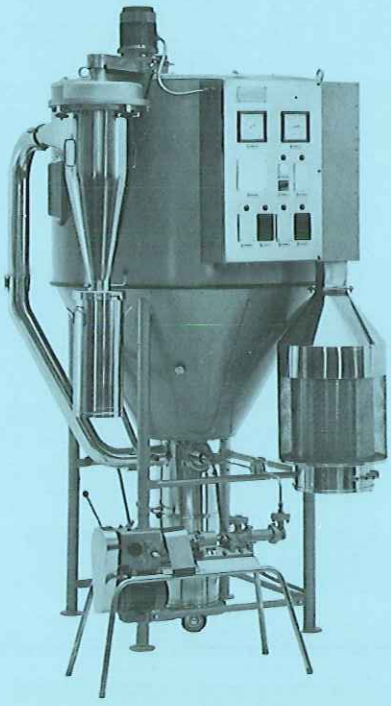
Dimensions:
Length: 1750 mm
Height: 2850 mm
Width: 1675 mm
Weight: approx. 780 kg



Nozzle atomization

Evaporative capacity:
10—15 kg/h

Dimensions:
Length: 1750 mm
Height: 3050 mm
Width: 1675 mm
Weight: approx. 660 kg

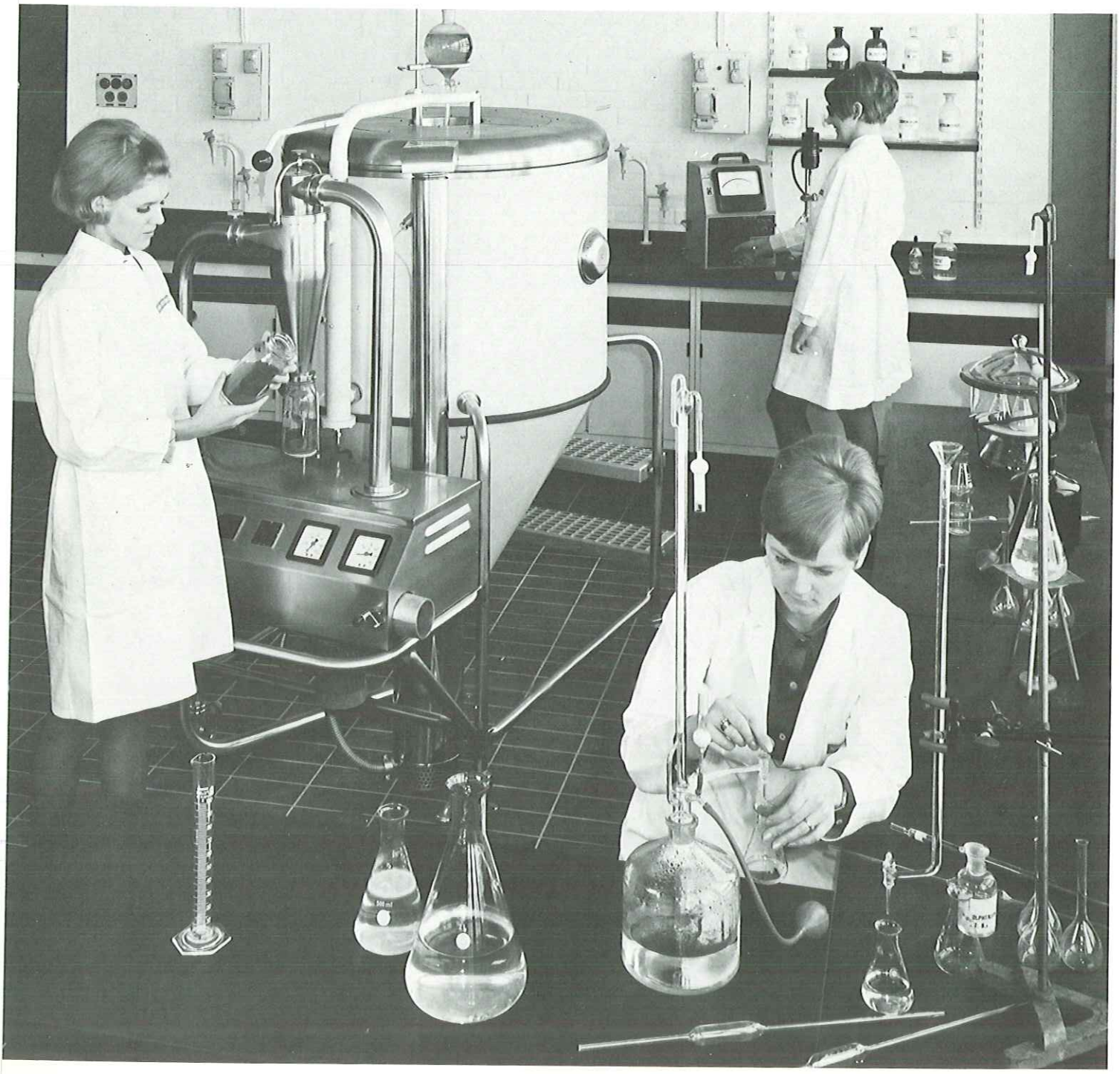


Portable Unit

A package unit

The portable spray dryer is designed with research and development requirements in mind. Small quantities of test products can be dried effectively. Drying results are obtained quickly to provide the important information for continuance of an undertaken project. Planning a spray drying process on an industrial scale begins with drying data obtained at laboratory level.

Data from the portable unit provide the vital link for scale-up to industrial production.
The portable unit features an air turbine driven atomizer wheel, ceiling air disperser, and single point product discharge from a cyclone.



Plant Sizes and Components

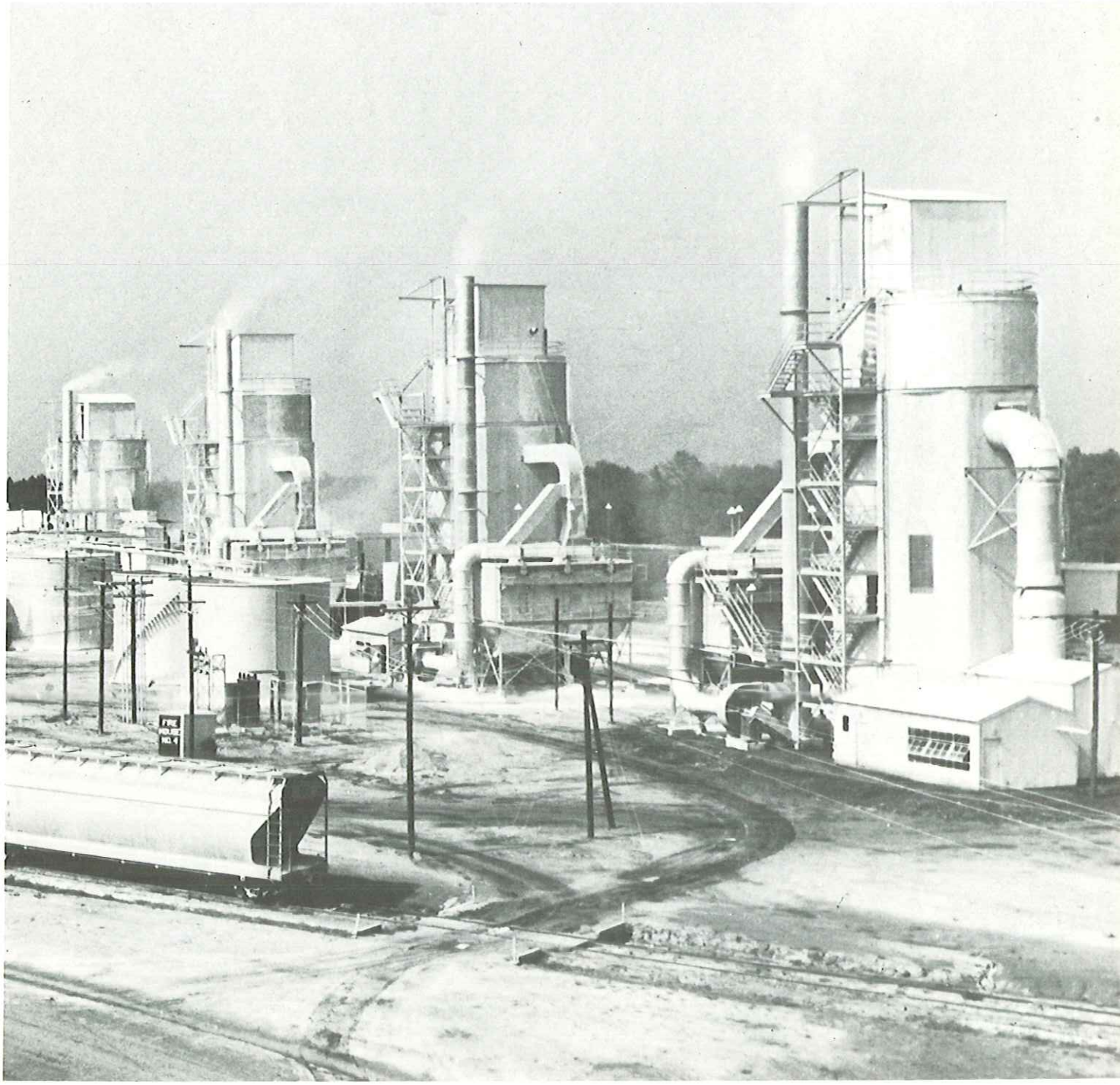
Niro Atomizer specialize in the design, engineering, construction, supply, and commissioning of drying equipment for capacities ranging from a few pounds up to 80 t/h of water evaporated.

Spray dryers with ceiling air dispersers have been standardized to cover evaporative capacities as shown in the curve on page 2.

The continual search for new dryer applications and further improvements of established techniques provide the experience to assist industries to achieve better products at lower production costs.

Niro Atomizer plants comprise a component choice of:

Atomizer:	rotary	nozzle	
Air disperser:	ceiling	central	
Drying chamber:	co-current	counter current	mixed flow
Heater:	direct	indirect	
Feed pump:	positive displacement	centrifugal	
Powder separation:	cyclone	bag filter	electrostatic precipitator
Air cleaning:	scrubber (wet)		
	vortex flow separator (dry)		



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