HOSOKAWA MICRON DRYING TECHNOLOGY

HOSOKAWA MICRON B.V.

Leaders in powder processing technology

BEPEX • MICRON • STOTT • VRIECO-NAUTA®

Hosokawa Micron Dryer

Introduction

Over a period of 70 years, Hosokawa have made constant efforts to meet the ever increasing technical demands of powder processing technology required in all sectors of industry throughout the world, starting with simple process equipment in the early days, to complete turn key powder processing plants in recent years.

The result of this vast experience in powder processing, includes a typical drying process for wet powders, called the Micron Dryer System. The extensive know-how in the field of drying, process engineering, design and manufacture of complete systems and plants for all branches of industry is exclusively provided for the European market by Hosokawa Micron B.V. and their representatives. This Micron Dryer System has been developed as the first patented dryer in the world, which combines grinding and classifying principles.

Hosokawa Micron offer full test house facilities to experiment on new materials and to meet client's specific requirements.

Process principle

The schematic flow diagram (figure 1) shows the principle of operation of the Micron Dryer System.
Wet material which can contain a large range of moisture contents is fed into the grinding and drying section of the dryer main body.
The impact energy imparted by the grinding rotor disperses the wet material into very fine particles.
A temperature controlled hot air stream from the air heater is drawn by the exhaust fan through the main body and fluidizes the fine particles in the grinding chamber. This condition guarantees optimal heat exchange and instant evaporation of moisture.
The dried particles are conveyed with the air stream to the top section of the dryer where a separator classifies the particles by size. Particles passing the classifier at the set cut point are conveyed with the exhaust air to a Hosokawa Pulsaire automatic reverse jet fabric filter.
The exhaust air of the system can be recirculated to the heater under certain conditions to reduce the overall energy consumption.
Due to its principle of design the Micron Dryer operates as a continuous drying system offering a wide range of applications.

Special features

Uniform product

The Micron Dryer, having three operations (drying, grinding and classifying) in one unit, produces products which are uniform in moisture and particle size.

Particle size control

The Micron Dryer is equipped with an air classifier at the outlet of the Dryer, enabling the fineness of the product to be easily controlled within a wide range.

Moisture control

By adjustment of both temperature and residence time of material, the moisture content in the product can be easily controlled to below 0.5% W.B.

High overall heat transfer coefficient

Rapid heat exchange takes place in the pulverizing section where the surface area of the material is tremendously increased. In addition to the increase in the surface area, the agitation effect of the classifier rotor plays an important role in obtaining high heat transfer coefficient. Practical data shows that the coefficient is 2000 to 9000 W/m^3 °C .

Space saving

Due to the high overall heat transfer coefficient and the combination of operations in one body, the Dryer is relatively small, requiring a small floor area with less heat loss than with conventional hot air dryers.

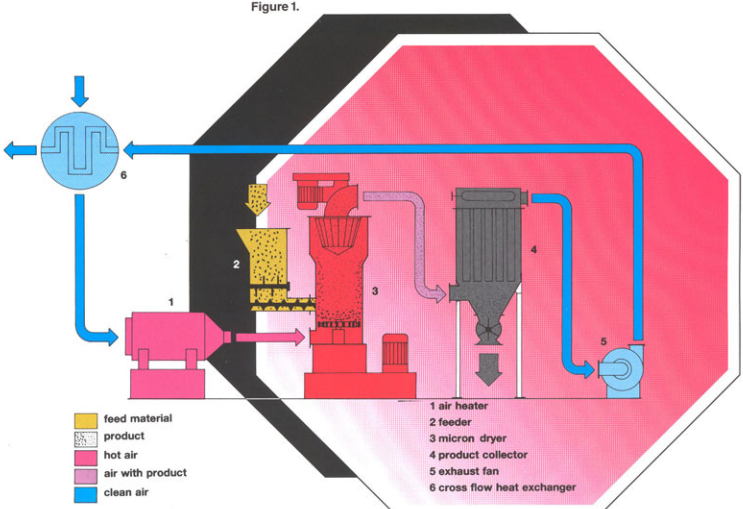
Short residence time

Very short residence times of a few seconds only can be achieved, so no deterioration of the product at high inlet gas temperatures occurs.

Dustfree operation

The totally enclosed system is generally operated with the exhaust fan, as the final item of equipment.
This keeps the system under negative operating pressure and avoids the possible escape of dust particles into the environment.

Figure 1.



Drying principle

Figure 2 shows the principle of operation of the Hosokawa Micron Dryer.
The dryer body consists of a vertically mounted classifier (1) with combined product and air outlet (2), wet material feeder (3), grinding rotor (4) and hot air or gas inlet (5). The specially designed feeder transfers the wet material into the grinding section of the dryer. The impact action of the grinding rotor disperses the wet material into micronized particles.
Hot air from the heater is drawn through the dryer by the fan where instant evaporation of the moisture occurs. The dried particles then enter the classifying zone (1).
The fine particles separated by the classifier leave the dryer at the outlet (2) and are collected in the filter unit.

The coarse particles rejected by the classifier are mixed with the feed material before being returned to the grinding section for further pulverization.
Because of the mixing of the feed with the dried course reject stream, materials which present difficult handling problems, such as adhesion or cohesion, are modified and can be processed more easily using this technique.

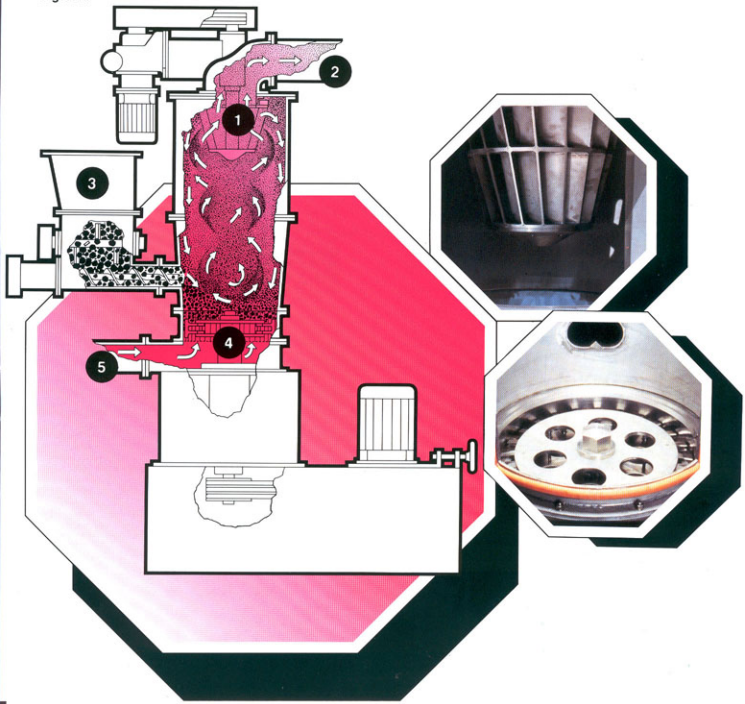
Applications

1. Drying wet powder, lumpy, flaky or fibrous materials
2. Drying wet filter cake, paste or slurry
3. Drying in inert gas atmospheres
4. Drying of water of crystallisation
5. Drying heat sensitive materials
6. Drying thixotropic materials
7. Drying dust explosive materials
8. Recovery of solvents

Type of dryer

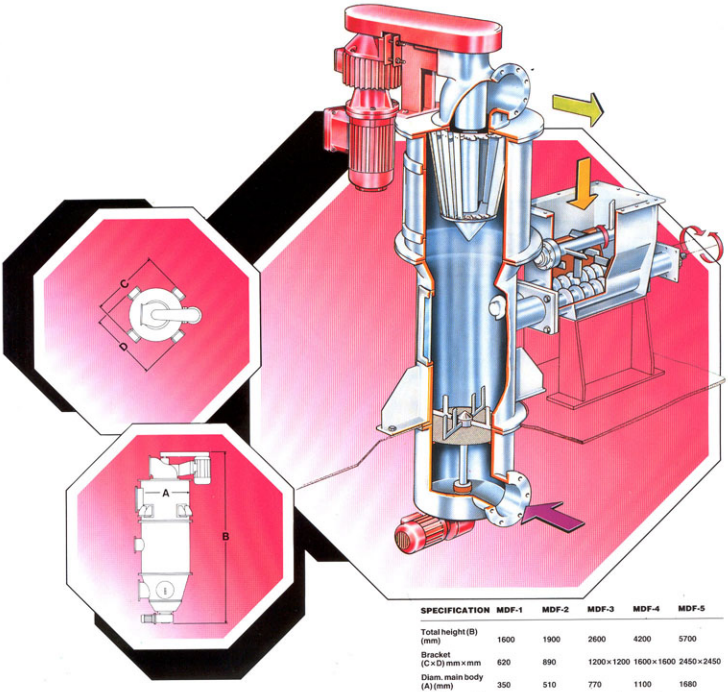
Three dryer models have been developed to handle a wide range of materials.
MDF
This model is designed to process soft agglomerates such as filter cakes of low to medium hardness.
MDV
Suitable when greater impact energy is required for grinding medium to hard agglomerates or materials, such as: organics, food, pharmaceuticals, etc.
MDH
Handles hard agglomerates or materials which have to be pulverized to a very fine particle size.
Special knife hammers can be fitted when fibrous materials are to be handled.

Figure 2.



MDF

Suitable for soft agglomerates. The wet material is deagglomerated and dried in a fluidised powder bed. The particle size and moisture content are controlled by the classifier and outlet gas temperature.



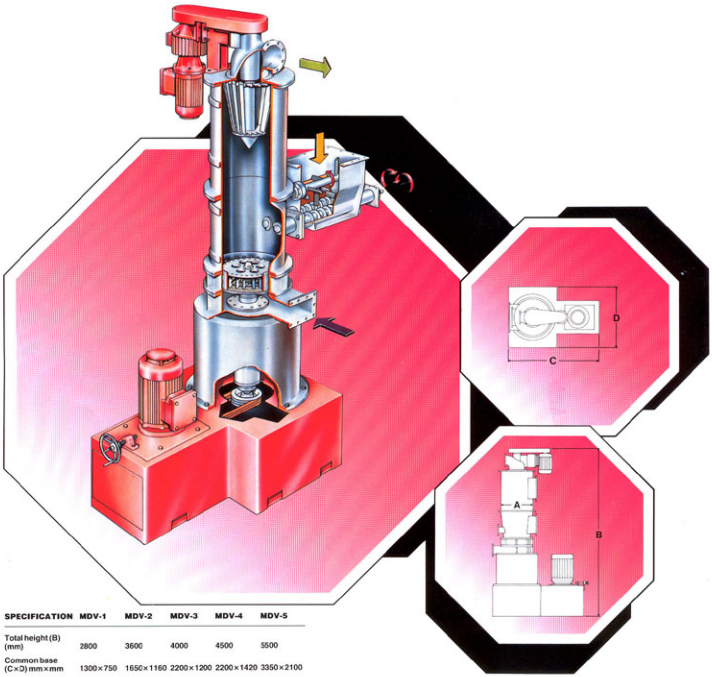
SPECIFICATION	MDF-1	MDF-2	MDF-3	MDF-4	MDF-5
Total height (B) (mm)	1600	1900	2600	4200	5700
Bracket (C×D) mm×mm	620	890	1200×1200	1600×1600	2450×2450
Diam. main body (A) (mm)	350	510	770	1100	1680
Weight (approx.) (kg)	500	1150	1900	3000	4500
Agitator section: motor (kW)	1.5	2.2	4.0	5.5	7.5
Max. rotor speed (rpm)	350	150	120	60	40
Classifying section: motor (kW)	0.75	1.5	2.2	3.7	5.5
Max. rotor speed (rpm)	2300	2000	1500	1300	800
Max. inlet temp. hot gas (°C)	450	450	450	450	450
Range of air rates (m^3/min.)	10-20	20-50	60-100	100-200	200-330
Max. evaporation capacity* Kg H_2O/Hr.	125	310	600	1200	2000

Data for reference only

* Evaporation capacity is based on a feed material with 50% (W.B.) moisture content and with 0.5% (W.B.) moisture in the product.

MDV

Most commonly used in all industries. The vertically driven grinding rotor disperses wet agglomerates and solids increasing the surface area of the particles. This considerably improves the heat transfer efficiency for the drying operation.



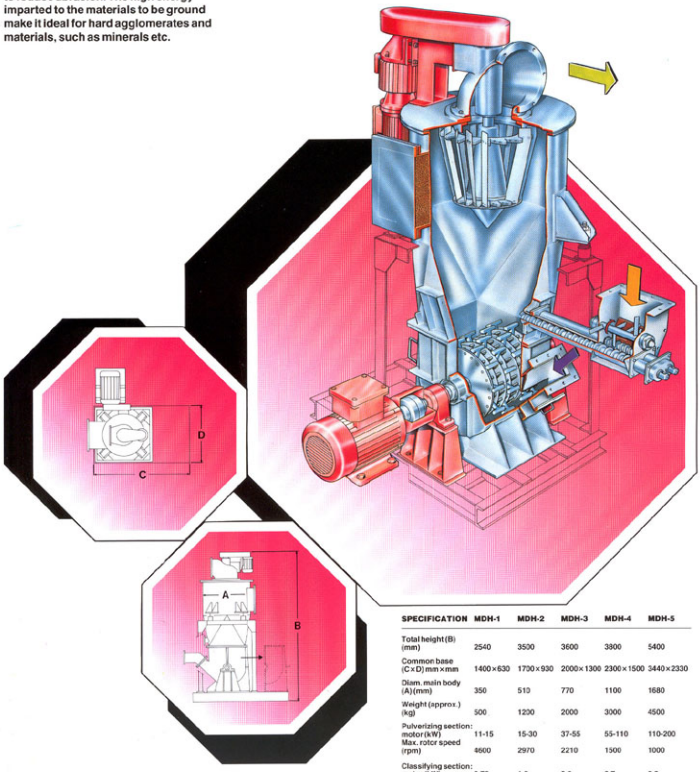
SPECIFICATION	MDV-1	MDV-2	MDV-3	MDV-4	MDV-5
Total height (B) (mm)	2800	3600	4000	4500	5500
Common base (C×D) mm×mm	1300×750	1650×1160	2200×1200	2200×1420	3350×2100
Diam. main body (A) (mm)	350	510	770	1100	1680
Weight (approx.) (kg)	500	1500	2500	4000	6000
Pulverizing section: motor (kW)	3.7	7.5	11-22	22-37	37-50
Max. rotor speed (rpm)	4500	3200	2200	1500	600
Classifying section: motor (kW)	0.75	1.5	2.2	3.7	5.5
Max. rotor speed (rpm)	2300	2000	1500	1300	800
Max. inlet temp. hot gas (°C)	450	450	450	450	450
Range of air rates (m^3/min.)	10-20	20-50	60-100	100-200	200-330
Max. evaporation capacity* Kg H_2O/Hr.	125	310	600	1200	2000

Data for reference only

* Evaporation capacity is based on a feed material with 50% (W.B.) moisture content and with 0.5% (W.B.) moisture in the product.

MDH

Suitable for fine pulverizing and drying. The horizontally driven grinding rotor of the dryer is fitted with stirrup type swing hammers, which can have hardened tips to reduce abrasion. The high energy imparted to the materials to be ground make it ideal for hard agglomerates and materials, such as minerals etc.



SPECIFICATION	MDH-1	MDH-2	MDH-3	MDH-4	MDH-5
Total height (B) (mm)	2540	3530	3600	3800	5400
Common base (C×D) mm×mm	1400×630	1730×930	2000×1300	2300×1500	3440×2330
Diam. main body (A) (mm)	350	510	770	1100	1680
Weight (approx.) (kg)	500	1230	2000	3000	4500
Pulverizing section: motor (kW)	11-15	15-30	37-55	55-110	110-200
Max. rotor speed (rpm)	4600	2970	2210	1500	1000
Classifying section: motor (kW)	0.75	1.5	2.2	3.7	5.5
Max. rotor speed (rpm)	2300	2000	1500	1300	800
Max. inlet temp. hot gas (°C)	450	450	450	450	450
Range of air rates (m³/min.)	10-20	20-50	60-100	100-200	200-330
Max. evaporation capacity* Kg H_2O/Hr.	125	310	600	1200	2000

Data for reference only

* Evaporation capacity is based on a feed material with 50% (W.B.) moisture content and with 0.5% (W.B.) moisture in the product.

Complete systems

Drying systems, based on the Hosokawa Micron dryer have been installed all over the world for more than 35 years. In house experience and know how of drying processes enables Hosokawa to design, manufacture and install complete drying systems, including all necessary ancillaries.

Feeder

Various types of feeders are available to ensure accurate metering of wet materials into the dryer body such as:
Single, double or multiple screw type feeders for wet cakes of high moisture content using:

Screw Feeder

- standard full flight screws
- overlapping full flight screws
- paddle screws
- ribbon screws.

Pump feeder

Slurries, pastes and thixotropic materials are pumped into the dryer using:

- screw pump
- diaphragm pump
- hose pump.

Feed intake hopper

Specially designed feed hoppers with various agitators guarantee a constant head of wet material above the feeder for accurate feed to the dryer. For larger volumes or thixotropic feed materials, a Vrieco-Nauta mixer is used as a live hopper which can control the thixotropic nature of the feed material.

Heater

An air heater is necessary for the supply of hot air to the dryer.
The heater includes a temperature control system to maintain a constant air temperature at the dryer outlet.
Types of air heaters applicable are:

Direct air heaters

- gas burner
- oil/paraffin burner
- Electric heater
- hot gas from other sources

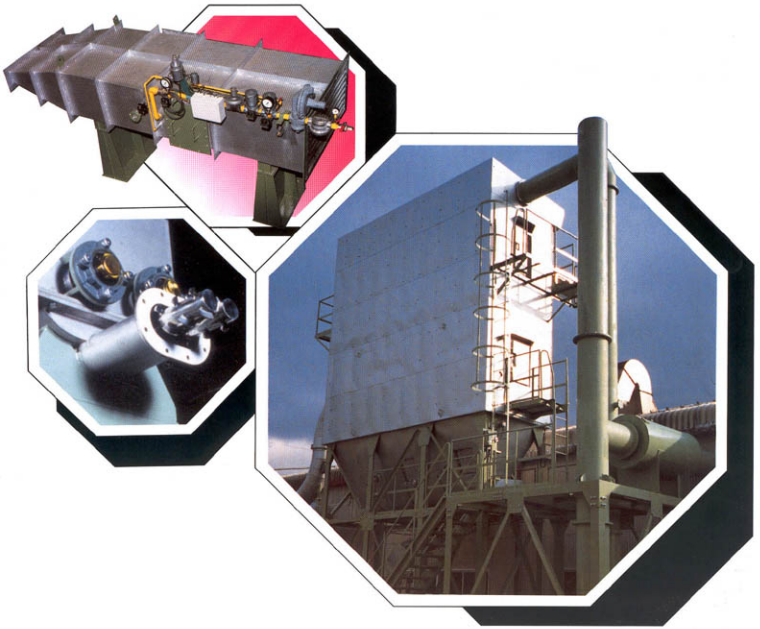
Indirect air heaters

- steam heat exchanger
- thermo-oil heater
- gas/gas heat exchanger

An air intake filter can be installed when clean process air is required.

Product collector

The dried and micronized product is collected in a bag filter either directly or by a cyclone combined with a bag filter. When either collection system is used a Hosokawa Pulsaire automatic reverse jet dust collector is supplied. The appropriate filter rates and media are selected depending upon the nature of the material to be processed.



Coarse particle rejection mechanism

For certain materials which contain impurities, a coarse particle rejection port can be fitted in the top section of the Micron Dryer. This feature guarantees a high quality product and economical operating conditions including reduced wear rates.

Heat recovery system

The exhaust air from the fan has a relatively high temperature and it can be economical to recover this heat, reducing the operational cost of the plant.
Methods applied are:
- gas/gas heat exchanger
- heat exchangers with transfer media (thermoil etc.)

Dust explosion protection

With hazardous materials such as organics, food, pharmaceuticals etc., the risk of dust explosion must be considered. In such cases, pressure-shock-resistant equipment with explosion barrier valves (EV1) (EV2) are available.

Fan

To aspirate the system and to convey the dried material under suction a centrifugal fan is installed.
The fan is selected to suit the operating conditions of the dryer system.

Conveying duct

The function of the duct from the Micron Dryer is to convey the dried powder to the product collector. The duct should be kept as short as possible to prevent heat losses and condensation.

Plant control system

Diagram 3 shows the instruments required for a typical plant control system.

Basic control

The plant is basicly controlled by the temperature control system (TIC 1) and the overload alarm system (LIA 1). The outlet temperature is maintained at a preset value by TIC 1, controlling the moisture content of the product. The load alarm switch (LIA 1) gives an on/off signal to the feeder to avoid overfeeding.

Automatic control

Full instrumentation for automatic plant control can be supplied to optimize operating conditions.
Instruments included are:

TIA 1 – max. inlet air temperature of dryer
TIA 2 – max. outlet air temperature of dryer
TIA 3 – min. outlet air temperature of dryer
FIC 1 – Airflow control; to maintain a constant air flow in the system.
PDIA 1 – Pressure drop control; to control the max. quantity of product in the drying chamber.

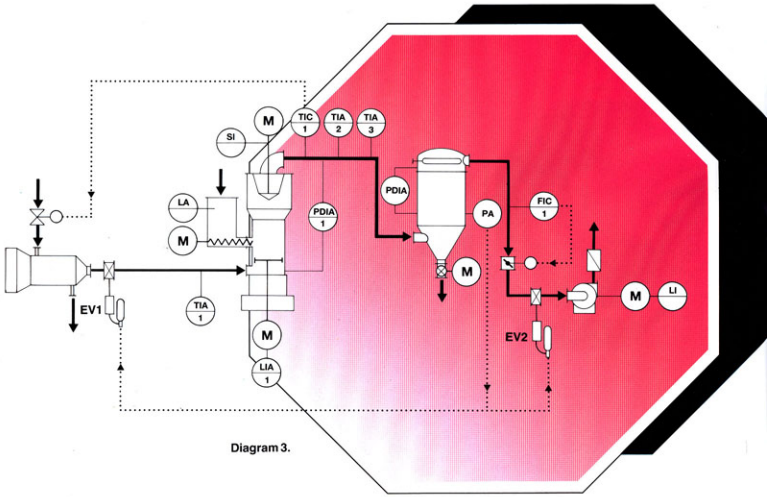
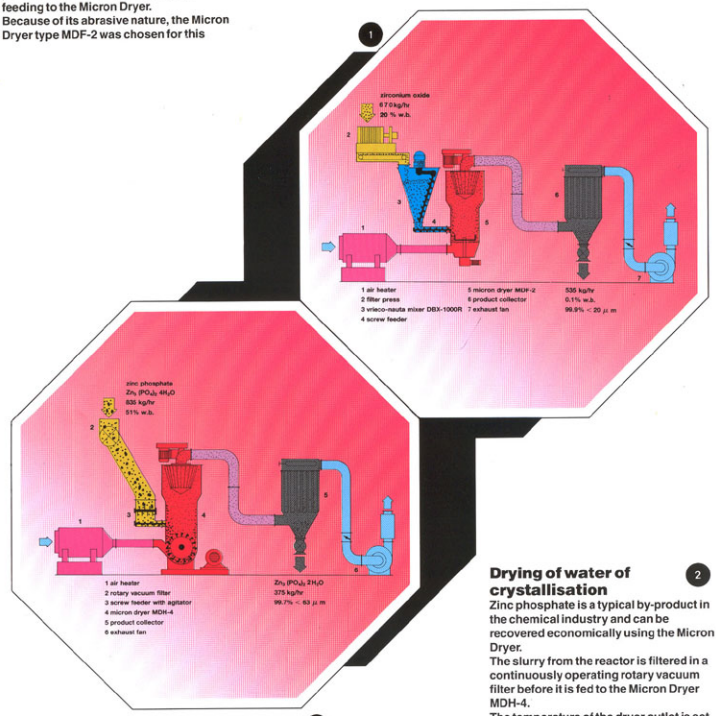


Diagram 3.

Typical processes

1 Drying abrasive material

Zirconium oxide (ZrO_2) is one of the typical ceramics for electronics, optical instruments, refractories etc. This is due to its chemical stability and hardness. After alkalization and recrystallisation, purified ZrO_2 is filterpressed before feeding to the Micron Dryer.
Because of its abrasive nature, the Micron Dryer type MDF-2 was chosen for this application. Wet filter cake is dispersed and dried in the fluid bed in combination with the separator action. The gentle operation of this dryer model reduces wear problems to a minimum. The thixotropic nature of the feed material requires a Vrieco-Nauta mixer acting as a live hopper before feeding to the dryer.



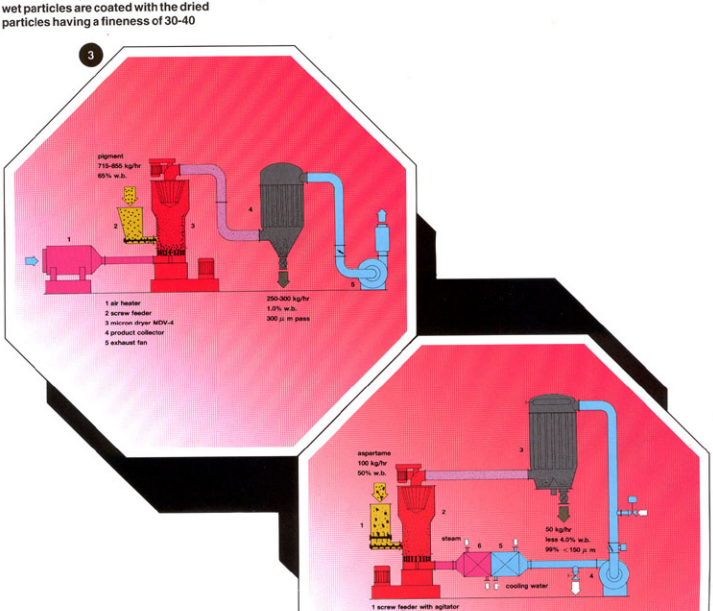
2 Drying of water of crystallisation

Zinc phosphate is a typical by-product in the chemical industry and can be recovered economically using the Micron Dryer.
The slurry from the reactor is filtered in a continuously operating rotary vacuum filter before it is fed to the Micron Dryer MDH-4.
The temperature of the dryer outlet is set at 140 °C to drive off some of the water of crystallisation. Adjustment of the operating conditions of the dryer, specifically the outlet temperature, controls the water of crystallisation. The product is pulverized to a fineness of 99% or more passing a 38 micron control sieve and is changed from $4H_2O$ to $2H_2O$ after drying.

3

Micro-granulation

Pigments and dyes are often required dustfree to avoid handling problems. Wet material is fed into the grinding section of the Micron Dryer where a rotor with knife hammers creates a dense fluid bed of dried and fine particles. The micronized wet particles are coated with the dried particles having a fineness of 30-40 micron. This process is called micro-granulation. When accurately controlling the air flow, separator rotor speed and temperature, a micro-granulated product with a fineness of 300 micron can be produced succesfully with the Micron Dryer.



4 **Drying in inert gas atmosphere**

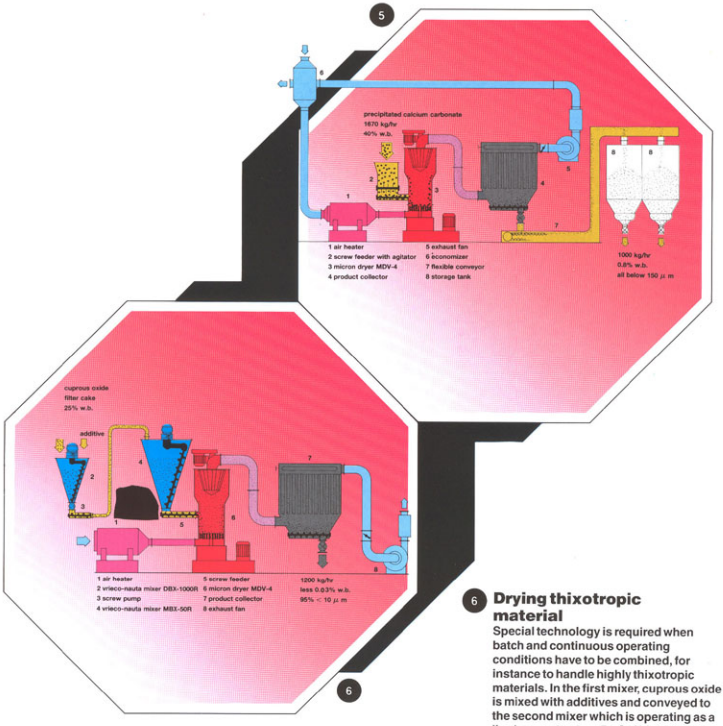
When explosive materials such as food and pharmaceuticals have to be processed the Micron Dryer can be designed to operate in an inert gas atmosphere. This system has been designed for the production of aspartame, used as a sweetening agent for diet foods.

The Micron Dryer system operates succesfully for the production, drying and particle size control in the final process stage.

To meet the requirements of maintaining both flavour and explosion protection, the dryer operates in a nitrogen gas atmosphere in a closed system.

5 Energy saving dryer

The operational costs of a dryer system become more important when low cost products have to be processed.
Precipitated calcium carbonate is such a material. This material is widely used as a filler for various types of plastics, rubber, paper etc. The Micron Dryer system reduces the overall energy consumption considerably. Electrical power and fuel savings are 30% when compared with a conventional belt dryer.



6 Drying thixotropic material

Special technology is required when batch and continuous operating conditions have to be combined, for instance to handle highly thixotropic materials. In the first mixer, cuprous oxide is mixed with additives and conveyed to the second mixer which is operating as a live hopper to store 5 m^3 of highly thixotropic CuO_2.
The Vrieco-Nauta mixer maintains the pasty nature of the materials before feeding to the Micron Dryer. These products require an accurate control of fineness and moisture content and these conditions are satisfied by the Micron Dryer as a standard feature.

Product reference list

MATERIAL	MODEL	INPUT KG/HR	MOISTURE CONTENT FEED % WB	MOISTURE CONTENT PRODUCT % WB	FINENESS μm	TEMPERATURE INLET °C	TEMPERATURE OUTLET °C
Agricultural Chem.	MDV-2	110	47	0.9	< 44	155	85
Anh. Sodium Sulphate	MDV-3	2000	14	0.4	< 150	250	90
Active Carbon	MDV-2	100	50	1.0	—	400	100
Alginate (acid)	MDH-3	200	67	15	< 1000	150	80
Alginate (sodium)	MDH-4	500	70	12	< 600	200	85
Aspartame	MDV-2	100	50	< 4.0	< 150	150	85
Bentonite	MDH-4	7000	20-25	5-8	< 63	450	90
Blowing agent	MDV-3	700	20	0.3	< 20	135	60
Carbon black	MDV-3	590	70	0.5	—	450	100
Chalk	MDH-5	7400	20	1.0	< 40	380	100
Chrome yellow	MDH-2	500	35	0.5	< 44	350	100
Clay	MDV-1	170	24	1.0	< 50	220	90
Cuprous oxide	MDV-4	1600	20-25	0.03	d 95=10	300	120
Diatomite	MDH-3	1500	40	2.0	< 100	380	80
Dye stuff	MDV-2	200	35	3.0	< 70	200	80
Dye stuff	MDV-3	300	33	2.5	< 74	150	90
Fumaric acid	MDF-2	315	10	0.15	d 50=150	185	110
Glutamic acid	MDV-1	130	20	1.0	< 300	130	70
Herbicide	MDV-1	95	10	0.3	< 71	85	55
Lactose	MDV-4	2000	2.0	0.5	< 250	130	90
Methionine	MDV-2	300	35-42	0.3	< 150	200	100
Magnesium hydroxide	MDV-2	400	35	2.0	—	320	80
Pigment	MDV-3	500	40	0.3	d 50=44	280	60
Pigment	MDV-4	500	75-80	1.0	< 45	280	70
Pharmaceutical	MDV-3	200	30	0.25	—	120	75
Polyvinyl alcohol	MDV-2	130	60	0	< 300	160	60
Rubber chemical	MDV-2	160	18	0.1	< 149	115	70
Rubber chemical	MDV-3	300	30	0.1	< 74	130	70
Stearate	MDV-4	600	56	2.0	< 43	160	70
Stearate	MDV-5	1390	40	0.5	< 74	160	75
Starch	MDV-1	180	13	4.6	< 74	145	80
Starch (Meta)	MDH-1	50	57	10	< 74	200	80
Sorbose	MDV-4	550	2-4	0.1	< 74	120	90
Ultramarine blue	MDV-3	500	40-45	0.6	< 44	240	90
Yeast	MDV-4	800	80	5	< 300	300	80
Yeast	MDH-5	1000	23	5	< 175	125	85
Zinc Phosphate	MDH-4	835	51	0.3	< 20	450	140
Zirconium oxide	MDF-2	670	20	0.1	< 20	350	120

Research and Development

Hosokawa Micron B.V. offer extensive test and development centres where customers' products can be accurately tested prior to final design and determination of the most efficient process, system or plant.
All data collected over the many years of testing various materials, is building the firm base of our know how.
By utilising the latest processing technologies a continuous update of know how is ensured.

Whether you require a single machine or a complete powder processing system, the same skilled and experienced staff are at your service to ensure that your requirements are met and the most suitable equipment will be offered.

Our research and development centres are backed up by the Hosokawa Micron Corporation. The Hoskawa Micromeritics Laboratory in Hirakata/Japan is sourcing technical developments in Europe, America, Australia and Asia.
When you have problems in the field of powder processing we could be of help to solve them.
Hososkawa Micron test and development centres are looking forward to assisting you in finding solutions to solve such problems.

Service

Behind each Hosokawa Micron installation there is an effective and well trained service organisation, carrying essential parts in stock. In the event of a breakdown, our customers can be back into production with minimum time loss and inconvenience.
Fitters and parts can be on site at very short notice. When purchasing Hosokawa Micron equipment you may rely on this fast and effective service. An additional service that we offer is that of periodical maintenance contracts to ensure that your installations operate efficiently.

Process engineers for: mixing-drying-grinding-separating-metering-weighing

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HOSOKAWA MICRON B.V.

Hosokawa Micron B.V. is a member of the Hosokawa Micron Group, responding to global needs through an emphasis on materials science and engineering. The Group is an international provider of equipment and technology for powder and particle processing, plastics processing and confectionery products. The Group maintains facilities for research, engineering, manufacturing and service in each of the world's major industrial markets.

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