Fluid-Bed Dryers / Coolers

Drying • Cooling • Instantizing • Roasting Agglomeration • Crystallization • Coating powdery and granular products

Vibrating or static design

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P 145 E

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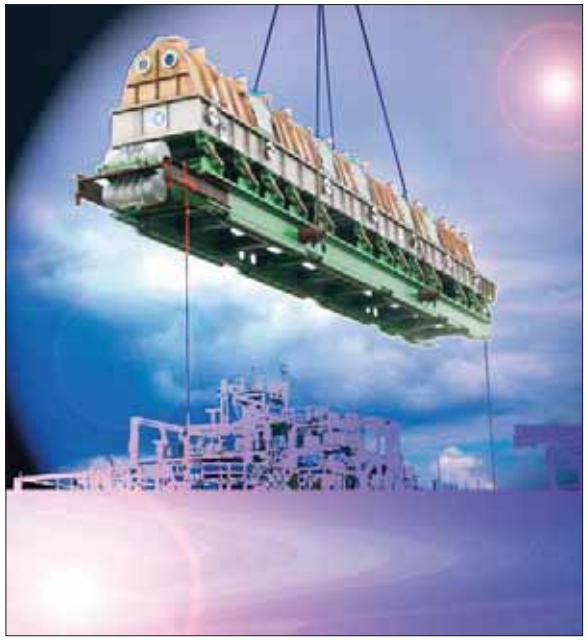
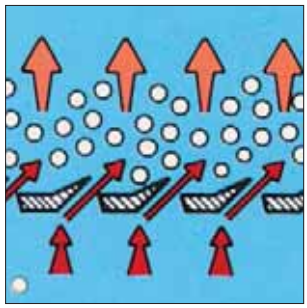


Fluid-bed dryers / coolers

Fluid-bed dryers / coolers enable bulk materials to be fluidized by a fluid passing through a product bed.

Contents



Applications

Food industry

Baby foods
Baking agents
Cornflakes
Dextrose
Gelatines
Cereals
Instant tea
Instant coffee
Potato products
Cocoa powder
Table salt
Coconut flakes
Herbs
Almonds
Flour
Milk powder
Lactose
Nuts
Chives
Sorbitol
Starch
Sugar

Chemical industry, plastics, pharmaceuticals

ABS
Polyamide
Polyethylene (HDPE, LDPE)
Polypropylene
Polyvinyl chloride
Polystyrene
Acrylates
Biological products, enzymes
Calcium phosphates
Chemical intermediates
Epoxides
Pigments
Lithium hydroxide
Lithium chloride
Polymethylacrylate
Polycarbonate
Polyurethane
Salts
Detergents
Zirkonium oxide

Other industries

Activated carbon
Building aggregates
Expanded clay
Plaster
Sand
Glass fibers
blast-furnace slag
Metal oxides
Metal powders

Fig. 4

Several experimental units are available for determining the product-specific drying properties that are essential for the design. Experiments can be carried out either at our own trial center or directly at the customer's facility.

VIBRA SCHULTHEIS fluid-bed dryers

Principle:

The drying or cooling fluid (air or another process gas) flows vertically and uniformly through the product bed which is conveyed on the fluidizing plate. The gas velocity and the vibration are adjusted on the one hand to achieve an optimally fluidized product that is conducive to direct heat exchange and on the other to prevent the solid particles from being pneumatically discharged. The large contact surface which is formed between the solid particles and the gas as a result of the swirling action results in extremely rapid heat transfer. The advantages of our Series VF and VR vibrating fluid-bed dryers / coolers are mainly derived from the fact that the swirling action in the product bed — and hence optimal heat transfer — is possible at a lower air velocity than in a static fluid bed. Drying and cooling processes based on the vibrating fluid-bed principle are therefore extremely gentle. If very narrow tolerances are specified for the residual moisture content or product quality, a vibrating batch-type fluid-bed dryer in the dVW series can be used instead. Static fluid-bed systems are ideal for easily fluidizable products with a very homogeneous or fine particle structure.

Drying

The hot or warm air (or process gas) is passed up through the product bed in a cross-flow process as the product is conveyed over the fluidizing plate. The amount of moisture which is removed from the product by the hot air in the form of water vapor is dependent on the retention time and the water release properties.

Cooling

Cooled air or gas at ambient temperature is used for cooling. If the product to be cooled still contains sufficient sensible heat, the product stream can be simultaneously dehumidified as it is cooled.

Roasting

Bulk materials are roasted in the vibrating fluid bed in a batch process. The roasted materials are mainly used for organic products such as hazelnuts, almonds, coconut flakes, pistachios etc.

Agglomeration / instantizing

Integrated spray nozzles distribute the agglomerating fluid (e.g. water, binder solution, steam) uniformly throughout the fluid bed. The uniformly moistened product particles adhere to one another. The resulting loose agglomerate is then gently dried to the required final moisture content to give it its instant properties.

Calcination

Molecules are fractionated or separated at medium to high temperatures. In the majority of cases, chemically bonded water of crystallization is separated during this process or volatile components expelled from solid substances.

Crystallization

The fluid-bed principle allows the original amorphous structure of polyester or polyurethane pellets to be converted into a crystalline structure characterized by long-term stability.

Figs. 5.1 / 5.2
Vibrating fluid-bed dryer at a detergent factory

The most important advantages at a glance:

- High specific drying capacity
- Optimal energy efficiency
- Vibration-controlled fluid bed
- No cluster formation even with a wide particle size range
- High temperature stability
- Gentle product handling
- Simple cleaning
- High hygienic standard
- Quick product changes
- Extremely reliable

Figs. 5.2

Fig. 6
VF 40/10 vibrating fluid-bed dryer at a food processing plant

Types available

Vibrating fluid-bed dryers / coolers, Series VF

Vibrating system with two directly mounted vibrating motors
Max. fluidizing plate area 15 m^2 **Page 8,**
combined with Type VSK screen section **Page 12**

Fig. 7

Natural-frequency fluid-bed dryers / coolers, Series VR

Two-mass natural-frequency system with base frame excitation by double vibrating motor drive
Max. fluidizing plate area 40 m^2 **Page 10**

Fig. 8

Vibrating fluid-bed dryers / coolers, Series dVW
Round design for batch operation

Max. nominal diameter 2000 mm **Page 14**

The choice of machine type is determined by the product properties and the process parameters.

Fig. 9

Static fluid-bed dryers / coolers, Series SF

Several product chambers can be connected in series to obtain a fluidizing plate area of any size **Page 16**

Fig. 10

Fig. 11
The robust vibrating motor drive , which has a continuously adjustable out-of-balance force, supports the swirling action in the bulk material and enables residual product to be discharged from the product chamber.

Vibrating fluid-bed dryers / coolers
Series VF

Fluidizing plate area 0.1 to 15 m^2

Type of construction

Series VF vibrating dryers / coolers essentially comprise an air box (lower part) and a suction hood (upper part). A removable, perforated fluidizing plate, which is individually designed for each application, is mounted between these two parts.

An inlet and outlet for the bulk material to be treated are provided at the start and end of the conveying surface formed by the fluidizing plate. The lower part supports the vibrating motor and is mounted on soft springs. The self-synchronizing double vibrating motor drive with continuously adjustable out-of-balance force ensures a uniform retention time. An adjustable weir is installed upstream of the outlet for controlling the bed height and the retention time. An inspection window and cleaning ports simplify the work of the operator.

The gas / air and heat technology consists of proven systems for generating hot gas, heating air, conditioning cooling air, cleaning the air supply, and removing dust from the exhaust air.

Fig. 12
Vibrating fluid-bed dryer at a plastics processing plant

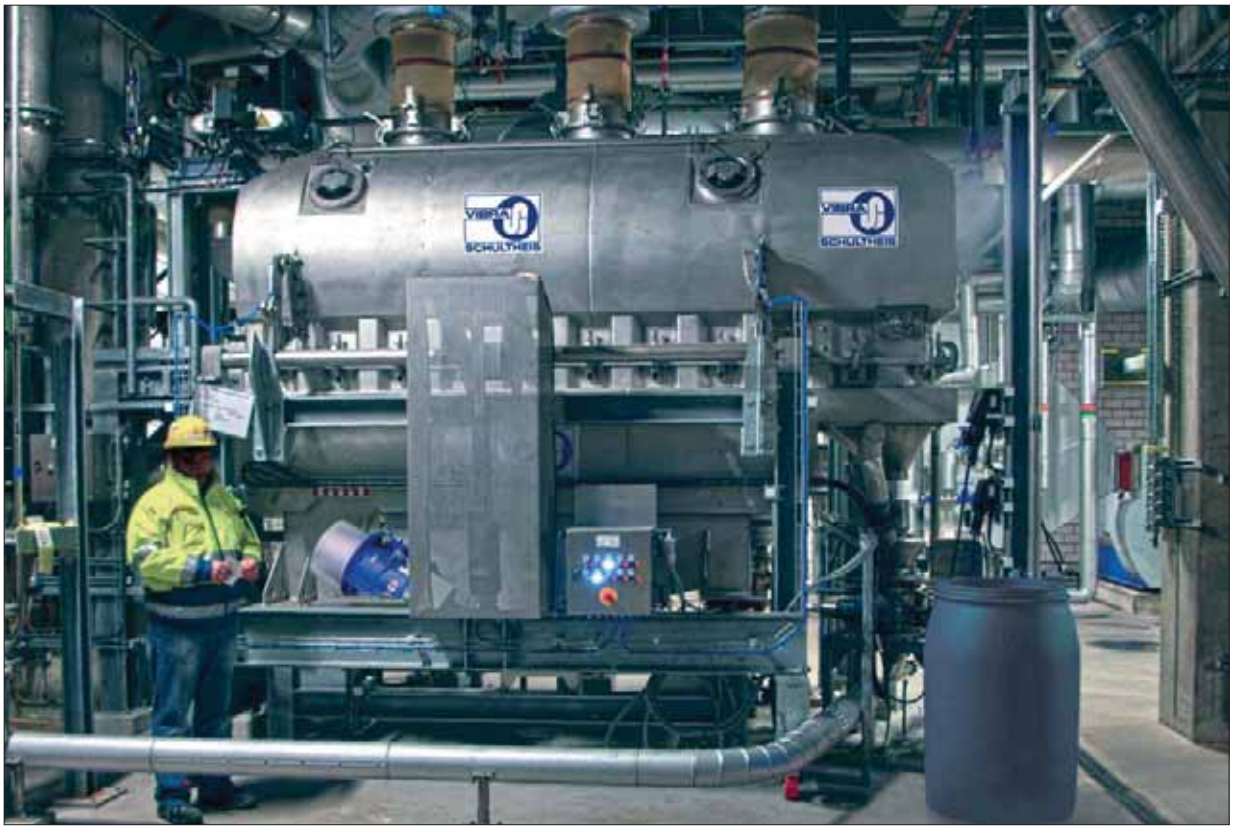


Fig. 13
VF 20/1.5 laboratory fluid-bed dryer

Sizes

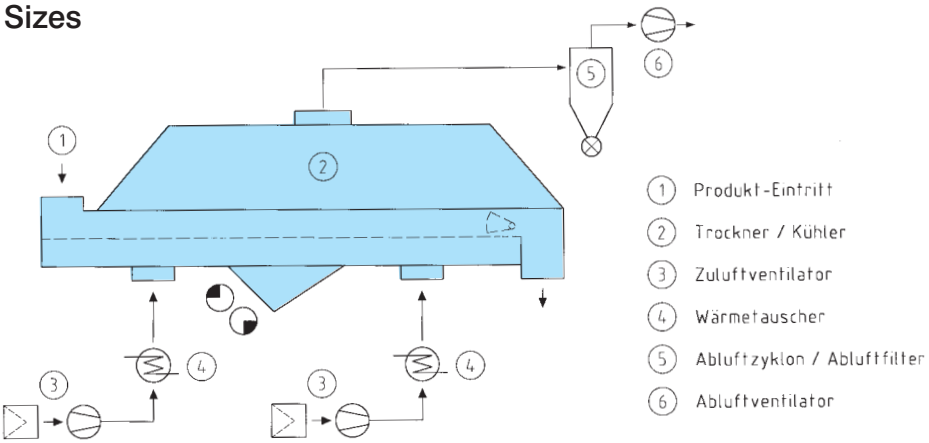


Fig. 14 Flow chart

Series VF comprises vibrating fluid-bed dryers / coolers with a fluidizing plate area

from **1000 mm x 100 mm (= 0.1 m²)**
bis **10 000 mm x 1500 mm (= 15 m²)**

including several practical, intermediate sizes.

The number of drying and cooling areas and the number of air outlet points vary according to the requirements of each application. The same applies to the arrangement of the weirs, the inspection window, the cleaning ports, and the optional thermal insulation.

Fig. 15
VF 40/10 vibrating fluid-bed dryer at a food processing plant

Fig. 16
The product chamber contains no internal obstructions that could impede cleaning

Natural-frequency fluid-bed dryers / coolers Series VR

Fluidizing plate area 10 to 40 m²

Series VR is designed for heat exchange surfaces of 10 m² or more. The basic design and operating principle of the dryers / coolers in this series are similar to those of Series VF apparatus, except that a natural-frequency system with base frame excitation is used to transmit the vibration.

The mechanical design as a two-mass oscillating system ensures excellent vibro-stability, even with large fluidizing plate areas. Owing to the good mass balance, the machine can be installed without a special foundation. The "silent", maintenance-free version of the twin vibrating motor drive runs remarkably quietly, so that no unwanted structure-borne noise occurs no matter how large the fluidizing plate.

The countervibrating frame and the natural-frequency spring stations have a modular design. Weirs and inspection / cleaning flaps are offered as standard components. Even though the fluidizing plate area is individually tailored to each application, the machines are still affordable.

The vibration velocity and retention time can be adapted to the actual process conditions with the help of electronic frequency controllers.

Fig. 17 VR 150/15 natural-frequency fluid-bed dryer for boric acid

Fig. 18
Walkways simplify operation and maintenance

Sizes

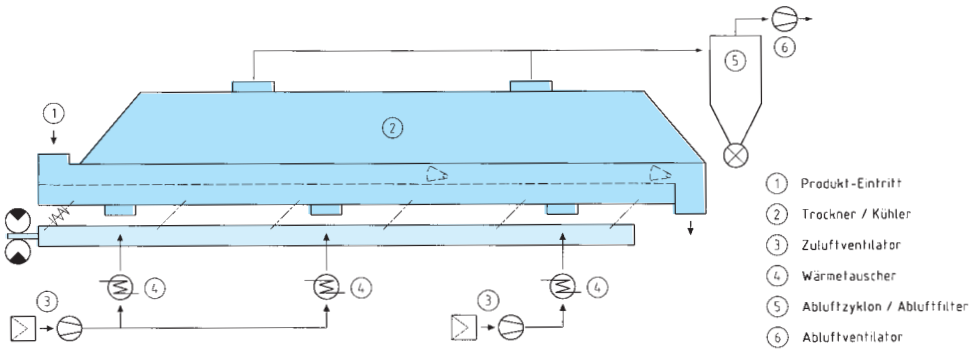


Fig. 19 Flow chart

Series VR natural-frequency fluid bed dryers / coolers are designed to allow optimal adaptation to the specific tasks and installation conditions of each individual project.

The machines in this series are offered with a maximum working width of 2 m and a maximum working length of 20 m.

Fig. 20 VR 150/15 natural-frequency fluid-bed dryer for milk powder

Fig. 21
Hydraulically operated hood

VSK screen coolers / dryers

Our vibrating fluid-bed apparatus, integrating additional functions over and above the actual thermal process, was developed in response to calls for compact machines that would save valuable space. Apart from the fluid bed itself, these combined machines also feature a dewatering section and / or a screening section. We use the term screen cooler / dryer to describe a combination of a screening machine and a fluid-bed dryer / cooler.

Before entering the screening section, the granular material is fluidized on a special fluidizing plate by a high-velocity air flow which cools and dries it thoroughly, and simultaneously removes any dust. A continuously adjustable weir determines the bed height and the retention time.

Oversizes are separated in the downstream screening section in the same way as in our purpose-built SRK screening machines.

A fine screen for removing any fines can be inserted between the fluidizing plate and the oversize screen.

Both the fluidizing plate and the screen insert can be dismantled and cleaned very easily.

The machines are offered with a maximum effective area of 6 m^2 and a maximum throughput of 8000 kg/h. All of our screen coolers / dryers are supplied complete with the necessary air handling equipment such as fans, heat exchangers, filters, separators, and airlocks.

Fig. 22
VSK 25-7/7 vibrating fluid-bed dryer with integrated screening section and all air handling equipment for drying and screening plastic pellets, including dust filters

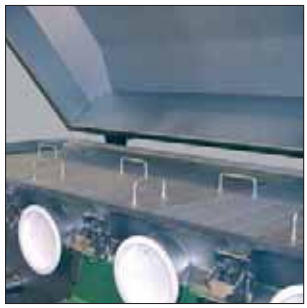


Fig. 23
Easy-to-remove screen inserts

Figures 22 and 24 show various machines of this type. The machine illustrated in Figure 24 is designed to allow rapid cleaning if frequent product changes are envisaged. The hood can be opened with the aid of a hydraulic cylinder.

Fig. 24
VSK 22-20/8-2 screen cooler with cooling area and inserts for coarse and fine screening. The hood can be opened to facilitate rapid cleaning.

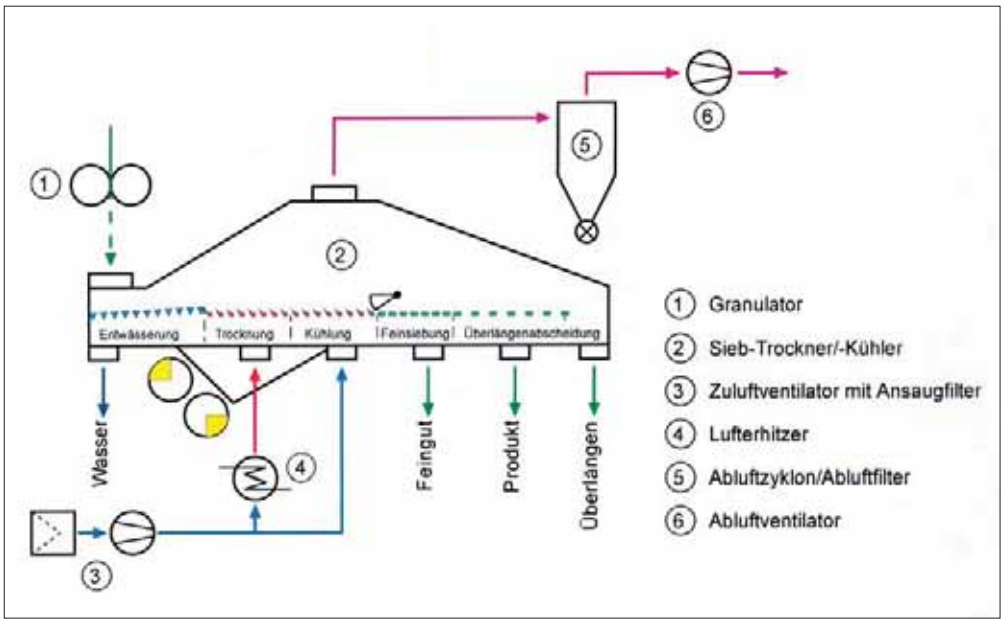


Fig. 25
Process flow chart of a screen cooler / dryer with a dewatering section

Fig. 26
Type dVW 10 batch dryer conforming to pharmaceutical standards

Vibrating batch-type fluid-bed dryer Series dVW

This series comprises batch-type fluid-bed dryers with a working diameter from 250 to 1750 mm.

Our vibrating batch-type fluid-bed dryers are designed to leverage the benefits of fluid-bed technology for products requiring extremely careful drying, for example if very narrow tolerances are specified for the residual moisture content or product quality in conjunction with very long drying times.

Series dVW vibrating fluid-bed dryers have a round fluidizing plate area. The working chamber (fluid-bed hood) is extended above the planned product bed height, to prevent the agitated product particles from being inadvertently discharged when the air velocity is reduced. The product batch to be dried is introduced into the apparatus through a sealable inlet port and uniformly distributed assisted by the vibration. Suitable feeding devices are used to restrict the feeding time to a minimum. Throughout the drying process the product is continuously circulated by means of the vibrating motor for a freely selectable and precisely settable time. The vibration assisted principle means that even difficult-to-dry products in a relatively thick bed can also be uniformly dried.

Unlike conventional batch-type fluid-bed dryers, these vibrating dryers do not have to be taken apart and mechanically emptied after drying the product. At the end of the drying process, the product is discharged via a flap assisted by the vibration. The apparatus therefore only cools down slightly and is immediately ready to receive the next batch. The air handling equipment (for conditioning the supply and exhaust air) can likewise remain switched on while the product is being fed into the machine. The exhaust air from the dryer can be cleaned in a separate cyclone or filter system.

Fig. 27
Roasting plant for hazelnuts and almonds

Fig. 28

However, it is also possible to clean this air with the help of special cartridge filters in the dryer's exhaust-air hood, and to return the cleaned fines directly to the drying chamber. The round type of construction simplifies the design of flameproof apparatus.

Figs. 29 / 28

dVW 12.5 batch-type fluid-bed dryer conforming to hygienic standards with electrically operated hood opening / closing mechanism

Fig. 30
Static fluid-bed dryer for an instant product

Static fluid-bed dryers / coolers

Static fluid-bed dryers and coolers are ideal for products that are easy to fluidize. They have no mechanical drive, which means they are lighter and simpler to manufacture — and hence cheaper than the vibrating fluid-bed apparatus described above. The product is conveyed mainly as a result of the quasi-hydraulic behavior of the fluid bed; the retention times of the bulk materials differ to a greater degree than with vibrating dryers or coolers which operate at the lower fluidizing point. The fluid beds are generally comprised of several different areas with different gas flow rates and temperatures. Controllable, height adjustable weirs are used to optimize the bed height and thus also the retention time in each area.

Fig. 31
Static fluid-bed dryer with a fluidizing plate area of 26 m2 and steam-heated heat exchanger inserts for a detergent product

Fig. 32
Spray agglomeration

Agglomeration, granulation, coating

Agglomeration, granulation, and coating in vibrating fluid bed machines can significantly improve the application-related properties of powdery products in the chemical, pharmaceutical, and food industries. Agglomeration, granulation and coating technologies are commonly used in these three industrial sectors.

Principle

The solid layer that is fluidized in the fluid bed is selectively wetted with liquids using special atomization nozzles and then solidified during the drying process. During spray granulation the layer starts to build up directly from the liquid phase.

Properties and benefits

- Increased resistance to abrasion
- Improved flow
- Less clumping
- Instantization of food products, for example
- Solid substance protected against chemical reactions, e.g. with oxygen, light, or moisture
- Efficient masking of taste and / or smell
- Ability to selectively influence surface properties, e.g. color, gloss etc.
- Retarded release of active ingredients

Designs

The design is based on each customer's individual requirements and verified by means of tests at our trial center. Either batch or continuous equipment can be supplied, depending on the application. Planning, turnkey delivery, and commissioning are taken care of by an experienced team of highly qualified project engineers and trained specialists at our production facility.

Fig. 33 Trial center

Fig. 34
VIBRAFLOW perforated plate for directed air flow

Internals, details

Fluidizing plates

Our VIBRAFLOW perforated plates, with their special hole pattern and application-specific pressure loss, are used as fluidizing plates in our fluid-bed machines to achieve a directed blowing action of the air on the fluidizing plate area. These plates are welded or bolted to vibro-stable, stainless steel frames for installation in our vibrating fluid-bed systems.

Temperature zones – bed height weirs

Conformity with a defined temperature profile can be ensured by installing suitable barriers with air inlets in the air chamber. The continuously adjustable weirs arranged on the outlet side have various designs to enable the product height to be optimized, and thus also the retention time.
Weirs with several different designs are available. The most suitable weir for each bed height depends on the particle structure, particle size range and tendency of the product to form clumps.
We differentiate between the following weir types:
- Continuously adjustable shell-type weir
- Continuously adjustable shell-type weir with clump discharge function (pneumatically operated)
- Continuously adjustable ramp-type weir
- Hinged weir plate used as an intermediate or end weir
- Height adjustable combined weir

Insulation

The welded insulation protects the operator against accidental contact, reduces heat loss, and prevents condensation at high gas temperatures.

Cleaning, hygiene

High availability and hence short downtimes for cleaning and maintenance are vital with modern production processes. To reduce downtime to a minimum, the machines developed by VIBRA SCHULTHEIS are optimized for specific processes and designed to take account of individual product requirements regarding hygiene and cross contamination.

A basic distinction is made between wet and dry cleaning irrespective of the generally applicable requirements concerning surface quality and the elimination of corners which are difficult to reach.

Fig. 35

Dryers conforming to a high hygienic standard are fitted with removable seals

Wet cleaning. If fluid-bed apparatus conforming to hygienic standards is to be wet-cleaned, it is generally designed so that the air box, fluidizing plate, and hood form an all-welded unit that can be automatically cleaned by means of built-in CIP nozzles (Fig. 36.1).

Bild 36.1

Bild 36.2

Dry cleaning. If the fluid-bed apparatus is to be dry-cleaned, there are two possible designs, both of which allow the fluidizing plates to be removed from the fluid-bed housing.

With variant 1 (drawer type), the single or multi-piece fluidizing plate is pulled out of the dryer housing (Figure 36.2), either at the end or at the side, and cleaned outside of the apparatus. The hood remains attached to the air box and does not need to be dismantled. In certain applications involving food contact the fluidizing plates are wet or dry-cleaned in a separate area after they have been removed. In addition to conveyors and swivel mechanisms we also supply fully automatic washing and blasting plants for this purpose to guarantee efficient dry cleaning no matter how stubborn the fouling.

Variant 2 features an opening / closing mechanism that allows the dryer hood to be opened by means of electric or hydraulic drives. The fluidizing plate can then either be removed from the dryer that is to be cleaned or, as shown in Figure 37, left inside it and cleaned on top and underneath.

Figs. 37.1 to 37.3 Easy-to-clean vibrating fluid-bed dryer. The hood can be opened with or without the fluidizing plate for cleaning on top and underneath.

Fig. 38

Typical plants

Fig. 39
Drying plant for washing powder

Fig. 40
Drying plant at an R&D center

Fig. 41

Fig. 42

Drying and cooling plant comprised of two vibrating fluid-bed dryers and one vibrating fluid-bed cooler for manufacturing impregnated moldings at high temperatures

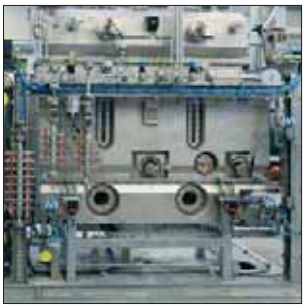


Fig. 43

Figs. 43 / 44

Static fluid-bed system with process technology

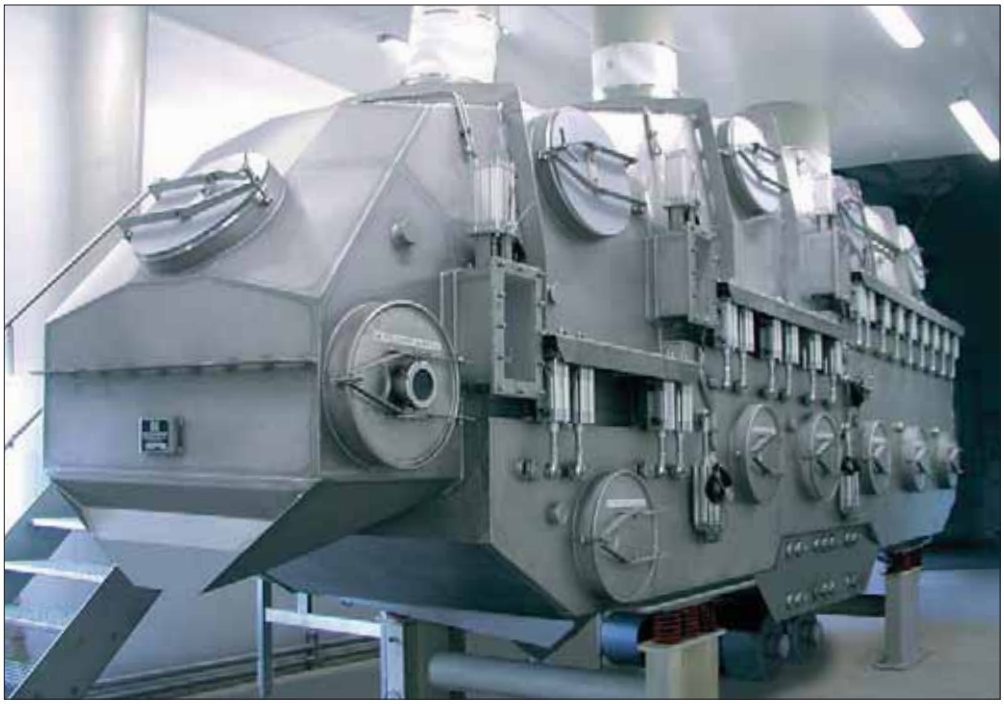


Fig. 45

Drying plant for a sensitive food product. The machine operates in quasi-continuous batch mode with the help of the reversible VARIO drive, to enable the retention time and temperature profile to be complied with precisely.

Fig. 46

Trial center

Our trial center features numerous experimental units covering all important aspects of thermal and mechanical processes. Vibrating trough and tube conveyors, batching and metering equipment, conveying troughs and spiral conveyors with or without heat exchanger decks, vibrating screening machines, and fluid bed dryers and coolers with all essential measuring instruments and peripheral apparatus such as fans, compressors, heating coils, heat exchangers, and filters are available and ready for use on more than 1000 m^2 of floor space. Several of these units can also be loaned for experiments on our customers' premises.

The tests carried out here provide a starting point for efficient planning of the customer's machinery and plant.

Fig. 47 Trial center

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