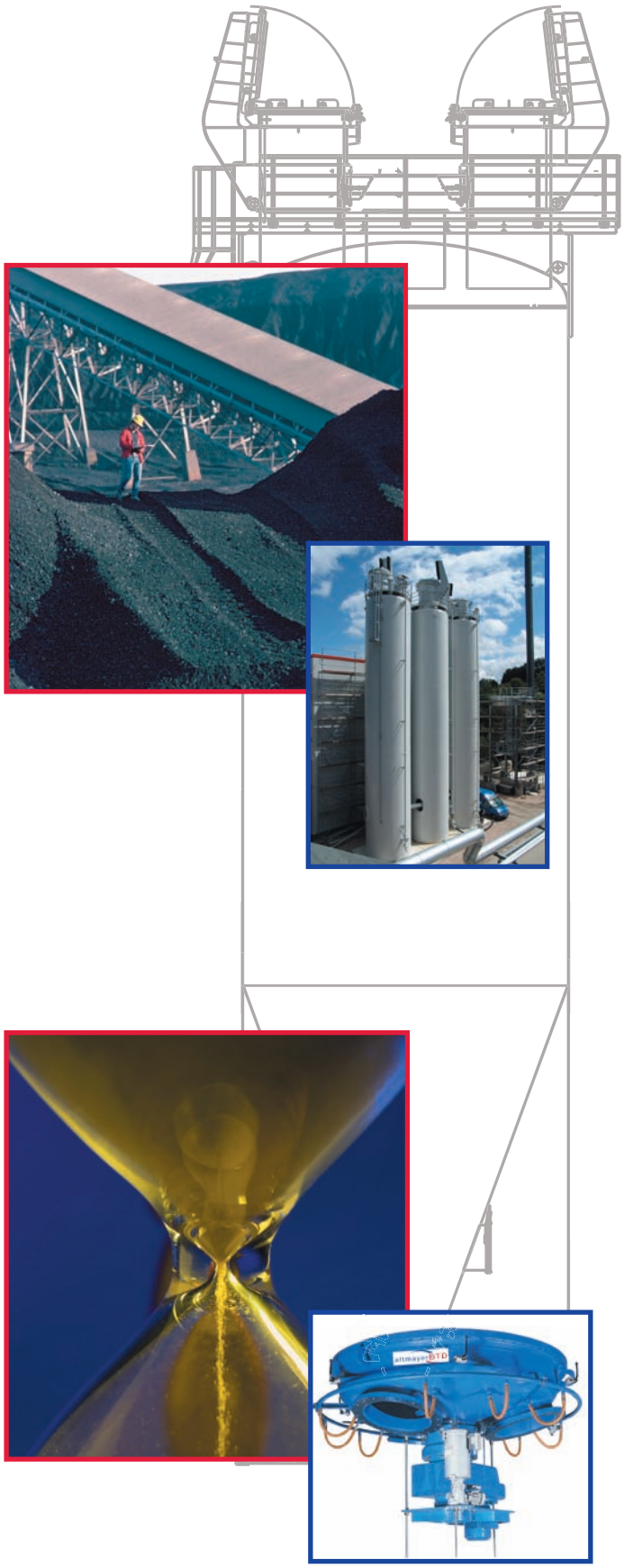
altmayerBTD



Silo Technology

Silo Discharge Devices

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What do we offer?

altmayerBTD GmbH & Co. KG is the right partner for system, bin, energy and environmental technology. Our tradition-rich company's product portfolio ranges from bin and reservoir technology to heating and drinking water systems and solar technology, to storage and transport of bulk solids.

Our **silos** are well known wherever bulk solids are stored, processed or transported. They come in volumes from 50 m^3 to 5,000 m^3 and in diameters from 2,500 mm to 15,000 mm. They have various designs, are made from different materials and are adapted to the demands of the solids being stored. For a sure and continuous discharge, there are a number of **special discharge devices** to choose from.

For explosive solids or special processes, our pressure-shock-resistant or pressure-tight silos are suitable. They meet very high safety standards and comply with the applicable European norms. Whether factory prepared or welded on site, altmayerBTD silos offer the best possible technology, efficiency and durability.

As a result of our experience in many different industrial sectors and the wide range of our portfolio, we can offer the optimal solution for each application, if it is about transport, storage and handling of the most varied kinds of bulk solids.

Whether it is factory-welded silos up to 300 m^3, standard silos or silos up to 5,000 m^3 welded on site, **altmayerBTD** is your expert partner for design, planning construction, installation and set-up of silo systems.

altmayerBTD's management system complies with the requirements of ISO 9001:2008. The company is not only certified for producing pressure devices according to pressure equipment directive 97/23 EG (modules G and B1 + F), but also holds manufacturer qualification for welding steel structures per DIN 18800-7:2002-09 class E.

Factory-Welded Silos

The company's production capabilities allow construction of factory-welded silos of diameters from 1,800 mm to 4,400 mm and volumes from 5 m^3 to 300 m^3. Addition of accessory parts, such as filters, overflow protection, discharge aids, etc., and complete electrical cabling and controls right from the factory provide decisive advantages. A system is delivered to the customer that has already undergone demanding tests on the manufacturer's own premises. This reduces on-site installation work to a minimum, so that the system can be started up shortly after delivery.

The silos come in various designs:

- Single-chamber silos
- Multiple-chamber silos with one or two piece partitions
- Silos with one or more outlets
- Placement on steel construction or skirt support
- Silos with conical or flat bottom
- Silos for pressure-free operation or pressure-shock-resistant / pressure-tight silos

Silos Welded on Site

Beyond a certain size, silos welded on site are used to reduce transport and handling costs. For this, precisely fitted segments are put together in our factory and taken to the construction site as transportable, installation-ready units. There, the parts are assembled and welded into a whole.

In this way, even silos with diameters up to 15,000 mm and a volume of 5,000 m^3 can be built individually. In contrast to bolted silos, the welded design ensures that the silo body is completely sealed.

Like factory-welded silos, silos welded on site come in various versions.

Standard Silos

Standardization of individual silo systems guarantees cost effectiveness and short delivery times, but also a high level of mature technology.

This applies especially to our 120 m^3 coal dust silos, which have been produced in large numbers for many years. These silos meet the highest safety standards and are transported to the installation site as a complete unit.
Within a day, they are ready to operate and can be connected to the other assemblies.

Despite standardization, we maintain a high degree of flexibility to meet our customers' individual requirements.

Explosion Resistant Silos

For storage of explosive solids, we offer special silos with an explosion-resistant design. A distinction is made between silos that are pressure-tight (no deformation allowed) and pressure-shock-resistant (deformation allowed). The silos are designed for either the solid's maximum explosive pressure (up to 9 bar) or, in case explosion pressure relief is used, for the reduced explosive pressure (generally 2 bar).

We make not only static calculations for pressure-shock-resistant silos, but also the calculations for the pressure relief surface according to VDI 3673 or NFPA68. Our approved explosion flaps protect our pressure-relieved silos. In the event of an explosion, the explosion flap will open and allow the silo to relief pressure. Unlike rupture disks, explosion flaps are self-closing and can be used again after an explosion. If needed, we equip explosion flaps with underpressure safety mechanisms and electric heating.

We have decades of expertise in this field and guarantee our customers the highest quality and greatest safety.

Complete Silo Technology from One Source

altmayerBTD discharge devices are the core of a comprehensive storage, transport and processing program for bulk solids. Planning, production and installation from one source guarantee flexibility and a high standard of quality. Take advantage of our company's expertise and technical capabilities. We are deeply involved in developing bulk solids processing technology.

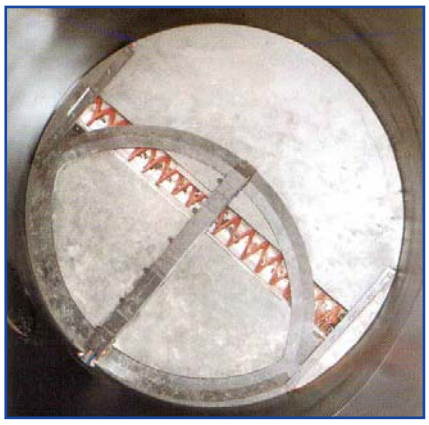
Technical Solids and Applications for the Silo Discharge Devices

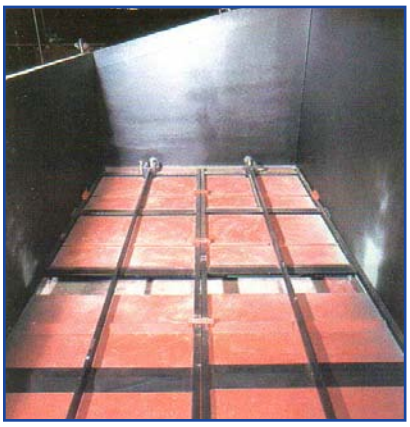
Industry	Solids
LINEX	
Waste water treatment	Sewage sludge, industrial sludge, filter cake
Wood industry, fibre industry	Shavings, sawdust, wood chips
Waste treatment	Pasty, lumpy wastes
Power plants, incinerators	Sewage sludge, alternative fuels
Drying facilities	Paste materials
ROTEX®	
Cement industry	Raw coal, FGD gypsum, petroleum coke, cement, clinker, gypsum, marl, clay, slag sand
Rocks and soils	Sand, rocks
Power plants	FGD gypsum, raw coal, fly ash, furnace ash, residues
Steel works, aluminium industry	Blast furnace slag, raw coal, coke, ores, bauxite, iron ore pellets
Lime production	Limestone, raw coal
Waste incineration plants	Ash, slag
Chemical industry	Salts, soot, plastic granules
Waste water treatment	Sewage sludge, industrial sludge, filter cake
Wood industry, fibre industry	Tree bark, shavings
ROTAFLOW®	
Food industry	Milk powder, sugar, instant powders, flour, soy flour
Power plants	Ground limestone, hydrated lime, fine coal, coal dust
Rocks and soils	Clay, cement, gypsum, limestone, marl, coal dust, ground slate, silica sand
Chemical industry	Pigments, fertilizers, pesticides, plastic granules, glass fibre, oxides, sodium chlorate, sodium powder, silicic acid, lead oxide, detergent, graphite, barium, potash, chalk, titanium oxide, soot, coal dust
Steel works, aluminium industry	Foundry sand, binders, aggregates, fine coal, coal dust
Wood industry	Wood shavings, sawdust
Water treatment	Ground limestone, hydrated lime, flocking agent, aggregates, activated carbon, hard coal dust
Glass industry	Aggregates, sand, glass batch, pigments

Industry	Solids
Agitator	
Food industry	Milk powder, sugar, instant powders, flour, soy flour
Power plants	Ground limestone, hydrated lime, fine coal, coal dust
Rocks and soils	Clay, cement, gypsum, limestone, marl, coal dust, ground slate, silica sand
Chemical industry	Pigments, fertilizers, pesticides, plastic granules, glass fibre, oxides, sodium chlorate, sodium powder, silicic acid, lead oxide, detergent, graphite, barium, potash, chalk, titanium oxide, soot, coal dust
Steel works, aluminium industry	Foundry sand, binders, aggregates, fine coal, coal dust
Wood industry	Wood shavings, sawdust
Water treatment	Ground limestone, hydrated lime, flocking agent, aggregates, activated carbon, hard coal dust
Glass industry	Aggregates, sand, glass batch, pigments
Fluidization	
Food industry	Milk powder, sugar, instant powders, flour, soy flour
Power plants	Ground limestone, hydrated lime, fine coal, coal dust
Rocks and soils	Clay, cement, gypsum, limestone, coal dust, ground slate, silica sand
Chemical industry	Pigments, fertilizer, pesticide, sodium powder, silicic acid, lead oxide, detergent, graphite, barium, potash, chalk, titanium oxide, soot, coal dust
Steel works, aluminium industry	Foundry sand, binders, aggregates, fine coal, coal dust
Water treatment	Ground limestone, hydrated lime, flocking agent, aggregates, activated carbon, hard coal dust
Glass industry	Aggregates, sand, glass batch, pigments
VIBREX	
Food industry	Milk powder, sugar, instant powders, flour, soy flour
Power plants	Ground limestone, hydrated lime, fine coal
Rocks and soils	Clay, cement, gypsum, limestone, ground slate, silica sand
Chemical industry	Pigments, fertilizer, pesticide, plastic granules, glass fibres, oxides, sodium chlorate, sodium powder, silicic acid, lead oxide, detergent, graphite, barium, potash, chalk, titanium oxide, soot, coal dust
Steel works, aluminium industry	Foundry sand, binders, aggregates, fine coal
Wood industry	Wood shavings, sawdust
Water treatment	Ground limestone, hydrated lime, flocking agent, aggregates
Glass industry	Aggregates, sand, glass batch, pigments

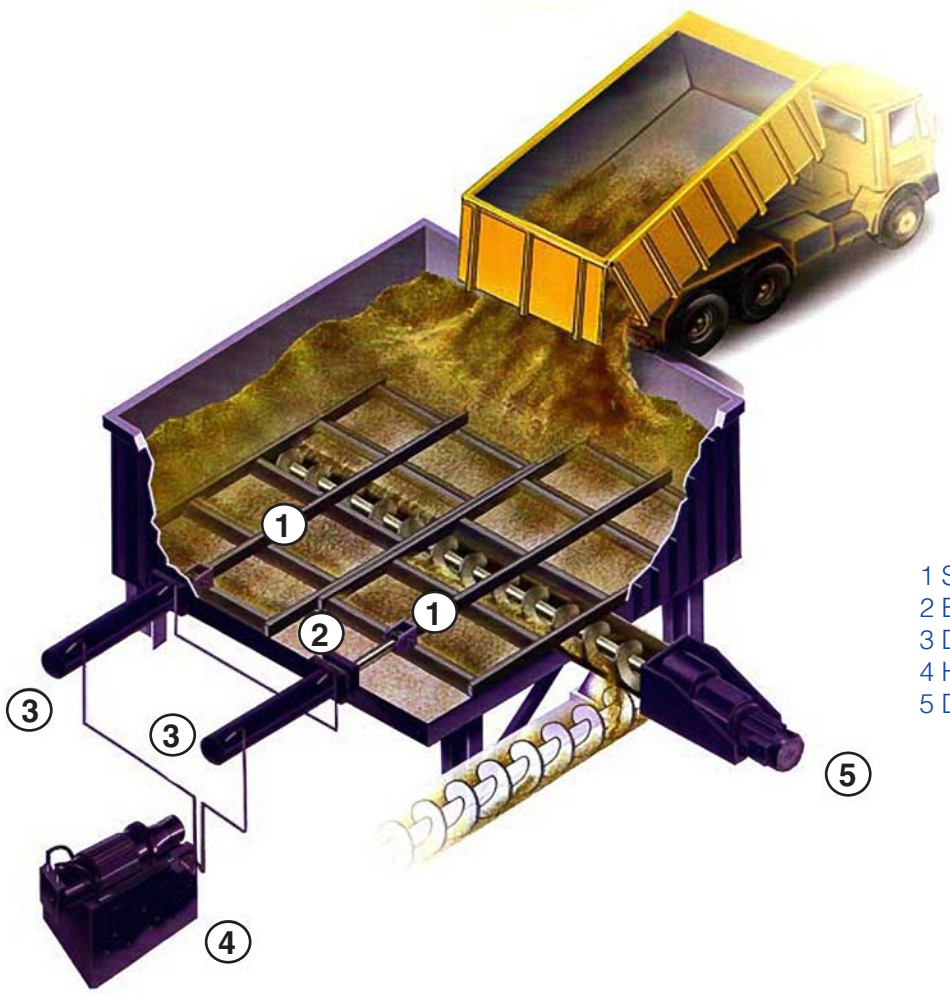
LINEX

Safe Silo Discharge for Bad Flowing Bulk Solids





Solids with extremely bad flow characteristics and considerable time compaction can form arches of several metres. Very steep hopper slopes are necessary to achieve mass flow. As it is not desirable for technical and economic reasons to build a silo with correspondingly large outlet diameters and steep hopper walls, the LINEX silo discharge device is the suitable solution to strip the solids from the entire diameter of the silo.



1 Slide frame
2 Even discharge platform
3 Drive cylinder
4 Hydraulic unit
5 Discharge screw

Benefits

- Full activation of the silo cross section
- Less space consumption due to a linear drive installed directly on the silo wall
- Easy maintenance thanks to external drive and seal components
- Reduced silo height
- Easy retrofitting to existing silos
- Prevention of material compaction due to hydraulic unit pressure limits
- Safe operation even after long downtime

Operation

The outlet diameter necessary for preventing arching or ratholing is also the input diameter of the LINEX silo discharge device. An ovular slide frame oscillates over a level discharge platform with one or more outlet slots. In the case of a rectangular bin, one or more rectangular slide frames are used. The slide frame has a wedge profile. With each translational movement of the slide frame, the standing edge of the wedge profile, which is oriented towards the outlet slot, slides the product into the outlet. Meanwhile, the flat side of the wedge profile on the opposite side undercuts the product. The slide frame is driven by a hydraulic cylinder with a hydraulic unit. If the slide frame's end positions are not reached, due to localized material compaction or foreign objects, a pressure limit for the hydraulic drive initiates a reversal movement of the slide frame. This means that even in this case, safe silo discharge is maintained. Below the silo discharge opening there are one or more floor-mounted discharge screw conveyors. According to requirements, the discharge can be arranged in the middle or on each face of the silo.

Technical Data

The LINEX silo discharge device is available in various designs. For both basic forms of the slide frame, one or more cylinders can provide the drive. Discharge can be central, one-sided or two-sided using one or more screw conveyors. The device offers a multitude of possibilities for system- and material-specific designs.

Materials

- Standard steel
- Standard steel, coated
- Stainless steel
- Wear-resistant steel

ROTEX®

Efficient Silo Discharging Devices for Smooth Operation

Storing and conveying bad flowing solids are sensitive processes in ore processing, the chemical industry, waste incineration, wood chip recycling, coal loading at power plants, and removal of flue gas gypsum or ashes, to name just a few examples.

Designing a silo for bad flowing solids sets process engineers a most difficult task. At this, it is important to specify the limit conditions for the silo geometry and the abrasion behaviour of the solids towards the wall to guarantee safe discharge of the material. As a result of the two extreme flow types in silos, mass and funnel flow, operational interruptions are to be expected with materials that do not flow freely. With funnel flow, generally only one column of material empties above the outlet opening, so that part of the material remains in the body of the silo. With mass flow, a stable arch of material can form above the outlet opening, so that removal is blocked.

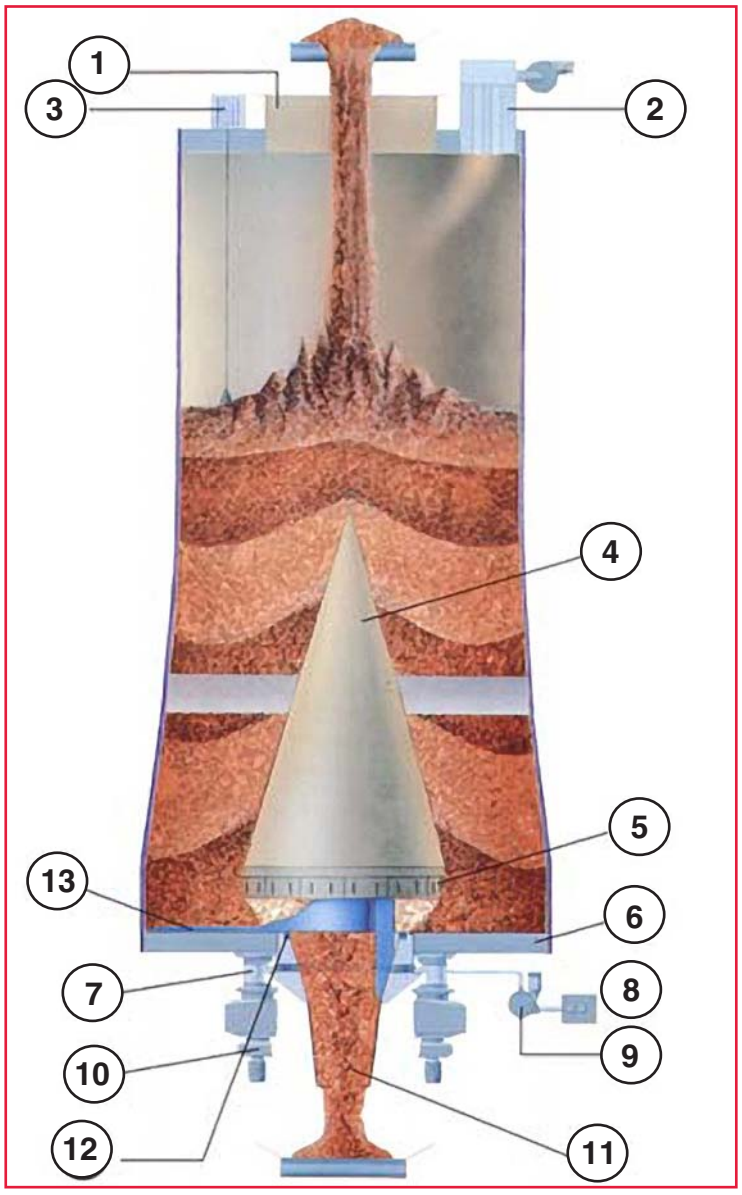
Benefits

- First in / first out principle
- Full activation of the silo cross section, even with difficult products, through negative silo geometry
- Safe operation even after long downtime
- Pressure-relieved discharge
- Extremely robust silo discharge
- Low energy requirements
- Drive elements freely accessible from exterior
- Adjustment of discharge output using an adjusting ring when empty
- Grain sizes up to 250 mm
- Discharge volumes up to 2,000 m^3/h

Operation

Demand for safe, dispensed discharge of extremely bad flowing materials, combined with the advantages of mass flow silos has led to the development of the ROTEX® bunker discharge device. Over a horizontal floor with a central opening, a logarithmically formed discharge arm moves the material away from the periphery and towards the opening. The special shape of the discharge arm prevents compaction of the materials during the discharge movement. A relief cone over the discharge chute takes over a large part of the material load. Relieving the discharge area prevents compaction of the materials in the discharge area, even during long downtimes.

The choice of design parameters is specified according to the characteristics of the material and guarantees discharge behaviour with the advantages of mass flow silos. Among other things, the cone angle, the gap width between the cone and the outer cylinder, the height of the constriction ring, the sheet metal surface characteristics, the shape of the cylindrical material and possible undercutting of the discharge arm are considered. The constriction ring can be adjusted from underneath and allows later adjustment of the flow behaviour to various silo materials.

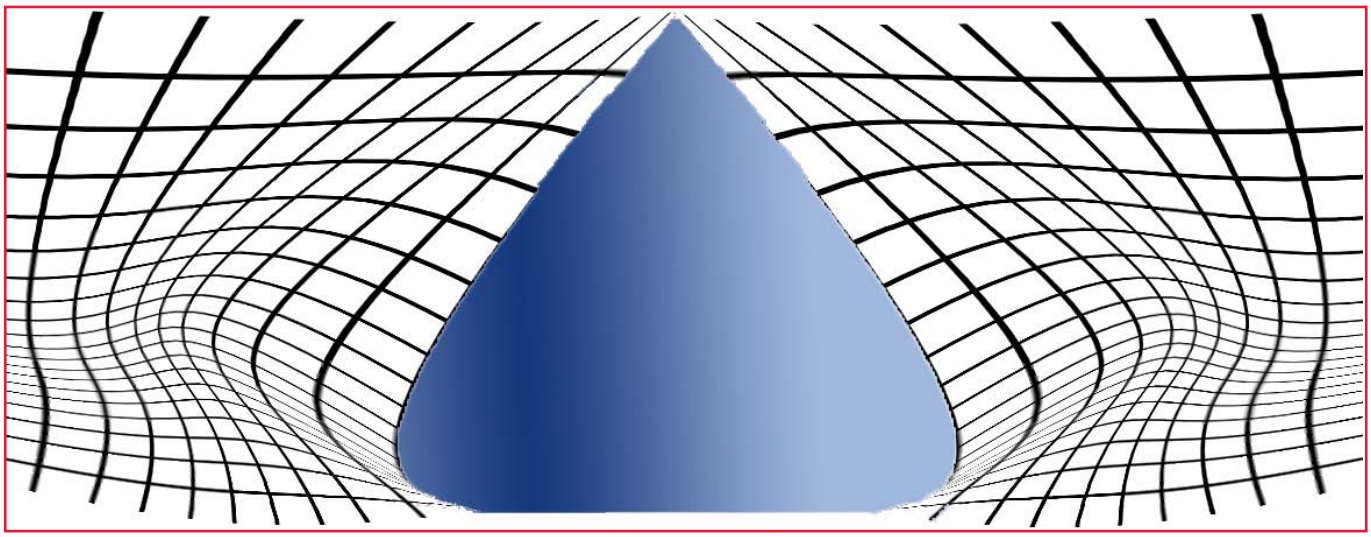


Funnel flow

Mass flow

1 Ventilation port
2 Exhaust air filter
3 Fill level measurement
4 Internal relief cone
5 Height-adjustable guide plates
6 Discharge platform of wear-resistant, high-strength steel
7 Pinion drive, slew bearing
8 Grease pump control — on site
9 Grease pump
10 Spur-gear drive motor
11 Discharge chute
12 Sealing element
13 Discharge arm

The experiment represented below shows the flow profile determined and confirms the exemplary behaviour of the ROTEX® bunker discharge device, which lowers the material surface uniformly in almost all diameters. This prevents dead zones and segregation, keeps the material discharge constant and even bad flowing materials are safely discharged and dosed.



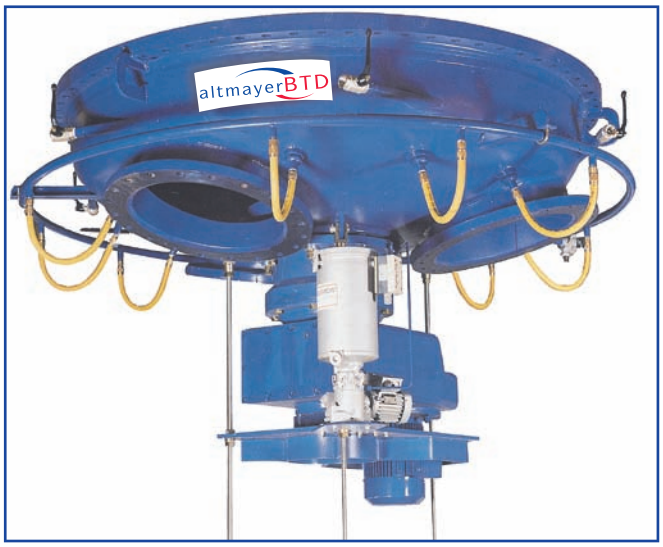
Technical Data

The ROTEX® bunker discharge device is available in a wide variety of standard sizes. Production in intermediate sizes allows the whole silo system to be tailored to the operator's economic and technical requirements. Even custom designs, such as the explosion-resistant construction according to VDI 3673, with all associated system components and pressure relief equipment can be supplied, thanks to the experience of a pioneer in this field. ROTEX® bunker discharge devices are suitable for discharging solids with grains up to 250 mm, with a discharge volume up to 2,000 m^3/h.

Certified per 94/9/EG: BVS 08 ATEX H 024 X

ROTAFLOW®

Uniform Material Discharge with Mass Flow Behaviour for Silos with Several Outlets



When a silo is being emptied, exit problems often occur with arching or ratholing in a functionally inappropriate silo design.

For solids flowing in silos, a distinction is made between mass flow and funnel flow. While with mass flow all the material in the silo moves, it is mostly the material above the discharge that moves with funnel flow. As a result of funnel flow behaviour dead zones and compaction of the material in this area arise. On the other hand, with mass flow the material surface sinks uniformly. The material is discharged without segregation. If the discharge opening in a mass flow silo is too small, a stable arch of material will form above it. In contrast, if the discharge opening is too small in a funnel flow silo, both arches and ratholing can occur. In both cases, the product discharge comes to a complete standstill. With sufficiently large exit diameters, however, discharge mass flow rates often occur that are far larger than the required values. In silos that have several independently operated outlets, these problems take on added significance.

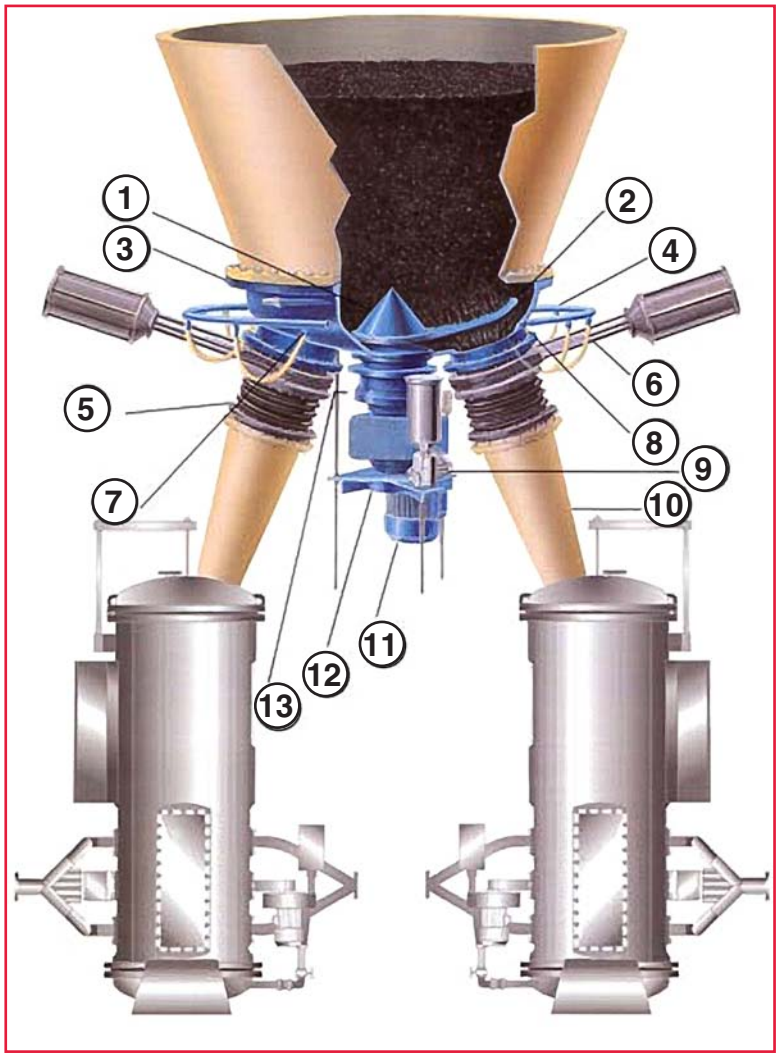
Benefits:

- Full activation of the activator inflow diameter
- Safe operation even after long downtime or after downtime at individual outlets
- No vertical activator movement — thus no material compaction
- Reverse switching to break up caked material
- Easy retrofitting to existing silos
- Reduced silo height
- Simple maintenance with external and externally removable drive, bearing and seal elements
- Can be used with any silo size

Operation

The outlet diameter necessary for preventing arching or shafts is also the inflow diameter of the ROTA-FLOW® solids activator. Over the vaulted activator base, there is a centrally placed rotating activator blade of wear-resistant, high-strength steel. The driveshaft is securely sealed at the silo's exterior by several externally removable special gaskets. A grease pump safely lubricates all bearings. In the vulnerable silo cross section, the rotary activator blade discerns the entire column of solids and prevents inactive zones from forming.

The solids are pulled away from the entire cross-section of the activator by the spatial effect towards the circumference associated with the rotational movement. Material compaction is impossible even if the outlet diameters are closed, because the activator acts on the material only at horizontal planes. The special dispersal nozzles built into the activator base guarantee easy activator start-up even after long downtimes. To support subsequent metering devices, air can also be fed in dependent on the gear motor's power consumption. Once the constant power consumption is reached, a constant density of the material can be assumed. The possibility to reverse the activator rotation in relation to the gear motor's power consumption guarantees breakup of localized material compaction after long system downtimes.



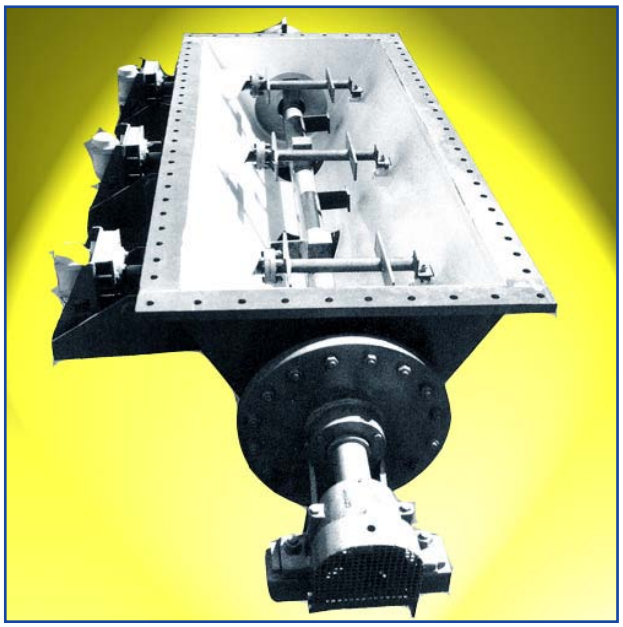
Technical Data

Size:	DN 1800
	DN 2600
Pressure shock resistance:	2 bar
	9 bar
Materials:	Standard steel, Wear-resistant steel, Stainless steel
Certified per 94/9/EG	BVS 05 ATEX H 007 X

1 Central cone
2 Revolving activator blade
3 Welding neck flange
4 Fluidizing air pipe
5 Compensator
6 Pneumatic slide gate
7 Fluidizing nozzles
8 Dome activator base
9 Grease pump
10 Discharge chute
11 Gear motor
12 Speed monitor
13 Bearing and coupling unit

Agitator

Metered Material Discharge with Bad Flowing Solids for Silos with Several Outlets



When fine-grained, bad flowing solids are stored in improperly dimensioned silos, malfunctions develop due to arching or funnel flow.

While as a result of arching the silo discharge comes to a complete standstill, with funnel flow complete emptying is prevented by ratholing. This flow behaviour results in operational downtime, segregation of products, grain shrinkage, dead zones, material flooding when the funnel walls collapse, incomplete silo emptying and non-uniform flow behaviour.

These problems become more significant if the silo has several independently operated outlets. The discharge mass flow rates of the individual outlets become mutually dependent, and after long outlet downtime it becomes hard to activate the material flow again.

Benefits

The mature design of the discharge agitator with its robust, durable construction offers special benefits in a wide range of applications.

- Safe, dispensed product discharge with mass flow behaviour for bad flowing solids in bins with several outlets
- No arching or ratholing
- Pressure-relieved outlets, trouble-free continuous feeding of conveying and metering systems
- Full activation of the outlet diameter
- Safe operation after long downtimes of the system or of individual outlets
- Homogenization of material through an intensive mixing effect
- Can be used even at high temperatures
- Virtually maintenance-free operation
- Low energy requirement

- Can be adapted to various bunker shapes
- Can be retrofitted to existing silos
- Can be used with any silo size

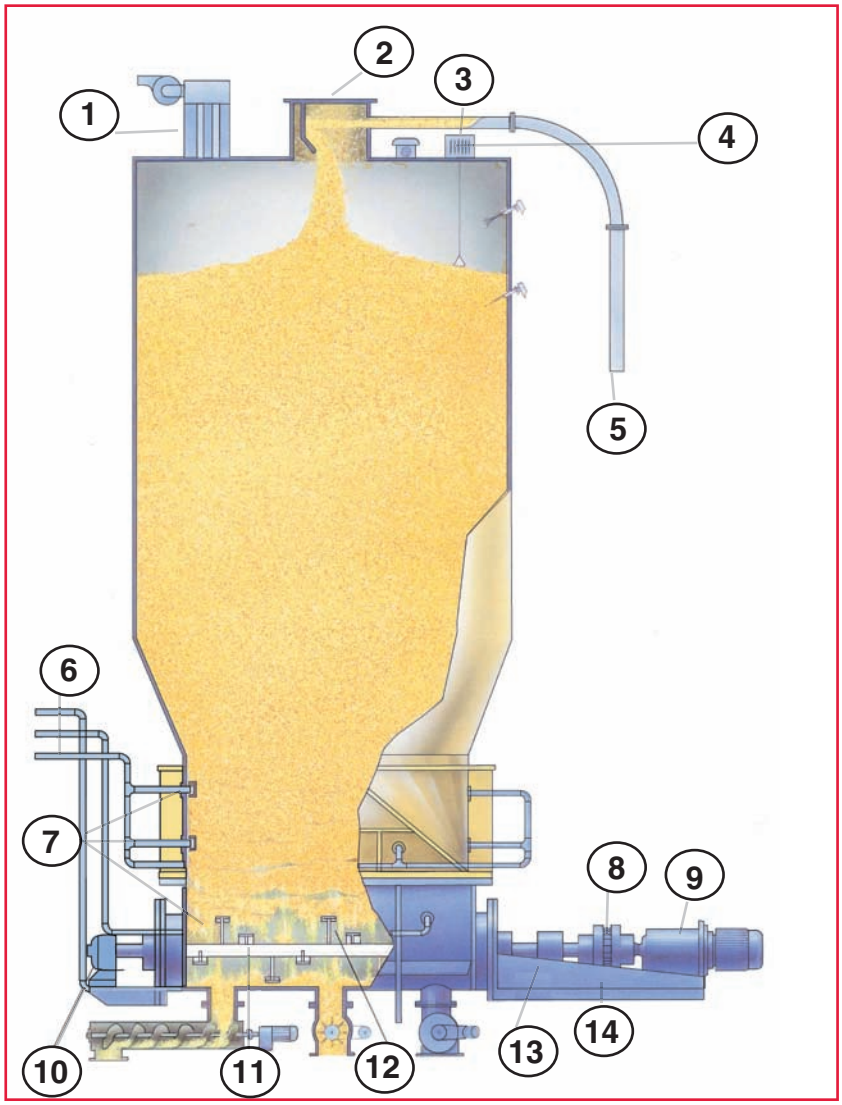
Operation

Motivated by constantly repeated operational problems in silos with several outlets, altmayerBTD has developed a discharge agitator integrated into the cone end of the silo. The basic shape of the hopper is that of a wedge. The wedge-shaped hopper guarantees flow conditions significantly better than those in conical hoppers when it comes to mass flow behaviour. Another important advantage is the fact that the circular discharge opening's diameter — which prevents arching — is about double the size of the narrow side of the wedge.

The robust discharge agitator, flange mounted to the hopper outlet, has a massive agitator shaft and is driven by a slow-running spur-gear drive motor. The shape and size of the agitator scrapers set on the shaft are determined by the material characteristics and the discharge geometry of the individual outlets. There are also special designs with additional horizontal activators. The special aeration nozzles built into the cone end and the agitator trough guarantee easy start-up even after long downtimes.

To achieve high volumetric metering precision of the subsequent metering devices, air can also be fed depending on the gear motor's power consumption. Once the constant power consumption is reached, a constant density of the material can be assumed. The discharge agitator meets the need for complete activation of the silo outlet diameter while restricting the mass flow rate as needed. Subsequent metering devices redirect the loosened mass flow. This prevents compaction and shearing of the material and reduces the risk of the material flowing only in preferred areas by the principle of least resistance. This allows direct installation of rotary feeders or screws.

Another possible application of the discharge agitator is in silos with pneumatic discharge equipment for cohesive solids that are extremely difficult to fluidize. Aeration must lift these materials as a whole, or cracks and ratholes will form. Only with mechanically supported fluidization fluidized beds do form and guarantee trouble-free discharge. The size of the discharge agitator is determined by the number and size of the subsequent metering devices, as well as by the need to prevent arching over the narrow side of the agitator, and to prevent funnel flow.



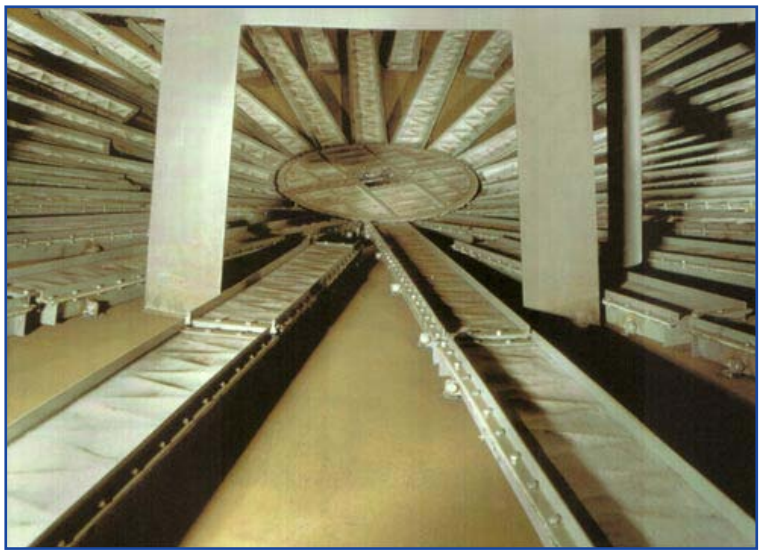
1 Exhaust air filter
2 Filling dome
3 Positive / negative pressure valve
4 Continuous fill level measurement
5 Filling pipe
6 Fluidizing air pipes
7 Fluidizing nozzles
8 Couplings
9 Spur-gear drive motor
10 Speed monitor
11 Agitator shaft
12 Agitator scraper
13 Special gasket
14 Pedestal bearing

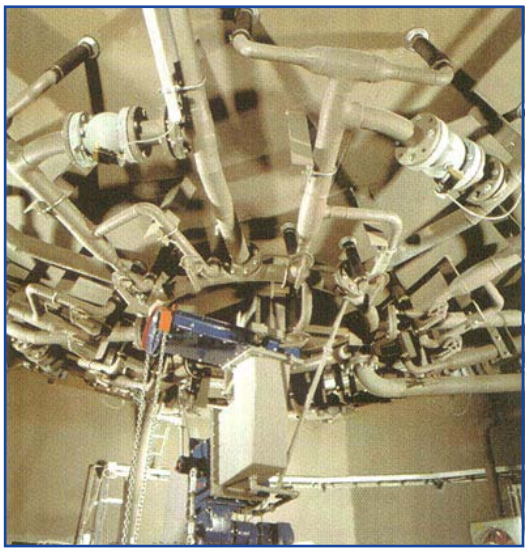
Technical Data

Length:	1,000 to 4,500 mm
Pressure shock resistance:	2 bar
	9 bar
Materials:	Standard steel, wear-resistant steel, stainless steel

Fluidization

Uniform Material Discharge with Mass Flow Behaviour for Silos with One or More Outlets





During storage in bins or silos, many materials tend to de-aerate or compact. Their flow characteristics change, often causing operational problems when emptying. These are distinguished by arching or ratholing. If the discharge opening is not big enough, a stable arch of material will form above it.

On the other hand, ratholing (funnel flow) results in dead zones and time compaction in these areas. Achieving mass flow with these materials requires steep hopper slopes and large outlet diameters, which are often undesirable for technical and economic reasons.

Benefits

altmayerBTD has many years of experience in bulk materials technology, so our customers always get the technically and economically optimal solution. Besides laboratory investigation of the material characteristics, this also includes the design of the silo geometry and choice of the necessary equipment. This provides the customer with the following benefits:

- Safe, dispensed product discharge
- No arching or ratholing
- Mass flow characteristics in the silo through reduction of wall abrasion forces and reduction of internal friction
- Robust design for long life
- Can be adapted to various bunker shapes

- Optimal silo discharge
- Low energy requirement
- Longer storage periods are possible, safe discharge even after long downtimes
- Can be used even at high temperatures or pressures

Operation

Through fluidization, flow with air or another gas, certain materials can be converted to a fluid-like state. Air input loosens masses of fine-grained particles so that they behave like a liquid and display good flow characteristics.

The air reduces the friction between the particles and against the hopper wall. This allows flatter hopper slopes and smaller outlet diameters. The result is a mass flow silo without dead zones and the associated risk of time compaction and self ignition.

For fluidization, many elements are available that allow optimal adaptation of the system to the specific characteristics of the material and the silo geometry.

For extensive aeration, special pneumatic tissue covered flutes or boxes are used. Especially with large silos, this allows flat hopper slopes and lower construction heights. Furthermore, it allows construction of bins for homogenization of bulk solids. Strips or pads of porous materials — plastics or metals — allow air introduction in applications where either purity (e.g., in the food industry) or temperatures and pressures in the bin are important.

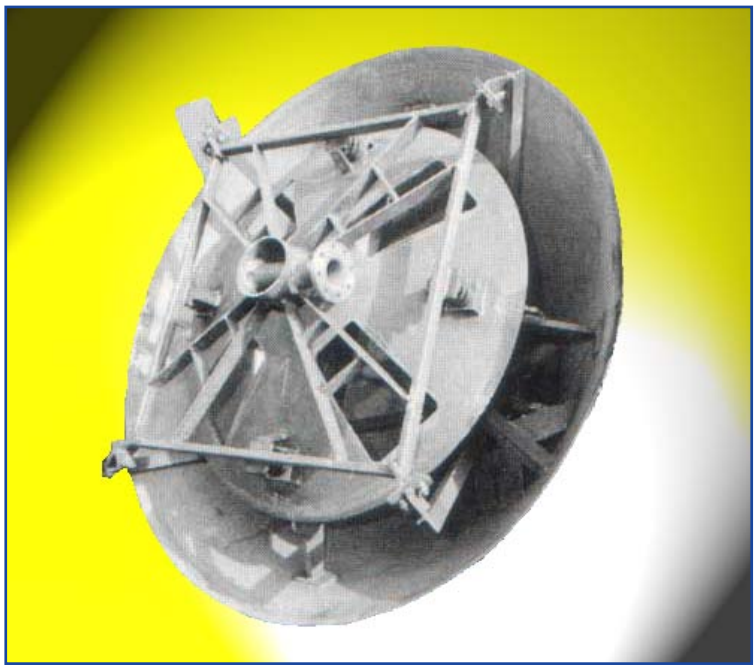
Aeration nozzles also guide gases into the material mass, such as for fire fighting in silos by inertization with nitrogen or carbon dioxide.

With cohesive, very fine-grained materials, special aeration nozzles are used that pulse air against the hopper wall to reduce wall wear and fluidize the material. The intermittent air input prevents the ratholing - typical of cohesive solids, through which the air uselessly escapes upward or through the outlet nozzle.

Another advantage of this manner of aeration is the reduction of the amount of required air to a minimum. After all, production and processing of compressed air is expensive. Besides this, compressed air is undesirable in several processes, such as with flammable or hygroscopic dusts.

VIBREX

Metered Material Discharge with Bad Flowing, Fine-Grained Solids



In storing, conveying and metering bad flowing solids, only especially powerful bunker discharge equipment guarantees a frictionless metering process. For emptying silos, the type of material flow is largely determined by the silo geometry and the internal friction of the material and the wall friction.

A distinction is made between mass flow and funnel flow. With funnel flow it is mostly the material above the outlet in the funnel that moves. A flow funnel is formed by the sinking of the material surface in the silo's core area and by subsequent flow of the material on the surface from the sides of the centre of the silo. This flow behaviour results in segregation of products, dead zones, material flooding when the funnel walls collapse, incomplete silo emptying and non-uniform flow behaviour. On the other hand, with mass flow all the material in the silo moves. The material surface sinks uniformly during discharge. This means that the bin's entire volume is used, and the least possible segregation is achieved, along with constant bulk density during emptying. Thus, only a mass flow silo fulfils the basic task of discharging the stored material trouble-free, in unchanged quality.

To prevent stable arches of material above the exit openings, their smallest dimension must exceed a minimum value that can be specified according to the Jenike process. With these exit diameters, however, discharge mass flow streams often occur that are far larger than the required values.

Benefits:

The mature design of the VIBREX silo discharge device with its robust, durable design offers special benefits in a wide range of applications:

- Safe, metered product discharge with mass flow behaviour for bad flowing solids
- No arching or ratholing
- Effective reduction of wall friction and internal friction within the material
- Pressure-relieved hopper for trouble-free continuous feeding of conveying and metering systems

- Removal-oriented material activation, preventing additional compaction
- Homogenization of material through an intensive mixing effect
- Optimal silo discharge
- Can be used even at high temperatures
- Virtually maintenance-free operation
- Low energy requirement
- Can be adapted to various bunker shapes
- Can be retrofitted to existing silos without changing the height or the downstream conveying and metering systems
- Can be used with any silo size

Operation

Demand for safe, metered discharge with mass flow behaviour with an outlet diameter adapted to the design requirements has led to development of the VIBREX silo discharge device for bad flowing, fine-grained materials.

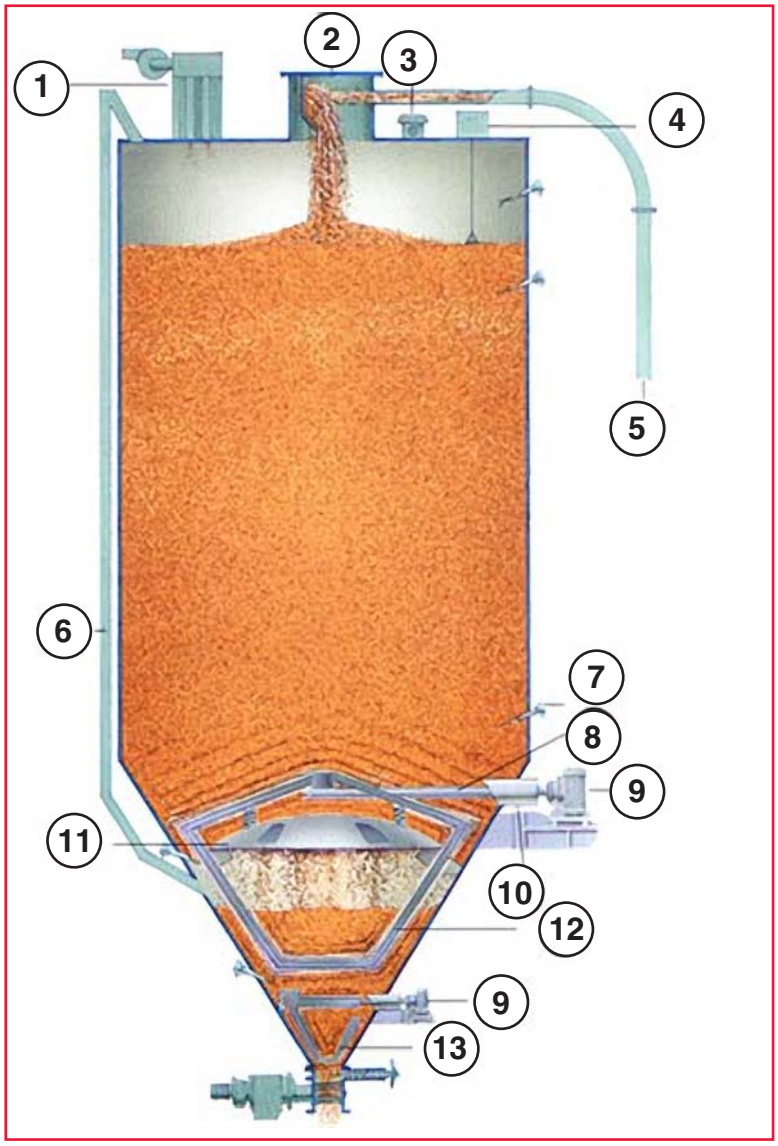
Above the load relief dome, there is an embedded vibration frame driven by a vibration drive with continuously adjustable unbalance force. The driveshaft is securely sealed at the silo's exterior by a special externally removable gasket. The size and width of the side ring gap are determined by the individual characteristics of each material. With directed horizontal vibrations, the vibration frame activates the entire diameter of the material above the load relief dome. The flow movement extends across the entire diameter of the bunker and displays mass flow behaviour. The solid flows into the free volume of the cone, which is released from the solid pressure and through this release, the solid displays considerably better flow characteristics. Additionally, the vibration arms, which are adjusted to the slope of the cone, improve the flow behaviour in the free volume of the cone.

The material's flow behaviour at the individual base openings creates an intense mixture effect, which greatly contributes to the material's homogeneity. The air which is displaced by the material flow into the free volume of the cone is guided through a release line to the silo head area. Conversely, the vacuum created in the bunker top during discharge is reduced by a return air stream. The vibration frame of the load relief dome works intermittently between the two material levels determined by the level indicator in the cone area.

This removal oriented activation safely prevents a compaction of the solid in the silo cone top.

The outlet activator in the discharge area works on the principle of the upper vibration frame. It is operated parallel with the running bunker discharge, where interval and activation times are adapted to the product characteristics and the discharge mass flow rate. Outlet precision of +/-10% can be achieved.

The minimum size Dmin of the VIBREX bunker discharge device is determined by the requirement that in every silo height the unconfined yield strength fc occurring during storage is less than the compressive stress necessary for formation of a stable arch of material. The unconfined yield strength fc caused by the maximum principal stress operating in the bin as well as the wall friction angle is determined by experiment.



1 Exhaust air filter
2 Material inlet dome
3 Positive / negative pressure valve
4 Continuous level measurement
5 Filling pipe
6 Air relief pipe
7 Level indicator
8 Drive shaft
9 Vibration drive unit
10 Special seal
11 Load relief dome
12 Vibration frame
13 Discharge activator

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