Overview solids rotary valves
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I. Summary
Throughout the bulk solids industry, rotary valves are used for discharging and (volumetric or gravimetric) dosing of dust, powder or granular solids. The standard designs and their design criteria are well known. However, the different tasks and working conditions often require solutions in the form of special constructions, which the solids solutions group have developed further from the basic design. In general, the product characteristics and operating parameters determine the design and construction of the rotary valve. In some cases, rotary valves also have safety tasks to perform, such as preventing the spread of dust explosions.

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II.1 solids Rotary valves in Basic, Clean, Heavy, Hygienic design, type SRVS, according to ATEX-Directive 2014/34/EU, zone 20 inside, zone 21 outside, type SRVP protection system

The solids solution group offers rotary valves in accordance with the respective requirements in the Basic, Clean, Heavy, Hygienic and Protective system versions. All rotary valves in this series comply with the Machinery Directive 2006/42/EU, which has been in force since 2009, and were designed for use under Ex conditions. The rotary valves have been tested by a universally recognised and accredited test centre, DEKRA - Exam. Their suitability for zone 20 has been certified with a type examination. This means that these rotary valves can be used in Zone 20 Category 1 according to ATEX Directive 2014/34/EU with a declaration of conformity.

Features:
- Inlet geometry for 100% fill level
- Outlet geometry for complete emptying of the cells

The product properties and operating parameters are crucial for the design and construction of the rotary valve. Essentially, these are different rotor types, e.g. rounded rotor chambers or replaceable sealing strips made of elastomer or steel.

Advantages:
- robust and wear-resistant
- inexpensive and low maintenance
- suitable for use according to ATEX-directive 2014/34/EU in zone 20 inside, zone 21 outside
- security for the operator through type examination with declaration of conformity

As a protection system according to ATEX, the sister series type SRVP is additionally available. This guarantees maximum plant safety for the operator.
II.2 solids Rotary valves as a protection system according to ATEX, pressure shock resistant and flame propagation proof type SRVP

Features / advantages:
- Pressure shock resistant for 13 bar g and flame propagation proof,
- Protection system category 1 according to ATEX-Directive 2014/34/EU, dust explosion class St1, St2, St3, zone 20 inside, constant/extended period/frequent risk of dust explosion, zone 21 outside, with type examination by a notified body
- Identification: II 1/2 D

Task formulation:
In industry, finer and finer dusts are being processed. If these dusts are flammable, an ignitable mixture is created with air. An explosion occurs if there is an ignition source, such as sparks or hot surfaces.
In order to avoid the propagation of pressure waves and/or sparks or flames, rotary valves in pressure shock-resistant and flameproof design are a tried and tested means, above all because they also handle conveying and metering tasks. They are installed upstream from pneumatic conveyors, up and downstream from mills and containers, as well as for safety-related separation of individual plant sections.

Solution:
For use under Ex conditions, the solids rotary valve type SRVP, pressure shock resistant and flame-propagation proof, has undergone significant further development.
The dimensioning and design of the rotor, especially the gap between the rotor and the housing, has been designed in such a way that, in the case of a dust explosion, the sparks entering at a very high speed are extinguished in the rotary valve. The axial fixation of the rotor has been adapted to the increased loads and reinforced. The shaft seal to the outside has been optimised by means of special radial shaft seals.
This rotary valve was extensively tested by DEKRA - Exam with a mining test track under explosive conditions. Various series of experiments with dust explosions were performed.
The solids Rotary valve type SRVP was certified with a type examination for pressure shock resistance up to 13 bar g and effective and safe flame propagation proof. Thus, this rotary valve is a category 1 protection system according to ATEX Directive 2014/34/EU and guarantees the operator maximum plant safety.
II.3 solids Rotary valves in Clean design, type SRVC, according to ATEX Directive 2014/34/EU, Zone 20 inside, Zone 21 outside

Features / advantages:
- suitable for food in dry processes with dry cleaning, easy to disassemble, easy to clean
- maintenance-friendly
- cost-effective and low-maintenance due to simple construction

A particularly cost-effective and maintenance-friendly solution is the newly developed solids Rotary valve type SRVC. Due to its simple design with the bearing in the coupling and the cell wheel attached to the drive shaft, it can be disassembled and cleaned in a few simple steps. For this purpose, only the cover must be unscrewed from the drive, then the cell wheel can be pulled out of the housing, and all maintenance-related parts are easily accessible.

This rotary valve does not require its own roller bearings, requiring only a single shaft bushing, thus reducing the number of wear parts and simplifying maintenance.

A hygienic version at hygiene level 1 according to EN ISO 14159 and EHEDG guidelines, suitable for foodstuffs, is also available.
II.4 solids Rotary valve in Hygienic design type SRVS-Hygienic according to hygiene levels 2 and 3 according to EN ISO 14159 and EHEDG guidelines

Features / advantages:
- in wet processes and dry processes with wet cleaning for food, cosmetic products and pharmaceuticals
- meets 2006/42/EU, Machinery Directive with appendix 1 paragraph 2.1. Food processing machines, EHEDG guidelines, as well as GMP requirements under intended use and DIN EN 1672-2
- stainless steel version in suitable alloy
- FDA-compliant seals
- internal surface finish according to EN 10088 2B with roughness value Ra ≤ 0.8 µm, sheets outside from 6 mm 1D according to EN 10088, glass-bead blasted outer castings Ra = approx. 6.3 µm, permissible casting flaws according to quality class VC2 according to DIN EN 1370
- electropolished as far as technically possible and meaningful
- dead-space free, gap-free, suitable for wet cleaning in the assembled state (CIP) with subsequent inspection and subsequent cleaning, if necessary
- welding according to EN ISO 5817 + AC: 2006 Assessment Group B as well as continuous, gap-free and non-porous with roughness value Ra ≤ 0.8 µm, outside Ra ≤ 3 µm

The solids Rotary valve type SRVS has been further developed to a Hygienic version. It is easy to dismantle and clean and was designed to HACCP and EHEDG guidelines, suitable for food, with retractable cell wheel and optional guide rails. The risk assessment required in the new Machinery Directive 2000/42/EU, which has been in force since 29.12.2009, also took into account the microbiological, physical and chemical requirements.
CIP wet cleaning
1. The rotor remains installed
2. Flushing of the feeder with cleaning liquid takes place with rotating rotor and flushing the shaft feed-through with compressed air
3. Drying, analogue flushing
4. If necessary, the rotor is removed after CIP cleaning and the cleanliness of the critical points is checked and, if necessary, subsequently cleaned. In case of validation of the CIP cleaning (Riboflavin test), additional measures (verification, cleaning) are determined.
5. Drive rotor back in
II.5 solids Rotary valve type SRVP-Hygienic as protection system according to ATEX 2014/34/EU

This rotary valve was tested by a recognised and approved testing laboratory, the DEKRA. The solids Rotary valve type SRVP has been certified as suitable for zone 20 and as a protection system with a type examination. Thus, this rotary valve can be used in zone 20 category 1 according to ATEX Directive 2014/34/EU with declaration of conformity. It is pressure shock resistant up to 13 bar g and flame-proof.

It is cleanable wet, easy to disassemble and was designed according to EU regulations and EHEDG guidelines, suitable for foodstuffs, with retractable cell wheel and optional guide rails and certified according to Type EL - Class II. CIP cleaning prevents entry of the cleaning solution into the storage area. The rotor remains installed. The flushing of the valve with cleaning fluid takes place with the rotor rotating. The shaft feedthrough is flushed with compressed air. It is then dried. If necessary, the rotor is removed after CIP cleaning and the cleanliness of the critical points is checked and, if necessary, subsequently cleaned. In case of validation of the CIP cleaning (Riboflavin test), additional measures (verification, cleaning) are determined. Then the rotor is retracted again. The removal and installation of the rotor is simple and time-saving, since no adjustments are necessary. The seals also remain intact because the bearing bush remains in the end shield. The double bearing of the rotor shaft in the bearing bush results in an exact radial fixation and allows high bending moments and thus high differential pressures.
II.6 solids Rotary valve in Heavy design, high temperature version

In harsh conditions, e.g. abrasive products or in power plant operation with high availability, the following rotary valve features come into play:

- remote bearings
- gland packing
- materials for temperatures up to 500°C
- wear-resistant: housing with insert wear bushing, hard chrome plating or armouring, rotor fitted with tungsten carbide
III. solids Microfeeding Rotary Valve

Microfeeding rotary valves are used for dosing of small quantities in the range from 3 dm³/h to approx. 4000 dm³/h and product flow properties from very viscous to extremely fluid. Other factors include: dosing against pressure difference up to 1.5 bar, temperatures up to 150°C, dosing accuracy below ± 2% (without differential pressure), low pulsation mass flow.

To meet these requirements, the solids Microfeeding rotary valves have special cell wheels with very small chambers (<10 cm³) arranged in multiple rows offset from one another to prevent mass flow pulsation. For a high dosing accuracy, a clearing device in the outlet area ensures complete emptying of the chambers. Special design features are: robust cast iron housing, precision rotor, shaft seal pressure-tight up to 1.5 bar, temperature up to 150°C, external bearings, worm geared motor. For optimum filling of the rotor chambers an agitator tank is connected upstream from the rotary valve. This achieves a 100% degree of filling.

The Microfeeding rotary valve unit plus agitator can be combined by means of load cells and weighing electronics to a differential dosing scale.

solids Microfeeding rotary valves have been successfully deployed in flue gas cleaning systems for dosing adsorbents such as lime hydrate, hearth furnace cokes, activated carbon, loaded adsorbent in recirculation and limestone flour.
Manually filling

Deaerated product with uniform bulk density

No segregation, mass flow, prevention of bridges

Microfeeding rotary valve type MDS

Filling out of the silo

Hopper with agitator type MDS

Delivery of the product into the dosing equipment

Restricted guidance

Pressure- / vacuum-seal for dosing into the pneumatic blowing system

Restricted discharge
IV. solids Self-cleaning Rotary Valve

Task formulation:
Self-cleaning rotary valves are used like basic rotary valves for discharging and dosing, but for the following difficult bulk material properties: adhesive, cohesive, hygroscopic, bridging, moisture or vapours from below (e.g. from a reactor).

Solution:
The special structure and function of the solids Self-cleaning rotary valves reliably prevents product from sticking in the chambers of the cell wheel. The Self-cleaning rotary valve has also proven itself with steam/vapours and moisture from below. In the rotary valve housing, the cell wheel and the scraper rotate synchronously and in opposite directions to one another, so that material adhering in the cell wheel chambers is scraped off by the scraper. The geared motor, which is directly coupled via an elastic compensating coupling, drives the scraping wheel shaft. The cellular wheel is driven by this shaft via the single-stage helical gear. As a result, the cell wheel and scraper run synchronously and in opposite directions without mutual contact. The cell wheel and scraper are equipped with adjustable sealing or scraping strips made of special steel or elastic material. The scraper thus scrapes adhering product from the rounded cell wheel chambers. This falls down through the outlet opening in the housing.

Other design features are: Housing, cell wheel and scraper wheel in welded steel construction, cell wheel with interchangeable and adjustable scraping strips in steel or elastic material, stuffing box seal and grease barrier, on both sides external flanged bearings (lubricated for life), cell wheel and scraper wheel driven synchronously via single-step helical gear, drive via elastic coupling, on request safety slide coupling, in special cases chain drive, motor console with three-phase helical geared motor, 2 opposite inspection openings in the scraper wheel area.
In addition to the standard Self-cleaning rotary valves, further variants are possible:

**solids High-temperature self-cleaning rotary valves in Heavy design, up to 350°C**

The RRS-Heavy-HT self-cleaning rotary valve has an external, widely offset high-temperature bearing incl. cooling air supply with solenoid valve, pressure regulator and fixed piping. The shaft seal has stuffing box packings with purge air supply incl. solenoid valve, pressure regulator and fixed piping.

**Pressure-shock-proof solids Self-cleaning rotary valves**
Shockproof up to 10 bar g, as well as a variant with distribution of the mass flow at the outlet of the self-cleaning rotary valve to 4 partial flows.

The solids Self-cleaning rotary valve ensures high functional reliability in difficult applications, e.g. discharge of: fly ash at 250°C in conjunction with rising vapours from below, REA gypsum with 10% moisture, moist, loaded adsorbent from fabric filter, brown coal with 50% moisture, diverse fine chemicals, partly corrosive, therefore material in contact with the product stainless steel.
Blow-through rotary valves are used as a space-saving and cost-effective feed body for the pneumatic conveying and for discharging and dosing from a container in a pneumatic pressure or suction conveyor system. The leakage air flow from the pneumatic conveyor system into the storage tank can be minimised to a pressure of 1.5 bar.

The bulk material falls as in normal rotary valves in the inlet into the rotor chambers and is transported by the rotor rotation downwards. However, the product does not fall out through an outlet opening in free fall, but is horizontally blown out by means of conveying air in pressure or suction operation by the integrated conveyor tube connection. Since the delivery line leads through the valve so to speak, construction height is saved and effective emptying of the chambers is achieved. solids Blow-through rotary valves are manufactured with tight tolerances between the bearings on both sides, direct drive with mounted geared motor, optionally as protection system category 1 according to ATEX 2014/34/EU with type examination, pressure shockproof 10 bar, flameproof with certificate.

For many pneumatic conveying tasks, the blow-through rotary valve, which can be used for pressure and suction conveyor systems, is a simple and therefore inexpensive solution. There is only one moving part (rotor) and thus a reduction in maintenance costs. In addition, the integrated conveyor line connection with its short distance from the rotor axis saves a considerable amount of height.

Examples of the use of blow-through rotary valves are the conveying of chalk, limestone, zinc oxide, zinc stearate, sugar, hydrated lime, hydrated lime mixed with hearth furnace coke, detergent raw material, bleaching earth, etc.
solids Blow-through rotary valve in Clean design:

- optionally in contact with the product (inside), ground. surface quality according to the desired Ra value.
- all welds gap-free.
- optionally electropolished.
- direct drive (no chain, grease free)
- suitable for food
- suitable for use according to ATEX-Directive 2014/34/EU in zone 20 inside, zone 21 outside