ZIRKOPLEX ZPS

CLASSIFIER MILL

HOSOKAWA MICRON

HOSOKAWA ALPINE

PROCESS TECHNOLOGIES FOR TOMORROWSM

IMPORTANT FEATURES

❯ Grinding and classifying in one machine

❯ Optimum accessibility

❯ Easy cleaning;
a benefit for frequent product changes

❯ Designed for processing adhesive products that
tend to deposit

❯ High air flow rate = cool grinding

❯ Excellent precision of cut, steep particle size
distributions

ZPS schematic diagram
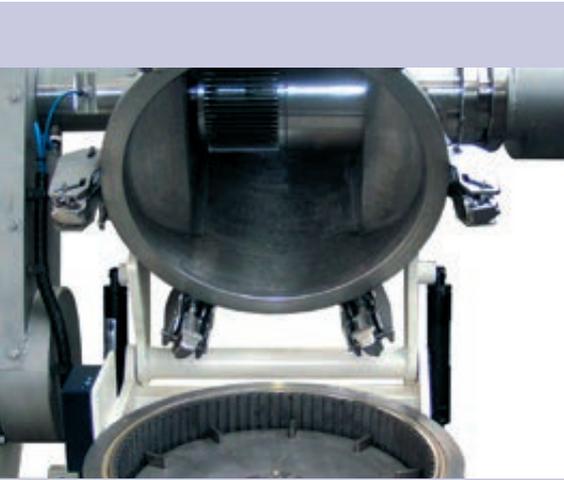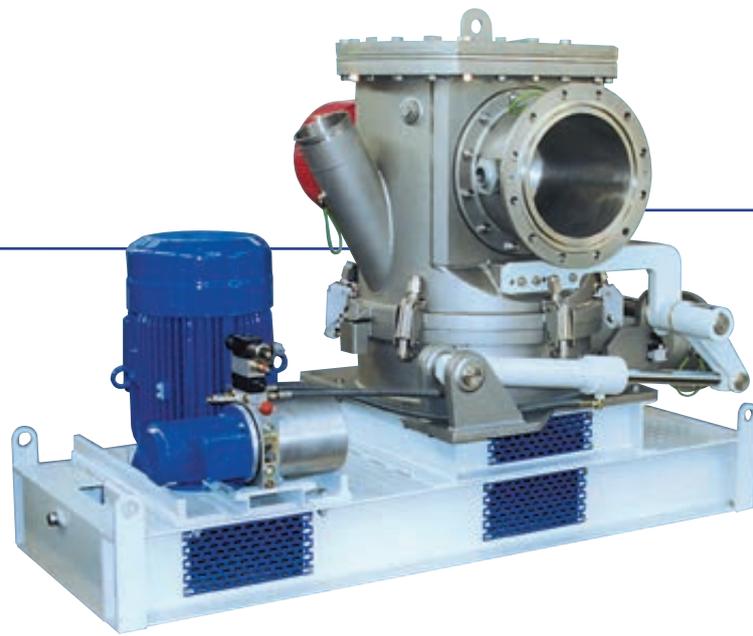
AREA OF APPLICATION

The Zirkoplex ZPS classifier mill is distinguished by its versatile range of product fineness levels. Independent of the conditions in the grinding section, these levels are determined by the air classifier. Zirkoplex classifier mills are universal in use for materials up to a Mohs hardness of approximately 3.5 in cases where requirements call for extremely high end-product fineness levels at the lowest possible energy consumption.

❯ Chemicals

❯ Minerals / Metals

❯ Pharmaceuticals

❯ Food / Feed

PRINCIPLE OF OPERATION

The size-reduction elements comprise an impact beater unit plus a stationary triangular-ribbed grinding track that surrounds the grinding chamber. The impact beater unit is designed to ensure that the grinding process is very efficient. The impact beaters are exchangeable; the grinding track is in segmented design. A Turboplex ultrafine classifier with one or more horizontal classifying wheels is integrated into the top section of the mill.

The feed product, charged to the machine by a system-sided feed unit, enters at the filling socket and is intercepted by the impact beaters on the beater disc. The combined action of the beaters and grinding track serves to comminute the product, which is then transported via the classifier to the fines discharge. The air introduced into the machine at the air inlet cools, transports and also classifies the product in the integrated classifier. Depending on the specification,

the feed product can also be introduced into the machine entrained in the air. In this case, the machine is used without the feed unit or the feed unit is closed. The fines, extracted in accordance with the cut point set at the classifier, exit the machine via the fines discharge. Particles that are too coarse are rejected by the classifying wheel and are comminuted by the beater unit until they can pass through the classifying wheel and thus correspond to the required fineness as specified by the classifying wheel speed. The end product is separated from the air in a downstream system-sided collection unit. The feed product enters the classifying chamber from above via a rotary valve, any particles that already display the end-product fineness are discharged immediately by the Turboplex ultrafine classifier without having to pass through the grinding unit. The air is supplied to the mill by a connection at the side of the machine.
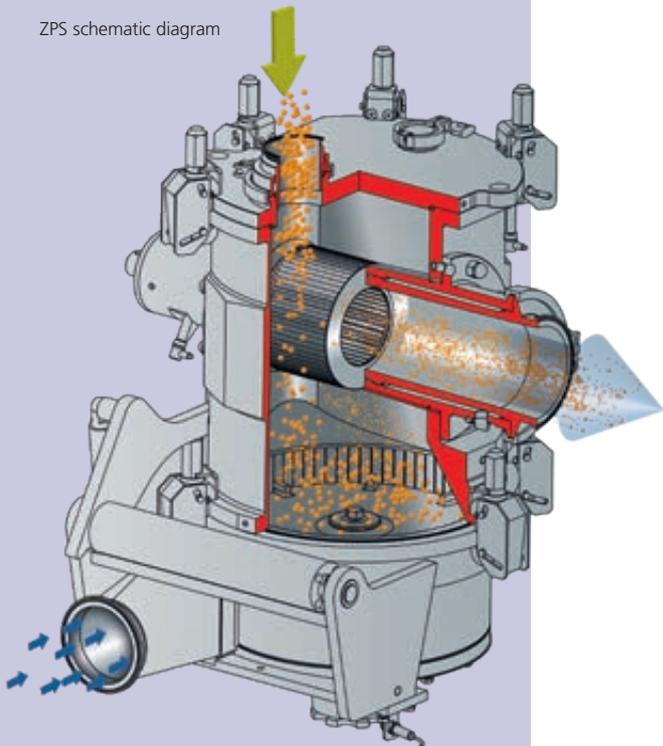
DESIGN PHILOSOPHY

The ZPS Zirkoplex classifier mill has been tried and tested in practical application all over the world. The design and capacity are constantly updated to adhere to the latest research results and to meet practical requirements.

> ATEX certification is assured for all our products according to your production requirements

> Zirkoplex ZPS are available in different designs: unpressurised, pressure-compensated and pressure-shock resistant

> Special fluidisation equipment at critical points

> Deposit-free and gentle processing of pigments, wax, resins, etc.

> Stable classifying characteristics: once set, the classifying fineness remains constant

TEST CENTRE

Spread over more than 3,000 sqm the Hosokawa, the Alpine application test centre in Augsburg / Germany provides ample space for carrying out tests for system configuration and for determining application-related technical warranty parameters. The following mechanical and thermal process technology operations can be carried out on a production and on a laboratory/pilot scale:

> Size reduction (dry and wet)
> Granulator technology/ shredding
> Air classification
> Wet classification
> Sieving, separation
> Mixing, drying, dry grinding
> On-line particle size analysis of dry powders in the range of 0.5 - 850 µm directly on the grinding/classifying system

› 200 ZPS in pharmaceutical design
WIP / CIP / SIP-capable

pico zirk
HOSOKAWA ALPINE

FOR R+D

Extreme miniaturisation allows processing minute samples, and process can be repeated on a production scale at a later stage. This is beneficial when processing very expensive materials.

SPECIAL DESIGNS

The ZPS classifier mill also offers versatile design options. The ZPS is universal in use and can be adapted to suit pilot-scale as well as production-scale processes or products with special requirements.

PHARMACEUTICAL / GMP DESIGN

The ZPS with a horizontal classifying wheel delivers a sharp top cut even for challenging products. Thanks to the large product chamber, even dust explosive products can be milled without trouble. Moreover, all components that come into contact with the product can be sterilized in an autoclave.
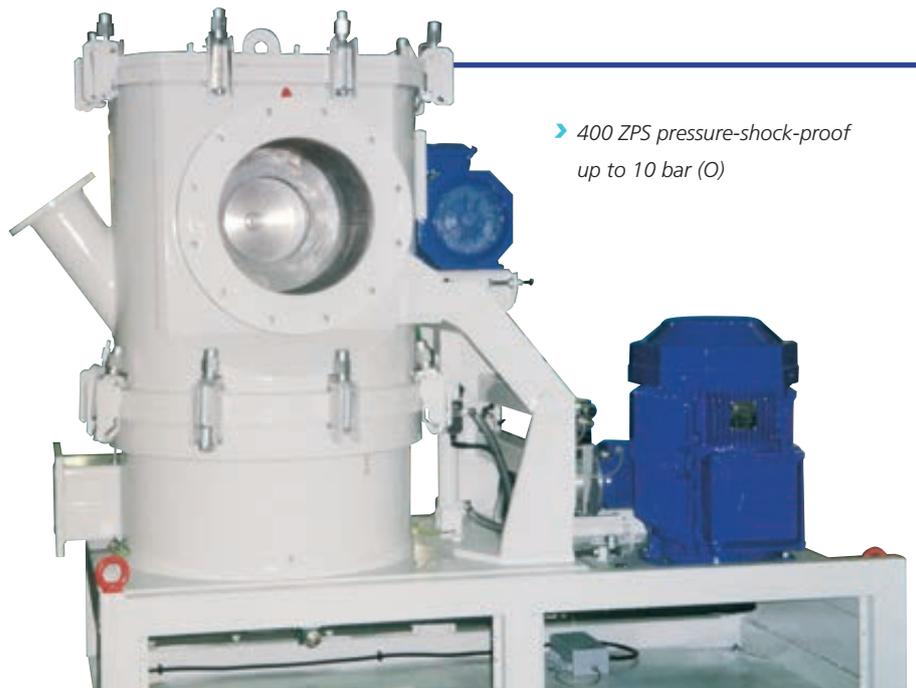
EXPLOSIONS-PROOF

Special safety regulations apply for products that are prone to dust explosion. Optionally, this problem can be solved either by pressure relief, explosion suppression or a pressure-shock resistant system design. We prefer to the latter option, as a pressure-shock resistant design is suitable for all areas of operation and the maintenance costs can be reduced to a minimum. For this concept, the machines, cyclones, filters and pipelines have a pressure-shock resistant design to withstand pressures up to 10 bar (0). All relevant sliders and valves are pressure-shock resistant and equipped with a flashback arrester to ensure that the line can withstand the maximum explosion pressure.

› 400 ZPS pressure-shock-proof up to 10 bar (O)

SPECIAL DESIGNS

ATEX
All ZPS models are certified to ATEX in accordance with the EC type examination certificate No. IBExU03ATEX 1152 X and marked II 1 (i) D / 2 (o) DG c IIC T5.

EXTREME WEAR PROTECTION
The use of oxide ceramic for wear protection can significantly increase the service life of the mill.
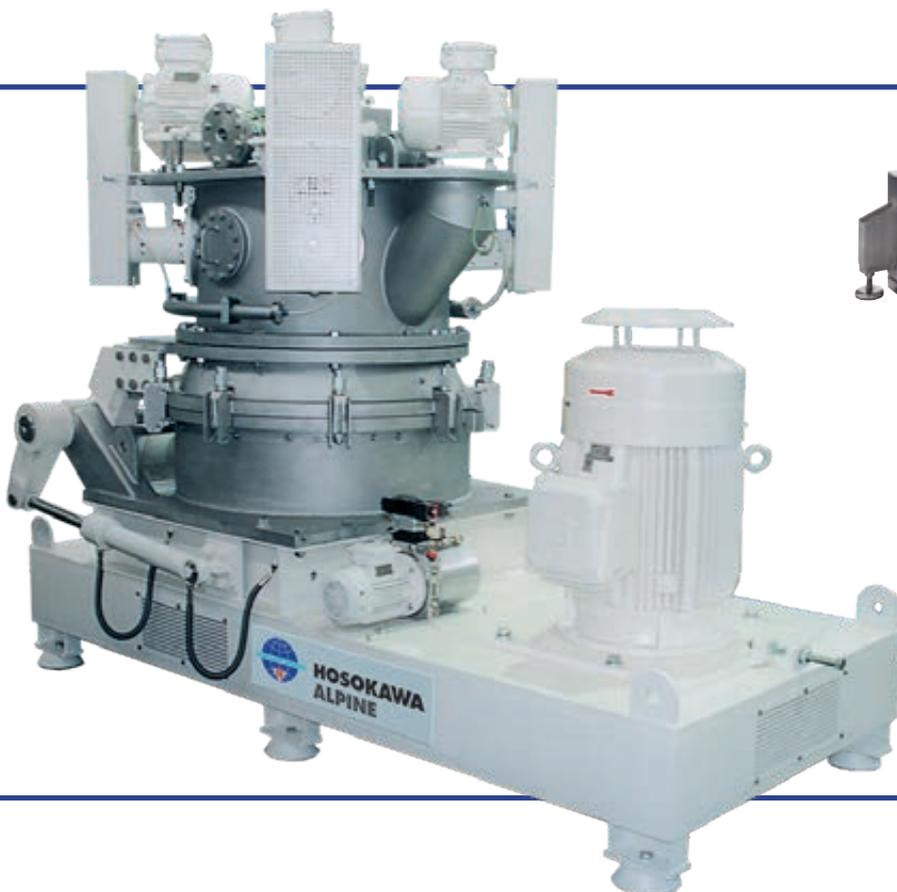
MULTI-WHEEL CLASSIFIER HEAD
In response the rising demand for higher throughput rates and ever increasing end-product fineness levels in dry processing, Hosokawa Alpine has set up several turbo classifier wheels of identical sizes. This multi-wheel classifier concept was first introduced for the Alpine Tuboplex classifier, which was then able to produce ultrafine products with only one classifier, specially in the range of between 3 and 6 µm with a very high output of fine products and maximum precision of cut – in a cost-efficient process.
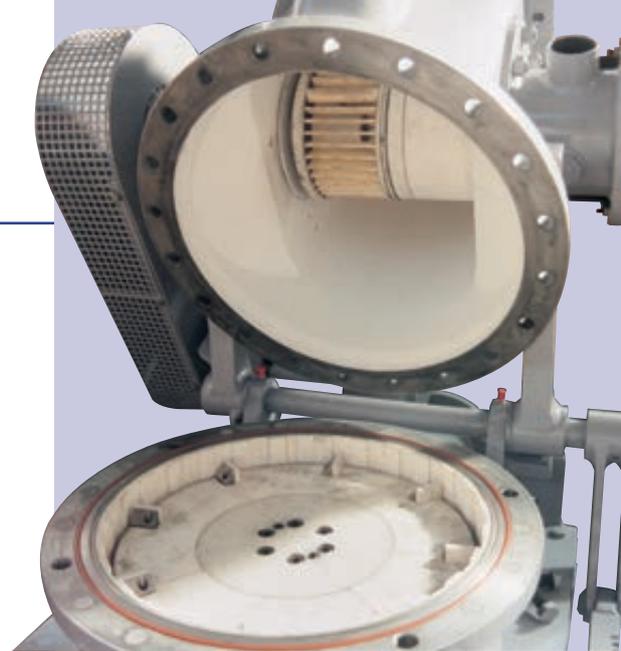
❯ *ZPS with ceramic wear protection*

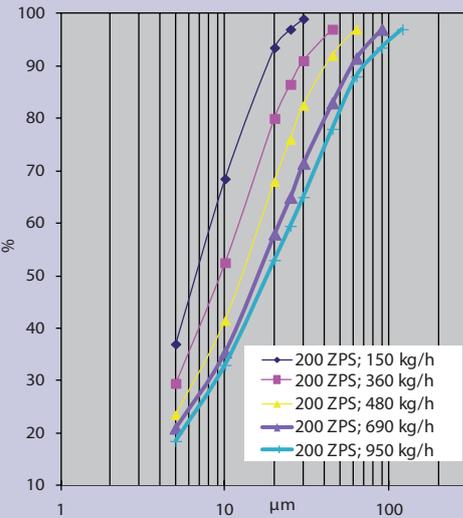❯ *200 ZPS in pharmaceutical design for cleanroom integration*

❯ *200-4 ZPS with multi-wheel classifier head*

APPLICATION EXAMPLE NOVOLAK

- 200 ZPS; 150 kg/h
- 200 ZPS; 360 kg/h
- 200 ZPS; 480 kg/h
- 200 ZPS; 690 kg/h
- 200 ZPS; 950 kg/h

IMPORTANT FEATURES

> High airflow rate – cool grinding without deposits

> Integrated Turboplex ultrafine classifier with high precision of cut, powder qualities with steep particle size distribution and no spatter

> Separately adjustable parameters such as
>> Mill speed
>> Classifier speed

> Easy operation, quick cleaning

> Energy-efficient, cost-efficient processing

1 Zirkoplex ZPS classifier mill

A Feeding

B Final product

> *Line example with Zirkoplex ZPS – for processing E-PVC*

APPLICATION EXAMPLE E-PVC

E-PVC is an amorphous, thermoplastic polymer that is distinguished by a hard and brittle structure. It is used for the following areas of application:

> Film
> Window profiles
> Floor coating
> Wall panels
> Coated materials
> Caulk and plastisol

As a base material for these end products, E-PVC must have fineness levels of <63 µm and <30 µm and a steep top cut. Milling and classifying can ensure that these requirements are met.

The milling and classifying processes are carried out on a Zirkoplex ZPS classifier mill. The classifier is integrated into the mill's top section. Critical machine areas are equipped with a special fluidisation system, which prevents the product from depositing.

Zirkoplex classifiers are perfect for this area of application, because they provide unobstructed access, easy cleaning, cool grinding and an outstanding precision of cut.

The flow chart shows a 630 ZPS setup with the following parameters: feed material with sprayed material fineness: about 90% < 63 µm final product output and finenesses.

> Fineness levels 0.1 % > 63 µm about 2,500 kg/h

> Fineness levels 1 % > 30 µm about 1,500 kg/h
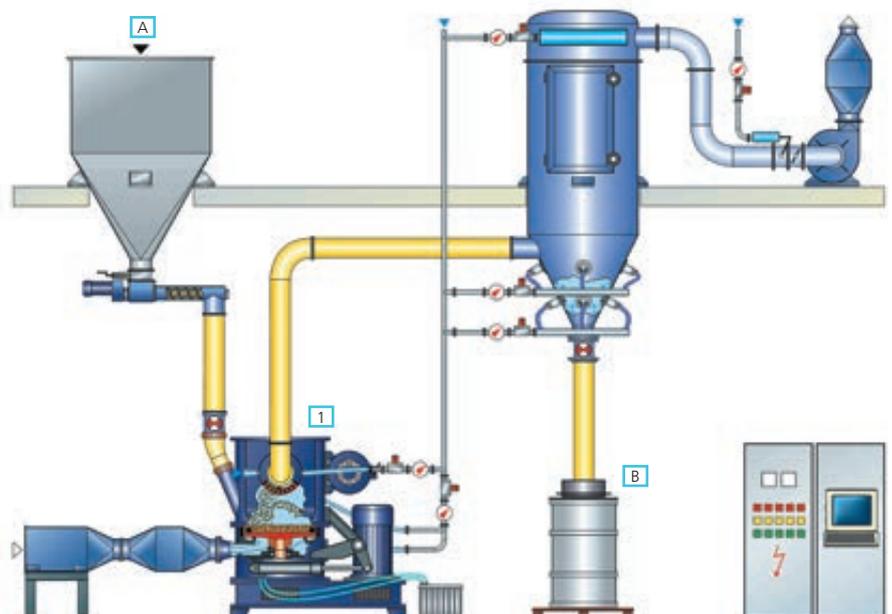
PRACTICAL EXAMPLES

Product	End-product fineness *	Througput kg/h	Machine size
Aluminium hydroxide	50 % < 3 - 3.5 µm 99 % < 10 µm	170	200 ZPS
Lead oxide	99 % < 6 µm 99 % < 40 µm	300 1,500	315 ZPS 315 ZPS
Calcium phosphate	50 % < 5 µm 97 % < 15 µm	1,300	630 ZPS
Iron oxide red	99 % < 25 µm	400	315 ZPS
Iron oxide red	99 % < 45 µm	500	200 ZPS
Sodium polyphosphate	99 % < 250 µm	560	200 ZPS
Novolak	99.99 % < 65 µm 97% < 50 µm	800	315 ZPS
PE wax	50 % < 6 - 9 µm 99 % < 15 - 22 µm	140 - 200	200/4 ZPS
Zinc chromate	99.9 % < 5 µm 99.9 % < 10 µm	100 150	315 ZPS 315 ZPS
Zinc oxide	99.9 % < 10 µm 99.9 % < 23 µm	250 1,500	315 ZPS 315 ZPS

* Powder fineness in % > µm – measuring points of particle size distribution.
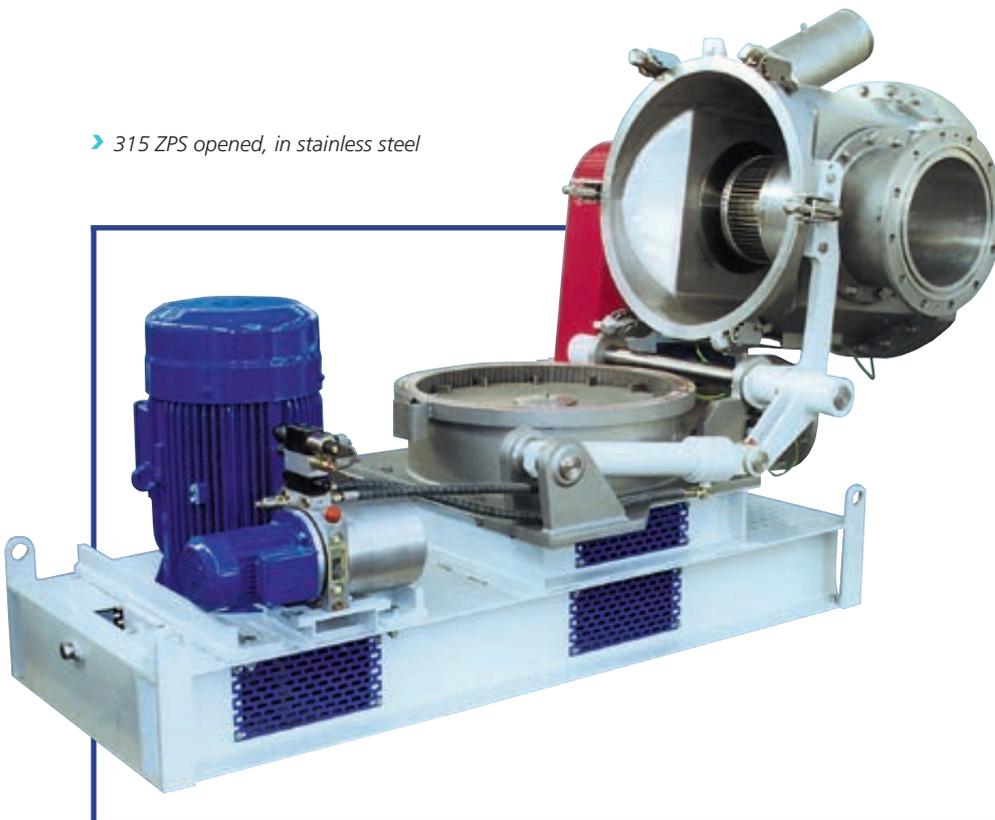All values are non-binding reference values only.

NOVOLAKS

Novolaks are synthetic rubbers. They are produced by polymerisation, polyaddition or polycondensation reactions.

› 315 ZPS opened, in stainless steel


PIGMENTS

Pigments are chromophoric substances that are incorporated into different materials. Pigments are normally classified as inorganic and organic. The former category includes natural inorganic pigments such as ochre and synthetic inorganic pigments such as white pigments or iron oxide. The largest group of organic pigments are synthetic organic pigments such as AZO pigments.

FOOD

APPLICATION EXAMPLE SOY PROTEIN CONCENTRATE

- 200 ZPS; 321 kg/h
- 200 ZPS; 297 kg/h
- 200 ZPS; 253 kg/h
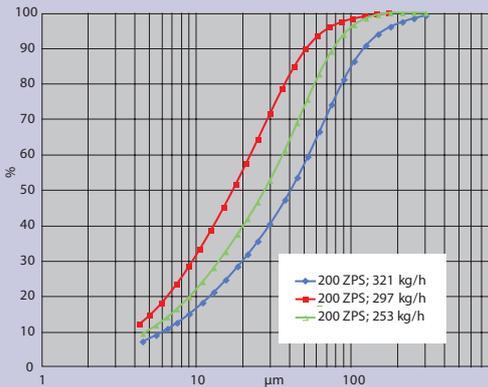
IMPORTANT FEATURES

- Excellent precision of cut, easy to adjust
- Steep particle size distribution
- Stable classifying characteristics: once set, the fineness remains constant
- Pressure-shock resistant design
- Wear protection concept available

1 Zirkoplex ZPS classifier mill

A Feeding
B Final product

- *Line example with Zirkoplex ZPS – for soy processing*

PROCESSING TECHNIQUES OF THE FOOD INDUSTRY

Soy is one of the most important oil-bearing plants in the world. Its steadily growing importance is reflected by corresponding developments in the food and feedstock industry. It is used in the following areas of application:

- Food
- Part of a vegetarian and vegan diet
- Milk substitute, e.g. milk for calves
- Feed supplement for poultry, cattle, pigs
- Cosmetics and bodycare products

The ZPS classifier mill has been tried and tested for soy processing for many years. Processing includes the removal of the hulls of the full-fat soybeans using hammer mills and air classifiers, ultrafine milling and packaging. If required, protective filtering will take place prior to packaging.

After the valuable soy protein is extracted (SPC – soy protein concentrate) and dried, it is processed on a ZPS, which yields the standard end product fineness levels of 99.5 % > 75 µm and 99.5% > 200 µm. Other fineness levels can also be delivered. As soy and soy proteins are organic substances, processing is subject to explosion protection.
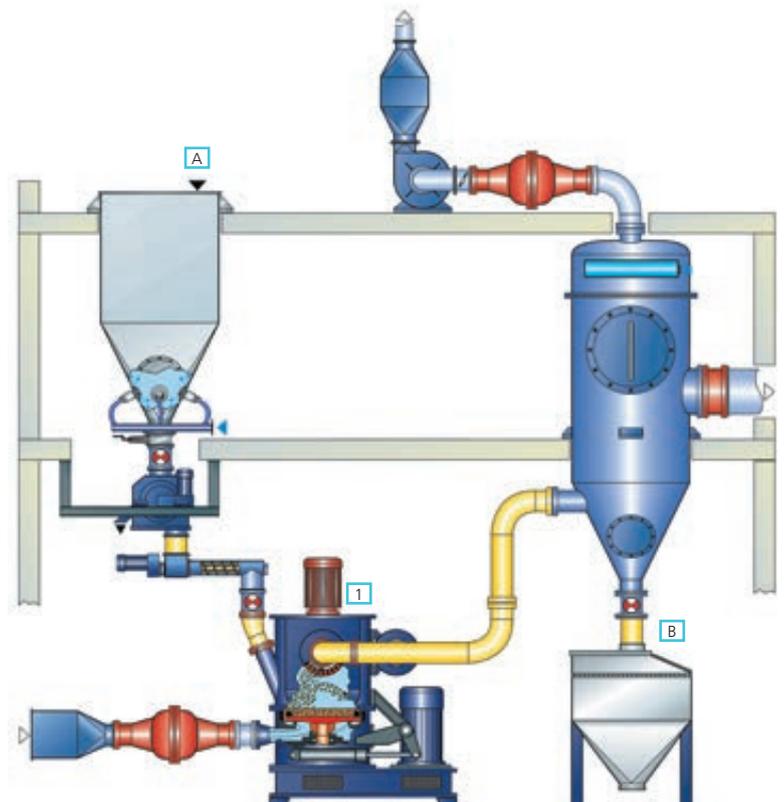
The flow chart shows a setup with pressure relief for the mill and the filter and explosion protection valves on the clean air side.

PRACTICAL EXAMPLES

Product	End-product fineness *	Throughput kg/h ZPS 200
Algae	98 % < 73 µm	106
Colour malt	99 % < 100 µm	130 - 400
Aquatic feed	95 % < 315 µm	420
Gelatine	90 % < 150 µm	108
Guar splits	99 % < 100 µm	45
Oat kernels	97 % < 315 µm	272
Oat hulls	95 % < 150 µm	40
Lactose	95 % < 400 µm	600
Lupines (white), legumes	99 % < 79 µm	140
Corn / soy flour, extruded	99 % < 200 µm 99 % < 400 µm	200 200
Palm fibre	97 % < 250 µm	20
Broken rice	99 % < 200 µm	400
Rice flour	99 % < 75 µm	120
Soy, full-fat	99.5 % < 200 µm	150
SPC	99.5 % < 75 µm	400
Wheat germs	97 % < 250 µm	150
Wheat bran	99 % < 200 µm	84

* Powder fineness in % > µm – measuring points of particle size distribution.
   All values are non-binding reference values only.

THICKENING AGENTS

Thickening agents are swelling agents, which absorb liquid, then swell up, producing a viscous or colloid solution. They are used in many industrial, cosmetic and pharmaceutical or dietary applications such as tomato sauce, deserts, jam, weight-loss products and many more.

PROTEIN SHIFTING PROCESS

Mechanical processing of raw materials such as peas, beans and lupines involve a protein shifting process. The main principle of this process is the comminution of the raw material by means of fine grinding and external air classifying for the purpose of producing a protein-rich fine fraction.

> ❯ 750 ZPS in stainless steel for food applications and in standard steel for feed applications

APPLICATION EXAMPLE TALC
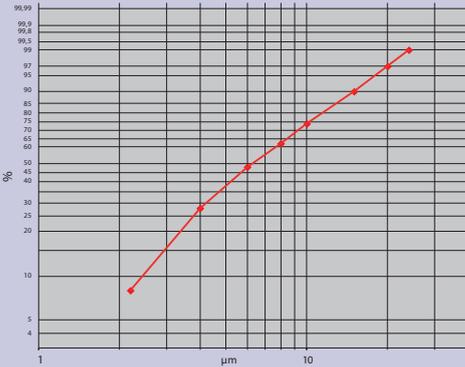
IMPORTANT FEATURES

› Wear protection for different machine components
› Steep particle size distribution
› Stable classifying characteristics: once set, the classifying fineness remains constant
› Optional: periodic rejection of hard to grind ingredients

MINERAL APPLICATION TALC

Talcum is a special material of the filler segment. It is distinguished by the following properties:

› Flaky, laminar structure
› Low hardness (1 Mohs)
› Water insoluble
› High whiteness level
› Chemical resistance

Talcum processing - important facts:

› High abrasiveness of the soft talc contaminants (quartz, dolomite, etc.)
› Retention of the flaky structure

The ZPS classifier mill is the perfect system for talcum powder processing that meets all requirements. It is a multi-purpose system for fine grinding with integrated classifier for processing soft materials and producing spatter-free end products with a steep particle distribution and precise top cut with a low energy consumption. Wear protection measures will protect the system from abrasive ingredients of the feed material. Wear protection is available for the following components:

› Classifier wheel
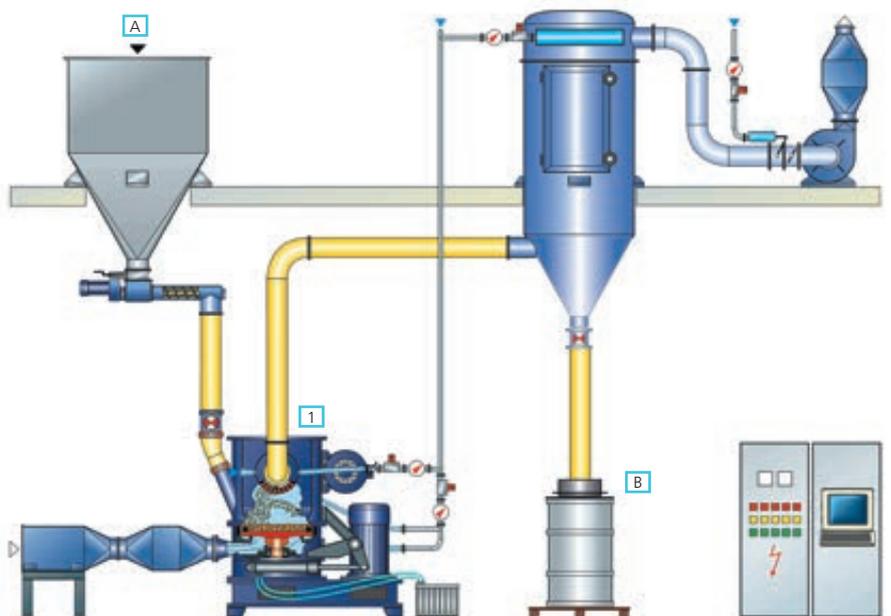› Fines discharge
› Grinding track
› Impact disks

A special ZPS design is also available for periodically rejecting abrasive ingredients deposited in the machine.

1 Zirkoplex ZPS classifier mill

A Feeding
B Final product

› Line example with Zirkoplex ZPS – for talc processing

PRACTICAL EXAMPLES

Product	End-product fineness *	Throughput t/h ZPS 630
Aluminium hydroxide	90 % < 32 µm	2.1
Lignite	97 % < 90 µm	1.2
Calcium carbonate	97 % < 25 µm 97 % < 32 µm	1.7 2.2
Diatomite	97 % < 75 µm	2.8
Graphite	50 % < 25 µm	1.3
Kaolin	99 % < 18 µm	3.2
Silica	99 % < 10 µm	1.1
Natural gypsum	99.99 % < 100 µm	4.3
Perlite	99 % < 80 µm	1.2
REA gypsum	99.9 % < 90 µm	3.8
Talc	97 % < 20 µm	1.4
Wollastonite	97 % < 80 µm	0.6

*   Powder fineness in % > µm – measuring points of particle size distribution.
    All values are non-binding reference values only.

› *1000 ZPS in standard steel for*

  applications in the mineral industry

WOLLASTONITE

Wollastonite is a mineral that belongs to the family of the silicates and germanates and occurs in several modifications of the same chemical formula, but with different crystal structures ranging from fibrous to spicular. Wollastonite is used in ceramic products, asbestos fibres, insulating materials or as a functional filling material by the plastics industry.

GRAPHITE

Graphite is a grey-black mineral with a high electrical conductivity. Graphite with the suitable purity is used for lithium-ion batteries for electric mobility applications. It is also used for the production of lead pencils, casting moulds, oven linings and as an electrode material, lubricant, lightweight construction material for carbon fibres and many more.

ZIRKOPLEX ZPS SIZES

The ZPS is available in 10 sizes with drive capacities between 4 and 315 kW. Perfectly matched, the grinding chamber, grinding elements as well as the air intake, classifier and grinding disk speed allow easy comparison of all systems in one range. The grinding results of one mill size can be applied to all others.

Size	ZPS	100	140	200	315	400	200/4	500	630	750	1000
Scale-up factor	F approx	0.33	0.5	1	2	3	4.2	4.2	6.5	9	13
Mill drive (max.)	kW	4	11	15	37	55	90	90	132	200	355
Mill speed (max.)	1/min	11,200	8,400	5,600	3,350	2,800	2,250	2,250	1,800	1,460	1,120
Beater unit Ø	mm	200	280	400	630	800	1,000	1,000	1,250	1,530	2,000

Size	ATP	100	140	200	315	400	200/4	500	630	750	1000
Classifier drive (max.)	kW	3	4	7.5	11	15	4x7.5	22	30	37	45
Classifier speed (max.)	1/min	11,200	8,500	6,000	4,000	3,000	6,000	2,250	2,000	1,600	1,200
Fineness level	$d_{97}=\mu m$	8 – 100	8 – 100	8 – 120	8 – 120	8 – 120	8 – 120	8 – 120	10 – 180	10 – 200	15 – 200
Airflow rate	m³/h	300	600	1,200	3,000	4,800	4,800	7,500	12,000	18,000	30,000

PHARMACEUTICALS

HOSOKAWA MICRON

MACHINE SIZES

ZPS classifier mill	ø Grinding disk (mm) Drive (kW)	ø Classifier (mm) Drive (kW)	Airflow rate (m³/h)	Scale-up factor
20	40/0.2	20/0.2	12	--
50	100/1.1	50/1.1	80	0.06
70	150/2.5	100/1.5	150	0.15
100	200/3	100/1.5	300	0.33
140	280/7.5	140/2.2	600	0.5
200	400/11	200/4	1,200	1

IMPORTANT FEATURES

> Large grinding chamber for depositing,
   adhesive products
> CIP/SIP Design
> Modular line component for multi-process lines
> Can be integrated into isolator systems

SYSTEMS FOR THE PHARMACEUTICAL INDUSTRY

Used for pharmaceutical applications, Zirkoplex ZPS classifier mills are distinguished by their steep particle size distribution and cost-efficiency. With their horizontal classifier wheel, ZPS mills deliver a perfectly sharp top cut even for challenging products that are prone to depositing.

The ZPS classifier head is identical to that integrated into Alpine's ATP classifiers. This way, the ZPS can also be used on multi-process lines. These systems deliver fineness levels of between 20 μm and 150 μm and can also be used for the following applications: ultrafine classifying, fine impact milling, opposed-jet milling and spiral jet milling. Mobile, very versatile and cost-efficient, multi-process lines combine several mill types, which share the same ancillary equipment and can be exchanged quickly. The gas purged bearing design of the ZPS classifier and mill shaft is well established and also available for CIP/SIP applications.

ZPS classifier mills of sizes between 20 ZPS (pico*line*) up to 200 ZPS are used for the pharmaceutical segment for processing very small batches of HAPIs as well as huge quantities of basic pharmaceuticals with an hourly capacity up to several hundred kilos. ZPS mills can be integrated into Hosokawa Alpine isolators.

> 200 ZPS in pharmaceutical
   design for integration into
   cleanroom wall

HOSOKAWA ALPINE Aktiengesellschaft

P. O. Box 10 11 51

86001 Augsburg

GERMANY

Address for visitors and deliveries:

Peter-Doerfler-Straße 13 – 25

86199 Augsburg

GERMANY

Tel: + 49 821 / 59 06-0

Fax: + 49 821 / 59 06-101

E-mail: mail@alpine.hosokawa.com

www.hosokawa-alpine.com

HOSOKAWA ALPINE Aktiengesellschaft

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