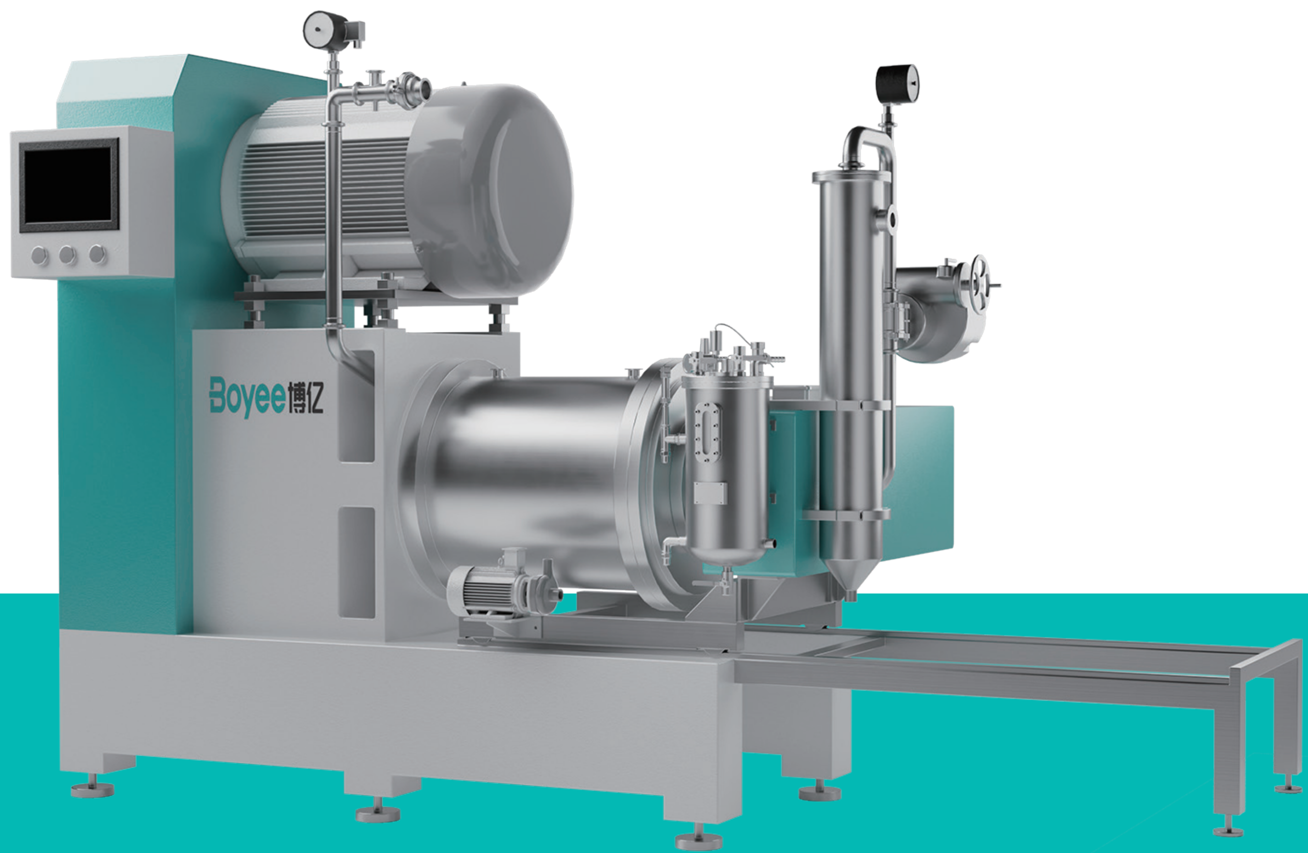
Stabler Equipment, Purer & Finer Outputs

LMM Ultrafine Centrifugal Nano Bead Mill

Ultra-fine grinding with clog-free efficiency, compatible with zirconia beads as small as 0.05mm.



Equipment Introduction

The LMM bead mill innovation lies in its unique filterless separation system design. It abandons traditional filter methods, achieving precise separation of material and grinding media through dynamic centrifugal technology. This innovation not only enhances discharge stability and uniformity but also fundamentally eliminates the risk of screen clogging.

Equipment Features

- Ultra-fine Grinding with Uniform Dispersion
- Achieves Efficient Nano-scale Pulverization without clogging
- Independent Operation of Material Grinding and Separation
- Innovative Dynamic Centrifugal Separation Technology
- Specifically Designed for Low-Viscosity Materials
- Grinding Media as Small as 0.05mm Can Be Used

Working Principle

01 Feeding and Grinding System

The LMM Ultra-Fine Centrifugal Nano Grinding Mill employs an innovative grinding system. Materials enter the grinding chamber and are rapidly and uniformly ground into ultra-fine particles under the impact and shear forces of high-speed rotating grinding media. This grinding method not only ensures the material's ultra-fine particle size but also achieves uniform dispersion.

02 Ultra-fine Grinding Media

The LMM sand mill is particularly well-suited for processing low-viscosity products. With grinding media as small as 0.05mm, it can handle materials requiring extremely fine particle sizes, such as nanoscale materials.

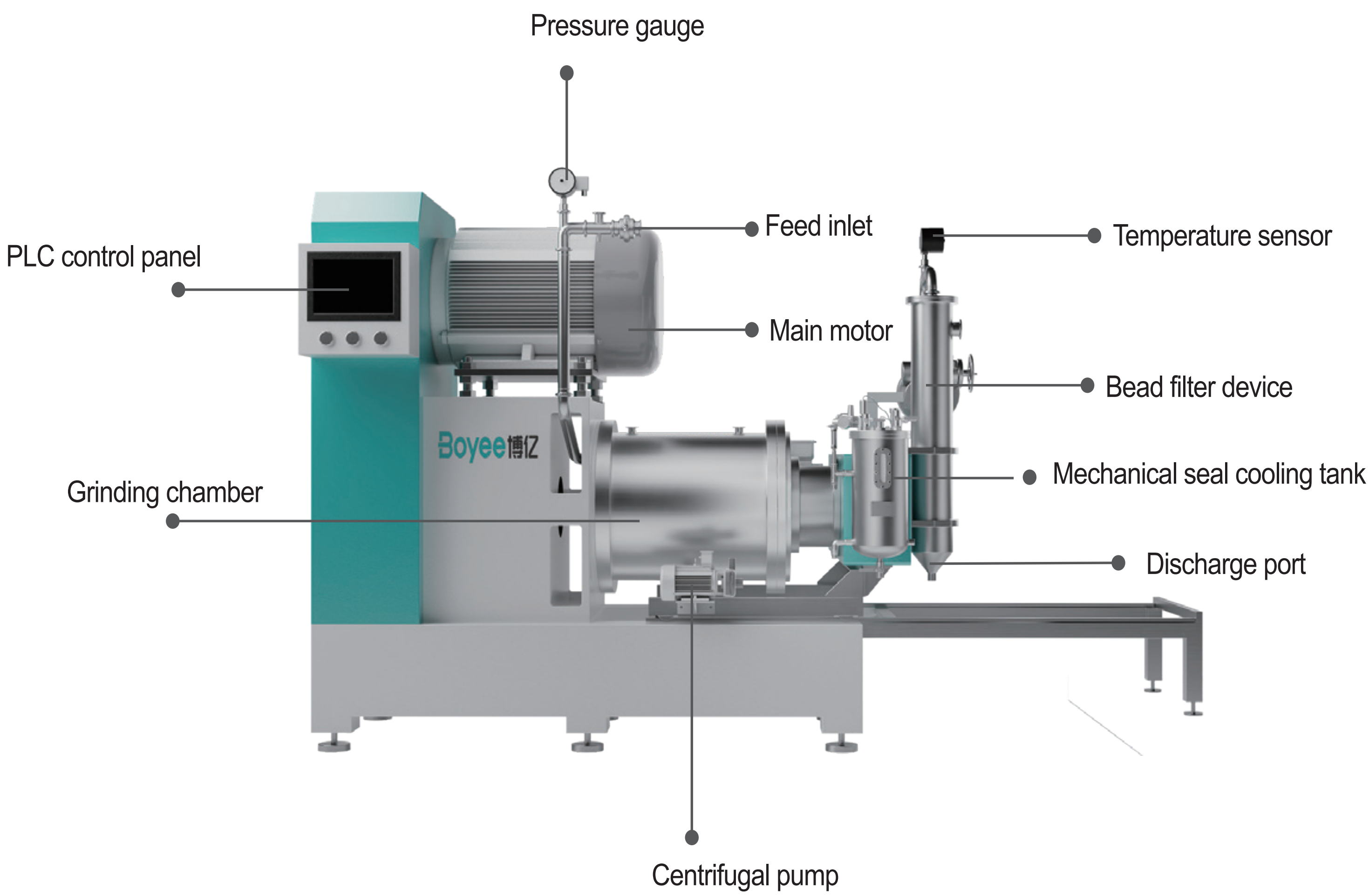
03 Cyclic and Cryogenic Grinding

The equipment features a unique cooling circulation system that effectively manages heat generated during the grinding process, thereby maintaining the material at a low temperature. Low-temperature grinding not only helps preserve the stability of material properties but also reduces equipment wear and enhances production efficiency.

04 Discharge

When the material reaches the desired grinding fineness, it is propelled by centrifugal force toward the periphery of the grinding chamber and smoothly discharged through a specially designed outlet. This design effectively prevents material blockage during the grinding process, ensuring continuous operation and efficient production of the equipment.

Overall Structure



The minimum pulp volume required for circulation must be twice the cylinder volume of the equipment, with a maximum of 15 to 20 times the cylinder volume.

Parts Introduction

Pressure Sensor: Pressure sensors may be used to monitor internal equipment pressure or hydraulic system pressure, ensuring proper equipment operation and providing necessary safety protection.

PLC Control Panel: Serves as the equipment's control center, responsible for receiving and processing various input signals while controlling equipment operation according to preset programs. In sand mills, the PLC control panel is used to set and adjust grinding parameters, monitor equipment status, and handle malfunctions.

Feed Inlet: The channel through which materials enter the grinding chamber. In sand mills, the inlet design must ensure smooth and uniform material flow into the grinding chamber, preventing grinding efficiency issues caused by blockages or uneven distribution.

Main Motor: The power source of the sand mill, responsible for driving the grinding media and material within the chamber to achieve high-speed rotation and collision, thereby performing the grinding action. The performance and stability of the main motor significantly impact the grinding efficiency and operational reliability of the sand mill.

Temperature Sensor: Monitors the operating temperature of the equipment or the material temperature to ensure the equipment operates within safe temperature limits and prevent material degradation due to excessive heat.

Discharge Port: The passage through which material exits the grinding chamber. In sand mills, the discharge port design must ensure smooth material discharge and prevent residue buildup that could compromise the grinding effectiveness of subsequent batches.

Grinding Chamber: The core component of the sand mill, housing the grinding media, material, and rotor assembly. During operation, the grinding media and rotor structure interact with the material within the chamber. Through high-speed rotation and collision, they perform the grinding action, achieving material refinement and homogenization.

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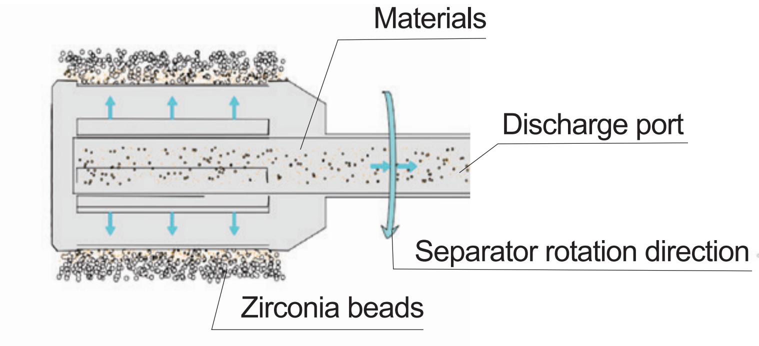
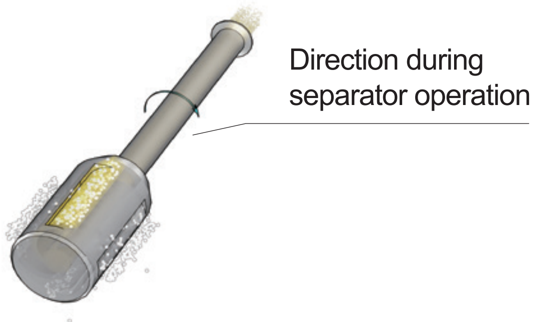
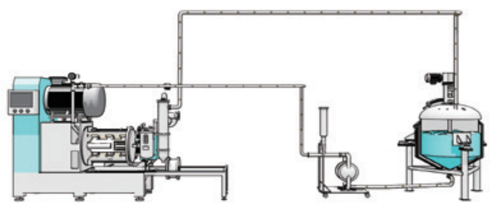
Dynamic Centrifugal Force Precisely Separates Zirconia Beads from the Material

The centrifugal separator utilizes rotor centrifugal force to achieve efficient bead separation, suitable for high-speed, high-flow circulation and applications with fine-particle media. It can process beads as small as 0.05mm. By employing a non-porous wheel for centrifugal separation, it separates refined materials and heavier-density beads without clogging coarse particles.

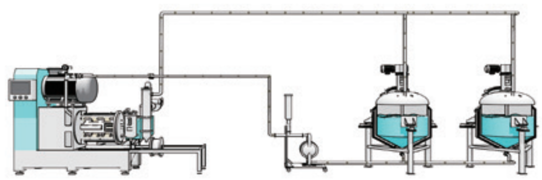




Single Tank Circulation



Dual Tank Circulation



Single-vessel grinding involves creating a closed-loop system between the sand mill and a single vessel, where material undergoes continuous grinding. Dual-vessel grinding, however, establishes a circulation system between the sand mill and two vessels, enabling processes such as alternating grinding or classification between different vessels.

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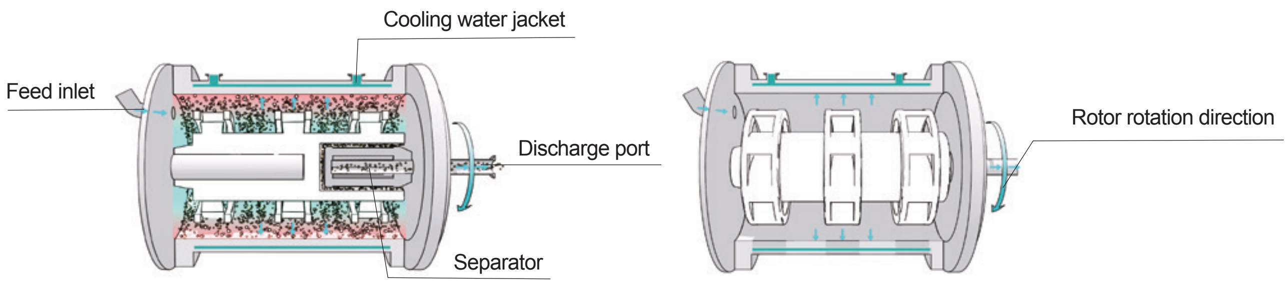
Advantages of Rotor Structure Design

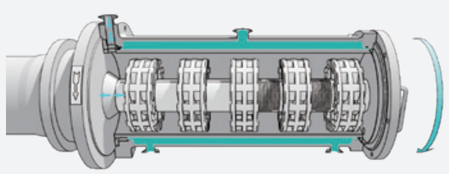


Achieve nano-level efficient pulverization without clogging

Nano-level high-efficiency pulverization technology enhances operational frequency through high-density packing of grinding media. Combined with the synergistic action of patented centrifugal separators and centrifugal pumps, it forces continuous media circulation to achieve efficient dispersion while preventing over-pulverization.

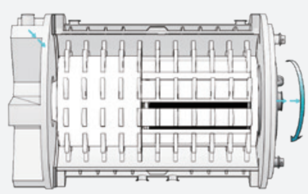
Principles of Rotor Structure

Turbo Rotor



The higher-standard turbine rotation generates a vortex within the chamber, propelling the grinding media into rotational motion. This continuous shear and dispersion of larger particles within the material is enhanced by the media's extensive range of motion and diverse movement patterns, resulting in higher capture rates for ground particles. The engineered turbine accelerator, combined with more wear-resistant materials, better meets stringent product requirements. This design delivers high efficiency, low energy consumption, and minimized pollution.

Pin Rotor



The rotating pin shaft drives the grinding media into motion. The grinding media continuously collide with each other, undergoing repeated opening and closing movements, thereby crushing large particles of the material being ground. However, the grinding media exhibit a limited range of motion, resulting in restricted capture efficiency for the grinding particles.

Advantages and Disadvantages of Turbine and Pin-Type Structures

Advantages and Disadvantages of Turbine Rotors

Advantages

Particle size distribution is concentrated. Due to more thorough grinding between larger grinding media, the ground material exhibits a more uniform particle size distribution without structural damage. The centrifugal and shear forces generated by the turbine are distributed more evenly and gently, better ensuring material structure integrity and minimizing wear. The turbine primarily relies on centrifugal force to impart kinetic energy, thereby reducing bead breakage rates and minimizing grinding media loss. Low heat generation. The turbine rotor does not rely on collision or compression for grinding, resulting in relatively less physical friction and lower heat generation. Suitable for high viscosity: The turbine rotor also delivers superior grinding performance for high-viscosity materials.

Disadvantages

High cost: The turbine features a complex, integrated structure, resulting in high maintenance costs and complicated cleaning procedures. Its intricate design also makes routine maintenance relatively more cumbersome.

Advantages and Disadvantages of Pin Rotors

Advantages

Suitable for low-viscosity materials, pin-type rotors deliver superior grinding performance through greater impact force. Easy to operate, pin-type rotors feature a relatively simple structure and straightforward handling. This makes them particularly advantageous in applications requiring rapid rotor replacement or maintenance. Cost-effective, pin-type rotors offer a simpler structure and lower cost compared to turbine-type rotors.

Disadvantages

The particle size distribution is broader. Since pin mills primarily rely on the impact force of pins to grind materials, the contact area between grinding media and materials is smaller, leading to uneven grinding and an irregular particle size distribution. This results in high energy consumption, as pins require greater kinetic energy to achieve the target particle size, causing overall energy consumption to be elevated. When the pins of the pin-type rotor strike the material, the immense impact force may cause structural damage and excessive wear to the material. Similarly, when the pins strike the grinding media, they may fracture and damage the media, resulting in higher overall media loss and a higher rate of bead breakage. The pins require greater kinetic energy to impact both the material and the media. The high friction generates significant heat, necessitating a more robust cooling system.

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Comparison of Turbine and Pin-Type Features

Type	Turbine	Pin
Grinding impact force	Moderate	larger
Energy consumption	Low	High
Water consumption (chiller energy consumption)	Low	High
Grinder wear	Low wear (long service life)	High wear (short service life)
Zirconium ball wear	Minimal crumbling, low abrasion	High crumbling rate, high wear
Cavity pressure	Large	minor
Grinding efficiency	Low	High
Particle size distribution	Centralized	Broad
Material structure damage	Minor damage	Significant damage
Heat output	Low	High
Use viscosity	High viscosity	Low viscosity
Rotor structure	Simple, few components	Complex with numerous components
Grinding temperature	Low temperature (gentle grinding)	High temperature (gentle grinding)
Probability of material blockage	High flow rate, resistant to clogging	Broken beads clog nets easily
Particle size / Morphology	Particle size distribution extremely narrow / Shape smooth	Narrow particle size distribution / Sharp edges and corners
Dispersion uniformity	Excellent	Good
Price	High	Low

Turbine rotors and pin rotors function differently during the grinding process. Turbine rotors primarily achieve grinding effects through centrifugal and shear forces, making them suitable for high-speed grinding and dispersion of materials. Pin rotors, on the other hand, mix materials with grinding media through rotational and oscillating motions. The specific choice of rotor structure depends on the grinding mill's application requirements and material characteristics.

The rotor structure material is selected based on the characteristics of the material being processed

Rotor material (Zirconia, Silicon Nitride, Polyurethane, Alumina, Hard Alloy, PU + Tungsten Carbide Alloy)

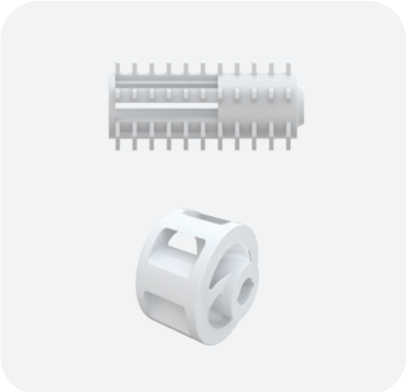
Zirconium Oxide, Aluminum Oxide

Function: Primarily used for grinding and dispersing tasks requiring wear resistance and corrosion resistance.

Advantages: High hardness, excellent wear resistance, strong chemical stability, suitable for grinding and dispersing high-viscosity, high-solids-content materials.

Material Characteristics: Features high hardness, high wear resistance, and good chemical stability, maintaining stable performance under harsh conditions such as high temperatures, strong acids, and strong alkalis.

Suitable Applications: Battery materials, MLCC, inks, pharmaceutical raw materials, food additives, etc.



Zirconia material

Silicon Nitride, Silicon Carbide Materials

Function: The grinding cylinder and rotor structure can withstand high temperatures, high pressures, and highly corrosive environments, making it suitable for grinding processes requiring exceptional wear resistance and corrosion resistance.

Advantages: High hardness, high strength, and excellent wear resistance ensure long-term precision grinding performance. It also exhibits superior thermal shock resistance and chemical stability.

Material Characteristics: Outstanding mechanical properties and thermal stability. Its low density and excellent self-lubricating properties help reduce friction and wear during grinding.

Suitable Applications: Semiconductor ceramics, chemical materials, etc.

Silicon nitride, silicon carbide materials

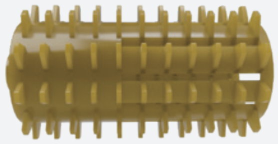
Polyurethane (PU)

Function: Primarily used for low-speed, low-load grinding and dispersion tasks, especially involving soft materials.

Advantages: Excellent wear resistance, good elasticity, and strong impact resistance. Suitable for grinding and dispersing soft materials without causing damage.

Material Characteristics: Superior elasticity, wear resistance, oil resistance, and tear resistance, coupled with chemical corrosion resistance. Ideal for low-speed, low-load grinding and dispersion processes.

Suitable Applications: Battery materials, ceramic materials, chemical materials, inks, coatings, etc.



Polyurethane material

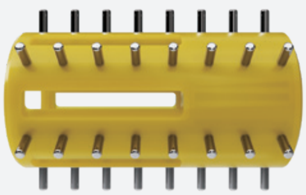
PU + Tungsten Carbide (Alloy)

Function: Used for grinding high-hardness, high-wear-resistance materials.

Advantages: Extremely high hardness, excellent wear resistance, strong corrosion resistance, suitable for grinding high-hardness materials.

Material Characteristics: High hardness, high strength, and good wear resistance; maintains stable performance during high-load, high-speed grinding processes; offers extended service life and grinding efficiency.

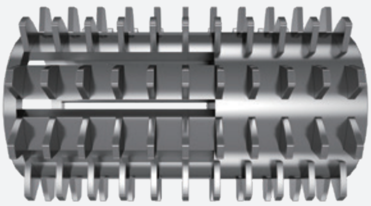
Suitable Applications: High-hardness materials.



PU + tungsten carbide (alloy) material

Hard Alloy

Suitable for machining high-hardness, high-toughness materials, featuring high hardness, wear resistance, heat resistance, and corrosion resistance.



Grinding Cylinder Structure

Raised Liner Cylinder

The inner wall of the protruding liner cylinder features regular or irregular protrusions. During rotation, these protrusions cause the material to undergo multi-angle collisions, compression, and shearing with the grinding media, thereby enhancing grinding force. Simultaneously, the protrusions disrupt the material flow pattern, promoting mixing and dispersion while eliminating grinding dead zones.

Smooth Inner Liner Cylinder

The smooth inner liner cylinder features a sleek inner wall design. Leveraging centrifugal force and gravity during cylinder rotation, it ensures stable rolling and sliding of materials and grinding media. Its low-friction, residue-free properties facilitate easy cleaning while reducing operational resistance and saving energy consumption.

Grinding Cylinder Material

Zirconia Cylinder

High wear resistance, zero pollution, low energy consumption

Silicon Nitride Cylinder

Wear resistance, corrosion resistance, thermal shock resistance, high hardness and strength

Silicon Carbide Cylinder

High hardness, wear resistance, and rapid heat dissipation

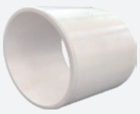
Polyurethane Cylinder

Abrasion resistance, excellent elasticity, and strong tear resistance

Wear-resistant Alloy

High wear resistance, high strength, excellent corrosion resistance and high-temperature resistance, as well as outstanding impact resistance

Zirconia Cylinder



Silicon Carbide Cylinder

Silicon Nitride Barrel

Wear-resistant Alloy

Grinding Media (Zirconia Beads)

The size of grinding media should be selected based on the material and grinding requirements, with smaller diameters typically yielding better results. In high-speed sand mills, spherical or near-spherical media are most suitable as they effectively leverage the mill's impact and shear forces. Additionally, high-density media can enhance both these forces, thereby improving grinding efficiency.

Zirconia Bead Size Range(mm)

0.03-0.05	0.8-1.0
0.05-0.1	1.0-1.2
0.1-0.15	1.2-1.4
0.15-0.2	1.4-1.6
0.2-0.25	1.6-1.8
0.25-0.3	1.8-2.0
0.3-0.4	2.0-2.2
0.4-0.5	2.2-2.4
0.6-0.7	2.4-2.6
0.7-0.8	2.8-3.0

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Density of Zirconia Beads

The higher the specific gravity of zirconia grinding beads, the greater the impact force and grinding efficiency, but the greater the wear on the grinding mill's contact parts. Therefore, matching the slurry viscosity with the flow rate is crucial: low-density grinding beads are suitable for low-viscosity slurries, while high-density grinding beads are more suitable for high-viscosity slurries.

Hardness of Zirconia Grinding Beads

The greater the hardness of the grinding beads, the lower the theoretical wear rate, but this increases abrasion on the contact components. However, optimization can be achieved by adjusting parameters such as filler content, slurry viscosity, and flow rate.

Spherical Degree of Grinding Media

The higher the rotational angular velocity ω of spherical grinding media, the greater the additional energy. However, uneven spheres hinder rotation, reducing additional energy and adversely affecting grinding efficiency. Regarding uniformity: - From a kinetic perspective, consistent diameters result in equal momentum, where larger spheres impacting smaller ones reduces grinding efficiency. - From a geometric perspective, mixing media of different diameters fills voids, increases contact points, and thereby enhances grinding efficiency.

Selection Guidelines for Different Sizes of Grinding Media in Sand Mills

Grinding ball size mm	Final particle size um	Initial particle size um	Slurry viscosity cps	Solid content %（wt）	Linear velocity m/sec	Filter gap mm
0.05	<0.05	<5	<1000	<25	≤15	0.02
0.1	<0.08	<10	<1000	<25	≤15	0.05
0.2	<0.1	<20	<2000	<30	≤15	0.1
0.3-0.4	<0.1	<20	<10000	<35	≤15	0.15-0.1
0.4-0.6	<1	<40	<10000	<60	≤12	0.22-0.2
0.7-0.9	<2	<80	<20000	<70	≤12	0.3-0.35
0.9- 1.1	<10	<150	<20000	<70	≤8	0.5
1.75-2.5	<20	<150	<20000	<70	≤8	0.6

Note: The above data is for reference only. Actual figures may vary depending on specific processes. For further details, please contact us.

Double-Ended Mechanical Seal with Cooling Circuit (Boyee Exclusive Patent)

The double-ended design represents a significant technological innovation in Boyi mechanical seals. Compared to single-ended mechanical seals, it excels in ensuring the flatness of the mating surfaces between the rotating and stationary rings.

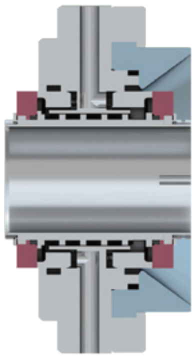
Core Advantages of Mechanical Seals

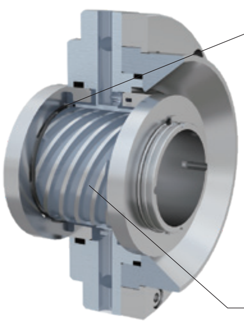
Prevent material leakage

Under eccentric shaft operation, the double-ended design achieves precise positioning through fixed static rings on both sides, effectively limiting displacement of the mechanical seal spiral sleeve and thereby enhancing leak prevention capabilities.

Elastic components form a "zero-gap" sealing barrier

The mechanical seal spring preloads the static and dynamic ring end faces. Under the combined action of medium pressure and spring force, the sealing pair is further compressed, achieving a tight axial seal.





PTFE Spiral Water Jacket:

The "Smart Temperature Control Assistant" for Mechanical Seals

The PTFE spiral water jacket of Boyi Mechanical Seals features an ingenious design. Without a pump, water flows naturally for preliminary cooling; with a pump, accelerated water flow enhances cooling efficiency. The spiral structure ensures uniform cooling across the sealing area, maintaining optimal temperatures for mechanical seals. This extends service life and supports efficient equipment operation.

Introduction of PLC Control System

The BYZr sand mill is equipped with a comprehensive and advanced control system supporting manual, semi-automatic, or fully automatic operation modes to meet diverse user requirements. This system not only provides convenient mill status monitoring and an intuitive interface but, more importantly, comprehensively monitors and records all critical parameters related to the grinding process, ensuring production transparency and traceability.

The core of this control system lies in its PLC control module. This standardized component is not only highly functional but also exceptionally scalable, allowing for easy addition or optimization of features based on specific customer requirements. Furthermore, the module incorporates built-in automatic protection functions that respond promptly to abnormal conditions, effectively safeguarding the safe and stable operation of the grinding machine.

1) Process control achieved through product temperature or input power
2) Automation modules suitable for both batch and continuous operations
3) Data exchange via modems
4) Connectivity to computers or other optional control systems is included in our scope of supply

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Applications

Nano New Materials	Semiconductors	Pharmaceuticals
Silicon Carbon Anodes	Lithium Iron Phosphate	Biological Products
Conductive Slurries	Inkjet Ink	Electronic Ceramics
Lithium Iron Phosphate	Ceramic Ink	Cosmetics
Solid-State Electrolytes	Ink and Coatings	Food/Chemicals

Specifications

Model	Chamber Volume (L)	Drive Power (KW)	Bead Diameter (mm)	Batch Capacity (L)	Feed Rate (L/min)	Weight (KG)	Dimensions (m)
LMM-3L	3	7.5/7.5	0.1-1	7.4-35	6-42	800	1427x960x1711
LMM-10L	10	18.5/7.5	0.05-1	24-100	6-42	1500	2223x1367x1870
LMM-30L	30	45/7.5	0.05-1	62-300	6-42	2300	2924x1287x1850
LMM-60L	60	75/11	0.05-1	116-500	25-50	2800	3280x1368x2240
LMM-90L	90	75-90/11	0.1-1	173-1000	41-65	3300	3300x1730x2140
LMM-150L	150	160/15	0.1-1	300-3000	66-100	5800	4500x1700x2400
LMM-400L	400	315-355	0.1-1	732-10000	100-300	10000	4600x1600x2400

Other Parameters

Mode	Rotational speed (r/min)	Discharge particle size (μm)	Coolant consumption (㎡/s)	Ice water machine (P)	Zirconia sphere filling rate	Zirconia ball filling weight(KG)	Rotor diameter (mm)	Number of rotor groups	Standard diaphragm pump	Separation method	Energy consumption (kwh)
LMM-3L	1450/1500-2916	0.1-1	2-3	5-8	70%-80%	5-8.2	210	1	1 inch	Centrifugal Separation	18.675-20.88
LMM-10L	1460/1200-1920	0.05-1	3-5	8-10	70%-80%	31-35.5	200	3	1 inch	Centrifugal Separation	31.88-33.35
LMM-30L	1316/1200-1946	0.05-1	5-7	10-15	70%-80%	80-91	280	3	1 inch	Centrifugal Separation	59.85-63.525
LMM-60L	825、990/1200-2051	0.05-1	10-13	20-25	70%-80%	150-171	340	3	1 inch/1.5 inch	Centrifugal Separation	100.7-104.375
LMM-90L	776、825/1200-1731	0.1-1	12-15	30-35	70%-80%	224-256	360	3	1.5 inch	Centrifugal Separation	111.725-130.4
LMM-150L	630/1000-1470	0.1-1	15-25	50	70%-80%	388-444	460	4	2 inch	Centrifugal Separation	211.75
LMM-400L	445/1000-1470	0.1-1	35-65	80-120	70%-80%	947-1083	720	Rod pin set 1	2 inch/3 inch	Centrifugal Separation	373.8-443.2