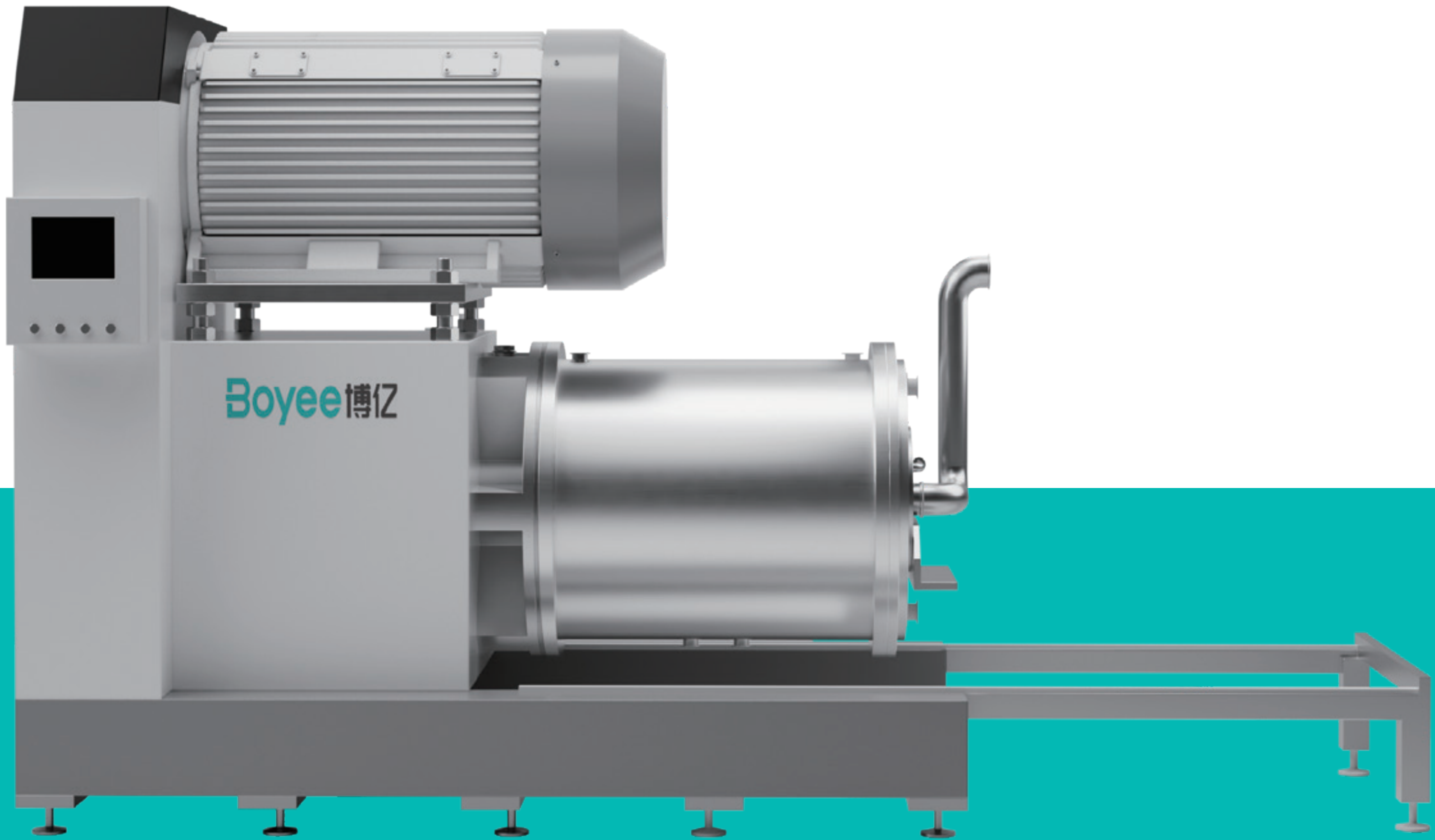
Stabler Equipment, Purer & Finer Outputs

NMM High-Flow Screen-Type Nano Bead Mill

High-flow recirculation grinding process resolves traditional clogging issues, delivering high-throughput and precision particle reduction.



Equipment Introduction

The Boyi large-flow rapid-screen nano sand mill features a rapid-screen design for fast transmission and an optional grinding system—either the patented TurboMax turbine type or the pin-type. It is specifically designed for processing high-viscosity, high-concentration materials, completely overcoming the limitations of traditional materials. It not only offers high flow rates and outstanding efficiency but also extremely low energy consumption.

Equipment Features

- Turbine accelerator enables high-energy uniform grinding motion
- Cooling circuit design with spiral guidance
- Special discharge separation system
- Fully ceramic grinding chamber structure, free from metal contamination
- Double-ended mechanical seal with cooling circuit
- Large-flow circulation design
- Variable frequency speed control
- Basic type and explosion-proof type available

Working Principle Introduction

01 Feeding & Grinding System Selection

Traditional slurry is pumped into the grinding zone of the NMM series sand mill. Users can choose to equip it with either the patented TurboMax turbine-type or the pin-type grinding system. Using high-speed rotating grinding media, t he material is subjected to temperature-controlled adjustment, impact, and shearing to achieve refined grinding.

02 Post-Grinding Filtration

The ground material is washed and filtered through a screen, effectively separating the grinding media from insufficiently ground particles, ensuring the discharged product has a uniform and fine particle size.

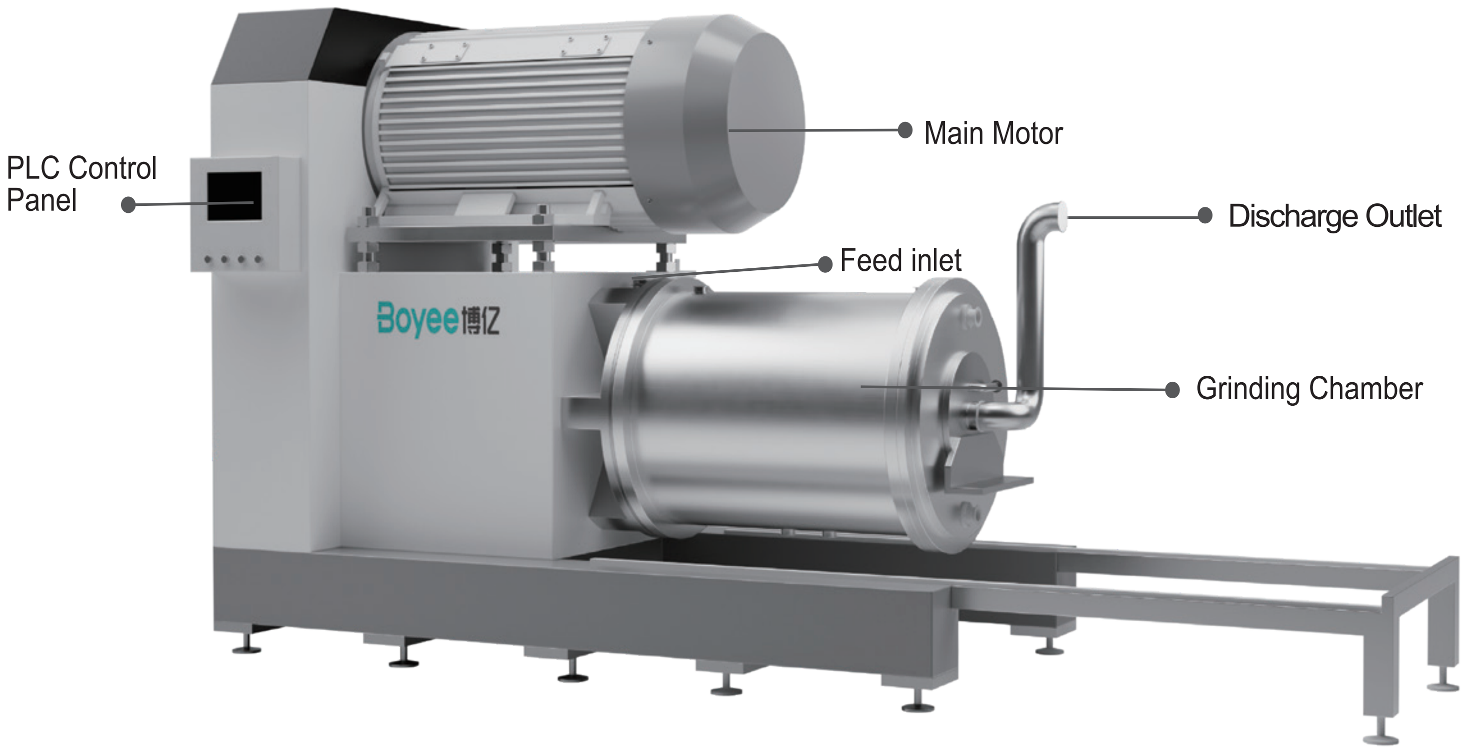
03 Circulation Grinding

Material that does not pass through the screen is circulated back to the original slurry for continued grinding until the desired particle size distribution is achieved.

04 Discharge

After screen filtration and circulation grinding, material meeting the particle size requirements is discharged through the outlet, completing the entire grinding process.

Overall Structure of Large-Flow Screen-Type Nano Bead Mill



The material circulation volume should be at least 2 times, and at most 15-20 times, the equipment's chamber volume.

Introduction to Components of the Large-flow Screen-type Nano Bead Mill

Pressure Sensor: The pressure sensor is likely used to monitor the internal pressure of the equipment or the hydraulic system pressure, ensuring normal equipment operation and providing necessary safety protection.

PLC Control Panel: This serves as the control center of the equipment, responsible for receiving and processing various input signals and controlling the equipment's operation based on preset programs. In the sand mill, the PLC control panel is used to set and adjust grinding parameters, monitor equipment status, and handle faults.

Air Source Processor (FRL Unit - Filter, Regulator, Lubricator): In the sand mill, the air source processor is used to provide the required air supply for the pneumatic system.

Feed Inlet: This is the channel through which material enters the grinding chamber. In the sand mill, the design of the feed inlet should ensure that material enters the grinding chamber smoothly and uniformly, preventing blockages or uneven distribution that could affect the grinding result.

Main Motor: This is the power source of the sand mill, responsible for driving the grinding media and material within the grinding chamber to rotate and collide at high speed, thereby achieving the grinding action. The performance and stability of the main motor significantly i mpact the grinding efficiency and operational stability of the sand mill.

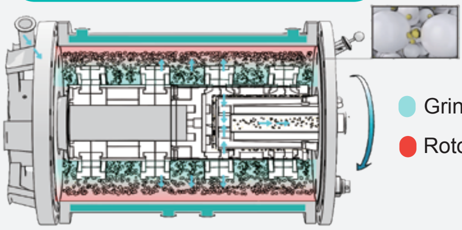
Temperature Sensor: This monitors the operating temperature of the equipment or the temperature of the material to ensure the equipment operates within a safe temperature range and to prevent material degradation due to excessive heat.

Discharge Outlet: This is the channel through which material exits the grinding chamber. In the sand mill, the design of the discharge outlet should ensure smooth discharge of the material and prevent residue from affecting the grinding results of the next batch.

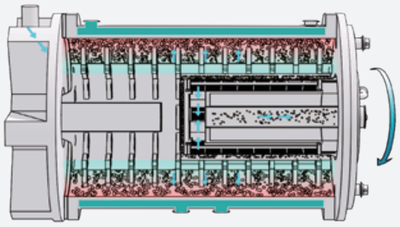
Grinding Chamber: This is the core component of the sand mill, containing the grinding media, material, and rotor assembly. During operation, the grinding media and rotor assembly within the chamber act upon the material through high-speed rotation and collision, achieving comminution and homogenization of the material.

Advantages of Rotor Structure Design

Uniform Grinding



High Energy Density



- ### Helical Flow Channel Design

  Slurry and grinding beads impact in counter-current flow, resulting in high shear intensity.

- ### Nano-level Fine Grinding with Narrow Particle Size Distribution

  NMM Model Dynamic Uniform Distribution Technology → Enables nano-level fine grinding.

- ### High Energy Density Grinding Beads

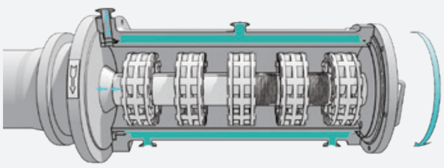
  Delivers nano-level impact force for powerful crushing efficiency.

- ### Dynamic Uniform Distribution Technology

  Ensures zero dead-zone distribution of grinding beads for precise and controllable particle size.

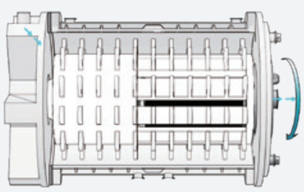
Principles of Rotor Structure

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.

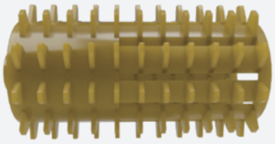
Material Characteristics: Outstanding mechanical properties and thermal stability. Its low density and excellent self-lubricating properties help reduce friction and wear during grinding.

Suitable Applications: Semiconductor ceramics, chemical materials, etc.

Silicon nitride, silicon carbide materials

Polyurethane (PU)

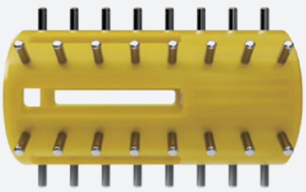
Function: Primarily used for low-speed, low-load grinding and dispersion tasks, especially involving soft materials.
Advantages: Excellent wear resistance, good elasticity, and strong impact resistance. Suitable for grinding and dispersing soft materials without causing damage.
Material Characteristics: 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)

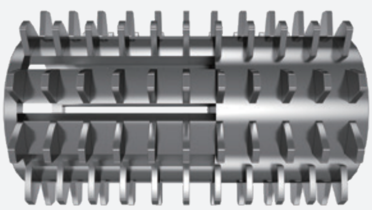
Function: Used for grinding high-hardness, high-wear-resistance materials.
Advantages: Extremely high hardness, excellent wear resistance, strong corrosion resistance, suitable for grinding high-hardness materials.
Material Characteristics: High hardness, high strength, and good wear resistance; maintains 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.



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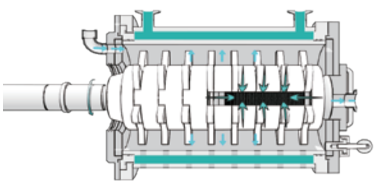
Separation Method

(Select the separation method based on material properties (particle size, viscosity) and separation precision requirements)



Working Principle of Filter Separation

The filter screen separation utilizes the principle of mesh screening. Material is forced through the filter screen under pressure, where larger particles and grinding media are intercepted. Qualified material passes through and is discharged. The filter screens are available in zirconia ceramic and wedge-shaped stainless steel materials to accommodate different operational requirements.

Filter Structure (Ceramic Disc/Wedge Shaped Filter)

Ceramic laminated disc

A three-dimensional filtration structure formed by stacking multiple thin sheets, which gathers and traps impurities through sheet walls and grooves to achieve high-efficiency filtration.

Wedge-shaped filter screen

A three-dimensional filtration structure formed by stacking multiple thin sheets, which gathers and traps impurities through sheet walls and grooves to achieve high-efficiency filtration.

Discharge and Separation Materials

Stainless Steel Filter Mesh

Filtration Function: Stainless steel mesh effectively removes impurities, particles, and suspended solids from liquids or gases, ensuring the purity of the output material. Corrosion Resistance: Due to the excellent corrosion resistance of stainless steel, this mesh operates stably in various corrosive environments, extending equipment lifespan. High-Temperature Stability: Stainless steel mesh maintains its filtration performance in high-temperature conditions, making it suitable for applications requiring high-temperature processing.

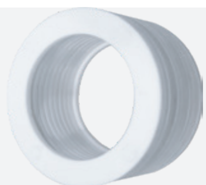
Separation Material: Ceramic/Stainless Steel Separator Plate

Note: 1L-5L models feature ceramic laminated separation material; larger capacities utilize stainless steel.

Ceramic Separator

Wear Resistance: Ceramic plates possess high hardness and wear resistance, effectively preventing damage to screening mesh.

Stability: Ceramic materials also exhibit excellent chemical stability, maintaining consistent performance across diverse environments.



Stainless Steel Separator Plate

Separation Effect: Stainless steel separator plates precisely separate particles of different sizes, ensuring the output particle size meets specifications.

Corrosion and High-Temperature Resistance: Stainless steel separator plates exhibit excellent corrosion resistance and high-temperature tolerance.

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

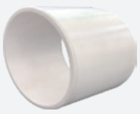
Polyurethane Cylinder

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

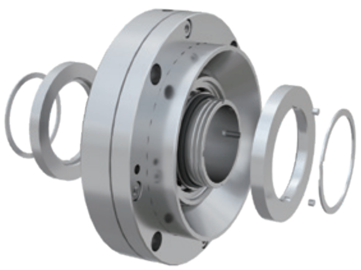
Grinding ball size mm	Final particle size um	Initial particle size um	Slurry viscosity cps	Solid content %（wt）	Linear velocity m/sec	Filter gap mm
0.05	<0.05	<5	<1000	<25	⩽15	0.02
0.1	<0.08	<10	<1000	<25	⩽15	0.05
0.2	<0.1	<20	<2000	<30	⩽15	0.1
0.3-0.4	<0.1	<20	<10000	<35	⩽15	0.15-0.1
0.4-0.6	<1	<40	<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

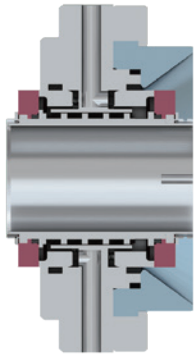


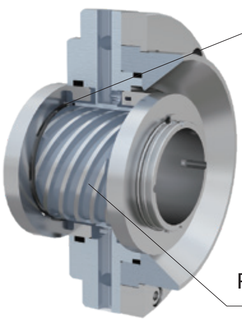
Prevent Material Leakage

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.

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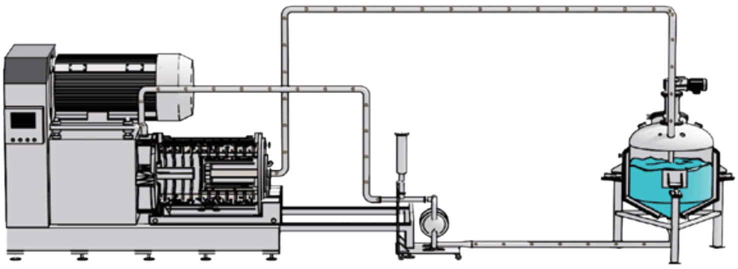
High-Flow Circulation Design



Operating Mode and Mechanism of High-Flow Circulation Operation

The slurry circulates at high speed, with grinding media fully activated throughout to achieve “multiple-frequency pulverization and rapid dispersion” in an efficient cycle.

Advantages of Circulating Grinding

Achieve fineness targets and particle size uniformity

Cyclic grinding subjects materials to repeated shearing, impact, and friction from grinding media, achieving continuous refinement. During this process, materials are continuously mixed and ground within the grinding chamber, ensuring every portion receives thorough and uniform processing. This prevents situations where some materials become excessively fine while others fail to meet particle size requirements.

Maximize energy utilization and minimize ineffective grinding

Recirculating grinding allows materials to spend more time in contact with grinding energy within the grinding chamber. Particles that were not sufficiently ground during the initial pass can re-enter the grinding zone and continue utilizing the grinding media's energy, thereby preventing energy waste and enhancing overall grinding efficiency. By specifically recirculating materials that have not achieved the required particle size, a greater volume of material can be processed within a given timeframe.

Reduce raw material waste

Maximized utilization of input materials, reduced scrap due to particle size non-compliance, and lowered production costs.

Complex material handling and diverse production requirements

For materials with uneven hardness and complex structures, achieving the desired particle size uniformly in a single grinding pass is challenging. Circulating grinding enables multiple targeted grinding cycles tailored to the characteristics of different material sections, thereby meeting the grinding requirements of various complex materials. Whether for large-scale industrial production or small-batch, multi-variety laboratory R&D, circulating grinding offers flexible adaptability.

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

Specifications

Model	Chamber Volume (L)	Drive Power (KW)	Bead Diameter(mm)	Filter gap (mm)	Screen Gap (L)	Feed Rate (L/min)	Weight (KG)	Dimensions (mm)
NM-M3L	3	7.5	0.1-2	0.05-1	7.4-35	6-42	400	910x680x900
NM-M10L	10	18.5	0.1-2	0.05-1	22.6-100	6-42	1280	2223x1367x1870
NM-M30L	30	37-45	0.1-2	0.05-1	58-300	6-42	1700	2950x1220x1850
NM-M60L	60	75	0.1-2	0.05-1	126-500	25-50	2300	2985x1204x2240
NM-M90L	90	75-90	0.1-2	0.05-1	196-1000	41-65	2500	3320x1240x2140
NM-M150L	150	160-200	0.3-1	0.15-0.5	325-3000	66-100	5200	4500x1500x2400
NM-M400L	400	315-355	0.3-1	0.15-0.5	715-0000	100-300	8600	4900x1865x2750

Other Parameters

Model	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	Filter type	Cross-sectional area	Energy consumption (kwh)
NM-M3L	1450	0.1-2	2-3	5-8	70%-80%	5-8.2	200	1	1 inch	Filter Separation	Ceramic Disc /Wedge-Shaped Filter	$162.7cm^2$	9.205-11.175
NM-M10L	1460	0.1-2	3-5	8-10	70%-80%	29-33	200	3	1 inch	Filter Separation	Ceramic Disc /Wedge-Shaped Filter	$344.2cm^2$	24.38-25.85
NM-M30L	1316	0.1-2	5-7	10-15	70%-80%	75-85	280	3	1 inch	Filter Separation	Ceramic Disc /Wedge-Shaped Filter	$1232.7cm^2$	44.35-56.025
NM-M60L	0-825/990	0.1-2	10-13	20-25	70%-80%	163-186	340	3	1 / 1.5 inch	Filter Separation	Wedge-Shaped Filter	$1322.5cm^2$	89.7-93.375
NM-M90L	776/825	0.1-2	12-15	30-35	70%-80%	253-290	360	3	1.5 inch	Filter Separation	Wedge-Shaped Filter	$1512.8cm^2$	100.725-119.4
NM-M150L	630	0.3-1	15-25	50	70%-80%	420-481	460	4	2 inch	Filter Separation	Wedge-Shaped Filter	$2050.7cm^2$	196.75-236.75
NM-M400L	445	0.3-1	35-65	80-120	70%-80%	925-1058	720	Rod Pin 1 Set	2 / 3 inch	Filter Separation	Wedge-Shaped Filter	$8849cm^2$	373.8-443.2