



Process Technology for Ceramic Applications

Push the boundaries...

Ceramic applications have become indispensable in the modern world. They are used wherever conventional materials reach their limits, be it wear resistance, heat resistance, biocompatibility or even special electrical properties. Ceramic materials can always be selected specifically for the particular application, for example heat-resistant components in space travel or the inrun of a ski jump. Because of their versatility, ceramics are used more often than one would expect. Mixing and grinding down to the submicron range - as a laboratory machine, stand-alone machine or even as a complex production plant, NETZSCH has been involved with ceramic applications for 150 years. Countless references and experiences are proof of the trust of many national and international customers.

PUSH THE BOUNDARIES WITH NETZSCH.

Proven Excellence.

Whether at home or on the move, in the office or even in production, parts and components made of high-tech ceramics can be adapted to a wide variety of applications. Where other materials reach their limits, high-tech ceramics are employed. Hardness, wear resistance and temperature resistance are the properties that matter. But it is precisely these properties that demand top performance from our production machines. For this reason, the machines must always be specially adapted to the particular requirements as well, e.g., purity, hardness or wear protection. Wet mills in this area are lined with either PU or ceramic, depending on the solvent used. NETZSCH dry mills are also suitable as pre-mills for larger quantities. Deaerators, such as our *DeAERATOR*, reduce the amount of air in ceramic slurries in order to achieve a better sintering result.



TASKS that we have successfully implemented

DRY PROCESSING

Product	Machine	Production capacity [kg/h]	Feed fineness [µm]	End fineness [µm]
Alumina	<i>s-Jet</i> ® 1000	250	d ₉₉ = 72.2	d ₅₀ = 1.33 d ₉₉ = 4.52
Alumina	SpheRho® 30	22	d ₉₉ = 180	$d_{50} = 0.7$ $d_{99} = 3.15$
Zirconia	CGS 50	70	d ₉₉ = 285	d ₅₀ = 5.4 d ₉₉ = 15.6
Silicon carbide	CGS 16	4	$d_{99} = 38$	$d_{50} = 3.2$ $d_{99} = 7.8$



CERAMIC / HIGH TECH COMPONENTS

WET PROCESSING

Product	Machine	Production capacity [kg/h] slurry	Feed fineness [µm]	End fineness [µm]	Process
Alumina	Zeta® 10	44	d ₉₉ = 6.17	$d_{50} = 0.47$ $d_{99} = 1.43$	Circulation
Alumina HPA	Discus® 30	20	d ₉₉ = 198	$d_{50} = 1.74$ $d_{99} = 4.03$	Circulation
Zirconia	Discus® 20	12	d ₉₉ = 91.3	$d_{50} = 0.69$ $d_{99} = 1.86$	Circulation
Silicon carbide	KE 50	12	d ₉₉ = 8.1	$d_{50} = 0.73$ $d_{99} = 2.43$	Circulation

DEAERATION

Product	Machine	Production capacity [kg/h] slurry	Feed density [kg/l]	Final density [kg/l]	Process
Zirconia	MiniVac	30	0.89	1.79	Passage

Utility ceramics have been with us for thousands of years and are ubiquitous in our daily lives. Utility ceramics is the term used to describe any ceramic that has been created to support us in our everyday lives. Since these are mostly mass-produced goods, grinding units with a high throughput capacity are used. Starting materials for utility ceramics are mainly ground natural minerals. Coating compounds for protection or decoration, are a large area of application for the NETZSCH agitator bead mills, for example, the *Discus*[®] series.



TASKS that we have successfully implemented

WET PROCESSING

Product	Machine	Production capacity [kg/h] slurry	Feed fineness [µm]	End fineness [µm]	Process
Glaze	Discus® 20	1600	$d_{95} = 48.8$	d ₅₀ = 6.18 d ₉₅ = 33.2	Passage
Engobe	Discus [®] 20	750	d ₉₉ = 113	d ₅₀ = 10.8 d ₉₉ = 58.2	Passage
Bone meal for bone china	Discus® 4	250	$d_{90} = 310$	$d_{20} = 1$ $d_{90} = 14$	Passage
Glaze for ceramic tiles	Discus® 100	3 900	d ₉₀ = 110	d ₉₉ = 65	Passage





PROCESS TECHNOLOGY FOR THE PROCESSING OF MINERALS

Our sister company NETZSCH Ecutec in Barcelona Spain has specialized in the grinding and preparation of minerals. With its wide range of machines, NETZSCH Ecutec will meet your wishes and requirements for the processing and preparation of natural minerals. If you're interested, we'll be happy to forward your inquiry or you can contact NETZSCH Ecutec directly. ECUTEC Barcelona S.L. Carretera de l'Hospitalet 147, Edificio Londres 2º-1ª 08904 Cornellà, Barcelona | Spain

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Whether for grinding, polishing or wear protection, only the hardest ceramics are used here. The most important representatives are oxides, nitrides and carbides. The correct choice of grinding process and grinding chamber lining are the decisive factors. For dry processing, the jet mill is particularly suitable, as the product particles grind each other. After grinding, our high-performance classifiers ensure separation into the various FEPA classifications. Since, in some cases, sufficiently wear-resistant grinding beads do not exist for wet mills, it is then necessary to switch to autogenic grinding with grinding grit from the corresponding regrind.



TASKS that we have successfully implemented

DRY PROCESSING

Product	Machine	Production capacity [kg/h]	Feed fineness [µm]	End fineness [µm]
α-Alumina	s-Jet® 500	900	d ₉₉ = 178	d ₅₀ = 20.1 d ₉₉ = 82.7
Silicon carbide	s-Jet® 500	230	6.3% > 800	d ₅₀ = 9.26 d ₉₉ = 43.2

CLASSIFYING

Product	Machine	Production capacity [kg/h]	Fine material [µm]	Coarse material [µm]
Alumina Dedusting	CFS 340 HD-S	4400	-	$d_{10} = 41$ $d_{99} = 161$
Tungsten carbide Dedusting	CFS 8 HD-S	50	$d_{10} = 8.5$ $d_{90} = 20$	$d_{10} = 12$ $d_{90} = 25$
Hard materials Fines production	CFS 8 HD-S	27	d ₉₇ = 2.1	-



WET PROCESSING

Product	Machine	Production capacity [kg/h] slurry	Feed fineness [µm]	End fineness [µm]	Process
α-Alumina	Zeta® 25	11	d ₉₅ = 351	$d_{50} = 0.129$ $d_{95} = 0.207$	2 Passages
Boron nitride	Zeta® 10	7	d ₉₉ = 4.02	$d_{50} = 0.68$ $d_{99} = 1.72$	Circulation Autogenic grinding
SiC	KE 50	30	d ₉₉ = 14.5	d ₅₀ = 1.36 d ₉₉ = 5.79	Circulation Autogenic grinding
Boron carbide	KE 50	13	d ₉₀ = 11.9	$d_{50} = 1.42$ $d_{90} = 3.61$	Circulation Autogenic grinding
CMP Slurry	Zeta® 10	38	d ₉₀ = 0.55	$d_{50} = 0.14$ $d_{90} = 0.24$	Circulation
CMP Slurry	Zeta® RS 4	7.5	d ₉₉ = 0.19	$d_{50} = 0.096$ $d_{99} = 0.127$	Circulation

Traditional materials such as porcelain and steatite, which are used for insulators, ceramic fuses and lamp sockets, are fading further into the background. In their place, more and more electronic components such as capacitors, resistors, varistors and many others are made of ceramics. Together with the substrates, they also enable a higher degree of micronization of electronic circuits. In many of these comminution tasks, the ceramic solids should only be finely dispersed in the liquids without creating new, sharp-edged fragments. This process is called "mild dispersing". The ZETA® RS is particularly suited for this.



TASKS that we have successfully implemented

DRY PROCESSING

Product	Machine	Production capacity [kg/h]	Feed fineness [µm]	End fineness [µm]
Barium titanate	ConJet® 32	13	d ₉₉ = 185	d ₉₉ = 1.7
Alumina	s-Jet® 500	9.95	d ₉₉ = 69	$d_{99} = 0.85$
Alumina	s-Jet® 500	902	d ₉₉ = 178	d ₉₉ = 82.7



WET PROCESSING

Product	Machine	Production capacity [kg/h] slurry	Feed fineness [µm]	End fineness [µm]	Process
Barium titanate	Zeta® 10	15	$d_{95} = 1.09$	$d_{50} = 0.11$ $d_{95} = 0.29$	Circulation
Barium titanate	Discus® 20	145	$d_{95} = 6.04$	$d_{50} = 0.68$ $d_{95} = 1.58$	Passage
Lanthanum hexaboride	LabStar Zeta®	0.5	$d_{95} = 0.82$	$d_{50} = 0.157$ $d_{95} = 0.228$	Circulation
Alumina	Zeta® 25	17	d ₉₅ = 2.92	$d_{50} = 0.13$ $d_{95} = 0.21$	Circulation
Barium titanate	Zeta® RS 4	13	d ₉₉ = 15.2	$d_{50} = 0.24$ $d_{99} = 0.82$	Mild Dispersing



Barium titanate after stressing in the ZETA® RS nano mill (mild dispersing)

In the case of catalysts, not only the carrier materials but also the active substances are finely ground. Because of their expensive active substances, these so-called washcoats must be processed with as little residue as possible. With a relatively small grinding chamber capacity and high power density, our high-performance mills such as the *Neos* series are ideally suited for this purpose.



TASKS that we have successfully implemented

DRY PROCESSING

Product	Machine	Production capacity [kg/h]	Feed fineness [µm]	End fineness [µm]
Zeolite	s-Jet® 500	7	d ₉₉ = 8.33	$d_{50} = 0.73$ $d_{99} = 2.25$
Molybdenum trioxide	CGS 16	5	d ₉₉ = 1800	$d_{50} = 0.66$ $d_{99} = 2.87$
Alumina	SpheRho® 30	25	d ₉₉ = 210	$d_{50} = 0.65$ $d_{99} = 3.45$





WET PROCESSING

Product	Machine	Production capacity [kg/h] slurry	Feed fineness [µm]	End fineness [µm]	Process
Zeolite	Zeta® 10	5.5	d ₉₉ = 243	$d_{50} = 0.17$ $d_{90} = 0.28$	Circulation
Washcoat	Discus® 20	270	d ₅₀ = 40 - 70	$d_{50} = 3.74$ $d_{99} = 14.1$	2 Passages
Catalyst compound	Discus® 20	600	d ₉₀ = 35.7	$d_{50} = 4.54$ $d_{90} = 8.19$	Passage
Washcoat	Neos 20	19	d ₉₅ = 2.09	$d_{50} = 0.09$ $d_{95} = 0.51$	Circulation





PRODUCTION MACHINES for Dry Grinding

CGS Fluidized Bed Jet Mill

The CGS fluidized bed jet mill with integrated classifier enables low-contamination fine grinding of dry products of any hardness. Due to the special grinding principle, product grinding is completely autogenous. The comminution energy is provided exclusively by gas jets, so that there is no wear on grinding tools. An optional ceramic lining is available for wear protection.

SPHERHO® Agitator Bead Mill

The SPHERHO® dry agitator bead mill is fed con-tinuously via a rotary feeder. A shaft equipped with exchangeable agitator tools is mounted inside the horizontally positioned grinding con-tainer. The grinding media, which are evenly distributed in the grinding tank, are vigorously kept in motion by the agitator tools, and the resulting shear/pressure and impact stress yields ultra-fine grinding with a relatively low coarse fraction. Due to a potential gradient, the product moves axially through the grinding container and exits the mill vertically at the product outlet into a downstream conveyance system.





- Low-contamination grinding
- Suitable for materials of any hardness
- High-efficiency grinding process
- Optional ceramic lining for wear protection
- Compact design
- High degree of fineness achievable
- Optional grinding chamber cooling
- Optional ceramic lining for wear protection

CONJET® High-density Bed Jet Mill

The $CoNJe\tau^{\circ}$ high-density bed jet mill is the combination of a spiral jet mill with an integrated classier wheel. This combination facilitates the highest levels of fineness and thus higher throughput rates to be achieved regardless of the product load. The degree of fineness is set by only adjusting the speed of the classifier wheel. Residue-free grinding and only minimal product buildup within the machine are other outstanding features of the $CoNJe\tau^{\circ}$. Thanks to the compact design, machine maintenance and complete cleaning when changing products are extremely easy. The mill can also be lined with a ceramic for low-contamination processing.

s-JET® Steam Jet Mill

The s-JET® process developed and patented by NETZSCH uses superheated steam as the grind-ing gas - absolutely dry! Thus, the s-JET® steam jet mill is the systematic advancement of the air jet mills with integrated air classifier estab-lished on the market. With steam rather than air as the grinding medium, significantly higher jet energy is available. The s-JET® steam jet mill achieves higher outputs and opens up new fineness ranges for dry grinding.



- Optimal access to grinding chamber and classifier for quick and easy cleaning and maintenance
- Highest level of fineness and steep grain size distribution
- Compact design
- Optional low-contamination ceramic lining



- Low-contamination grinding for the highest product purity
- Significantly higher efficiency at high throughput rates
- Grinding and drying possible through the use of superheated steam
- Lower specific energy requirement at high throughput rates

PRODUCTION MACHINES for Wet Grinding

Discus® Agitator Bead Mill

Discus[®] is a powerful horizontal agitator bead mill with disc agitator. The large lengthdiameter ratio, the variable material designs, as well as the large range of grinding media diameters, allow application-specific design of this machine for your task. Thus, the *Discus*[®] can be used both as a pre-mill for calcinates up to 3 mm or as a fine mill for ceramic slurries. Worn agitator shaft parts can also be replaced individually and therefore inexpensively.

ZETA® Agitator Bead Mill

The Z_{ETA} ° grinding system – the grinding sys-tem for circulation and multi-passage opera-tion. Suitable for any viscosity and almost all ceramics. With this technology, you can use a wide variety of grinding media from 0.2 to 3 mm in diameter to achieve the highest product qualities and finenesses down to the nanome-ter range. The parts that contact the product can of course be made from a wide variety of materials. All-ceramic models are available up to the ZETA® 150.





- Grinding chamber lining available in various materials
- Use of grinding beads from 0.4 mm to 6 mm
- Suitable for passage and circulation operation
- Grinding chamber volumes available up to 10000 l
- Low specific energy requirement
- Individually replaceable agitator shaft parts



- Grinding chamber lining available in various materials
- Use of grinding beads from 0.2 mm to 3 mm
- High degrees of fineness attainable
- Designed for circulation operation



NEOS Agitator Bead Mill

The *NEOS* grinding system stands for the highest performance, product quality and efficiency. While reliably employing the smallest grinding media, the required quality of your products can be realized with high production output and low specific energy requirements. The Neos agitator bead mill can also be constructed of different materials.

ZETA® RS Nano Mill

The ZETA® RS series agitator bead mills were developed for the use of so-called micro grinding media. This was achieved through adaptation of the geometric ratios of the ZETA® circulation mill and the use of innovative separation systems. This mill makes it possible to process products in a wide range, from gentle dispersion conditions to very high energy densities, in both passage and circulation mode.





- Highest power input without product overheating
- Maximum volume throughput
- Use of very small grinding media 0.1 to 0.8 mm
- Highest degrees of fineness achievable
- High process reliability



- Safe use of micro grinding media in the range 30 μm - 300 μm
- No clogging of the screen thanks to the open separation system, even at low peripheral speeds
- Use of different grinding media sizes possible without changing the can
- Reduction in the size of the grinding media through wear and tear during long operating times is not a problem
- Reliable operation even under "gentle" dispersing conditions

PRODUCTION MACHINES for Classification,

CFS/HD-S Fine Classifier

NETZSCH fine classifiers are used for the frac-tionation of dry pre-ground powders. Opti-mum selectivity at maximum feed rates for both coarse and fine material separation is achieved in the usual application range of ap-prox. $30 \ \mu\text{m} - 150 \ \mu\text{m} (d_{99})$. The fine classifiers can be designed as stand-alone machines or for inline operation in plants.

MasterMix[®] Dissolver

The *MASTERMIX*[®] dissolver is used to disperse solids in liquids. The mixing process takes place in batches in a stationary or mobile container. The speed of the dispersing tool is infinitely adjustable.





- Best separation limit
- Free of coarse particles
- Patented classifier wheel
- High operational reliability
- Low wear
- Easy maintenance

- Compact design minimal space requirement
- Various, easily exchangeable tools also in steel-free design
- Optimal positioning of the dispersing tool by means of lifting/lowering device
- Customized tank lid designs

Dispersion and Deaeration

EPSILON Inline Disperser

The *EPSILON* works together with a product tank in circulation. After the machine is started, the liquid component flows to the *EPSILON* and is pumped back into the tank by the strong pumping action of the rotor. This creates a strong negative pressure, which is used to suck in the powdered solids. Since the process chamber of the *EPSILON* has no narrow shear gaps, there is virtually no abrasion and wear.

DE**A**ERATOR

Deaeration of liquid to highly-viscous products according to the VTR principle (vacuum-thin film-rotation process). The machines can be used as stand-alone units in passage operation or integrated into plants in inline operation.





- Permanently reproducible product quality
- High production output due to rapid product intake
- Closed process housing
- No adhesion of dust in the batch tank
- Deaeration of the product after powder feed
- Improvement of the sintering results
- Minimum production loss
- Quick and easy cleaning
- Low maintenance
- Throughput capacity from 20 to 4000 kg/h

PROCESS TECHNOLOGY AND PLANT ENGINEE

Plant Engineering

Whether you need a complete turnkey solution or just advice on a certain aspect of plant construction - we have the necessary know-how. For more than 100 years, NETZSCH has been designing and building systems using the latest production machines and manufacturing techniques. We implement projects for companies all over the world. Talk to our experts. At NETZSCH you get everything from a single source:

- Plant design
- ATEX design for solvent-based slurries
- Process monitoring, control and automation
- Software development and application-specific programming
- Process engineering
- Electrical installation
- Steel construction for the extended peripheral equipment
- Product feed and discharge systems
- Machine and container construction
- Extraction systems



RING

Project Management

From start to finish, you can rely on our professional project management. We have the resources and skills to oversee even the most extensive project as a unit. We aim to maintain the highest standards in all projects, and in all areas:

- Project planning, including health and safety reports, statements in accordance with ATEX 94/9 and ATEX 100a
- Site supervision and site management
- Installation of the machines
- Installation and testing of the instrumentation and control systems
- Commissioning of the individual machines and the entire system
- Training of the operating personnel
- Support for production start-up





MODULAR PLANT CONCEPT FROM NETZSCH

The established modular approach for turnkey production plants is a professional concept for bundling and structuring complete and com-plex processes. For each process step, the re-quired equipment is installed in a functional group on a specially defined and designed plant segment (module). According to the pro-cess design, the modules are arranged in such a way that the defined media flows fit together with their connection points. In this way, a turnkey production plant with a compact layout can be realized. By adopting the core features of standard container designs, existing and proven logistics concepts can be used without any problems. The individual process modules, which are en-tirely pre-assembled in our production facili-ties, are assembled to form the complete plant. Finally, a factory acceptance test is car-ried out in this fully functional production plant. Subsequently, the individual modules along with all of the equipment are disassembled again and shipped to our customers via stand-ard transport. On site, the modules can then be quickly moved to their final production loca-tion, where the plant is reassembled under the supervision of NETZSCH experts. The start-up of production then takes place by, so to speak, simply turning the key.

Benefits

- Complete production process in significantly less space
- Clearly defined interfaces for media flow and data acquisition
- Resource savings (e.g., 90% cleaning fluid) through logical function groups and clear process design
- High level of flexibility in product portfolio and production capacity ("Plug & Produce")
- Possibility for quick and easy retrofitting of the entire system ("Re-plug & Produce")
- Simple and inexpensive transport due to adaptation of the design to standardized transport concepts (ready-to-transport units)
- Fast operational readiness thanks to complete pre-installation (ready-to-install production units)
- Shortened installation and commissioning times thanks to early technical acceptance at NETZSCH



Our process engineering knowledge is available to you in application laboratories around the world

Worldwide – in Germany, Russia, the USA, Brazil, China and India – you have the opportunity to work with our experts in special process engineering laboratories.

During trials, we prepare your products in order to achieve exactly the result you have specified. Together with you, we carry out tests for the design of machines, for process optimization or for quality assurance and develop process engineering solutions. We evaluate the results using our extensive analytics, e.g. particle size distribution and viscosity, as well as imaging methods.

In order to support our customers with the market launch of new products, we also offer contract grinding on existing machines and systems.

Our worldwide service network gives you security for your production

Technical assistance must come quickly and function perfectly. That is why we offer an extraordinary range of services with the certainty that highly qualified NETZSCH employees perform these services worldwide. Our specialists help reliably and quickly. We advise you in your language, wherever you are.

The NETZSCH service network extends over all continents. In this way we strengthen the competitiveness of our customers, facilitate smooth, efficient processes and ensure maximum machine availability.

Our range of services includes:

- Process engineering
- commissioning
- Inspection
- Maintenance
- Conversions
- Overhauls
- Process optimization
- Spare Parts



ArterSales SUPPOR

The NETZSCH Group is an owner-managed, international technology company with headquarters in Germany. The Business Units Analyzing & Testing, Grinding & Dispersing and Pumps & Systems represent customized solutions at the highest level. More than 3,800 employees in 36 countries and a worldwide sales and service network ensure customer proximity and competent service.

Our performance standards are high. We promise our customers Proven Excellence – exceptional performance in everything we do, proven time and again since 1873.

Proven Excellence.

Business Unit Grinding & Dispersing – The World's Leading Grinding Technology

NETZSCH-Feinmahltechnik | Germany NETZSCH Trockenmahltechnik | Germany NETZSCH Vakumix | Germany NETZSCH Lohnmahltechnik | Germany NETZSCH Mastermix | Great Britain NETZSCH FRÈRES | France NETZSCH España | Spain ECUTEC | Spain NETZSCH Machinery and Instruments | China NETZSCH India Grinding & Dispersing | India NETZSCH Tula | Russia NETZSCH Makine Sanayi ve Ticaret | Turkey NETZSCH Korea | Korea NETZSCH Premier Technologies | USA NETZSCH Equipamentos de Moagem | Brazil

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