



ADVANCED MATERIALS

Martoxid® Aluminum Oxides

Calcined Aluminas for
Technical Ceramics

Aluminum oxides to
meet and exceed the
most demanding ceramic
applications requirements



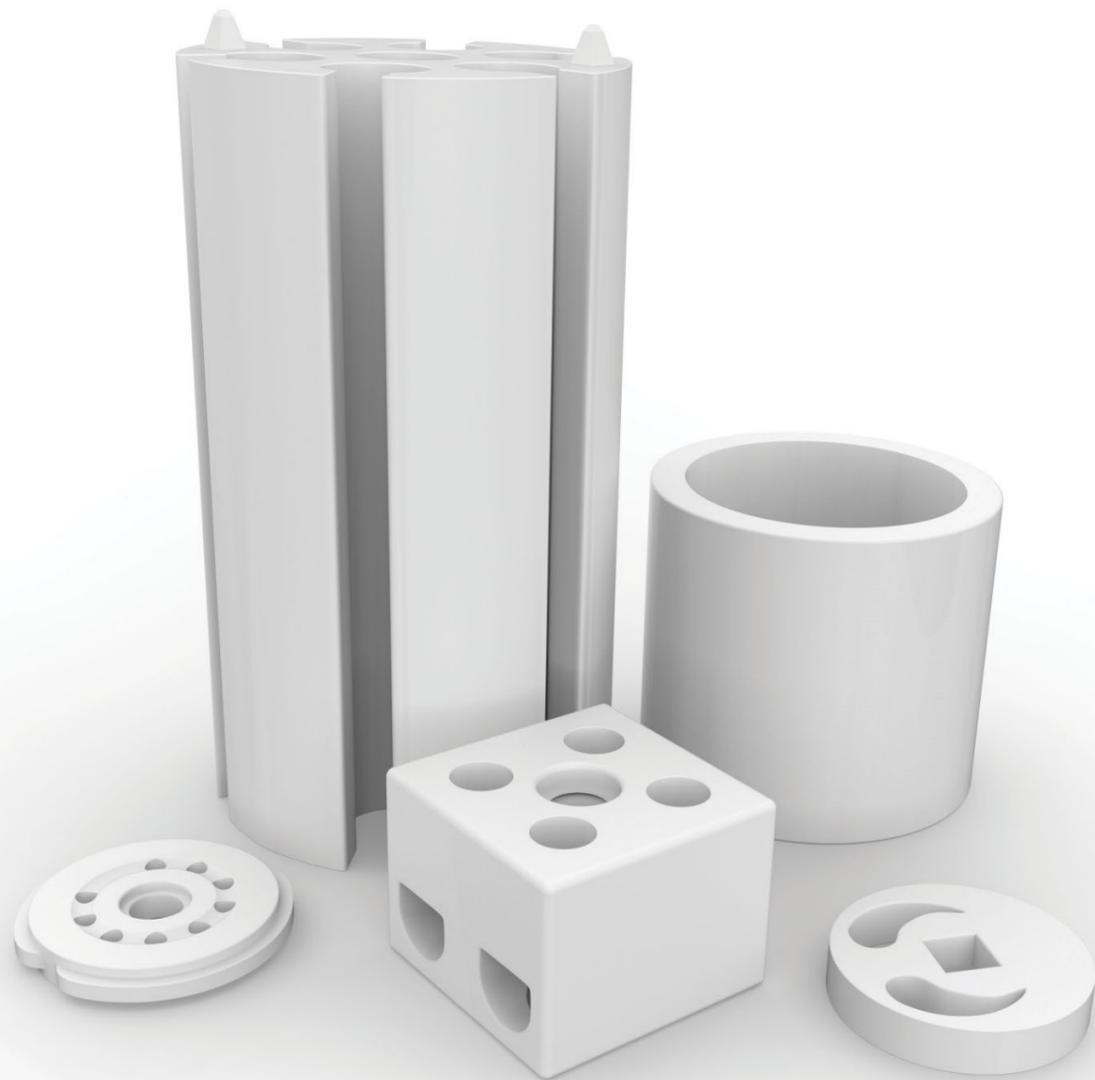
Huber's Martoxid® Products

Huber Advanced Materials offers a range of tailor-made Martoxid® aluminum oxides to meet and exceed the most demanding requirements of ceramic product producers

Martoxid® best-in-class ceramic materials provide highest chemical purity, low alkali content ($\text{Na}_2\text{O} < 0.1\%$), optimized crystal properties, finest particle size, optimized particle size distribution, best rheological behavior and unsurpassed ceramic reactivity.

Each product has specific characteristics for distinct fields of application. Typical application fields include high mechanical strength, extreme hardness, excellent resistance to wear, temperature and corrosion, thermal conductivity and good electrical insulation.

Huber Advanced Materials produces a wide range of Martoxid® specialty oxides with constant quality characteristics. Stringent quality control and careful manufacturing procedures ensure a consistent process and low batch-to-batch variability.



Martoxid® Product Portfolio

	Grade	Characteristics	Applications
UNGROUND	MPS	Unground alumina for manufacturing high purity super reactive alumina compounds $\geq 99.5\% \text{Al}_2\text{O}_3$	Specifically developed feedstock for engineering ceramics, providing highest sintered densities
	MRS	Unground alumina for manufacturing of highly reactive ceramic compounds $> 98\% \text{Al}_2\text{O}_3$	Specifically developed feedstock for engineering and performance ceramics
	MZS	Unground material for specific processing on the customers' milling equipment	Ideal feedstock for wear resistant engineering ceramics
	MDS	Unground material dedicated to the customers' upgrading equipment	Ideal for the manufacturing of high quality spark plugs, insulators and automotive converters

	Grade	Characteristics	Applications
GROUND	MZS-3	Fine ground material for further treatment on the customers' milling equipment; qualified for extrusion	Technical ceramics $> 92\% \text{Al}_2\text{O}_3$ such as thread guides, seal discs and wear resistant electronic parts
	MDS-6	Deagglomerated and pre-refined powder for fine preparation of the feed materials	To produce high quality spark plugs, insulators and automotive converters

	Grade	Characteristics	Applications
SUPERGROUND	MZS-1	Superground alumina with narrow particle size distribution; qualified for injection molding	For the production of ceramics with an alumina-content up to 99.7% such as electronic and mechanical engineering parts
	MRS-1	Roundish shaped, superground alumina with narrow particle size distribution and high sintering potential	Specifically developed feedstock for film substrates, mechanical engineering and performance ceramics
	MR-23	Fine ground alumina with optimized shrinkage	Electrical and technical ceramics $> 92\% \text{Al}_2\text{O}_3$ such as housings, vacuum tubes, substrates and seal discs
	MR-32	Superground alumina with controlled wide grain size distribution and high green density; for low shrinkage applications	For formulations $\geq 99.5\% \text{Al}_2\text{O}_3$, dedicated to advanced ceramics mostly used for electrical and mechanical engineering components
	MR-70D	Thermally reactive Al_2O_3 (fired density $> 3.88 \text{ g/cm}^3$ at 1600°C); for mechanical, electrical, chemical and thermal loads	Technical ceramics with an alumina content of 99.7% such as pump parts, bearings, substrates and tubes

Martoxid[®] unground, ground and superground calcined aluminas

Typical chemical properties

Martoxid [®] Grade	MPS	MRS	MZS	MDS	MZS-3	MDS-6	MR-23	MZS-1	MRS-1	MR-32	MR-70D
STATE OF MILLING	UNGROUND	UNGROUND	UNGROUND	UNGROUND	GROUND	GROUND	SUPERGROUND	SUPERGROUND	SUPERGROUND	SUPERGROUND	SUPERGROUND
Al ₂ O ₃ Content [%]	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.8
Na ₂ O Content [%]	~ 0.05	~ 0.02	~ 0.03	~ 0.02	~ 0.03	~ 0.03	~ 0.03	~ 0.03	~ 0.02	~ 0.03	~ 0.01
SiO ₂ Content [%]	~ 0.06	~ 0.05	~ 0.06	~ 0.06	~ 0.07	~ 0.07	~ 0.07	~ 0.08	~ 0.07	~ 0.07	~ 0.01
Fe ₂ O ₃ Content [%]	~ 0.03	~ 0.03	~ 0.03	~ 0.03	~ 0.03	~ 0.03	~ 0.03	~ 0.03	~ 0.03	~ 0.03	~ 0.02
CaO Content [%]	~ 0.02	~ 0.02	~ 0.02	~ 0.02	~ 0.02	~ 0.02	~ 0.02	~ 0.02	~ 0.03	~ 0.03	≈ 0.02
α-Content [%]	≥ 90	≥ 90	≥ 95	≥ 97	≥ 95	≥ 97	≥ 93	≥ 93	≥ 90	≥ 93	≥ 90
Specific Surface Area (BET) [m ² /g]	~ 4.5	~ 1.8	~ 1	~ 0.6	~ 1.2	~ 0.9	~ 1.8	~ 2.2	~ 3	~ 4	~ 9
Primary Crystal Size [μm]	~ 0.6	~ 1.2	~ 2.5	~ 4	~ 2.5	~ 4	~ 2.5	~ 2.5	~ 1.2	~ 2	~ 0.6
PARTICLE SIZE DISTRIBUTION											
d ₁₀ [μm]					~ 0.8	~ 0.9	~ 0.65	~ 0.5	~ 0.5	~ 0.5	~ 0.2
d ₅₀ [μm]					~ 3.5	4.5	~ 2.5	~ 1.7	~ 1.2	~ 1.7	~ 0.8
d ₉₀ [μm]					~ 12	~ 13	~ 8	~ 4.5	~ 2.8	~ 4.5	~ 4
≥ 45 μm [%]					~ 1	~ 1	~ 0.1	~ 0.01	~ 0.01	~ 0.5	~ 0.3
Bulk Density [kg/m ³]	~ 950	~ 900	~ 850	~ 750	~ 550	~ 600	~ 600	~ 650	~ 950	~ 1050	≈ 500
Pressed Density at 50 MPa [g/cm ³]							≥ 2.15	≥ 2.15	~ 2.25 (100 MPa)	~ 2.45	≥ 2.15 (100 MPa)
Sintered Density at 1600 °C* [g/cm ³]									~ 3.3	~ 3.4	~ 3.88

*Retention Time: 2 Hours at T_{max}

Martoxid[®] Calcined Aluminas for Technical Ceramics

The Martoxid[®] aluminum oxide grades are the material of choice for technical ceramics applications as they meet and exceed the highest product quality standards and customer requirements. Our comprehensive listing of Martoxid[®] grades on the previous page is showing all grades offered by Huber Advanced Materials along with individual product characteristics and ceramics applications. Martoxid[®] MRS and Martoxid[®] MRS-1 are aluminas specifically designed to meet our customers' requirements in high performance ceramics. They are well-suited for use in sophisticated electronic

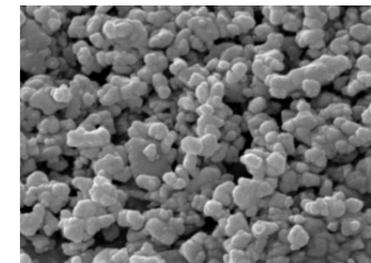
applications, mechanically stressed and engineering components.

To get a better understanding of our comprehensive line-up of Martoxid[®] product offerings for technical ceramics, above is a snapshot of the typical chemical and physical properties and unique product characteristics. You will notice the products are divided into groupings to showcase our unground, ground and superground grades.

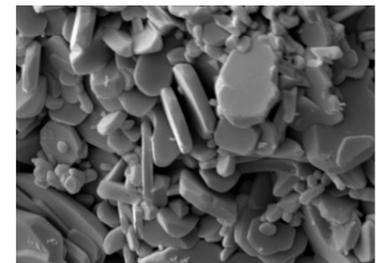
Visualize the outstanding appearance of two Martoxid[®] grades

Under the Scanning Electron Microscope (SEM), one can truly visualize the outstanding physical appearance of Martoxid[®] MR-70D and Martoxid[®] MDS.

Look closely at the excellent technical pattern and symmetry of both products. Unground Martoxid[®] MDS is ideal for automotive and insulation applications while Martoxid[®] MR-70D is thermally reactive and ideal for a number of industrial ceramics applications.



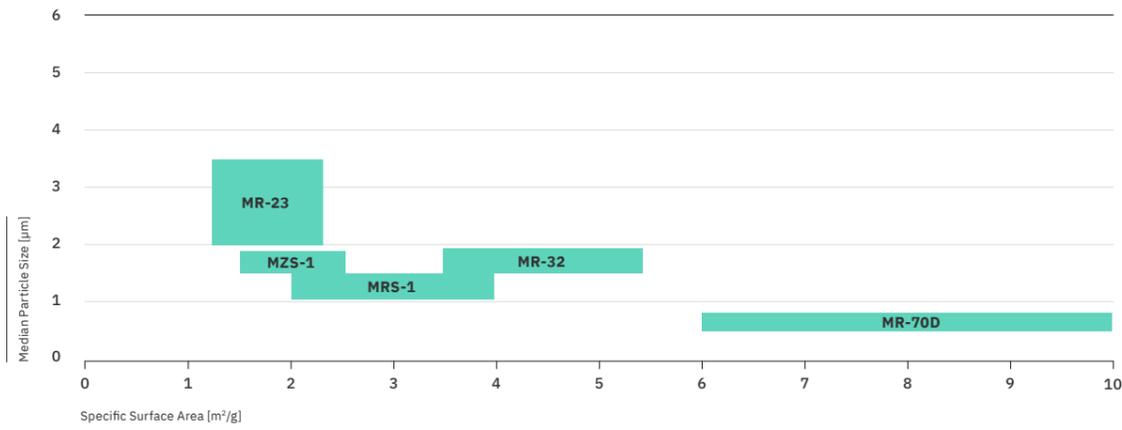
Martoxid[®] MR-70D 5μm



Martoxid[®] MDS 10μm

Superground Martoxid® grades

Plotting median particle size and specific surface area



The high performing superground Martoxid® grades meet the requirements of many high-end ceramic applications. This plot of Martoxid® superground products by median particle size (µm) and specific surface area (m²/g) shows the wide range of grades available from Huber Advanced Materials.

Since we offer a number of products with varying properties, we will work closely with you to completely understand your specific ceramics application to identify and customize the product solution perfectly suited for your application.

LET US WORK FOR YOU!

Huber Advanced Materials has more than half a century of supplying calcined aluminas for the most demanding technical ceramics applications. In addition to our innovative **Martoxid® grades** that we've presented, we provide superior technical service and expertise along with a deep dedication toward providing fast, personalized customer service and support.

We look forward to working with you. Contact us today for more information and samples of our array of Martoxid® calcined alumina products for your technical ceramics applications.

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Touching lives.
Enhancing safety.
This is
Huber Advanced Materials.



Our global footprint

The Huber Advanced Materials (HAM) SBU is a specialty chemicals business with a global, leading position in the development and production of halogen-free fire retardant solutions, smoke suppressants and specialty aluminas touching lives and enhancing safety for millions of people around the world.

Americas

Fairmount, GA
Atlanta, GA
Kennesaw, GA
Marblehead, IL
Bauxite, AR

Europe

Bergheim, Germany
Breitenau, Austria

Asia Pacific

Qingdao, China



2

R&D Centers

6

Manufacturing plants

3

Customer Care
Centers



Martinswerk GmbH

+49 2271 9020
info@martinswerk.com
www.martinswerk.com

Europe, Middle East, Africa & India

Huber Advanced Materials

+1 866 564 8237
hubermaterials@huber.com
www.hubermaterials.com

Americas

HEM (Qingdao) Co. Ltd.

+86 532 58792008
hubermaterials@huber.com
www.hubermaterials.com

Asia Pacific