ALMATIS
PREMIUM ALUMINA

PREMIUM ALUMINA FOR CERAMIC APPLICATIONS

Almatis Burnside, Inc.,
Burnside,
Louisiana, USA

Almatis, Inc.,
Bauxite,
Arkansas, USA

Almatis, Inc.,
Dalton,
Georgia, USA

Almatis, Inc.,
Leetsdale,
Pennsylvania, USA

Almatis, Inc.,
Neville,
Pennsylvania, USA

Almatis B.V.,
Rotterdam,
The Netherlands

Almatis GmbH,
Ludwigshafen,
Germany

Almatis Alumina
Private Ltd.,
Falta, India

Qingdao Almatis
Co. Ltd.,
Qingdao, China

Almatis Limited,
Iwakuni, Japan

Almatis – The Premium Alumina Company

With more than 100 years of alumina expertise, Almatis is the world's leader in the development, manufacture and supply of premium alumina and alumina-based products.

Almatis is both a global and fully integrated producer, serving our customers from sixteen strategically located sales, research and manufacturing sites. Our employees strive to exceed customers' expectations through industry leading customer service, technical support and manufacturing excellence. We implement leading technologies and continuous improvement programs, which have established Almatis products as the benchmark for quality and consistency. Our commitment to strong partnerships with our customers creates innovative solutions that support and enhance their growth in all regions of the world.

Almatis offers the most comprehensive alumina product portfolio in the industry. Our broad product line includes:

- Tabular aluminas
- Calcined and reactive aluminas
- Polishing aluminas
- Calcium aluminate cements
- Alphabond 300
- Dispersing aluminas
- Brown sintered alumina, BSA 96
- Alumina and magnesia-rich spinels
- Calcium hexa-aluminates, Bonite and SLA-92

Across our core markets—refractories, ceramics and polishing—we deliver one-stop shopping, always expanding our portfolio to meet customer and market requirements.

QUICK FACTS:

Global specialty alumina producer with over 100 years of expertise

Most comprehensive alumina portfolio

Closer to our customers with highest quality products

Reliable and secure supply from our refinery and 9 world-class production facilities

Excellent global and local service with leading-edge technical support

Continuous development of innovative solutions and applications know-how

Ceramics: Strong and Versatile

MAJOR APPLICATIONS FOR ALMATIS CALCINED AND TABULAR ALUMINAS:

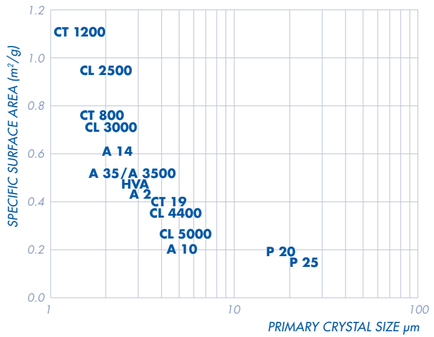
- *Technical and Advanced Ceramics*
- *Spark Plugs and Insulators*
- *Honeycomb and Porous Substrates*
- *Specialty and LCD Glass*
- *Functional Fillers*
- *Investment Casting*
- *Metal Filtration*
- *Regeneration Burners*

Ceramic is a term meaning "to burn," as in burned earth, with earthenware being one of the first known applications. Today the term "ceramic" encompasses a much wider range of materials and applications.

Alumina is one of the most common materials used in ceramic applications. Its strong chemical bonds and physical stability provide superior properties in key application areas ranging from fine grained technical ceramics to wear-resistant ceramics and electrical insulators.

Almatis offers the broadest portfolio of specialty calcined and tabular aluminas in the industry. Our premium aluminas are regarded for their highly consistent properties, ensuring efficient, defect-free ceramic manufacturing.

Unground calcined aluminas



Calcined aluminas

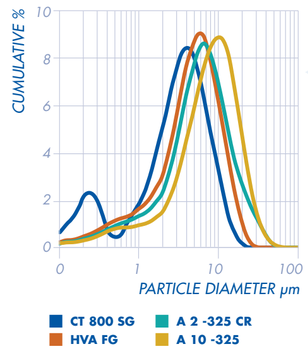
Almatis offers a variety of unground calcined aluminas with primary crystal sizes ranging from 0.3 – 25µm. Our calcined alumina purity levels range from 99.5 - 99.8%, including normal soda (≤0.35%), intermediate soda (≤0.20%), low soda (≤0.10%) and ultra-low soda (≤0.05%) products.

Ultra-low soda calcines

The soda content of an alumina often dictates its ability to be used in a specific application. Since residual Na_2O at the particle surface can become soluble and change pH and rheology characteristics, some wet processes respond better to aluminas with ultra-low soda levels. Almatis offers a number of calcined aluminas with a guaranteed Na_2O content ≤0.05%, such as A 14, A 14 -325 and CT 3000 LS SG. CT 3000 LS SG is our highly reactive batch ground product that also features a low SiO_2 content, which is especially critical for products that are subjected to harsh chemical or wear environments.

Continuous ground calcines

Continuous ground calcined aluminas feature broad particle size distributions, which are a blend of individual crystals and partial agglomerates. Almatis produces its continuous ground products in highly efficient ball mill-air classifier systems with a focus on controlling median particle size and +45µm residual agglomerate content.



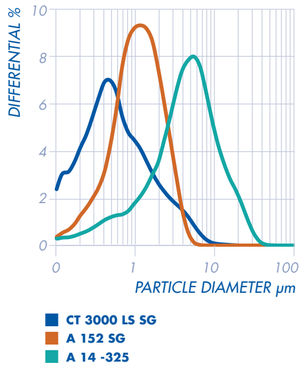
Batch ground reactives

Batch ground aluminas are fully ground products often used for the manufacture of technical and advanced ceramic parts. Almatis produces batch grounds with mono-modal (CT 3000 SG) and bi-modal (A 15 SG) distributions, which are suitable for use in a variety of processes. While many applications require the narrow particle size distribution of a mono-modal product, bi-modal products are used where higher green densities are needed.

Specialty tabular products

Almatis produces specialized tabular alumina fractions targeted for the investment casting, functional filler, ceramic roller, metal filtration and regeneration burner markets. Some of our tabular products are available in low iron (LI), intermediate soda (SP) and ultra-low soda (XLS) versions, or as washed products (Tabalox). We also offer a variety of spherical alumina balls in smooth (T162) and round (T160, FBA) versions for applications such as filter beds and regeneration burners.

Higher Purity Ceramics



Technology continues to evolve and provide the world with a faster, smarter and greener lifestyle. Computer interfaces, smart devices and touchscreens are examples of technology made possible through advances in physical materials, such as alumina. Though alumina is generally regarded for its refractory and insulating qualities, it has also been at the forefront of materials innovation for decades.

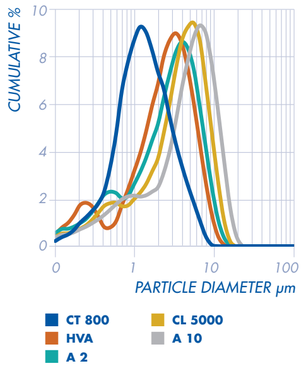
Alumina is a critical material for the manufacture and processing of modern technologies such as silicon wafer chips, solar panels, batteries, LED lighting, electronics, LCD and cover glass, jet engines, synthetic polymers and refined metal alloys, as well as the products that insulate and dissipate heat generated from these applications. While not often recognized, alumina has played a silent but key role in enabling the development of critical materials for emerging technologies.

Almatis aluminas for higher purity ceramics feature low and ultra-low Na_2O levels and have typical purity levels of 99.8% or higher. These products are often the major or only powder component used in a particular formulation.

Applications include technical and electronic ceramics, wear ceramics for harsh chemical environments, high performance spark plugs and catalyst supports.

		UNGROUND				CONTINUOUS GROUND		BATCH GROUND		
Product Properties		**CT 1200**	**CL 2500**	**CL 3000**	**A 14**	**CL 3000 FG**	**A 14 -325**	**CT 3000 LS SG**	**A 152 SG**	**CT 1200 SG**
Surface Area	[m^2/g]	1.1	0.9	0.7	0.6	0.9	0.8	7.6	4.3	3.1
Primary Crystal / Ground D_{50}	[µm]	1.2	1.7	1.8	2.1	3.9	4.8	0.4	1.2	1.3
Al_2O_3	[%]	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.8
Na_2O	[%]	0.06	0.06	0.06	0.03	0.06	0.03	0.02	0.06	0.06
SiO_2	[%]	0.01	0.01	0.01	0.02	0.01	0.03	0.02	0.03	0.03

Technical Ceramics



Technical and advanced ceramics succeed where other materials fail, such as with corrosive environments, extreme temperatures, high wear rates, large stresses or high electrical currents. Alumina provides a specific set of properties that allow technical ceramics to succeed, including a high melting temperature, physical stability, hardness, wear resistance, heat resistance, corrosion resistance, thermal conductivity and mechanical strength.

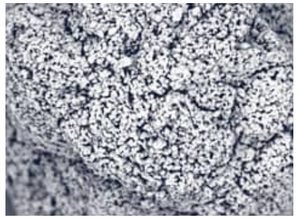
These characteristics make alumina an excellent choice for a wide variety of applications. Some of the most common applications are components used in automotive, electronics, energy, environmental, household, industrial and medical devices.

Almatis unground calcined aluminas for technical ceramics need to be processed further and are often spray dried prior to use in a particular application. Choosing an unground product allows the user to control the particle size distribution and simultaneously blend other batch components.

The primary crystal size, specific surface area and morphology of our unground aluminas are tightly controlled to provide a consistent and easy to process alumina in wet or dry systems.

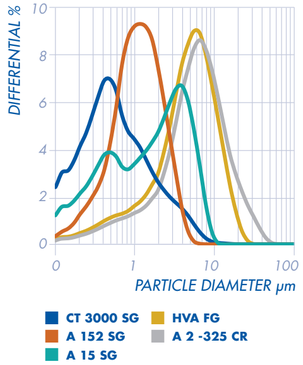
Product Properties		CT 800	HVA	A 35	A 2	CL 5000	A 10
Surface Area	[m^2/g]	0.7	0.5	0.5	0.4	0.3	0.2
Primary Crystal Size	[µm]	1.7	2.7	2.7	3.0	4.1	4.8
Al_2O_3	[%]	99.7	99.7	99.7	99.6	99.8	99.7
Na_2O	[%]	0.12	0.12	0.11	0.30	0.06	0.08
SiO_2	[%]	0.01	0.01	0.01	0.02	0.02	0.04

Primary crystal size determined by planetary grind.



SEM: Almatis CT 800 unground

Technical Ceramics



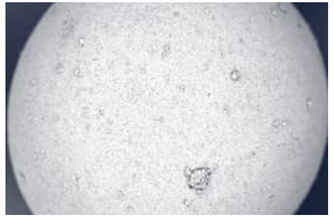
Technical and advanced ceramic components have functional and supporting roles within their applications to provide a safe operating environment. The alumina components are mainly internal to equipment such as protective coatings, liners and seals for high temperature, wear or corrosive environments. Other alumina products such as spacers, feedthroughs, tubes, rings and mounts offer electrical or thermal resistance. Regardless of whether the end-use application is industrial, commercial, medical, analytical or household, alumina-based products are critical for reliable operation.

Almatis batch and continuous ground calcined aluminas for technical ceramics are well suited for various formulations, whether as the only component in an all-alumina body, major component in a high-alumina body or as filler in a low-alumina matrix.

Almatis batch ground products are ideal for users that do not have internal grinding capability or would prefer an already ground product. They have been successfully used in many production processes, including tape casting, slip casting, injection molding, roll compaction, uniaxial and isostatic pressing, and extrusion.

		CONTINUOUS GROUND			BATCH GROUND					
Product Properties		**CT 800 SG**	**HVA FG**	**A 2 -325 CR**	**CT 3000 SG**	**A 16 SG**	**A 152 SG**	**CT 1200 SG**	**A 15 SG**	**CT 530 SG**
Surface Area	[m^2/g]	1.1	0.7	0.7	7.5	8.8	4.3	3.1	4.9	5.1
Ground D_{50}	[µm]	3.2	4.8	5.0	0.4	0.4	1.2	1.3	1.7	1.6
Green Density Pressing Pressure	[g/cm^3]				2.23 90 Mpa	2.21 34.5 Mpa	2.34 34.5 Mpa	2.38 90 Mpa	2.55 34.5 Mpa	2.60 90 Mpa
Fired Density Temperature / 1hr	[g/cm^3]				3.91 1540 °C	3.90 1540 °C	3.86 1620 °C	3.92 1670 °C	3.86 1670 °C	3.90 1670 °C
Shrinkage Temperature / 1hr	[%]				17.1 1540 °C	17.5 1540 °C	15.3 1620 °C	15.6 1670 °C	12.8 1670 °C	13.2 1670 °C
Al_2O_3	[%]	99.7	99.7	99.6	99.8	99.8	99.8	99.8	99.8	99.8
Na_2O	[%]	0.12	0.12	0.30	0.08	0.07	0.06	0.06	0.07	0.08
SiO_2	[%]	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04

Ready-to-Press Powder



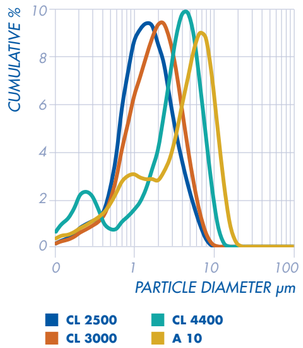
CT 3000 SDP: Spray dried powder granule

Spray dried powders are turnkey materials mainly used in isostatic and uniaxial pressing applications. While many manufacturers prefer to formulate their own pressing powder, others prefer the efficiency of procuring a ready-to-press product. Common applications for spray dried powders are for the production of semiconductor manufacturing supports, technical ceramics, wear parts, and household and medical devices.

Almatis spray dried powders are produced from thermally reactive aluminas CT 3000 SG and CT 3000 LS SG. The granule distribution, binder formulation and chemical purity provide an easy-to-press powder capable of achieving high fired density and strength. These properties combine to ensure its use in a wide variety of applications, particularly for semiconductor manufacturing and technical ceramics.

Product Properties		CT 3000 SDP	CT 3000 LS SDP
Surface Area	[m^2/g]	7.0	7.2
Ground D_{50}	[µm]	0.4	0.4
Granule D_{50} (Sieve)	[µm]	170	170
Green Density (90MPa)	[g/cm^3]	2.31	2.31
Fired Density (1600 °C/1hr)	[g/cm^3]	3.91	3.93
Shrinkage (1600 °C/1hr)	[%]	16.6	16.7
Al_2O_3	[%]	99.7	99.8
Na_2O	[%]	0.08	0.03
SiO_2	[%]	0.02	0.02

Electronic Substrates



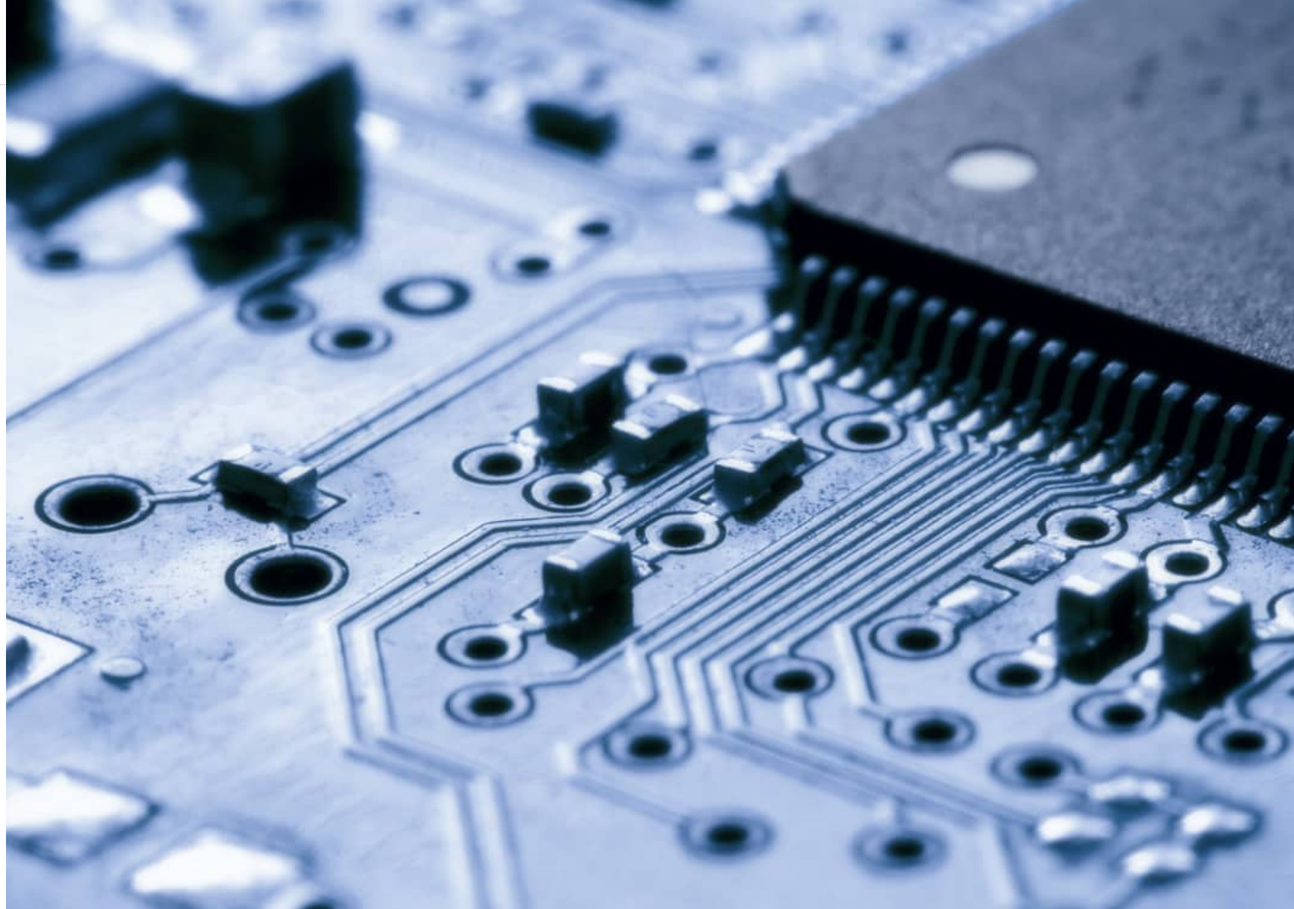
Electronic substrates are the base supports for production of electronic circuits used in computer chips, multi-chip modules, circuit boards and disk drives. Ceramic substrates are often tape cast or roll compacted into thick- or thin-film flexible sheets. The sheets are cut to size and are then available for a variety of processing steps such as being punched, filled and laminated, scribed and co-fired. Once fired, the co-fired package or sintered substrate may also have subsequent processing steps such as laser machining, lapping, polishing, etching or plating.

Mechanical strength, hardness and overall integrity are improved when alumina is added to formulations, as are thermal and electrical properties such as expansion coefficient, conductivity, dielectric constant and resistivity.

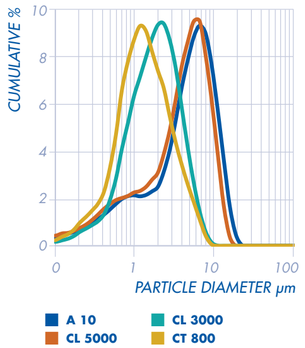
Almatis offers unground and continuous ground calcined aluminas for thick-, mid- and thin-film electronic substrates. We offer unground products for users that want to wet or dry process the alumina to achieve a desired particle size distribution, and continuous ground products for users that prefer to blend rather than grind the components. Our aluminas also feature low impurity levels, specifically low Na_2O content, for improved processing and final substrate properties.

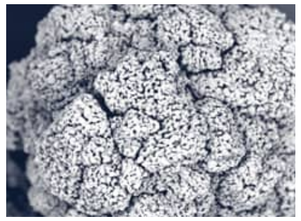
		UNGROUND				CONTINUOUS GROUND			
Product Properties		**CL 2500**	**CL 3000**	**CL 4400**	**A 10**	**CL 2500 SG**	**CL 3000 FG**	**CL 4400 FG**	**A 10 -325**
Surface Area	[m^2/g]	0.9	0.7	0.4	0.2	1.1	0.9	0.6	0.5
Primary Crystal / Ground D_{50}	[µm]	1.7	1.8	3.8	4.8	3.5	3.9	5.2	8.0
Al_2O_3	[%]	99.8	99.8	99.8	99.7	99.8	99.8	99.8	99.7
Na_2O	[%]	0.06	0.06	0.06	0.08	0.06	0.06	0.06	0.08
SiO_2	[%]	0.01	0.01	0.02	0.04	0.02	0.02	0.02	0.04

Primary crystal size determined by planetary grind.



Spark Plugs





SEM: Almatis CL 3000 unground

Spark plugs are a critical part of ignition systems in internal combustion engines and industrial applications. As the voltage differential between the electrodes exceeds the dielectric breakdown voltage of the gases in the chamber, the gases ionize and a spark is generated. The spark ignites the fuel/air mixture and typically facilitates a thermomechanical energy conversion.

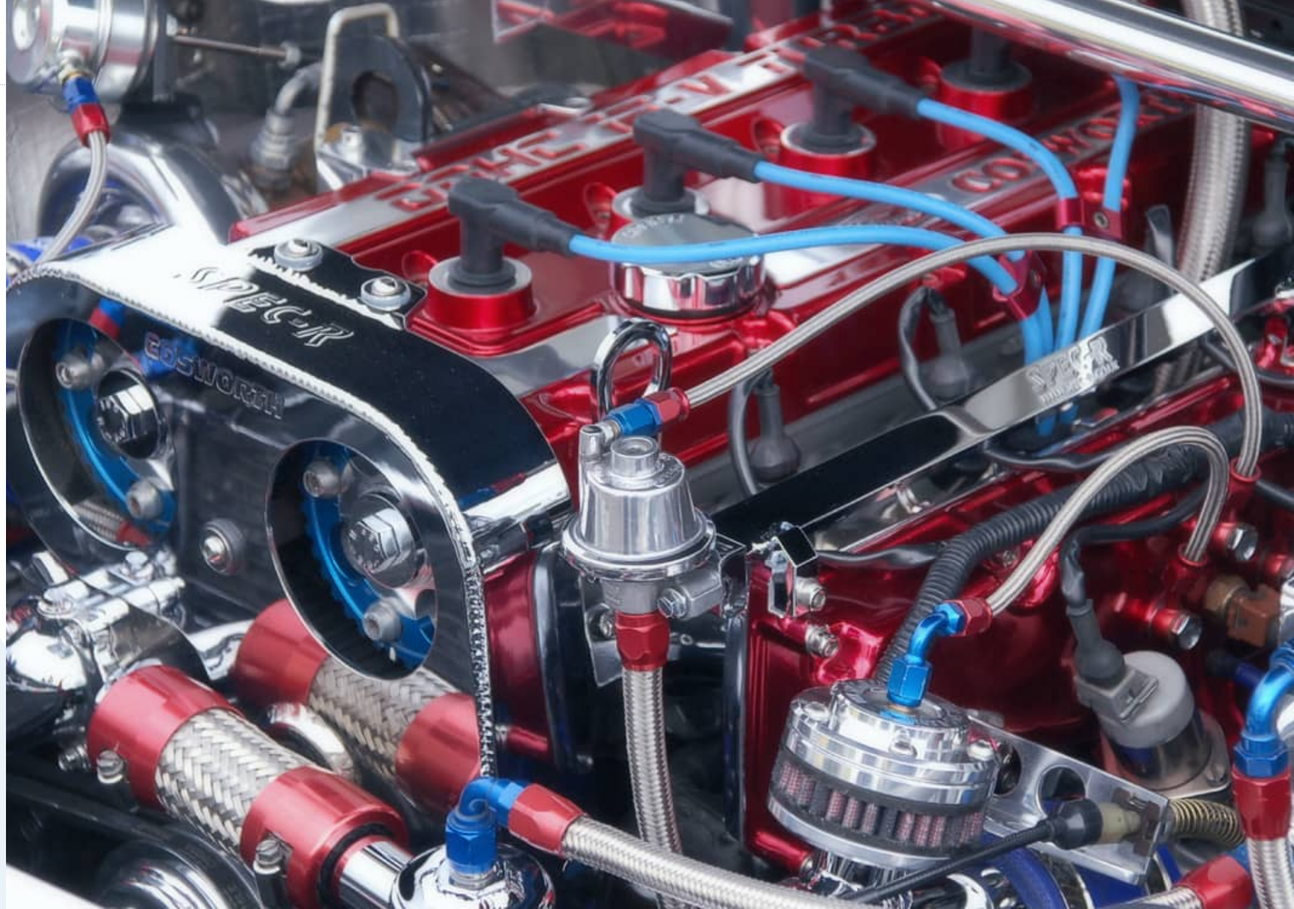
Alumina is used in the insulator, which insulates the central electrode and must have a high dielectric strength. As ignition technology evolves with a focus on energy efficiency, the spark plug is being subjected to higher voltages while the geometry is becoming increasingly elongated. These increased demands require a more robust insulator with thinner walls and higher dielectric strengths.

Almatis calcined aluminas for spark plug applications include coarse, medium and fine crystalline products with intermediate and low Na_2O levels. These products are easily processed in wet or dry grinding systems and provide tight shrinkage characteristics for the insulator body.

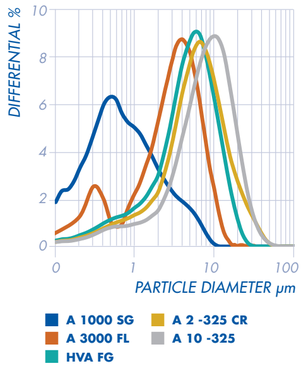
From standard bodies to high performance insulators, Almatis aluminas have consistently met the ever-tightening industry requirements of thinner walls and higher dielectric strengths for over 50 years.

Product Properties		CT 1200	CL 2500	CT 800	CL 3000	CT 700	CL 5000	A 10
Surface Area	[m^2/g]	1.1	0.9	0.7	0.7	0.6	0.3	0.2
Primary Crystal Size	[µm]	1.2	1.7	1.7	1.8	2.0	4.1	4.8
Green Density	[g/cm^3]	2.19	2.22	2.28	2.27	2.30	2.38	2.36
Al_2O_3	[%]	99.8	99.8	99.7	99.8	99.7	99.8	99.7
Na_2O	[%]	0.06	0.06	0.12	0.06	0.12	0.06	0.08
SiO_2	[%]	0.01	0.01	0.01	0.01	0.01	0.02	0.04

Unground particle size distributions determined by planetary grind.



Honeycomb Ceramics



SEM: Almatis HVA FG

Emissions control solutions are critical for reduction of greenhouse gases and particulates from sources such as mobile vehicles and stationary power plants. Global energy consumption is expected to rise over 50% in the next 30 years and the number of vehicles on the roadways will soon exceed 90 million. While these numbers are only expected to increase, particularly in developing areas, environmental regulations are getting tighter.

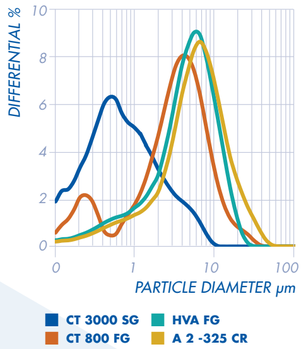
Honeycomb ceramics are substrates that support an active catalyst in emission control applications. Substrate consistency is necessary for the coating process, both to ensure adequate emissions regulation and because of the high value associated with the precious metals being used.

Almatis aluminas for honeycomb ceramic applications include batch and continuous ground products. Our fine crystalline aluminas are ground in batch ball mills to provide a narrow particle size distribution for use as the fines component of a mix or as a standalone component in a high performance product.

Our coarse crystalline aluminas are continuous ground to provide a broad distribution and air classified to minimize the +45µm agglomerates. The strict controls we place on our process ensure a consistent product for making reproducible, high-quality substrates.

		CONTINUOUS GROUND				BATCH GROUND		
Product Properties		**CT 800 SG**	**HVA FG**	**A 2 -325 CR**	**A 10 -325**	**CT 3000 SG**	**A 1000 SG**	**A 3000 FL**
Surface Area	[m^2/g]	1.0	0.7	0.7	0.5	7.5	8.2	1.6
Ground D_{50}	[µm]	3.2	4.8	5.0	8.0	0.4	0.6	1.9
Wet Mesh <45µm	[%]	99.9	99.4	99.2	99.0	99.9	99.8	99.9
Al_2O_3	[%]	99.7	99.7	99.6	99.7	99.8	99.8	99.8
Na_2O	[%]	0.12	0.12	0.30	0.08	0.08	0.07	0.07
SiO_2	[%]	0.02	0.02	0.02	0.04	0.03	0.03	0.02

Wear Parts

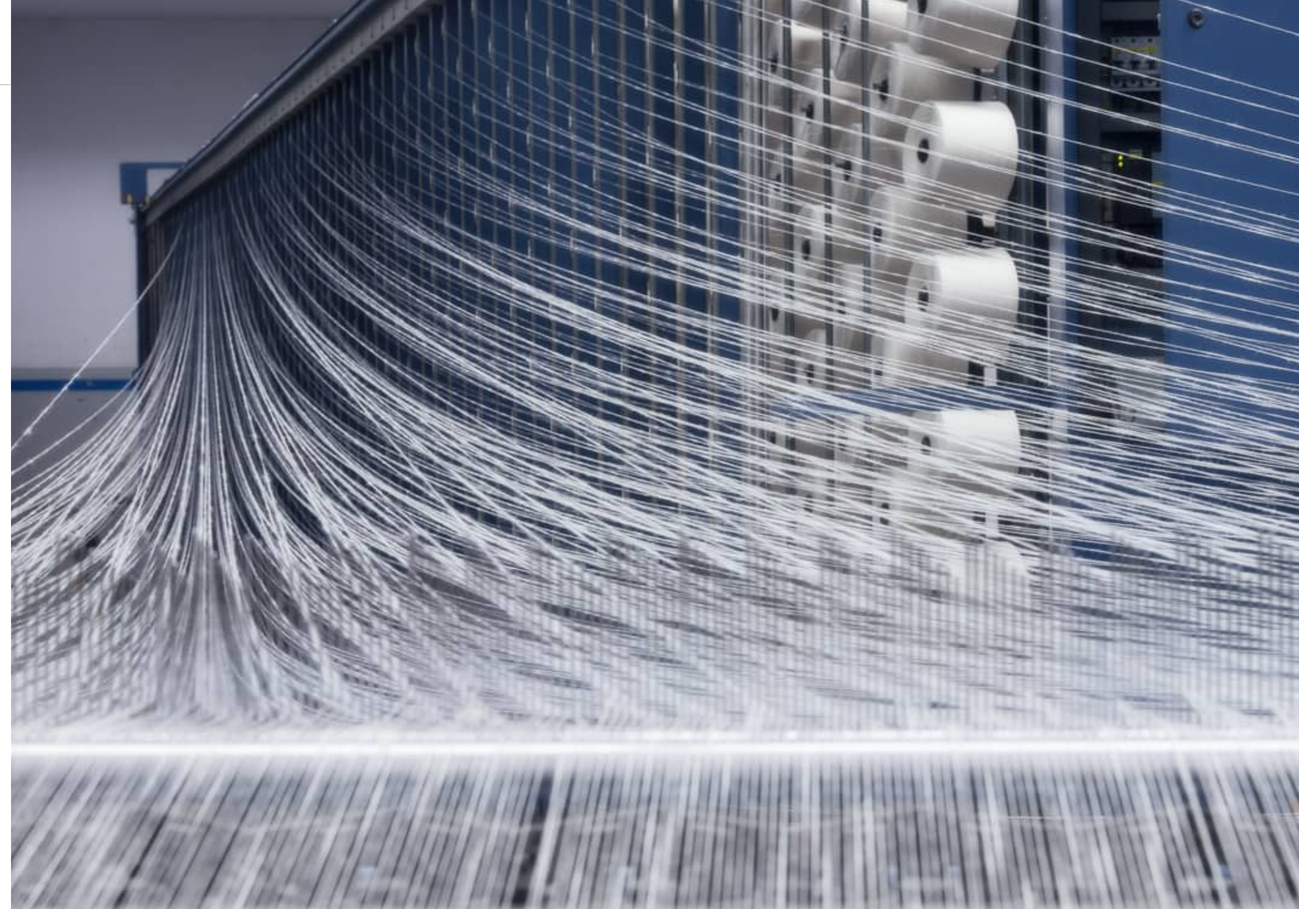


Wear parts are necessary to maintain high throughput manufacturing, such as processing pulp into paper or thread into fabric. The sheer volume and rates associated with these industries necessitate a minimal amount of operational downtime and therefore a certain longevity or lifetime in the supporting components. To ensure component longevity, ceramic wear parts are often incorporated into these operations, replacing similar metal or polymer-based parts.

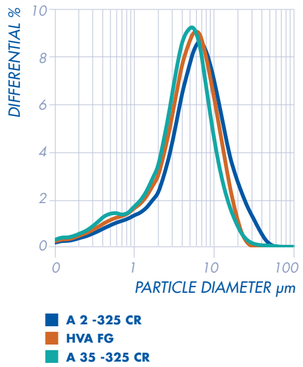
Alumina wear parts are commonly used in pulp and paper, textile, industrial grinding, food, pharmaceutical and medical industries. Parts such as wear liners, valves, plungers, tools, blades, cones, nozzles, tips, seals, bearings, tubes and rods are all made from alumina in order to survive particularly harsh manufacturing conditions.

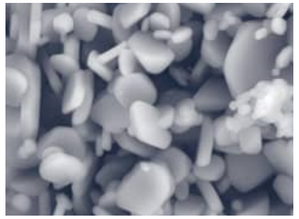
Almatis calcined aluminas for wear parts are available as unground, continuous ground and batch ground products. The product choice is dependent on processing capability, desired alumina content in the formulation and the end-use application. Lower alumina formulations typically use coarse crystalline, normal and intermediate soda products, such as A 2 and CT 800, or their continuous ground equivalents. As the alumina content in the formulation increases, the product choice usually transitions to an intermediate or low soda product such CL 2500 or CT 3000 SG.

		UNGROUND				CONTINUOUS GROUND		BATCH GROUND	
Product Properties		**CL 2500**	**CT 800**	**WRA**	**A 2**	**CT 800 FG**	**A 2 -325 CR**	**CT 3000 SG**	**A 1000 SG**
Surface Area	[m^2/g]	0.9	0.7	0.6	0.4	0.9	0.7	7.5	8.2
Primary Crystal / Ground D_{50}	[µm]	1.7	1.7	2.3	3.0	3.5	5.0	0.4	0.6
Wet Mesh <45µm	[%]	–	–	–	–	99.8	99.2	99.9	99.8
Al_2O_3	[%]	99.8	99.7	99.7	99.6	99.7	99.6	99.8	99.8
Na_2O	[%]	0.06	0.12	0.12	0.30	0.12	0.30	0.08	0.07



High Voltage Insulators





SEM: Almatis A 2 unground

Electrical insulators play a substantial role in electrical power distribution. Insulator posts provide non-conductive supports that ensure safe and reliable suspension of high voltage power lines. The insulators must also be able to withstand demanding mechanical, electrical and environmental conditions.

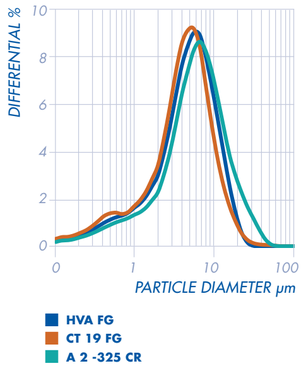
Alumina is used in high voltage insulators to increase dielectric and mechanical properties. Coarse crystalline, unground and continuous ground aluminas are recommended in order to maximize these important properties. When continuous ground aluminas are used, the particle size distribution should have a minimal +45µm fraction, as large residual agglomerates can lead to defects in the final insulator.

Almatis calcined aluminas for high voltage insulators are available in unground or continuous ground versions. Unground products need to be processed further by the user, while the continuous ground products are processed in closed-circuit continuous mill-classifier processes.

The ground D_{50} and residual +45µm content are controlled to ensure a consistent particle size distribution with minimal coarse agglomerates. For sensitive insulator applications or to achieve high mechanical and dielectric strengths, we recommend the usage of our coarse removed (CR) and fine ground (FG) products rather than our standard <45µm calcines.

		UNGROUND			CONTINUOUS GROUND		
Product Properties		**HVA**	**A 2**	**CT 19**	**A 35 -325 CR**	**HVA FG**	**A 2 -325 CR**
Surface Area	[m^2/g]	0.5	0.4	0.4	0.8	0.7	0.7
Primary Crystal / Ground D_{50}	[µm]	2.7	3.0	4.0	4.5	4.8	5.0
Wet Mesh <45µm	[%]				99.3	99.4	99.2
Al_2O_3	[%]	99.7	99.6	99.7	99.7	99.7	99.6
Na_2O	[%]	0.12	0.30	0.08	0.11	0.12	0.30

Porcelain and Whitewares



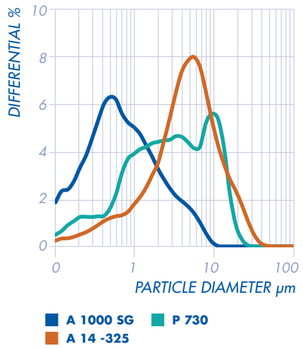
Whitewares refers to chinaware and sanitary ware for household applications. These products are typically porcelains that may be alumina containing. Though porcelain formulations can achieve the required alumina content using natural ores and minerals, the choice of synthetic alumina dramatically improves the properties of the final product because ofalumina's purity and controlled physical characteristics.

Alumina is used in chinaware and sanitary ware applications to improve thermal and mechanical properties. The improved thermal properties help food and beverages remain hot for longer periods. Improved mechanical strength helps facilitate the design and manufacture of thinner parts and complex geometries.

Almatis aluminas for whiteware applications are coarse crystalline continuous ground products. The coarse crystalline products provide improved thermal properties and the controlled particle size distribution results in improved strength and fewer defects as compared to natural ores or minerals. Our products are available in normal soda grades and also intermediate soda versions for when improved purity is critical to the application.

Product Properties		A 35 -325 CR	HVA FG	A 2 -325 CR	CT 19 FG
Surface Area	[m^2/g]	0.8	0.7	0.7	0.6
Ground D_{50}	[µm]	4.5	4.8	5.0	5.5
Wet Mesh <45µm	[%]	99.3	99.4	99.2	99.3
Al_2O_3	[%]	99.7	99.7	99.6	99.6
Na_2O	[%]	0.11	0.12	0.30	0.08

Catalyst Carriers



Catalyst carriers are porous substrate materials used in the chemical and petrochemical industries for refining liquids and gases into intermediate and end-use products. Refineries around the world convert naturally occurring liquids, gases and intermediates into usable products such as fuels, chemicals, oils and lubricants. The refining process involves cracking hydrocarbons at high temperatures and pressures in the presence of a catalyst.

Alumina is used in the production of catalyst carriers because of its high-temperature inert properties, making it a suitable substrate material to host the catalyst while not degrading its function or interacting with the chemical reactants. The pore structure of the catalyst carrier is critically important in the hydrocarbon cracking process, since it is where the reaction is catalyzed. Certain characteristics of the alumina powder can influence catalyst carrier pore size and distribution, therefore raw material consistency is critical in production of an effective carrier substrate.

Almatis calcined aluminas for catalyst carrier applications include unground, continuous ground and batch ground products. Our products feature tightly controlled particle size distributions and consistent surface areas to ensure a proper pore structure is achieved every time. We also offer different purity levels, particularly related to Na_2O content, to meet specific formulation needs. Certain formulations also require a hydraulic ceramic binder and Almatis offers 70% and 80% calcium aluminate cements to meet these needs.

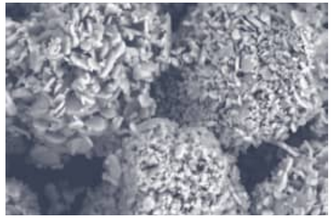
		UNGROUND			CONTINUOUS GROUND					BATCH GROUND	
Product Properties		**CL 2500**	**CL 3000**	**A 14**	**P 730**	**A 13 -325**	**CL 2500 SG**	**CL 3000 FG**	**A 14 -325**	**CT 3000 SG**	**A 1000 SG**
Surface Area	[m^2/g]	0.9	0.7	0.6	9.0	9.5	1.1	0.9	0.8	7.5	8.2
Primary Crystal / Ground D_{50}	[µm]	1.7	1.8	2.1	2.2	2.5	3.5	3.9	4.8	0.4	0.6
Al_2O_3	[%]	99.8	99.8	99.8	99.7	99.7	99.8	99.8	99.8	99.8	99.8
Na_2O	[%]	0.06	0.06	0.03	0.30	0.20	0.06	0.06	0.03	0.08	0.07

Glass

Alumina is added to glass formulations to improve mechanical strength, hardness, thermal and optical properties. These properties are important in end-use applications such as LCD glass, cover screens, armor, and fiberglass for industrial, marine and aerospace industries.

Batch consistency is critical in all glass applications and switching from a natural ore or hydrate source to synthetic alumina may provide a significant improvement. The low impurity levels of synthetic alumina allow the user to maintain more consistent batch chemistry, melt viscosity and flow behavior.

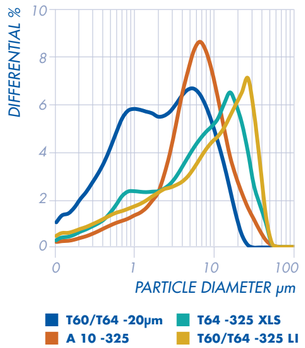
GMA is a series of fully calcined, unground aluminas specially designed for glass applications. These aluminas are greater than 99% Al_2O_3 purity and feature low moisture and loss on ignition levels and a range of alkali contents. The content of <45µm fines and +425µm coarse particles is controlled in order to meet the tight demands of specific glass applications and prevent stone formation. In specific instances when small kiln designs or high pull rates are being utilized, control of the <45µm fines can be critical.



SEM: Almatis GMA 30 NS

Product Properties		GMA 30 NS	GMA 30 IS	GMA 25 NS	GMA 30 LS	GMA 15 LS
Al_2O_3	[%]	99.5	99.6	99.5	99.7	99.7
Na_2O	[%]	0.40	0.28	0.40	0.12	0.12
SiO_2	[%]	0.03	0.03	0.03	0.03	0.03
Fe_2O_3	[%]	0.03	0.03	0.03	0.03	0.03
CaO	[%]	0.03	0.03	0.03	0.02	0.02
LOI (110 °C to 1100 °C)	[%]	0.2	0.2	0.2	0.2	0.2
+35mesh/0.425mm	[%]	0.01	0.01	0.01	0.01	0.01
+100mesh/0.150mm	[%]	4	3	4	3	3
+325mesh/0.045mm	[%]	78	78	82	78	88

Functional Fillers



Filler materials are used to enhance or improve the properties of a given product. Alumina is used as filler material for a wide variety of applications due to its advantageous physical and chemical properties. The alpha-phase of alumina has superior mechanical, thermal and electrically insulating properties compared to most other oxide materials and is one of the most inert oxides available.

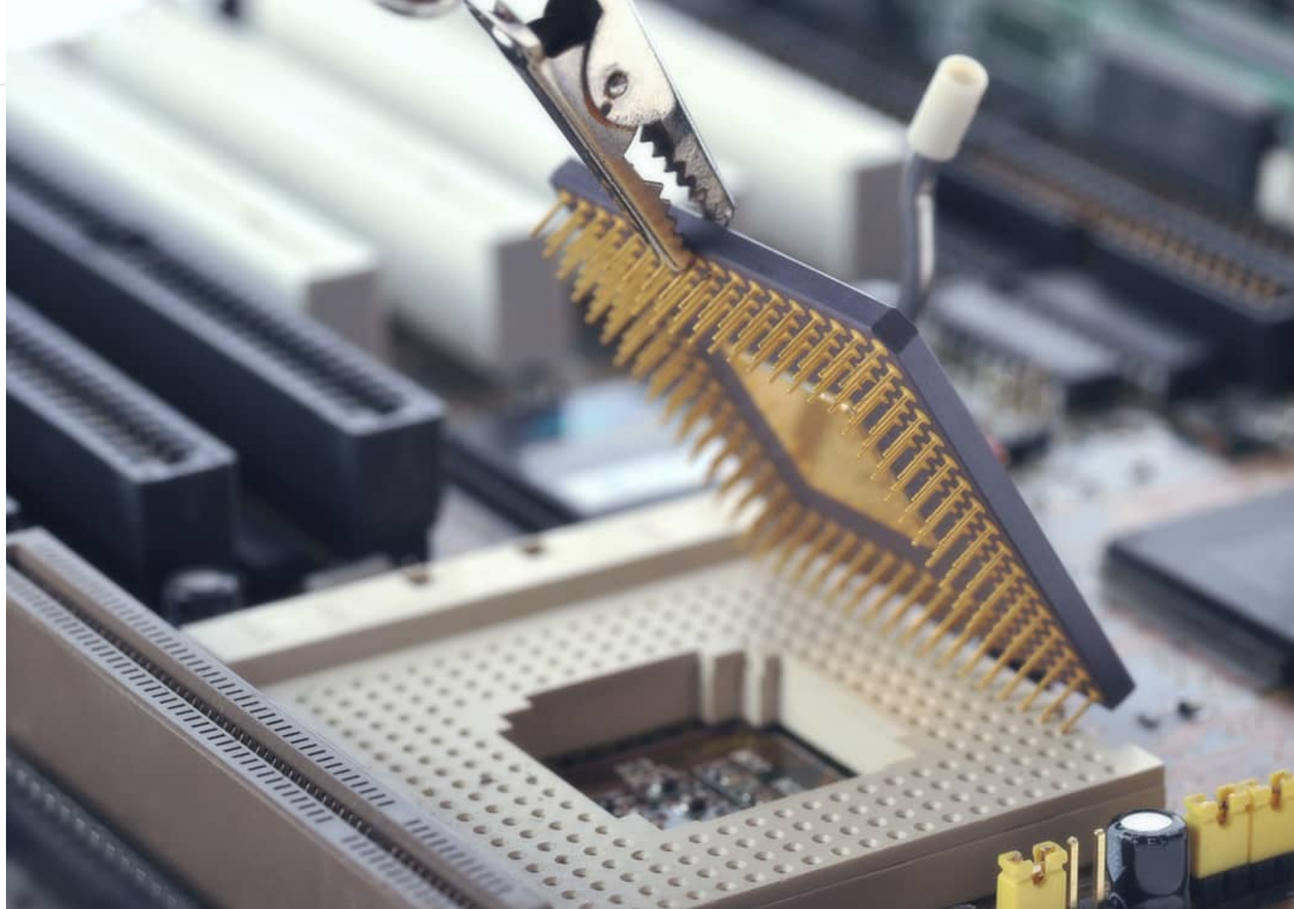
Many common filler applications include thermal management solutions for electronics, wear protection in coatings and lacquers, pigments and modifiers in paper and glazes, and strength improvement in composites.

Almatis offers ground calcined and tabular alumina products for filler applications. Specific focus on particle size consistency and control of the coarse tail of the distribution differentiate our products and improve their performance.

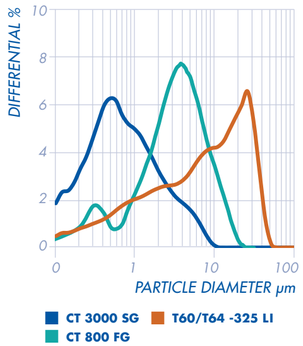
Our low soda and ultra-low soda tabular aluminas combine the properties of our standard aluminas with a low alkali content. The extremely low total Na_2O content results in even lower solubility of free Na^+, minimizing potential undesired chemical interactions between the alumina filler and matrix components.

SEM: Almatis T60/T64 -325 LI

		CALCINED ALUMINA				TABULAR ALUMINA			
Product Properties		**A 3500 SG**	**CL 4400 FG**	**A 10 -325**	**Gilox 63**	**T60/T64 -20µm**	**T64 -325 XLS**	**T64 -325 SP**	**T60/T64 -325 LI**
Surface Area	[m^2/g]	2.5	0.6	0.5	0.2	2.5	1.0	1.0	0.9
Ground D_{50}	[µm]	2.3	5.2	8.0	17.0	2.7	9.0	9.0	9.5
Wet Mesh <45µm	[%]	99.9	99.5	99.0	92.0	99.5	97.5	97.5	97.5
Al_2O_3	[%]	99.8	99.8	99.7	99.5	99.5	99.7	99.6	99.5
Na_2O	[%]	0.07	0.06	0.08	0.35	0.30	0.03	0.11	0.30



Ceramic Rollers



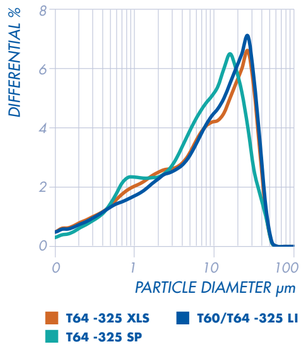
Ceramic tile production exceeds 10 billion square meters worldwide each year, making it one of the most popular choices for household, recreational, business and industrial applications. Tile sizes vary, but there is a trend towards using larger pieces, which are difficult to produce with flat surfaces.

Many of the rollers used today are alumina-containing. Alumina rollers outperform other materials because of their mechanical strength and creep resistance under high temperature and load conditions, which is particularly important in the firing of large tiles. Alumina rollers also have a longer application service life than other materials, making it the clear choice for high performance roller products.

Almatis offers specific tabular and calcined alumina products for ceramic roller production. Our particle size distributions are advantageous as compared to white fused alternatives due to higher particle packing. Ground calcined products can be added to increase alumina content and strength properties.

		CONTINUOUS GROUND CALCINES			CONTINUOUS GROUND TABULAR		CRUSHED TABULAR		
Product Properties		**CT 3000 SG**	**CT800 FG Q**	**CT 800 FG**	**T60/T64 -325 STD**	**T60/T64 -325 LI**	**T60/T64 -48 LI**	**T60/T64 48x200**	**T60/T64 -65**
Surface Area	[m^2/g]	7.5	1.0	1.0	0.8	0.9	–	–	–
Ground D_{50}	[µm]	0.4	3.0	3.5	8.5	9.5	–	–	–
Wet Mesh <45µm	[%]	99.9	99.8	99.8	96.5	97.5	–	–	–
+0.3mm	[%]	–	–	–	–	–	1	2	–
+0.25mm	[%]	–	–	–	–	–	3	–	–
+0.212mm	[%]	–	–	–	–	–	–	29	3
+0.125mm	[%]	–	–	–	–	–	29	47	12
+0.063mm	[%]	–	–	–	–	–	–	–	38
+0.045mm	[%]	–	–	–	–	–	29	3	41
Al_2O_3	[%]	99.8	99.7	99.7	99.5	99.5	99.5	99.5	99.5
Na_2O	[%]	0.08	0.12	0.12	0.30	0.30	0.30	0.30	0.30

Investment Casting



Investment casting is used to produce parts with complex geometries and tight tolerances. Alumina is used in the shell building process to provide strength, creep resistance and thermal management during casting. Regulating heat transfer is critical in the solidification process and facilitates the casting of metals with different grain structures.

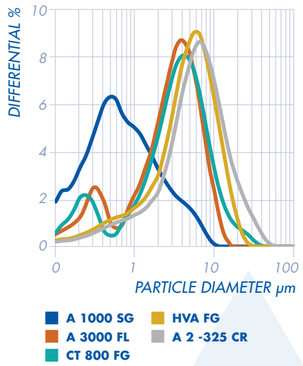
Alumina is used in investment casting depending on the melting temperature, solidification behavior and desired grain structure of the metal. The most common metals cast in alumina-containing molds are vacuum cast superalloys and titanium alloys, which are typically used in commercial aerospace, defense and industrial gas turbine applications.

Almatis ground flour products have a broad particle size distribution to allow for higher solids loadings and plate weights. The reduced alkali content of our low and ultra-low soda flours improve slurry stability and lifetime.

Almatis stucco products have the benefit of consistent distribution and minimal fines to prevent dusting during shell application. Reduced dust improves stucco adherence to the dip coat and also provides a safer and cleaner operating environment.

		CONTINUOUS GROUND TABULAR (FLOUR)			CRUSHED TABULAR (STUCCO)			
Product Properties		**T64 -325 XLS**	**T64 -325 SP**	**T60/T64 -325 LI**	**T60/T64 14x28**	**T64 14x28 XLS**	**T60/T64 28x48**	**T64 28x48 XLS**
Surface Area	[m^2/g]	1.0	1.0	0.9	–	–	–	–
Ground D_{50}	[µm]	9.0	9.0	9.5	–	–	–	–
Wet Mesh <45µm	[%]	97.5	97.5	97.5	–	–	–	–
+1.4mm	[%]	–	–	–	1	1	–	–
+1.0mm	[%]	–	–	–	19	19	–	–
+0.71mm	[%]	–	–	–	50	50	1	1
+0.5mm	[%]	–	–	–	96	96	11	11
+0.25mm	[%]	–	–	–	–	–	81	81
+0.212mm	[%]	–	–	–	–	–	97	97
Al_2O_3	[%]	99.7	99.6	99.5	99.5	99.7	99.5	99.7
Na_2O	[%]	0.03	0.11	0.30	0.30	0.03	0.30	0.03

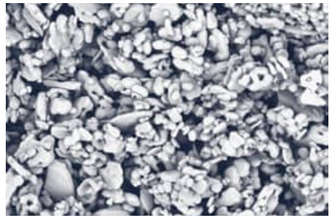
Porous Ceramics



Porous ceramics are often used as filters for metal castings. These filters must effectively remove slag impurities or inclusions and remain inert to the metal to prevent oxidation. The filters must also have controlled thermal properties, such as expansion and shock resistance, as they often are subjected to temperature fluctuations or cyclic conditions.

Alumina is used in ceramic foam filters as an inert substrate material that can withstand the temperatures required for molten metal casting. Alumina-based foam filters are used for primary aluminum casting, foundry castings of steel, aluminum and other non-ferrous alloys, investment casting, and chemical processing.

Almatis aluminas for porous ceramic applications include soft and hard calcined aluminas available in continuous ground and batch ground versions. These aluminas have controlled crystal morphology, tight particle size distributions and specified impurity levels to ensure consistent performance and chemical inertness.



SEM: Almatis CL 2500 SG

		CONTINUOUS GROUND					BATCH GROUND			
Product Properties		**CT 800 FG**	**CL 2500 SG**	**CT 9 FG**	**HVA FG**	**A 2 -325 CR**	**CT 3000 SG**	**A 1000 SG**	**CTC 20**	**A 3000 FL**
Surface Area	[m^2/g]	0.9	1.1	0.9	0.7	0.7	7.5	8.2	2.0	2.5
Ground D_{50}	[µm]	3.5	3.5	4.3	4.8	5.0	0.4	0.6	1.8	2.7
Al_2O_3	[%]	99.7	99.8	99.7	99.7	99.6	99.8	99.8	99.7	99.8
Na_2O	[%]	0.12	0.06	0.10	0.12	0.30	0.08	0.07	0.12	0.07

Metal Filtration and Regeneration Burners

Metal Filtration

Almost 50 million metric tons of aluminum are produced globally, serving primary end-use markets for transportation, packaging, engineering and construction. Impurity and slag removal is a critical part of the ingot casting process. Filter beds filled with tabular alumina products are an excellent choice to achieve necessary quality requirements while maintaining high throughput rates during production.

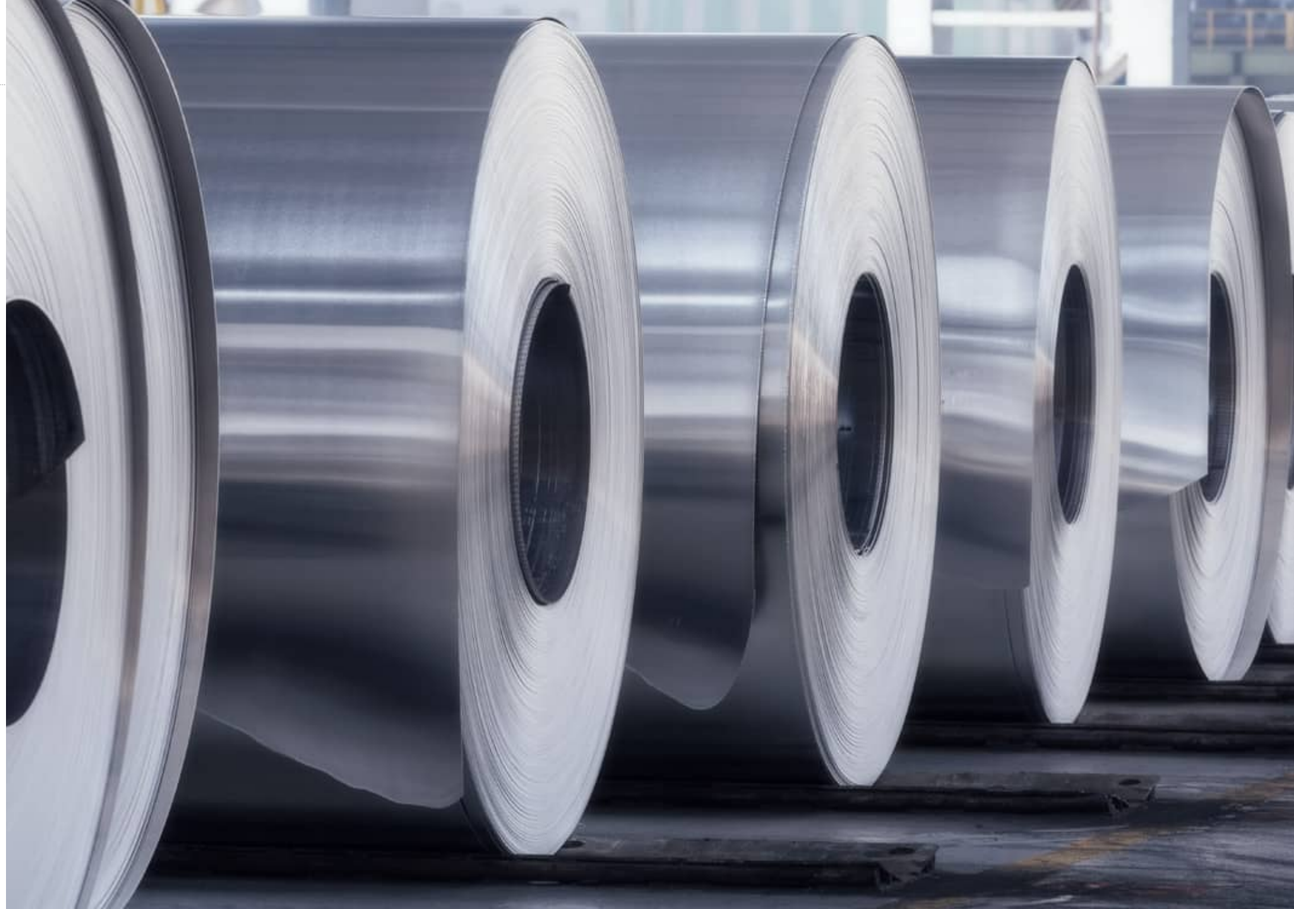
Regeneration Burners

Aluminum production requires a high amount of energy consumption and furnace efficiency is critical. Recycling furnace exhaust gases to pre-heat combustion air allows for higher fuel efficiency and reduction in emissions, particularly NO_x and CO_x. Tabular alumina support balls are used to facilitate the heat transfer process in order to maintain an efficient and robust system.

Almatis Tabular Aluminas for metal filtration and regeneration burner applications include various sized support media and crushed aggregates. Our spherical and round support media can withstand challenging thermal cycling conditions and ensure efficient heat recycling. The 18mm and 19mm media are also effective as the filter bed support base for metal casting.

Our crushed aggregates are the perfect complement to filter bed supports because of their particle size distribution, minimal fines content and low levels of soluble ions. For especially critical alloy castings where embrittlement is a concern, we offer an ultra-low soda product. For processes where fines elimination is critical, washed products are also available.

		COARSE AGGREGATE			ROUND & SPHERICAL SUPPORT MEDIA			
Product Properties		**T64 3x6 XLS**	**T60/T64 3x6**	**T64 3x6 Tabalox**	**T-160/FBA 18mm**	**T-162 19mm**	**T-162 25mm**	**T-162 37mm**
Crystal Phase		α	α	α	α	α	α	α
Bulk Specific Gravity	[g/cm³]	3.45	3.55	3.55	3.55	3.65	3.65	3.65
Al_2O_3	[%]	99.6	99.4	99.4	99.4	99.7	99.7	99.6
Na_2O	[%]	0.03	0.30	0.30	0.30	0.20	0.20	0.20



Alumina Expertise Starts in our Research Labs

ALMATIS APPLICATION LAB LOCATIONS:

- *Bauxite, Arkansas, USA*
- *Leetsdale, Pennsylvania, USA*
- *Rotterdam, Netherlands*
- *Ludwigshafen, Germany*
- *Falta, India*
- *Qingdao, China*

For over 100 years Almatis has been at the forefront of alumina-based research, striving to develop, improve and perfect our products and processes. Our innovative products and solutions have supported the refractory, ceramics and polishing industries for decades, allowing our customers to develop cutting edge products and advance their businesses.

Our knowledgeable technical team understands the needs of our customers and their demanding applications. We focus on customer service and support, helping our customers learn and understand more about our products, their properties and the test methods used to ensure their high quality.

Almatis has dedicated applications and development laboratories in all major geographic regions of the world. Our labs focus on advancing our in-depth product knowledge and providing support to the various industries we supply.

Through cooperation and collaboration, our alumina-based product expertise can help you succeed in overcoming your next development challenge.

ALUMINA FOR CERAMICS

	UNGROUND CALCINED ALUMINAS																			CONTINUOUS GROUND CALCINED ALUMINAS																			BATCH GROUND CALCINED ALUMINAS													SELECT TABULAR ALUMINAS																			CEMENT	
PRODUCT	P 25	A 10	CT 19	CL 5000	CL 4400	A 14	CL 3000	CL 3000	CL 2500	CT 1200	A 2	A 35	HVA	WRA	CT 700	CT 800	GMA	A 13	Gilox 63	A 10 -325	CT 19 FG	CL 4400 FG	A 14 -325	CL 3000 FG	CL 3000 SG	A 2 -325	A 2 -325 CR	A 35 -325	A 35 -325 CR	HVA FG	WRA FG	CT 800 FG	CT 800 SG	CT 800 FG Q	A 13 -325	P 730	CT 3000 LS SG	A 16 SG	CT 3000 SG	A 1000 SG	A 1000 SGD	A 152 SG	A 152 SG/NM	A 152 GS/NM	CT 1200 SG	A 15 SG	CT 530 SG	CTC 20	A 3000 FL	A 3500 SG	CT 3000 SDP	CT 3000 LS SDP	T60/T64 -20µm	T60/T64 -325 LI	T64-325 SP	T64-325 XLS	T60/T64 -48mesh	T60/T64 -65mesh	T60/T64 1.4x28	T60/T64 28x48	T60/T64 3x6	T64 3x6 XLS	T64 3x6 XLS Tabalox	T-162 25mm	T-162 19mm	T-160 18mm	FBA 18mm	CA-14 M	CA-25 R
Higher Purity Ceramics						■		■		■													■	■													■																																		
Technical Ceramics		■		■	■			■		■						■						■		■			■		■			■				■	■		■	■	■	■	■	■	■	■		■	■	■	■																
Electronic Substrates		■		■	■	■	■	■	■	■												■		■	■																																												
Spark Plugs		■		■			■	■	■	■			■		■	■				■		■		■	■						■						■	■				■			■																						
Honeycomb Ceramics																			■		■		■					■		■	■		■		■		■	■	■	■	■					■						■																
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Porous Ceramics																											■			■	■				■			■	■	■								■	■																		
Wear Parts							■	■	■			■	■	■		■										■				■	■				■			■	■	■																											
High Voltage Insulators			■					■				■	■	■														■	■	■	■	■	■																																		
Porcelain & Whitewares			■									■						■			■							■	■	■	■	■	■	■		■																														
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Ceramic Rollers										■																					■	■	■				■																																
Metal Filtration & Regeneration Burners																																																																						
Glass						■					■	■	■				■	■																																																					

*All data contained in this brochure represent typical properties obtained by Almatis test methods and are not intended to be taken as guaranteed values or specifications.

Almatis is committed to the global and secure supply of premium alumina products. Our focus on quality enables us to offer high-performance products with a long service life.

Our premium alumina products are made to global standardized specifications to facilitate supply from any plant to any region. Additionally, we offer tailor-made product solutions to specific market and customer needs.

Global quality and health and safety standards are rigorously applied in all our locations around the world. Almatis manufacturing facilities comply with EHS standards and ISO 9001, ISO 14001, and OHSAS 18001 to ensure high and consistent quality, while protecting the environment as well as our employees and contractors.

Almatis has a worldwide network of technical and sales specialists that understand application requirements and the latest market trends. Their in-depth knowledge allows the development of innovative new product solutions to enhance our customers' business. Six regional research and application laboratories work in close cooperation with our customers to optimize formulations and solve all application challenges.

For you, our customer, Almatis specialists are here to help.

For solutions to your alumina needs, contact us at ***ceramics@almatis.com***

THE ALMATIS WORLD – CLOSER TO THE CUSTOMER

USA
Almatis, Inc.
501 West Park Road
Leetsdale, PA 15056

Phone +1 800 643 8771
Phone +1 412 630 2800

Germany
Almatis GmbH
Lyoner Straße 9
60528 Frankfurt

Phone +49 69 957 341 0

India
Almatis Alumina Private Limited
Kankaria Estate, 2nd Floor
6, Little Russel Street
Kolkata 700-071

Phone +91 33 2289 4694

P.R. China
Qingdao Almatis Co. Ltd.
No.1 Song Hua Jiang Road
Qingdao Economic &
Technology Development Zone
Qingdao, 266510

Phone +86 532 8572 8035

Japan
Almatis Limited
Morimura Bldg.
1-3-1 Toranomon
Minato-ku, Tokyo 105-8451

Phone +81 3 3502 2371

Brazil
Almatis do Brasil Ltda.
Avenida Jose de Souza Campos, 243
2° Andar – Cambuí
Campinas, SP 13025-320

Phone +55 19 3515 1400

Germany
Almatis GmbH
Giulinstrasse 2
67065 Ludwigshafen

Phone +49 621 5707 0

Think alumina, think Almatis.