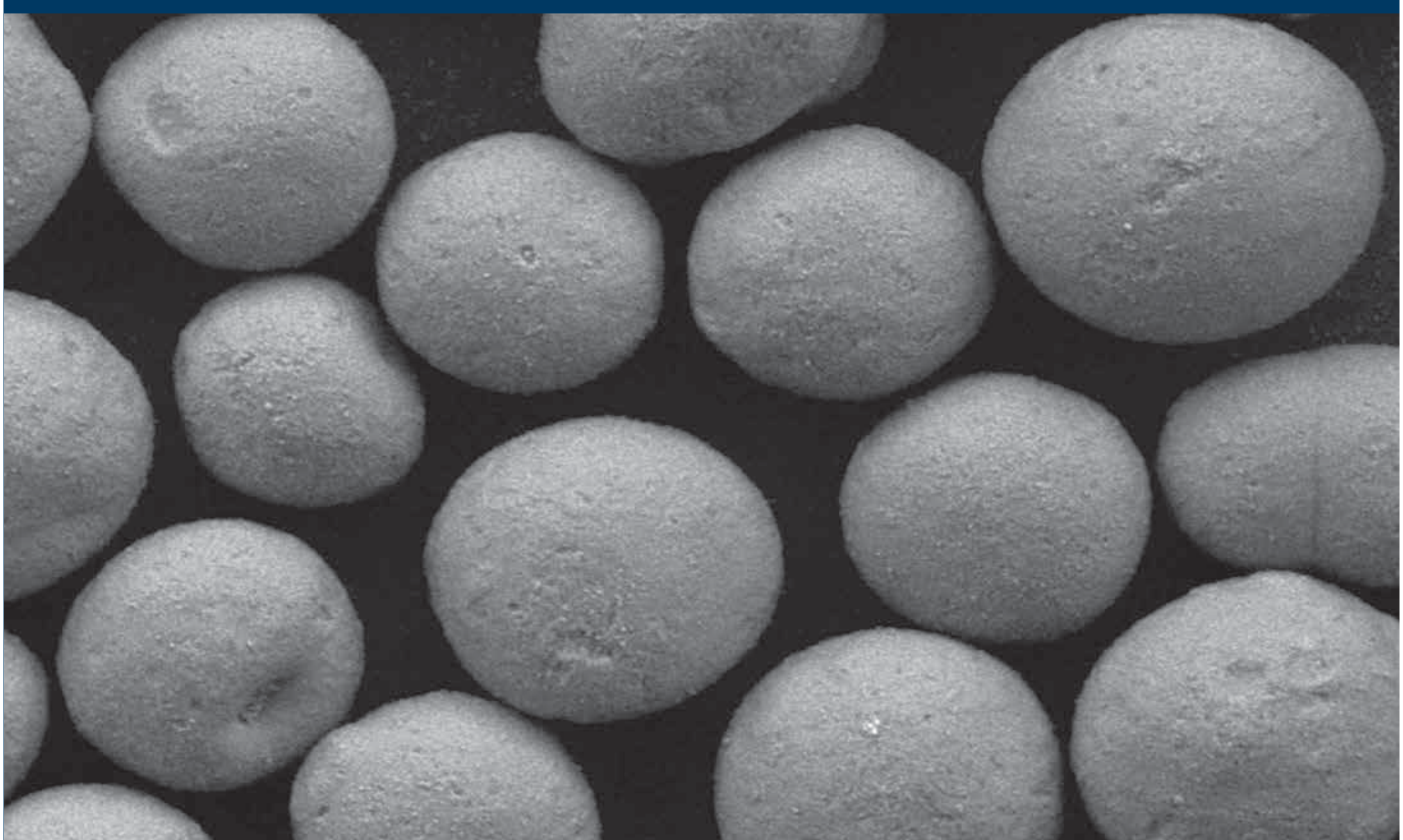
PURALOX
CATALOX
High-purity calcined aluminas

Sasol Chemicals



About us

We at Sasol Chemicals innovate for a better world and deliver long-term value to our customers, communities and society.

Our broad portfolio of high-value products plays an integral role in the creation of numerous solutions that benefit the lives of millions of people.

Thousands of companies around the world leverage our technology, world-class facilities, expertise and collaborative approach to tackle their challenges.

Content

1. Alumina production process

Sasol Inorganics produces high- and ultra high-purity aluminas primarily through synthetic aluminum alkoxide processing routes. The alumina is produced either as co-product with synthetic linear alcohols (Ziegler method) or directly from aluminum metal (on-purpose route).

Several production steps must be completed to produce the different alumina-based products. In the first step, an aqueous intermediate (alumina slurry) is produced, which is further tailored in the subsequent processing steps to obtain the various products sold on the market. These can be alumina hydrates, calcined aluminas and doped versions thereof.

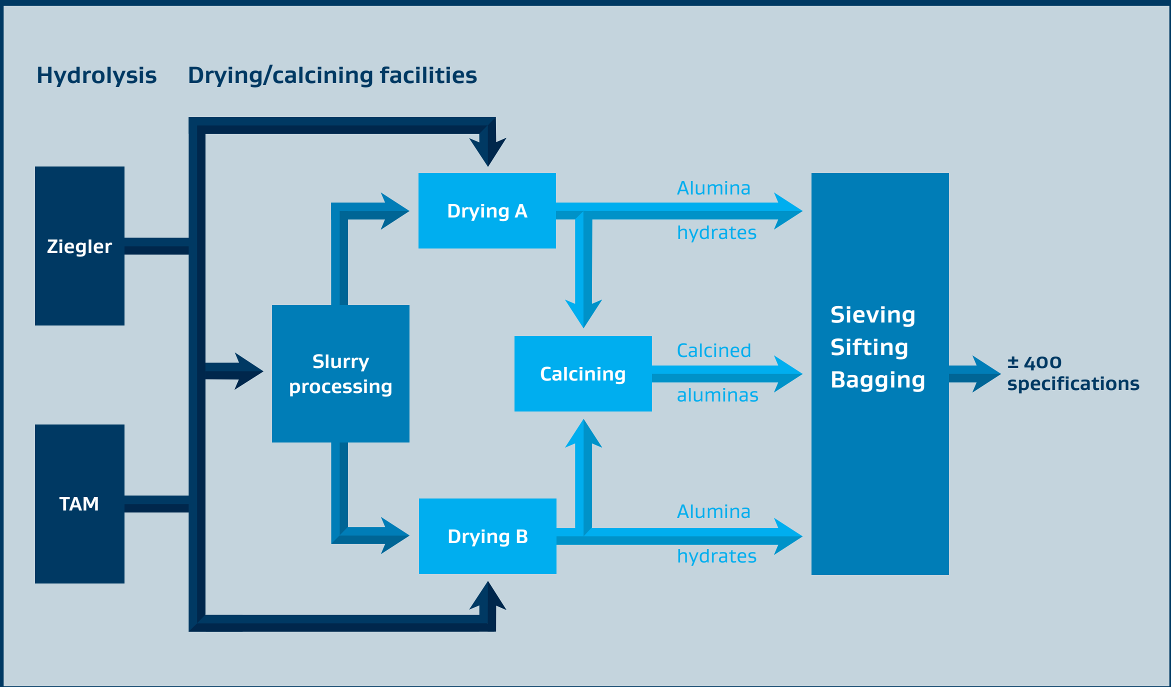


Figure 1: Schematic for the alumina manufacturing process

2. PURALOX/CATALOX

2.1 High-purity aluminas

PURALOX and **CATALOX** are the trademarks for the aluminium oxides derived from the controlled activation of **PURAL** and **CATAPAL** high-purity alumina hydrates. **PURAL** and **CATAPAL** are the respective trademarks of synthetic, high-purity boehmite (AlOOH) and bayerite ($Al(OH)_3$), manufactured in Brunsbüttel, Germany, and Lake Charles, USA. The proprietary process used in the preparation of these high-purity aluminium oxides allows Sasol to control many important physical properties and hence “tailor-make” a product for your needs. Both **PURALOX** and **CATALOX** are available as white, free flowing powders with high purity and consistency. Due to the precisely controlled processing conditions during and after manufacturing these aluminium oxides, **PURALOX** and **CATALOX** make excellent starting materials for the catalyst industry. They provide excellent specific catalytic activities, high surface area stability, and low attrition loss.

PURALOX and **CATALOX** are arguably the best starting materials for the catalyst industry where consistency and an stable nature of the support is highly desired. These characteristics are of great importance for fluid and slurry bed applications. Due to their high thermal stability, **PURALOX** and **CATALOX** are widely used raw materials for washcoat formulations in environmental emission control catalysts. Recent developments have found other suitable uses for these materials in applications outside catalysis such as polishing, chromatography, adsorbents and gas separation.

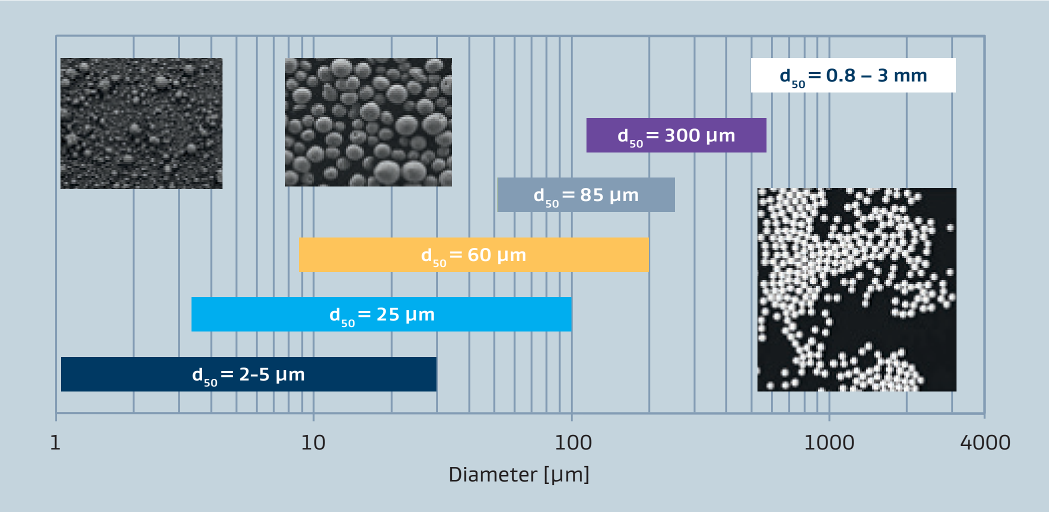
2.2 Advantages of PURALOX and CATALOX

Unlike other alumina manufacturing processes which use less pure bauxite derivatives as a starting material, Sasol has pioneered a process based on aluminium alkoxide which produces synthetic alumina hydrates of high purity. Examples of some trace impurities are shown in table 1. Sasol produces aluminium oxides with a wide range of possible particle size distributions (Figure 2).

Dry-milled versions of our alumina are available under the tradenames **PURALOX UF** and **CATALOX UF** as well. These ultra fine materials comprise mean particle sizes in the range of typically 2–6 µm, which can be tailored upon customer request.

Ultra high-purity grade **(PURALOX UHPA)** are available upon request (as shown in table 2).

Figure 2:
Areas of particle size distribution of **PURALOX** and **CATALOX** aluminas



Chemical purity of PURALOX and CATALOX aluminas

Impurity	ppm (typical)
Na_2O	<20
Fe_2O_3	50–100
SiO_2	50–120

Table 1

Purity of PURALOX UHPA aluminas

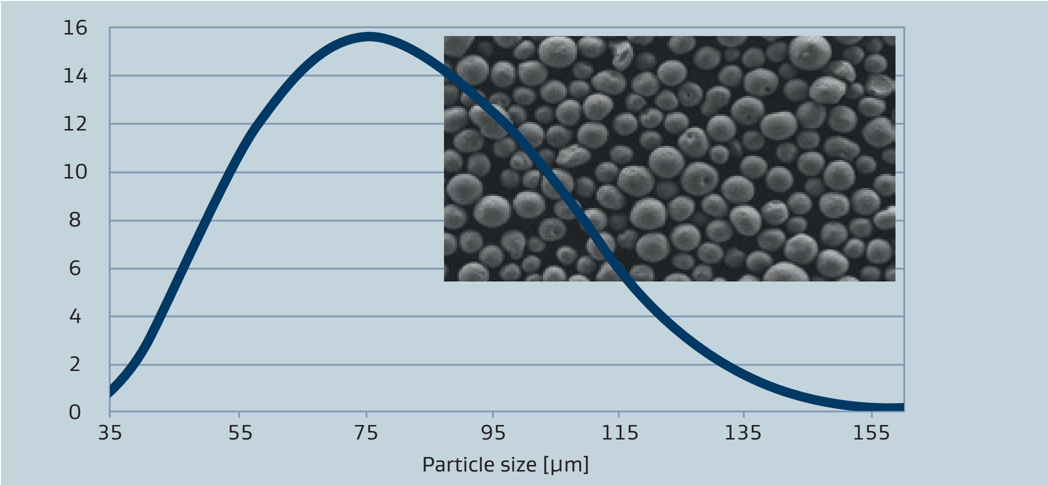
Impurity	ppm (typical)
Na_2O	1
Fe_2O_3	3
SiO_2	3

Table 2

2.3 PURALOX and CATALOX for fluid bed application

The unique ability of Sasol to adjust certain physical properties makes the aluminas perfect for a variety of applications. For example, fluid bed applications demand for rather coarse aluminas that also exhibit a high level of attrition resistance. Our **PURALOX SCCa** and **CATALOX SCCa** series is optimized to meet these requirements. Figure 3 shows a typical particle size distribution. Other ranges are also available upon request.

Figure 3:
Particle size distribution and SEM-picture of a typical **PURALOX SCCa**-product

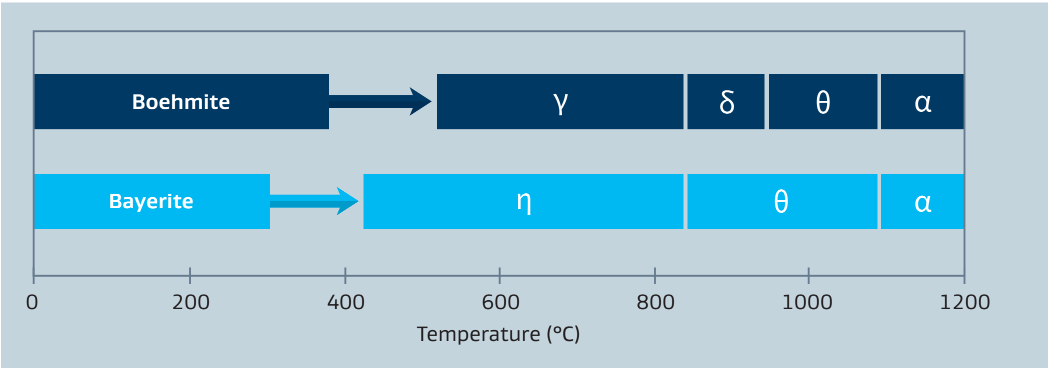


2.4 Calcination

The final crystalline phase and physical properties of the alumina depend on the physical properties of the starting material as well as the calcination process. Our calcined aluminas are predominantly based on high-purity boehmite as the starting alumina hydrate.

Typical calcination temperatures of the boehmite lie within 600 – 1,100 °C. Applying such temperatures, the physically and chemically bound water is removed, transforming the hydrate into an oxide. High temperature calcination leading to α-Alumina can also be applied.

Figure 4:
Sequence of phase transitions



The physical properties of the aluminum oxides are to a large extent adjusted at the stage of the corresponding hydrates by varying their crystallite size and shape. This way, aluminas with tailored porosities are accessible, ranging from high-density to high-porosity materials. These two border cases are illustrated in figure 5.

Properties such as the crystalline phase, surface area and porosity can be altered significantly by varying the calcination process. Figure 6 shows a graphic representation of the relationship between the surface area, pore volume and average pore radius. Depending on the physical characteristics of the initial alumina hydrate Sasol is able to prepare aluminum oxides with various pore volumes.

Figure 5:
Electron tomography of
a) high-density
b) high-porosity
aluminas showing different crystallite arrangements.

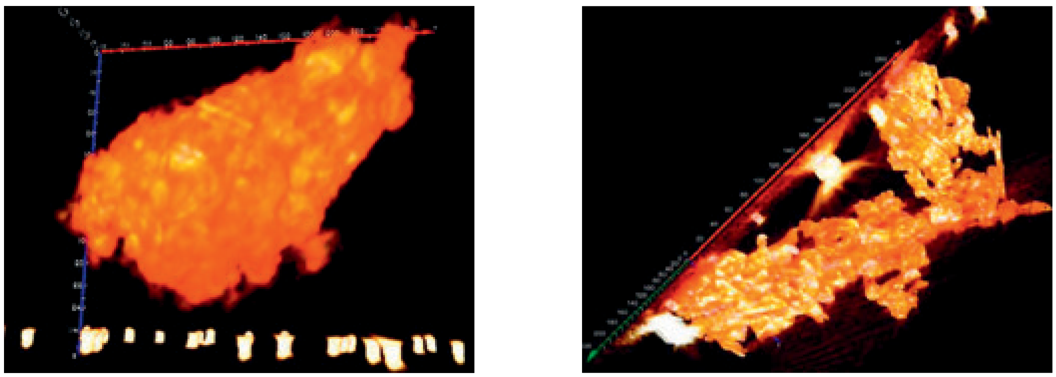
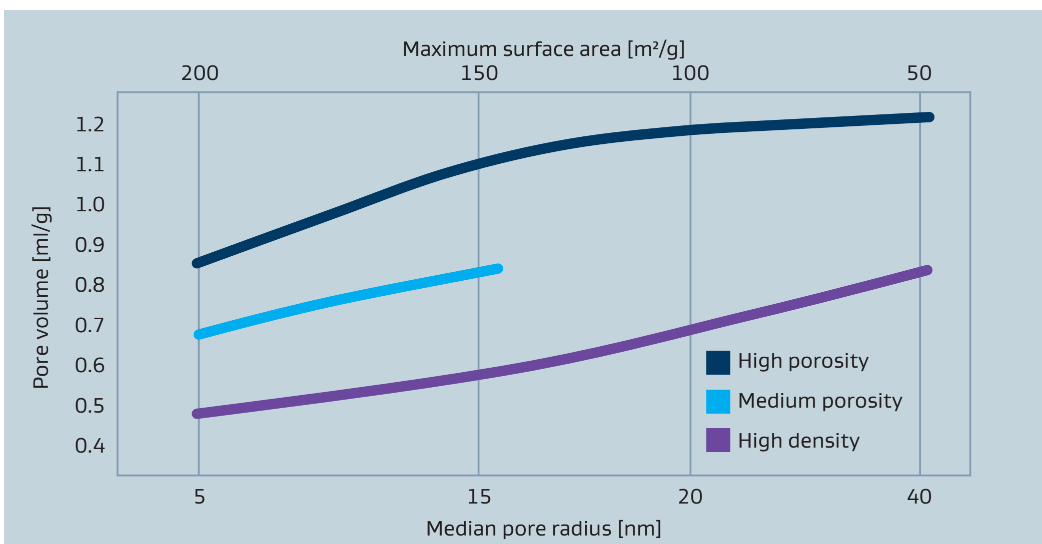

a) b)

Figure 6:
Alumina grades with different porosities



2.5 Doped aluminas

Sasol aluminas are also available as doped or even multi-doped versions (e.g. Si, Mg, La, Ce, Zr). The resulting interplay of well-defined physical properties and chemical modifications is a further step towards optimized support materials for various applications like emission control or refinery catalysts. As an example, the addition of lanthanum-oxide improves the thermostability of the base alumina as it can be seen in figure 8.

More details about doped aluminas can be found in our "Doped Aluminas" brochure.

Figure 7:
SEM-EDX illustration of a La-doped alumina

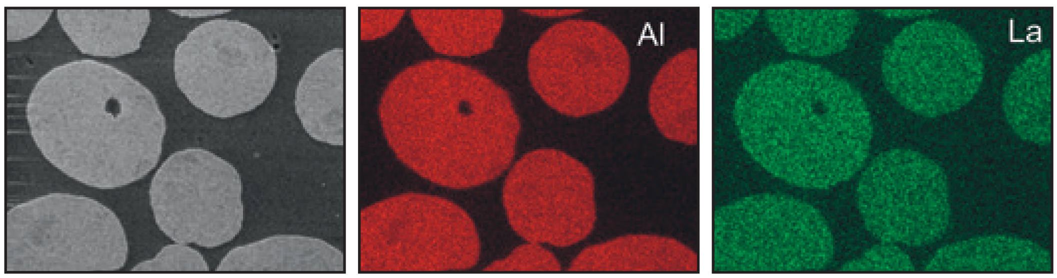
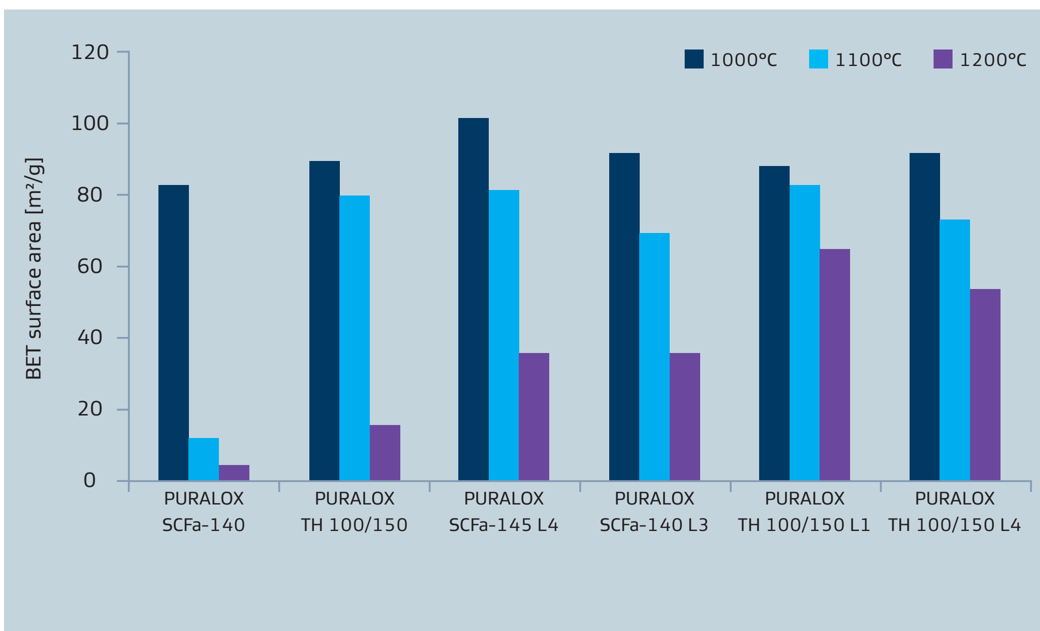


Figure 8:
Thermostability of pure, La-doped aluminas



3. Technical data

3.1 High-density aluminas

Typical chemical and physical properties		PURALOX/CATALOX SBa series	PURALOX/CATALOX SCFa series	PURALOX/CATALOX SCCa series	PURALOX/CATALOX SCFa-140 L3	PURALOX/CATALOX SCFa-145 L4
Al_2O_3	[%]	>99.7	>99.7	>99.7	97	96
Na_2O	[%]	0.002	0.002	0.002	0.002	0.002
La_2O_3	[%]	–	–	–	3	4
L.O.I.	[%]	2	2	2	2	2
Loose bulk density	[g/l]	500–800	500–800	600–850	500–700	550–750
Particle size (d_{50})	[µm]	45	25	60–150*	30	30
Range of s. a. (BET)**	[m²/g]	90–210	90–210	90–210	140	145
Pore volume	[ml/g]	0.35–0.50	0.35–0.50	0.35–0.50	0.5	0.5
Pore radius	[nm]	4–10	4–10	4–10	8	7
Thermal stability:						
Surface area: 24h/1100 °C	[m²/g]	15	15	15	80	90
Surface area: 24h/1200 °C	[m²/g]	5	5	5	40	40

3.2 High- and medium-porosity aluminas

Typical chemical and physical properties		CATALOX 18HPA 150	PURALOX TH 100/150	PURALOX TM 100/150	PURALOX TH 100/150 L4
Al_2O_3	[%]	99.7	>99.7	>99.7	96
Na_2O	[%]	0.002	0.002	0.002	0.002
La_2O_3	[%]	–	–	–	4
L.O.I.	[%]	4	2	2	2
Loose bulk density	[g/l]	200–600	300–500	300–500	30–500
Particle size (d_{50})	[µm]	20	35	35	35
Range of s. a. (BET)**	[m²/g]	120–180	150	150	150
Pore volume	[ml/g]	0.7–1.2	0.8–1.1	0.7–1.0	0.8–1.0
Pore radius	[nm]	9.5–15	11	11	11
Thermal stability:					
Surface area: 24h/1100 °C	[m²/g]	60	80	50	80
Surface area: 24h/1200 °C	[m²/g]	5.6	20	10	50

Chemical purity: C: 0.05 %, SiO_2: 0.01–0.015 %, Fe_2O_3: 0.005–0.015 %, TiO_2: 0.01–0.30 %

* Figures show the range of particle size distribution (d_{50}) available upon request.
** Figures show the range of surface areas (+/- 10m²/g) available on request.

Further specialty grades are available upon request.
Analytical methods see page 14.


sasol

4. Product information

4.1 Storage and transfer

PURALOX and **CATALOX** aluminas are dry, pure aluminium oxides, however, since all aluminas adsorb atmospheric moisture, facilities should be designed to avoid excessive exposure to moist air. By excluding moisture from the storage of alumina, shelf life is extended. **PURALOX** and **CATALOX** are abrasive materials.

Therefore, handling and storage equipment should be abrasion resistant carbon steel, aluminium or polypropylene-lined steel.

4.2 Safety and handling

PURALOX and **CATALOX** aluminas are classified as a non-toxic, non-flammable nuisance dust. Exposure to high concentrations of dust may cause physical irritation. Repeated or prolonged exposure with skin may result in dryness and irritation.

Handling procedures should be designed to minimize inhalation and skin exposure. Normal good housekeeping and operating procedures should ensure personnel safety.

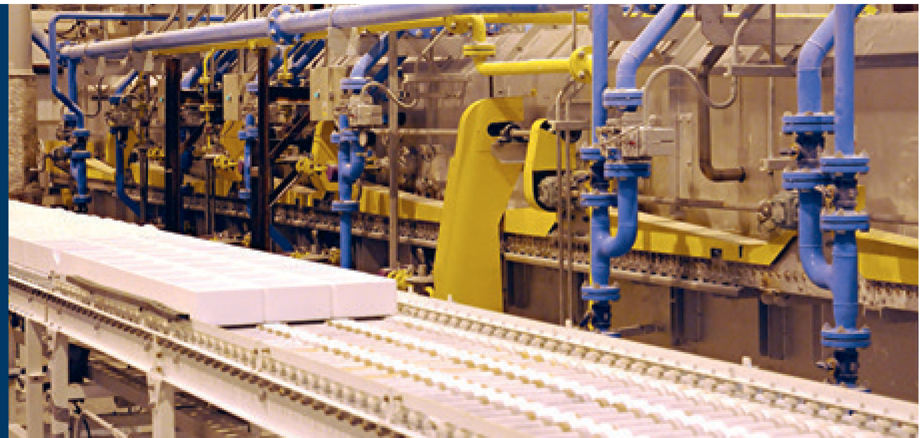
For doped aluminas please check the corresponding material data safety sheet.

4.3 Technical support

Sasol is committed to customer satisfaction and we offer a full range of technical support to complement the products.

Technical sales and support is available worldwide to help you choose the right alumina for your end use, as well as to provide guidance on the aluminas' safe and efficient handling.

The products described in this brochure are small indications of our capability. We look forward to discussing specific technical requirements with you in detail so that together we can develop unique products for your application.

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5. Certifications

All Sasol Chemicals locations worldwide are certified to DIN ISO 9001/14001and to OHSAS 18001 standards (Occupational, Health and Safety Assessment Series), and the German plants additionally comply with EMAS III (Eco Management and Audit Scheme).

Our production sites operate according to an internationally recognized, integrated quality, environmental and safety management system that has been established at the sites for many years.

6. Analytical methods

6.1 Element analysis

Alumina powder is quantitatively brought into solution by using acids and then analyzed by ICP, atomic emission. Additionally, X-ray fluorescence spectroscopy is used.

6.2 Identification of crystalline phases

Powdered samples of the alumina are analyzed by using X-Ray Diffractometry (XRD) on either a Siemens D5000 or a Philips X'Pert diffractometer. The resulting powder patterns allow for identification of the crystalline compounds of the materials.

6.3 Particle size distribution

The particle size distribution of alumina may be measured by various instruments, namely, Cilas Granulometer 1064 supplied by Quantachrome, Malvern Mastersizer or Luftstrahlsieb (air sieve) supplied by Alpine.

6.4 Surface area analysis*

The surface area of the alumina is measured by using an instrument supplied by Quantachrome (Nova series) or by Micromeritics (Gemini series). The method entails low temperature adsorption of nitrogen at the BET region of the adsorption isotherm.

6.5 Pore volume and pore size distribution*

The porosity is measured by nitrogen adsorption and desorption using Autosorb instruments supplied by Quantachrome.

6.6 Differential scanning calorimetry (DSC)

Netzsch STA 449C Jupiter, Setaram 92 or Perkin Elmer instruments may be used with a selected heating rate to obtain the exothermic and endothermic transitions of alumina. Additional test methods are available for other physical properties upon request.

* after thermal treatment at 550 °C for three hours

At your service

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Advanced Materials

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Source reference:
Cover: Sasol Germany GmbH, p. 3: Sasol Ltd., p. 5 - 9, p. 11, p. 13, p. 15: Sasol Germany GmbH

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