

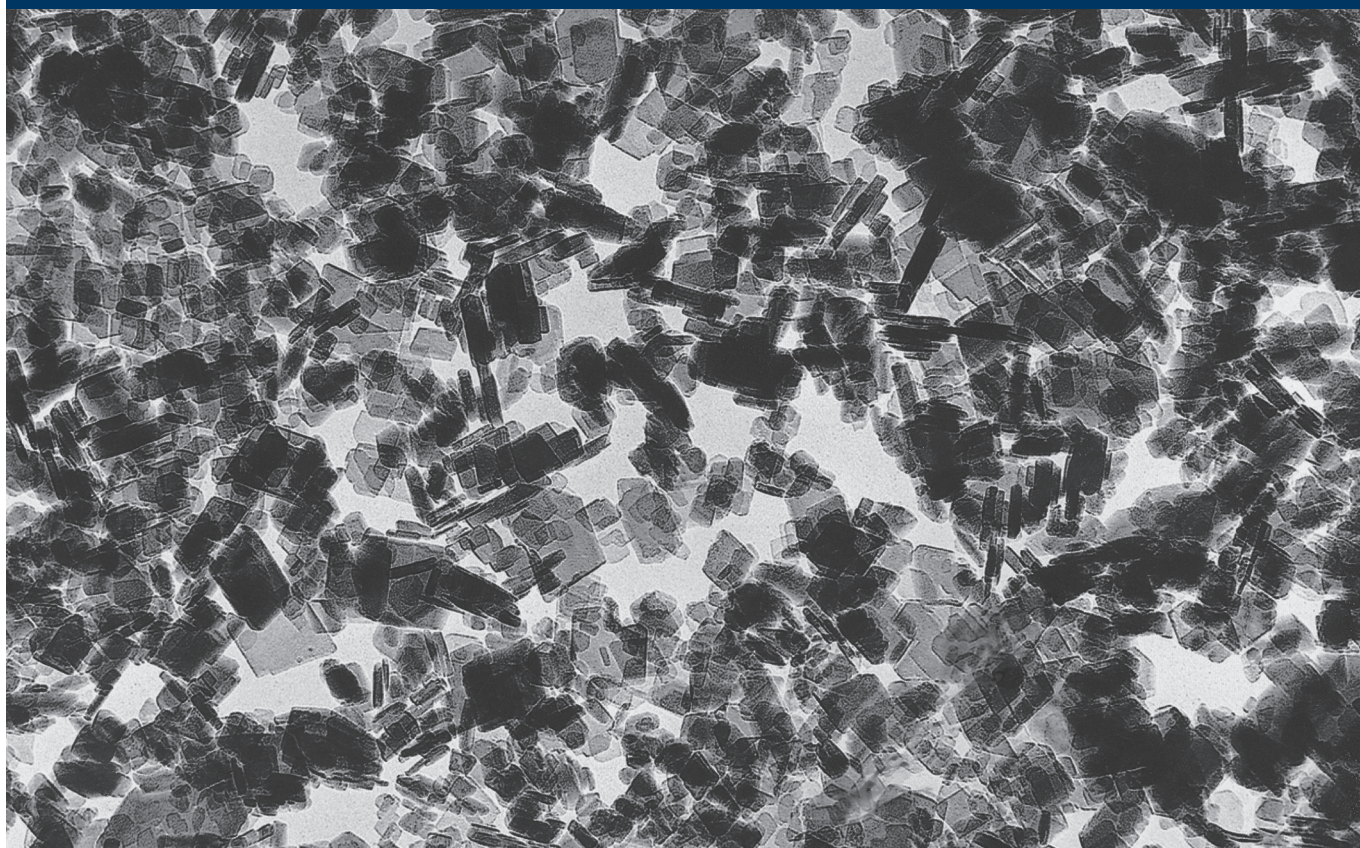


SASOL

PURAL CATAPAL

High-Purity Alumina Hydrates

Sasol Performance Chemicals



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About Us

Sasol Performance Chemicals develops and markets a broad portfolio of organic and inorganic commodity and specialty chemicals and comprises three key business divisions: Organics, Advanced Materials and Wax. Our offices in 18 countries serve customers around the world with a multifaceted portfolio of state-of-the-art chemical products and solutions for a wide range of applications and industries.

Surfactants, surfactant intermediates, fatty alcohols, linear alkyl benzene (LAB), short-chain linear alpha olefins, mineral oil-based and synthetic paraffin waxes, high-purity and ultra-high-purity alumina as well as high-quality carbon solutions form the basis of our key product range.

As individual as the industrial applications they serve, the tailor-made solutions offered by our products create real business value for customers. Ongoing research activities result in a continuous stream of innovative product concepts that help our customers position themselves successfully in future markets.

Our products are used in countless applications in our daily lives to add value, security and comfort. Typical examples include detergents, cleaning agents, personal care, construction, paints, inks and coatings, metalworking and lubricants, hot-melt adhesives, bitumen modification and catalyst support for automotive catalysts and refineries as well as other specialty applications including oil and gas recovery, agriculture, plastic stabilization, and polymer production. Every day, our researchers explore ways to improve our products and develop innovations that improve the quality of people's lives.



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.

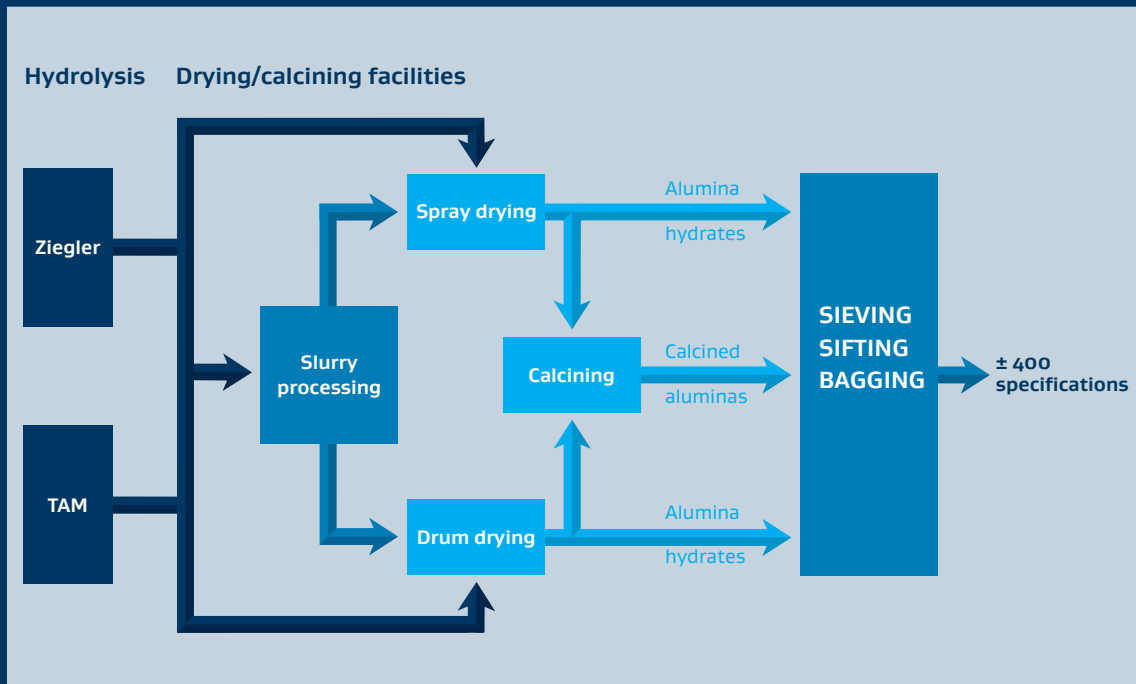


Figure 1: Schematic for the alumina manufacturing process

2. PURAL/CATAPAL

2.1 High-Purity Alumina Hydrates

PURAL and CATAPAL are the respective tradenames for the high-purity alumina hydrates manufactured in Brunsbüttel, Germany, and Lake Charles, Louisiana, USA. PURAL and CATAPAL are available as white, free-flowing powders whose unique combination of purity and controllable physical properties make them excellent starting materials for many products. This family of alumina hydrates (boehmite, AlOOH , and bayerite, $\text{Al}(\text{OH})_3$) has historically been chosen as supports or binders for catalysts in refinery and chemical processes. Recent developments in many other applications have demonstrated these unique aluminas have applications in areas far beyond catalysts.

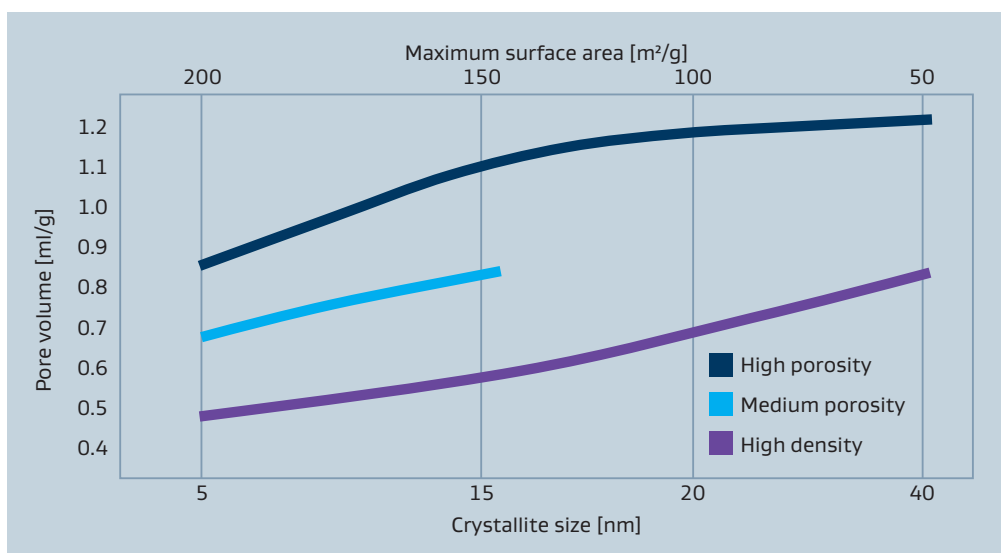


2.2 Advantages of PURAL and CATAPAL Alumina Hydrates

Sasol pioneered processes to convert aluminium metal to synthetic alumina hydrates of high-purity (figure 1). Unlike other alumina manufacturing processes that start with bauxite derivatives, our processes yield aluminas with significantly lower levels of common impurities such as iron, sodium and silica (as shown in table 1). Additionally, our 50 years of alumina manufacturing experience allows us to control and adjust physical properties such as surface area and porosity (figure 2), particle size (figure 3), crystal size and shape (figure 4) and peptization behavior (figure 5) so that our customers are not limited in their thinking for possible uses for the aluminas.

Ultra-high-purity grades (PURAL UHPA) are available upon request.

Figure 2:
Relationship between
crystallite size, pore volume



Chemical purity of PURAL and CATAPAL Alumina Hydrates	
Impurity	ppm (typical)
Na ₂ O	<20
Fe ₂ O ₃	50–100
SiO ₂	50–120

Table 1

Purity of PURAL UHPA Alumina Hydrates	
Impurity	ppm (typical)
Na ₂ O	1
Fe ₂ O ₃	3
SiO ₂	3

Table 2

Figure 3:
Examples of particle size distributions
of PURAL and CATAPAL

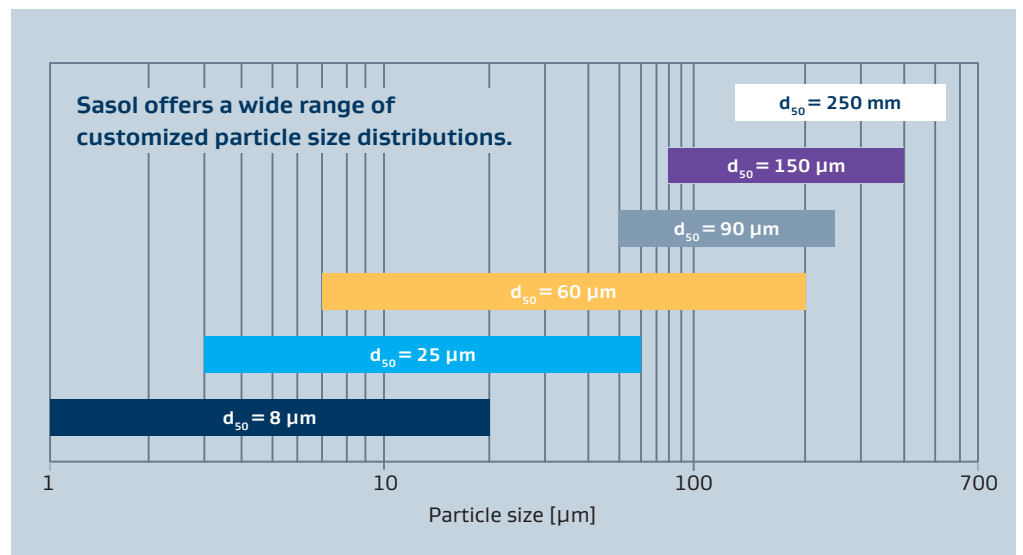


Figure 4:
Boehmite of different crystal shapes

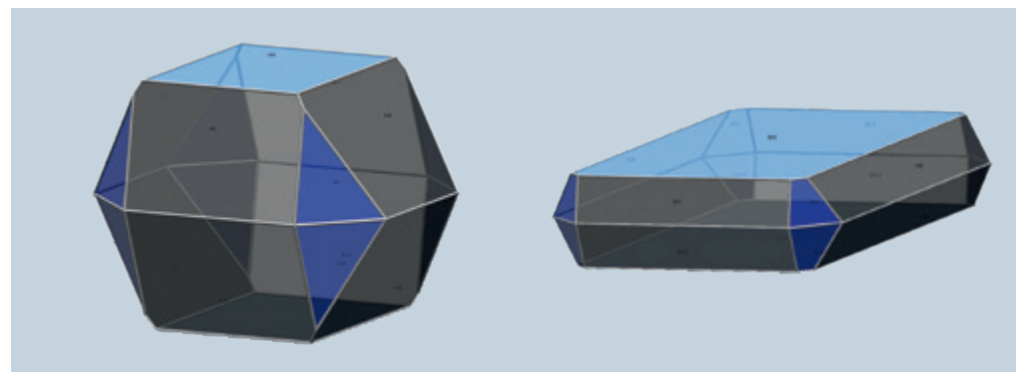
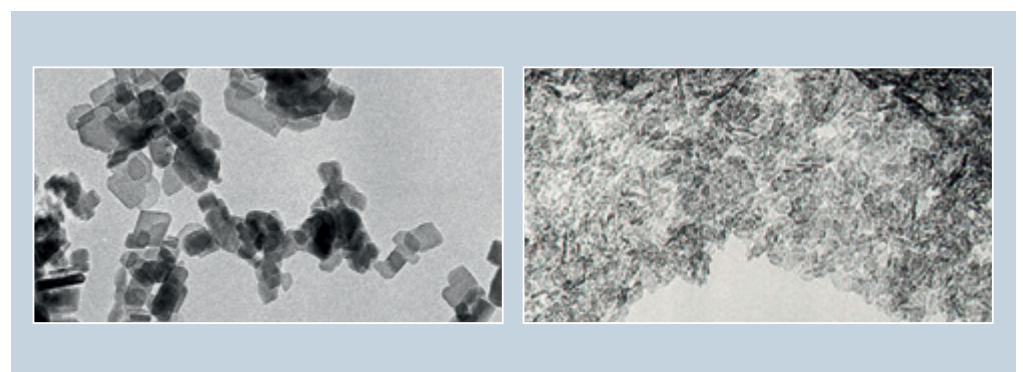


Figure 5:
TEM images of boehmite
with different crystallite sizes



2.3 Processing of PURAL and CATAPAL

The unique ability to adjust the physical properties of the boehmites makes them perfect for a variety of different end use applications requiring different types of processing.

2.4 Extrusion Behavior

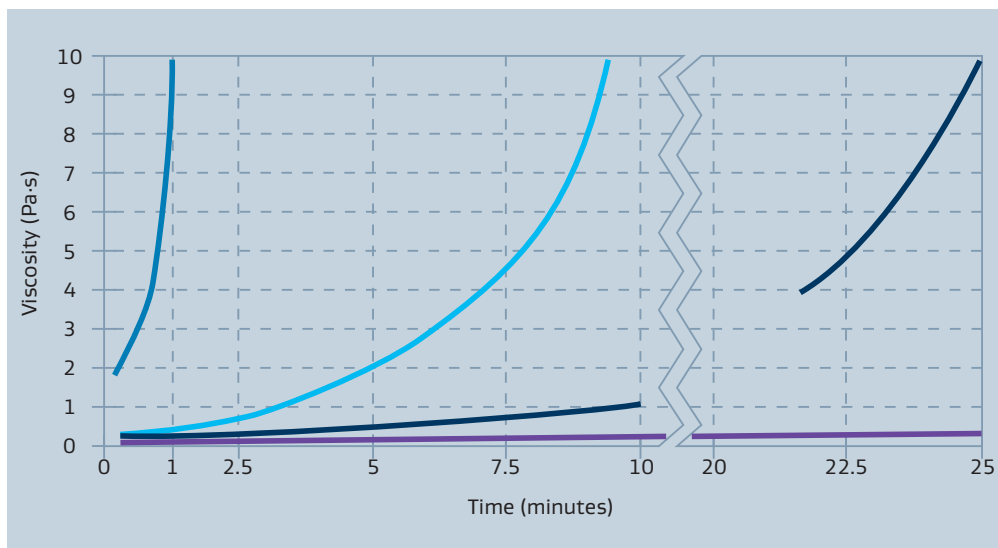
Extrusion is a key use for these types of alumina hydrates due to their ability to form excellent extruded supports. This application takes advantage of the ability to peptize in the presence of organic/inorganic acids.

A wide variety of extrudate properties can be obtained by using different grades of PURAL and CATAPAL and by controlling the formulation and extrusion variables. Optimum formulations depend on the exact choice of mixer, extruder and powder properties. General extrusion guidelines can be recommended by our technical staff.

Our unique ability to adjust the peptization behavior means that the gelling behavior of PURAL and CATAPAL can be modified to supply a product optimized for our customers' own unique set of processing conditions. Nitric acid gelation time (NAG) is a valuable tool for selecting the right material for your processing conditions.

NAG is the time required for a concentrated dispersion of boehmite to reach a certain viscosity by peptization. This behavior is shown in figure 6 and illustrates the range of NAGs we are able to produce on our customers' request. The graph is not meant to indicate the only NAGs available.

Figure 6:
Viscosity behavior of
boehmite dispersions
having different NAG values

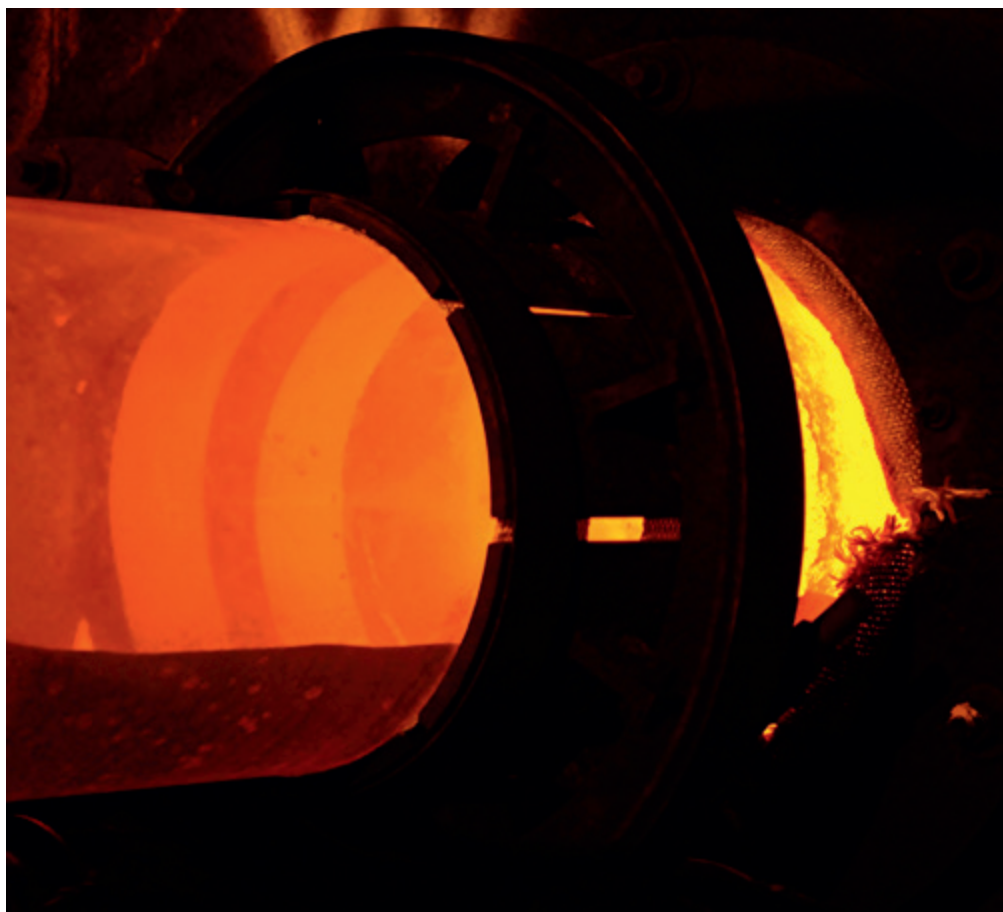
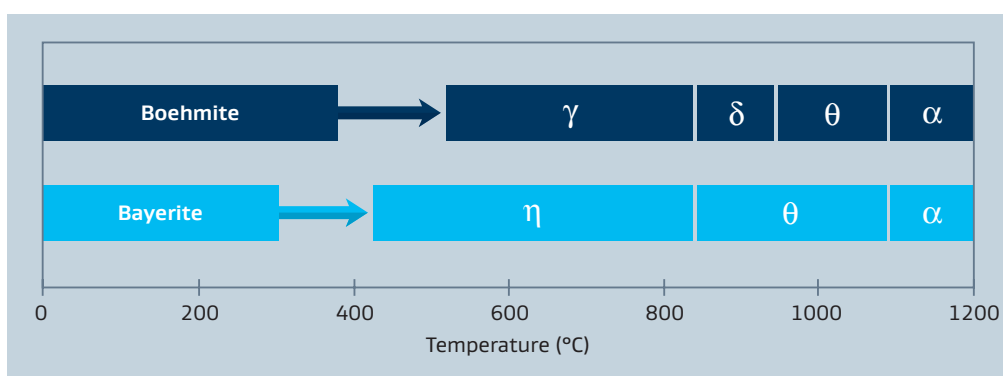


2.5 Calcination

The final crystalline phase and physical properties of calcined aluminas depend on the initial crystalline properties of the starting alumina hydrate as well as the calcination temperature. The sequence of phase transitions of boehmite and bayerite are shown in figure 7.

Physical properties such as crystalline phase, surface area and porosity can be altered significantly by varying the calcining time and temperature. Applied temperatures are typically between 600 °C and 1,000 °C. This process results in the loss of physisorbed and crystal water.

Figure 7:
Sequence of phase transitions



3. Technical Data

3.1 High-Density Alumina Hydrates

Typical chemical and physical properties		CATAPAL A	CATAPAL B	PURAL SB	PURAL SCF	CATAPAL C1	CATAPAL D	PURAL 200 CATAPAL 200	PURAL* BT
Al ₂ O ₃	[%]	72	72	74	74	72	76	80	64
Na ₂ O	[%]	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Loose bulk density	[g/l]	670–750	670–750	600–850	500–700	670–750	700–800	500–700	500–700
Packed bulk density	[g/l]	800–1100	800–1100	800–1100	800–1100	800–1100	800–1100	700–900	600–800
Particle size (d ₅₀)	[μm]	60	60	45	25	60	40	40	5–10
Surface area (BET)**	[m ² /g]	250	250	250	250	230	220	100	360***
Pore volume**	[ml/g]	0.45	0.50	0.50	0.50	0.50	0.55	0.77	0.30***
Crystallite size (120)	[nm]	<4.5	4.5	5.0	5.0	5.5	7.0	40	40****

3.2 High(TH)- and Medium(TM)-Porosity Alumina Hydrates

Typical chemical and physical properties		PURAL TM 70	PURAL TH 80	PURAL TM 100	PURAL TH 100	PURAL TH 200	PURAL TH 500
Al ₂ O ₃	[%]	75	75	78	75	78	80
Na ₂ O	[%]	0.002	0.002	0.002	0.002	0.002	0.002
Loose bulk density	[g/l]	350–550	350–550	300–500	300–500	250–450	200–400
Particle size (d ₅₀)	[μm]	35	35	35	35	35	35
Surface area (BET)**	[m ² /g]	200	180	150	150	110	80
Pore volume**	[ml/g]	0.75	0.9	0.9	1.1	1.2	1.3
Crystallite size (120)	[nm]	8	10	15	14	22	40

Chemical purity: C: 0.25 %, SiO₂: 0.01–0.015 %, Fe₂O₃: 0.005–0.015 %, TiO₂: 0.01–0.20 %

*Bayerite

**After activation at 550 °C for 3 hours

***After activation at 350 °C for 3 hours

****(331) reflection (bayerite)

Further specialty grades are available upon request.

Analytical methods see page 14.



4. Product Information

4.1 Storage and Transfer

PURAL and CATAPAL alumina hydrates are mildly abrasive materials with a Mohs hardness of 3.5 to 4.0. Therefore, handling and storage equipment should be abrasion resistant carbon steel, aluminium or polypropylene-lined steel are recommended.

Blower or vacuum systems are typically used to move the product. A minimum of 4,000 ft/min fluidizing velocity is recommended. Since alumina will adsorb atmospheric moisture facilities should be designed to avoid moist air contact with alumina.

4.2 Safety and Handling

PURAL and CATAPAL are classified as a non-toxic, nuisance dust. Exposure to high concentrations of dust may cause physical irritation.

Repeated or prolonged contact with skin may result in drying and irritation. Handling procedures should be designed to minimize inhalation and skin exposure. Normal good housekeeping and operating procedures should ensure personnel safety. See also 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 choose the right alumina for your end use, as well as to provide advice on the aluminas' safe and efficient use.

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.

5. Certifications

All Sasol Performance Chemicals locations worldwide are certified to DIN ISO 9001/14001 and 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 recognised, integrated quality, environmental and safety management system that has been established at the sites for many years.



6. Analytical Methods

Tests on PURAL and CATAPAL

6.1 Trace Element Analysis

Alumina hydrate 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 Crystallite Type and Average Crystal Size

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 diffractogram enables the laboratory to identify the crystal structure of the material.

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 PURAL and CATAPAL is measured by using an instrument supplied by Quantachrome (Nova series) or by Micromeritics (Gemini series). The method entails nitrogen adsorption at the BET region of the adsorption isotherm.

6.5 Pore Volume and Pore Size Distribution

The boehmite is first calcined at 550 °C for three hours in preparation for analysis. The porosity is measured by nitrogen 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.

6.7 Nitric Acid Gelation (NAG)

200 g of powder is dispersed in 234,5 g of distilled water and is then stirred for exactly 3 minutes. 98 ml of 3.93 % nitric acid is then quickly added under stirring to create a 37.5 weight % dispersion. The viscosity of the dispersion is then measured. The NAG value is defined as the time required for the dispersion to gel to 9,500 mPa·s from the time that the acid is added.

Additional test methods are available for other physical properties upon request.

* After alumina activation at 550 °C for 3 hours.





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