

**sasol**

# DISPERAL DISPAL

**High-Purity Dispersible  
Alumina Hydrates**

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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.

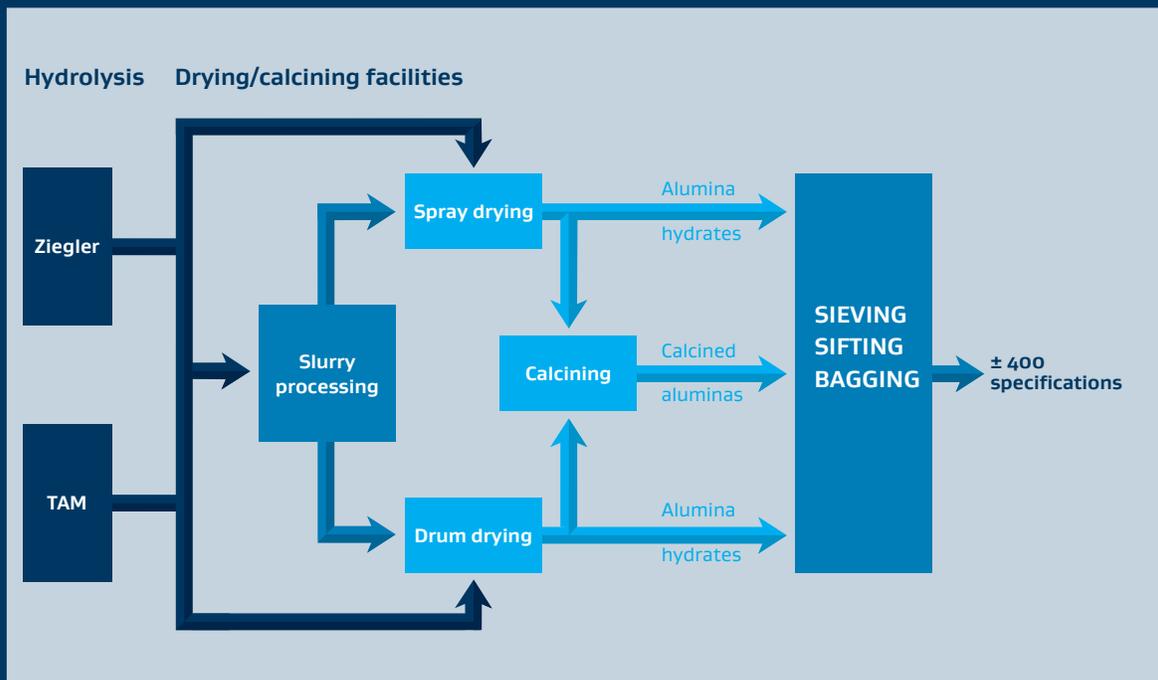


Figure 1: Schematic for the alumina manufacturing process

## 2. DISPERAL/DISPAL

### 2.1 High-Purity Dispersible Boehmites

DISPERAL and DISPAL are the trademarks for the high-purity, highly dispersible boehmite powders and sols/dispersions manufactured by Sasol in Brunsbüttel, Germany, and in Lake Charles, Louisiana, USA. These boehmites, which are nano-sized in the dispersed phase, exhibit a unique combination of purity, consistency and dispersibility that make them excellent materials for use in colloidal applications. The Sasol range of dispersible boehmites has traditionally been used in applications such as sol-gel ceramics, catalysis, refractory materials, rheology control and surface frictionizing.

Other applications include surface coating as well as paint detackification, polymer-additives and functional fillers.

### 2.2 Features of Sasol Dispersible Boehmites

The unique product characteristics of Sasol dispersible boehmites can lead to many advantages for use in different systems. Some key features are:

- The high purity boehmites are produced under careful control to yield products with consistent quality and reliable performance.
- The powders are highly dispersible. Low-viscosity nano-sized particle sols can be prepared at room temperature in 10 to 30 minutes with concentrations of 10–40 wt.% AlOOH.
- The boehmites are versatile. They can be employed under a variety of application conditions, including low or high pH and low or high shear.
- Sasol also offers boehmites which are dispersible in polar and non-polar organic media.

Figure 2:  
Translucent to opaque boehmite sols,  
each with a concentration of  
10 wt.% AlOOH



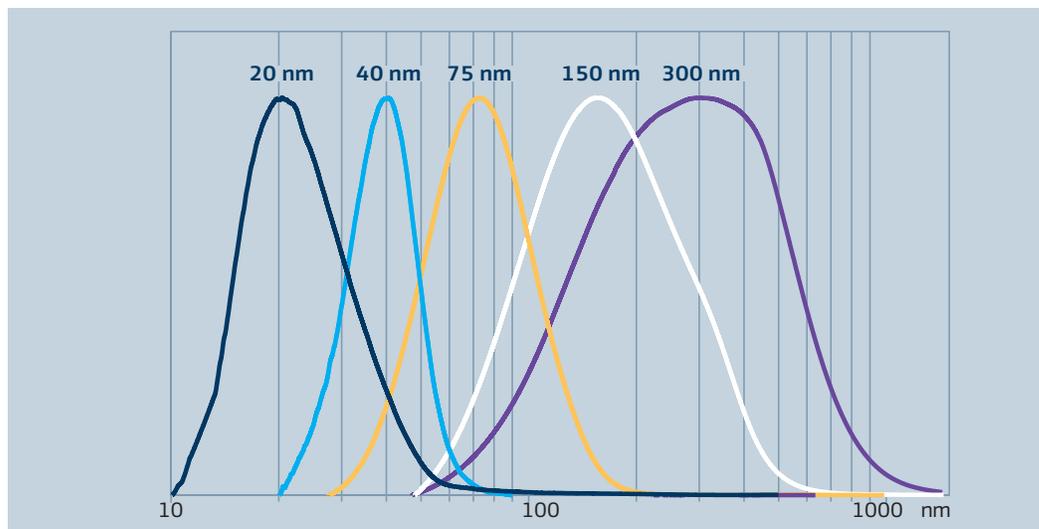
### 2.3 Advantages of DISPERAL and DISPAL

Sasol pioneered processes utilizing alkoxide chemistry to convert primary aluminium metal into synthetic boehmite of exceptional purity. Unlike other alumina manufacturing processes that start with less pure materials, Sasol's processes yield aluminas with significantly lower levels of common impurities such as iron, sodium and silica (table 2). Additionally, our 50 years of experience, in combination with other proprietary production techniques, allow us to produce highly dispersible boehmites with a wide range of physical properties such as dispersed particle size (figure 3) resulting in translucent to opaque dispersions (figure 2). Thus, our customers are not limited in their thinking for possible uses for the aluminas.

Table 1

Chemical purity of DISPERAL and DISPAL boehmite powders	
Impurity	ppm (typical)
Na <sub>2</sub> O	<20
Fe <sub>2</sub> O <sub>3</sub>	50–100
SiO <sub>2</sub>	50–120

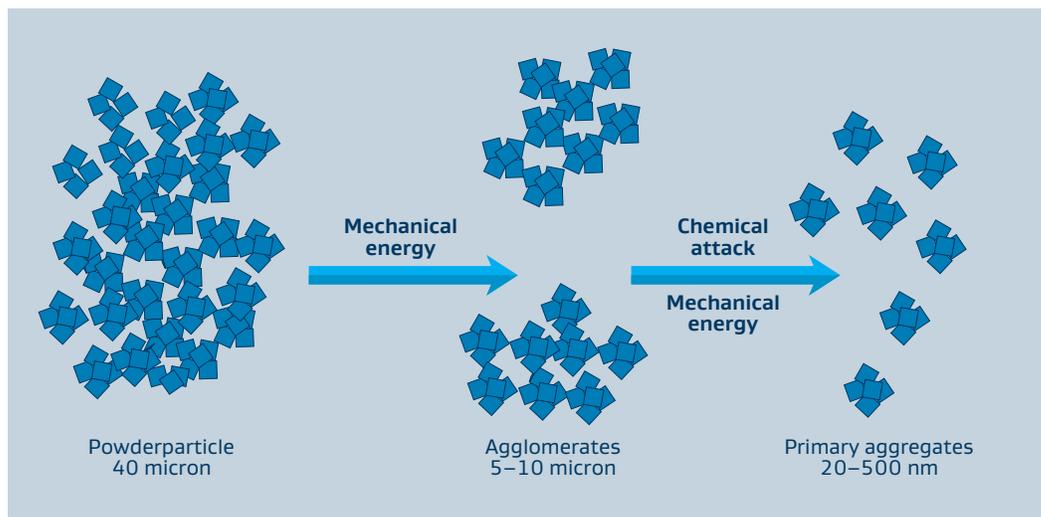
Figure 3:  
Dispersed particle size distributions  
of selected products



## 2.4 How to Disperse and Use DISPERAL and DISPAL

DISPERAL and DISPAL powders may be dispersed by following the descriptions below. Figure 4 shows a schematic representation of what occurs to the powder during dispersion using chemical attack and mechanical energy.

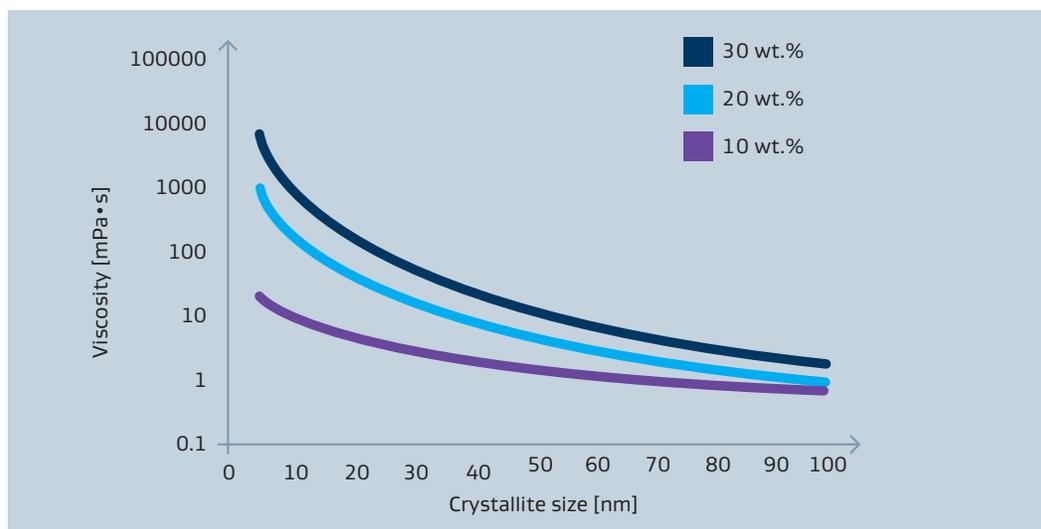
Figure 4:  
Schematic mechanism of dispersion



## 2.5 Water Dispersible Boehmite

To form a colloidal sol or dispersion from a water dispersible DISPERAL or DISPAL powder (see page 10), simply stir the powder in deionized water with moderate to intense agitation at room temperature for 20–30 minutes. The maximum achievable solids loading will vary according to the specific boehmite selected (figure 5). For most applications, the boehmites perform best when completely dispersed prior to further formulation. The resulting pH will be between 3 and 5. DISPAL 11 N7-80 that is modified with 0.1 wt.% nitric acid can be dispersed at pH 6–7 as well.

Figure 5:  
Schematic mechanism of dispersion



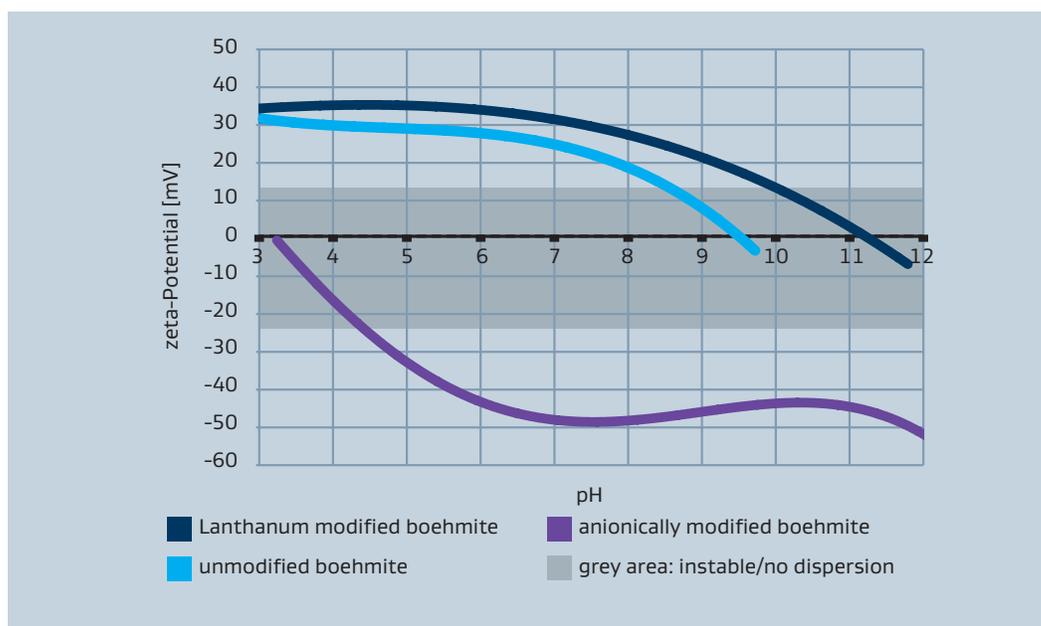
## 2.6 Acid Dispersible Boehmite

Dispersions of acid dispersible products may be formed in a similar fashion described above by dispersing in dilute aqueous monovalent acids such as nitric, hydrochloric, formic or acetic (typically < 1 wt.% acid) at pH 3–5.

## 2.7 Neutral to Alkaline Dispersible Boehmites

By changing the surface chemistry Sasol boehmites can also be stabilized under neutral and alkaline conditions. By modification with lanthanum the iso-electric point can be shifted to higher pH values, providing stability at pH 6–7. DISPERAL HP14/7 and DISPAL 18C9 are surface modified with citric acid to provide colloidal stability at pH 8–10. The stability of the dispersion is dependent on the absolute value of the zeta potential (figure 6).

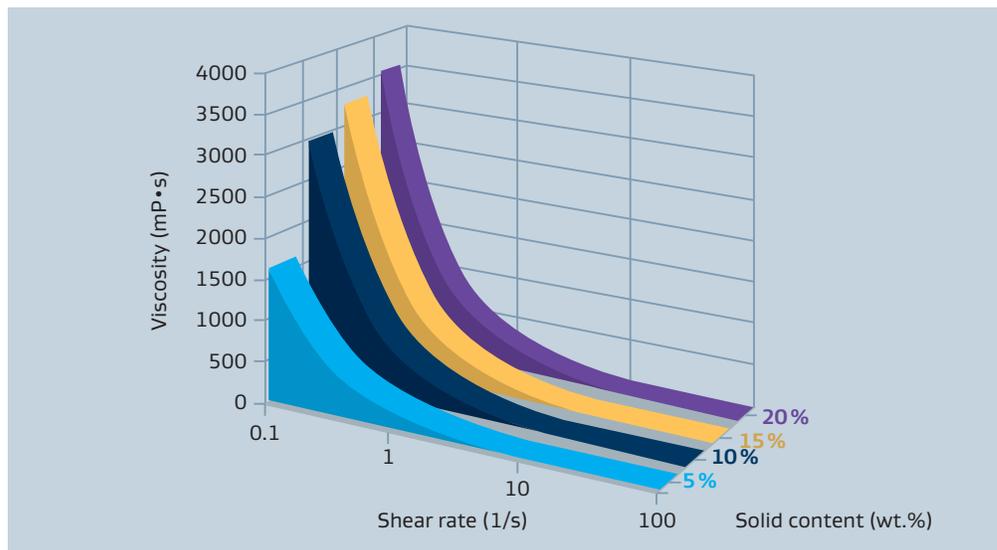
Figure 6:  
Zeta potential curves of some boehmites



## 2.8 Rheology

Rheological characteristics of boehmite dispersions can be affected by numerous factors. These include product used, solid content, crystallinity, water quality, pH, ionic strength and other formulation components. Figure 5 gives example curves of viscosity versus crystallite size for some typical Sasol products. Also low-viscosity dispersions can be “thickened” by the addition of acids, bases or salts to form thixotropic, shear-thinning systems (figure 7). This, for example, allows boehmite to function as a thickener for many types of either acidic or basic formulations.

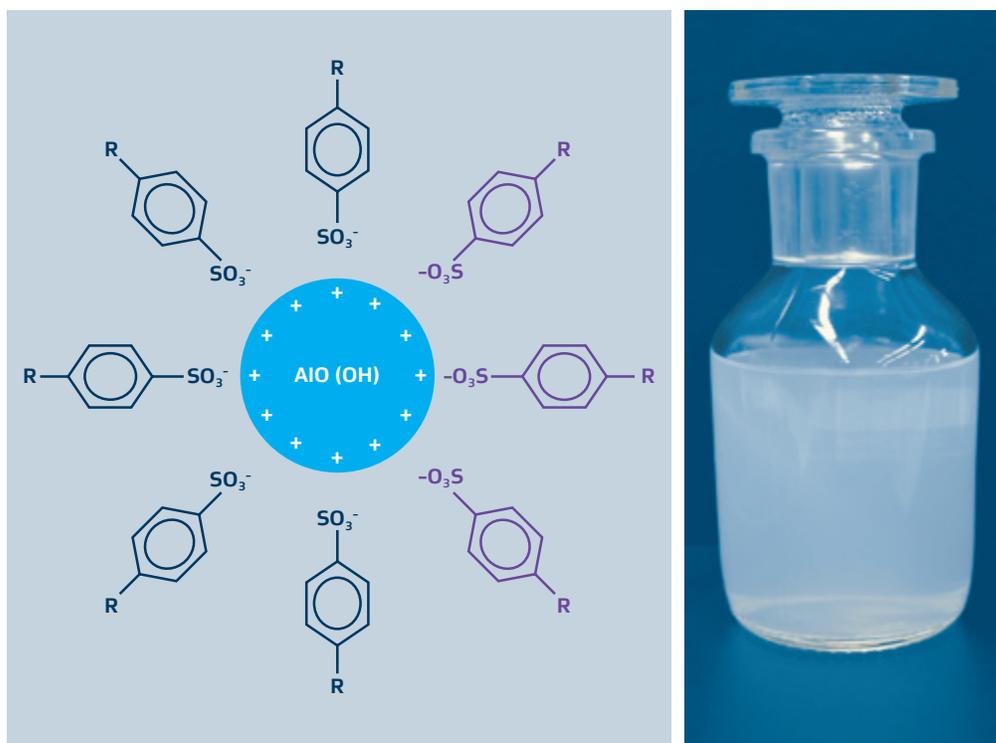
Figure 7:  
Effect of boehmite concentration on  
viscosity versus shear rate



## 2.9 Solvent Dispersible Boehmites

Sasol dispersible boehmites may be dispersed in organic solvents. Stable dispersions can be prepared by dispersing the non-modified boehmite powder under intense mixing into the solvent in presence of a stabilizing agent. For further, detailed information please contact one of our representatives. Another option is the use of already surface-treated boehmites that do not need further stabilization (figure 8). Different grades are available for polar and non-polar solvents (see page 10).

Figure 8:  
Schematic for a surface modified  
boehmite and dispersion in ethanol  
(solid content 10 wt.%)



## 3. Technical Data

### 3.1 Water Dispersible Boehmites

Typical chemical and physical properties		DISPERAL P2	DISPAL T25N4	DISPAL 25F4	DISPAL 23N4-80	DISPAL 18N4-80	DISPAL 14N4-80	DISPAL 11N7-80	DISPAL 10F4	DISPAL 8F4
Al <sub>2</sub> O <sub>3</sub>	[%]	72	78	78	80	80	80	80	83	83
NO <sub>3</sub>	[%]	4.0	4.5	–	1.6	1.1	0.7	0.1	–	–
H <sub>3</sub> COO <sup>-</sup>	[%]	–	–	2.0	–	–	–	–	0.25	0.2
Loose bulk density	[g/l]	850–1000	800	820	980	870	850	620	550	500
Particle size (d <sub>50</sub> )	[µm]	45	30	30	50	50	50	40	30	30
Surface area (BET)**	[m <sup>2</sup> /g]	260	>230	250	200	180	140	100	100	95
Pore volume**	[ml/g]	0.5	0.4	0.4	0.4	0.5	0.5	0.8	0.8	0.7
Crystallite size (120)	[nm]	4.5	7.0	8	9	15	18	30	40	53
Dispersed particle size***	[nm]	20	50	70	90	110	120	220	240	350

Dispersions of water dispersible products may be formed by simply stirring the powder in deionized water.

### 3.2 Acid Dispersible Boehmites

Typical chemical and physical properties		DISPERAL	DISPERAL 20	DISPERAL 40	DISPERAL 60	DISPERAL 80	DISPERAL HP 14	DISPERAL HP 18	DISPAL 18HP
Al <sub>2</sub> O <sub>3</sub>	[%]	77	77	80	80	95	77	77	77
Loose bulk density	[g/l]	400–600	500–700	400–600	300–500	200–500	300–500	300–500	300–500
Particle size (d <sub>50</sub> )	[µm]	15	35	35	35	35	35	35	35
Surface area (BET)**	[m <sup>2</sup> /g]	180	150	100	100	80	160	150	150
Pore volume**	[ml/g]	0.5	0.7	0.8	0.9	0.9	1.1	1.2	1.2
Crystallite size (120)	[nm]	10	20	40	50	65	14	18	18
Dispersed particle size***									
Measured with PCS	[nm]	80	150	250	350	500	100	150	200
Measured with disc centrifuge	[nm]	40	100	180	250	300	80	100	–

### 3.3 Surface Modified Boehmites

Typical chemical and physical properties		DISPERAL HP 14 L1	DISPERAL HP 14/7	DISPAL 18C9	DISPERAL OS-1	DISPAL 25SR	DISPAL 25SRL
Al <sub>2</sub> O <sub>3</sub>	[%]	75	70	70	65	65	60
Surface treatment		La-acetate	Citric acid	Citric acid	p-toluene sulfonic acid	p-toluene sulfonic acid	Dodecylbenzene sulfonic acid
Loose bulk density	[g/l]	300–500	300–500	300–500	400–600	400–600	400–600
Particle size (d <sub>50</sub> )	[µm]	35	35	35	35	35	35
Surface area (BET)**	[m <sup>2</sup> /g]	150	150	150	240	240	240
Pore volume**	[ml/g]	1.0	1.0	1.0	0.5	0.5	0.5
Crystallite size (120)	[nm]	14	14	14	10	10	10
Stability	[pH]	3–6	8–10	8–10	–	–	–

Chemical purity: C: 0.25 %, SiO<sub>2</sub>: 0.01–0.015 %, Fe<sub>2</sub>O<sub>3</sub>: 0.005–0.015 %, TiO<sub>2</sub>: 0.01–0.15 %

\* Particle size as measured on the powder

\*\* Activation at 550 °C for 3 hours

\*\*\* 10 wt.% Al<sub>2</sub>O<sub>3</sub> in 0.4 wt.% HNO<sub>3</sub>

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

Dispersions of acid dispersible products may be formed by dispersing in dilute aqueous monovalent acids (typically 1 wt.% acid) such as nitric, hydrochloric, formic, lactic or acetic acid.



## 4. Product Information

### 4.1 Storage and Transfer

DISPERAL and DISPAL boehmite powders are mildly abrasive materials having a Mohs hardness of 3.5 to 4.0. Therefore, handling and storage equipment should be designed for such materials. Examples are aluminium, abrasion resistant carbon steel and polypropylene or epoxy-lined steel. Blower or vacuum systems can be used to move the powders.

A minimum of 4,000 ft/min fluidizing velocity is recommended. Boehmite powders will absorb atmospheric moisture and facilities should be designed appropriately. The liquids are readily pumpable using standard centrifugal or positive displacement pumps. Due to the pH range of available products, recommended materials for process equipment include stainless steel, or polymeric-lined steel.

### 4.2 Safety and Handling

DISPERAL and DISPAL boehmite powders are classified as non-toxic nuisance dusts. Exposure to high concentrations of dust may cause physical irritation and drying of skin and eye tissues. Repeated or prolonged contact with alumina sols may cause irritation as well. Handling and shipping procedures should be designed to avoid such contact and to minimize the inhalation of airborne dust. Normal good laboratory practices and operating procedures should ensure personnel safety. See also corresponding material data safety sheet.

### 4.3 Technical Support

The Sasol alumina organization is committed to offering the technical service necessary to ensure customer satisfaction. Technical support is available worldwide to aid you in choosing the best alumina for your needs, as well as for providing advice on safe and efficient use. The products described in this brochure give some indications of our total capability. We look forward to discussing specific technical requirements with you.

## 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

### 6.1 Crystallite Size

Crystallite dimensions in powdered boehmite samples are analyzed using X-ray diffraction techniques on X-ray diffractometers supplied by Siemens or Philips.

### 6.2 Dispersed Particle Size

The particle size distribution of diluted boehmite sols and dispersions is measured using laser diffraction or photon correlation spectroscopy techniques on Malvern, Horiba or Cilas instruments. Alternatively dispersed particle sizes can be measured using a disk centrifuge supplied by CPS.

### 6.3 Dispersibility of Boehmite Powder

A specified amount is added to water or dilute acid under stirring. The mixture is then stirred for a specified period of time to form a dispersion. The dispersion is centrifuged, and the undispersed residue is isolated, dried and weighed to determine the percentage of non-dispersed material.

### 6.4 Surface Area

The boehmite is first calcined at 550 °C for three hours in preparation for analysis. Alumina surface area is then measured using BET nitrogen adsorption techniques on instruments supplied by Quantachrome (Nova series) or by Micromeritics (Gemini series).

### 6.5 Trace Element Analysis

Trace element analysis is performed by using several methods, including X-ray fluorescence of pressed alumina disks and wet techniques (ICP/OES).

### 6.6 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.



# At Your Service



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