sasol
reaching new frontiers

DISPERAL®/DISPAL®
High purity dispersible aluminas

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DISPERAL and DISPAL are the trade-names for the high purity, highly dispersible, boehmite alumina powders and sols/dispersions manufactured by Sasol in Brunsbüttel, Germany and in Lake Charles, Louisiana, USA. These aluminas, 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 more recently developed uses include surface coating as well as paint detackyfication.

Advantages of DISPERAL and DISPAL aluminas

Sasol pioneered processes utilizing alkoxide chemistry to convert primary aluminum metal into synthetic boehmite aluminas 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 1). Additionally, our 30 years of experience, in combination with other proprietary production techniques, allows us to produce highly dispersible aluminas with a wide range of physical properties such as dispersed particle size (figure 2) resulting in translucent to opaque dispersions (figure 1). Thus, you do not need to be limited in your thinking and development of novel alumina-containing products.

Table 1

Chemical purity of DISPERAL and DISPAL alumina powders

Impurity	ppm (typical)
Na_2O	20
Fe_2O_3	100
SiO_2	120

Features of Sasol dispersible aluminas

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

- *The aluminas are synthetic. Being synthetic, these high purity materials are produced under careful control to yield products with consistent quality and reliable performance.*
- *Both powders and pre-dispersed alumina are available. Thus, you can choose the form that is most appropriate for your processing needs.*
- *The powders are highly dispersible. Low viscosity nano-particle sols can be prepared at room temperature in 10 to 30 minutes.*
- *The aluminas 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 aluminas which are dispersible in organic media, eg alcohols, dimethylformamide (DMF) etc.*

Figure 1
Translucent to opaque alumina sols, each with a concentration of 10 wt.% Al_2O_3

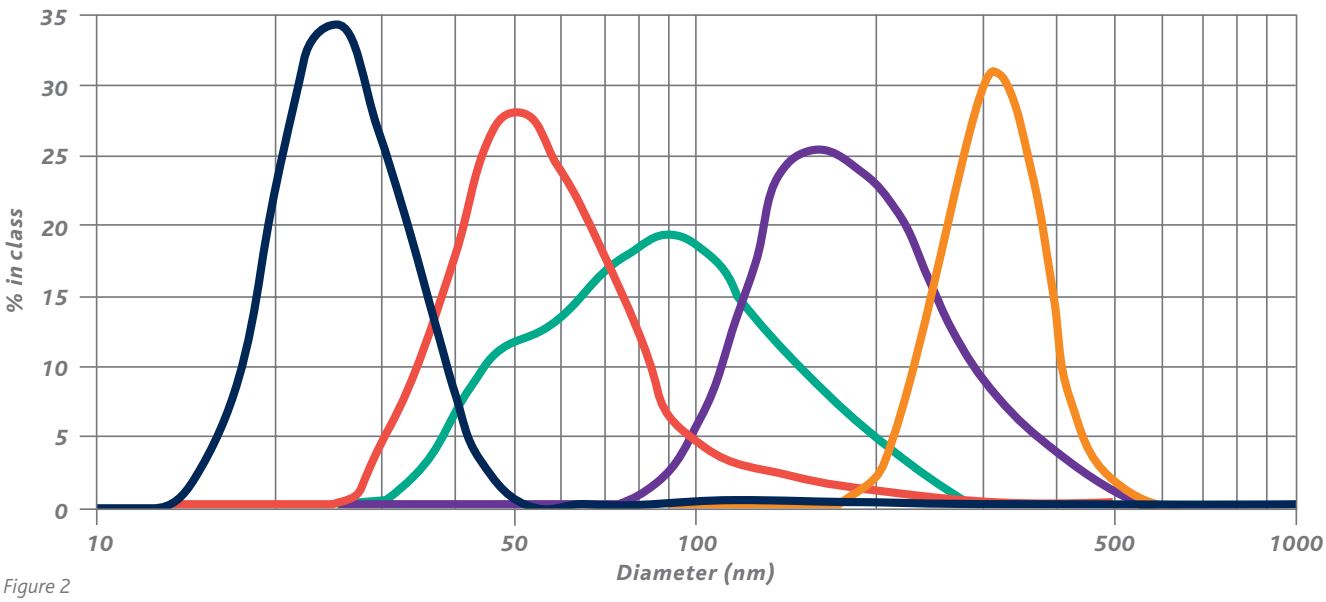

Figure 2
Dispersed particle size distributions of selected products

How to disperse and use DISPERAL and DISPAL aluminas

DISPERAL and DISPAL powders may be dispersed by following the descriptions below. Figure 3 shows a schematic representation of what occurs to the powder during dispersion using chemical attack and mechanical energy.

Water dispersible alumina

To form a colloidal sol or dispersion from a water dispersible DISPERAL or DISPAL alumina powder, 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 alumina product selected (figure 4). For most applications, the aluminas perform best when completely dispersed prior to further formulation.

Acid dispersible alumina

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).

Detailed descriptions of the dispersing procedure are available on request.

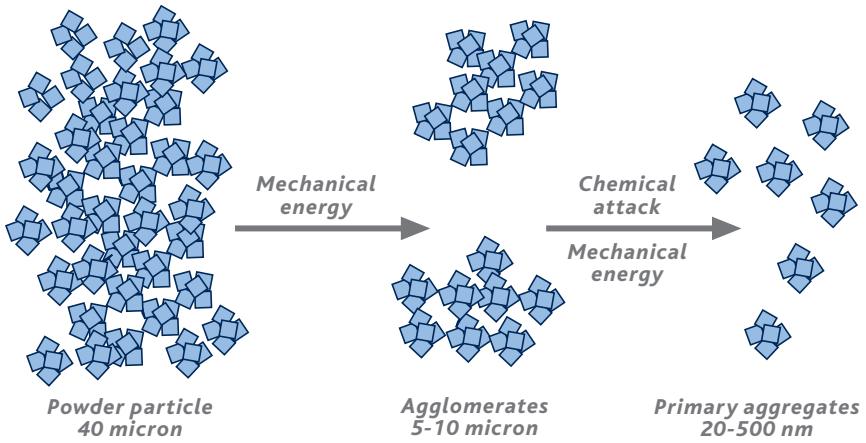

Figure 3
Schematic mechanism of dispersion

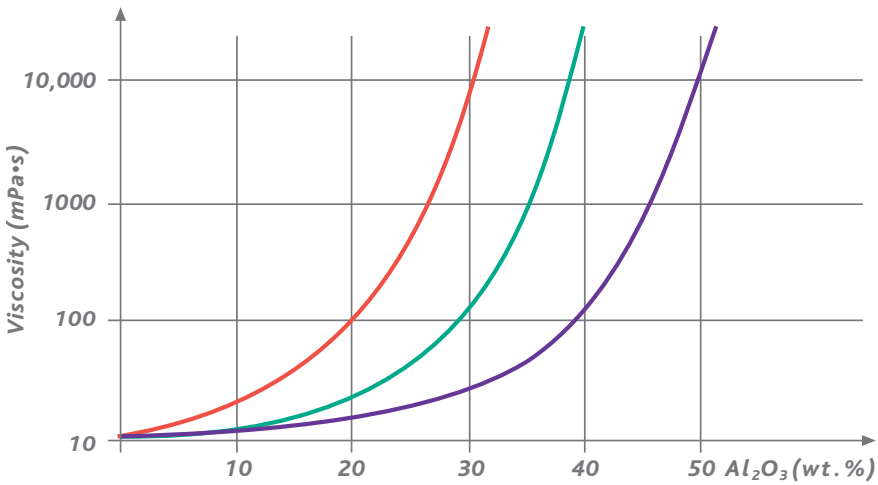

Figure 4
Viscosity versus alumina concentration for different products

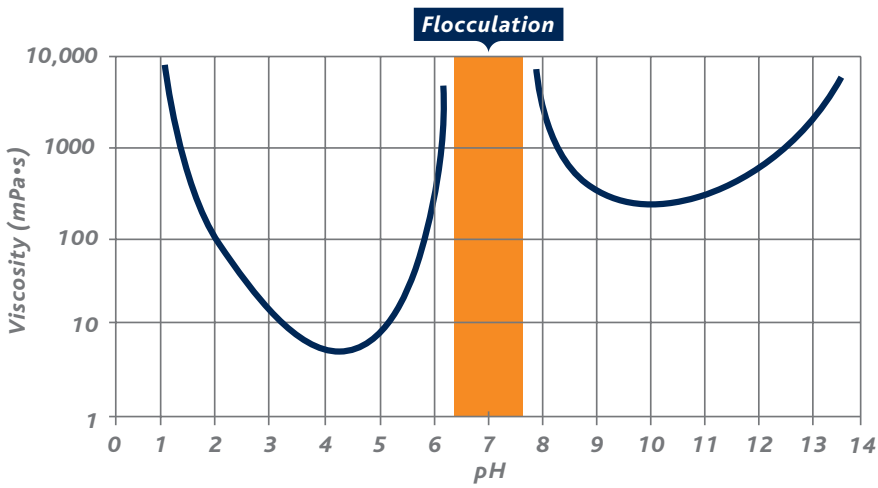

Figure 5
Viscosity versus pH

Organic dispersible alumina

Sasol dispersible aluminas may be dispersed in organic solvents, for example, a dispersion in DMF may be prepared by dispersing the alumina powder, under intense mixing, into DMF containing 0.4 wt.% nitric acid. Information on dispersions in more sophisticated organic systems are available, please contact one of our representatives.

Rheology

Rheological characteristics of alumina dispersions can be affected by numerous factors. These include product used, solid content, crystallinity, water quality, pH and other formulation components. Figure 4 gives example curves of viscosity versus alumina concentration 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 (figures 5 and 6). This, for example, allows alumina to function as a thickener for many types of either acidic or basic formulations.

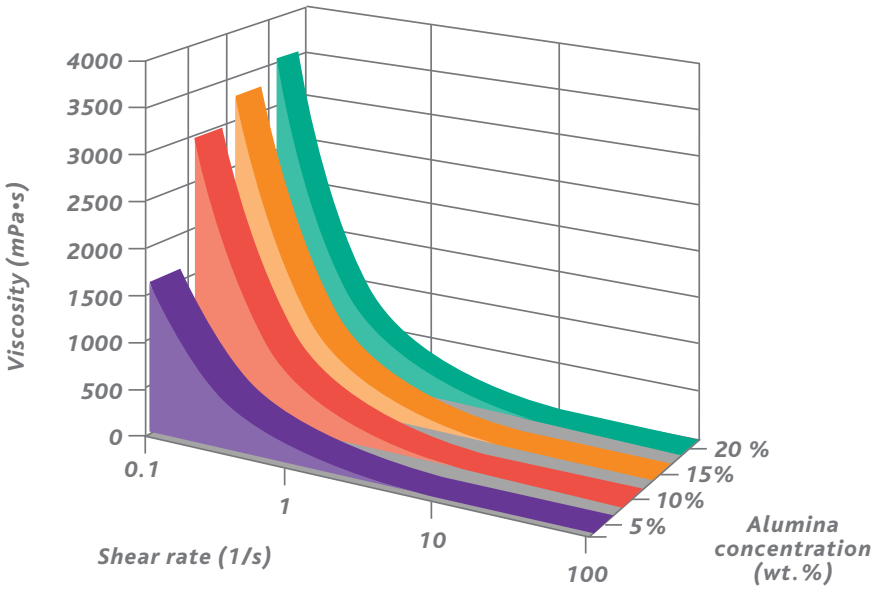

Figure 6
Effect of alumina concentration on viscosity versus shear rate

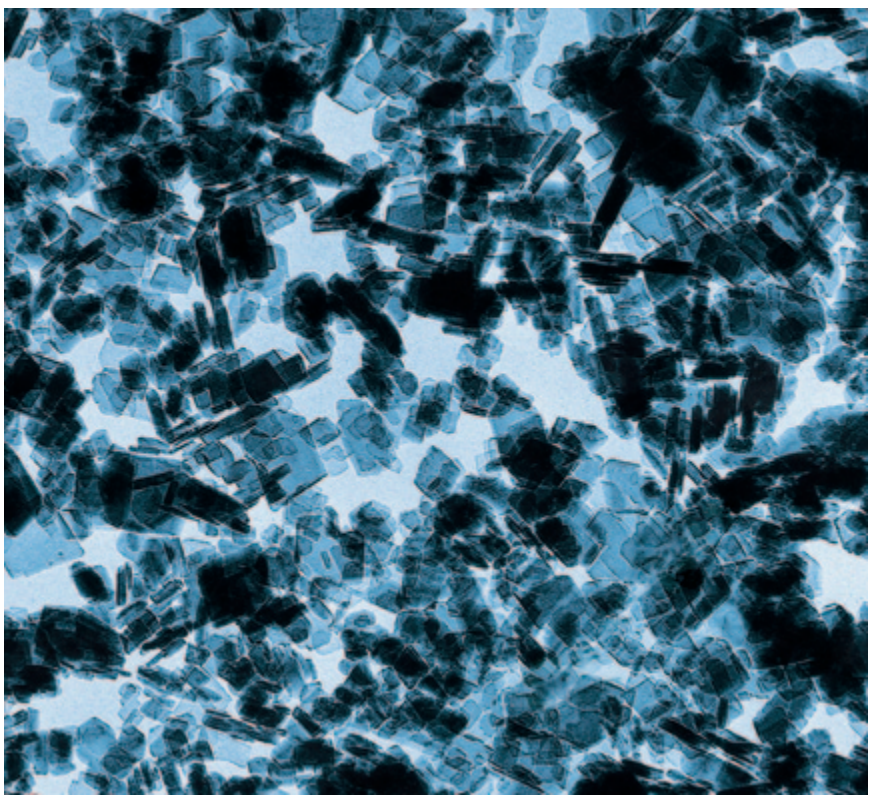

Figure 7
Transmission electron micrograph of a dispersible alumina (magnification: 180,000x)

Storage and transfer

DISPERAL and DISPAL alumina 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 aluminum, 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. Alumina 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 aluminum, stainless steel, or polymeric lined steel.

Safety and handling

DISPERAL and DISPAL alumina 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.

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.

Analytical methods

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

Dispersed particle size *The particle size distribution of diluted alumina sols and dispersions is measured using laser diffraction or photon correlation spectroscopy techniques on Malvern or Cilas instruments.*

Dispersibility of alumina powder *A specified amount of alumina powder 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 percent non-dispersed material.*

Surface area *The boehmite aluminas are 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).*

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).*

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DISPERAL DISPAL 01/03 GB

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Product information

DISPERAL® *Acid dispersible boehmite alumina systems*

High purity aluminas

Typical chemical and physical properties		DISPERAL	DISPERAL 20	DISPERAL 40	DISPERAL HP 10	DISPERAL HP 14	DISPERAL HP 18
Al_2O_3	[%]	77	77	80	77	77	77
Na_2O	[%]	0.002	0.002	0.002	0.002	0.002	0.002
Loose bulk density	[g/l]	400–600	500–700	500–700	400–600	400–600	300–500
Particle size (d_{50})*	[µm]	25	30	50	30	35	35
Surface area (BET)**	[m^2/g]	180	150	100	200	190	150
Pore volume**	[ml/g]	0.5	0.7	0.8	1.0	1.1	1.2
Crystallite size [120]	[nm]	10	20	40	10	14	18
Dispersed particle size***	[nm]	80	150	300	150	170	200
Dispersibility (10% Al_2O_3/0.4 % HNO_3)	[%]	98	98	98	98	98	98
Dispersibility (30% Al_2O_3/1.0 % HNO_3)	[%]	—	97	98	96	97	98

Chemical purity: C: 0.25 %, SiO_2: 0.01–0.015%, Fe_2O_3: 0.005–0.015 %, TiO_2: 0.01–0.15 %
* Particle size as measured on the powder
** After activation at 550°C for 3 hours
*** 10 wt.% Al_2O_3 in 0.4 wt.% HNO_3

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

Further specialty grades are available upon request

Status: 01/2003

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Product information

DISPERAL®, DISPAL® *Water dispersible boehmite alumina systems*

High purity aluminas

Typical chemical and physical properties		***DISPERAL P2***	***DISPAL 23N4-80***	***DISPAL 23A4-80***	***DISPERAL HP 14/2***	***DISPAL 18N4-80***	***DISPAL 14N4-80***	***DISPAL 11N7-80***
Al_2O_3	[%]	72	80	80	75	80	80	80
Na_2O	[%]	0.002	0.002	0.002	0.002	0.002	0.002	0.002
NO_3	[%]	4.0	1.6	—	1.3	1.1	0.7	0.1
Acetate	[%]	—	—	1.6	—	—	—	—
Loose bulk density	[g/l]	850	980	980	600	870	850	620
Particle size(d_{50})*	[µm]	45	50	50	35	50	50	40
Surface area (BET)**	[m^2/g]	260	200	200	170	180	140	100
Pore volume**	[ml/g]	0.5	0.4	0.4	1.0	0.5	0.5	0.8
Crystallite size [120]	[nm]	4.5	9	9	13	15	18	30
Dispersed particle size	[nm]	25	90	90	170	110	120	220
Water dispersibility	[%]	97	98	98	97	98	98	97

Chemical purity: C: 0.25 %, SiO_2: 0.01–0.015 %, Fe_2O_3: 0.005–0.015 %, TiO_2: 0.01–0.15 %
** Particle size as measured on the powder*
*** After activation at 550°C for 3 hours*

To form a colloidal sol or dispersion simply stir the powder in deionized water with moderate agitation at room temperature for 10–20 minutes

Further specialty grades are available upon request

Status: 01/2003