PRODUCT OVERVIEW

AERODISP®

AERODISP® Fumed Silica and Metal Oxide Dispersions

EVONIK
POWER TO CREATE

AEROSIL® Fumed Silica – More than just a Powder

Dr. Harry Klöpfer, chemist at Degussa, one of the predecessor companies of Evonik and inventor of AEROSIL® fumed silica.

Evonik has been manufacturing dispersions based on fumed silica since 1953. Today, we provide various dispersions for many different applications. They are manufactured using innovative technologies and are known under the AERODISP® trademark. They are either based on water or other solvents and contain our AEROSIL® fumed silica or AEROXIDE® fumed metal oxides. Our product portfolio includes dispersions with different pH values and solid contents to satisfy a wide range of requirements.

AERODISP® dispersions are easy to handle and work with. In many applications their properties outperform those of powders.

Our AERODISP® products have a milky-white appearance and low viscosity. Depending on the product, solid contents are between 12 to 50% by weight with narrow particle size distributions ranging from 50 to 300 nm. The dispersing processes, as well as the additives used for stabilization, are product specific.

The special aggregate structure and high purity of the dispersed AEROSIL® fumed silica and AEROXIDE® fumed metal oxide particles make our dispersions superior to other conventional colloidal systems.

Discover the advantages and benefits that AERODISP® products can provide in your application.

AERODISP® Fumed Silica Dispersions – It is the Structure that Matters

The computer model of an AEROSIL® aggregate clearly shows the remarkable structure of the fumed silicon dioxide particle.

Highly filled, yet low viscosity dispersions based on fumed silicon dioxide particles are an attractive alternative to the traditional powder form.

AERODISP® dispersions are used as an anti-slip agent for textile finishing and other purposes. The increased friction caused by the silica aggregates prevents the individual fibers of the fabric from rubbing against each other.

One of the most distinct characteristics that set our dispersions apart from common colloidal systems is the structure of the fumed silica and metal oxide particles. By structure, we refer to the way the dispersed particles are made up of aggregated nano-sized primary particles, forming a shape similar to that of a cluster of grapes.

Key factors are the size and number of primary particles, the degree of coalescence and the branch-like structure of the aggregates. This „structure“ can yield excellent results in many applications, even when relatively small quantities are used.

In the paper and textile industries, AERODISP® grades are used in anti-slip applications. The aggregates are attached to the fibers and their structure prevents them from rubbing against each other. Much less AERODISP® dispersion is required when compared to common silica sols. For the typical non-slip finish in textile applications, we recommend our cationic dispersions.

AERODISP® products can also be used to polish other metal and metal oxide layers. In the metal industry, our dispersions are used to pretreat surfaces. In the coil coating process, this pretreatment process improves the adhesion and flexibility of the coating.

The „structure“ of AEROSIL® fumed silica and AEROXIDE® fumed metal oxide particles make our dispersions very versatile in anti-blocking or release agent applications as well. In the plastics and metal casting industries, even small amounts of AERODISP® products suffice to space or stabilize other, larger particles.

AERODISP® Products – The Ideal Reinforcement in Many Industries

Modern plastic applications require special reinforcing agents such as our ethylene glycol based dispersions.

Using AEROSIL® fumed silica in synthetic fibers alters their mechanical properties and colorability.

Scratch-resistant coatings are in great demand – AERODISP® dispersions are the ideal ingredients.

Our AERODISP® dispersions have a reinforcing function in many applications. For example they improve the mechanical properties of polymers. They are especially practical to use because the particles are already evenly distributed and stabilized. Thus, the complex process of dispersing is not necessary and is replaced by a simple mixing process.

For manufacturing PET bottles and films, we recommend our ethylene glycol based dispersions. The AEROSIL® fumed silica particles increase the tear-resistance and improve the mechanical durability of these types of products.

Gas and moisture permeability can be optimized as well. In textiles, our dispersions can also be used as reinforcing fillers for the fibers. Depending on the system, this can alter the dyeability and spinability.

For polyester fibers, we recommend our ethylene glycol based dispersions. In paint and coating systems, AERODISP® grades increase hardness and scratch-resistance.

In metal plating applications, AERODISP® dispersions can be used to adjust the properties of electrolytically deposited metals, such as zinc or nickel. AERODISP® products are also used in formulations of metal pretreatments for corrosion resistance and as a parting aid in metal casting.

AERODISP® products can enhance the performance and application of cementitious systems as well as of construction additives, being able to become a key component thereof. In very fluid cementitious systems as self-levelling underlayments or self compacting concrete, phase segregation and bleeding are avoided.
This is achieved by influencing the rheological behavior of the system as well as by reduction of bleed water channels through pore-blocking. Furthermore, due to the fact that AEROSIL® fumed silica is a highly pozzolanic reactant, a faster and higher early strength development can be achieved, counteracting the retarding effect of PCE if present in the formulation. Other beneficial effects that can be obtained in e.g. plaster application are anti-shrinkage and anti-dirt pick up by creating a less dense matrix after hardening, therefore less deep open pores. Additionally, an improved homogeneity of component distribution with the consequent improvement on the finished surface can also be achieved.

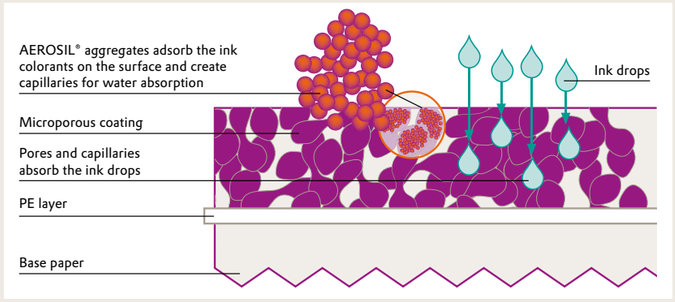
Due to its morphology, particle size and possibility of hydrophobicity AERODISP® grades can be as well suitable for stabilization of emulsions by pickering effect.

AERODISP® Products – for Applications where Adsorption Counts

The high specific surface area of the AEROSIL® fumed silica and AEROXIDE® fumed metal oxide particles in our dispersions results in excellent adsorption properties – making them the ideal choice to fix substances to a substrate.

AERODISP® dispersions can be used to create glossy, microporous coatings for inkjet photographic paper. These coatings not only adsorb ink colorants with pinpoint accuracy but also waterproof them. These coatings consist of networks of pores and capillaries formed by aggregates of our fumed metal oxides. They absorb ink drops within fractions of a second and fix the colorants at a high resolution and in brilliant colors. For inkjet applications, we recommend our specially developed cationic types: AERODISP® W 630, AERODISP® W 440 and AERODISP® WK 7330. The aluminum oxide particles in AERODISP® W 630 and AERODISP® W 440 are inherently positively charged (cationic). The silicon dioxide particles of AERODISP® WK 7330 are cationized with small quantities of a polymer. The key in this application is that the positively charged particles of the coating fix the mostly negatively charged (anionic) ink colorants. Subsequent exposure to water will not dislodge them.

Diagram of microporous inkjet photographic paper



Large-format inkjet printers can print posters several meters wide.

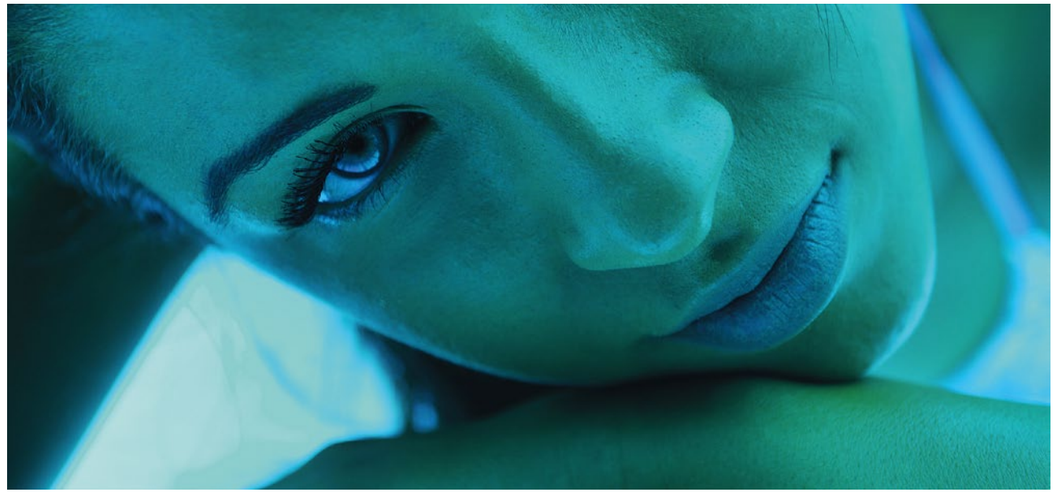
AERODISP® Products – for Maximum Clarity

As a result of their high purity, AERODISP® dispersions are particularly well suited as raw materials in glass and ceramic applications.

Properties of ceramics can be modified with titanium or aluminum oxides, which are available in dispersed form as well. Our dispersions can also be used to create glass or ceramic coatings on a variety of substrates. The coating process is based on dip-coating and sintering. Another unique application can be performed with AERODISP® W 1244.
This grade is used in the production of fire resistant glass. Details can be found in our Technical Information 1407.

AERODISP® products are also a raw material for lamp phosphors and illuminants, which require silica sources of high purity.

The extreme purity and tiny aggregates of the fumed metal oxides of our dispersions are the key to modern illuminants with their high light yield and customized color spectrum.



AERODISP® W 1244 is a ready to use dispersion for the production of fire-resistant glass.

AERODISP® Products – Rheology Control in a Convenient Form

AEROSIL® grades are well known as a rheology modifier in coatings and adhesives formulations, among others. AERODISP® dispersions are an easy to mix form of AEROSIL® fumed silica.

AERODISP® – the homogeneous, liquid dispersion of AEROSIL® fumed silica for all your waterborne applications.

Similar to AEROSIL® fumed silica, AERODISP® grades can also be used to regulate the flow behavior (rheology) of liquids and semi-solid systems.

With AERODISP® products, solid particles, for example pigments, can be stabilized in aqueous formulations. In inkjet printing applications, the small particle size of AEROSIL® fumed silica is particularly important, because the ink has to pass through very fine nozzles.

Developments for the Future – We Are Always Preparing for What's Ahead

There are many more applications for AERODISP® grades coming up. In Lithium-Ion Batteries e.g. AERODISP® grades are used to avoid shrinkage of the separator membrane. This prevents short circuits and makes the batteries safer.

In plastic films AERODISP® types can build up a barrier against gas diffusion. The finely dispersed fumed oxide particles are plugging holes within the polymer matrix of the film and can therefore significantly increase the diffusion pathway for unwanted gases like water vapor or air. Recent research has brought new insights in the usage of AERODISP® products for the improvement of the tribological behavior of oil based lubricants.

Moreover, we are continuously working to develop new dispersions and dispersing techniques. Examples are dispersions of hydrophobic metal oxides as well as solvent system alternatives to water and ethylene glycol. Do not hesitate to contact us and learn more about our developmental work. We may already have solutions that meet your particular requirements.

New types of dispersing technologies and high energy milling enable us to manufacture extremely fine particle metal oxide dispersions. These products can be identified by an extra X at the end of the product name. AERODISP® 740 X and VP Disp. W 2730 X titanium dioxide dispersions are manufactured using this technology.

These dispersions are well suited for catalytic and photocatalytic applications e.g. degrading harmful substances when treating water or indoor air or reducing algal and bacterial growth on surfaces. Dispersed fumed titanium dioxide can also be used in the paper and plastics industries.

Further hydrophilic and hydrophobic dispersions of fumed silica and metal oxides in organic solvents are available on request.

AERODISP® fumed titanium dioxide dispersions are well suited for photo-catalytic applications e.g. to degrade harmful substances.

Understanding colloidal systems is the key to developing customized dispersions.

AERODISP® Dispersions – Properties and Characteristics

Dispersions of fumed metal oxide particles form a complex colloidal system. Colloids are disperse systems with particles smaller than 1 µm. The surface chemistry of the particles and the way they interact with components of the solution plays an important role in these systems and can be employed selectively to stabilize them.

Zeta potential is a measure of the surface charge on the particle. If the zeta potential is sufficiently large, particles of similar charge will repel each other electrostatically, preventing coagulation. Whether these charges are positive or negative is irrelevant in this case. Systems are normally considered to be stable if the zeta potential is greater than +20 mV or less than -20 mV.

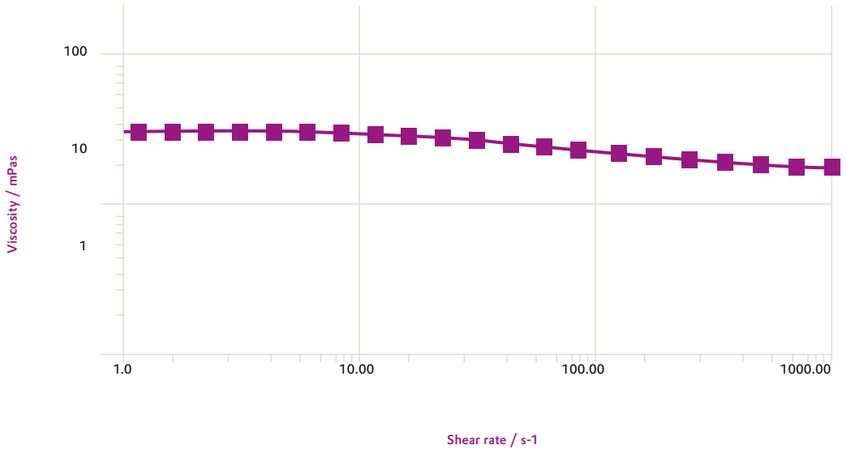
There is a direct relationship between zeta potential and pH value. Aluminum oxide dispersions are inherently cationic and stable in acidic pH ranges. Silica dispersions are especially stable in alkaline pH ranges (around 10). As a result of strong demand for acidic silica dispersions, we also offer cationized AEROSIL® dispersions. Their zeta potential curve is modified through the addition of a cationic polymer and resembles that of aluminum oxide dispersions. Since the effectiveness of a dispersion depends on the pH value of the formulation, we offer products for different pH ranges. It is important to carefully select the right dispersion that best suits the intended application. When measuring pH using standard glass membrane electrodes, keep in mind that the pH value of colloidal systems not only depends on its H+ concentration, but also on agitation and shear conditions during measurement.

Other factors that affect the stability of dispersions are: salt content of the solution, temperature and the adsorption/desorption equilibria of other ingredients that can possibly produce unexpected effects in more complex formulations. Viscosity of a dispersion is also an important physico-chemical parameter.
We perform a complete analysis of each of our dispersions over a wide range of shear, using modern testing equipment and methods. Many of our dispersions exhibit Newtonian flow behavior. Dispersions at higher loading levels exhibit slight shear thinning, meaning they flow better when they are moved or processed. At rest, their viscosity increases again, preventing particles from sedimenting.
In rare cases, shear thickening (dilatancy) may occur at extreme shear loads (>1000 s^{-1}).

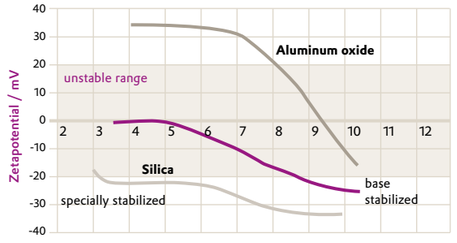
It is difficult to measure the size of fumed metal oxide particles because the methods commonly used treat the particles as spheres and the results are calculated accordingly. AEROSIL® or AEROXIDE® particles are not spherical but consist of aggregates of primary particles. Ultimately, this leads to varying results, depending on the testing method used. Comparable results can only be obtained when the same testing methods are used.

Dynamic light scattering (PCS - Photo Correlation Spectroscopy) and static laser diffraction are proven methods to measure the size of fumed metal oxide particles. The diagram below shows an example of the aggregate size distribution of AERODISP® W 7520, as measured using the static light scattering method.

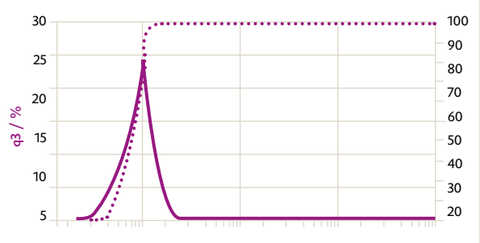
Viscosity curve
Viscosity curves show the flow behavior of dispersions



Zeta potential
The zeta potential is a measure of the surface charge. Stable dispersions result when particles of similar charge repel each other



Particle size distribution
Particle size distribution of AERODISP® W 7520 measured using static light scattering (Horiba LA-910)



Application Consulting is One of Our Core Competencies

AERODISP® in an IBC.

Packaging, Delivery and Storage
Depending on the region and product, AERODISP® products are available in 60 kg containers, 220 kg drums and 1000 or 1200 kg intermediate bulk containers (IBCs). Samples are supplied in either 1 quart, 1 gallon, 1 liter or 5 liter containers.

Depending on the product, AERODISP® dispersions should be used within 6 or 12 months from the date of manufacture. There are several factors that need to be considered with respect to storage stability:

Depending on the region, special insulated packaging is available to protect dispersions from freezing.

- Frost and excessive heat must be avoided because they could cause the solid particles to aggregate and sediment.
  Our dispersions are normally stable in terms of sedimentation, creaming out or segregation because of their fine particle size. We recommend storage at room temperature. In isolated cases, some slight sedimentation may occur.

- The viscosity of our dispersions with high solid contents may increase further, especially at high temperatures or as a result of fluctuations. This process is easily reversed by agitation or shearing.

- To prevent biological contamination, we use sterile-filtered, deionized water during production and add small amounts of a suitable preservative to some products.

Safety and handling
You will receive a safety data sheet (SDS) with every sample or initial delivery of our products.

Our dispersions are easy to handle. They can be pumped, transported and dosed with most equipment suitable for liquids. Special precautions are only required in a few cases. Our specialists will gladly advise you on handling matters at any time.

The Advantage of a Global Enterprise – Local Proximity

As a leading specialty chemicals company Evonik relies on the business philosophy: „as decentralized as possible, as centralized as necessary".

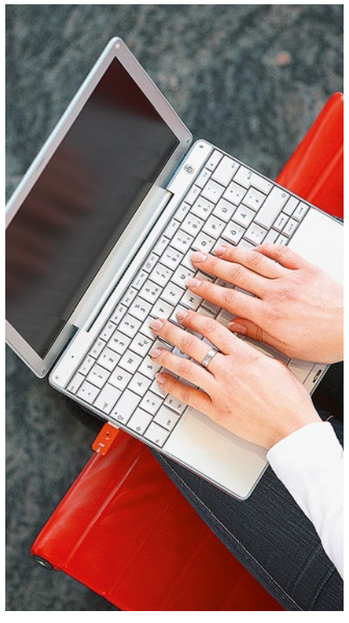
The decentralized organization at all levels and in all divisions of the company is tailored to operative units which can respond to the market quickly, flexibly and on a customer-oriented basis. As a brand operating worldwide, AEROSIL®, AEROXIDE® and AERODISP® products use production facilities, application-related service centers, research centers and commercial and technical service offices in all regions of the world.

The mere fact that we produce on 3 continents represents a decisive advantage for us and our customers when it comes to an effective world-wide delivery service. We also offer our customers the biggest service network of all suppliers on the market.

The combination of highest product quality and a focus on service and consulting is a major cornerstone of the AEROSIL® strategy. As a brand that is active worldwide we also want to combine with partners to form a strong, international network in which we concentrate our areas of expertise.

A functioning globality, which our customers experience on a local level.

Always close by.



Technical Literature

For more detailed technical information on our products, please contact us at one of the addresses listed on the back of this brochure or send an e-mail to ask-si@evonik.com.

You may also use our website www.aerosil.com to access specific product information sheets directly through the product finder database, or request our technical information publications.

Product overview
AEROSIL® fumed silica

Technical overview
AEROSIL® fumed silica

Industry brochure photo inkjet media

Technical information No. 1322
Paper Sizing with AERODISP® fumed silica dispersions

Technical information No. 1278
Handling of AERODISP® fumed silica and alumina dispersions

AERODISP® application chart

INDUSTRY	APPLICATION	STRUCTURE	ADSORPTION	REINFORCEMENT	RHEOLOGY	RAW MATERIAL	SPECIAL EFFECTS	RECOMMENDED DISPERSIONS
PAPER	Inkjet	■	■		■			AERODISP® W 630, WK 7330, W 925
	Paper Sizing	■	■					AERODISP® W 7330 N, WK 7330
	Special Coatings	■			■		■	AERODISP® W 1824, W 1836, W 7520
	Special Paper						■	AERODISP® W 1836, W 1824, etc.
	Anti-Slip	■						AERODISP® W 7330 N, W 7520 (N), W 7225 P
METAL	Polishing	■		■				AERODISP® W 1226, W 925, etc.
	Metal Treatment	■		■		■	■	AERODISP® W 7512 S, W 7520, WK 7330, etc.
	Electrolytic Plating						■	AERODISP® W 7512 S, W 630, etc.
TEXTILES	Non-Slip	■		■			■	AERODISP® WK 7330
	Synthetic Fibers	■					■	AERODISP® G 1220, etc.
	Technical Wovens	■			■			AERODISP® W 7520, WK 7330, etc.
	Fire Protection			■		■	■	AERODISP® W 7520, etc.
PAINTS & COATINGS	Waterbased, Acrylic	▣			■			AERODISP® W 7520, AERODISP® WR 8520, etc.
	Woodstains	■					■	AERODISP® W 1714, W 7520, etc.
	Gravure Printing Inks	■	■		■			AERODISP® W 7520 P, etc.
	Solvent-based			■			■	AERODISP® 1030
POLYMERS	Cellophane, Viscose Fibers			■			■	
	PET-Foils	▣		■			■	AERODISP® G 1220, VP Disp. G 6020 X
	PET-Fibers			■	■		■	AERODISP® G 1220, VP Disp. G 6020 X, etc.
	Latex		■					AERODISP® W 7622
	Sealants	■		■	■			AERODISP® W 7520, W 7622, etc.
	Pressure Sensitive Adhesives	■		■	■			AERODISP® W 7330 N, W 7520 N, W 1226
	Other Polymers	▣			■			AERODISP® W 7520, W 630, etc.
GLASS & CERAMICS	Ceramics					■	■	AERODISP® W 440, W 450 ZX, W 7520, etc.
	Fluorescent Powders					■	■	
	Water/Air Purification						■	
	Self-cleaning Surfaces						■	AERODISP® W 740 X, VP Disp. W 2730 X
	Alternative Energy						■	AERODISP® W 740 X, VP Disp. W 2730 X
	Lamp Phosphors and Illuminants					■		AERODISP® W 630
CONSTRUCTION	Specialty Concrete, Plasters	■	■	■	■			AERODISP® W 7520, W 7520 P, etc.
BATTERIES & GEL BATTERIES	Separators for Li-Ion Batteries	■		■			■	AERODISP® W 440, AERODISP® W 7520
	Gel Batteries	■			■			

Physico-chemical data of AERODISP®

Grades	Solids content[1]/ wt.%	pH value[2]	Viscosity[3]/ mPas	Density at 20 °C/ (g/cm³)	Stabilizing agent/ remarks
Aqueous silica dispersions, alkaline					
AERODISP® W 7520	20	9,5-10,5	≤100	1,12	Ammonia
AERODISP® W 7520 N	20	9,5-10,5	≤100	1,12	NaOH
AERODISP® W 7520 P	20	9,0-10,0	≤300	1,12	KOH
AERODISP® W 7622	22	9,5-10,5	≤1000	1,14	Ammonia
AERODISP® W 1226	26	9,0-10,0	≤100	1,16	
AERODISP® W 7330 N	30	9,5-10,5	≤1000	1,20	NaOH
AERODISP® WR 8520	20	10,0-11,0	≤100	1,13	DMEA
AERODISP® W 7225 P	25	9,8-10,8	≤100	1,16	KOH
AERODISP® W 7225 G	25	9,8-10,8	≤100	1,16	KOH
AERODISP® W 1244	48	10,6-11,2	≤200	1,44	KOH
Aqueous silica dispersions, acidic					
AERODISP® W 1714	14	5,0-6,0	≤100	1,08	Phosphate/[4]
AERODISP® W 1824	24	5,0-6,0	≤150	1,15	Phosphate/[4]
AERODISP® W 1836	34	4,0-6,0	≤200	1,23	Phosphate/[4]
AERODISP® W 7512 S	12	5,0-6,0	≤100	1,07	Ammonia
Aqueous silica dispersions, cationic					
AERODISP® WK 7330	30	2,5-4,0	≤1000	1,20	Cationic Polymer/[4]
Aqueous mixed oxide dispersions					
VP Disp. W 340	40	2,5-5,5	≤1100		
Aqueous alumina dispersions					
AERODISP® W 440	40	3,0-5,0	≤1000	1,38	
AERODISP® W 450 ZX	50	6,0-9,0	≤100	1,53	
AERODISP® W 630	30	3,0-5,0	≤2000	1,26	
AERODISP® W 640 ZX	40	6,0-9,0	≤70	1,39	
AERODISP® W 925	25	3,0-5,0	≤1000	1,20	
VP Disp. W 470	70	4,0-9,0	≤2000	1,20	Citric acid
VP Disp. W 640 XC2	40	7,0-10,0	≤2000	1,35	special anionic
VP Disp. W 640 XC8	40	7,0-10,0	≤200	1,35	special anionic
Aqueous titania dispersions					
AERODISP® W 740 X	40	5,0-7,0	≤30	1,41	
VP Disp. W 2730 X	30	6,0-8,0	≤5000	1,28	

Grades	Solids content[1]/ wt.%	Fumed metal oxide	Viscosity[3]/ mPas	Density/ (g/cm³)	Solvent
Solvent-based dispersions					
AERODISP® G 1220	20	Silica	≤300	1,23	Ethylene Glycol
AERODISP® 1030	30	Silica, hydrophobic	≤10 000[3]	1,16	MPA
VP Disp. E 5315 X	15	Silica, hydrophobic	≤ 50	0,86	Ethanol
VP Disp. G 1220 X	20	Silica	≤200	1,24	Ethylene Glycol
VP Disp. G 6020 X	20	Silica	≤200	1,24	Ethylene Glycol
VP Disp. G 7520 X	20	Silica			Ethylene Glycol
VP Disp. IPA 2730 X	30	Titania	≤200	1,14	Isopropanole
VP Disp. IPA 5015 X	15				Isopropanole

[1] Solid contents may vary ±1%
[2] Measured according to EN ISO 787-9 method
[3] Measured according to DIN EN ISO 3219 at a shear rate of 100 s^{-1}
[4] Stabilized with small amounts of aluminum compounds

Further dispersions of hydrophilic and hydrophobic silica and metal oxides in organic solvents are available on request. The data represents typical values, not production parameters.Developmental products are labeled with the VP Disp. designation. Their commercialization depends on market response. Even though they are produced in commercial quantities, future availability should be verified. In some cases, these products may not have undergone complete testing.

EUROPE, MIDDLE-EAST, AFRICA, LATIN AMERICA
Evonik Resource Efficiency GmbH
Business Line Silica
Rodenbacher Chaussee 4
63457 Hanau-Wolfgang
Germany
PHONE +49 6181 59-12532
FAX +49 6181 59-712532
ask-si@evonik.com
www.evonik.com
www.sipernat.com

NORTH AMERICA
Evonik Corporation
Business Line Silica
299 Jefferson Road
Parsippany, NJ 07054-0677
USA
PHONE + 1 800 233-8052
FAX + 1 973 929-8502
ask-si-nafta@evonik.com

ASIA, PACIFIC
Evonik (SEA) Pte. Ltd.
Business Line Silica
3 International Business Park
#07-18 Nordic European Centre
Singapore 609927
PHONE + 65 6 809-6877
FAX + 65 6 809-6677
ask-si-asia@evonik.com

RE-23-June17-Tools

EVONIK
POWER TO CREATE