



**AEROSIL® for  
Paints and Coatings**

**AEROSIL®**



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

## AEROSIL® – more than just a powder

Evonik Industries developed AEROSIL® fumed silica more than 70 years ago, and has dominated the world's development and production of fumed silica ever since. Many things as we know them in our daily lives would be unthinkable without AEROSIL® particles. For example, AEROSIL® fumed silica is found in earthquake-proof building foundations, in silicone sealing compounds for bath tubes, in the plastic walls of yachts, in insulating materials for ceramic hot plates and in paints and coatings.

AEROSIL® fumed silica has become indispensable, not just as a product in itself, but because the highly-specialized, environmentally-friendly technologies enabled by AEROSIL® products have become firmly rooted in numerous branches of industry. In addition to the actual product AEROSIL® fumed silica, we can offer real solutions for many technical applications with unbeatable advantages. Our specialist teams in Research & Development take care of a continuous improvement of the products and their



applications. Competent, dedicated laboratories work on solutions for application and handling techniques that are present for you, our customers, worldwide, by our technical support and customer service.

Efficient logistics guarantee that deliveries arrive on time whereas well-designed packaging means easy and convenient handling of our products. Our policy regarding the long-term range of AEROSIL® products offers planning

security and prevent unexpected investment costs for alternative solutions. Our global presence helps us to combine available know-how to form an international network. In this way, we work hand-in-hand with you towards providing individual solutions for your systems, and meeting your high standards, thus making your products even more successful.



## AEROSIL® – The Ideas just Keep on Flowing

For you AEROSIL® fumed silica benefits from the smallest things. The average primary particle size of the fumed silicas used in coatings is between seven and sixteen nanometers. If it would be possible to form a chain using the primary particles contained in one gram of AEROSIL® 200, it would stretch 17 times the distance between the earth and the moon. The smaller the particles are, the greater the effects in many cases, and the wider the range of applications.

Together with you, we are investing in future-oriented, innovative applications to be a part of these growing markets. AEROSIL® fumed silica can be applied in so many different ways, that, together with you, we may be able to use it to solve a problem tomorrow which we know nothing about today.

### **The Widest Range of Products**

Thanks to the numerous AEROSIL® grades specially designed for use in paint applications, Evonik is equipped with a portfolio of products which offers technical advantages at all stages of a coating's life, i. e. „Production and Storage“, „Application“, and „Dry Paint Film“. AEROSIL® can be used not only to adjust the rheological properties of a liquid coating, but also to improve the settling behavior of pigments and fillers, to generate scratch-resistant surfaces and also to help regulate the flow behavior of powder coatings.



### Unique Coatings Technology Center

Technical service is provided by the Coatings Technology Center for matting agents, and aluminum silicate, as well as for AEROSIL® fumed silica. This unit centralizes know-how on the individual products and their application in coating systems, and uses this knowledge to provide customer-friendly solutions. In addition to standard dispersing equipment, such as dissolvers, ball mills, and pearl mills, the Coatings Technology Center is also equipped with state-of-the-art means of application and curing. The optical and mechanical properties of a dry paint film are assessed in accordance with currently valid standards, including the criteria set by the automotive industry. For basic scientific support, methods such as electron microscopy (SEM, TEM, EDX) or oscillating rheometry are available.

The worldwide presence of our coatings experts, as well as a close cooperation with the AEROSIL® research team, guarantees a customer-oriented development of products.

### AEROSIL® in Paints and Coatings

Production and Storage	Application	Dry Paint Film
Dispersibility of pigments	Rheology (sag behavior)	Improved scratch resistance
Pigment stabilization	Fixation of special-effect coatings	Optical properties (coloristics, gloss)
Reduced settling of pigments	Electrostatic charge control of powder coatings	Viscoelastic properties (adhesion, elasticity)
Free flow of powder coatings		Water resistance/corrosion protection



AEROSIL® Provides Solutions – Anti-settling is just one

## AEROSIL® – Beneficial for Production and Storage

### **AEROSIL® as an Anti-settling Additive**

One of the most traditional applications of AEROSIL® fumed silica in the coatings industry is its use as an anti-settling or suspension agent for fillers and pigments. This important performance enhancement results from two mechanisms. First, the AEROSIL® particles envelop the pigment particles, preventing reagglomeration. Second, the pseudoplasticity of the coating as a result of using AEROSIL® products reduces the sedimentation of the pigments and fillers. The most effective AEROSIL® grade for this application depends on a number of factors, such as the binder used, the kind and concentration of pigments or fillers

requiring stabilization, and the presence of other additives.

AEROSIL® fumed silica is used very successfully as an anti-settling or suspension additive in applications such as zinc dust paints and anti-corrosion paints, the latter being based on black micaceous iron oxide, zinc phosphate or calcium silicate. AEROSIL® products have also proven themselves in electrically conductive coatings containing metallic powders or flakes.

In particular it is relatively easy to prevent products with a low specific density from settling, for example, silica-based matting agents or various pigment blacks.



Free flow  
(left) flow behavior adjusted by use of AEROSIL® R 972  
(right) powder coating without AEROSIL®

### **AEROSIL® for Powder Coatings**

A small addition of AEROSIL® fumed silica to a powder coating prior to the fine grinding considerably improves its free flow properties. The electrostatic charge of the powder coating will not be negatively affected, regardless of whether the powder has a positive or negative charge. The use of hydrophobic AEROSIL® grades will ensure a long-lasting charge due to its moisture protection. The generally very low added amounts of < 0.5 % do not negatively influence the leveling of the powder coatings during curing.

AEROXIDE® Alu C, which is produced using the same process as for AEROSIL® fumed silica, assumes a special status here. Unlike AEROSIL® products, AEROXIDE® Alu C displays a positive charge. For this reason, this product is often used in powder coatings that are triboelectrically applied, both to increase the electropositive chargeability of the powder coating, and also to regulate the flow properties.



Application properties of a coating (left) reference (right) containing 0.5% of AEROSIL® R 816

## Rheology Control by AEROSIL® – The Key to Quality Coatings

# AEROSIL® – Beneficial for the Application

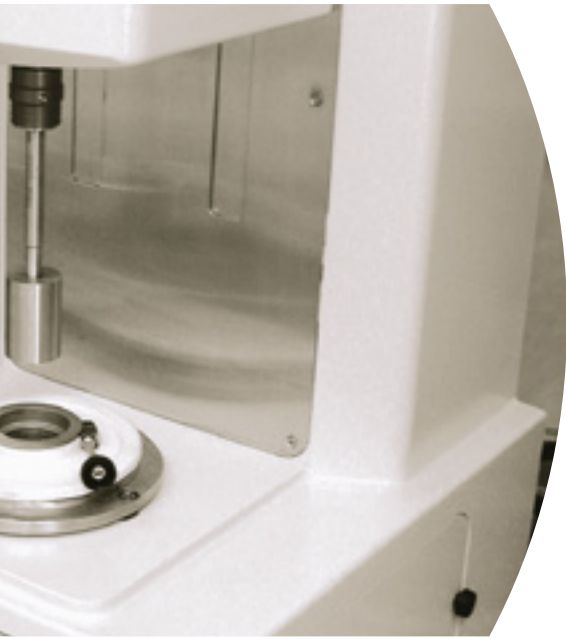
### **AEROSIL® for Rheology Control**

The rheological properties of paints and coatings can be regulated according to the needs with either hydrophilic or hydrophobic AEROSIL® grades. Added amounts of 0.3 - 1.0 %, based on the total formulation, are typical in nearly all solvent and water-based systems, as well as in high-solids coatings.

The incorporation of AEROSIL® particles into a coating generally produces a pseudoplasticity that is often linked

to a thixotropic effect, i.e. a dependence on time. The dependence of the flow behavior of pseudoplastic coating systems on the shear rate guarantees high level application due to the low viscosity at high shear rates. Especially with spray application, where very high shear forces occur, this low viscosity at application conditions results in the formation of very fine paint droplets, which can be distributed onto a substrate for optimal leveling. The high viscosity of a coating at low shear



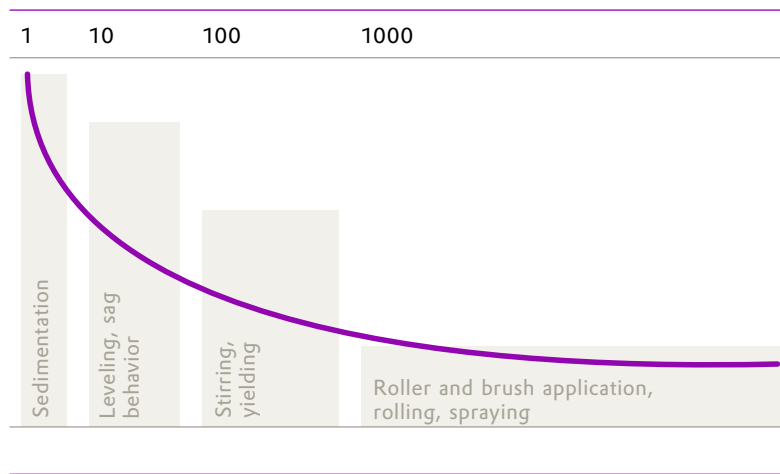


Rheometer MCR 300 Paar Physica

forces or at rest ensures an increased maximum wet-film thickness by using AEROSIL® fumed silica. It also serves to counteract the sedimentation of pigments and fillers.

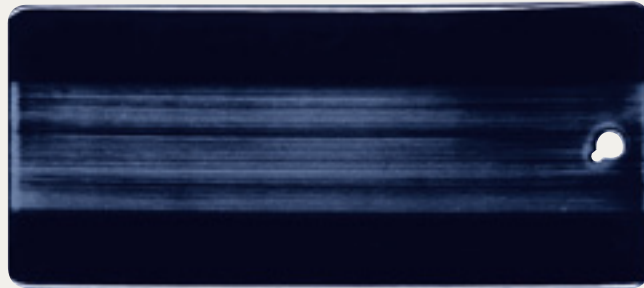
AEROSIL® grades are also used successfully to regulate the rheology of special-effect coatings. The fixing of the special effect in metallic base coats and in structural or hammer-finish paints, deserves a special mention here.

### Viscosity



Shear rate [s<sup>-1</sup>]





Improved scratch resistance  
(left) containing AEROSIL® R 9200/AERODISP® 1030  
(right) reference

AEROSIL® Ensures an excellent Long-time Look of your Products

## AEROSIL® – Beneficial for the Cured Paint Film

### Secondary Effects of AEROSIL®

By using AEROSIL® fumed silica, the gloss and coloristics of many pigmented coating systems are improved as a result of the increased degree of dispersion and the prevention of pigment reagglomeration during storage.

Another significant effect arising from the use of AEROSIL® fumed silica is the improved water resistance and corrosion protection of coatings. While this effect can also be observed when hydrophilic AEROSIL® grades are used, the use of hydrophobic AEROSIL® grades considerably increases the efficiency. Besides providing greater stabilization of the pigments used in the paint system, a barrier effect inherent to all hydrophobic AEROSIL® particles is one of the reasons for this behavior.

This prevents moisture from penetrating the paint film, thus protecting the surface. The use of hydrophobic AEROSIL® grades as a medium to increase corrosion protection was described as far back as the 1960's.

### AEROSIL® to improve Scratch Resistance

Evonik has developed a new generation of fumed, hydrophobic and structure-modified silicas to improve the scratch resistance of UV-curing, High-Solid and conventional solvent-based two component paint systems. Among these, is the most recently presented AEROSIL® R 9200, which is described in detail in Technical Information No. 1284. In order to improve the scratch resistance of a top coat and to keep the desired

optical properties, it is necessary to disperse the structure-modified AEROSIL® in a concentration of 5 to 15% (computed on solid binder) in a bead mill in combination with fine (approx. 0.5 mm) ZrO<sub>2</sub> beads. To make it easier for our customers to handle this innovative fumed silica Evonik developed a user-friendly dispersion. The result is AERODISP® 1030, a 30 wt. % dispersion of AEROSIL® R 9200 in 1-methoxy-2-propyl acetate (MPA). The dispersion AERODISP® 1030 is quite easy to use: Simply combine with the resin and other paint ingredients while agitating, with a dissolver for example. Stir the dispersion prior to use. The residual gloss of a paint film can be improved up to 35 % after a scratch stress.



Typical bag packaging of Evonik AEROSIL®



AEROSIL® in the new bulk container (FIBC: Flexible Intermediate Bulk Container)

## AEROSIL® – Technical Handling Service Enables Compact Solutions

### Handling

The term handling is used to describe the techniques required to move AEROSIL® products within a customer's plant. The following topics should be regarded as the main priorities:

- Emptying of packaging units
- Silo storage
- Internal conveying
- Dosage
- Introduction of the material into the processing machinery

In addition to these points, the term handling also includes topics essential to putting the above steps into practice. More detailed information about the offering of this service is available from the customer service agent in your area.

### Packaging

AEROSIL® fumed silica in powder form is available in three different packaging units. The standard packaging is the multi-layer paper bag, with an additional polyethylene liner for certain products. The weight of the bags ranges from 10 to 20 kg, and depends on the AEROSIL® grade and its set tapped density. Evonik also offers AEROSIL® fumed silica in FIBC (Flexible Intermediate Bulk Container). Depending on the product and its densification ratio, the weights of the filled FIBC's also vary. Large-scale users may also have the product delivered by silo truck, which requires a corresponding storage silo at the customer's location. AEROSIL® dispersions, known as AERODISP®, are delivered in 60 L cans, 220 L barrels and 1 m<sup>3</sup> IBC's (Intermediate Bulk Containers).

### Storage Stability

AEROSIL® fumed silica is chemically inert to a large extent and shows no chemical changes after long periods of storage, provided it is stored under suitable conditions. Nevertheless, it should be noted that a small number of substances do react with silicon dioxide. Due to its high specific surface, volatile substances may be adsorbed on the AEROSIL® surface. This adsorption is reversible in the case of moisture. The adsorption of moisture is significantly reduced by the organic modification of the hydrophobic AEROSIL® grades.

It is possible that prolonged periods of storage may cause the AEROSIL® products to become slightly compacted. This can lead to a minimal rise in the tapped density, which might slightly affect correlated product properties.

## AEROSIL® – an Overview

	Rheology control Anti-sagging	Anti-settling Pigment stabilization	Corrosion protection	Other effects
<b>Solvent-based coatings (2-pack systems)</b>	AEROSIL® R 972 AEROSIL® R 974 AEROSIL® R 805 AEROSIL® R 812 AEROSIL® R 812S	AEROSIL® R 972 AEROSIL® R 974 AEROSIL® R 805 AEROSIL® R 812 AEROSIL® R 812S	AEROSIL® R 972 AEROSIL® R 974 AEROSIL® R 805 AEROSIL® R 812 AEROSIL® R 812S	AEROSIL® R 7200 <sup>1)</sup> AEROSIL® R 9200 <sup>1)</sup> AERODISP® 1030 <sup>1)</sup>
<b>Solvent-based coatings (baking and air drying systems)</b>	AEROSIL® 200 AEROSIL® 300 AEROSIL® R 972 AEROSIL® R 974 AEROSIL® R 805 AEROSIL® R 812 AEROSIL® R 812S	AEROSIL® 200 AEROSIL® R 972 AEROSIL® R 974	AEROSIL® R 972 AEROSIL® R 974 AEROSIL® R 805 AEROSIL® R 812 AEROSIL® R 812S	AEROSIL® R 7200 <sup>1)</sup> AEROSIL® R 9200 <sup>1)</sup> AERODISP® 1030 <sup>1)</sup>
<b>Water-based coatings (clear coats)</b>	AEROSIL® 200 AEROSIL® COK 84 AEROSIL® R 816 AERODISP® WR 8520			
<b>Water-based coatings (pigmented systems)</b>	AEROSIL® 200 AEROSIL® COK 84 AEROSIL® R 974 AEROSIL® R 816 AEROSIL® R 805 AEROSIL® R 812 AEROSIL® R 812S AERODISP® WR 8520	AEROSIL® 200 AEROSIL® COK 84 AEROSIL® R 816 AEROSIL® R 972 AEROSIL® R 974 AERODISP® WR 8520	AEROSIL® R 816 AEROSIL® R 972 AEROSIL® R 974 AEROSIL® R 805 AEROSIL® R 812S	
<b>UV-curing coatings</b>	AEROSIL® 200 AEROSIL® R 972 AEROSIL® R 974 AEROSIL® R 711			AEROSIL® R 7200 <sup>1)</sup> AEROSIL® R 9200 <sup>1)</sup>
<b>Powder coatings</b>				AEROSIL® 200 <sup>2)3)</sup> AEROSIL® R 972 <sup>2)3)</sup> AEROSIL® R 812S <sup>2)</sup> AEROSIL® R 8200 <sup>2)3)</sup> AEROXIDE® Alu C <sup>2)4)</sup> AEROXIDE® Alu C805 <sup>2)4)</sup> AEROXIDE® Alu 130 <sup>2)4)</sup>
<b>Unsaturated polyester</b>	AEROSIL® 200 AEROSIL® 300 AEROSIL® 380			

1) scratch resistance improvement

2) free flow additive, anti-caking

3) dispersing additive

4) increase in electropositive charge



**Detailed information**  
regarding our publications  
is available from:

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## Working with AEROSIL®

The handling of AEROSIL® fumed silica is receiving increased attention at a time when automation, rationalization, industrial hygiene for the protection of employees and environmental regulations are all becoming more and more important. Parallel to these developments, the Business Line Silica has been expanding its activities in this field for more than ten years.

The planning of dust-free, automatic plants for AEROSIL® fumed silica requires a fundamental knowledge of the products, together with experience in process engineering when handling fumed oxides. We combine our experience in this field with the specific know-how of our customers, and the know-how of the manufacturers of conveying, dosage and production units. This enables us to develop joint concepts which facilitate the handling of AEROSIL® products at our customers' plants.

### **Technical Bulletin Fine Particles, No. 28**

- The Handling of Synthetic Silicas and Silicates

### **Technical Information 1125**

- AEROSIL® for waterbased Coatings

### **Technical Information 1197**

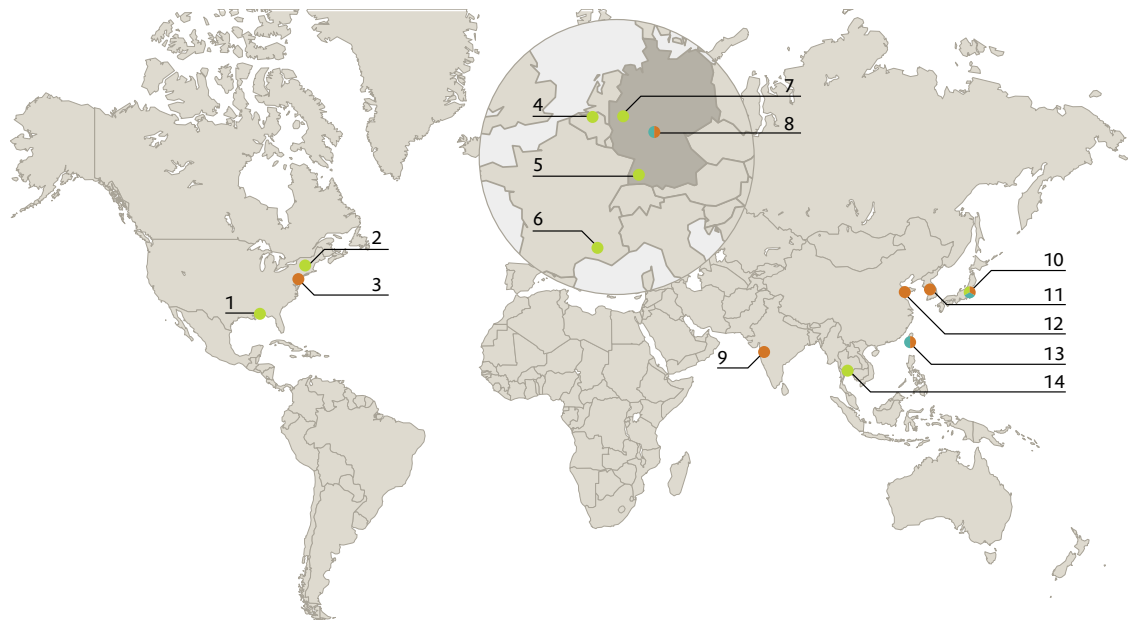
- AEROSIL® for High Solid Coatings

### **Technical Information 1219**

- Semi Bulk Containers for AEROSIL®

### **Technical Information 1284**

- AEROSIL® R 9200 to improve the Scratch Resistance of Paint and Coating Systems



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|--|--|---|
| <ul style="list-style-type: none"> <li>● <b>Production</b></li> <li>1 Mobile, USA</li> <li>2 Waterford, USA</li> <li>4 Antwerp, Belgium</li> <li>5 Rheinfelden, Germany</li> <li>6 Roussillon, France</li> <li>7 Leverkusen, Germany</li> <li>10 Yokkaichi, Japan</li> <li>14 Map Ta Phut, Thailand</li> </ul> | <ul style="list-style-type: none"> <li>● <b>Research &amp; Development</b></li> <li>8 Hanau, Germany</li> <li>10 Yokkaichi, Japan</li> <li>13 Ta Yuan, Taiwan</li> </ul> | <ul style="list-style-type: none"> <li>● <b>Applied Technology</b></li> <li>3 Piscataway, USA</li> <li>8 Hanau, Germany</li> <li>9 Mumbai, India</li> <li>10 Yokkaichi, Japan</li> <li>11 Seoul, Korea</li> <li>12 Shanghai, China</li> <li>13 Ta Yuan, Taiwan</li> </ul> |
|--|--|---|

## The Advantage of a Global Enterprise – Local Proximity

Size usually creates distance – but not at Evonik. 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® uses 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. With a total of more than 1200 motivated employees and more than 100 service offices in 95 countries, we also offer our customers the biggest service network of all suppliers on the market.

The combination of highest product quality and a marked 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.**

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**Evonik. Power to create.**