

FUMED METAL OXIDES



CABOT

creating what matters

Delivering Superior Performance Benefits for Diverse Applications



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Looking for a versatile fine particle that delivers functionality to your most demanding application? Cabot's cornerstone products – CAB-O-SIL® and CAB-O-SPERSE® Fumed Silica and SpectraAl™ Fumed Alumina – provide exceptional performance benefits for a wide variety of applications and industries. Since the early 1950s, our fumed metal oxides (FMO) business has been developing, producing and marketing fumed metal oxides to meet the challenging requirements sought by our customers around the world.



Today we continue to advance our fine particle technologies to bring you unique fumed metal oxides that meet your individual requirements. Our competencies in fine particle technology include:

- Advanced manufacturing and handling of carbons, mixed oxides, refractory metals and aerosols.
- Surface modification of very fine particles, such as silicas, carbon, color pigments and catalysts.
- Manufacture of single and complex multiphase particle-media composites for specific properties, such as color, dispersion stability, charge generation, electrochemical behavior and insulation.

Quite simply, if you need it, we can probably make it.

Superior performance for common applications

Due to their unique particle characteristics, enormous surface area and high purity, fumed metal oxides provide superior performance benefits for many types of consumer and industrial applications including adhesives, coatings, inkjet media, pharmaceuticals, toners, cosmetics and food additives.



The chart below shows the functions of fumed metal oxides and how they are used in common applications. Our customers find new uses for fumed metal oxides every day – from wind-powered generators to photo paper for inkjet printers.

If you have a question about the right fumed metal oxide for your application, please consult our sales and technical service staff through our online technical service option, CABOTech. You can find it on the Cabot website at www.cabot-corp.com.

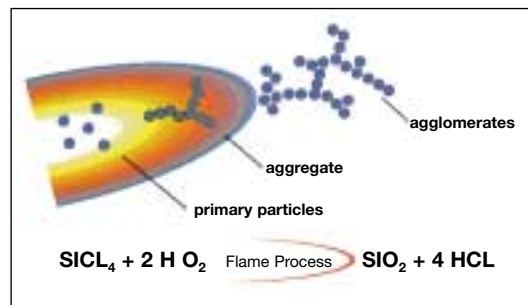
Function	Customer applications
Reinforcement	Rubber, sealants
Rheology control	Adhesives, sealants, composites, coatings, cosmetics
Free-flow	Coatings, pharmaceuticals, toners, food
Abrasion	Polishing
Void-forming	Inkjet media, insulation
Electrical/charging	Toners
Light diffusion	Cosmetics, inkjet media
Other functions	Cosmetics, new applications

How fumed metal oxides are manufactured

Untreated fumed metal oxides

Untreated fumed metal oxides are manufactured via a high temperature hydrolysis process. Vapor phase hydrolysis of volatile, metal chloride compounds occurs in a hydrogen and oxygen flame. This combustion process creates metal oxide molecules, which condense to form particles. The particles collide, attach and sinter together. The result is a three-dimensional branched chain aggregate less than a micron in length. The flame process also imparts the following characteristics to the particles:

- High purity
- Extremely small particle size and high surface area
- Non-porous primary particles; however, the aggregate structure contains void space which results in adsorptive capacity
- Unique surface chemistry with active hydroxyl groups which renders the particle hydrophilic (an affinity for water)
- Various crystalline phases, from completely amorphous silicon dioxide to fumed alumina with a mixture of gamma, theta, alpha and amorphous phases



What is an aggregate? An aggregate can be composed from 2 to 200 primary particles or molecules. Due to its composition, an aggregate is not easily broken during the dispersion process, making it ideal for many applications.

Treated fumed metal oxides

For systems requiring hydrophobic grades, Cabot provides treated fumed metal oxides. Ideal for systems where untreated metal oxides fail, Cabot's treated fumed metal oxides deliver a number of performance benefits including:

- Hydrophobicity to other systems
- Reduced moisture adsorption
- Effective rheology control
- Increased compatibility with organic systems

The process for treating fumed metal oxides is relatively straightforward. The hydroxyl groups formed during the manufacturing process make the particle surface chemically active. These chemically reactive hydroxyl groups are the attachment sites for the agents used to make treated grades of fumed metal oxides. The resulting surface changes make the fumed metal oxides hydrophobic and modifies its rheology control properties.

Fumed metal oxide particles can be treated with silanes or silazanes to replace the silanol groups on the particle surface, yielding a partially to fully treated surface, depending on the treatment. Treatment is accomplished via a solvent-free fluidized bed process. Because the treatment groups are chemically bonded to the particle surface, treated fumed metal oxides contain no volatile organic components.

Fumed metal oxide functions and applications

Matching surface energies for optimal performance

The primary functions of Cabot fumed metal oxides come from the interactions of the oxide surfaces with the application formulation. The strengths of these interactions, called surface energies, are controlled for optimum performance.

For example, improved reinforcement is achieved by increasing the attraction of the oxide to the components of the formulation. (See Figure 1.)

Fig. 1:
A strong oxide/formulation interaction reinforces the product.



Rheology control is obtained by balancing the attraction of the oxide particles to each other with the attraction of the oxide particles to the formulation. (See Figure 2.)

Fig. 2: A strong oxide-oxide attraction forms networks and controls the rheology.



One of Cabot's core competencies is matching the surface energies of its oxides to customer formulations for optimal performance.



Unique benefits for diverse applications

Cabot's fumed metal oxides provide the following performance benefits:

Reinforcing agent

Fumed silica is used for reinforcement of silicone compounds and organic polymers. Unfilled polymers have very little strength; adding fumed silica to the rubber strengthens it, allowing it to be stretched and deformed without breaking.

Typical applications range from silicone o-rings and bathroom caulks to construction sealants and even baby bottle nipples. Without fumed silica, a silicone rubber nipple could easily be ripped by the infant's teeth. With the addition of just a small amount of fumed silica, the nipple can be stretched, chewed on, etc, without tearing.



Rheology control agent

Fumed silica is most widely used for rheology control of liquid systems. One of the properties fumed silica provides to liquid systems is thixotropy. At rest, the fumed silica thickens the liquid; under shear force the liquid system thins, and once the shear force is removed the liquid system thickens again. The use of fumed silica in liquid systems ranges from coatings and printing inks to polyester laminating resins and adhesives.

The clear, glossy coating on the body of your car is an excellent example of how our customers use the thixotropic behavior of fumed silica to achieve the performance needed. Clear coatings are applied by spraying; the shear forces generated in the spraying process cause the coating to thin and lose viscosity. This allows the paint droplets to flow together to form a continuous coating on the surface of the car. No longer under shear, the viscosity of the coating recovers, preventing the coating from dripping or sagging on the surface.



Free-flowing and anti-caking agent

Another use of fumed silica is as a free-flow, anti-caking agent for powdered materials. Many powders have poor flow characteristics, meaning they form lumps and clumps – which can clog manufacturing equipment. The addition of a small amount of fumed silica to a powder dramatically improves its flow – making it flow smoothly and rapidly through processing equipment. The food, cosmetic, pharmaceuticals and toners industry rely on the anti-caking properties of fumed silica.

Fumed silica is also used in food, such as seasonings. As a consumer, you want your seasoning to pour smoothly, evenly and without lumps. Ground spices, herbs and other flavorings tend to be sticky and hence have poor “flowability”. Adding a tiny amount of fumed silica to the seasoning coats the sticky particles, allowing them to flow smoothly.



Absorbing agent

Because of their excellent absorbing qualities, fumed silica and fumed alumina particles are used for coatings on glossy photo paper for inkjet printers. The particles’ unique structure and porosity quickly absorb the liquid ink and promote fast drying on the paper. Cabot fumed silica and alumina particles are quickly replacing slow-drying, polymer-based coatings.



Hydrophobicity

Fumed silicas can be surface treated to be hydrophobic – that is, to repel water. The addition of treated, hydrophobic fumed silica in sunscreen products improves their water resistance. Treated fumed silica can encapsulate water droplets to form a free-flowing “dry” powder that is more than 90 % water.

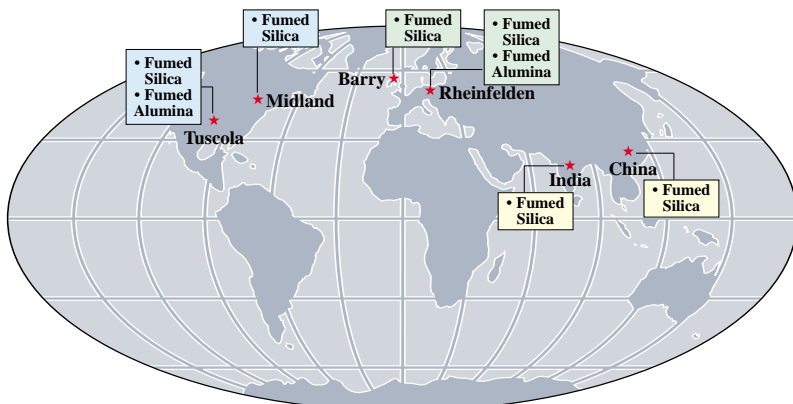


Safety, Health and Environment

Cabot is committed to conducting our business responsibly so that we protect our employees, the public and the environment. Our safety, health and environmental (SH&E) commitment is a core value of the corporation and an integral part of our business activities. All Cabot employees, managers and contractors are responsible for providing a safe and healthy environment for our co-workers, contractors, customers and the communities in which we operate. Our goal is to meet or exceed all applicable SH&E laws and regulations in our business activities. For more information about our health and safety record, please visit the Cabot web site at www.cabot-corp.com

Global operations

Cabot's FMO manufacturing plants are located worldwide, including China. Our Sales and Technical Service organizations serve customers in every region of the world, providing customized service on a local basis. Cabot Technical Centers are located in Billerica (U.S.A.), Rheinfelden (Germany) and Shanghai (China).



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