

MANY APPLICATIONS FOR FUMED and PRECIPITATED SILICA

NOTTINGHAM COMPANY



PERFORMANCE PROCESS, INC.

Performance Based Silica for Diverse Applications



Performance Process, Inc. - Mundelein, IL.
Nottingham (*Div. of Performance Process, Inc.*) - Atlanta, GA.

- **Adhesives**
- **Sealants**
- **Plastics**
- **Inks**
- **Paints**
- **Coatings**
- **Defoamers**
- **Greases**
- **Toner**
- **Silicone Rubber**
- **Agriculture**
- **Cable Gels**
- **Food**
- **Fire Extinguishers**
- **Polyester Resins**
- **Cosmetics**

Rheology control, Suspension and Stability behavior, Adsorbent, Free-flow of powders, Anti-setting, Anti-sagging, Anti-blocking, Reinforcement, Pigment stabilization & dispersion, Print definition, Anti-setoff, Mechanical/Optical properties improvement, Thixotrophy, Thickening, Hydrophobicity control, and Improved processability.

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► Benefits for Variety of Applications

Versatile fine particles that delivers functionality to your most demanding application. Our Silica products - PROFUSIL (fumed) and PERFORM-O-SIL (precipitated) provide exceptional performance benefits for a wide variety of applications and industries. We continue to advance our fine particle technologies to bring unique fumed and precipitated silica that meet your individual requirements. We manufacture single and multiphase particle-composites for specific properties, such as dispersion, stability, hydrophobicity, and functionality. Due to their unique particle characteristics, and large surface area, fumed silica provides superior performance and benefits for many types of consumer and industrial applications including adhesives, plastics, sealants, coatings, inks, toner, cosmetics, inks, food additives, and defoamers. We will help our customers find the right fumed and precipitated silica for their specific applications. If it's something you need, we can probably make it. If you have a question about the right fumed silica or precipitated silica for your application, please contact our offices in Mundelein, IL. and Atlanta, GA.



► Our Chemistry

Treatment: Polydimethylsiloxane and Octamethylcyclotetrasiloxane surface treatments of our silica particles, account for the hydrophobic behavior of our treated silicas. In most cases, these treatments determine the interaction of our silica particles with solids and liquids. The surface of our silica particles can be chemically modified by reacting various silanes and silazanes to give the hydrophobicity results necessary for various applications and functionalities.

► Defoamers & Antifoams

Defoamers/Antifoams usually consist of a suspension of hydrophobic or hydrophilic precipitated silicas in mineral oil, soybean oil or in silicone oil. Precipitated silicas have a tendency to settle, because of their relatively large agglomerate sizes. The addition of hydrophobic PROFUSIL either completely prevents or at least significantly reduces this undesirable effect. There are also many defoamer/antifoam systems where hydrophobic PROFUSIL is the active silica component. PROFUSIL H22 is very effective in these formulations, especially for Food applications, Urethane coatings, Clear-coats, Inkjet paper coatings, Inks, and in areas dealing with micro-foam, and the need for good deaeration. If you have customers who require Defoamers/Antifoams which contain silica less than 1.0 micron particle size, then PROFUSIL is your solution.



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► Using PROFUSIL as a Thickener

PROFUSIL's thickening and thixotropic effects are largely dependent on the intensity and efficiency of dispersion. At least a dissolver should be used. Optimum dispersion is best achieved using rotor-stator type equipment, bead mills or triple roll mills. Choosing the most suitable method and dispersion equipment depends on the consistency of the system. It is sometimes advisable to produce a concentrate from part of the liquid or part of the formulation with the total quantity of PROFUSIL and then to disperse this with high shear. The remaining liquid of remaining part of the formulation should then be added to reduce the PROFUSIL content to the required level. In principle the thickening effect of PROFUSIL increases with decreasing primary particle size. However, as particles become increasingly fine, they necessitate higher shear levels to achieve the optimum thickening effect. An additional advantage worth noting is the high temperature stability of viscous systems thickened with PROFUSIL. The use of PROFUSIL for rheology control is very suited for coatings, plastics, printing inks, adhesives, lubricants, creams, ointments and in toothpastes.

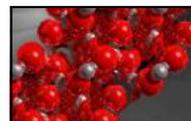
► Adsorbent and Carrier

Due to its high specific surface area, PROFUSIL is able to adsorb gaseous, liquid or solid materials, the latter must be of course in a dissolved form. PROFUSIL will preferentially adsorb those compounds capable of forming hydrogen bond linkages with the silanol groups on its surface or which can interact on an acid-alkali basis. In addition to forming genuine adsorbates, PROFUSIL is also able to hold substantial quantities of liquid within the micropore structure of its agglomerates, thus enabling it to act as a carrier. Liquids and pastes can be converted into powder form by this method, making them considerably easier to dose and handle.



► Thickening & Thixotropy

When untreated silica is dispersed in a nonpolar liquid, the silanol groups on the surface of different particles can interact by hydrogen bond with each other to form connecting bridges. A three dimensional structure develops, which has a thickening effect. This structure can be broken down again by subjecting the system to mechanical stress, either through stirring or shaking. The extent of the break down depends on the type and duration of the mechanical stress. The thickened system thereby regains its mobility. When in a state of rest, the PROFUSIL particles link up again and the original viscosity is restored. This effect is known as thixotropy. It can be shown that a system thickened with PROFUSIL requires a certain minimum amount of energy to enable it to flow. Hydrophilic silica has a less pronounced thickening effect in polar and semi-polar liquids. In these systems, surface treated PROFUSIL, often shows a remarkable rheological effectiveness, particularly where liquid mixtures or solutions are concerned. This is due to the formation of three-dimensional solvate- or adsorbate structures.

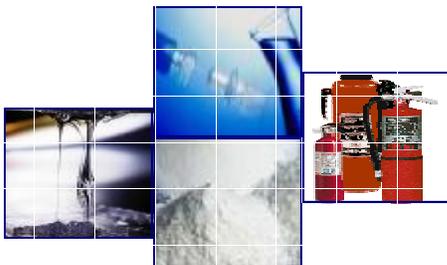


► Suspension, Dispersion, Grinding

PROFUSIL prevents or delays the sedimentation of solids in liquid systems, such as pigmented coatings or resins containing fillers. This effect can be mainly explained by the formation of a yield point, which results from the use of PROFUSIL. Stability is achieved within the system when the weight of the filler or pigment particles is insufficient to overcome this yield point. Even in instances where settling is unavoidable, the sediment may be re-dispersed without problems. The agglomerates are deposited between the solid particles and have a loosening effect on the solid structure, which provides for an easy remixing.



PROFUSIL is a successful grinding aid for solid particles, both in the dry state and in liquid media. Solid particles can only be broken down to a certain level by grinding or applying shear. A point is then reached where the "fragment particles" begin to reaggregate faster than they are being broken down and dispersed. When using PROFUSIL, these "fragments" become encapsulated which makes it more difficult for their high energy surfaces to recombine. This enables a particle size reduction when dry grinding or dispersing solids in liquids, which is significant for many applications. In many instances, additions of hydrophobic PROFUSIL, during the dispersion stage, have achieved clear improvements in pigmentation performance in coatings.



► Reinforcement of Elastomers

Using PROFUSIL as a reinforcing filler in elastomers produces a considerable improvement in their mechanical properties, such as tensile strength, elongation at break and tear resistance. PROFUSIL also helps to control the influence of temperature on mechanical properties. The level of improvement depends on the type of polymer and on the type and concentration of PROFUSIL used.

Typical applications areas

- HTV-Silicone Rubber
- Extruded Parts
- RTV-Silicone Rubber
- Moulding Compounds
- Sealing Compounds
- Casting Compounds
- Liquid Silicone Rubber
- Extruded Parts
- Injection Mouldings
- Synthetic Rubber
- Cable Insulation
- Sealants

► Free-flow and Storage

PROFUSIL greatly increases the free flow and storage stability of powdered substances, which have a tendency to cake. The most plausible explanation for this effect is the formation of a mono-particle layer of silica around the powder particles, which reduces "inner friction" and develops a ball-bearing effect. Typical applications are in fire extinguisher powders, table salt, tomato powder, tablet powder blends, plastic powders and some negative toners.

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► Printer & Copier Toner

PROFUSIL fumed silica can improve the flow characteristics and charge stability of toners, and performance enhancements such as improved resolution and print quality of laser beam printers or plain paper copiers. Driving the technological advancement is smaller particle sized – dry toner. The main effects of PROFUSIL in this application are to improve the flowability of the dry toner and to minimize the electrostatic charge variation of dry toner at different ambient conditions such as 85 % relative humidity, 40° C (summer) and 20 % relative humidity, 10° C (winter). As a general rule, the development of toners for clear, high-resolution copies by printers or plain paper copiers is made easier in any environment, using even the smallest particle size toners, by the use of small percentages of PROFUSIL.

► High Temperature Insulation

PROFUSIL has outstanding thermal insulation properties due to the fact that Amorphous silicon dioxide has a very low solid state conductivity. Furthermore, the space between the particles is in the same order as the mean free path dimensions for oxygen and nitrogen molecules. Thermal conductivity drops with decreasing average primary particle size.



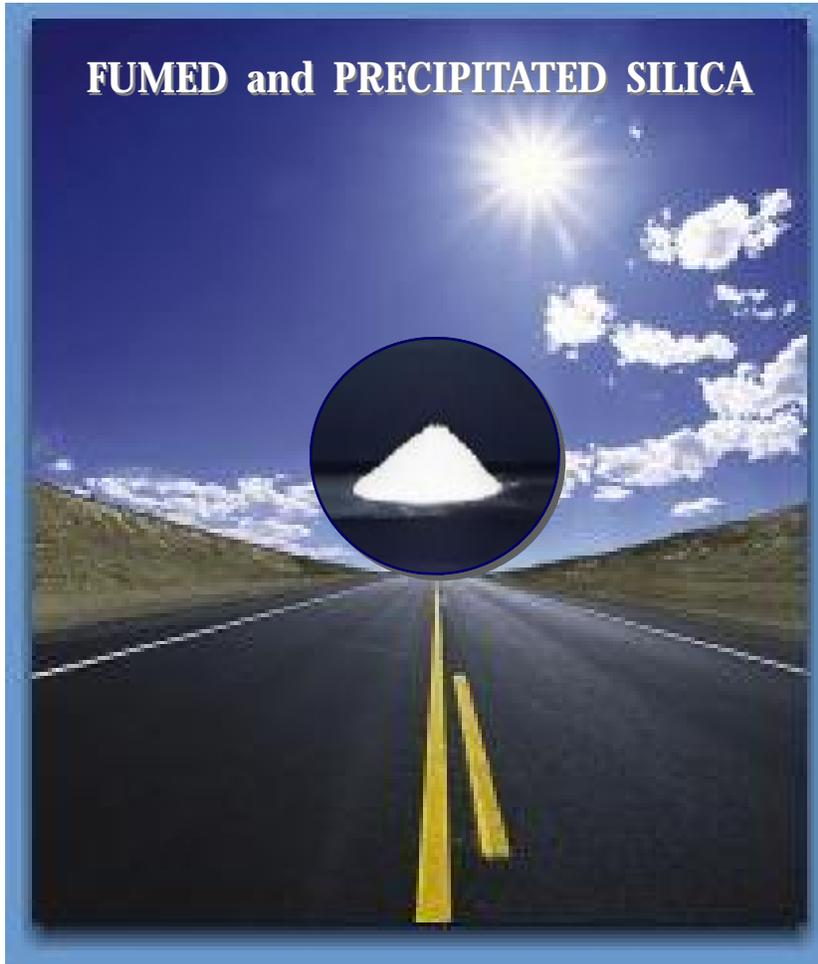
► Electrostatic Charge Effect

PROFUSIL has a tendency to acquire a negative triboelectric charge. This is because of the slightly acidic silanol groups on the particle surface, which result in an isoelectric point at approximately pH 2. This effect is particularly important in toners, where the negatively charged "powdered" printing ink has to adhere to a positively charged roller and produce a latent image. In plastic powders possessing a strong negative electrostatic charge, such as PVC, PE, PA or EP, PROFUSIL can reduce the tendency to acquire this charge and the unwelcome characteristics that are associated.

► Storage & Stability

PROFUSIL will remain chemically stable for many years under suitable storage conditions, providing it does not come into contact with hydrofluoric acid or any highly alkaline substances, since these types of material will always react with silicon dioxide. In the case of water, any adsorption is reversible. It is possible for slight compaction to occur during longer storage time, particularly in the lower layers of a pallet. This can lead to a minor increase in tapped density and to a change in the structure. It is advisable to store PROFUSIL and other fumed oxides in closed containers under dry conditions and to protect them from volatile substances. The product should be used within two years of the date of manufacture.

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Take The Road To Your Solution !

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