

# SIPERNAT<sup>®</sup> specialty silica and AEROSIL<sup>®</sup> fumed silica for fire extinguishing powders

Technical Information 1413



## 1 In Brief

In case of a fire, extinguishers have to be reliable. For dry powder extinguishers, this means that the contents have to fluidize easily even after a long storage time. With proper fluidization, the powder will flow out evenly and completely—achieving the equipment's full potential.

The challenge in formulating fire extinguishing powders is that they have a tendency to pick up moisture during storage due to the ingredients' hygroscopic nature. Hygroscopic powders have a tendency to cake and result in poor performance. Adding hydrophobizing agents and flow aids to the powder reduces its tendency to cake and ensures a long lasting flowability.

SIPERNAT® specialty silica and AEROSIL® fumed silica serve two purposes in this application:

- 1 They help grind raw materials for fire extinguishing powders to a very fine particle size, which prevents the mill from clogging.
- 2 They are highly efficient flow aids for the final powders and enable them to be fluidized easily. Hydrophobic SIPERNAT® and AEROSIL® grades increase long term storage stability, as they prevent reagglomeration caused by moisture absorption.

### Benefits for you and your customer:

- Reduced caking tendency
- Improved storage stability
- Improved flowability
- Easy fluidization
- Consistent quality



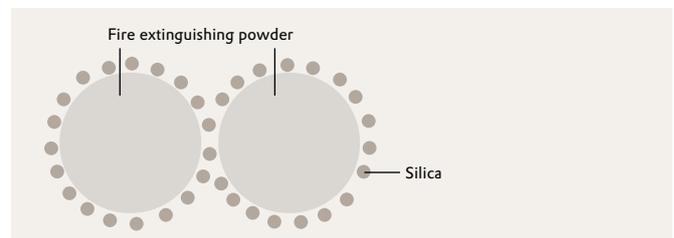
**Figure 1**

Fire extinguishers are an important equipment in cars

## 2 SIPERNAT® specialty silica as grinding aids for fire extinguishing powders

Fire extinguishing powders consist of inorganic salts. ABC-powders usually contain monoammonium phosphate (MAP) as active ingredient and ammonium sulphate as diluent. Among the most common ABC powders, the MAP concentrations are around 40%, 75% and 90%. In BC powders, a variety of active ingredients can be used. Sodium bicarbonate and potassium chloride are the most common choice for this type of powder. Heavy salts such as barium sulphate are added to increase the density.

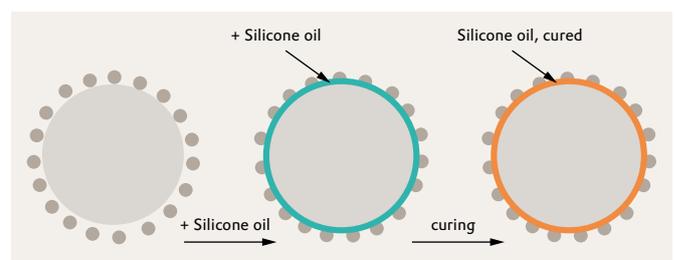
The first step in the production of these powders is to grind the raw materials. Pin mills are often used for this process. Adding 0.5 to 1% of a hydrophilic silica such as SIPERNAT® 22 S or 0.5% of a hydrophobic grade such as SIPERNAT® D 17, results in easier and finer grinding, while preventing the particles from reagglomerating.



**Figure 2** Silica acts as spacer and prevents reagglomeration

## 3 SIPERNAT® specialty silica and AEROSIL® fumed silica improve the flowability and prevent reagglomeration

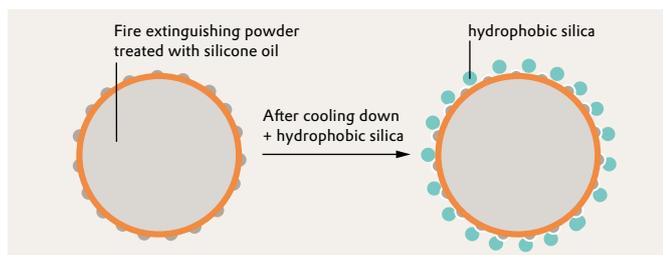
After or during milling the fire extinguishing powder usually is coated with a silicone oil, like a polymethylhydrogensiloxane, which is then heat cured. Some silicone oils also can cure at room temperature using catalysts. The cured silicone oil coating hydrophobizes the surface of the particles and prevents them from picking up moisture.



**Figure 3** Silicone oil treatment of the powder and curing process

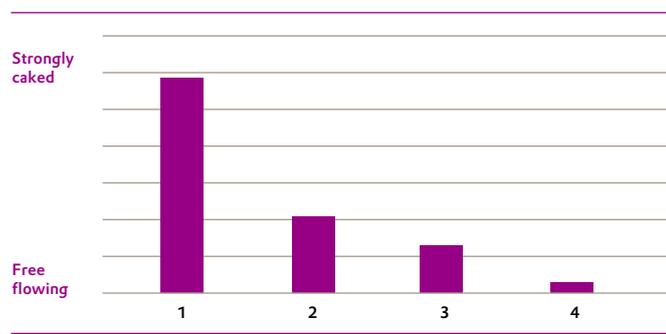
## 4 Product recommendations

Often the addition of silica in the milling process and silicone oil treatment alone are not sufficient to ensure long-lasting storage stability of the fire extinguishing powder. A second treatment with SIPERNAT® specialty silica leads to a further reduction of the caking tendency. The silica is mixed into the powder after the silicone oil treatment process has been completed. A hydrophobic silica such as SIPERNAT® D 17 is more efficient at reducing caking than a hydrophilic one. In particular the hydrophobic silica can prevent the formation of solid bridges in the fire extinguishing powder, while having only minor influence on its bulk density.



**Figure 4** Second treatment with hydrophobic silica reduces caking further

In the following test the storage stability of an ABC powder was tested in a wet/dry cycle. The powder was stored initially for 4 h at 40 °C and 75 % relative humidity and subsequently for 20 h at 40 °C and 30 % relative humidity. Then the intensity of the caking was evaluated using a texture analyzer.



**Figure 5** Caking tendency of fire extinguishing powder with addition of different types of silica

The results show that the addition of only 0.5 % of the hydrophobic silica grade SIPERNAT® D 17 leads to a significantly lower caking tendency compared to 1 % of a hydrophilic standard silica.

For high quality ABC-powders with particularly fine particles, hydrophobic AEROSIL® types such as AEROSIL® R 972, AEROSIL® R 812 or AEROSIL® R 8200 are even more efficient. AEROSIL® R 812 and AEROSIL® R 8200 are especially easy to disperse in the fire extinguishing powder when compared to other silica types.

<b>SIPERNAT® 22 S</b>	Hydrophilic silica with fine particles and high absorption capacity. Recommended as grinding aid for fire extinguishing powders.
<b>SIPERNAT® D 10</b>	Hydrophobic silica with very fine particles. Recommended for the post-treatment of siliconised ABC-powders. Prevents fine powders from caking and improves the flowability after storage very well.
<b>SIPERNAT® D 13</b>	Hydrophobic silica with fine particles. Recommended for the post-treatment of siliconised ABC-powders. Prevents fine powders from caking and improves the flowability after storage very well.
<b>SIPERNAT® D 17</b>	Hydrophobic silica with fine particles. Recommended for the post-treatment of siliconised ABC-powders. Prevents fine powders from caking and improves the flowability after storage very well.
<b>AEROSIL® R 972</b>	Hydrophobic fumed silica with very fine particles. Recommended for the post-treatment of siliconised fire extinguishing powders. Suitable for high quality ABC-powders. Prevents fine powders from caking and leads to an excellent flowability after storage.
<b>AEROSIL® R 812</b>	Hydrophobic fumed silica with very fine particles. Recommended for the post-treatment of siliconised fire extinguishing powders. Suitable for high quality ABC-powders. Prevents fine powders from caking and leads to an excellent flowability after storage. Easy to disperse.
<b>AEROSIL® R 8200</b>	Hydrophobic fumed silica with very fine particles. Recommended for the post-treatment of siliconised fire extinguishing powders. Suitable for high quality ABC-powders. Prevents fine powders from caking and leads to an excellent flowability after storage. Extremely easy to disperse.

The table above provides an overview of some of the most frequently recommended SIPERNAT® specialty silica and AEROSIL® fumed silica types for fire extinguishing powders. Individual formulations may require other product grades which are not listed here.

We look forward to answering your questions and working with you to help find the right SIPERNAT® or AEROSIL® product for your individual situation, as well as to provide assistance in handling and processing of our products.

## 5 Additional literature

- 1 TI 1213 (Specialty Silica as Flow Aid, Anticaking Agent and Carrier Substance Recommended Mixing Procedures for Powders and Granulates) Technical Information, Evonik Resource Efficiency GmbH
- 2 TI 1351 (SIPERNAT® specialty silica and AEROSIL® fumed silica as flow aid and anticaking agent), Technical Information, Evonik Resource Efficiency GmbH
- 3 TI 1360 (SIPERNAT® and AEROSIL® – an Essential in Industrial Powder Technology) Technical Information, Evonik Resource Efficiency GmbH

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