TECHNICAL INFORMATION 1356

AEROSIL® SIPERNAT® ZEOFREE®

AEROSIL®, SIPERNAT®, and ZEOFREE® for Drink Mix Powders and Functional Beverages

EVONIK
Leading Beyond Chemistry

1. AEROSIL®, SIPERNAT®, and ZEOFREE® products assist in the manufacturing of high-quality powdered beverages

Silica and silicates are essential for smooth manufacturing of high-quality instant beverages. Of utmost importance is that the dry ingredients and final mixture flow well and do not cake upon subsequent storage.

Excellent flow behavior of all ingredients is crucial for accurate and precise dosing as well as processing of the final beverage preparation by the manufacturer.

Easy handling of the drink formulation is also advantageous for the consumer, as this means increased convenience and dispersion when added to water.

Minimized caking is important for retaining the quality of the instant beverages, even under sometimes adverse storage conditions in food service restaurants or at the consumer's home. When caking of the powdered beverage is inhibited, manufacturers may be able to reduce the need for additional moisture barriers, thus promoting efficacious packaging.

This reduction in caking prolongs product shelf life, supporting sustainability across the food value chain.

Advantages of using AEROSIL®, SIPERNAT®, and ZEOFREE® in powdered beverages

Optimized Powder Flow

- Accurate and precise dosing of ingredients
- Improved mixture handling
- Increased filling and packaging speeds
- Increased convenience for end consumer

Prolonged Shelf Life

- Decreased caking tendency
- Maintained product quality
- No lump formation enabling easier beverage preparation
- Reduced need for moisture barrier in packaging

Reduced Dust Generation

- Mitigates dust formation in plant operations
- Cleaner work environment
- Reduces dust-related packaging issues

Products that can benefit from AEROSIL®, SIPERNAT®, and ZEOFREE®

Food Ingredients

- Hydrolyzed proteins
- Amino acids
- Citric and malic acids
- Flavors and flavor extracts
- Milk powder
- Nondairy creamer
- Sugar and sugar substitutes
- Vitamins

Consumer Products

- Instant iced tea and fruit drink mixes
- Chocolate drink and hot cocoa mixes
- Pre-workout powders
- Protein supplement powders

2. AEROSIL®, SIPERNAT®, and ZEOFREE® are cost effective conditioning agents

The high performance of AEROSIL®, SIPERNAT®, and ZEOFREE® products results from the simultaneous combination of the spacer effect preventing interparticle contact and their high absorption capacity.

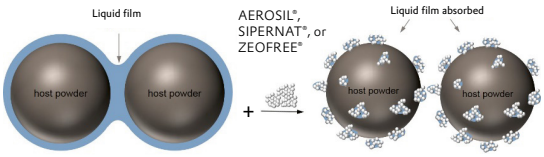
Both features together make the AEROSIL®, SIPERNAT®, and ZEOFREE® products high performance process aids that prevent caking and keep your products free-flowing.

The absorption capacity of SIPERNAT® and ZEOFREE® silica and silicate products is exceptional. SIPERNAT® 22 S and ZEOFREE® 5162 can absorb twice its own weight. For formulations with higher moisture content, SIPERNAT® 45 S and SIPERNAT® 50 can absorb three times its own weight in liquid.

The spacer effect separates the host particles and minimizes the attractive forces between them. The absorption capacity keeps the product surface dry and prevents caking during production, transport, and storage.

Figure 1: Spacing effect of Evonik silica

Figure 2: Schematic of Evonik silica absorbing liquid from host surface

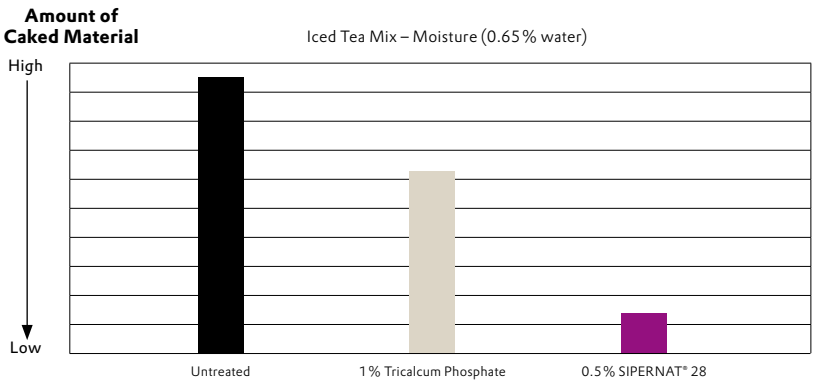


On average only half the dosage of AEROSIL®, SIPERNAT®, and ZEOFREE® products is required to achieve the same or improved flowability and anticaking performance compared to tricalcium phosphate in numerous instant beverage formulations.

This can be observed in **Figure 3** where only 0.5 % dosage of SIPERNAT® 28 is sufficient to nearly eliminate caking and prolong shelf-life of instant iced tea mix during storage.

Because of their higher efficacy, AEROSIL®, SIPERNAT®, and ZEOFREE® products help to reduce overall production costs.

Figure 3: Caking reduction of instant iced tea at minimal dosage



Mixing conditions: Paterson Kelley (PK) V-blender, speed 30 RPM, 10 min.
Measurement: Sieve Residue Caking, internal EVONIK Industries method (HDG SEM 18.132)

3. Minimizing caking tendency of powdered formulations

AEROSIL®, SIPERNAT®, and ZEOFREE® products can effectively prevent caking and agglomeration due to moisture uptake caused by hygroscopic ingredients and various powdered beverages upon subsequent storage. Due to their higher surface area, AEROSIL®, SIPERNAT®, and ZEOFREE® products can compete for moisture more effectively than alternative anticaking agents.

This effect can be observed in **Figure 4** illustrating caking reduction of an apple flavored powdered drink stored at 30°C and 60 % relative humidity. After three days of storage, the powdered drink was sieved (1.4 mm) to remove lumps from the powder. Caking was minimized in the sample containing SIPERNAT® 22 S which passed easily through the sieve.

Figure 4: Apple-flavored instant drink powder treated with different anti-caking agents after storage
From left: Untreated raw material, treated with 2% Tricalcium Phosphate; treated with 2% Magnesium Oxide, treated with 2% SIPERNAT® 22 S

Mixing conditions: Tumble Mixer (Turbula, Willi Bachofen AG) for 15 minutes.

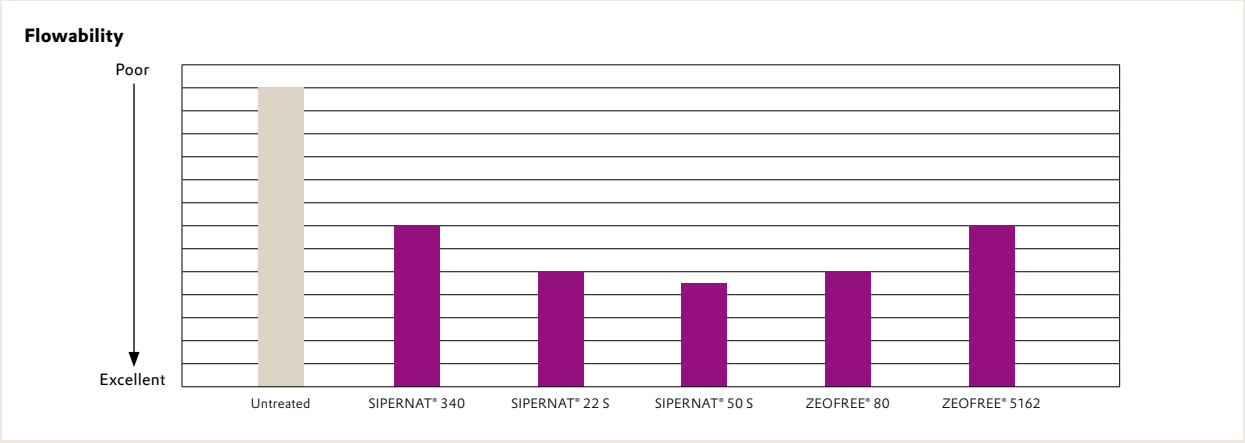
4. Optimizing flowability of powdered beverages and ingredients

The addition of just 0.5 to 1 % of AEROSIL®, SIPERNAT®, or ZEOFREE® is sufficient to improve the flow characteristics of problematic sticky ingredients, such as milk powder or non-dairy creamer, and achieve optimal flowability that facilitates dosing and handling of the powder.

Improved flow performance can be observed in **Figure 5** and **Figure 6**, where at 0.5 % dosage all products evaluated significantly improved flowability of the nondairy creamer powder allowing it to pass through a smaller orifice.

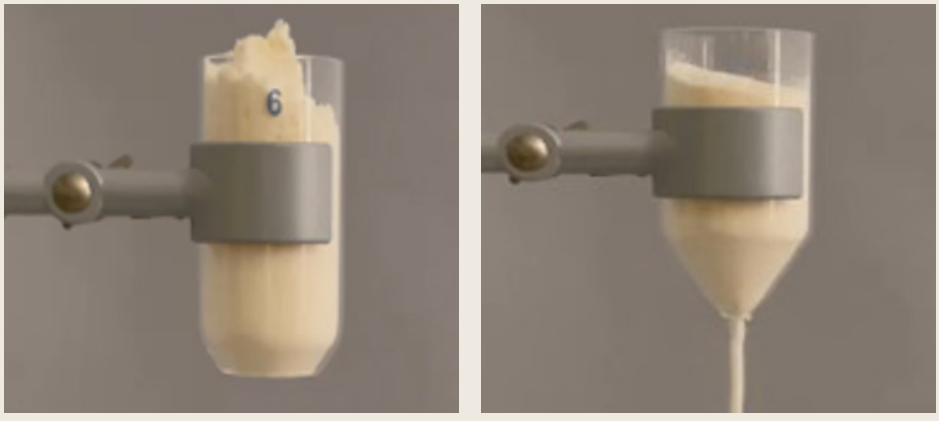
In many different applications AEROSIL®, SIPERNAT®, or ZEOFREE® products outperform other flow aids in their effectiveness.

Figure 5: Flowability improvement of non-dairy creamer



Mixing conditions: Paterson Kelley (PK) V-blender, speed 30 RPM, 10 min.
Measurement: Flodex flowability index, internal EVONIK Industries method (HDG SEM 18.135)

Figure 6: Flowability of non-dairy creamer without and with silica
From left: Untreated raw material, treated with 1% SIPERNAT® 22 S



Mixing conditions: Paterson Kelley (PK) V-blender, speed 30 RPM, 10 min.
Measurement: Sieve Residue Caking, internal EVONIK Industries method (HDG SEM 18.132)

5. Dust reduction of powders with AEROSIL®, SIPERNAT®, and ZEOFREE®

By reducing the adhesion forces of fine powders, the individual particles become freely movable and thus separate from each other. Because of this, dustiness of this powder may increase. As dust is inconvenient and a possible irritant during manufacturing as well as packaging processes, it needs to be mitigated.

The more particles stick to each other, the less likely it is that they will cause dust. By carefully choosing the right free flow and anti-caking agent, it's often also possible to minimize the dust content of a powdered mixture.

Figure 8 shows the dust content of instant tea mixed with silica products at different dosage levels. In contrast to the tea sample without silica, all samples containing silica contained significantly less dust.

Dustiness was determined with a Palas® DustView system (see **Figure 7**). Dust measured by the extinction of a laser beam. The dust value is calculated from the dust amount measured at 0.5 sec and at 30 sec.

Figure 7: Palas®, Dustview Schematic

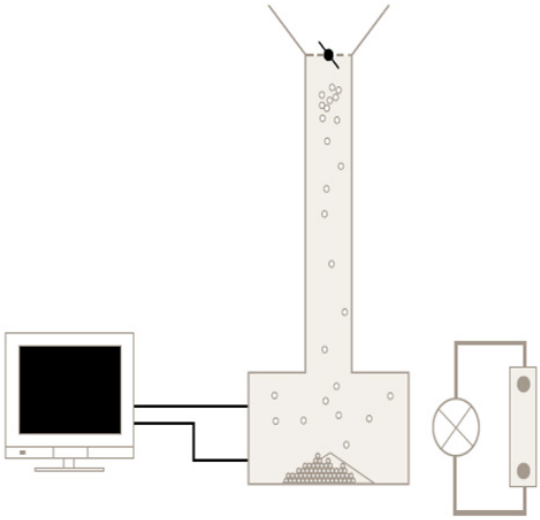
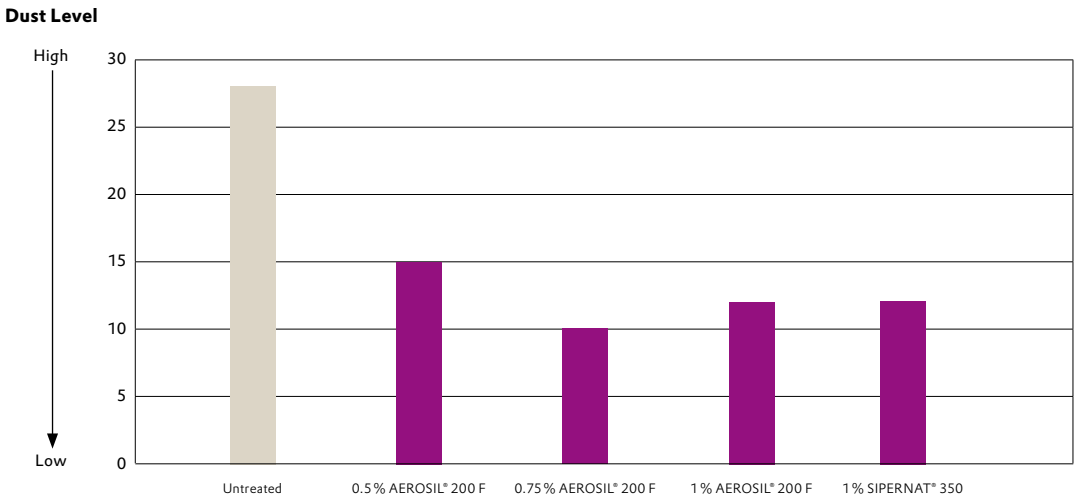


Figure 8
Instant tea dust reduction



Mixing conditions: Somakon Mixer, speed 400 rpm, 3 min.
Measurement: Palas®, Dustview
Measurement of dustiness analogous to CIPAC MT 171, internal Evonik Industries method: PA IM-SI-PS-AT/LSC 7018 D.03

6. Summary

As demonstrated above, various factors must be considered, when choosing the right flow and anti-caking aid for powdered beverages and ingredients. Depending on your product and the specific manufacturing process, the type and dosage of the added Evonik silica or silicate needs to be carefully selected.

- Selecting the proper particle size anti-caking agent is critical to ensure uniform coverage of the host particle. Uniform coverage is necessary to improve flow and decrease caking.
- The point of addition at which the anti-caking agent is added in the blending process is frequently critical to optimizing anti-caking agent performance. When making a blend which contains very hygroscopic ingredients, it is best to add all the anti-caking agent to these ingredients first rather than at the end of the blend.
- When free-flow and caking-inhibition during storage is critical, SIPERNAT® 45 S, SIPERNAT® 50 S or AEROSIL® 200 F could be suitable options.
- If dust-minimization while improving the flowability is important at your plant, formulations including AEROSIL® 200 F or SIPERNAT® 350 should be tested. Optimized mixing conditions and dosage are the key.
- For maintaining clarity and low turbidity of the final beverage preparation SIPERNAT® 380, SIPERNAT® 28 or AEROSIL® 200 F are highly recommended.

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