AEROSIL® SIPERNAT® ZEOFREE®

Evonik Silica

Essential, Sustainable, and Safe

Industry Brochure 319

EVONIK
Leading Beyond Chemistry

The Success of **Synthetic Amorphous Silica**

Synthetic Amorphous Silica

Synthetic Amorphous Silica (SAS) is a highly pure, non-crystalline form of silica. SAS has been used for decades in food, cosmetics, pharmaceuticals, and other areas due to its expansive range of properties. It is the only form of silica produced by Evonik. SAS has repeatedly been proven to be safe and has been permitted to be used as a food additive.1) In the European Union, it has the food additive reference number E 551.

AEROSIL®, SIPERNAT®, and ZEOFREE® are the brand names from Evonik for SAS. These are tried-and-trusted products that have proven themselves over a long period of time. The production processes have essentially remained the same and the principal particle structure as well as the characteristics of Evonik SAS grades have not changed in decades.

UNIQUE ADVANTAGES FOR VARIOUS APPLICATIONS

Used for decades already, SAS provides numerous advantages along the entire value chain, benefitting food manufacturers and retailers as well as consumers. Due to its adsorption properties, SAS is used as an anticaking agent in powders as well as a flow aid. It ensures user friendliness of food and reduces the amount of ingredients lost by caking.
Food manufacturers benefit from constant product quality and less cleaning downtime when handling powders. Retailers profit from storage and transport stability. Consumers enjoy the convenience of free-flowing powders. Free-flowing ingredients are easier to use – whether it's to season a meal or make an instant beverage. Flowable powders are precise to dose, even after several months. More efficient dosing means more sustainable use. In addition, SAS prevents food from forming clumps, therefore consumers use it longer and do not dispose otherwise still good food.

Sometimes, SAS is the only viable option to ensure the product's key performance.

- In the area of instant drinks, some alternatives can have an influence on the taste of the product. SAS does not influence the taste.
- Non-nanostructured alternatives usually employ a completely different mode of action and in many cases do not perform as well as SAS as both anticaking agents and free-flow aids. Thus, higher dosage of additives is necessary.

> **All in all, SAS aids the sustainable production and usage of food and facilitates its hygienic processing and consumption due to its adsorption properties.**

Evonik SAS:
Sustainable and Safe

Silica naturally occurs in a lot of plants, especially cereals and grass

SAS: performance derived from nature

Silica or silicon dioxide (SiO_2) is a material containing silicon and oxygen. Identically structured, it appears in nature, for instance in various plants [17] or as the major constituent of sand. Derived from this most abundant natural raw material on earth, Synthetic Amorphous Silica (SAS) is a highly pure product that supports the sustainable manufacturing, storage, and use of food.

The manufacturing process converts the quite inhomogeneous natural raw material sand into a product with a constantly high quality, which can be used for a wide spectrum of specific applications. As product manufacturer Evonik is able to constantly produce and control the quality ingredient SAS according to set standards and high customer demands.

SAS SUPPORTS SUSTAINABLE MANUFACTURING, STORAGE, AND USE OF FOOD

Food manufacturers benefit from the constantly high quality of our product. Using SAS means less cleaning downtime when handling powders. SAS in free-flowing powders can prevent manufacturing plants from occasionally halting due to clogging of pipes.

This saves time, cleaning efforts, materials, and energy.

- **In one example, the cleaning frequency of a spray dryer was reduced from every 2 to 3 days to once every 5 days. This results not only in approx. 40% reduction of downtime, but also less food waste as well as massively less energy and water consumption for cleaning. Only one cleaning cycle of a spray dryer requires between 0.2 to 2 MJ of energy.[4]**
- **In another example, where nearly 25% of the product of a spray dryer was lost via the outlet air from the cyclone, the use of silica resulted in a higher product recovery from the cyclone due to less adhesion of the product to the cyclone walls. Thereby, a substantial reduction of the food wasted in the drying process to only 10 to 15% was achieved.**

Furthermore, SAS contributes to enhanced product stability and better storability of many food products, reducing food waste and inefficient use of resources. SAS in food ensures for example longer usability by consumers. Clumps in consumer's food often lead to the unnecessary early disposal of otherwise still good food.

SUSTAINABILITY IMPACTS ACROSS THE FOOD VALUE CHAIN

The effects of silica bring advantages and benefits not only to food manufacturers, but to all participants within the overall food chain, including consumers.

- **Sustainability** of the food chain is enhanced, less food loss means that less animal feed, fertilizer, water and effort – and on the whole less CO_2 – have been unnecessarily spend per food unit produced.
- **Enjoyment & Convenience** is increased for consumers, because free flowing ingredients are easier to use whether it's to season something or make an instant beverage.
- **Healthy** nutrition is supported, because silica ensures the reliable and constant dosage of nutrients.

Evonik silica enhances efficiency and sustainability in all stages of the food value chain.

FOOD ADDITIVES & INGREDIENTS
- Easy-to-handle powders
- Efficient drying and/or milling processes
- Storage and transport stability
- Converts liquids to highly concentrated absorbates

FOOD MANUFACTURING
- Exact ingredient dosing
- Constant product quality
- High throughput
- Less cleaning downtime

RETAIL/FOOD SERVICE
- Storage & transport stability
- Less cleaning downtime for equipment such as vending machines

CONSUMERS

Sustainability

Enjoyment & Convenience

Health

SAS is a **safe solution for food**

The physical structure of SAS consists of aggregates which form larger entities called agglomerates. The size of these agglomerates meets the customer needs to solve caking and flowability issues. The differentiating product properties and quality parameters of SAS fulfil all technical and functional criteria and enable SAS to perform as an anti-caking agent and flow aid.

Moreover, the EU commission confirms that "'nanomaterial' is a categorization of a material by the size of its constituent parts. It neither implies a specific risk, nor does it necessarily mean that this material actually has new hazard properties compared to its constituent parts or larger sized counterparts" [15)]

SAS has repeatedly been proven to be safe. Its use as a food additive (identification number is E 551) is approved by the European Food Safety Authority (EFSA). SAS has been extensively evaluated regarding its effects on humans, animals, and the environment.[3)] Most recently in January 2018, EFSA has confirmed the safe use of E 551 in food in its scientific opinion: "including studies with nano silicon dioxide, there was no indication of adverse effects". [1)]

Notwithstanding the inclusion of SAS in any given nano classification [6)], nano is merely a size indicator and not a risk indicator. SAS remains safe for human consumption as food additive.

There are ambiguous nano definitions.

"Nano" in general refers to the particle size of certain materials. Thereby nanomaterials classify particles ranging in size from 1 to 100 nanometers. Nanomaterials occur naturally, e.g. in milk. However, different definitions of nanomaterials apply for regulated industries, such as food or cosmetics. For instance, legally binding European definitions, such as the cosmetic (EC 1223/2009), novel food (EU 2015/2283) or food information regulation (EU 1169/2011), consider additional aspects besides particle size. Against this background, SAS does not classify as a nanomaterial under these regulations. Looking at its structure in detail, Evonik SAS does not contain isolated nanoparticles.[12)]

Examples of publicly available scientific literature that demonstrate the safety of Silica used in food:

- **Claudia Fruijtier-Pölloth**, Arch. Toxicol. (2016), DOI 10.1007/s00204-016-1850-4: Metastudy / review article: The safety of nanostructured synthetic amorphous silica (SAS) as food additive E 551

- **EFSA** Panel on Food Additives and Nutrient Sources added to Food (ANS), EFSA Journal (2018), DOI 10.2903/j.efsa. 2018.5088: Re-evaluation of silicon dioxide (E 551) as a food additive of synthetic amorphous silica, approved in the EU for use as a food additive (E 551).

- **Klaus Weber** et al., Toxicology Research and Application (2018), DOI: 10.1177/2397847318805273: Aerosols of synthetic amorphous silica do not cause lung fibrosis, a pathological, often fatal, alteration of lung connective tissue.

Literature

1) **EFSA** (2018). Reevaluation of silicon dioxide (E 551) as a food additive. In: EFSA Journal 16(1).

2) **Fruijtier-Pölloth, C.** (2016).The safety of nanostructured synthetic amorphous silica (SAS) as a food additive (E 551). In: Arch Toxicol: 1–32.

3) **Takizawa, Y.**, et al. (1988). Oral Ingestion of Syloid to Mice and Rats and its Chronic Toxicity and Carcinogenicity. In: ACTA MED BIOL 36(1): 27–56.

4) **Ramirez, C. A.**, et al. (2006). From fluid milk to milk powder: Energy use and energy efficiency in the European dairy industry. In: Energy 31: 1984–2004.

5) **Contado, C.**, et al. (2016). Physicochemical and toxicological evaluation of silica nanoparticles suitable for food and consumer products collected by following the EC recommendation. In: Anal Bioanal Chem 408(1): 271–286.

6) **ECHA** (2019). Silicon dioxide; synthetic amorphous silicon dioxide (nano): https://echa.europa.eu/de/substance-information/-/substanceinfo/100.028.678

7) **Peters, R.**, et al. (2012). Presence of nano-sized silica during in vitro digestion of foods containing silica as a food additive. In: ACS Nano 6(3): 2441–2451.

8) **Tarantini, A.**, et al. (2015). Genotoxicity of synthetic amorphous silica nanoparticles in rats following short-term exposure. Part 1: oral route.
In: Environ Mol Mutagen 56(2): 218–227.

9) **Yoshida, T.**, et al. (2014). Intestinal absorption and biological effects of orally administered amorphous silica particles.
In: Nanoscale Res Lett 9(1): 532.

10) **Fruijtier-Poelloth, C.** (2012). The toxicological mode of action and the safety of synthetic amorphous silica – A nanostructured material. In: Toxicology 294: 61–79.

11) **Krug, H. F.** (2014). Nanosafety Research – Are We on the Right Track? In: Angewandte Chemie International Edition 53(46): 12304–12319.

12) **Albers, P.**, et al. (2015). Physical boundaries within aggregates – differences between amorphous, para-crystalline, and crystalline structures.
In: Cryst. Res. Technol.: 1–20.

13) **ASASP** (2019).
Statements: https://www.asasp.eu/index.php/publications

14) **Marin, R.**, et al. (2018). Effects of sample preparation on particle size distributions of different types of silica in suspensions. In: Nanomaterials 8(7): 454.

15) **SASSI**. Position Paper Regarding Synthetic Amorphous Silica (SAS).

16) COMMISSION STAFF WORKING PAPER: Types and uses of nanomaterials, including safety aspects accompanying the Communication from the Commission to the European Parliament, the Council and the European Economic and Social Committee on the Second Regulatory Review on Nanomaterials, 2012.

17) **Lindner G. G.**, Comparison of Biogenic Amorphous Silicas Found in Common Horsetail and Oat Husk With Synthetic Amorphous Silicas, Frontiers in Public Health, 10 (2022), https://www.frontiersin.org/articles/10.3389/fpubh.2022.909196; DOI=10.3389/fpubh.2022.909196

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The Silica specialists at Evonik - Inside to get it right.

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