

Storing Precipitated Silica



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1 General information

SIPERNAT® and ULTRASIL® are amorphous, precipitated silica made by Evonik Industries. Precipitated silica is used in many different applications and industries throughout the world. If the product properties of the precipitated silica are to be maintained, they must be packaged and stored to suit their specific requirements.

2 How precipitated silica is packaged and delivered

Multi-layer paper bags are the standard packaging used these days and are suitable for all modes of transport, such as truck, railroad, airplane, and ship. Precipitated silica is delivered in other kinds of packaging, too, for example, FIBCs (Flexible Intermediate Bulk Containers), which makes it especially easy for customers to handle our products without creating dust. Precipitated silica is largely delivered as bulk products in bulk trucks.

Evonik Industries packs and ships its precipitated silica (Figure 1) as follows. See Technical Bulletin TI 1232 for more information:

- Bags stacked on pallets, including securing the transport
- Semi-bulk deliveries in FIBCs on pallets
- Bulk deliveries in bulk trucks or silo containers



Figure 1 Precipitated silica shipped in sacks, semi-bulk containers or full bulk

3 Storage conditions and stability

Since precipitated silica is porous and has a high specific surface area, there is the danger that it may absorb vapors or gases, thereby having a negative impact on the properties of the product. For this reason, always keep the product away from sources of contamination.

As regards storage temperatures, there are no particular limits from a technical safety aspect. In general, temperatures up to 50 °C have proved to be uncritical. Low temperatures such as severe frost also have no adverse effect on the silica.

3.1 Storing bags and semi-bulk containers

While precipitated silica can be stored indefinitely, we recommend that you use the product within 24 months. Ultimately, however, its usability depends considerably on how it is stored.

The production date can be seen clearly from the control number that is printed on each bag or FIBC.

The lot number can be explained as follows: **PPYMMDDSS**: Herewith is **PP** = plant ID; **Y** = year (0–9); **MM** = month (01–12); **DD** = day (01–31); **SS** = internal number

For example, the lot number 193010305 shows that the date of production was 3rd January 2013.

With products that are sold as food or feed additives, the production date and expiration date are also printed clearly on the packaging.

While with these forms of packaging the design of the primary packaging (bag, FIBC) and, in some cases, additional outer packaging such as polyethylene shrink wrapping or stretch film offer a certain degree of protection against environmental effects, it is always recommended that precipitated silica is stored in a closed, dry warehouse.

Adsorption or compaction processes (see Section 3.1.2), and so forth, may adversely affect the application. For this reason, precipitated silica that has been stored for some time should be checked before it is used.

3.1.1 Influence of relative humidity (RH)

This relates especially to absorption of moisture. Storage tests have shown that silica does absorb varying amounts of water under different climatic conditions. Silica products absorb moisture depending on their grade and how they have been stored. Usually, increased moisture absorption also causes changes to the surface of the silica. This means that measured values for CTAB and BET will also change accordingly. Figures 2, 3, 5, and 7 show examples of the effect of moisture absorption and the resulting loss on drying (LOD) based on measurements of selected products from various applications.

3.1.1.1 Application: tire industry

Figures 2 and 3 show the aging of ULTRASIL® VN3 GR silica as regards its BET and CTAB surface areas and the respective loss on drying. It must be stressed that the CTAB surface area, the surface area that has an effect on rubber, is not particularly affected by the method or duration of storage. By contrast, the BET surface area is reduced noticeably under drastic conditions. The diagrams clearly show that the BET surface area draws closer to the CTAB surface area the older the silica is. This can be explained by the *healing* of micropores, which, however, has virtually no effect on the technical application properties.

Figure 4 illustrates the effect of storage on some mechanical rubber properties. There are no significant effects on performance compared to the standard.

Figure 2 Ageing progression of ULTRASIL® VN3 GR

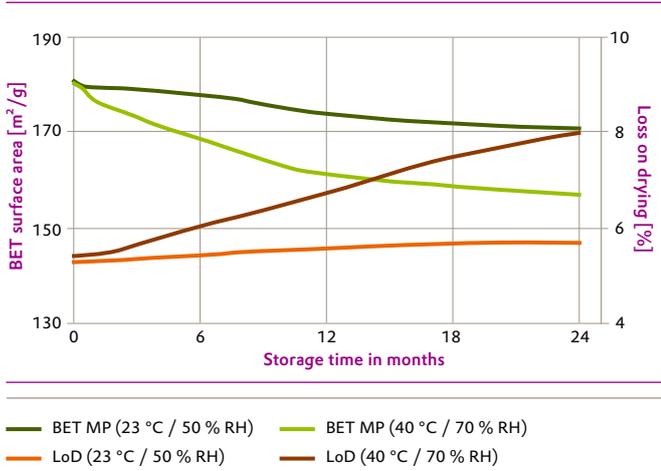


Figure 3 Ageing progression of ULTRASIL® VN3 GR

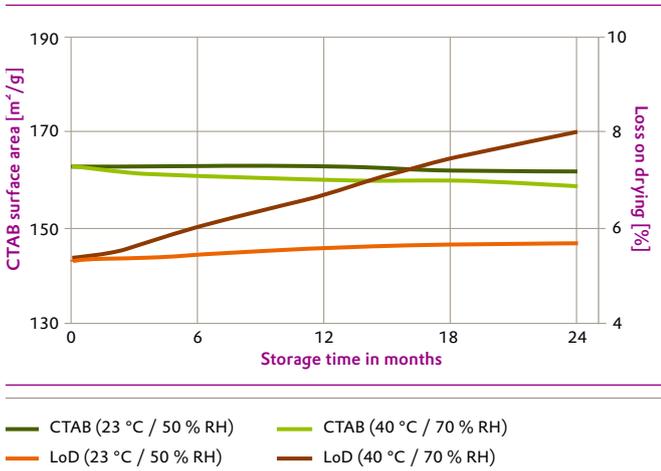
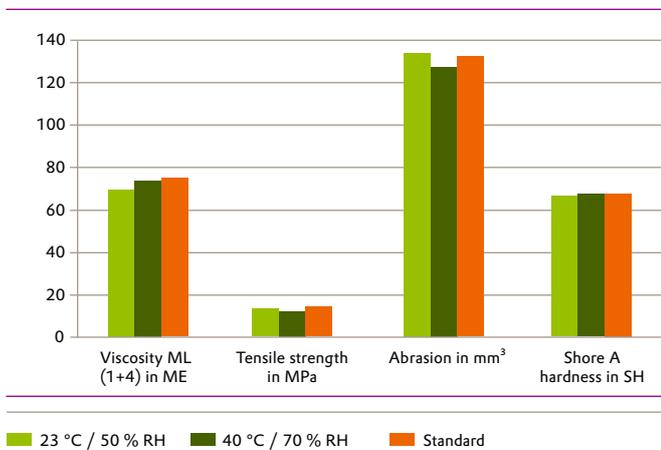


Figure 4 Tire and rubber relevant data of ULTRASIL® VN3 GR after 24 months



3.1.1.2 Application: free flow and anti-caking

The silica grade SIPERNAT® 22 S absorbs much more moisture under tropical conditions (Figure 5).

In the flow improvement of a model substance, silica stored under temperate or tropical conditions exhibited no reduction in performance compared to the standard, even after being stored for two years (Figure 6). The method is described in Technical Bulletin TI 1360 "SIPERNAT® and AEROSIL® – an Essential in Industrial Powder Technology."

Figure 5 Ageing progression of SIPERNAT® 22 S

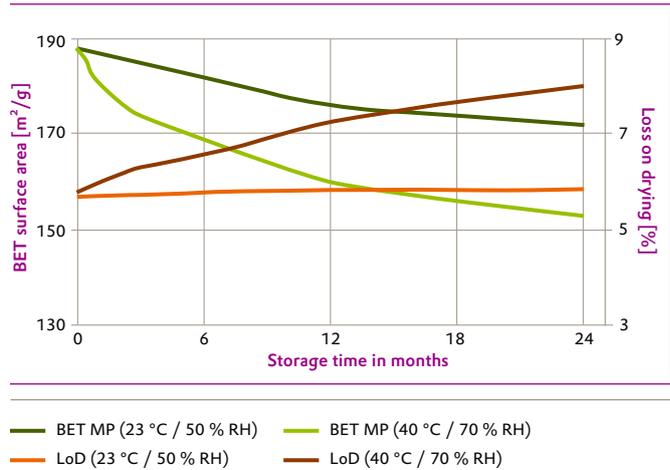
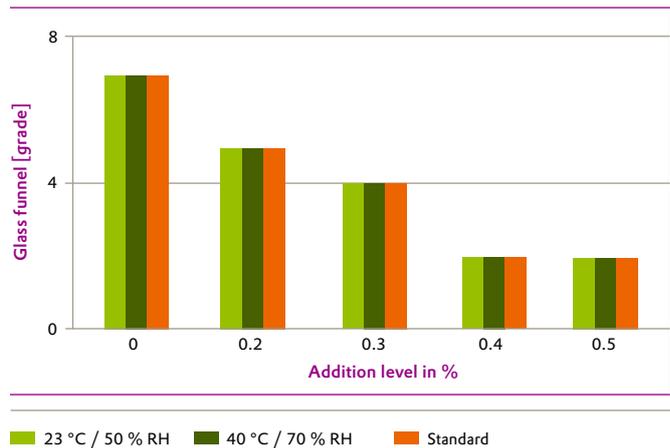


Figure 6 Flow improvement by means of SIPERNAT® 22 S after 24 months



3.1.1.3 Application: carrier

SIPERNAT® 22 that is stored under tropical conditions also exhibits a significantly greater reduction in BET surface area and increased moisture absorption (Figure 7). In the technical application test to determine maximum absorption capacity (see TI 1360), the SIPERNAT® 22 stored under temperate conditions was similar to the standard after 24 months' storage (Figure 8). The material stored under extreme conditions is still at a good level despite increased moisture and a slightly lower maximum absorption capacity.

Figure 7 Ageing progression of SIPERNAT® 22

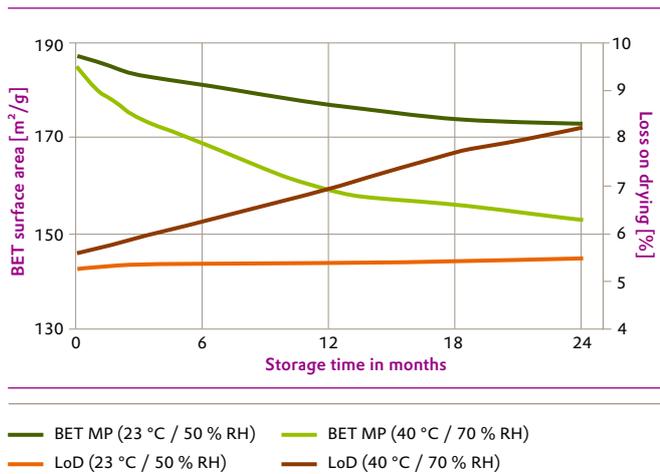
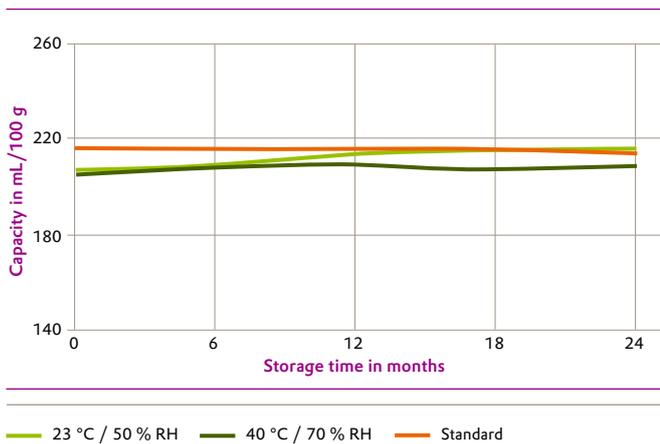


Figure 8 Maximum absorption capacity of SIPERNAT® 22



The investigation results presented here were determined from individual samples within the scope of a study. We recommend that users investigate the material under their own individual storage and production conditions.

3.1.2 Compaction

Pallets with bags or FIBCs should not be stacked on top of each other, since the load can increase tamped density and cause compacted agglomerates to form. These compacted agglomerates may cause problems in certain applications. Therefore, it is highly recommended that shelf systems be used to stack pallets above each other. Figure 9 shows a high bay rack system as an example of this.



Figure 9 Warehouse with high bay racking to store bags and FIBC

3.2 Storage of precipitated silica in silos

Some precipitated silica grades can be delivered in bulk. In addition to the design of the warehouses for bags and semi-bulk containers, the described storage conditions must also be observed when bulk material is stored. In this case, a suitable silo is needed for storage. If several precipitated silica products are used as bulk material, several storage silos must be installed. **Figure 10** shows an example of such a silo system.

The following statements apply to storage silos and also to smaller containers, such as intermediate or day silos. The silos must be designed to suit the product properties of the respective precipitated silica. Primarily, this concerns the silo geometry (height, diameter, cone angle) and the discharge aids. Detailed information about this topic can be found in the technical bulletin series Fine Particles No. 28 "Handling of synthetic silica and silicate.

The volume of the storage silos is determined by delivery quantity and consumption. Precipitated silica is delivered in quantities of 60 to 90 m³ per truck.

Factors such as the product loosening during unloading and maintaining a residual volume to ensure uninterrupted production must be considered for the dimensioning of the silos. This results in a silo volume of between 120 and 180 m³, depending on the type of silica.

The silos are generally constructed of aluminum alloys, such as AlMg₃, or stainless steel 1.4571 (in exceptions also 1.4301). If carbon steel is used, the silo should be coated inside to prevent corrosion. However, the disadvantage of coatings is that they have to be checked regularly to make sure that they are still in good condition and have to be maintained if this is not the case.



Figure 10 Storage of precipitated silica in silos

If precipitated silica is stored for a long time with no discharge, this may result in what is known as consolidation by time. This can cause discharge problems for the silo and can also have disadvantages for technical applications.

With critical applications, discharge aids can help fluidize the content of the silo with dry air during discharge. These aids can also be used regularly to reduce consolidation by time if no material is removed for a long time.

If product fluidization is chosen as the discharge aid, it would be an advantage if dry air were used for this purpose. This ensures that the atmosphere in the enclosed silo will remain dry and that the effects of moisture described in Section 3.1.1 are eliminated.

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