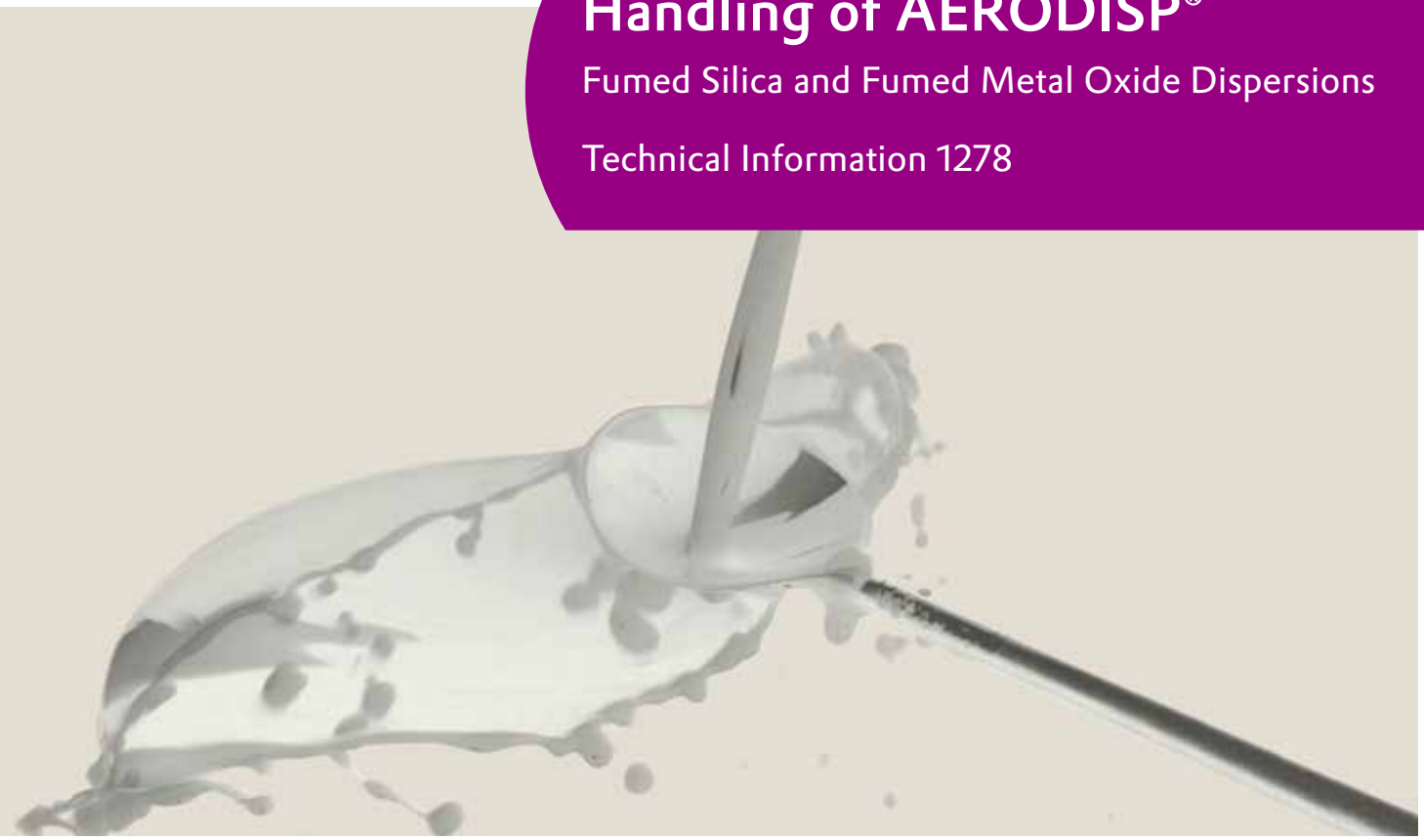
Handling of AERODISP®

Fumed Silica and Fumed Metal Oxide Dispersions

Technical Information 1278



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Introduction

Evonik Industries has extensive knowledge, sophisticated equipment and many years of experience, all of which are necessary to produce high quality dispersions.

AERODISP® is the ideal solution for the dust-free handling of AEROSIL® fumed silica and AEROXIDE® fumed metal oxides. A special manufacturing process and many years of know-how enable us to provide these products in an exceptional state of dispersion.

AERODISP® Fumed Metal Oxide Dispersions consist of different particles such as fumed silicon dioxide, fumed aluminum oxide or mixed oxides which are dispersed, using the latest technology. Our product portfolio covers a broad range of dispersions with varying pH values and solid contents to meet the demands of a diverse range of applications. The dispersion media used are water or ethylene glycol.

In addition to excellent performance characteristics, these dispersions also offer our customers major handling advantages. AERODISP® dispersions are available in different containers (see next paragraph on packaging), to meet customer needs and facilitate dosing, incorporation and handling.

AERODISP® dispersions are easy to transport and work with. This technical information describes the pumping, dosing, packaging and storage of our AERODISP® dispersions to support our customers using these products.

Types of packaging, frost protection

The smallest AERODISP® packaging size is the 60 kg container. Nine of these containers can be transported on one pallet (see **Figures 1** and **2**). These containers cannot be recycled. Evonik does not offer the 60 kg containers in North America.

Figure 1
60 kg container (not available in all regions)

Figure 2
Nine 60 kg containers on a pallet (not available in all regions)

Another packaging option is the 200 liter drum with 220 kg of dispersion. Two of these drums can be shipped on a pallet (see **Figures 3** and **4**). They cannot be recycled either and are used only once.

Figure 3
220 kg drum

Figure 4
Two 220 kg drums on a pallet

The largest packaging option is the reusable 1 m^3 **IBC** (**I**ntermediate **B**ulk **C**ontainer), made of plastic (see **Figure 5**). It contains 1000 kg or 1200 kg of dispersion, depending on product density. Please refer to our industry brochure, "Dispersions," for more detailed information on product properties.

Figure 5
1 m^3 Intermediate Bulk Container

The empty containers are returned to the IBC manufacturer for cleaning. Websites of these and other companies are listed on page 7.

In some regions, additional insulated packaging materials are used in conjunction with the containers mentioned above. These are used during the winter months to protect the dispersions from freezing (see **Figures 6**, **7** and **8**). In addition, we use climate controlled vehicles for transportation during the winter months. Evonik does not use insulated packaging materials in North America; instead, every container is equipped with a freeze check indicator. These freeze check indicators signal if the product was exposed to temperatures below freezing during transport.

Figure 6
60 kg container with cardboard box and insulated packaging (not available in all regions)

Figure 7
Two 220 kg drums on a pallet with insulated packaging (insulated packaging not available in all regions)

Figure 8
1 m^3 IBC on a pallet with insulated packaging (insulated packaging not available in all regions)

Figure 9
5 liter and 1 liter sample

Samples

Within Europe, samples are shipped in 5 liter or 1 liter containers (see **Figure 9**). Dispersions of titanium dioxide are dispatched in dark bottles in order to prevent the excellent photocatalysts from undesired interaction with light. In North America, they are supplied in 1 gallon or 1 quart containers. Larger quantities can be provided upon request.

Special considerations

- **Materials for systems and containers**

The containers and conveyer pipes should be made of stainless steel V4A or HDPP (other polymers may also be used). The use of brass components should be avoided because of the corrosive effect the dispersion could have on them.

- **Diluting AERODISP® with water**

Generally, AERODISP® dispersions can be diluted with water as needed, without changing major characteristics, such as particle sizes. When diluting, we recommend the use of deionized water. Tap water, because of its ion content, can result in flocculation and other instabilities.

- **Effects of temperature on the stability of dispersions**

Extreme temperatures should be avoided at all times, particularly temperatures below freezing. The formation of ice crystals within the dispersion leads to irreversible damage. To keep AERODISP® products from freezing during winter months, we use our climate controlled containers or trucks for transportation. Depending on the region, frost-check indicators or insulated packaging are used as well.

High temperatures, on the other hand do not result in immediate damage, but accelerate the normal aging process. Dispersions can be used and processed at temperatures ranging up to 60 °C or higher. It is important to point out that at temperatures of 50 °C and above, the water can evaporate quickly from the dispersion. This can lead to crusting around the edges or to the formation of a firm surface film. The resulting hard particles would contaminate the dispersion. However, this should not be a major concern in closed systems.

• **Possible interactions with other formulation components**
As with all colloidal systems, AERODISP® dispersions are stabilized against flocculation, sedimentation and gelling.

The stabilization is achieved by providing the surface of the particles with a positive or negative charge, either by adjusting the pH-value or by introducing special surfactants, which cause the particles to repel and remain in suspension.

In more complex formulations, which contain additional components like polymers or salts and solvents, this equilibrium can be disturbed by the interaction with other components of the formulation. This can have undesirable effects. In many cases, a simple change in the order in which components are added to the formulation, or a change in the pH-value may be the answer. In other cases, it might be necessary to use dispersions stabilized by other means. For more information, please contact our technical service.

• **Change in pH-values**
The pH-value can be adjusted within certain limits by adding acids or bases, provided that the fundamental characteristics of the dispersion (acidic/basic) are not compromised. In the case of AEROSIL® fumed silica dispersions, it must be noted that the maximum thickening occurs within the neutral range, and sometimes even leads to gelling.

• **Cleaning the system and containers**
It is most efficient to rinse the equipment with fresh water immediately after using it. It helps to prevent the formation of dry residues, which in most cases can only be removed mechanically (brushes, high-pressure cleaning units) or chemically, with the help of strong bases (silicas), acids (aluminum oxide) or other chemical cleaning agents.

• **Equipment design and maintenance**
Conveyer pipes should be slightly graded. This will enable the system to self-drain and prevent residues or deposits of the dispersion from remaining inside the equipment.
It is important to remember that dried dispersion residues cannot be redispersed and should be treated like contaminants; therefore the equipment should be rinsed after each use.
Cleanout valves should be installed on existing equipment as needed.

• **Agitating AERODISP® inside the IBC**
Normally, AERODISP® products do not need to be stirred up or agitated. The thermal movement itself is sufficient to keep the nano-scale particles in suspension. However, after standing for a prolonged period of time, a vertical density-gradient develops as a result of gravity. This can be measured with a sensitive densitometer. Moreover, a minor sedimentation of coarser particles may be observed in some AERODISP® products. These effects can easily be reversed with a Viscojet-mixer shown in **Figures 10** and **11**. Both figures show this by using a container filled with water and red/yellow plastic granules.

The Viscojet mixer is an easy to work with, portable device. The agitator can be adjusted to operate at different speeds. It can be inserted into a container through a relatively small opening of about 150 mm. The Viscojet mixer is very efficient, while maintaining low shear forces. It works well in rectangular containers.

Figure 10
Viscojet in IBC prior to dispersion

Figure 11
Viscojet during dispersion process

Recommended pumps

A suitable pump type for AERODISP® dispersions are self-priming, pneumatically operated double membrane pumps. They should be made of cast stainless steel and with PTFE coated membranes. **Figure 12** shows a cross-section of a double membrane pump with ball-valves. The dispersion is alternately drawn into the chamber and is immediately forced out (listed on page 7). Membrane pumps made out of plastics (e. g. PP) can be installed as well. In general, the membrane pumps are known to be very low-maintenance devices.

Another type of pump suitable for pumping AERODISP® dispersions is the peristaltic hose pump (**Figure 13**).

A flexible hose is squeezed in a circular motion and generates a vacuum. The dispersion is drawn in and then forced out the other end.

The peristaltic hose pump is also self-priming and is operated electrically. There is no contact between the dispersion and the moving components of the pump, as in case of the membrane pump.

Other types of pumps that are suitable for dispersions are: rotary pumps, centrifugal pumps and drum-pumps (**Figures 14**, **15**, and **16**).

In most pumps, the dispersion is drawn in and transported by a rotating component of the pump. Naturally, the pump components are in contact with the dispersion. It is important to keep in mind that abrasive dispersions can damage pump seals, especially when working with dispersions of fumed alumina. In this case, the seals should use a sealing fluid (deionized water). When choosing the type of pump, factors such as the kind of container, viscosity of the dispersion, desired quantity (m^3/h), distance and height (m) must be taken into account. Evonik's handling technology group gladly supports our customers to select the right equipment for their individual situation.

Figure 12
Double membrane pumps

Figure 13
Peristaltic hose pump

Figure 14
Rotary pump

Figure 15
Drum-pump

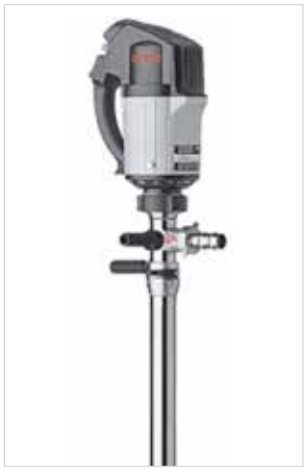

Figure 16
Centrifugal pump

Bulk deliveries

In some regions, larger quantities of AERODISP® can be delivered in bulk truck containers with a capacity of 25 m^3. With these, approx. 25 metric tons of AERODISP® can be delivered per container.

The container is delivered in a framed structure as displayed in **Figures 17** and **18** and can be positioned at the customer's location to serve as a storage container. Alternatively, a storage tank at the customer location can be used to reduce rental costs. When weather conditions mandate, bulk deliveries take place in a specially insulated container to protect the product from freezing.

Figure 17
Delivery of 25 m^3 AERODISP® container

Figure 18
25 m^3 container

Websites of additional suppliers

Pumps
www.craneflow.de (Crane and ELRO Pumps)
www.wildenpump.com
www.axflow.com
www.leva.com
www.almatec.de
www.ponndorf.de
www.netzsch.com
www.ssppumps.com
www.boerger.de
www.flux-pumpen.de
www.ittwww.com
www.speck-pumps.de
www.friatec.de
www.ksb.de
www.wernert.de

IBC/others
www.schuetz.net
www.werit.eu
www.inotec-gmbh.com

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