EVONIK INDUSTRIES

Semi-bulk packaging for AEROSIL®

Technical Information TI 1219

Evonik. Power to create.

One type of packaging for AEROSIL® is the Flexible Intermediate Bulk Container (FIBC), which fills the gap between 10 kg paper bags, its traditional packaging, and shipment as a loose bulk material in silo trucks (see **Figure 1**).

The FIBC is a flexible container with a volumetric capacity of 2 m^3, having a central inlet spout in its lid and a central discharge spout at the bottom. It has four loops sewn into its top corners, from which it can be suspended during discharge. When the container is hung, the discharge spout, located at the bottom, is ready to begin discharging AEROSIL®.

A special FIBC has been designed to take into account the bulk material properties of AEROSIL®. The cost of the packaging materials is thus higher than for paper bags. One can also achieve different transport capacities, depending on the means of transportation and the grade of AEROSIL®.

Figure 1 FIBC with AEROSIL®

A tool was specially developed to ensure that dischar-ging occurs as easy and dust-free as possible. This Powder Emptying System (PESy) can be connected dust-tight to the FIBC while the FIBC is still closed. After the container has been opened, the PESy allows the AEROSIL® to be discharged.

To this end, the PESy must be connected either to a compressed air-driven double-diaphragm pump, a pneumatic suction conveyer, or to a processing apparatus that generates negative pressure (e.g., Ystral Conti TDS). The PESy allows the contents of the FIBC to be fluidized, ensuring the complete emptying of its contents with little manual labor.

Using PESy on AEROSIL® in FIBCs provides the following advantages:

- **Dust-free discharge**
- **Less manual labor (compared to bags)**
- **Faster emptying**
  (relative to the amount of AEROSIL®)
- **Low investment costs**
  (Evonik provides the PESy without charge)
- **Safety from electrostatic charging of the packaging system**
- **Lower risk of contamination**
  (when paper bags are cut open, paper fibers can contaminate the product)

The container (FIBC)

The FIBC consists of polypropylene flat yarn mesh with an additional internal layer that ensures dust-free handling. The individual cloth runs are sewn with special sealing materials so that even the seams are dust-tight.

It is easily possible for quite high electrostatic charges to accumulate when handling AEROSIL® (see Technical Bulletin series Fine Particles No. 62 “Synthetic silicas and electrostatic charging”). The FIBC thus consists of a special material that is capable of electrostatic discharge ($R_A \leq 10^8\ \Omega$), so that the bag meets the requirements for “type C FIBC”.

The electrostatic discharge capability of the FIBC is important in order to prevent the danger of spark formation (e.g., in the vicinity of solvents or other flammable media) and to protect those who handle these materials.

The FIBC is completely capable of electrostatic discharge and must therefore be grounded during emptying. This way, the FIBC will not be able to accumulate a charge. The FIBC may therefore even be used in Explosion Zone 1 [1)], an area in which the occasional appearance of a dangerous, explosive gas atmosphere must be taken into account (e.g., in the immediate vicinity of containers with contents like Zone 0).

[1)] according to the Explosion Guidelines of the Berufsgenossenschaft Chemie (Institution for Statutory Accident Insurance and Prevention in the Chemical Industry), Germany

The FIBC can even be used in Explosion Zone 2[1], an area in which the occasional appearance of a dangerous, explosive dust atmosphere must be taken into account. Containers of this size that are not capable of electrostatic discharge may not be used in the above zones[1)].

However, the FIBC may not be used in Explosion Zone 0[1)], an area in which a dangerous, explosive gas atmosphere is continuously or frequently present or present long-term (i.e. for the predominant part of the time) (e.g., the interior of containers containing flammable liquids having a flash point below their processing temperature).

The dimensions of the containers are customized to the respective means of transport. The FIBCs used in Europe and for export overseas are designed for transport in ISO shipping containers. This ensures efficient utilization of the means of transport available. In this case, the standard is the 2-m^3 FIBC (see **Figure 2**).

Figure 2 2 m^3 – FIBC with AEROSIL®

[1)] according to the Explosion Guidelines of the Berufsgenossenschaft Chemie (Institution for Statutory Accident Insurance and Prevention in the Chemical Industry), Germany

[2)] Special size

Some selected products are already available for purchase alternatively in FIBCs having a volumetric capacity of 1 m^3 [2)] (please contact our Sales department). This size has the advantage that it can also be emptied in buildings with inadequate ceiling height.

Both FIBCs are shipped on CP3 pallets (114 cm x 114 cm) (see **Figure 3**).

Figure 3 1 m^3 and 2 m^3 – FIBCs on CP3 pallet (114 cm x 114 cm)

Our US plants use FIBCs with dimensions different from the above for deliveries in the NAFTA region. This permits optimum use of the larger means of transport in North America. In this case, the standard is the 96 ft^3 FIBC (see **Figure 4**).

Figure 4 96 ft^3 FIBC containing AEROSIL® (NAFTA)

A 56-ft³ FIBC is also available as a special size for selected products. It too makes it possible to empty FIBCs in rooms with a low ceiling height. These FIBCs are shipped on 45″ x 45″ pallets (see **Figure 5**).

The emptying apparatus

An emptying apparatus, known as PESy (Powder Emptying System), was developed for dust-free emptying of the FIBC with the simplest possible resources (see **Figure 6**).

Figure 5 96 ft³ and 56 ft³ – FIBC on pallet (45″ x 45″)

Figure 6
PESy (Powder Emptying System) US patent 5 746 347 EP patent 0 761 566

In order to improve the loading factor of the means of transport, the respective special sizes are generally shipped stacked in pairs.

Table 1 lists the dimensions of the individual FIBC sizes, and **Table 2** (page 14) indicates the filling quantities. Depending on the technology, the dimensions of the filled and palleted FIBC may deviate from the given nominal sizes for the packaging. We will gladly provide more detailed dimensions upon request.

Table 1 Dimensions of the FIBCs

Europe	North America
2 m³: 1050 mm x 1050 mm x 2000 mm	**96 ft³:** 44″ x 44″ x 86″
1 m³ (special size for selected products): 1050 mm x 1050 mm x 1000 mm	**56 ft³:** 44″ x 44″ x 50″

The PESy makes it possible to connect a still sealed FIBC to a flexible conveying line in a dust-free manner and to open the FIBC only after a dust-free connection has been established. It is furthermore possible to use a PESy that has been introduced into the opened FIBC to fluidize the AEROSIL® inside the container. Compressed air or an inert gas can be used for this; in both cases it is necessary to take the customer-specific dew point requirements into consideration. Fluidization significantly improves the flowability of the AEROSIL®, allowing the AEROSIL® to be emptied from the FIBC without trouble. In exceptional cases when bridging nevertheless does occur, the bridges can be broken with a small amount of mechanical agitation.

To empty the FIBC, the PESy must be connected to a conveyer that generates negative pressure so that the AEROSIL® can be suctioned out of the FIBC. Examples of such conveyers are compressed air-driven double-diaphragm pumps, pneumatic suction conveyers or self-priming processing equipment such as the Ystral Conti TDS.

Evonik provides the PESy to the customer for use with AEROSIL® at no charge. The customer must supply the other equipment for emptying FIBCs with the PESy (e. g., tie-bar, crane, safety frame, controller for clocking the fluidization, conveying line, conveying mechanism). Upon request, Evonik also offers the PESy for sale, as well as a safety frame with a controller for clocking the fluidization.

Discharge

The shrink wrapping must be removed from the FIBC before the FIBC can be emptied. Please note that the shrink wrapping provides moisture protection and that premature removal can result in greater drying loss.

Figure 7 Lifting yoke with safety hooks

To empty the FIBC, use a lifting yoke with safety hooks to lift it on the four loops located on the top corners (see **Figure 7**).

This procedure is necessary to ensure that the four loops on the corners of the FIBC are pulled upwards vertically. Pulling the loops together toward a central point would significantly hamper the discharge of the FIBC. For safety reasons, the lifted FIBC should be positioned above a rack. In many countries, including Germany, it is illegal to stand underneath a suspended load. Since it is necessary to go underneath the FIBC to connect it and open it, such a frame is necessary (see **Figure 8**).

It is ultimately the responsibility of the operator to inform himself of the local safety regulations and to take the appropriate measures.

Figure 8 Safety frame for FIBC discharge

Figure 9 FIBC before discharge

When the FIBC is positioned above the rack (the FIBC should not be resting on the safety frame) (see **Figure 9**), it must be grounded (see **Figure 10**) because, as explained above, rather high electrostatic charges could otherwise arise. Once the FIBC has been grounded, the PESy may be connected.

The outlet has two Velcro fasteners. The strap located directly on the bottom seals the FIBC outlet. The second strap is used to tie the outlet together into a "gooseneck." To insert the PESy into the outlet, first open the outer fastener that holds the "gooseneck" and pull the outlet straight (see **Figure 11**).

Figure 10 Grounding the FIBC

Figure 11 Opening the gooseneck binding

Figure 12 Inserting the PESy into the discharge spout

Now open the strap until the entire cross section of the outlet is released. Insert the PESy into the outlet as far as possible so that the mobile slide of the PESy moves into its frontmost position (see **Figure 12**).

Now pull the Velcro fastener tight so that it is seated in the groove located on the slide and fixes the PESy into the outlet, thereby creating a seal between the outlet and the PESy (see **Figure 13**).

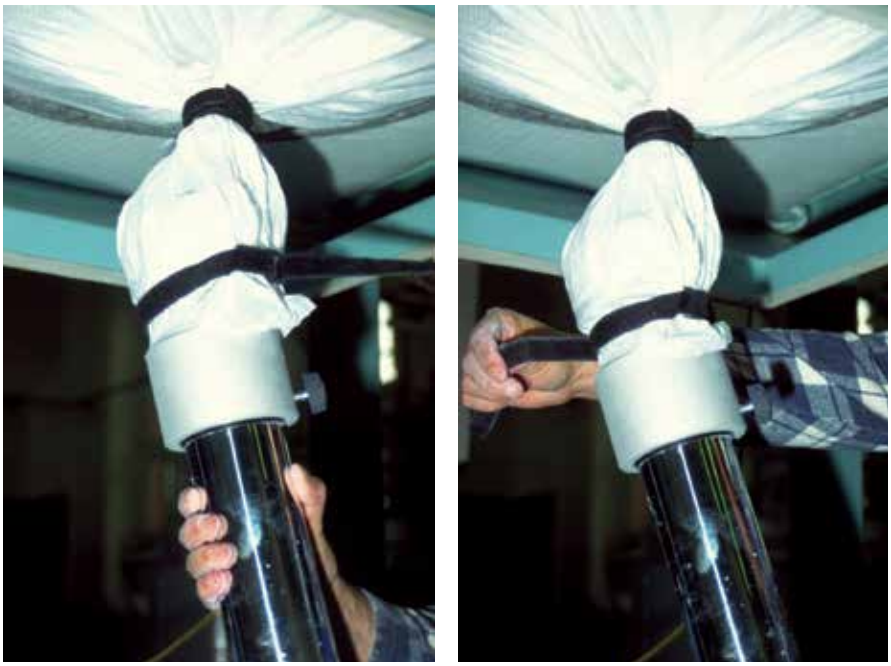
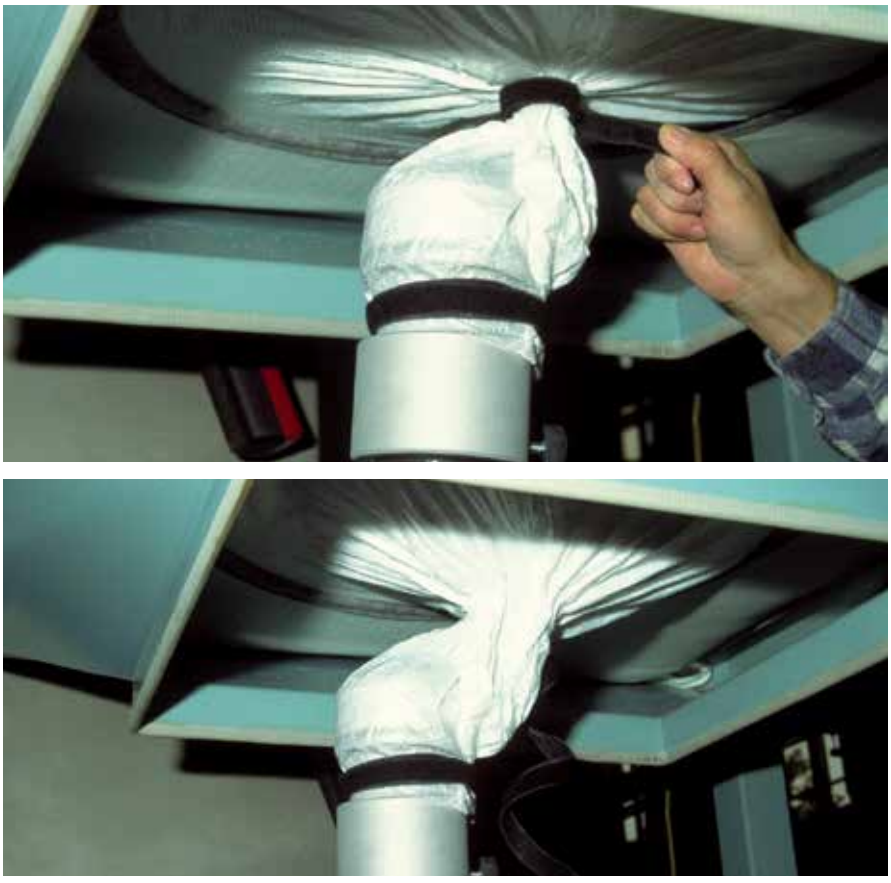


Figure 13 Fastening the PESy to the discharge spout of the FIBC



Connecting the PESy to the flexible delivery hose produces a closed connec-tion to the FIBC. Now open the top Velcro faste-ner that seals the FIBC. Pull the spout straight to release the outlet (see **Figure 14**).

Figure 14 Opening the discharge spout

This makes it possible to push the PESy into the FIBC through the slide fastened to the FIBC. To this end, loosen the screw on the slide and push the PESy's internal tube upwards. After the tube has reached its end position, retighten the screw on the slide (see **Figure 15**).

Figure 15 Pushing the PESy into the FIBC

The head of the PESy is now positioned directly above the bottom of the FIBC, and the fluidization gas can disintegrate the AEROSIL® well. If the PESy has not been pushed up, the fluidization cannot work efficiently.

The valve for injecting the fluidization gas can now be opened and the conveyer switched on. An electrical controller that has a clock-pulse generator capable of adjusting control pulse durations and idle times between 0.1 and 30 seconds clocks the fluidization gas so that the pulses achieve an optimum fluidization (see **Figure 16**).

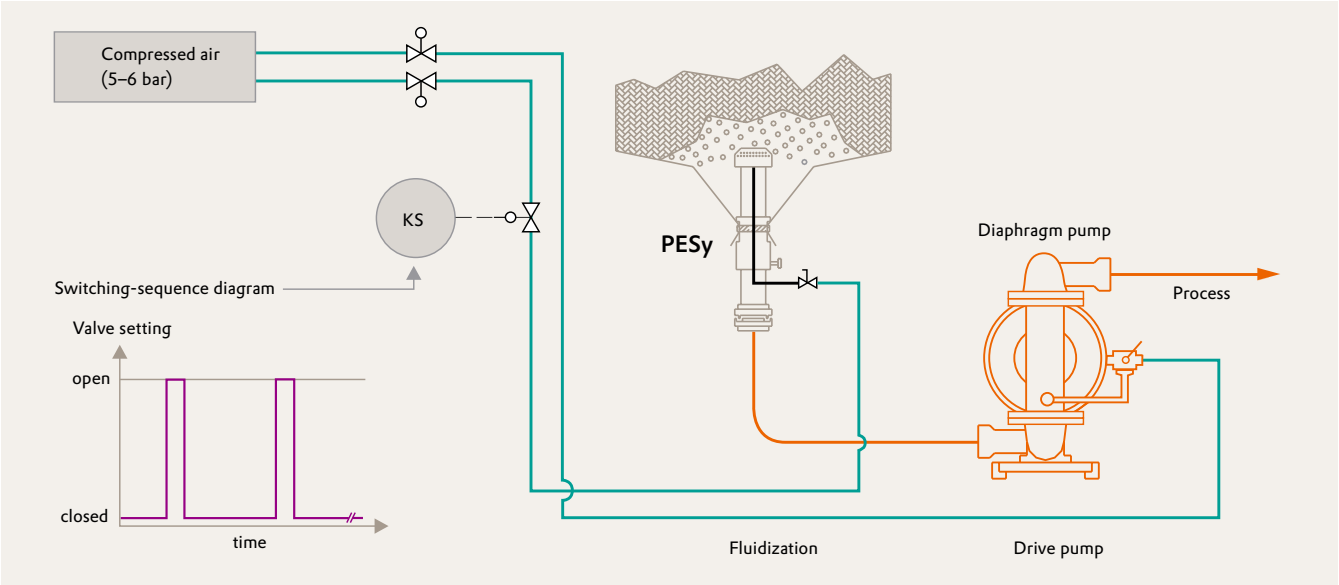


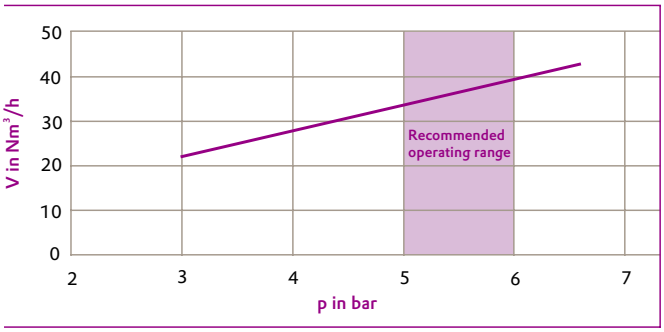
Figure 16 Position of the PESy during discharge with clocked fluidization

A pulse duration (valve open) of 0.5–1.0 seconds and an idle time (valve closed) of 5–10 seconds can be assumed as the guide value. The exact pulse durations and idle times must be individually adapted during startup, however. The goal is to adjust the fluidization so that the disintegration of the AEROSIL is kept as low as possible while still guaranteeing rapid, safe and reliable discharge.

For safety reasons, a continuous fluidization without product flow should not continue beyond 2 minutes. If this time is nevertheless exceeded, leaks could occur in the FIBC.

Figure 17 plots the air volume flow rate during the PESy fluidization as a function of the set air pressure. In order to determine the required compressed air capacities, the air flow volume rates read from the plot must be calculated with the respective ratio of pulse to idle time.

Figure 17 Air volume flow rate during PESy fluidization



That is, an air requirement of 39 Nm^3/h at 6 bar must be supplied during the fluidization pulse. But in a fluidization of, for example, 1 second clocking and 9 seconds idle, the resulting air consumption will amount to only 3.9 Nm^3/h. In order to truly supply the specified air flow on the PESy during the short pulses, it is necessary to choose a solenoid valve and supply hose that are suffi-ciently large. An inside diameter of 12 mm has proven sufficient in practice. In addition, the clearance between the solenoid valve and the PESy should be no more than 5 meters.

Now empty the AEROSIL® from the FIBC. As a rule, this will not require any mechanical support (see **Figure 18**). But it is possible that a little mechanical agitation might be necessary to support the discharge process at the beginning and also near the end.

If bridges should nevertheless form during discharge, these can be easily broken by hauling down the FIBC until it is shortly above the support frame.

Figure 18 FIBC during discharge

This will cause the side walls to bulge. Afterwards, lift the FIBC again, allowing the bottom to assume a slightly conical shape (see **Figure 19**).

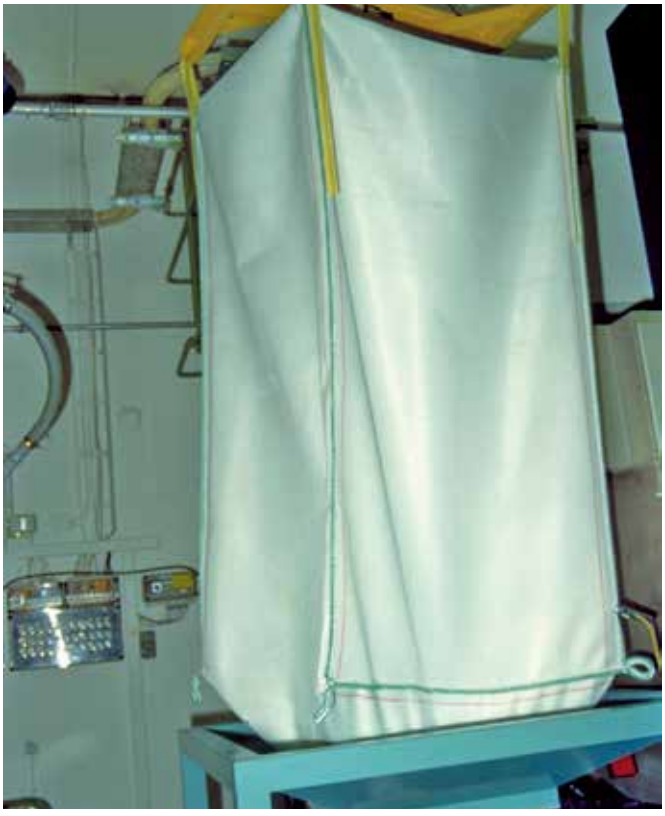


Figure 19 FIBC near the end of the discharge process

An alternative approach is brief (max. 2 minutes), continuous fluidization of the FIBC when discharge is interrupted. The slight excess pressure that arises will again cause the side walls to bulge, causing the bridges to collapse. Experience has shown, however, that such measures are necessary only in exceptional cases.

Once the FIBC has been emptied, first withdraw the PESy so that the discharge spout will also empty itself as much as possible. To this end, loosen the screw on the slide and withdraw the internal tube of the PESy (see **Figure 20**).

Now stop the fluidization. During the brief moment that the conveyance system is still turned on, the FIBC will suck itself together somewhat. When this has occurred to a sufficient extent, shut off the conveyance and seal the FIBC again using the top Velcro strap (see **Figure 21**).

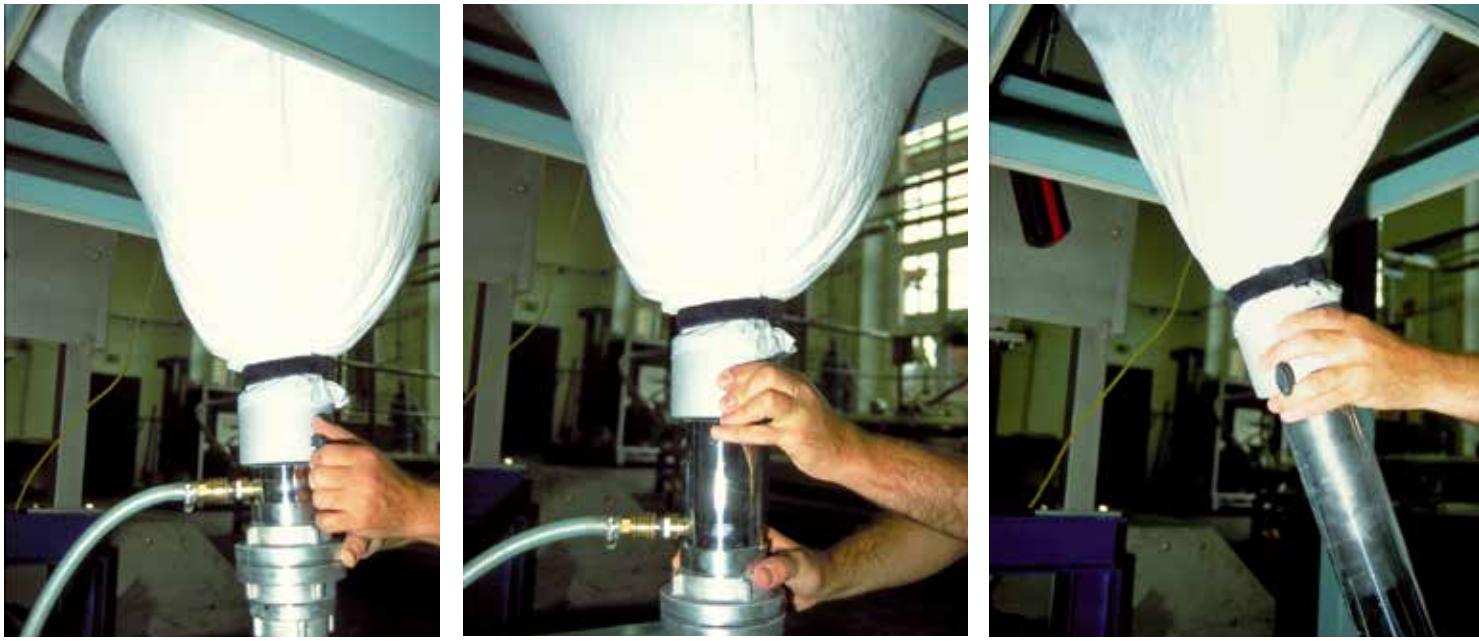


Figure 20 Withdrawing the PESy at the end of discharge

Figure 21 Sealing the discharge spout

Now release the lower strap and pull the PESy out of the outlet completely. (see **Figure 22**).

Now tighten lower strap and use it to tie a gooseneck that seals the FIBC dust-free (see **Figure 23**).

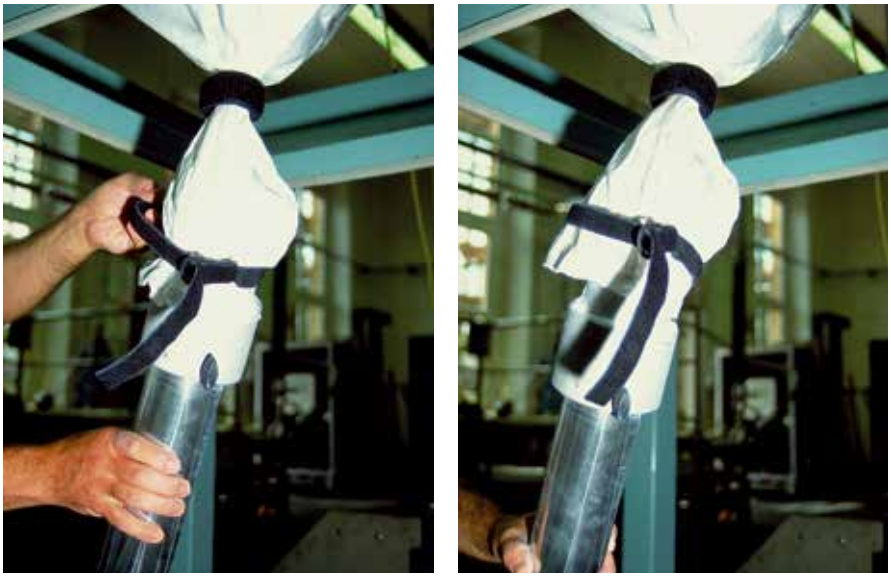


Figure 22 Removal of the PESy from the discharge spout

Figure 23 Tying the gooseneck to seal the FIBC dust-free after emptying

When this has been completed, hoist down the FIBC and remove it from the lifting apparatus (see **Figure 24**). This completes the discharge process.

For quality reasons, the FIBCs are offered only as disposable containers. In Germany, our partner **RIGK** can dispose of the empty container. For questions about this subject, please contact our Sales/Customer Service.

Experiments in our pilot plant and at our customers have resulted in discharge times (pure conveying time for emptying a 2 m^3 FIBC) between 15 and 45 minutes, depending on the conveying system. When self-priming processing machinery such as the Ystral Conti TDS is used, it is necessary to take care that the suction power declines as the viscosity of the liquid increases. The lower suction power will increases the discharge time, however. Discharge times between 45 and 90 minutes have already been observed in this case.

Safety Note:
The FIBC must be grounded during filling and emptying (Type C).

The maximum filling weight (SWL) is 500 kg (SF5).

Figure 24 Removing the FIBC from the lifting apparatus

Figures 25, 26 and **27** show several ways of using different conveyer systems together with the AEROSIL®-FIBC and the PESy.

Figure 25
Emptying an FIBC with a compressed air driven double-diaphragm pump

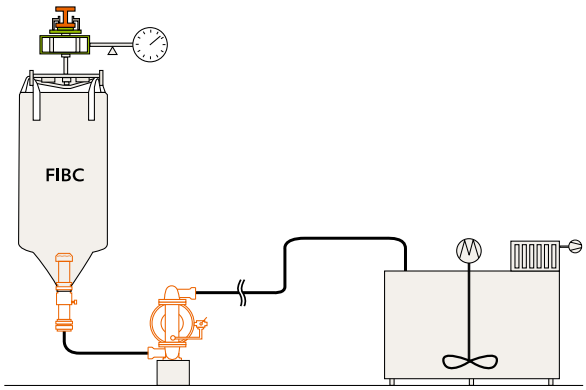


Figure 26 Emptying an FIBC with a pneumatic suction conveyer.

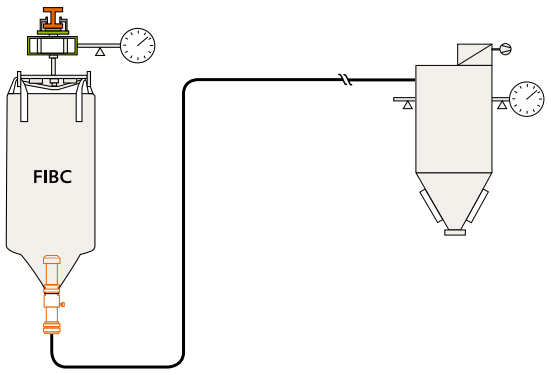
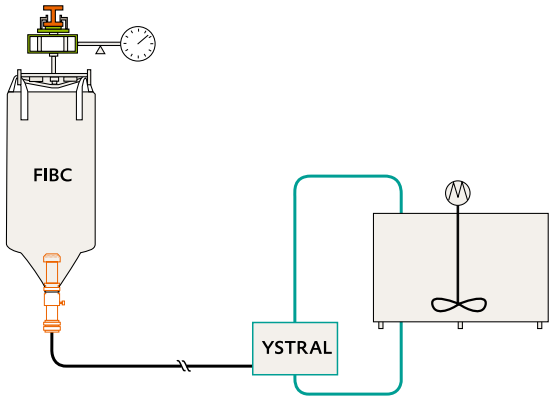


Figure 27 Emptying an FIBC using a Ystral Conti TDS.



Products

The following products can currently be obtained in the FIBC (as of February 2009):

Table 2 Filling quantities of the FIBC by product and region

Europe: (and export overseas)

Product	Filling weight in the 2 m^3 FIBC
AEROSIL® 150	180 kg
AEROSIL® 200	180 kg
AEROSIL® 300	180 kg
AEROSIL® 380	180 kg
AEROSIL® R 972	200 kg
AEROSIL® R 974	200 kg
AEROSIL® R 805	130 kg
AEROSIL® R 202	150 kg
Product	**Filling weight in the 1 m^3 FIBC**
AEROSIL® R 805 VV 90	90 kg
AEROSIL® R 202 VV 90	90 kg

North America: (for NAFTA ex works USA)

Product	Filling weight in the 96 ft^3 FIBC
AEROSIL® 150	450 lbs
AEROSIL® 200	450 lbs
AEROSIL® 200 HV	450 lbs
AEROSIL® 300	450 lbs
Product	**Filling weight in the 56 ft^3 FIBC**
AEROSIL® R 972	220 lbs

Other products may possibly be obtained in FIBCs upon request.

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