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 The PQ Corporation

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Bulletin 17-54

# Bulk Storage of Dry Solid Sodium Silicates

## INTRODUCTION

PQ customers who buy METSO® sodium metasilicates, or other dry solid silicates, in substantial quantities may find it advantageous to consider the economics of bulk shipments. Determining factors are:

1. Bulk price differential (bags vs. bulk)
2. Elimination of:
  - a) disposal of empty bags
  - b) labor in handling bags
3. Ability to automate in-plant handling and mixing.

Refer to page 6, "Cost Analysis of Package Versus Bulk Delivery," for a detailed study of the economics involved.

## PRODUCTS

The following METSO products are suited to bulk delivery:

METSO BEADS® 2048 anhydrous sodium metasilicate  
METSO PENTABEAD® 20 pentahydrate sodium metasilicate

## DELIVERY EQUIPMENT

These dry products are suited to pressure differential (P.D.) bulk delivery. Trailer tank loadings range generally from 36,000 to 46,000 pounds. Unloading requires up to one and one half hours depending upon lading weight and the bin location.

The P.D. bulk trailer operates simply by maintaining a pressure over the product 2 psig higher than the transport line pressure. Proper balance between transport air and product volume must be established to avoid transport line clogging and to minimize unloading time.

Pressure for unloading trucks is provided by a tractor mounted blower which supplies low-pressure ambient air. The ambient air may be humid at times. Solid sodium silicate products may adsorb moisture, become sticky, and cause problems in handling during transport to the storage tank or bin. Where dry air is required, the quality of the air conveying product from the truck to the storage bin can be protected and assured by passing it through a dryer. To prevent moisture from entering into the tank during product removal, the air that replaces the product should first be passed through the dryer. The dryer should be a desiccant type that can be regenerated as often as necessary.

Where product is unloaded from bulk rail cars, the pressure for unloading the cars must be provided by the receiving plant.

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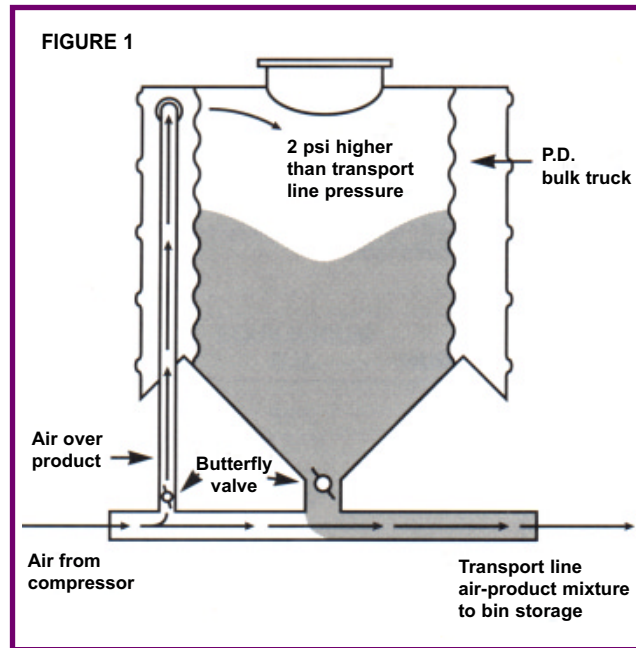


Figure 1 illustrates how the P.D. unit typically operates.

**UNLOADING SYSTEM**

The P.D. unloading system will operate adequately in optimum time when the combined lift and horizontal transfer distances are in the range of 150'. Distances in excess of 150' may be acceptable but unloading time will increase.

Piping to the storage bin should be 4" in diameter with long sweeps and bends to minimize friction loss and potential blocks in the line. Short radius bends should be avoided. Provisions should be made to permit periodic internal inspection of both unloading and vent lines via weatherproof ports.

The 4" unloading line should be equipped with a quick make-break male fitting ("Kamlock" type or equivalent) plus a closure cap. The unloading hose, with female fitting, completes the unloading connection.

Bulk storage bins should be installed so as to minimize total unloading piping. Inclined rather than flat horizontal runs are preferred.

**UNLOADING PROCEDURE**

The P.D. truck is positioned for connecting its transport hose to the customer's unloading line. The unloading line should immediately rise vertically or, if horizontal, have no vertical rise within 10' to 12' of the entry point, to allow the product to develop enough speed to carry well before the point of rise. This may be accomplished with one or more 20' lengths of hose.

The truck-mounted compressor develops pressure in the tank above the product. (A relief valve is set to relieve pressure at 15 psig; above-product pressure will not necessarily reach this value.) Air is admitted to the transport line followed by the careful admission of product. Movement of the hose indicates flow has started and pressures are then balanced to provide uniform product flow. Periodic valve adjustments may be required to maintain opti-

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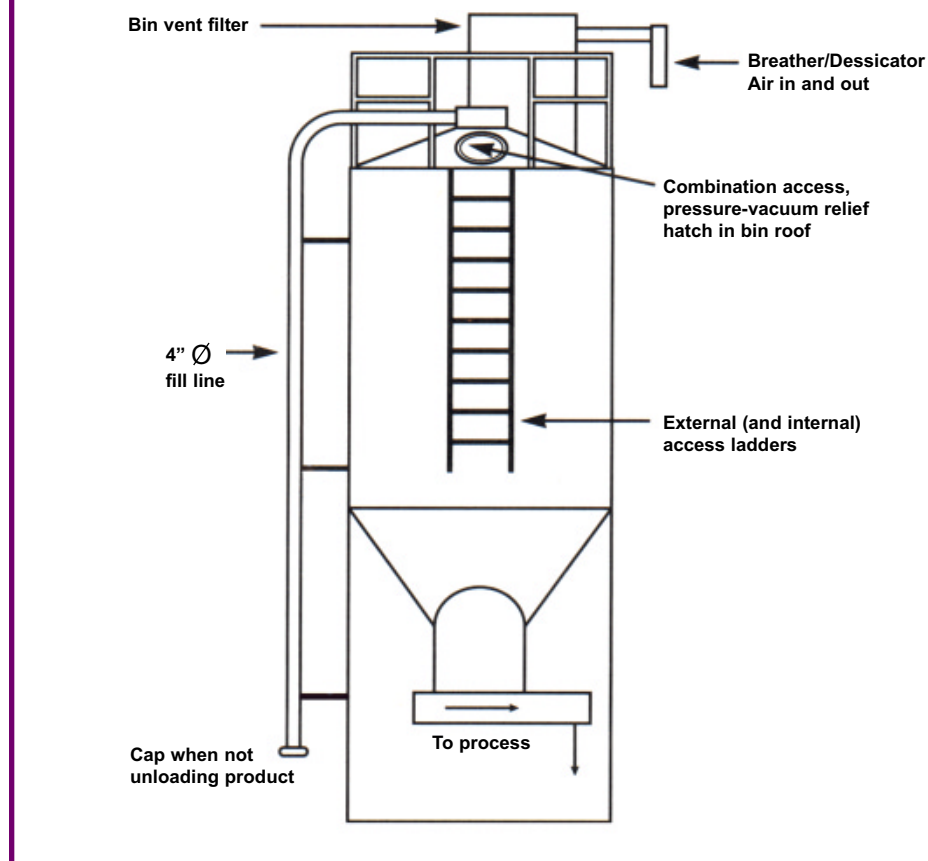
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**FIGURE 2**



imum transport line pressure (directly related to any given installation), as well as the 2 psig higher over-product pressure.

Loss of gauge pressure indicates that product has been unloaded.

### **BULK STORAGE**

Minimum storage capacity in the range of 60,000 to 70,000 pounds is suggested. For rail car bulk shipments, 250,000 pound bins are suggested. All welded, carbon steel is the preferred construction. Softer metals, such as aluminum, will not withstand the abrasive action of the silicate and metasilicate powders and should not be used in bin construction or for the transport piping. In situations where larger capacities are required, particularly with storage of pentahydrate sodium metasilicate, arrangements should be made periodically to decrease inventory.

For metasilicates and silicate powders of similar particle size, the sides of bottom cone sections should be sloped no less than 50° from vertical. For fine powders, the minimum angle is 60°.

A preferred bottom outlet is a “chisel” rather than “circular” design to reduce the incidence of “bridging.”

Vibratory-type, cone bottom dischargers are effective for the same purpose and produce a positive out-flow.

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Bin interiors should be thoroughly cleaned to remove rust scale and other contaminants prior to initial filing. This is best accomplished by sand blasting. Of lesser effect is, hammering or rattling the sides to loosen rust scale. The extra cost of descaled plate may be justified.

Epoxy coatings may be used on the interior surfaces. They require thorough surface cleaning and priming. This treatment may be preferred in some cases but with an initially clean interior, the extra cost is usually not justified.

For the anhydrous and pentahydrate metasilicate products, angle of repose on itself is 35° to 40°.

The bin requires venting to the atmosphere. A facility for dust control is required to serve P.D. truck unloading. The pneumatic conveying air is exhausted into a dust collector to collect any dust resulting from the conveying of the product. PQ recommends a type of collector that uses Dacron felt bags and the reverse jet cleaning principle. The dust collector air outlet must have a valve, which can be closed when the collector is not in use to prevent moisture entry into it. The dust collector should be mounted over an opening of the tank. However, bag-type dust control equipment may be a requirement.

Bulk storage bins exposed to the weather should be painted white or aluminum to minimize sun-heat absorption. This applies particularly to the pentahydrate product, which has a melting temperature of about 160°F.


**HUMIDITY CONTROL**

Dry crystalline sodium metasilicates (METSO products) exhibit a natural tendency to adsorb water from the ambient air. When stored in humid air for prolonged periods, these products may become sticky and cake into solid masses.

The following chart illustrates the relative humidity at which the moisture content of air is in equilibrium with common types of dry sodium silicates and, for comparison, with caustic sods (NaOH) and caustic potash (KOH).

PRODUCT	EQUILIBRIUM R.H.	HUMIDITY EFFECT
METSO PENTABEAD 20	55% to 35%	Gains wt. above 55% Loses wt. below 35%
METSO BEADS 2048	35%	Gains wt. above 35%
NaOH & KOH	1%	Gain wt. above 1% (At 7-9% R.H. are deliquescent; changing from solid to liquid).

**High Humidity.** When the relative humidity exceeds the “equilibrium” point, the solid silicates shown on the chart can adsorb water and gain weight. If the humidity exceeds the equilibrium point by only a few percentage points and exposure time is short, the gain in weight will be small. A substantially



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higher humidity will cause the dry silicate to become sticky. As the chart indicates, sodium and potassium hydroxide are more hygroscopic and, hence, far more "moisture-sensitive" than sodium silicates.

**Low Humidity.** Hydrated dry silicates (METSO PENTABEAD® 20) can lose water when ambient relative humidity is below the levels designated on the chart. However, this is rarely a problem in practice, since the weight loss is normally not significant.

**Storage.** For storage in bulk, provision should be made to maintain the relative humidity of the air within the storage bin at a level near the equilibrium point of the product (see chart).

When PQ dry silicates are supplied in packages (multiwall bags or drums), the packaging materials provide protection for storage at moderate humidity conditions for reasonable periods of time. Additional protection should be provided if high humidity conditions are common and/or if the products are to be stored for long periods.

**HANDLING PRECAUTIONS**

Sodium metasilicates upon prolonged contact may burn or irritate skin, eyes, and mucous membranes. Personnel handling these products should avoid contact with skin, eyes and clothing; provide protection for the eyes; and not take them internally. In case of contact, the skin or eyes should be flushed with plenty of water; for eyes, medical attention should be obtained.

**PQ ENGINEERING ASSISTANCE**

The illustrations in this bulletin are typical for P.D. delivery and bulk storage bins. PQ's technical service representatives can assist in developing plans to meet customers' specific requirements. Contact:

**ICD Industrial Chemicals-Technical Services**

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