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3M Advanced Materials Division

3M™ Glass Bubbles Metering and Mixing Guide

Introduction

This guide provides suggestions for efficient metering and mixing of 3M™ Glass Bubbles. These are only suggestions and are not intended for use as a design or operational manual. The user is responsible for determining what method and equipment are fit for a particular purpose and suitable for the user's operation.

Note: Before using 3M glass bubbles, please be sure to read the product label and Safety Data Sheet (SDS) and follow all applicable precautions and directions for use. Refer to the 3M Glass Bubbles Product Data Page for additional storage and handling information. See equipment manufacturer's recommendations and directions for use for all equipment and materials.

Note: The purpose of this guide is to provide basic information to product users for use in evaluating, processing, and troubleshooting their use of certain 3M products. The information provided is general or summary in nature and is offered to assist the user. The information is not intended to replace the user's careful consideration of the unique circumstances and conditions involved in its use and processing of 3M products. The user is responsible for determining whether this information is suitable and appropriate for the user's particular use and intended application. The user is solely responsible for evaluating third party intellectual property rights and for ensuring that user's use and intended application of 3M product does not violate any third party intellectual property rights.

Glass Bubble Differences

3M glass bubbles are engineered to help you reduce costs, enhance properties and improve processability when handled properly. And proper handling begins with recognizing that glass bubbles are different than typical irregularly-shaped mineral fillers. As hollow, non-porous spheres, glass bubbles handle differently than mineral fillers in storage, pumping, weighing, formulating, metering, and mixing.

Consider, for example, weight and volume. Glass bubbles in the flask at right are the same weight as the calcium carbonate at left. Glass bubbles, obviously, occupy more space. Equipment used to weigh mineral filler may not be capable of containing an equal weight of glass bubbles since the bubbles occupy up to 20 times the space at the same weight. Conversely, the equipment may not be sensitive enough to accurately weigh an equal volume of glass bubbles since the bubbles weigh so much less.

Because bubbles are hollow to help lighten end product weight, they can be broken by **compression** at constraining points, **shear** within tight clearances, and **impact** at turns. Chances for breakage can be reduced by balancing microsphere crush strength with equipment choice.

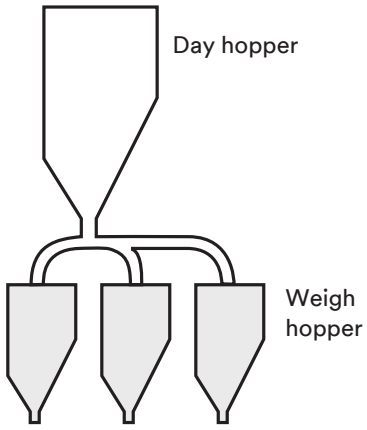
Basic Processing Considerations

Metering and mixing glass bubbles involves many variables and considerations for optimum results. This guide presents basic general information on **hoppers, metering and mixing equipment, and pumps**. For further support 3M technical service can help you solve and avoid problems, and take advantage of glass bubbles as quickly and easily as possible.

Day Hoppers and Weigh Hoppers

In high volume processing operations, a vacuum transfer system loads bubbles into a day hopper directly from the shipping container or a storage silo. The day hopper stores enough bubbles to feed one or more weigh hoppers throughout a work period. Weigh hoppers are close to the mixers to help minimize any delay in getting bubbles into the process.

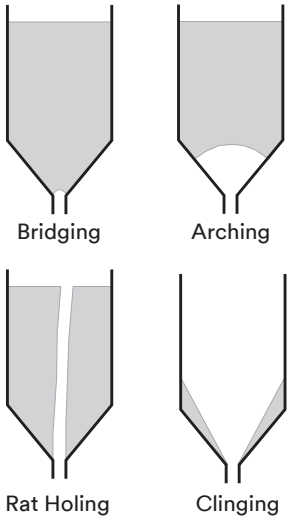
For a smaller processing operation, the day hopper and weigh hopper are the same unit. A vacuum transfer system loads bubbles into the single hopper directly from the shipping container.



Hopper Design

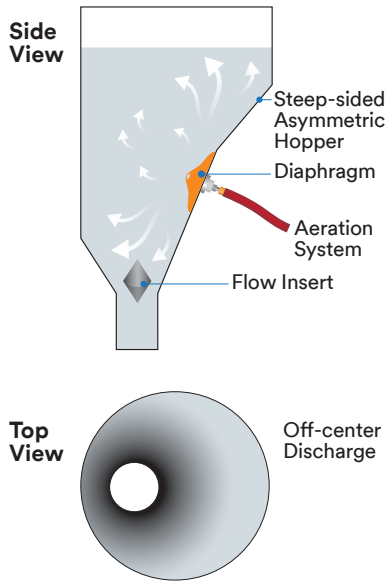
Symmetrical day or weigh hopper design can create discharge problems as shown at right. To help avoid these problems, you can **retrofit** an existing hopper with an aeration system to fluidize the bubbles. Aeration increases bubble bulk volume by 2 times, so the hopper must be large enough to accommodate the increased volume. For a **new installation, specify an asymmetrical hopper** with steep sides and offset entrance, outlet or sloped regions. For optimum flow, the new asymmetrical design can be combined with aeration.

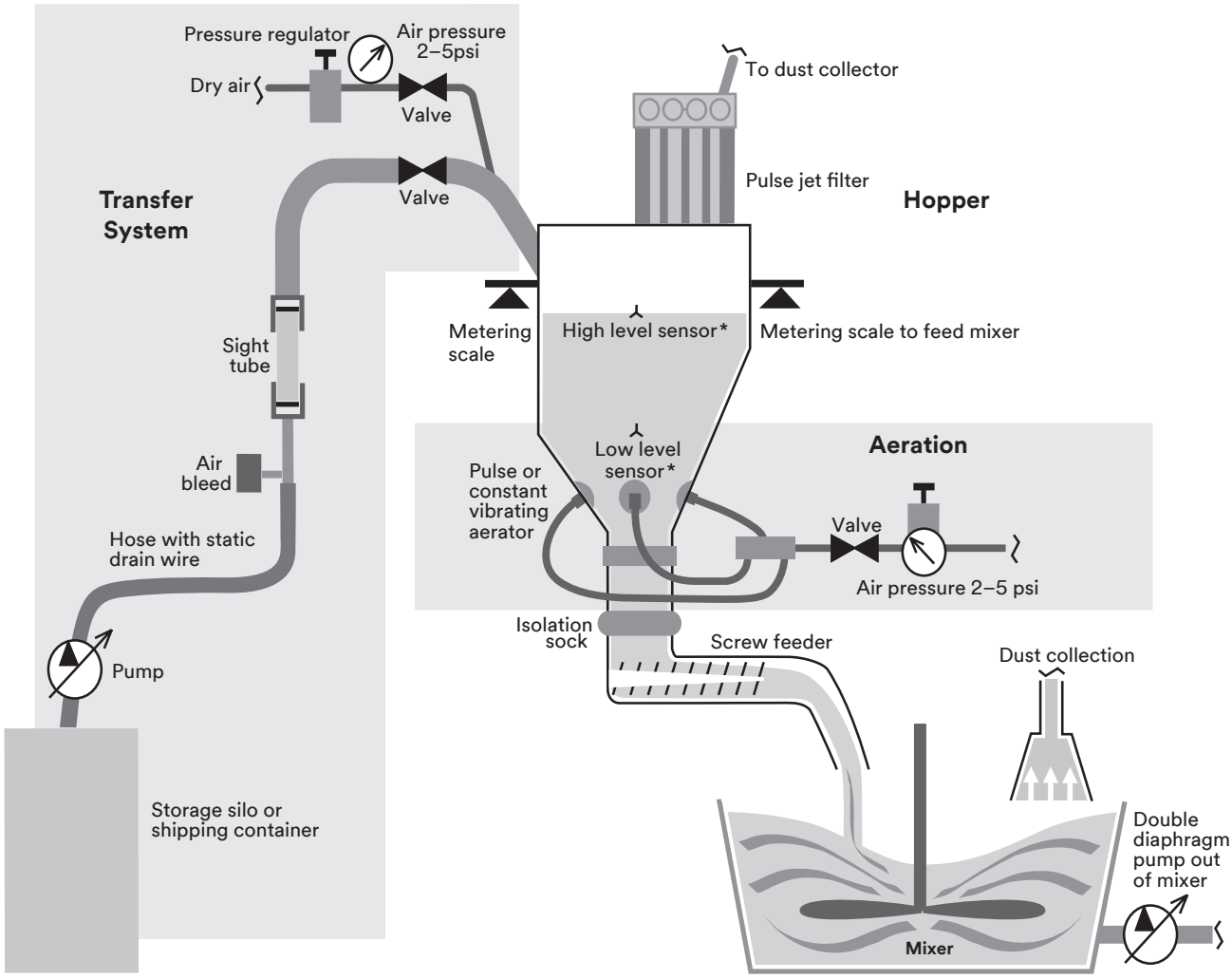
Symmetrical Hopper Discharge Problems



Asymmetrical Design

With a properly designed or retrofitted hopper, flow into a meter/feeder device is more uniform and faster than when transferring bubbles directly from a shipping container into a device. The hopper also helps reduce dust that can be generated when using fast, high volume conveying equipment.





* Signals vacuum transfer system to replenish hopper

Meter/Feeder Device

The meter/feeder device controls the flow of bubbles from the hopper into the process. Devices include the following:

- **Gravimetric Loss-in-Weight Dry Solids Feeder** measures bubbles by weight as the hopper empties. When the scale beneath the hopper is calibrated for the proper weight-to-volume ratio of lightweight bubbles, this feeder is preferred for efficient, accurate control in high speed automated systems.
- **Load Cells** measure weight but may require high sensitivity to maintain accuracy for the light weight of bubbles.

Transfer to Mixer

Bubbles can be transferred from the hopper into the mixer by either gravity discharge or a screw feeder. The screw should be designed with a pitch, channel size and flight depth that minimizes compression, shear and impact on the bubbles. For uniform bubble discharge consider a variable flight depth or variable pitch screw.

An isolation sock at the hopper discharge into the screw conveyor controls the bubble flow rate and helps prevent flooding.

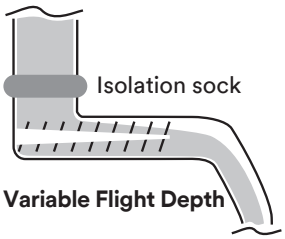
Note that there should be no 90° angles in piping between the screw conveyor and mixer. Turns in piping, if necessary, should be gradual and not exceed 45°. Piping should be grounded for static control.

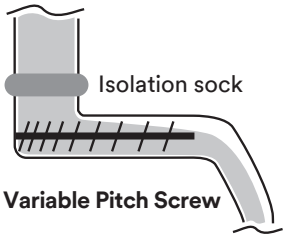
Mixing and Compounding

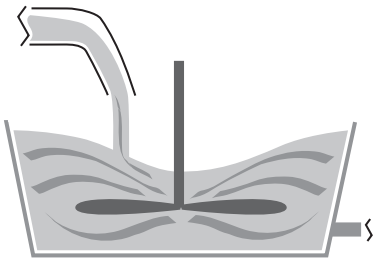
To minimize bubble breakage in mixing, two steps are suggested:

1. Introduce a steady or pulsed flow of bubbles directly into the liquid vortex from above.
2. Add the bubbles to the mixer as late as possible in the mixing process to minimize time of exposure to agitation.

Screw Feeders
Uniform Discharge







For best results use any high flow, low shear mixer such as the following:

- Anchor
- Planetary
- Double Planetary
- Propeller
- Pitched Blade
- Bar Turbine
- Horizontal
- Plow
- Sigma
- Hydrofoil

Do not use low flow, high shear mixers. As bubbles flow into the mixer, use a bag house dust collection system.

Pumping Dry or Wet

Glass bubbles or bubble-filled materials can be pumped in at least three instances:

1. Transfer dry glass bubbles from a storage silo or shipping container into a day hopper.
2. Transfer dry glass bubbles from a storage silo or shipping container directly into the mixer.
3. Transfer wet glass bubbles mixed with resin from the mixer to the next step in processing.

These two types of pumps have been used successfully:

- **Double diaphragm pumps**, when modified for use with dry powder, are preferred for transferring bubbles from bulk boxes or bags into a day hopper or mixer.
- **Peristolic pumps** can be used without significantly damaging the bubbles.

Pumping guideline: The glass bubble selected must have enough strength to survive the pump's maximum hydrostatic pressure.

Centrifugal, gear, lobe, and progressive cavity pumps should be avoided.

Service and Support Worldwide

The preceding pages provide an overview of the mixing and metering considerations associated with low-density 3M™ Glass Bubbles. The myriad of application-specific details cannot be covered in this basic guide. That's why 3M experienced engineers worldwide are ready to help you solve unique mixing and metering problems. As you plan your mixing or metering process, contact the 3M™ Glass Bubble experts at 3M for assistance. In the United States call 800-367-8905 and request Technical Service.

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