Packaging hard-to-handle materials in valve bags

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If your material is very fine, lightweight, non-free-flowing, or otherwise hard to handle, you should know there are ways to economically package the material in valve bags. After discussing requirements for economical bagging and listing some hard-to-handle materials, this article covers various methods for producing stackable valve bags of accurate weight and explains how to choose a valve sealer. Related information provides more detail about recycling valve bags and types of valve sealers.

Bagging operations are faced with achieving higher production rates, ensuring high bag-weight accuracy, maintaining a clean bag appearance, and keeping a clean environment for workers. Environmental concerns also demand that bag materials be recycled to reduce solid wastes. [Editor's note: For more information, see the sidebar, “Helping to meet environmental demands: Recycling valve bags.”] To achieve these goals economically can be a challenge.

Basic requirements for economical bagging include:

- A low initial equipment investment.
- Low equipment maintenance costs.
- A compact equipment design that will fit into your existing plant’s floor space and ceiling height without requiring expensive plant modifications.
- A low bag cost, which depends on your bag design, number of plies, and similar factors.

But when your material is hard to handle, bagging it cost-effectively presents a whole new set of challenges. Such a material can be very fine, lightweight (typically under 30 lb/ft³), and dusty; non-free-flowing; or hygroscopic.

Some examples of hard-to-handle materials are:

- Titanium dioxide
- Carbon black
- Iron oxide and other pigments
- Functional fillers (various mineral powders used as fillers in cement, mortar, and masonry mixes)
- Cement and mortar
- Calcium carbonate
- Clay
- Sand
- Silica and fumed silica

Such materials are packaged in valve bags rather than open-mouth bags to control dust, prevent fine powders from leaking, and prevent moisture or contaminants from entering the bag. An open-mouth bag’s sewn closure isn’t tight enough to provide such protection.

Economically packing a hard-to-handle material in valve bags requires equipment that:

- Operates automatically.
- Operates cleanly to keep the workplace clean and free of harmful dust or contaminants.
- Achieves accurate bag weights.
Helping to meet environmental demands:

Recycling valve bags

US bag manufacturers need to find ways to meet increasing demands for a cleaner environment. While US legislation within the next several years will no doubt reflect such environmental concerns regarding packaging waste, Europe is ahead of the game.

In Germany, recently enacted legislation seeks to prevent or reduce packaging material solid waste. The law demands that responsibility for recycling a package rests with the company that brought the package to market — creating a circular waste process, as shown in Figure A. As a result, two groups of German bag manufacturers have formed to collect, sort, clean, and recycle bags: one recycles kraft bags, the other plastic bags.

To recycle a bag, it must meet certain criteria. The most important is that you remove any residue from the bag. Generally, it’s easier to remove residue from a plastic bag because of its smooth surface.

A single-wall paper bag is very easy to recycle once you remove the residue.

But if the bag has multiple plies and some are plastic, you must remove these plastic layers before recycling. Such removal can be very costly and time-consuming or even impossible.

Bulk material processors are increasingly using plastic valve bags because they provide sealed packaging and are stronger than single-ply paper bags. The plastic bags are easier to recycle not only because they’re easier to clean, but because they have only one ply and thus contain less bag material. Low-melting-point plastic valve bags filled with plastic resin can also be used for batch inclusion, where the bag and its contents are added to the batch, thus requiring no bag disposal or recycling. Water-soluble plastic may also be used someday for batch inclusion.

Though it’s impossible to predict what local, state, and federal legislation will develop, you’d be wise to consider how any solid waste disposal and recycling laws may eventually affect the bag style and bagging equipment choices you make today. — R. Blain and T. Reckersdrees

- Produces sealed valve bags.
- Produces stackable valve bags to form secure pallet loads.

How to produce stackable valve bags of accurate weight

Accurately filling valve bags to your desired bag weight requires deaerating the material. This also ensures you can safely load the bags on pallets for shipping or pallet-stacking in storage.

The filling methods depend on the type of bag you use and the type of filling equipment — auger packer, impeller packer, or force-flow packer. Equipment that can fill bags while keeping your work environment clean is particularly important for hard-to-handle materials.

An auger packer uses a small, high-speed auger in its filling spout to fill valve bags; however, its limited ability to achieve accurate bag weights can restrict its use with hard-to-handle materials. It also operates relatively slowly. An impeller packer uses a rotating wheel to propel material more quickly into valve bags and adds some air to the bags. A force-flow packer (also called an air packer) adds blower air to a chamber on the packer to quickly move material into the bags, adding a high quantity of air to the bags. The force-flow packer can be used only with
perforated paper valve bags, which release the excess air. In addition, high pressure builds up in the bags, causing material blowback and spillage during bag discharge and limiting the force-flow packer’s use with hard-to-handle materials.

The release of excess air from perforated paper valve bags (and, more slowly, from paper bags without perforations) filled by impeller or force-flow packers is a natural, gradual venting method. Air is released as the bags are filled, handled, and stored on pallets through the bag perforations, paper walls, and folded bag valves.

However, this venting method can be slow, which reduces your packer’s filling capacity. As deaeration continues after the bags are stacked on a pallet, the bags can also become loose and unattractive and fail to stack securely. And such venting isn’t suitable for all hard-to-handle materials. For instance, moisture can enter the perforations, which can damage a hygroscopic material, and not all hard-to-handle materials readily release entrained air.

If this venting method won’t work for your application or if you must use plastic valve bags or multiwall paper valve bags with plastic liners, you can use other methods to remove excess air.

They include deaerating material before bag filling, using filter valve bagging, and using a vacuum packer.

**Deaerating material before bag filling.** This method requires an auger packer that has metal mesh surrounding the auger in the filling spout. The packer operates while a vacuum is applied, which draws air through the mesh as material flows from the auger into the valve bags. This deaerates the material as it flows through the auger, before it enters the bags.

While the method isn’t used as commonly as others for hard-to-handle materials, its advantage is preventing excess air from entering the bags, which eliminates the need for later venting. The resulting valve bags are tightly filled and stack securely.

**Using filter valve bagging.** This method requires using valve bags made with an air-permeable paper or plastic filter valve insert and filling the bags with an impeller packing system that uses a vacuum to remove excess air from the bags via the filter valve insert, as shown in Figure 1. (The method can also be adapted for use with an auger or force-flow packer.)

A material hopper (Figure 1a) is located above the impeller packer, or a flexible hose (Figure 1b) with a material level probe...
near its top links the material storage vessel to the impeller packer below it. In the latter case, the vessel is often fitted with a vibrating bin bottom to assist the flow of nonfree-flowing materials.

The impeller is housed in a box and attached to a vertical drive shaft. The impeller box is lined with porous sintered metal and linked to a compressed-air supply. A filling spout at the impeller outlet is equipped with inner and outer channels. The inner channel is lined with rubber and flexes to prevent material from clogging the spout as material flows into the valve bags; the outer channel has external slots for removing air from the bags. A mechanical tensioning device keeps each bag valve snugly attached to the filling spout. A pneumatically operated slide gate is located in the filling spout. The packer’s electronic weighing system includes a scale assembly mounted on a load cell beneath the packer frame. The scale assembly is linked to the system controller. The controller is tared to the frame’s weight, set to the desired bag weight, and linked to the slide gate. Dust hoods direct dust-laden air toward dust collection equipment.

In operation, material flows from the hopper, or (if so equipped) from the storage vessel through the flexible hose, into the impeller box. The hose lets material settle and achieve a consistent bulk density just above the impeller box; the consistent bulk density helps to achieve accurate bag weights. As the impeller withdraws material from the flexible hose for each filling cycle, the hose flexes and helps to prevent material buildup or bridging in the vessel. The material level probe activates the vibrating bin bottom (if so equipped) when the material level drops below the probe, ensuring consistent material flow into the impeller box.

The impeller rotates horizontally, pulling just enough compressed air through the porous sintered metal lining to generate an air cushion large enough to consistently convey the material to the filling spout. This prevents injecting air into the material and aerating it. The spout’s outer ring channel is kept under vacuum so that as each bag is filled, air in the bag can be removed through the spout’s external slots. At the same time, an air bubble forms in the bag corner just beneath the valve. Because the filter valve insert is right above the air bubble, the vacuum easily extracts the excess air without removing material from the bag.

Throughout filling, the electronic weighing system controls the coarse and fine flow of material through the filling spout by controlling the pneumatically operated slide gate, which increases or decreases the spout’s cross section. When the bag is filled, the controller completely closes the slide gate and stops the impeller. The packer can have one or more filling spouts and can fill from 200 to 300 bags per hour, per spout, depending on the material’s flowability.

The method can be more expensive than other methods because adding the filter valve insert typically costs between 1 and 1½ cents per bag, depending on the number of bags you order.
However, the method requires less filling time because no pressure can build up in the bag, permitting higher bagging rates. The lack of pressure buildup also prevents material blowback during filling and spillage from the valve during bag filling and discharge, which keeps your bagging operation clean. The lack of pressure buildup also permits you to use lower volume bags, which partially offsets the cost of the additional filter valve insert. The method can also fill paper or plastic valve bags that have airtight seals, which are required for a material with prolonged shelf life or for batch inclusion (in which plastic valve bags filled with plastic resin are added directly to the batch, saving discharging labor and disposal costs).

Using a vacuum packer. This method requires using breathable valve bags — that is, bags of single-wall paper, multiwall paper without plastic plies, or a breathable plastic compound (such as Tyvek) — and a vacuum packer equipped with a bifurcated evacuation chamber, as shown in Figure 2 (Figure 2a is a side view; Figure 2b is a front view). The chamber consists of two clamshell-like doors that close over the valve bag. A filling spout equipped with an inflatable boot runs from a material hopper above the packer into the chamber. A remotely located vacuum pump is connected through a control valve to the chamber. An evacuation port is located at the chamber bottom. An electronic weighing system has a scale assembly that mounts the chamber on a load cell; the load cell is linked to a controller. The controller, which is tared to the weight of the chamber and bag and set to the desired bag weight, is connected to two air-actuated butterfly valves preceding the filling spout.

In operation, a valve bag is placed on the filling spout and the boot inflates inside the valve to tightly seal it to the spout. The two chamber doors close around the bag, and the vacuum pump and vacuum control valve draw air out of the chamber, creating a vacuum inside the chamber typically from 5 to 15 inches mercury. Because the bag wall can breathe, the chamber’s vacuum draws material from the filling spout into the bag and simultaneously draws air from the bagged material into the chamber.

The electronic weighing system controls the butterfly valves. One valve has an adjustable orifice to supply either coarse or fine flow into the filling spout; the other valve has a solid plate that completely stops flow to the filling spout when the bag reaches the desired weight. Any dust residue in the chamber is extracted via the evacuation port. The vacuum packer’s bagging rate, typically between 60 and 120 bags per hour, depends on the material’s flowability and bulk density, the vacuum source, bag construction, and other factors.
A closer look:

Valve sealers

The vacuum method is suitable only for breathable valve bags and can’t fill bags from multiple filling spouts, the method provides other advantages. It accurately fills bags, and the lack of pressure buildup in the bag permits higher bagging rates, keeps your operation clean by preventing material blowback and spillage, and permits you to use lower volume bags.

How to choose a valve bag sealer

Valve bags for some materials don’t require sealing. The bags are simply filled and laid on their sides, and the material inside each bag presses against the valve and closes it. But you typically must seal valves on bags used for hard-to-handle materials.

For instance, a very fine, nonfree-flowing material such as a pesticide can be a health or environmental hazard and must be sealed into the bags to prevent leakage. Others, especially food products, must be sealed in for protection from moisture, insects, and other contamination.

Most valve bag sealers (typically called valve sealers) use heat via various means to make the seal. [Editor’s note: For more information, see the sidebar, “A closer look: Valve sealers.”]

When selecting a valve sealer, look for a unit that can match your valve bag packer’s capacity and that forms a seal at least ¼ inch wide. The wide seal will be leak-proof even when enclosing some particle residue in the seal area. A valve sealer that forms a wide seal without extending the bag valve is also preferable, because an extended valve requires special handling to ensure you can correctly mount the bags on the filling spout.

Editor’s note

All illustrations courtesy Haver Filling Systems unless otherwise credited.

References


2. Evac-U-Pak valve bag packer, W.G. Durant, Sante Fe Springs, Calif.

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