When you’re choosing a volumetric screw feeder to meter your material, there’s a lot to consider. Dry bulk solids metering can be more of an art than a science, so you’ll need to work closely with a feeder supplier to weed through all the screw feeder types and options. The supplier’s expertise in designing screw feeders to reliably meter a wide range of materials in every kind of operating environment is key to helping you find the feeder that will best meet your needs. After providing basic information about volumetric screw feeders, this article discusses how to partner with a supplier to evaluate your material and process requirements and choose a feeder best suited to your application. The final section covers what you should consider when having the supplier test a feeder with your material.

A volumetric screw (or auger) feeder is the most common type of volumetric dry bulk solids feeder in use today. It can handle a diverse assortment of materials, including those that are amorphous, cohesive, adhesive, fibrous, flaky, fluffy, or otherwise difficult to handle. The key to accurate material feeding with a volumetric screw feeder is to ensure that the feed screw is completely filled with material of a consistent bulk density.

It’s easy to fill the feeder’s screw with free-flowing granular materials, such as coffee beans, dry sand, or plastic pellets. Such materials will consistently fill the screw by gravity alone. However, ensuring that difficult materials, such as various pigments, fine powders, plastic regrind, flakes, fluff, or sawdust, flow consistently into the screw can be challenging and may require equipping the feeder with an agitator or similar device. Before discussing such flow-promoting devices and other details about selecting the right screw feeder for your application, let’s look at how the volumetric screw feeder works.

Volumetric screw feeder basics

The volumetric screw feeder, as shown in Figure 1, discharges material to a process at a certain feedrate, or volume per unit time (typically expressed in cubic feet per hour). The feeder’s basic components are an integral supply hopper, typically one feed (or metering) screw that rotates inside a trough below the hopper, a discharge tube that encloses the screw’s discharge end, a motor drive to power the screw, and a motor control (typically a variable-speed drive). Depending on the process requirements and the material’s flow characteristics, the feeder can be equipped with additional components, such as an agitator to ensure material flow without compaction.

Before starting the feeder, the operator typically sets the feeder’s motor control to a predetermined motor speed based on the desired feedrate and the screw’s known...
volume per revolution. (This is the known volume of space between adjacent feed screw flights, which allows each screw revolution to produce a defined volumetric output.) [Note: The operator should always verify the actual feeder output and adjust the initial motor speed setting as needed, since the physical properties of dry solid materials vary considerably.]

During operation, material flows downward from the hopper into the trough and fills the area between the screw flights. As the screw rotates, the flights push the material out through the discharge tube. The feedrate can be varied by adjusting the motor’s speed, by switching to a different screw size, or by equipping the feeder with two different-sized screws that operate independently (discussed later in this article).

**Supply hopper.** The feeder’s supply hopper is available in various sizes and shapes. While the hopper design usually isn’t critical for handling a free-flowing granular material, for handling a non-free-flowing, difficult material the hopper must be designed to ensure reliable downward material flow into the screw. Ideally, a hopper should have no converging walls that could create or support material bridging above the feeder inlet, which in this case must also have a broad unrestricted opening and the means (such as agitation) to fill the screw beneath. The hopper interior can also have a release coating or smooth finish to aid with the downward flow of difficult materials.

**Agitator.** If material doesn’t flow easily into the feed screw, especially when the supply hopper has a capacity larger than several cubic feet, the material in the hopper or trough may need to be agitated. This agitation can be internal or external, and each has pros and cons. An internal agitator — such as the large horizontal screw agitator shown in Figure 1 — can be very good at encouraging material flow, but it can make hopper cleanout more difficult and time-consuming. A vertical, top-mounted agitator can make connecting the hopper to upstream process equipment awkward or difficult. A hopper or trough with externally applied vibrators or pulsing flexible hopper walls can be effective at encouraging flow of difficult materials. In any case, the agitation must also condition the material — that is, help promote and maintain a uniform material bulk density — to provide accurate volumetric feeding.

**Screw and agitator configurations.** A screw feeder for handling difficult material can require a special feed screw design and can be configured in numerous ways to ensure that the feed screw is continuously filled with material of a consistent bulk density. For instance, the feeder can have one feed screw with no agitator (Figure 2a), one or two screws with a vibrated trough or a pulsing flexible-wall hopper, one screw with a concentric agitator that operates at the same or a different speed (Figure 2b), or one screw with one or two agitators mounted above it (Figure 2c).

**Motor drive.** The motor drive typically uses a motor and gears to drive the feed screw or agitator. A drive with steel gears will be significantly stronger and more durable than one with synthetic gears. The feeder can have one or more drives, depending on the screw and agitator configuration and the application. A single drive can power both the feed screw and the agitator, or separate drives — which can operate independently or in ratio to each other — can power each one.

Now you’re ready to determine which volumetric screw feeder can best handle your material’s characteristics and your process’s requirements. Expect to work closely with the feeder supplier as you consider the following factors.

**Evaluating your material**

Understanding your material’s flow characteristics is vital to volumetric screw feeder selection, so your first step should be to have your material evaluated. This usually involves providing a small material sample to the feeder supplier, so the supplier can assess the material type (such as powder, pellets, or fibers), basic flow characteristics (such as free-flowing, cohesive, adhesive, or fibrous), and bulk density. Depending on the results, the supplier may recommend that your material be tested (discussed later in the article) to determine which feeder model is best suited to your application.

**Evaluating your process requirements**

How your material will get to the screw feeder, what feedrate your process requires, and other process requirements will affect your feeder choice. Consider the following as you work with the supplier to choose the appropriate feeder for your process:

**Material delivery to the feeder.** Will the feeder be loaded manually or automatically? If it will be loaded manually, you may want to equip the feeder with a level indicator that can indicate when additional material is needed. If it will be loaded automatically, such as from a bulk bag unloader, a mechanical or pneumatic conveyor, or a storage hopper through an automatic valve, you’ll need to consider how the loading method will affect the material flow through the feeder.

For example, material that’s pneumatically conveyed will typically become aerated, or fluidized, during transport. In such a case, the storage hopper shouldn’t be attached directly to the feeder, because the aerated material could potentially flush (or flood) uncontrollably through the feeder’s integral supply hopper and the feed screw, especially when the material level in the hopper is low. Instead, a rotary valve should be mounted between the storage hopper and the feeder’s supply hopper, and both hoppers should include positive venting to promote material deaeration. Avoid selecting a feeder with a supply
hopper that has air jets or pads for promoting flow, because these devices can result in material aeration and flushing through the feeder.

**Required feedrate.** Your required feedrate will also affect your feeder selection. For example, your application might require a dedicated feeder for a single material and a reasonably narrow feedrate range, in which case, you’ll only need a single screw size to achieve the desired range. Alternatively, you may need a feeder to handle multiple materials at widely varying feedrates, which will require a feeder that allows the ability to change to another screw size to accommodate that range. To achieve a very wide feedrate range (without the need to change screws) or to provide fast- and dribble-feed outputs for a batching application, you can also choose a feeder with two different-sized independently driven screws, as shown in Figure 2d.

**Required output consistency.** You should also consider whether your process requires a smooth, steady flow of material from the discharge tube or can tolerate material pulsations (uneven discharge) typical of screw feeders. While operating the feed screw at a high speed (typically above 175 rpm) may minimize material pulsations, it can generate heat and cause premature feed-screw wear and a nonlinear output. Depending on your material’s characteristics, operating the feeder at high speed can also cause particle degradation or material adhesion to the screw or discharge tube. In many situations, a better way to achieve the desired feedrate is to select a feeder with a larger feed screw that’s operated at a lower speed. If pulsations will affect your process, the supplier may be able to equip the feeder with a specially designed feed screw or an adaptive device to smooth the output and minimize pulsations.

**Construction materials.** Your process will also determine what materials can be used for the feeder’s material-contact surfaces. For example, are high material temperatures a factor? Does your feeder need to be easy to clean or wash down to meet sanitary USDA, FDA, or

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**Figure 2**

*Typical volumetric screw feeder configurations*

- a. Single-screw feeder with no agitator
- b. Single-screw feeder with concentric agitator
- c. Single-screw feeder with two agitators mounted above the screw
- d. Feeder with two independently operated screws and two agitators
other requirements? Common construction materials for contact surfaces are carbon steel, Type 304 stainless steel, Type 316 stainless steel, and synthetic materials, such as ultrahigh-molecular-weight polyethylene, vinyl, and polyurethane. However, synthetic materials can be prone to discoloration (particularly when feeding certain color pigments and additives), can be more prone to cracking or wear, and may have temperature restrictions. You should also select appropriate materials for the screw and shaft seals, which vary by supplier.

**Feeder discharge area.** Pressure, moisture, temperature, and other conditions in the feeder discharge area can also affect your feeder choice. For example, if a pressure differential exists between your upstream process and the feeder’s discharge area, the feeder may require a pressure compensation system.

**Hazardous area classification.** Is the area where the feeder will be located classified as a hazardous location according to the National Electrical Code or local codes? If so, be sure that the feeder’s components (such as the motor and electronic controls) meet those requirements.

**Maintenance requirements.** Consider what feeder features you can choose to limit required maintenance. For example, you can avoid maintenance-intensive connections, such as hollow screw- or agitator-shaft attachments, chains, or couplings by choosing a feeder with a drive that’s directly connected to the screw (and agitator, if applicable). To reduce required maintenance, you can choose a feeder with a permanently lubricated drive. Also determine whether the supplier manufactures the feeder’s primary components. This can not only make it easier and quicker to get replacement parts, but also provide a secure supply of identical parts.

**Testing the feeder**

If you’ll be feeding a commonly handled material, testing the feeder you’re considering may not be necessary because the supplier will typically have test records for many common materials on hand. But feeder tests in the supplier’s lab using a sample of your material can be an important part of the feeder selection process if you have concerns about how effective a feeder will be for your application; your material is new, particularly difficult to handle, or from a source unfamiliar to the supplier; or your application has tough operating conditions.

Before testing, you’ll need to send the supplier a representative sample of your material. The supplier can tell you how much material is needed for the tests. Make sure that the test feeder will be the same model and size you’re considering (or as close to it as realistically possible), because performance often isn’t the same between two different-sized feeders. Also make sure that the test feeder can meet your feedrate range requirements and that the test period will cover a full cycle (as the supply hopper goes from full to empty) to check for potential output variations caused by headload effects at changing material levels.

If you prefer, you can usually visit a supplier’s lab to witness the tests in person. During testing, consider how well the feeder handles your material:

- Is material uniformly and reliably flowing downward into the feed screw with no ratholing or bridging?
- Is the feed screw full at all times?
- Is the feed output smooth enough for your process?
- Is there any drift (either higher or lower) in the feedrate output?
- Is there any material buildup on the feeder’s primary components?
- Does the feeder appear to be well-constructed and durable?
- Do the maintenance requirements appear to be minimal?

If the supplier is using an automatic (or computerized) feedrate sampling system during testing, make sure that you understand how the system is calculating accuracy for the test and how the demonstrated accuracy compares to the supplier’s feeder performance guarantee. If you’re testing multiple feeder models, make sure that the sampling times and the number of samples taken from each feeder are identical for a proper comparison.

When testing is completed, the supplier should give you a detailed report, including the recommended feeder model and its configuration (such as the feed screw size and type, agitator type, and any special features) for your application and the feedrate accuracy you can expect.

**For further reading**

Find more information on volumetric screw feeders in articles listed under “Feeders” in *Powder and Bulk Engineering*’s article index later in this issue or the Article Archive on *PBE*’s website, www.powderbulk.com. (All articles listed in the archive are available for free download to registered users.)

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