SCREW FEEDERS FOR METERING MATERIALS IN CHALLENGING APPLICATIONS: A Q&A

Screw feeders are used across a broad range of industries and material applications. This article discusses ways to help mitigate some of the application issues that can occur when using a screw feeder.

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Screw conveyors of all types are some of the most versatile bulk material handling equipment available. One specific type, the screw feeder, is used in a wide variety of applications for metering bulk materials. Screw feeders come in many sizes, lengths, configurations, and are constructed of a variety of materials.

Screw feeders are comprised of a screw mounted in an enclosed U- or tube-shaped trough or housing and typically are mounted to a hopper, bin, or silo at the start of a process. The screw is connected to a rotating drive shaft on one end and an end shaft on the other, with the screw supported by bearings at both ends.

Because the inlet of a screw feeder is flood-fed, as opposed to being control-fed like a standard screw conveyor, the unit's rotational speed and special flight spacing are crucial design factors in determining how much material will be delivered to the discharge with every revolution of the screw. Controlling the feedrate to the next process phase is critical in most processing environments, and screw feeders can be adapted accordingly. The following Q & A helps explain when a screw feeder can meet your specific needs.

Dealing with abrasive/corrosive materials
Q: We're discharging a wet, sludgy bulk material from a batch mixer and need to meter the material for further processing. Will a screw feeder hold up to very abrasive and corrosive materials?
A: This producer of nutritional supplements for animal feed needed a solution for an existing outdated and worn screw feeder. Design parameters of the application were for feed supplement densities ranging from 50 to 80 lb/ft³ and a feedrate capacity of 60 ft³/h. The unit had to move corrosive mixtures from a batch mixer and elevate them, at a 22-degree incline, for further processing.

Screw feeders are very capable of handling these types of abrasive and corrosive applications. However, using a screw feeder constructed of standard carbon steel or stainless steel components to move an abrasive material could result in rapid wear and lead to frequent maintenance and downtime, as well as high overall operating costs and premature equipment failure.

To combat the corrosive characteristics of these bulk materials, the new screw feeder was constructed of Type 304 stainless steel with hardsurfacing on the leading edge and periphery of the screw flights, as shown in Figure 1. Hardsurfacing involves applying a layer (or facing) of abrasion-resistant material, such as various combinations of chromium, tungsten, molybdenum, cobalt, or other sometimes exotic materials, onto a softer standard construction material such as carbon steel or stainless steel or other metal alloy base material. This can help combat the corrosive characteristics of the material being fed, improving screw longevity and reducing maintenance and downtime. The type of facing materials you use depends on component materials and your conveyed material’s application requirements and operating environment.

Dealing with varying material densities
Q: Our application involves unloading several different ingredients from railcars. Can a screw feeder handle many different materials with a variety of bulk densities?

Figure 1: Type 304 stainless steel screw construction with hardsurfaced flights combat corrosion and abrasion.
A: A food product required a screw feeder system for railcar unloading that could handle bulk materials including grains, corn, soybean meal, and phosphate. Design parameters for the application included bulk densities ranging from 40 to 85 lb/ft³, and a feedrate capacity of 9,778 ft³/h.

To solve the problem, a variable-pitch screw feeder was located in a pit under the railway tracks and extended 46 feet, the full length of a railcar. Each screw section measured approximately 23 feet long with a center bearing support. The screws had a large-diameter center pipe, designed according to torsional and bending load calculations.

To accommodate the varying materials and provide maximum horsepower and torque for metering the heaviest bulk materials, two independent drive units, as shown in Figure 2, were mounted on opposite ends of the screw feeder with a center discharge point. Variable-frequency drives controlled the feed rate.

**Dealing with interlocking materials**

Q: We’re bagging wood shavings for use as animal bedding. Can a screw feeder meter bulk materials that interlock or stick together?

A: This wood products company needed to control the flow of wood shavings from a hopper to a bagging system. Wood shavings were interlocking and matting together, causing flow problems. The application’s design parameters included material densities of 10 to 30 lb/ft³ and a feedrate capacity of 2,200 ft³/h. A twin-screw feeder with a custom pitch design was installed. Breaker bars, as shown in Figure 3, were added on each screw at the discharge to break up the interlocked wood shavings prior to discharge. In addition, each screw was powered by individual drive units and controlled by variable frequency drives. This way, the output speed of each screw could be varied independently to meet flowrate requirements and provide consistent material flow to the bagging system.

**Dealing with small spaces**

Q: My installation site is a confined space. Can I use a screw feeder to meter crushed limestone?

A: A mining services company needed four inclined screw feeders to meter crushed limestone from weigh hoppers to batch mixers. Special drive and trough designs can allow screw feeders to be operated in confined spaces. The screw feeders were designed with the smallest footprint possible. Special screw pitches with a close-tolerance fit to the tubular housings were used to increase conveying efficiency, as shown in Figure 4. Material density of 86 lb/ft³ and a feedrate capacity of 453 ft³/h were part of the design parameters. The drive units were mounted on the inlet (lower) end of the inclined feeders to save space. Custom-designed trough ends with adjustable shaft seals minimized material leakage and possible gearbox contamination in the confined-space arrangement.

**Dealing with sanitary standards**

Q: We meter various powdered food products into a blending process. Can a screw feeder meet Food Safety Modernization Act (FSMA) sanitary standards?

A: The application required a solution for metering cocoa powder and coffee from storage bins into a blending process. Screw feeders were the solution. Constructing the units from Type 304 stainless steel, with all internal welds polished to a smooth 180-grit surface finish free of pits, cracks, and crevices, allowed the units to meet stringent food-grade FSMA specifications. The screw design promoted a controlled, metered feed to the blenders. Hinged covers with quick-opening clamps, as shown in Figure 5, provided access for easy maintenance and frequent cleanout.
Installing food-grade shaft seals helped contain the food products within the feeders, further assuring standards were met.

Dealing with toxic materials
Q: We have a toxic product that requires a lot of cleaning of the equipment and no leaking. Will a screw feeder stand up to this kind of duty?
A: This crop sciences company needed to meter a fungicide powder from a mixer to a dryer. The equipment needed to be easily cleaned with strong solvents for formulation changes. Failure to properly and completely clean the internal and external surfaces of the equipment could result in product contamination. Manufacturing from Type 316 stainless steel helped prevent corrosion from the cleaning solvents, and continuous welding of all internal screw feeder surfaces, as shown in Figure 6, helped eliminate all cracks and crevices. Locating the screw feeder on an incline and using special close-tolerance, variable-pitch flights will help to increase conveying efficiency and improve the ability to clean the unit between batches. The drive was configured on the inlet end to conserve space. Air-purged shaft seals were used to prevent leakage of the fine powder.

Dealing with dense, heavy material
Q: We need to move rock slag. Will a screw feeder stand up to the tough duty of a dense, rocky material?
A: For this mining operation, a heavy-duty screw feeder was needed to remove rock slag that continually spilled from a belt conveyor. Screw feeders constructed out of the appropriate-strength, sometimes exotic materials, or a combination thereof, can stand up to the most difficult environments. The application’s design parameters included densities of 60 lb/ft³ and a feedrate capacity of 3,180 lb/h. Some of the rock slag measured as large as 6 inches. Installing a shaftless screw feeder, as shown in Figure 7, which allows open space between flights, works to help eliminate binding. Lining the screw feeder housing with a material like 3/8-inch-thick xylethon, an engineered plastic that’s tough, dense, and self-lubricating, helped to maintain the feeder’s abrasion resistance and allowed the unit to hold up well even when metering abrasive rock slag.

Features make the difference
A properly designed screw feeder can play a vital role in solving difficult screw feeder processing problems. Ask the important questions of manufacturers to ensure that they understand your specific plant process and have the engineering expertise to specify the right screw feeder for your application.

For further reading
Find more information on this topic in articles listed under “Feeders” in Powder and Bulk Engineering’s comprehensive article index in the December 2017 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.)
Shaftless spiral screw helps eliminate binding when metering dense, heavy materials.

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