Loss-in-weight feeder connections: More flexibility equals better feeding performance

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Properly connecting your loss-in-weight feeder to your process equipment can help ensure that the feeder will reliably weigh and dispense dry bulk material to your process. The trick is to install the feeder in a way that prevents external components from interfering with the feeder’s weighing ability. This article describes various types of connections and how to install them to ensure that they are flexible and don’t impair your loss-in-weight feeder’s performance.

A loss-in-weight (LIW) feeder measures the weight loss of a dry bulk material in an integral hopper as the material is dispensed to a process. This weight information is used to control the feedrate. Some of the feeder components are weighed components that move in response to the material’s weight loss. These include the feeder’s hopper, discharge device (such as a screw feeder, vibratory tray feeder, or belt feeder), and motor. Other components — including the feeder’s frame and support structure — are nonweighed components that remain stationary. The LIW feeder hopper’s load cell or cells, their mounting hardware, and wiring link the feeder’s weighed and nonweighed components.

The LIW feeder is also connected to external components in the process. A rigid, inflexible connection between any external component or nonweighed feeder component and the feeder’s weighed components can transmit artificial forces to the weighed components and interfere with weighing. The result will be unreliable feeding.

You can prevent these connections from affecting your LIW feeder’s performance by choosing and installing them properly to ensure that they’re flexible.

Typical connections

As shown in Figure 1, LIW feeder connections typically include the refill bin’s connection to the feeder hopper’s inlet, the dust collector’s connection to the feeder hopper’s air vent, the process equipment’s connection to the feeder’s discharge device, and the junction box wiring’s connection to the discharge device motor. In some cases, another external component — inert gas tubing — is connected to the feeder hopper to supply inert gas for handling an oxidizable or explosive material.

Refill bin, dust collector, and process equipment connections

The LIW feeder is typically connected to the refill bin, dust collector, and process equipment with flexible connections that provide a dust-tight seal between the feeder’s and the external component’s inlet or outlets (which are usually pipe stubs). The flexible connection is a short tube consisting of thin, flexible material such as polyurethane, latex, or white rubber, clamped at one end with a metal band around the feeder inlet (or outlet) and at the other end around the external equipment inlet (or outlet). When you select and install the flexible connection properly, the LIW feeder senses the connection’s mass as a constant force during feeding. This ensures that the flexible connection doesn’t impose artificial forces on the feeder that can adversely affect weighing and improperly change the feedrate.

However, if you select the connection improperly — for instance, by choosing one made of a thick, less flexible
material — or install it so that the connection can’t flex easily, the feeder will sense the connection’s mass as a variable force. The adverse effect on weighing will be greatest at low feedrates (up to 20 lb/h) and decrease with higher feedrates. This is because the LIW feeder weighs the material that discharges from the feeder in 0.5-second increments. At a 20-lb/h feedrate, the feeder weighs 1.26 grams of material in 0.5 second. If the improperly designed connection applies 0.1 gram of force to the feeder, the sensed weight — and, hence, the feedrate — can be off by ±8 percent, a significant error. But if the feedrate is 2,000 lb/h, the feeder discharges 126 grams of material in 0.5 second, and a flexible connection that applies 1 gram of force won’t significantly affect the feedrate. This is also why you can select a flexible connection made of thicker material for a LIW feeder operating at 2,000 lb/h and higher: The thicker material provides better durability for greater protection against damage to the flexible connection with less likelihood that any flexibility loss will affect the feedrate.

One of the most common flexible connections is a flexible bellows. The flexible bellows connects an inlet and outlet of the same diameter and bulges out between its inlet and outlet ends, as shown in Figure 1. The balloon-like bulge flexes to ensure that the mass of the flexible bellows that’s weighed by the LIW feeder is constant and doesn’t change with vertical movement of the feeder or other upstream equipment. One problem with the flexible bellows is that material can build up between its outlet and the equipment’s pipe stub. When such buildup accumulates, the
connection can lose some flexibility and require more cleaning.

Another flexible connection type is the flexible stepped bellows. This molded connection has a small-diameter inlet and large-diameter outlet. Because the flexible stepped bellows moves from small to large diameter, material is less likely to build up between the connection and the downstream equipment's pipe stub. A horizontal section in the connection's transition section from small to large diameter can be made of thicker flexible material for better durability without changing the connection's mass effect on the feeder. You can custom-mold a flexible stepped bellows to fit your equipment; premolded versions are also available in standard sizes.¹

When a flexible connection is used to connect the feeder's air vent to the dust collector, one potential problem is that the vacuum created by the dust collector can cause pressure on the connection. This can stretch the flexible connection and impair the feeder's weighing performance. One solution is to use an external vacuum exhaust, as shown in Figure 1. This connection consists of a pipe with a flared opening connected to the dust collector inlet and mounted over the LIW feeder's air vent but not connected to it; instead, a small air gap is left between the flared opening and the vent. The dust collector's vacuum draws the air-entrained dust upward through the air vent into the external vacuum exhaust, while the air gap ensures that the vacuum doesn't cause pressure on the connection. However, use this connection with some caution: If the LIW feeder hopper is refilled too quickly, the volume of air displaced from the hopper can overwhelm the dust collector and blow dust into the plant through the external vacuum exhaust's air gap.

Junction box wiring connection
Wiring leads from the feeder's junction box to the motor that drives the discharge device (not shown in Figure 1). The motor is part of the feeder's weighed section, but the junction box is not. To prevent the transmission of artificial forces through the wiring to the feeder, install the wiring so that it's flexible rather than taut and has a long horizontal section to prevent wire tension in response to the motor's vertical movement. If possible, loop the wiring's horizontal section to avoid placing tension on it.

While the feeder will weigh at least part of the wiring's mass, the flexible installation of the wiring allows it to impose a constant force on the feeder. This installation keeps the wiring from becoming tensioned in the vertical direction, thus preventing a variable vertical force on the scale as the feeder hopper moves from high to low material weight.

Inert gas tubing connection
If your LIW feeder will handle an oxidizable or explosive material, you can create an inert atmosphere in the feeder by adding an inert gas, such as nitrogen, to the feeder hopper. This requires installing flexible tubing between an inert gas supply and the feeder hopper. To ensure that the tubing doesn't impose artificial forces on the feeder, install the tubing horizontally and, if possible, with a loop between the gas supply and the hopper, as shown in Figure 1.

Also ensure that the inert gas doesn't impose a pressure difference greater than 4 inches water column between the gas pressure inside the feeder and that outside. Any pressure difference causes artificial forces that require the feeder to compensate for them. [Editor's note: For more information on LIW feeder pressure compensation, contact the author.]

Checking your connections
After you install a connection on your LIW feeder, you need to check whether it's flexible enough to prevent weighing errors. To do this, first read the feeder's displayed weight when the feeder hopper is empty. Then add calibrated weights to the hopper and check whether the displayed weight matches the total weight of the calibrated weights in the hopper. Periodically repeating this procedure will help you ensure that your connections remain flexible and contribute to your LIW feeder's optimal performance. PBE

Reference
1. Standard sizes of premolded flexible stepped bellows are available from Brabender Technologie, Mississauga, Ontario.

For further reading
Find more information on LIW feeder connections and gravimetric feeders in articles listed under “Feeders” in Powder and Bulk Engineering's comprehensive “Index to articles” (in this issue and at www.powderbulk.com).

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