When feeding a slightly cohesive material, how can I prevent ratholing in my feeder hopper?

Cohesive materials can impact feeder performance by forming the dreaded rathole above the feed screw. In extreme cases the rathole can collapse, resulting in material flushing out of the feeder’s discharge.

Flow aids, such as mechanical agitators, are key to feeding cohesive materials in a screw feeder. When used properly, an agitator will condition the material to a uniform bulk density and allow the material to completely fill the feed screw’s flights, eliminating bridging and ratholing and resulting in the greatest feed accuracy. There are two primary mechanical agitation systems available: external and internal.

**External agitation** typically uses external agitating paddles coupled with a flexible hopper. The advantages of this method are that there’s no physical contact between the material and the paddles and material segregation and degradation are minimized. The disadvantages to this method are that a flexible hopper isn’t compatible with certain material types, material temperatures, and chemical cleaners, which can make the flexible hopper brittle.

**Internal agitation** uses either a horizontal or vertical agitator that gently breaks up more cohesive materials. Note that this method isn’t meant to replace a mixer, as the agitator typically only spins at a few rpm. Internal agitation is more aggressive than external, as the material comes into physical contact with the agitator, which could be a disadvantage for adhesive and friable materials. However, this method is better for lower bulk density materials and helps the material fill the feeder’s screw flights. Conversely, higher bulk density materials may not feed properly with an agitator because of the amount of torque on the agitation motor. Very cohesive materials could even turn into a plug inside the feeder.

Consult with a sales engineer at a feeder manufacturer for help determining the best type of agitation for your material.

**Todd Messmer, applications engineering manager, Schenck Process, 262-473-2441**

Funnel flow causes a rathole to form in a feeder hopper. Assuming that your feeder is a screw feeder that has a screw with a constant diameter and pitch, the funnel forms above the screw’s lead end because the material flows into the first screw flight, which empties first as the screw turns. This phenomenon naturally occurs with many powders, flakes, and fibers and reduces the useful hopper volume, eventually creating the rathole. With free-flowing materials, the funnel can collapse as soon as the rathole forms and leave the successive flights of the screw empty.

However, with non-free-flowing, slightly cohesive materials, the rathole doesn’t collapse. Assuming that the feeder hopper is filled properly and isn’t too large, this problem can be solved by changing to a mass-flow screw design and improving the agitation mechanism in the feeder hopper.

A mass-flow screw has a progressive pitch, meaning the volume of space between screw flights increases from the lead end of the screw to the feed tube, allowing material to fill the screw flights evenly over its exposed length in the screw trough. This allows for a consistent material feed to the screw and more accurate and reliable feeding.

The two common agitation mechanisms available are a flexible-walled screw trough with external paddle massaging and internal rotational stirring blades. The best type of agitation can be determined by testing at a feeder supplier’s testing facility.

The feeder’s filling method, hopper volume, screw design, and agitation method should all work together to ensure accurate and reliable feeding.

**Guy Catton, president, Brabender Technologies, 905-670-2933**

There are a few design features that should be considered when dealing with cohesive materials prone to ratholing. You should first measure the material’s angle of repose and make sure that the hopper is designed to enhance material flow. A mass-flow hopper design will help the material flow evenly and an asymmetrical hopper design will discourage ratholing.

Opening the transition from the hopper to the feeder as large as possible will also promote material flow. You can achieve this by using a screw with a larger center shaft and smaller flights. A flared feeder trough can also increase the inlet area, and if the material is particularly stubborn, a live-bottom feeder design can be used.

You may also need to add agitation to your hopper, such as a mechanical agitator using paddles or pins above the feeder. These methods can keep the material moving and prevent ratholing. Air pads or vibration can also be used, but you must ensure that the devices are cycled on a periodic and not a continuous basis to prevent the material from becoming either airborne or compacted by the vibration.

The hopper wall’s surface is also an important consideration for material flow. The surface should be smooth with no ledges or protruding welds, which can cause flow issues. If possible, a polished or naturally slick wall surface, such as stainless steel or Teflon should be used. This keeps the coefficient of friction low so that the material releases easily from the hopper’s sides. If the material is cohesive due to its hygroscopic nature, localized humidity control may help as well.

When dealing with a cohesive material, consider all possible design features that promote smooth material flow to reduce downtime associated with material ratholing.

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