schenck process

CONVEYING IDEAS 2

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- Protecting fragile materials during pneumatic conveying
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How to improve gravimetric feeder performance

Tips and techniques to feed materials efficiently by Todd D. Messmer

What is the best way to improve my screw feeder's gravimetric performance?
The first thing we need to know is what material you are feeding. Gravimetric feeder performance is most affected by how well the material feeds volumetrically. The closer you can fill the flights of the feed screw volumetrically to 100 percent, the better the feeder will perform gravimetrically. To get the material to feed better volumetrically, the material's bulk characteristics must be analyzed.

Improving volumetric feeder performance

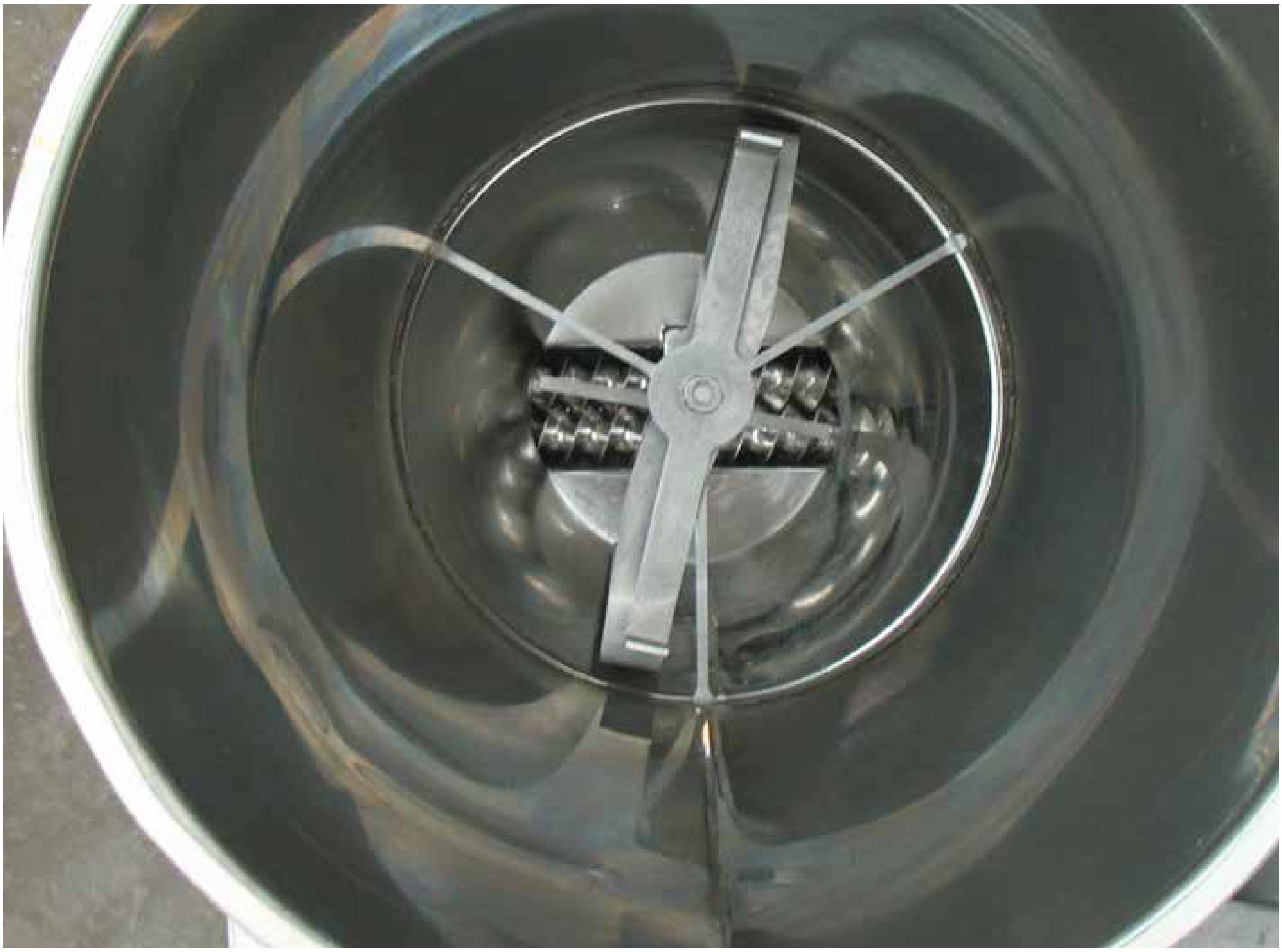
First, let's look at some of the most common material characteristics that affect volumetric feeder performance.

Free flowing

Plastic pellets are generally free-flowing materials. They feed under gravity without the need for special design considerations or flow enhancements.

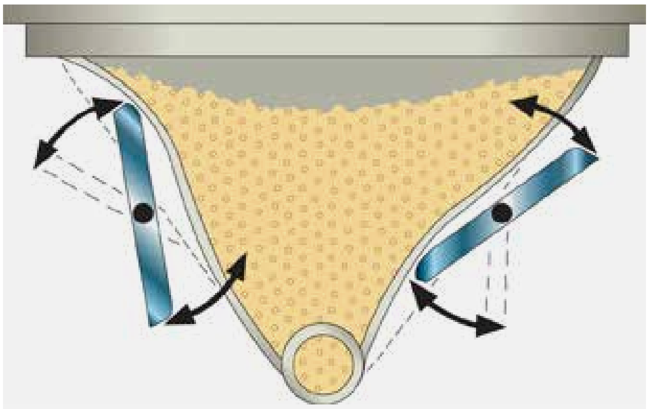
Adhesive

Some materials like to stick to everything. Pigments are notorious for adhering to all types of contact surfaces. Often, we need to clean feed screws and tubes just to keep the material from building up on them. Avoid feeders with internal agitation systems. We may need to look at different coatings, such as fluoropolymers or more polished contact services. Systems to self-clean the inside of the feed tube should be considered.



Cohesive materials like to pack like a snowball and need flow aids such as internal agitation, air sweeps or air pads to create movement or external vibration to break up the clumps.

Any electrical, plumbing or other connections to the gravimetric feeder must be made with flexible conduit/piping/tubing to have minimal effect on the movement of the gravimetric scale.



External feed hopper agitation: Pressure-sensitive materials are prone to pack, if used on large-volume hopper extensions. Sometimes external paddles, as shown above, are used to agitate flexible-walled hoppers to mitigate this problem. In some cases, though, higher-frequency agitation or vibration will cause these materials to pack.

Cohesive

These materials tend to pack like a snowball and are typically associated with a high angle of repose. They need flow aids such as internal agitation, air sweeps or air pads to create movement or external vibration to break up the clumps. Adding cross wires on the end of the feed tube to get the material to "pack" better into the flights of the feed screw can help.

Aeratable/floodable

These materials typically are associated with a low angle of repose. They behave like a fluid when aerated and will easily flush out of a feed screw, if it is not designed properly. A feed screw with a center rod versus an open flight often is needed with these materials. Consider smaller refills more frequently with these types of materials versus a larger refill, which often can aerate the material in the feeder, causing it to flood out.

Hygroscopic

These materials retain moisture very easily. Often, we hear customers say they left material in the feeder and when they came back the next morning, it had solidified because it collected moisture from the environment. Blanketing the material with clean, dry air or nitrogen can help keep moisture out of the feeder.

Pressure sensitive

These materials are prone to packing, if used in large-volume hopper extensions. Again, frequent smaller refills may help keep the material from packing. Feeders that use external paddle agitation with flexible-walled hoppers require close attention to the level of frequency with which the paddles are agitating the hopper walls. Higher frequency agitation or vibration often can pack these materials.

Low melt temperature

Heat-sensitive materials tend to break down, melt or caramelize when excess friction/energy is used on them. Try using a larger-diameter feed screw turning at a lower rpm than a smaller-diameter feed screw running at a higher rpm with these types of materials.

If all else fails, inquire about the testing capabilities of your material-handling equipment supplier. Often they have experience feeding the material and can suggest ways of improving performance. Material testing usually is free of charge and can be witnessed firsthand.

Gravimetric feeder performance tips

Now, after taking steps to improve material feeding volumetrically, let's take a look at several factors that will affect the gravimetric performance of the feeder.

Vibration

Vibration is detrimental to the operation of the gravimetric system because of the sensitivity of the scale, and special provisions must be taken to eliminate any vibration of the scale. Some possible ways to minimize vibration are to isolate the decking that the weighing system rests on; reinforce the decking around the weighing equipment so the decking flexes minimally; mount the weighing equipment on a high-mass pedestal (i.e., concrete-block table); mount the weighing equipment on vibration isolators; or mount the weighing equipment on structural members, not on the decking itself.

Heating/air conditioning/ventilation ducts

Heating, air conditioning and ventilation ducts cause air disturbances, which could translate into false scale movements and changing scale weights. These ducts may

Preventative maintenance programs are offered by some material-handling equipment suppliers. These should include a feeder audit and recommendations by a field service engineer for improving feeder performance.

need to be relocated away from the gravimetric system, especially for those systems with small load-cell capacities required for very accurate measurements.

Open windows and doors

Like the ventilation ducts, open windows and doors can create air disturbances that affect the gravimetric system. Special precautions may need to be taken to make sure that doors and windows especially to the outside remain closed. Ambient temperature: The air temperature where the gravimetric system – the scale, controller and feeder – is going to be placed must not exceed the temperature limit in the scale systems specifications, because load cells are temperature compensated.

Hazardous areas

Provisions for the class, division and group of hazardous areas must be taken into consideration. These areas typically require the need for intrinsic barriers within the feeding system, which will degrade the raw signal of the load cell because of the voltage drop across the barrier. Electrical power: The controller of the gravimetric system requires "clean power," much as a computer requires a clean line. This line should be free from any large inductive or capacitive loads. If uncertain about the condition of supply power, an isolation transformer or UPS (uninterruptible power supply) is recommended.

Large inductive and/or capacitive equipment

The scale and the scale cables (excitation and signal) must be separated from large inductive and/or capacitive loads, such as arc welders and large motors.

AC voltage power wiring

All cables associated with the gravimetric system should be run in separate conduit from all high-voltage AC signals.

Radio-frequency equipment

The scale and the scale cables must be isolated from RF-generating equipment.

Support systems

The floor, balcony, mezzanine, etc., on which the gravimetric system is mounted must have a rigid construction to provide a solid platform, as mentioned earlier.

Distance from the feeder and scale to the controller

For distances greater than 25 feet, contact the manufacturer for cabling recommendations.

Electrical ground

A solid electrical ground must be available for the feeder and the electrical controller.

Scale/feeder mounting

The mounting table or mounting base for the scale must be solid and preferably afford some vibration isolation between the scale and the floor.

Outdoor installations

If any gravimetric equipment is to be installed outdoors, extreme temperature variations should be noted and avoided if at all possible. Cabinet heaters may be required to keep the controller and the load cells at a nominal temperature.

Flexible connections

Any electrical, plumbing, or other connections to the gravimetric feeder must be made with flexible conduit/ piping/tubing to have minimal effect on the movement of the gravimetric scale. Use factory-recommended flexible connectors for feeder inlet and discharge ends when the scale system is part of a gravimetric feeder.

Maintenance access

Consideration should be given to allow maintenance personnel access to maintain the scale, gravimetric feeder and controller.

Corrosive atmospheres

Any corrosive vapors, dust, etc., should be noted and recommendations should be given on how to prevent corrosion by using resistant materials.

Refill mechanism

The mechanism used to automatically refill gravimetric feeders must be tight-closing, so the material cannot enter the feeder's extension hopper other than during the refill time. In addition, the refill device must be sized to refill the required amount of material so the feeder does not starve out.

Refill venting

Rapid introduction of dry material into a feeder hopper extension during a refill causes pressure to build up inside the hopper extension equivalent to the volume of air displaced by the volume of dry material. This pressure must be relieved, either by leaving the refill gate open so the displaced air can move into the refill hopper or by providing a vent in the feeder hopper extension.

Vacuum systems

Vacuum or pressure systems, either at the infeed or discharge of a feeder, may affect the gravimetric system by causing adverse suction or pressure on the system. These ancillary systems must be properly vented to prevent these conditions.

Contact your material-handling equipment supplier to inquire about a preventative-maintenance program that includes a feeder audit and recommendations by a field service engineer for improving feeder performance. Typically a small fee is associated with this service. However, when the cost is weighed against the alternatives of poor accuracy and frequent downtime, a feeder evaluation is worth the expense.

Gravimetric feeder performance is most affected by how well the material feeds volumetrically.

Protecting fragile materials during pneumatic conveying

Tips to design a conveying system to minimize kibble degradation by Jonathan O. Thorn

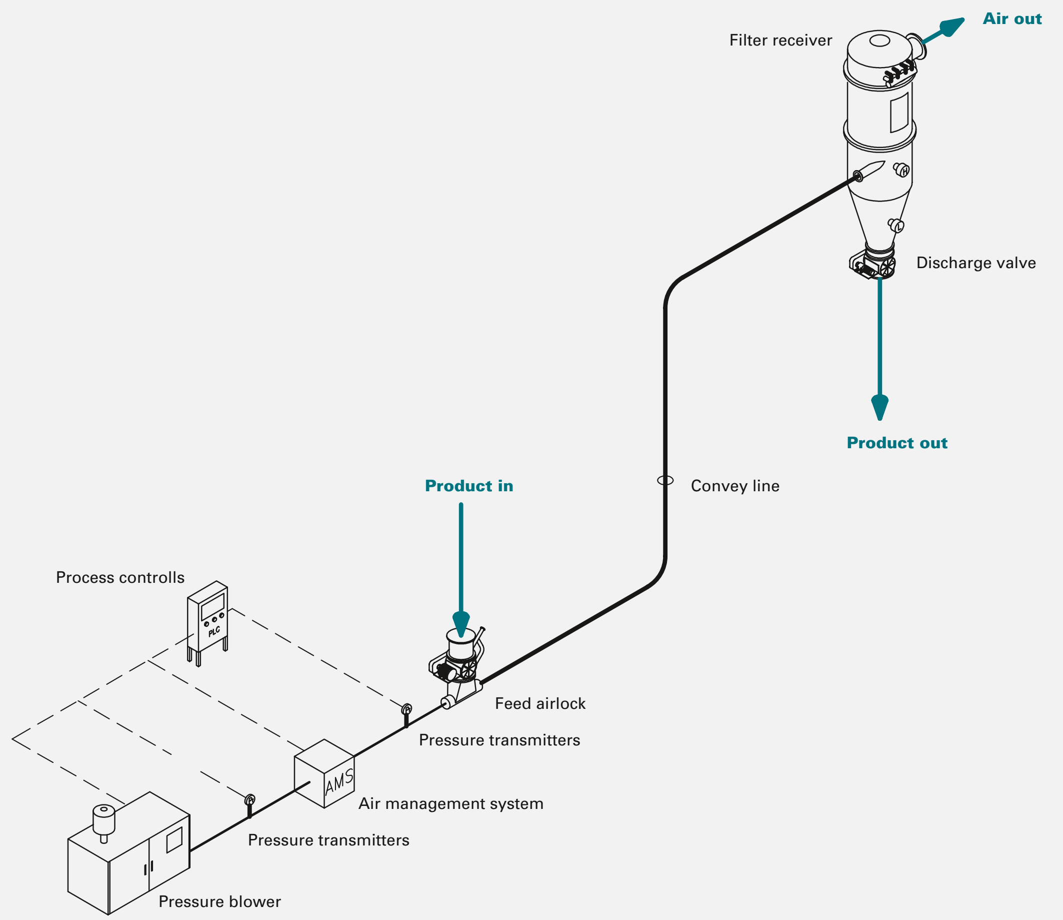
Pneumatic conveying is an effective method of transporting dry bulk materials that is clean (dust controlled) and protects the material from contamination. However, the use of pneumatic conveying to safely move a fragile or friable material that is susceptible to degradation is a concern for many pet food manufacturers.

Material degradation means different things for different materials. In pet food, degradation typically means broken kibble pieces or fines. Most users have their own definition of what constitutes degradation for their material as well as a method for measuring it; such as sieve analysis, measuring a shift in bulk density or even hand-counting larger particles in a sample.

For most types of degradation in pneumatic conveying, velocity is the strongest correlating factor followed by the condition of the convey line and receiving equipment.

Controlling velocity to minimize degradation
The effective air velocity in the convey line can significantly add to material degradation if not controlled properly. While material velocity ultimately creates the impacts, it is dependent on air velocity and controlled indirectly with the air stream. Depending on the nature of the system, velocity control will take several different forms.

Dilute Phase Conveying
While dilute phase conveying is the most common form of pneumatic conveying in the bulk solids industry, it is generally not recommended to handle fragile materials because it relies on a high velocity gas stream to entrain



Flow diagram of a pneumatic conveying system

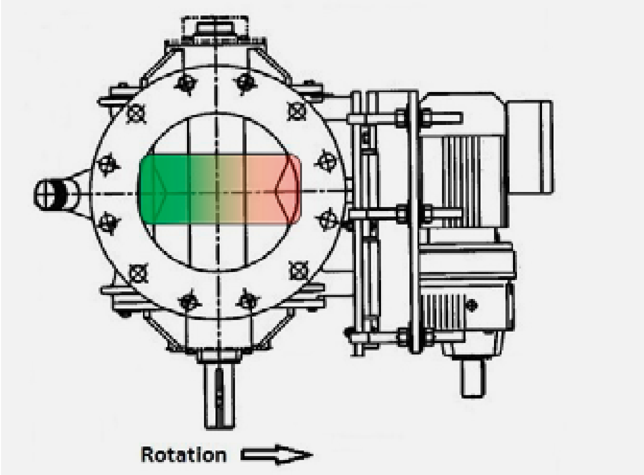
the material. There are conditions that warrant the use of dilute phase on fragile material and sometimes material degradation is an unexpected problem that becomes evident after the fact. In these cases, steps should be taken to minimize the effective air velocity in order to protect the material as much as possible.

If possible, start by equipping the conveying system with a variable frequency drive (VFD) on the blower (or air source) and feed device. Most dilute phase equipment operates at speeds higher than is required to insure it meets or exceeds the rate and conveying requirements. Therefore, the blower could be turning at speeds 10-20 percent higher than what is required to achieve entrainment of the material. Likewise, the feed device may introduce a higher rate of material than is required and indirectly increase the blower speed requirements. For a given conveying line size in dilute phase conveying, a lower feed rate will allow a greater reduction of air volume and, thus, greater reduction in the conveying velocity. Once the feed rate is set, use one of these methods to control and minimize the air volume and conveying velocity.

Simple speed correction - This requires manually adjusting the blower VFD until the blower is operating at the minimum speed that still reliably conveys the material. This works best with a simple conveying system that only handles one material. A system with multiple conveying rates and destinations may require multiple VFD settings or employ the compensation method.

Leakage compensation correction

This method takes feedback from a pressure transducer (on the blower or near the feedpoint) to tell the conveying system what pressure the rotary airlock valve is experiencing and then adjusts the blower speed to compensate by supplying a proportional volume of air.



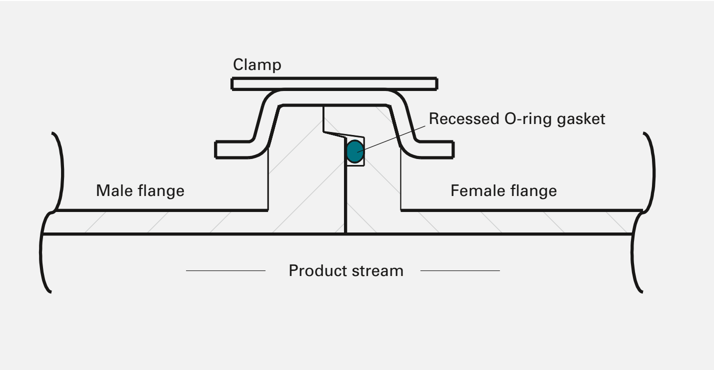
Material flow through a rotary airlock valve: Material should be introduced in a metered stream to the non-shear side of the valve in order to insure the material is in the pocket when passing the shear point.

To create the calculation sequence for adjusting the blower speed, information about blower performance and characteristics of the rotary airlock must be known.

Depending on how conservatively the dilute phase system is currently being operated, employing the above methods can significantly decrease the blower operating speed and the associated air velocity.

Dense Phase Conveying

Dense phase pneumatic conveying utilizes inherently lower air velocities to induce material flow in the pipeline. The material is proportioned into the low-velocity air stream and the air is forced to flow through the material creating moving “slugs”. The material in each slug bunches together and travels through the pipeline in a controlled motion.



No-ledge couplings: Installing machined pipe couplings that create a ledge-free union will virtually eliminate material damage from joints.

For dense phase flow to be stable, the system must operate in a prescribed velocity range. Air velocities outside of this range (high or low) will cause instability and surging and put fragile material at risk. Therefore, the system controls will provide some measure of the airflow/velocity and the system should be tuned to operate in the appropriate velocity range for that material.

The material feed rate also plays an important role in the stability of dense phase conveying. It must be great enough to produce multiple moving slugs in the line at one time. The turn-down ratio for material rate is limited to approximately 50 percent of the maximum, below which the system may become unstable.

Dense phase convey systems in general provide significantly reduced convey velocities (compared to dilute phase) and offer significantly greater product protection as a result. To realize the maximum benefit, the system should be tuned to operate in the velocity range required for stability, in addition to operating within the rate limitations.

The rotary airlock valve, common to dense phase and dilute phase pneumatic systems, features rotating blades capable of shearing material that fall between the blade tip and the housing. Material should be introduced in a metered stream to the non-shear side of the valve in order to insure the material is in the pocket when passing the shear point. If a metered feed is not possible, a shear protection baffle should be employed to help mitigate the shear.

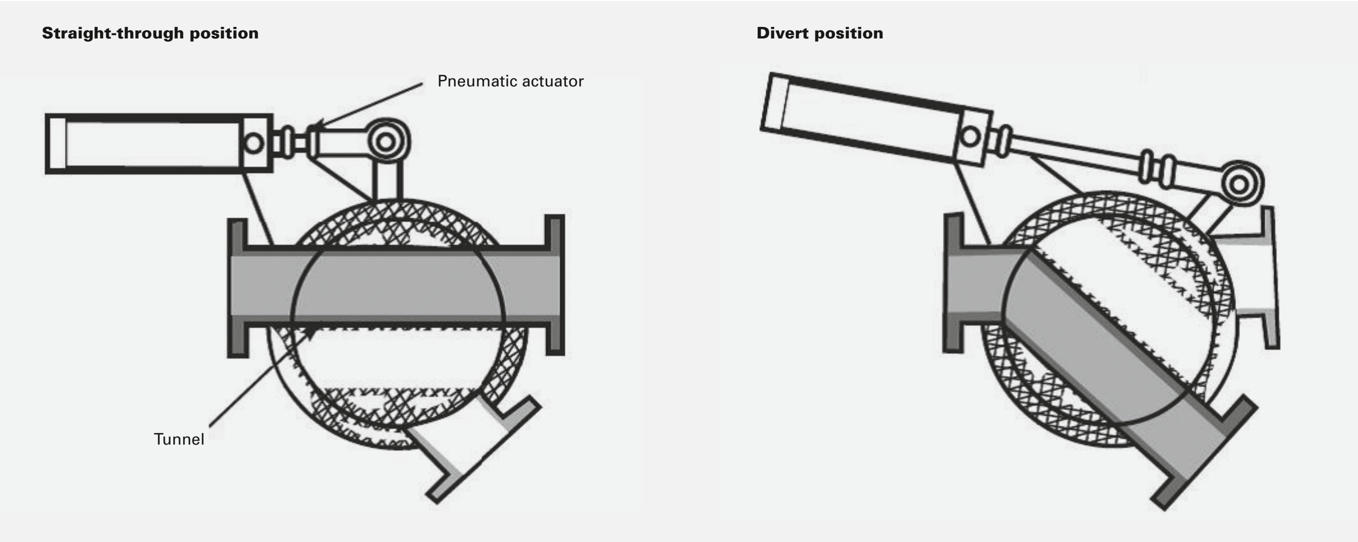
Reducing degradation from the conveying line

Once the flow is generated for a pneumatic conveying system, the material must pass through the convey line. Even if proper attention is paid to velocity and loading, an improper convey line arrangement can cause substantial material breakage.

Joints between pipe sections are typically the largest contributors to material degradation in a conveying line. Gaps can be created in a pipe joint when it is installed or when the pipe experiences thermal expansion and contraction. Any gap in the joint creates a sharp, knife-like inner ledge, equal in size to the pipe thickness, that shears off bits of material passing by the ledge. Beveling the downstream side of each pipe section will reduce the risk associated ledges. However, installing machined pipe couplings that create a ledge-free union will virtually eliminate material damage from joints.

To avoid material damage caused by conveying line bends and diverter valves, follow best practices for routing the conveying line. For example, eliminate inclined line sections and avoid back-to-back bends, which can create erratic operation such as surges. A standard formed pipe bend (or sweep bend) with a centerline radius approximately 6-8D is recommended. This formed bend maintains the circular pipe shape and allows the material to pass without changing its flow shape. Formed bends with smaller centerline radii are too abrupt and cause impact forces, while bends that are too long tend to stall conveying.
By using "tunnel"-typed diverter valves that maintain the pipe's full bore as much as possible will also protect the material from damage. Avoid using diverter valves that have inner ledges or change the shape of the pipe bore; non-round shapes can prevent material slugs in a dense phase conveying system from passing through the diverter valve.

As material reaches the end of the convey line, the method of introduction to the receiver can have a large impact on materials as well. A deceleration zone (section of enlarged pipe) at the inlet of the receiver is common to help reduce inlet velocities. The receivers themselves should have diameters >5x the line size.



"Tunnel"-typed diverter valves: By using "tunnel"-typed diverter valves that maintain the pipe's full bore as much as possible will protect the material from damage.

Tangential inlets are necessary on smaller receivers (<84 inch diameter) to keep material from impacting on the opposite wall. With tangential inlets, since material is now rotating against the wall of the vessel, insure any vessel features (such as doors) are flush and ledge-free. If possible, the receiver design should allow material exiting the conveying line to impact other material rather than a metal cone or other hard surface; at low velocity, most fragile materials will not be damaged by material-on-material impacts.

Taking the precautions and employing the methods described above will insure that pneumatically conveyed fragile materials are handled in the gentlest form possible for this type of handling.

4 ways MultiTrain™ LegalWeight manufacturing efficiency

Rail weighing technology designed to be quickly installed and weigh railcars at high speeds.

MultiTrain™ LegalWeight is a dynamic system designed for weighing railcars with solid or liquid loads. The system offers train and track operator's accurate weighing data, which allows them to avoid the potential hazards of an overloaded or unequally loaded railcar.

1. Fastest and most accurate weighing speed

MultiTrain™ LegalWeight provides high-precision railcar weighing using fast and legal-for-trade calibrated weighing of ingredients during transit, irrespective of either individual railcars or whole trains being weighed. The system can operate legal-for-trade (OIML) at industry leading weighing speeds up to 14 mph. When trains are not being weighed they can travel at the typical line speed for the track.

"The highest accuracy ensures that you can efficiently measure your amount of product," says Hayden Cornish, rail industry manager at Schenck Process. "Petfood manufacturers can instantly know if their suppliers are sending and charging them for the amount of ingredients stated on the manifest."

2. Quickest installation time reduces plant downtime

The MultiTrain™ LegalWeight system is manufactured with two precision loadcells that are integrated into a concrete weighing tie and bolted directly to the rib plate above it. This allows all vertical forces from the railcar to be transmitted directly via the loadcells. Weight values and associated measuring data are collected and processed through the use of weighing electronics and customized PC systems.

"We can install quickly and track downtime is minimized to hours instead of weeks," says Cornish. "Typically using another technology similar to this system can take 2 to 3 weeks to install versus 3 to 4 hours of downtime."

3. Improved logistics planning with custom designed software

MultiTrain™ LegalWeight also can help streamline logistics planning with customized software. "Custom integration is a big part of the system," says Cornish. "We can develop site specific reports and legal-for-trade certified reports for manufacturers. For example, we can push out information or data into the control system to match up train numbers and weights with a manufacturer's control system and their logistics planning."

Installations can take hours versus weeks compared to other systems.

The system offers, acquisition and output of railcar weights (first, second, single, and tare weighing), monitoring of railcar weights and legal-for-trade printout and storage of weigh data. Further customized functions include: railcar type identification, fully automatic weighing sequence, load distribution monitoring, integration into customer IT or ERP systems and hand-held terminals for railcar data acquisition.

4. Higher weighing speeds – No gaps or joins in the rail

The MultiTrain™ LegalWeight system is integrated into the existing rail without any gaps or joins in the rail. Because installation of the ties only takes hours, track downtime is greatly reduced compared to older designed pit type scales. A weighing range of over 390,000 lbs. per car is possible and measured with the use of weighing electronics and customized PC systems. The electronics can withstand temperatures of -22˚ to 122˚F and offer lightning and over voltage protection, which is ideal for harsh environments.

“Most other systems have a speed limit of less than 10 mph, but because our system has no gaps or joins in the rails you can weigh up to 14 mph at legal-for-trade accuracy – there is also no speed restrictions or slowdown required when in normal transit” says Cornish.

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