 Copyright CSC Publishing

Suppliers' Tips

How can I select a pneumatic conveying system for my fragile, friable material?

For fragile, friable materials, minimize system velocity. Degradation has been shown to be proportional to the conveying velocity raised to the "x" power, where "x" can be between 3 and 5. Dense-phase pneumatic conveying allows the lowest velocity. To further reduce velocity and degradation with this system type, the following methods can be used:

- **Oversize the conveying pipeline's diameter.** Don't simply design for the smallest line capable of meeting your capacity requirements. Increasing the line's diameter allows the same material throughput to be achieved with lower pressures and lower velocities and increases the ratio of cross-sectional area to circumference. This means that less material is actually contacting the pipeline wall and more material is, instead, contacting other particles and moving as part of the slug created in dense-phase systems.
- **Avoid purging the conveying line.** Leaving the line charged with material at all times (even when refilling the feed vessel) will ensure that there's a constant load on the system, limiting any uncontrolled velocity surges caused by rapidly expanding pressurized air that can occur when a line empties out (or refills).
- **Control slug lengths to reduce conveying pressure.** There are several ways to control slug length, the most common being the use of conveying line injectors or boosters, which can add additional airflow to the conveying line. A shorter slug generally conveys with a lower pressure differential across it, providing two benefits. First, the lower pressure results in less air expansion as it reaches the destination, creating less of a velocity surge as the slug exits the conveying line and enters the receiving vessel. Second, a lower operating pressure can result in a less tightly packed slug so there's less crushing force within the slug itself.
- **Design the discharge point at the receiving vessel to avoid unwanted material impacts.** Avoid cyclonic entry and discharge piping that might allow the slug to impact against the bin wall. It's generally best to connect the conveying line to the top of the receiving vessel so that the material discharges vertically, down onto a bed of material, which is generally softer than a bin wall. For vessels requiring side entry, use of a "deadhead" is generally best practice. In this discharge configuration, the pipeline entering the vessel has an opening along the bottom and an empty pipe space directly after the opening to catch material, forming a material pocket for the entering slug to hit rather than a steel deflector, before falling into the vessel.
- **Ask your supplier to conduct a full-scale conveying test.** The test should compare particle size and particle distribution of your material samples taken before and after the conveying process. Even when velocity is minimized, the material will still experience degradation. Testing is the only way to quantify the range of material degradation to expect. A sieve analysis is the most common method for size analysis, but other methods, such as laser diffraction, may be more appropriate for materials with a smaller particle size.

Scott Schmid, president, Cyclonaire, 402-362-2000

Any fragile material will suffer material degradation in a pneumatic conveying system. Material degradation is caused by impacts (with bends and deflectors) and shearing caused by interaction with the conveying pipeline walls. The system's flow pattern and the material velocity are key factors in material degradation, so a high-velocity dilute-phase pneumatic conveying system wouldn't be suitable.

Dense-phase pneumatic conveying offers different flow patterns and lower velocities. Material moves in a slug-flow pattern (so called because the material is conveyed via a series of compact slugs). This system typically has velocities ranging from 4 to 10 feet per second, which will greatly reduce impact breakage. Moreover, only the material in contact with the pipeline walls would suffer shearing degradation — with the majority of the material contained inside the slug in a very stable condition. This conveying method will produce very low degradation levels depending on the material being conveyed.

It's possible to achieve even lower velocities via a flow pattern called solid dense-phase pneumatic conveying, which relies on the pipeline being 80 to 90 percent full of material. A vessel full of material enters the pipeline and is conveyed only a few feet. At the same time, a corresponding volume of material will be discharged at the material destination. Material is "pushed" rather than conveyed, and velocities of 1 to 2 feet per second can be achieved. This type of conveying is restricted to uniform-sized round particles such as peanuts.

Whatever type of pneumatic conveying you select, request full-scale conveying tests from the supplier. Attend these tests and ensure that before- and after-conveying samples are taken to confirm that the level of material degradation is within acceptable limits.

John Bell, vice president, technology, Macawber Engineering, 865-984-5286

To gently handle fragile or friable materials, including carbon black prills, sugar, and glass bubbles, use a low-velocity dense-phase pneumatic conveying system, which will move the material slowly through the line in slugs. Dense-phase conveying is also a good option for spray-dried products such as milk powder, instant coffee, and baby foods. Degradation will be minimal if you're using a correctly designed system that conveys the material using the proper airflow velocity for that material. System selection depends primarily on the material being handled, so make sure potential suppliers conduct tests to verify that the system achieves the results you're looking for.

S. Michael May, director of dense phase technology, Coperion K-Tron, 785-825-3838