Evaluating how adding a second material inlet can affect your pneumatic conveying system

Recently, I received a phone call from a company asking how the addition of another inlet further downstream would affect their existing pneumatic conveying system. Luckily for them (and you), Paul Solt and I addressed that very question in a previous column that’s worth revisiting.

The existing pressure conveying system handles a 100-micron powder with a bulk density of 90 lb/ft³. As shown in black in Figure 1, the system has a blower, a Schedule 40 4-inch-diameter conveying line (including 150 feet of horizontal line, 80 feet of vertical line, and two 90-degree bends), and a material inlet (a rotary airlock feeder). In operation, the powder is fed to the conveying line at 250 lb/min and transported to a silo at the line’s end.

The system is running just fine, but our production needs have increased, so we’ll now connect a second material inlet (another rotary airlock feeder) to the system to add more of the same powder. This inlet will be 90 feet downstream from the original material inlet and will add powder at 100 lb/min to the system.

To see what effect this change will have on the system, let’s do the following exercise.

First, we’ll split the conveying system into two parts to see how each is affected: Part 1 is from the new material inlet to the silo receiving the powder (shown in green on Figure 1), and part 2 is from the system’s original material inlet to the new inlet (in black).

- In part 1, the conveying rate is now 350 lb/min (the 250-lb/min rate through the original inlet plus 100 lb/min through the new inlet), the available airflow volume is 300 scfm (because of another 50-scfm loss to leakage through the second rotary airlock feeder), and the powder is conveyed 60 feet horizontally, 80 feet vertically, and around two 90-degree bends to the silo. This changes the conveying line pressure in part 1 to ±5 psig and the pickup velocity to ±2,524 fpm.

- In part 2, the conveying rate is 250 lb/min, the available airflow volume is still 350 scfm, and the powder is conveyed 90 feet horizontally.

But with the additional 100 lb/min of powder conveyed through the system, there’s now 5 psig of back pressure at the end of part 2’s horizontal line segment! This changes the conveying system’s performance parameters. Now, the conveying line pressure is ±7 psig, the blower discharge pressure is ±8.5 psig, and the pickup velocity is ±2,650 fpm.

Next we need to be sure that the system’s existing blower can handle this higher pressure requirement. The blower runs at ±2,670 rpm. It has a 25-horsepower motor that provides ±14.5 horsepower at 7 psig, has a pressure-relief valve set at 10 psig for ±20 horsepower, and produces an air temperature rise across the blower of 94°F.

At the same ±2,670-rpm blower speed, with the blower discharge pressure now at ±8.5 psig, the
blower requirements change to ±17.5 horsepower with a resulting air temperature rise of 113°F. Fortunately, the existing 25-horsepower blower will be able to handle these new parameters.

The blower is able to handle the new inlet’s effects because, at 25 horsepower, the blower was conservatively sized for the original conveying system. So even though adding the second inlet changes the system’s original pickup velocity from ±2,850 to ±2,650 fpm, the blower’s speed can be increased to compensate for the resulting additional rotary airlock leakage and increased blower discharge pressure. (In a worst-case scenario, such as needing to return the system’s conveying velocity to the original ±2,850-fpm level, the blower motor could be replaced with a 30-horsepower unit.) The ±10 percent air temperature rise across the blower isn’t likely to be a concern, either.

Be aware that, unlike the conveying system change we’ve just examined, not all changes you make will have minimal impact on your pneumatic conveying system. Following the method outlined here to evaluate system changes will help you determine how a change will affect your conveying system’s operation. This will help you address any resulting issues so you can keep the system performing to your expectations. **PBE**

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**For further reading**

Find more information on this topic in articles listed under “Pneumatic conveying” in Powder and Bulk Engineering’s article index in the December 2018 issue or the Article Archive on PBE’s website. (All articles listed in the archive are available for free download to registered users.)

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