Tips

A quick look at pneumatic conveying system basics

Fabio Novelli and Mike Weyandt Nol-Tec Systems Inc.

This article provides some basic information about pneumatic conveying system types, operation, and applications.

A pneumatic conveying system transfers powders, granules, and other dry bulk materials through an enclosed horizontal or vertical conveying line. The motive force for this transfer comes from a combination of pressure differential and the flow of air (or another gas) supplied by an air mover, such as a blower or fan. By controlling the pressure or vacuum and the airflow inside the conveying line, the system can successfully convey materials.

Pneumatic conveying provides several advantages over mechanical conveying. A pneumatic conveying system can be configured with bends to fit around existing equipment, giving it more flexibility than a mechanical conveyor with its typically straight conveying path. This also means the pneumatic conveying system occupies less space than a comparable mechanical conveyor. The pneumatic conveying system is totally enclosed, unlike many mechanical conveyors, which enables the pneumatic system to contain dust. The pneumatic conveying system typically has fewer moving parts to maintain than a mechanical conveyor, as well.

Pneumatic conveying also has some disadvantages compared with mechanical conveying. One is the pneumatic conveying system's typically greater use of horsepower than a mechanical conveyor, resulting from the pneumatic system's need to change air pressure to produce conveying power. The pneumatic conveying system also uses a comparatively larger dust collection system than a mechanical conveyor because the pneumatic system has to separate the material from the conveying air at the system's end. Some materials also have characteristics that make them difficult to convey in a pneumatic system. Examples are materials with a large particle size and high bulk density, such as gravel or rocks, and extremely sticky materials, such as titanium dioxide, which tend to build a coating on material-contact surfaces and can eventually block the conveying line.

Pneumatic conveying system types and applications

Pneumatic conveying systems are classified by their operating principle into two basic types: dilute phase and dense phase. Either can run under pressure or vacuum.

Dilute phase. In dilute-phase conveying, particles are fully suspended in the conveying air and transported at low pressure and high velocity.

Dilute-phase pressure conveying is one of the most common conveying methods for powders or granules. It's most often used with nonabrasive, nonfragile materials that have a light bulk density (typically less than 62 lb/ft^3); common examples are flour, sugar, corn starch, plastic granules, sodium bicarbonate, hydrated lime, activated carbon, and zinc oxide.

In this method, illustrated in Figure 1a, a blower at the system's start supplies a high volume of low-pressure air to the system, and material is fed into the conveying line through a rotary airlock valve. The system relies on the airstream's velocity to pick up and entrain each particle, keeping the particles in suspension as they travel through the conveying line. The dilute-phase pressure conveying system requires relatively little headroom and is simple to operate, economical, and ideal for conveying material from a single source to multiple locations.

Dilute-phase vacuum conveying is suitable for conveying materials that tend to pack or compress under pressure, such as wood shavings and certain other fibrous materials, and for toxic materials that must not leak into the workplace air. This system is typically used to convey materials over short distances at low capacities. Dilute-phase vacuum conveying requires minimal headroom at the feedpoint and is ideal for conveying material from multiple sources to a single destination.

Dense phase. In dense-phase conveying, particles aren't suspended in the conveying air and are transported at high pressure and low velocity.

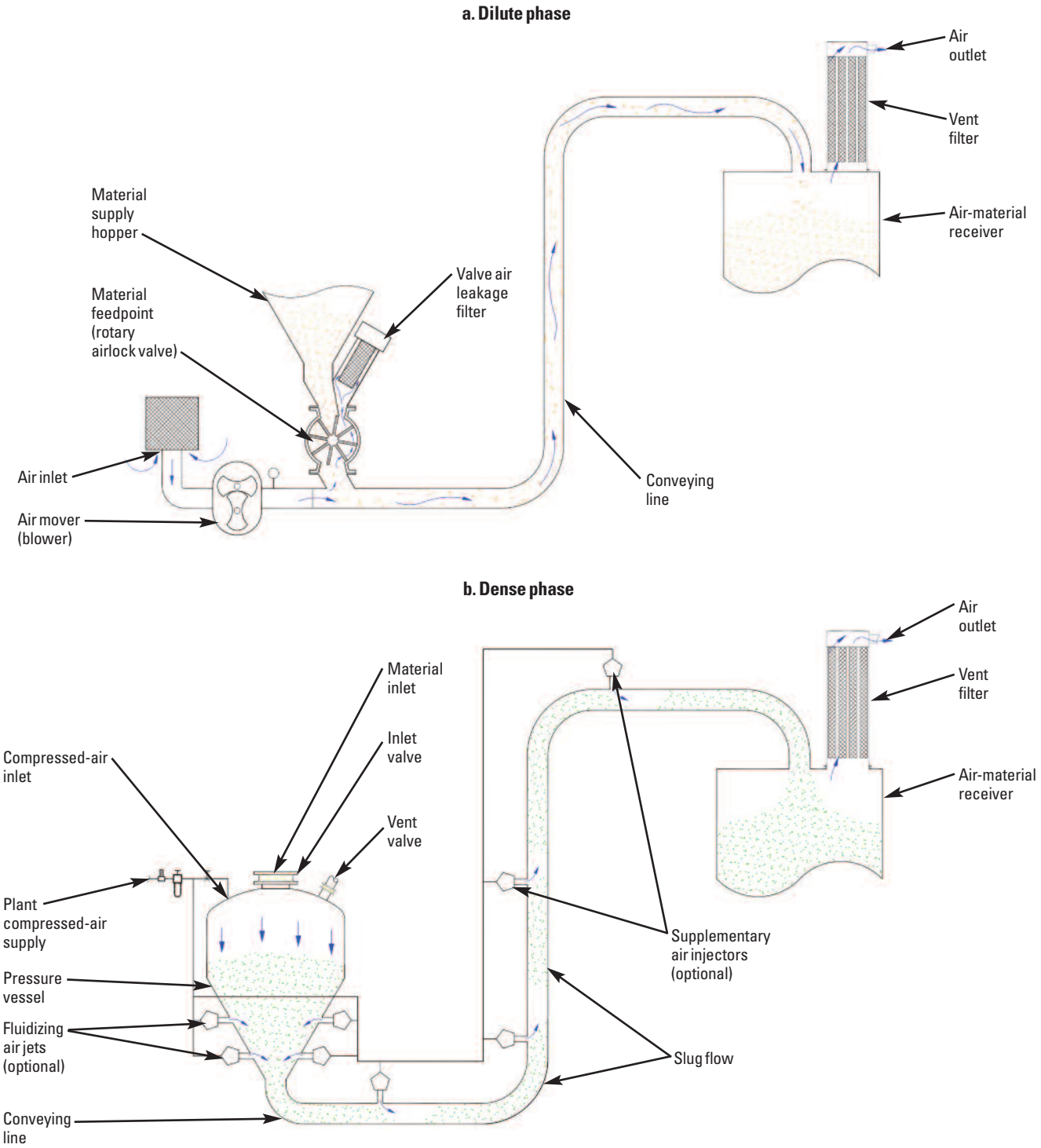
Dense-phase pressure conveying is suitable for gently conveying fragile or abrasive materials with particles ¾ inch and smaller over long distances (typically more than 250 feet). Commonly handled materials include silica sand, feldspar, fly ash, glass cullet, alumina, glass batch mix, carbon black, sorbitol, dextrose, candies, resins, cocoa beans, hazelnuts, and puffed rice cereal. The system conveys material at a relatively low speed to reduce material degradation, air consumption, and abrasion on pipeline, bend, and diverter contact surfaces. This system can also stop or start with the conveying line full of material.

Material conveyed by this method is loaded into a pressure vessel (also called a *blow pot* or *transporter*), as shown in Figure 1b. When the vessel is full, its material inlet valve and vent valve are closed and compressed air is metered into the vessel. The compressed air extrudes the material from the pressure vessel into the conveying line and to the destination. Once the vessel and conveying line are empty, the compressed air is turned off and the vessel is reloaded. This cycle continues until all the material required for the process has been transferred.

To overcome resistance in the conveying line, supplementary air injectors (also called *air boosters* or *air assists*) can be located along the conveying line (Figure 1b). These injectors provide additional air to help maintain conveying velocity, transfer material over long distances, and minimize line

Figure 1

Pneumatic conveying system types



plugging. They can also be used to gently restart flow when material is left in the line after the conveying cycle. An air injector should be used with a high-pressure manifold to prevent backfeeding of material into the compressed-air supply.

Dense-phase vacuum conveying is ideal for gently conveying fragile or abrasive materials short distances (typically 200 feet or less). This system is typically used to transfer powder and granules at a low rate (25 tph or less) in applications such as truck or railcar unloading.

A less commonly used *semidense-phase conveying system* is configured like other dense-phase systems but uses a pressure vessel with a fluidizing bottom so it can handle semiabrasive powders and fluidizable powders that need aeration to discharge into the conveying line. This method isn't the ideal choice for fragile materials or materials containing large, variable, or both large and variable particle sizes. The largest particles handled by this method are approximately ¼ inch. **PBE**

For further reading

Find more information on pneumatic conveying systems in articles listed under "Pneumatic conveying" in *Powder and Bulk Engineering*'s comprehensive article index (in the December 2009 issue and at *PBE*'s Web site, www.powderbulk.com) and in books available on the Web site at the *PBE* Bookstore. You can also purchase copies of past *PBE* articles at www.powderbulk.com.

Fabio Novelli *is process manager and innovation specialist at Nol-Tec Europe, Gorgonzola, Milan, Italy.* ***Mike Weyandt*** *is corporate sales manager for Nol-Tec Systems Inc., 425 Apollo Drive, Lino Lakes, MN 55014; 651-780-8600, ext.244, fax 651-780-4400 (mikeweyandt@nol-tec.com, www.nol-tec.com).*