How should you convey?

For dry bulk material transfer, pneumatic conveying is simply one of the most efficient, effective solutions. This method is widely used to convey a variety of materials for countless industries.

In a pneumatic system, materials are transferred within a fully enclosed pipeline through the use of air. The airflow, created by pressure differential, provides the energy needed to move the materials through the pipeline. The air source changes the air pressure, creating either pressure or a vacuum system.

For those considering pneumatic conveying, one of the most common questions is which conveying phase is the best option for your material. To answer this question, you must first assess the type of material you will be using for your application.



Particle Size and Shape

Particle size and shape refers specifically to a material's individual particles. This property has a significant influence on the selected phase of conveying because it determines flowability and how much air is needed to move the product.



Bulk Density

Where particle size and shape refer to individual particles, bulk density refers to the material in its bulk form (the mass divided by the volume occupied by the material). Bulk density helps to determine a system's design, the size of system components and what is required to successfully transport bulk solid products.



Moisture Content

Moisture can greatly affect flowability, so it is important to evaluate this characteristic when considering pneumatic conveying. Moisture can cause certain materials to pack in a dense phase convey line, while dilute phase systems maintain particle separation.



Friability

Is your material easily crumbled or pulverized? A variety of materials are friable, meaning particles are likely to be broken when they come in contact with any surfaces. The nature of dense phase and semi-dense phase conveying make them best suited for friable materials, as lower velocities aid in reducing particle degradation.



Cohesiveness

Materials that adhere to themselves or interlock under pressure tend to agglomerate. These types of materials can be difficult in all phases of pressure conveying but can work well with a dilute or dense phase vacuum system.



Hygroscopicity

Hygroscopic materials readily absorb and retain moisture when introduced to humid atmospheres. Hygroscopic products have a tendency to stick to or coat the walls of a convey line, which may eventually lead to blockages. If your material is subject to absorbing moisture from its surroundings, the air used for conveying may need to be dried to reduce moisture.

In addition to these material characteristics, you should also consider abrasiveness, static charge, explosivity, toxicity and melt point.

The Three Phases

While there are many complexities and subcategories that fall under the umbrella of pneumatic conveying, the technology can be broken down into three categories: dense phase, semi-dense phase and dilute phase. Understanding each of these phases will help you determine the best choice for your specific application.

Dense

High Pressure, Low Velocity
Dense phase pneumatic conveying is a relatively low-speed system where the material is not suspended in the air stream. The low velocity of dense phase means less wear and tear on both the system and materials being conveyed.

Ideal with:

- Very fragile materials and mixtures, as low speed and lower air volumes prevent materials from breaking down.
- Best for low- or high-rate transfer of abrasive or friable materials, as the slow convey speed reduces abrasion of convey lines.
- Slightly hygroscopic materials, without requiring the introduction of air-drying equipment because air quantities required for dense phase are significantly lower than those of semi-dense and dilute.
- Examples: Sand, sugar, carbon black prill.

Avoid usage with:

- Widely mixed particles as they tend to nest and pack within a convey line.
- Materials with entrained moisture, which are likely to form into a ball and stay in that shape. This can result in a plugged convey line.

Semi-Dense

Medium Pressure, Medium Velocity
Semi-dense phase, the intermediary step between dense and dilute phases, conveys materials using a medium velocity. Only a portion of materials are suspended in the air system.

Ideal with:

- Products in an aeratable state.
- Abrasive or friable materials.
- Examples: Cement, fly ash.

Avoid usage with:

- Materials with high moisture, which are prone to packing the convey line.
- Large particles of sizes greater than a half inch.
- Extremely long convey distances.

Dilute

Low Pressure, High Velocity
Dilute phase is a high-velocity system where the conveyed material is continuously suspended in the air as it is blown or sucked through the pipeline. Material does not accumulate at the bottom of the convey line at any point.

Ideal with:

- Non-abrasive and non-fragile materials with a light density.
- Certain batching systems.
- Examples: Flour, cornstarch.

Avoid usage with:

- Large or heavy particles are poor candidates for dilute phase as it requires high airflow (velocity) to keep the particle continuously suspended.
- Materials where particle degradation is an issue. The high velocity of dilute phase is not well suited for fragile materials that are easily broken down.
- Abrasive materials, which can lead to erosive wear of the convey line.
- Materials with high moisture, which are prone to packing the convey line.

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If you're unsure of your material's characteristics or which phase is right for you, check out our state-of-the-art testing facility, CycloTech. CycloTech provides full-scale system simulations of your dry bulk material and can test the transfer of materials in dense, semi-dense and dilute phases, in vacuum, pressure and combined vacuum-pressure modes.

On-site system failures can be expensive and even disastrous. A controlled testing environment allows you to identify failures, which can save you from errors in real situations that would result in significant time and money lost. Learn more about CycloTech by reading our guide, The Benefits of Material Testing with Cyclonaire.

Through more than 45 years of business, Cyclonaire has served virtually every industry around the world by successfully designing and developing innovative pneumatic conveying solutions for a variety of unique applications

To learn more, please contact Cyclonaire today at:

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