ADVANCED pollution control pty ltd

# Pneumatic Conveying Systems

Pneumatic Conveying Systems allow for **unloading** hopper cars and other bulk transporters without the need for a pit, by **transferring dry bulk** material through an **enclosed pipeline**.

The **purpose** of the Pneumatic Conveying System is to ensure that materials are conveyed in a **contained environment**, utilising air to do so, and avoiding spillage. This is normally done by moving residue or "in process" materials through a totally enclosed pipeline, in a clean, contained stream of air generated by either a vacuum pump, positive displacement blower, or compressor, which is attached to the system.

It is important to note that pneumatic conveying has **no moving parts** which come in contact with the materials at any time. Because it is a contained system, no dust is able to escape into the atmosphere and no contamination can enter into the system. For food processing and laboratory applications, the equipment used to collect the materials meets the strictest hygiene standards and can be easily cleaned due to the system being of modular design, for ease of routine cleaning and product change.

The **common elements** of a standard pneumatic conveying system involve a blower, a feeder to introduce the dry material to the conveying line, a receiver and a dust collection system. The energy required to move the material through the pneumatic conveying system is created by a pressure differential (measured in psi or bar) and airflow (cubic feet per minute / $m^3$ per hour). The blower's location in the system determines whether it will create either pressure or a vacuum: at the start of the system it creates pressure that pushes the air through the system; at the end it pulls the air, causing a vacuum that drives the airflow. It is the pressure or vacuum created by the blower position that causes the transfer of materials through the system.

**Conveying capacities** up to 200 tonnes per hour are available, depending on the material. Pneumatic conveying is appropriate for use for particles ranging from fine powders to pellets and bulk densities of 16 to 3,200 kg /$m^3$. Most commonly, dry materials such as fly ash, flour, cement, sand, plastic pellets, many types of chemicals, food products and minerals can be conveyed.

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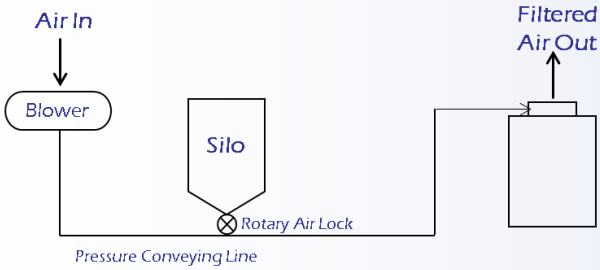
## Types of Pneumatic Conveying Systems

There are two main types of Pneumatic Conveying Systems: **Dilute Phase and Dense Phase**.

### 1. Dilute Phase

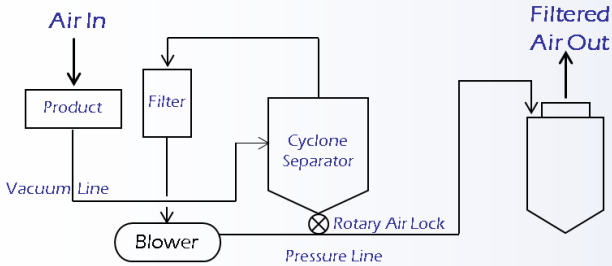
The basic premise of Dilute Phase conveying is that the particles are 'picked up' by the velocity of the airstream and remain airborne throughout the conveying process. The Dilute Phase system typically operates at a relatively high velocity and relatively low pressure. The air speed required depends on the size and density of the particles to be transported.




Dilute Phase Pressure Operation Pneumatic Conveying

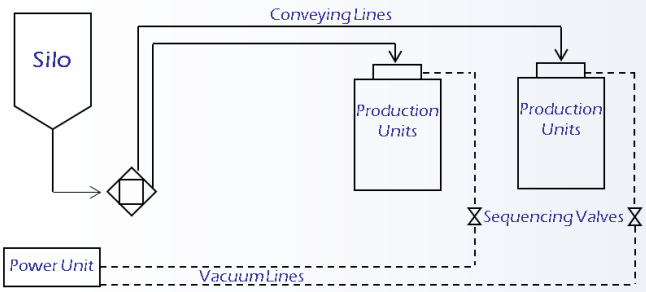
There are three main types of Dilute Phase Conveying Systems:

i) Dilute Phase Pressure Operation




Dilute Phase Pressure-Vacuum Operation Pneumatic Conveying

ii) Dilute Phase Vacuum Operation




Dilute Phase Vacuum Operation Pneumatic Conveying

iii) Dilute Phase Pressure-Vacuum Operation

The Dilute Phase system generally has the lowest initial investment cost.

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## Types of Pneumatic Conveying Systems

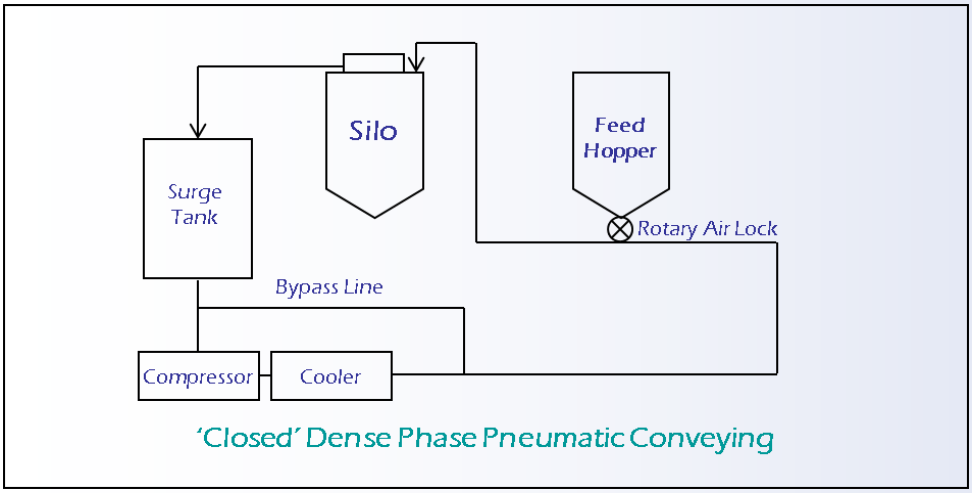
### 2. Dense Phase

The second type of Pneumatic Conveying System is the Dense Phase type, which uses relatively high pressure with relatively low air velocity.

Because of the high frictional resistance of powder and granular particles against the inside wall of the pipe system, particles cannot be transferred along the system in one long, continuous stream. Thus, some systems inject compressed air along the conveyor line to clear any blockages caused by low air volume or pressure. Although this increases the system's energy consumption, it increases the system's efficiency in conveying material. Such a system with air injectors is especially useful for handling abrasive particles by reducing excessive and premature wear on the system.

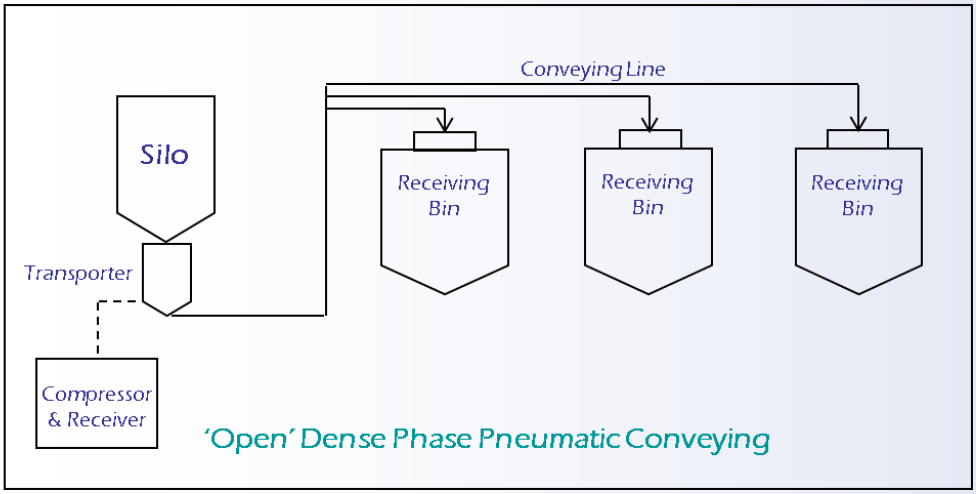
The Dense Phase system is further classified into two systems:

i) Closed System




'Closed' Dense Phase Pneumatic Conveying

ii) Open System




'Open' Dense Phase Pneumatic Conveying

The Dense Phase system is the best option for:

1. Materials that could be damaged by the higher velocity Dilute Phase system.
2. Abrasive materials.
3. Where a long conveying line is necessary, as it typically requires a smaller pipe diameter and thus requires less air volume and is much lighter, making installation and replacement easier.

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## A Comparison of Dilute and Dense Phase Pneumatic Conveying.

Although there is no standard way to categorize a Dilute Phase versus a Dense Phase Pneumatic Conveying System, here is a general comparison of the two types of systems:

| | Dilute Phase | Dense Phase |
|---|---|---|
| *psi* | Most operate below 15 psi | Most operate above 15 psi |
| *Mercury* | Most operate below 12 inches mercury | Most operate above 12 inches mercury |
| *Air velocity* *NB depends on material being conveyed* | Most operate between 3,500 and 9,000 fpm | Most operate at 3,000 fpm or lower |
| *Material velocity* | Nearly the same as the air velocity | Generally much slower than the air velocity |

## Selecting which type to use. Here are some factors to consider:

1. The material to be conveyed, including: particle size and shape, bulk density, moisture content, abrasiveness, friability, cohesiveness, hygroscopicity, static charge, explosivity, toxicity, melting point, etc
2. How will the system fit into the location and plant equipment?
3. Does the system achieve the material transfer rate required?
4. Should pressure or vacuum be used? Whether a Dilute or Dense Phase is selected, the decision must still be made as to whether the system should operate under pressure or vacuum. Vacuum is safest for such applications as those that involve toxic or explosive material, because there is no air leakage. Vacuum is also best for materials that pack tightly, are cohesive and tend to build up on surfaces, or are fibrous, because the vacuum separates the particles during the conveying process, rather than pushing them together or into the pipe walls, as a pressure system would.

### *Advantages of Pneumatic Conveying Systems*

- *Environmental (total containment means no dust to atmosphere)*
- *Prevents contamination (containment at both ends of the system)*
- *Low capital cost (pipe is the primary transport element)*
- *Reliability and minimal maintenance (few moving parts)*
- *The pipeline can be designed to fit around existing equipment, giving it a relatively small footprint*
- *Complies with and compliments OH&S procedures*
- *Cost effectiveness*
- *Being automated streamlines operations*
- *Increases Efficiency*
- *Ensures dust free operation*
- *No product contamination*
- *Hygienic*

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