Pneumatic Conveying Options: Operational and Maintenance Benefits
Comparison of Different Pneumatic Material Conveying Systems

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Pneumatic conveying has low capital cost and simple design, with a variety of different systems to choose from. A selection is reviewed here.

Over the past few years pneumatic conveying has been and continues to be the topic of a wide variety of discussions comparing it to mechanical systems, as well as comparing different types of pneumatic conveying systems. Everyone seems determined to replace this technology with mechanical equipment. The driving force behind this movement is power. Too often, the benefits of pneumatic conveying are not researched enough when key purchasing decisions. Key points to be considered when selecting a pneumatic conveying system are simple design, dependability, and environmental friendliness. This article discusses the various pneumatic conveying alternatives, comparing the operational and maintenance benefits from an operating viewpoint.

Pneumatic conveying is the perfect way to convey dry bulk solids; cement raw mix, cement, kiln dust, powdered coal and flyash, and for this reason along with pneumatic silo aeration, has played a major role in the conversion of the cement industry from wet to dry process. Pneumatic conveying systems have been called the arteries of a cement plant. The advantages of pneumatic conveying are:

- Environmental (no dust due to total containment)
- Prevents contamination (containment goes both ways)
- Low capital cost (a pipe is the primary transport element)
- Reliability & minimal maintenance (few moving parts)
- Simple operation and design

The only disadvantage of pneumatic conveying compared to mechanical conveying is power consumption.

**Airslide™ Air Gravity Conveyor**

The Airslide air-activated gravity conveyor is the ultimate of all pneumatic conveying system applications. Here is a system that uses the forces of gravity to do most of the work without any moving parts. Material is fluidized through a porous media with low pressure air. Material flow is achieved by sloping the Airslide to match the fluidized angle of repose of the powdered material. At the correct slope, fluidized powdered material flows with the consistency of a liquid. Capacities in excess of 56,000 ft³/hr can be achieved feeding or discharging material from storage silos, discharging material from trucks or railcars, general in-plant conveying and unloading/loading of ships and barges (Figure 1).
In addition to providing high-capacity material handling, the Airslide air-activated gravity conveyor offers many economical and environment advantages. Energy requirements are minimal because only a small volume of air at a low pressure is required to move material. Because the system is installed overhead, valuable floor space and added headroom is available for other purposes. By eliminating the need for massive support members, it permits a flexibility of plant design not available with straight-line conveyors.

The Airslide conveyor is dust tight. As a result, the system is extremely friendly to the environment. The top section of the conveyor acts as a vent duct. As material drops out of the air stream, it is reintroduced back into the material flow. This reduces the need for costly vent ducting and multiple dust collectors as may be required with mechanical conveyors.

Noise level is extremely low in the area surrounding the Airslide, since the system’s supply is the only moving part to generate noise and it is generally located in a remote insulated area to further reduce noise.

Maintenance of the Airslide conveyor is very simple. Keep the porous media dry, Airslide plenum clean and protect the impact points from abrasive wear and your conveyor will last a long time.

**Rotary Feeder System**

Rotary feeder pneumatic conveying systems are designed to operate at low line pressures and high velocity and are seldom used in cement plants. The application of the feeder, if used, is generally restricted to nuisance dust transfer systems. There are a number of reasons why this type of system is not preferred in cement plants. Cement-related products are abrasive and close tolerances of the feeder between the rotor and the body wear extremely fast under pressure differential conditions. Additionally, maximum design pressure differentials of 10 psig system design. Generally, capacity requirements are too high for economical designs.
Screw Pump System
Screw Pump pneumatic conveying systems are configured as shown in Figure 2.

This is the most prevalent type of pneumatic conveying in a cement plant due to its reliability, ease of maintenance, capacity, flexibility of equipment layout, and future capacity changes and because of its simplicity.

This is a two phase or medium phase type technology and works according to the scheme in Figure 3.

The term 'two phase' or 'medium phase' refers to the action of the conveyed material in the pipeline. There are two distinct conveying principles working together at the same time within the pipeline. Visualizing a cross section of the pipeline, you would see a wave-like action of material on the bottom of the pipe, while there is a swift movement of material in the upper section of the pipe. This action is caused by the changes in velocity within the pipeline. This type of conveying operates at velocities at or slightly above the saltation velocity of the material. The saltation velocity is the velocity point at which gravity overcomes the forward momentum of the particle. The particle falls from the stream and forms layers along the pipe bottom. As the layer of material increases, the area decreases and the velocity increases. At this point, the material becomes re-entrained in the flow stream. This action continues over and over again, giving the appearance of a wave-like action in the pipe. Through the pipeline length the conveying gas expands, the back pressure decreases and the velocity increases. As this happens, these waves of material give the appearance of slugs through the pipe at the termination of the conveying system.

The screw pump is actually a line charging device. A properly-designed feed hopper brings the material to the inlet of the screw which advances it, compacts it to provide a material seal (which prevents the convey air from blowing back up the feed hopper) and pushes the material through a mixing chamber where the material and convey air combine, accelerating into the convey line.

The advantages of a screw pump over a rotary feeder include longer operational life, higher capacities, relatively low volumes of conveying due to the denser material stream, the fact that it can operate at a constant speed while the capacity vary, that it operates at much higher pressure and that it seals against back pressure more effectively.
**Pressure Tank Systems**
The system with lowest power consumption for pneumatic conveying is phase. This mode of conveying is achieved by using high pressure, lower volume at reduced velocities to transport powdered materials. They work by filling up one pot at a time while the second is being emptied for continuous operation or as a batch operation with a single operating pot.

The behavior of the material in the pipeline is very much different from that of the medium phase transfer system. As shown In Figure 4, the material flows in the form of plugs through the pipe.

Because of their lower power consumption, these systems are becoming more popular to transport material longer distances and with higher capacities than screw pumps. While these systems, in most cases, reduce overall power consumption, they are more complicated to operate and not as reliable as a screw pump.

**Airlift™ System**
The Airlift system is a pneumatic elevator capable of conveying dry pulverized materials through a vertical pipe to discharge into receivers or bins at a substantially higher level. The use of the airlift system is suitable for those materials which can be fluidized by aeration without segregation (Figure 5).

The airlift system is characteristically a predominantly maintenance-free, reliable vertical conveyor. The only moving parts are the material and air supply. The totally-enclosed design provides a completely dust-free operation when connected to a dust collection system.

The airlift system consists of a feed bin, pipe, disengaging bin (alleviator) and one or two air supplies. The aeration air aerates the bottom of the feed bin, fluidizing the material within. The primary air conveys the material upward through the airlift pipe. In operation, the airlift system is a self-compensating system. As the product feed rate increases or decreases, the fluid level and conveying rate conform to such changes. Therefore, the airlift system matches the conveying rate to the incoming feed and compensates for any variations of the feed rate. With regard to maintenance, the airlift is much like the Airslide. It is quite simple to maintain since the only moving part is the conveying air supply.
### Features and Benefits of the Airlift™ System

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<td>• Minimum downtime</td>
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<td>Completely closed circuit</td>
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### Conclusion

Pneumatic material conveying equipment systems are the best avenues to transfer material from point to point. There are clearly enough benefits to show the value of this technology. You have a complete range of systems to choose from to handle any combination of applications. Systems can be designed to transport as little as a few pounds per hour to over a thousand tons per hour. In a time when the environment is a major concern, we should be looking for ways to handle our products in a method that prevents air contamination. Pneumatic conveying systems are totally enclosed, providing a safe means of transport. Today’s dust collection systems are far better than years ago, providing very efficient ways to collect and clean the contaminated air streams from the pneumatic conveying system.

Simplicity of operation and low maintenance for pneumatic conveying systems are two of the most important advantages when considering the design of a material handling system. Today, we seem to have lost the employee who could trouble-shoot a system and fix any problems based on long-time mechanical experience. As a result, you need to install systems that require simple operation with few moving parts. Many plants subcontract maintenance. This means that maintenance contractors do not know the special needs of a piece of equipment. This may cause more operational problems than ever before. Therefore, it is important that systems are installed that do not require continuous maintenance.

Depending on which type of pneumatic conveying system chosen, you have the ability to design a transport system that will provide low cost and trouble-free conveying.