CMT
Process Solutions

Pneumatic Conveying Systems

Dilute Phase Conveyance

Dilute phase is the most widely used pneumatic conveying system due to the simplicity of the overall system. Dilute phase systems convey products via low pressure (<15psig), high gas volumes. Product is normally conveyed at velocities between 4,000 – 6,000 FPM. The system relies on a high-velocity airflow to suspend the material in the air, allowing it to be conveyed through the pipeline. This type of system typically operates at a relatively low material-to-air ratios (1:5 to 1:10).

Basic Components of the Dilute Phase System include:

Motive – A positive displacement or regenerative blower is utilized to either blow or vacuum product from point to point.

Feed Source – Types include rotary airlock valves, venturi eductors and double dump valves which deliver product into the conveying line while preventing the pressure differential to affect the hopper or device above the feed source.

Piping – Product is transferred through piping or tubing and elbows. Each pipe is connected to the next via couplings or flanges.

Diverter Valves – Product is often conveyed from multiple feed sources to multiple destinations. Diverter valves direct product to the correct source and destination. Special care must be taken based upon abrasiveness and cross-contamination requirements.

Gas-Product Separator – At the discharge of the product, the air must be separated from the product/ dust. Bin vent filters and filter receivers are implemented, capturing the product on the filters, while allowing air to dissipate and release through the 'clean air plenum'.

Configuration

Dilute phase systems are configured in either a pressure or vacuum orientation. The ultimate choice is based on many factors to ensure objectives are met with operator safety, system reliability and longevity in mind.

Pressure Systems

The blower is placed ahead of the feed source and blows the product to the destination. The unit blows product into a gas-product separator, most often a filter receiver (FR) or bin vent filter where the gas and product is separated. This system requires a minimal number of components in application.

Applications/Advantages:

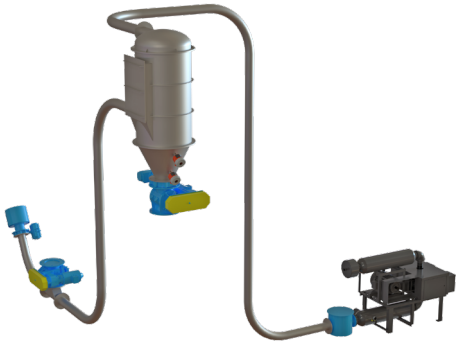
- Most pneumatic conveying systems.
- Longer runs, higher rates than vacuum systems.

Issues to Consider

- Abrasion. Highly abrasive products, such as silica, flyash and glass filled pellets, can be conveyed with a pressure system, but not often recommended. A specialty feed source, thicker pipe, and wear resistant elbows must be implemented. The pressure utilizes the abrasive products to 'sand blast' the inlet of the rotary valve, often wearing it out within weeks or months.
- Heat. As a pressure system can convey at up to 15 psig, it is important to note a one psi increase in pressure results in a gas temperature increases of 13F. So, at 10 psig, the gas temp will be 130F + the ambient air temp, 85F = 215F. Additionally, product temperatures will increase when contacting each elbow in the system. Products such as PE Pellets and Sugar are examples of products affected negatively by heat. Note: Heat exchangers can be provided to reduce the conveying gas temperature.

Vacuum Systems

The vacuum package (VP), still often referred to as the blower, is placed at the end of the conveying system. Product is vacuumed from the source to the destination. The VP pulls through a gas-product separator, most often a filter receiver (FR) where the product is captured on the filters, while the gas is pulled through the filters, returning to the VP. A static filter is placed ahead of the VP, in the conveying line, to prevent any particulate that passes through the filter receiver making it to the VP, which can cause a failure. At times HEPA filters are implemented based upon particulate size. Since there is always a vacuum pulled on the entire system, when a leak point surfaces, external air is pulled into the system, preventing product escaping into the environment, harming personnel.



Best Applications:

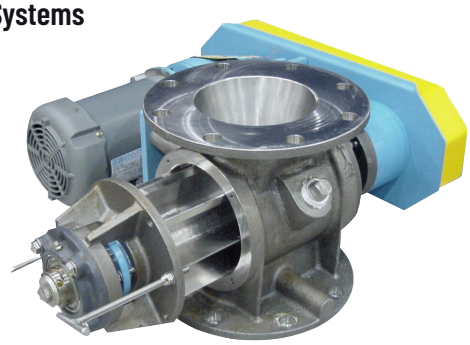
- Where maximum dust control is required.
- Toxic products.
- Abrasive applications.
- Cohesive products and products that often pack.
- Generally less than 150' of convey distance.

Dilute Phase Options

Feed Device

Pneumatic conveying systems, generally need to be fed, to prevent line plugs and long-term efficiency. Plastic pellets, coffee beans and similar products which, by nature, offer air pockets between each particle, allow for vacuum conveying with an adjustable air inlet device only.

Rotary Airlocks Valves – Pressure and Vacuum Systems



RVs are the most commonly selected feed device. These valves are comprised of a rotor, with multiple vanes or pockets, which is filled from the top side, and when rotating, discharges product at the outlet of the RV. Clearances of 0.005" between the rotor blades and the housing, create the "Airlock" allowing only minimal gas to escape past the valve back into the feed source bin. Additionally, when airlocks are used, the storage bin can be filled while discharging simultaneously.

Items to Consider

Venting

- Pressure System -Care must be taken to properly vent the gas which fills the empty pocket, when in the discharge position. Without proper venting this gas will be discharged to the feed bin, reducing product flow to the RV. Venturis are often an excellent solution to this issue.

Abrasive Products

- Pressure system. The abrasive product will 'sand blast' the bottom side of the RV, expanding the clearances, thereby allowing more blow back through the valve, decreasing flow rates. A venturi eductor or a specialty RVs with ceramic inserts should be utilized.
- Vacuum system – The wear is much less, as the sand blasting effect is mostly negated.

Fine, Abrasive Powders

- Pressure system. Air purge seals are required to slow the eventual leakage.
- Vacuum system is the most appropriate for this application.

Particle Size

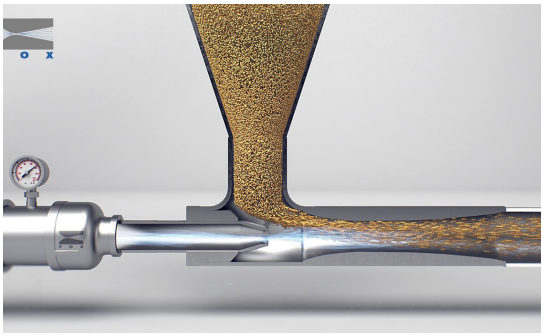
- Non-friable particulates like plastic pellets require an offset valve to prevent catastrophic failure at the infeed side of the RV. Venturis are an excellent option.
- Non-friable products like plastic flake or wood fiber require additional safeguards to ensure product is not jammed between the rotor and housing or end plates.

Batch accuracy

- Rotor pocket volume and speed must be reviewed to confirm selection. Reduced pocket volume and staggered pockets can be utilized to meet requirements.

Venturi Eductors – Pressure Systems Only

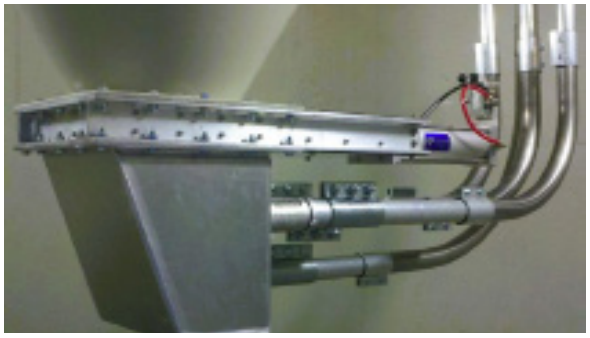
Fox's venturi eductors are self-regulating, pulling product from the source at a specified rate, then conveying via pressure to the destination. The eductor operates with no moving parts, can be manufactured for sanitary, as well as abrasive applications, utilizing hardened steel and ceramic inserts. By nature, they are not as efficient as a rotary airlock, at times requiring more HP at the motive.



Advantages

- No moving parts
- Excellent with abrasive products, plastic pellets, powder and many other products
- Excellent in applications less than 10,000 PPH and less than 300'.
- Best for applications with one inlet but multiple units can be implemented with one PD blower.
- Excellent with bulk bag unloading applications as the vacuum will completely suck the bag dry, collapsing it completely.

Vacuum Probe Boxes – Vacuum Systems Only



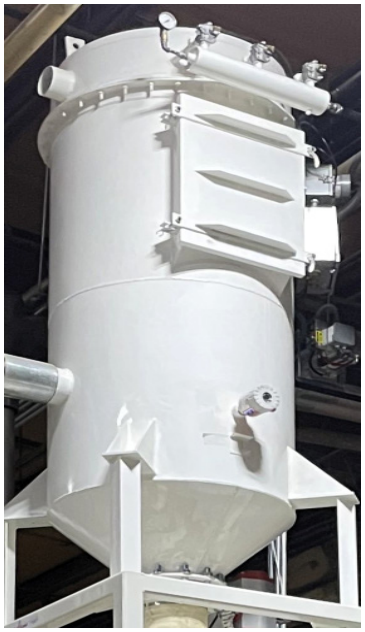
These units are generally used with plastic pellets and similar products. One or multiple probes are fitting into the probe box. An adjustable air inlet allows for more or less vacuum air into the system to affect overall flow rate. This reduces the overall system price as there is no motor or moving parts. While powders can be conveyed without a true feeder, line plugging potential grows. Adjustable VAT's can be incorporated to feed a single line system to prevent overfeeding.

Consider all Options. Contact a CMT technical rep to determine the optimal conveying technology for your products

Gas-Product Separators

Let's be honest. Almost all pneumatic suppliers will tell you that pneumatic conveying systems are dust tight. This is just not a true statement. The aforementioned addressed issues with various feed devices, piping, elbows and connectors and their possible contribution to dust issues. Additionally, the Gas-Product separator can easily be the largest contributor to dust emissions while it is designed to prevent this very issue. Vacuum systems are always provided with a static filter directly ahead of the VP. Why? Suppliers know that small amounts of product can readily get past the filters

Filter Receivers - Key Considerations



Filters

- Particle size drives the choice of filter media. Standard cartridges are rated to 0.8 micron. When smaller particulate are present other media must be chosen.
- Proper air to cloth ratios. With cartridges less than 2.5:1 ratio is required for long life and proper pressure drop when entering the filter receiver.
- Most bin vents and filter receivers utilize spun bond cartridges which can be Teflon coated when needed. Specific products such as wood fibers require bags.

Sealing Design

- Access Door. So often doors are provided with hinges and two clamps on the opposite side. This is not sufficient to seal the door to the filter receiver even with reinforcements, leading to product leaking around the seal.
- Magnahelic and Photohelic Gauges. These both rely on plastic tubing running from the clean air and dirty air plenum back to the gauge to provide the pressure differential. When pressure conveying into a filter receiver at 8, 10 or 14 psig, the product finds the path of least resistance, which is the tubing on the dirty air plenum. This also can occur during pulse cleaning. This renders the gauge useless, causing other issues.
- Pulse Cleaning. A filter receiver is fitted with either a rotary airlock valve or knife gate valve at the outlet. With the outlet sealed, and the pulse cleaning is cycled, product often leaks past the door seal and/or the connection to the clean air plenum. While in theory, air should escape through the other filters, which are not being pulse cleaned, the path of least resistant often is a poor seal.

Forward Thinking. CMT provides very specific solutions to address each of these problems to prevent 99% of all dust emissions, meeting your core objectives. Contact a CMT technical rep to review these items.

Bin Vent Filters

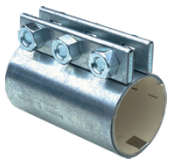
Used in pressure conveying applications only, on all Silo loading applications as well as Day Tanks within a facility. The bin vent advantages, over a filter receiver, include:

- The conveying gas pressure decreases substantially when it enters a silo or large day tank, due to the large open volume, thereby minimizing pressurization and potential dust emissions.
- The bin vent is attached to the tank via one heavy-duty, structural flange and gasket, providing an excellent seal.
- Top loaded bin vents, which are always recommended, provide an excellent seal between the dirty air and clean air plenum.

So often clients express a desire to use a vacuum system, as it pulls any leak "into the conveying line". The truth is, a pressure system with proper couplings or flanges and elbows can provide an equally dust tight solution. Ask a

Piping & Elbow Considerations

The following items are critical to the success of your system. Proper consideration and selection are essential.



Key Considerations

Layout - All piping must be run in horizontal and vertical lines only. Sloped lines will dramatically reduce your conveying efficiency and rate.

Tubing vs Piping - Correct choice is critical to provide long life and operator safety

Couplings vs Flanges – Correctly specified connectors are critical to containment and operator safety.

Elbows – Standard 10:1 or 20:1 elbows versus Ceramic Elbows vs. HammerTek elbows are critical to containment, operator safety and plant efficiency.

Detailed Design. Contact a CMT technical rep to understand which items should be combined and why.

Motive

Pressure Differential (PD) Blowers

PD Blowers are the most commonly utilized motive in pneumatic conveying applications. These units are used in either pressure or vacuum conveying systems. The same basic components are used in each, with the addition of a pre-filter when configured as a vacuum package.

Each blower is sized based upon the required conveying rate, pipe or tube size, length, temperature, humidity and altitude. Basic Rules: The conveying distance and convey capacity are inversely proportional when sizing blowers. Conveying pressure is directly proportional to the conveying distance.

With all dilute phase conveying systems, this pickup velocity, which is the minimum air speed required to entrain the product into the air stream, is most critical, as the air stream is at the lowest velocity at this point. The velocity is dependent upon the particle size and loose bulk density of the product. Finally the conveying velocity, Low/High is the air speed required to keep the solids in suspension.

Sound Enclosures

In operation, a blower creates noise pollution. Most will operate above 85 dBA, some over 100 dBA. Two types of sound enclosures are available. First, the entire blower package – the blower, motor, silencers and frame are placed within a sound enclosure. These typically come with a door and cooling fan and will bring the noise level down below 80 dBA. Second, special sound enclosures are made for the blower only. This generally will lower the dBA to an acceptable range with a substantial cost savings.

Regenerative Blowers

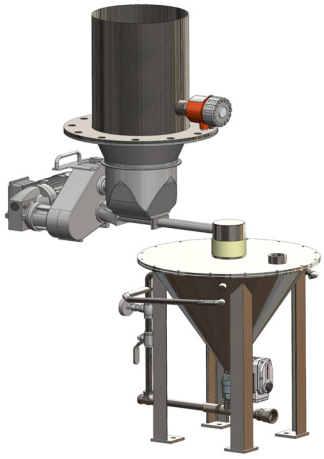
Regenerative blowers are non-positive displacement devices. These units operate at high speed, turning an internal impeller, which creates a spiral airflow pattern where the air is repeatedly accelerated and pressurized as it moves through the impeller blades and the side channel. These blower are used when conveying lighter products, over short distances, that require a low-pressure differential, generally less than 4.5" psig.

Powder Pumps

Powder Pumps use a combination of compressed air to fluidize the product. The pump's diaphragms move back and forth, creating alternating suction and discharge cycles. This action draws the fluidized powder into the chamber and pushes it out through the discharge port, conveying product through the pipe to the destination. These pumps are used in applications involving very fine powders that tend to act like a fluid, such as fumed silica, calcium carbonate, carbon black and other low density, (up to 45 PCF), highly aeratable products.

Solid-Liquid Conveying Systems

At times, creating a slurry and conveying is the most economical method of conveyance. In these applications, product is wetted at the feed point, then conveyed to the destination via the motive, generally water. These systems can utilize either a slurry eductor system or a positive mixing system, employing a tank and impeller-based mixer, and a liquid pump.



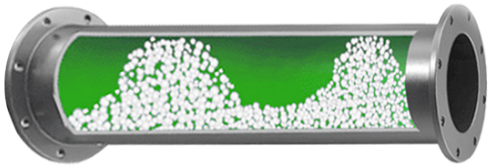
Venturi System for PAC

Dense Phase Conveyance

Dense phase systems convey bulk materials with high pressure (60-120 psig), at low velocity (400-1500 FPM). Product is moved in a slug or pulsed flow, meaning it travels in a semi-suspended state with a high material to air ratio (1:1 to 1:2).

Best Applications

- Abrasive Products – Silicas, Glass Filled Pellets, Alumina, Wheat Hulls, Fly Ash, Limestone, Coke, Sand, Granite, Mica and others.
- Friable Products - Minimize Degradation and Fines creation.
- Dense and Coarse products.
- Long distances.



Operation

In operation, the inlet and vent valves on the transporter are opened. The transporter is filled. After these valves are closed, the transporter is pressurized. This gas is provided by a compressor. Once the static pressure of the convey line is overcome, product flows. Boosters are placed approximately every 20', which break up the product into slugs, while aiding in the conveying of the product. Once the product has exited the transporter the pressure drops substantially, indicating the transporter is empty. Alternatively load cells indicate when the transporter is empty. The process then repeats.

Product can be completely emptied from the convey line with each batch/transport. Alternatively, the system can be run as a full line concept. Once the transporter is emptied, the conveying is stopped. Material stops within the conveying line. This allows for the highest rate of conveyance with a single system with the least degradation or abrasion. Multiple systems can be used to increase capacity, where one transporter is filled while the other is being emptied and conveyed.

Dense Phase - Key Considerations

- Rate & Size –Determines the required system configuration. Multiple transporters may be required to meet your rate.
- Headroom - Determines the configuration of the transporter - diameter and OAH.
- Batch Weighing – Often the transporter is placed on load cells to provide accurate batching which is then conveyed to your mixer, reactor or other system.
- Filling the Transporter – In many cases the transporter is placed at the outlet of a silo. Fast and accurate filling is often required. Consult about bin activators vs aeration systems.
- Empty or Full Line Concept – Your overall safety concerns, rate, particulate degradation, and abrasion are considered.
- Boosters or Not – A few suppliers provide systems without boosters. Testing of this concept with your product is required. Boosters are an industry wide acceptable feature which ensures proper conveying without line pluggage.
- Aeration – Transporter hopper aeration is often required. Additionally, an aeration discharge pan is incorporated for numerous products.
- Transporter Air Requirements - Consideration of your current air compressor capacity is required. A new air compressor may be needed.
- Installation Costs - Consideration for the added costs associated with the booster piping and electrical requirements along the run of the conveying pipe is required.
- Control System - A-B based PLC is provided to control the Transporter, as well as the entire process

Contact your CMT technical rep to determine if dense phase is the right approach for your application.

Railcar Unloading Systems

Railcars are attractive as they can transport approximately 240,000 lbs. of product and require little operator interface. Generally, but not always, this is the most cost-effective method of purchasing raw materials. Railcars are unloaded via pneumatic or mechanical conveyors or a combination of the two systems. Various types of railcars are available, based upon your products, which require different equipment and methods of unloading.

Mechanical Systems

With mechanical systems, a railcar is unloaded into a hopper that is fitted in a pit. The hopper will discharge to either a mechanical conveyor – screw conveyors to a bucket elevator or to a pneumatic conveying system that will load silos. Special consideration of tramp metal removal requires consideration .

Pneumatic - Push-Pull Systems

Typical Air Manifold

1. Each railcar is fitted with camlock fittings at each hopper outlet.
2. A vacuum hose is connected from the closest connection on the vacuum rail spur to the railcar.
3. The camlock is fitted with an adjustable air inlet to allow for vacuum conveying from the railcar.
4. Product is vacuum conveyed to a filter receiver, where the air and product are separated.
5. Product discharges through a rotary airlock.
6. A second blower conveys product to the silos.

Typical Filter Receiver Arrangement

Pneumatic - Pressure Differential Rail Cars

These cars, just like PD trucks, utilize a PD blower and valving to pressurize the vessel, to convey product from the railcar to the silo. Rail car lines are typically 5" dia. but can range from 4" to 8" which is dependent upon your unloading requirements

Pneumatic – Air Slide Rail Cars

These railcars are fitted with aeration material on the railcar hopper section. Compressed air is input, which fluidizes the material, causing it to flow to the discharge points of the railcar. Very fine powders, generally -325 mesh such as cement, fly ash, flour, alumina, and gypsum are transported in this style of railcar.

LABORSAVE

An Alternative to Trucks & Railcars

Labor Save's fully automated bag emptying systems offer a viable alternative to truck and railcar supply. But why would anyone want to 'go back to sacks' when trucks can deliver product at a lower cost? This 'lower cost' is not necessarily true, when reviewing the worldwide market, which is produced in 25 kg bags.

The fully automated, robot centered, sack emptying systems discharge up to 32 tons/ hour of product. These high-rate units only require an operator to deliver full pallets to the infeed conveyor, removing pallets from the pallet stacker and removing the automatically baled empty bags. Product is discharged through an integral hopper to a pneumatic conveying system which fills your silos.

Supply Chain Issues - Key Considerations

Firstly, the fully automated system offers a true backup solution to today's supply chain issues. Having a system that can accept pallets of sacks and maintain production levels is vital to many producers.

Improving your Bottom Line - Raw Material Savings

The LaborSave system provides the option to reach the worldwide market, which in many cases, provides real raw material savings in price/lb. When consuming millions of lbs. of product per week or month the total savings of 2 or 4 cents/lb. add up to real savings.

Watch Video Here

SPECIALTY SYSTEMS BY CMT

Bulk Bag Unloading Systems
Abrasion Resistant Systems
Wood Handling Systems
Batching Systems
Battery Systems
Mixing Systems