White Paper

Selecting a TYPE of Pneumatic Conveying System

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Pneumatic conveying is used to transport bulk solids in a pipeline using air or another gas if the situation would require so, as the transport medium between two distinct points.

The technology utilized in the sizing of the pipeline diameter, the amount of air/gas flow required and the amount of energy required to accomplish the task is based on scientific and academically developed algorithms, good engineering practices and lots of experience.

The initial decision-making phase of deciding what TYPE of system to use and what MODE of conveying to use must be done first – and then the detailed design activities can be carried out.

The choice of the TYPE of system is based on the nature and geometry of the conveying system and the MODE of conveying technology deals with matching up the physical characteristics of the material to be conveyed with the appropriate selection.

This paper will address the issue of selecting the TYPE of pneumatic conveying system.

Vacuum System

Figure 1 illustrates the basic layout of a vacuum system that is characterized by the location of the gas mover being located downstream of the filter receiver. The filter receiver is the piece of equipment at the terminal end of the system, in which the solids and conveying gas are separated.

Advantages of a vacuum system would be the ease of feeding solids at the beginning of the system because it is operating near atmospheric pressure conditions and the tendency to be a cleaner operation as any leakage would tend to be inward to the system. Therefore, if the product to be handled was in any way considered to be hazardous or toxic and not allowed to be dispersed into the ambient surroundings, a vacuum system would be a logical choice.

Because by the laws of mother nature, we are limited to how much negative pressure (i.e. vacuum) can be drawn to provide the energy to the system – vacuum systems are typically operating in the range of 12" to 18" Hg and therefore, limited by the relationship between system capacity and total equivalent conveying distance.

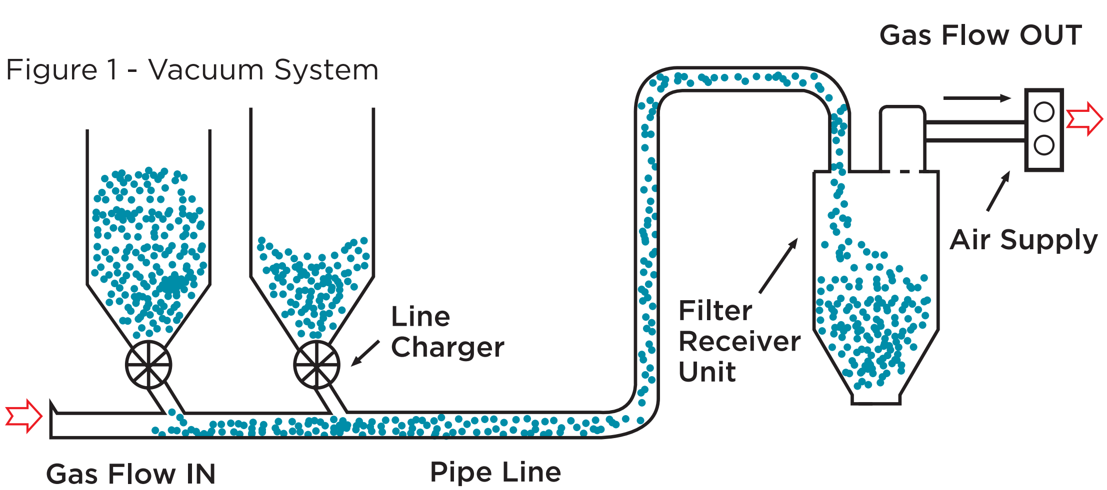
Because the beginning of the system is at near atmospheric conditions, the line charger has a relatively easy duty to perform and provides a lower cost design as compared to the line chargers used in pressure systems, where the pressure differential is significantly greater.

For that reason, when there are multiple pick-up points to be considered, using a vacuum system is a cost-effective solution.

Disadvantages would be the potential damage to the gas mover which could take place if the main filter receiver was to allow solid particulate to pass through and enter the high-speed blower which have very closely machined tolerances. Installing a secondary guard filter between the primary filter receiver and the inlet to the vacuum blower would address that potential issue.

If the material being handled was at a high enough temperature to create a situation where the transport gas rose beyond the allowable operating temperature of the vacuum blower, that too could have a catastrophic effect on the performance of the vacuum blower. Using a gas cooler to insure that the critical temperature is never reached or incorporating a bleed air quenching feature are two ways to protect the vacuum blower from that situation.

Figure 1 - Vacuum System



Pressure System

The pressure system shown in Figure 2 depicts the arrangement when the air/gas mover is on the upstream side of the product pick-up point.

Advantages of a pressure system would be the ease of feeding solids to multiple destinations because the ability to do that only requires the use of diverter valves in the convey line to send material to as many destinations as required.

Contrary to the vacuum system discussed in Figure 1, the pressure at the beginning of the system is now above atmospheric conditions which means the line charger has a compounded duty. It must deliver the material into the convey line at a controlled rate of flow and across a differential pressure. This scenario creates many challenges regarding wear on equipment, degradation to the product, leakage loss of conveying air, etc. However, the upside is that there are multiple options for the selection of the type of line charger based on the specifics of the application.

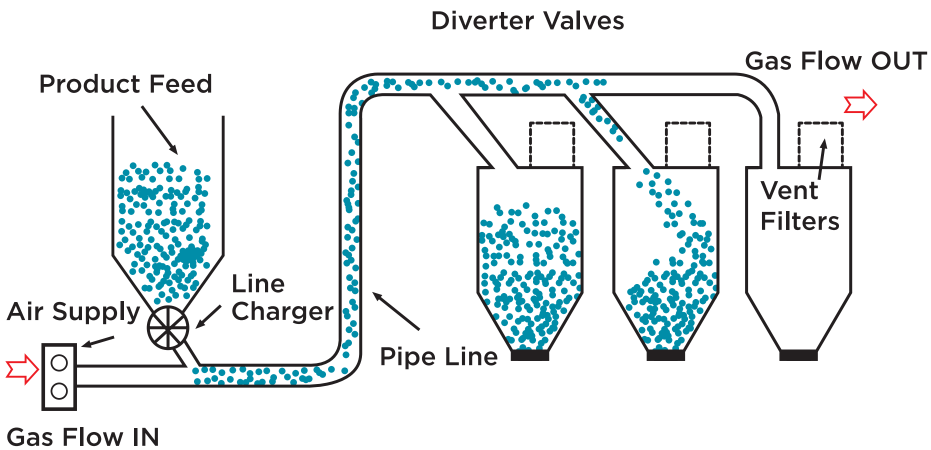
The most significant advantage of a pressure system is the ability to handle high convey capacity rates and/or transport the product over long distances. It can do that because there is no limit to the amount of pressure that can be developed to meet the convey system requirements. Systems using positive displacement blowers typically operate in the 15 to 18 PSIG range with 36 PSIG being the upper limit due to the availability of higher pressure blower designs. Above that point, the use of single or multiple stage compressors will come into play.

There are naturally downsides to the pressure system approach which includes any leaks in the system being external into the environment. This would normally rule out this type of system for those products considered to be hazardous or toxic and not allowed to be dispersed into the ambient surroundings.

Another disadvantage would be the potential damage to the gas mover that could take place if the main filter receiver was to allow solid particulate to pass through, then enter the high-speed blower which have very closely machined tolerances. Installing a secondary guard filter between the primary filter receiver and the inlet to the vacuum blower would address that potential issue.

If the material is temperature sensitive, because the gas coming from the gas mover will typically be at elevated temperatures, the use of a gas cooler upstream of the material pickup point would be incorporated into the system design.

Figure 2 – Pressure System



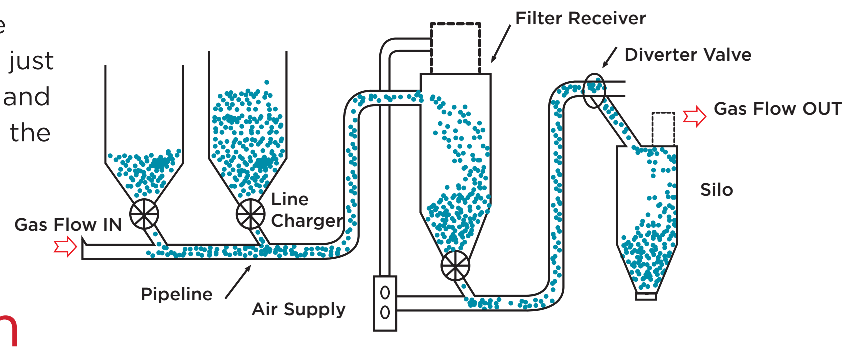
The Combination System

Having discussed the two most common choices for TYPES of pneumatic conveying systems and their advantages/disadvantages, we can logically ask the question "What if I need all of those benefits?"

Let's take an example such as an electric utility who has a very large dust collector on the back end of their system with (60) ash hoppers. They want to convey their fly ash to a silo which is a quarter mile away. This is a difficult application for anyone, however, it goes to show how incorporating a vacuum system to collect the ash from all the hoppers, convey it to a point just outside of the footprint of the dust collector and then drop it into a pressure system to handle the long-distance haul to the silo is the PERFECT application for a combination system.

While Figure 3 shows a single gas mover being used for both the vacuum side and the pressure side, this scenario would only work in a few situations. The more common approach by far would be to utilize separate gas mover units for each system.

Figure 3 - The Combination System

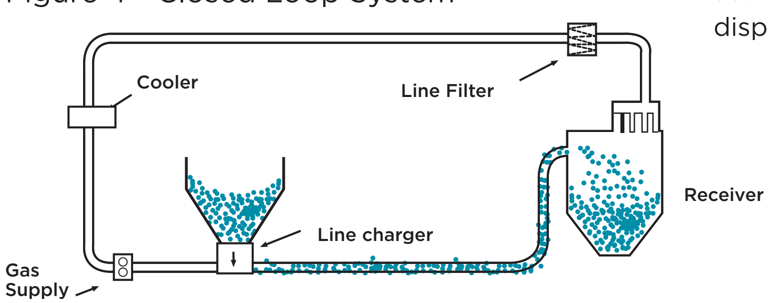


Closed Loop System

We have mentioned the application of handling hazardous and/or toxic materials. However, there is another application to consider when the products are combustible and/or cannot be exposed to air due to chemical changes which might take place. In those situations using an inert gas such as Nitrogen is the solution. However, because the gas can be expensive, we don't want to waste the gas by having it go through the system only once; so the third option of a closed loop system is to be considered.

Figure 4 is a very simple illustration of what is known as a closed loop system. As the name implies, the conveying gas is recirculated back to the beginning of the system and reused with minimal make-up gas being required due to any loss of gas or infiltration of oxygen which might take place. The actual final system design becomes complex when all the necessary equipment and instrumentation is included.

Figure 4 - Closed Loop System



In summary, when we consider the primary pneumatic conveying markets for transferring products from point A to point B, there is one initial choice to make—the type of system. The selection is driven by the specific geometry of a given application.

The specific material being conveyed does not really come into play except in a very limited number of cases.

For more information, or to discuss an application you have, contact your local authorized Gardner Denver positive displacement blower distributor.

About Gardner Denver Industrials Group

Gardner Denver Industrials Group delivers the broadest range of compressors and vacuum products, in a wide array of technologies, to end-user and OEM customers worldwide in the industries we serve.

We provide reliable and energy-efficient equipment that is put to work in a multitude of manufacturing and process applications.

Products ranging from versatile low- to high-pressure compressors to customized blowers and vacuum pumps serve industries including general manufacturing, automotive, and waste water treatment, as well as food & beverage, plastics, and power generation.

Our global offering also includes a comprehensive suite of aftermarket services to complement our products. Gardner Denver Industrials Group, part of Gardner Denver Inc., is headquartered in Milwaukee, Wisconsin, USA. Gardner Denver was founded in 1859 and today has approximately 7,000 employees in more than 30 countries.

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