

Selecting the Best Conveyor for your Application

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The benefits of four different types of conveyor - flexible screw, aero-mechanical, vacuum and pneumatic are discussed for conveying a wide variety of dry bulk solids and ingredients in the food, chemical, mineral, ceramic, pharmaceutical, plastics, rubber, water and many other industries. In specifying a conveyor system, engineers designing plants and processes should be familiar with the variety of options they have. It is also important that the engineers and buyers share as much information with the supplier at the outset as possible to avoid the risk of any difficulties later.

Suck, blow, entrain or screw? That's the decision we have to make each time a customer approaches suppliers such as Spiroflow Systems with a conveying application. The most important task of any conveyor manufacturer is to make sure we provide the customer with the most optimum solution for their application. We have to assure that the conveyor we jointly select and supply is the most efficient and most reliable available at the best possible price.

Although our task sounds simple, it is usually more complicated than that. To recommend a conveying system for an application, a thorough knowledge of the suitability and benefits of each type of conveyor is required. We also need to know what questions to ask the buyer to make sure that proper conveyor is selected and installed. Also, we need to consider that although suppliers like Spiroflow sell equipment each day, end user engineers and buyers may be purchasing their first conveyor!

As conveyor specialists, suppliers such as Spiroflow Systems, not only need to have an in-depth knowledge of their own equipment but also the broader scope since, on rare occasions, we have to be in a position to know when an application is beyond our capabilities and when we have to suggest a solution outside of our scope.



A typical Flexible Screw Conveyor installation.

INFORMATION REQUIRED FROM THE MANUFACTURER

As part of the selection process, the manufacturer needs to do their homework and provide the supplier with answers to certain questions. As a minimum, we feel that a manufacturer should provide answers to the supplier to the following 21 questions.

1. What product(s) or material (s) need to be moved?
2. What are its bulk densities?
3. What is the condition of the product or material in terms of such criteria as moisture content, average particle size and temperature?
4. Is the product likely to change in anyway in the future?
5. From what is the product being moved (for example, from a silo, bulk bag, or bag tip station)?
6. To what is the product being moved (such as a mixer, sifter, mill, reactor)?
7. If it's a reactor of any type, is there any steam, gas or solvent given off that might enter the conveyor?
8. How far will the conveyor travel horizontally?
9. How far will it travel vertically?
10. What route will the conveyor take (such as inside, outside or number of bends)?
11. Will the conveyor move a constant stream of material or pre-weighted batches on load cells?
12. At what rate is the material being moved in pounds per hour or batch size over a given time?
13. How often / for how long will the conveyor operate each day?
14. Is it important to deliver the material to the receiver in a homogenous manner - such as when flakes are added to a liquid to make a lump-free paste?
15. If the product is a mixture, is it essential that the integrity of the mix be maintained?
16. Is the material fragile and how important is it to minimize damage during conveying?
17. What other equipment is needed (such as a bag tip station, bulk bag discharger or receiver hopper)?
18. Will the conveyor operate in a dusty or otherwise hazardous area (i.e. will NEMA-rated explosion-proof motors and other such equipment be required)?
19. Is the conveyor manufacturer also supplying the control panel, level sensors and other accessories?
20. Will the conveyor be readily accessible for maintenance?
21. How long is the conveyor expected to run between services?

Beside the questions above, the manufacturer will most likely also require you to supply other information. What kind of information depends on the type of conveyor being considered and the manufacturer himself?

In selecting a conveying system for your application, it is important that you share as much information with the supplier as possible from the outset. By sharing this information, the risk of any problems you might have later is significantly reduced. Problems often occur when manufacturers or customers withhold critical information.

Ultimately, a product feasibility test may be advisable to determine the most suitable conveyor for the material concerned, the distance involved and the throughput required. Most conveying manufacturers have a database available of conveyor test results and of actual working conveyors, detailing which products perform well on a particular type of conveyor. Some manufacturers will have so much experience on conveying certain products that they can offer performance guarantees without the need to do any type of feasibility test.

SELECTING THE RIGHT CONVEYOR FOR YOUR APPLICATION

Here are the main parameters, benefits and disadvantages of the types of conveyor manufactured by Spiroflow Systems as well as other manufacturers.

Flexible Screw Conveyors

Flexible Screw Conveyors are often the simplest and least expensive solution for moving a variety of materials from Point A to Point B at rates of up to 40 tons an hour over distances of up to 65 feet. If greater conveying distances are required, multiple systems can be linked together.

Flexible screw conveyors consist of a stainless or heat treated and tempered carbon steel screw that rotates within an Ultra High Molecular Weight Polyethylene (UHMWPE) food grade tube. For most applications, this screw has a round cross section. But a flat or profiled version can also be used for fine, cohesive or easily smeared materials.

The term 'flexible' refers to the fact that these conveyors can be curved to some extent, depending on its diameter. This lets users route the conveyor around obstacles. Normally, using only one continuous curve is recommended for powdered, granular or flaked materials with a bulk density up to 150lb/ft³.

Flexible screw conveyors are designed to operate when full of material; running empty will lead to excessive noise and wear. Having a head of material in the feed hopper is desirable since it helps with the elevation of material upon start-up of the conveyor.

The main benefit of the flexible screw type of conveyor is its inherent simplicity. This results in low initial cost, quick installation time and low maintenance. Specific models are available for pharmaceutical, food and dairy applications that can be safely stripped down in minutes for thorough cleaning.

Wear is only a problem with abrasive products; life with other materials is almost indefinite. Tubes and spirals can be easily replaced. One of the latest developments is abrasion resistant rubber tubes for such applications as aggregates, sand, cement and glass cullet.

Since this type of conveyor should always operate when full of products, it is not recommended for moving batches or large

slugs of material. These types of conveyors are best used to deliver material from storage or a bag tip station to a weigh hopper or a vessel. For example, they are ideal for maintaining a constant head of material in packing machine hoppers by gently filling rather than dumping in batches. Because material flow is constant, flexible screw conveyors give accurate, highly repeatable batches if controlled by a simple time switch. Although flexible screw conveyors should run full of product, they can be emptied at the end of a batch operation or at the end of a shift by removing an end bung and running the conveyor in reverse at a reduced speed if necessary.

Aero-Mechanical Conveyors

The second type of conveyor, the Aero-Mechanical Conveyor (AMC), is ideal for total transfer of products at distances from 10 to 85 feet at rates of up to 120 tons per hour.

An alternative and more descriptive name for the AMC is a 'rope and disk' conveyor. This is because the AMC consists of several evenly spaced polyurethane disks attached to a wire rope. The rope and disks travel in a continuous loop fashion at a consistently high speed within parallel steel tubes. Housings enclose both ends of the conveyor and the rope and discs run from one tube to the other around specially designed sprockets. One sprocket drives the rope and disks while the



An Aero-Mechanical Conveyor (AMC) from Spiroflow Systems, Inc., Charlotte, North Carolina that operates high up into the roof area. In this situation, rope tension maintenance could be more difficult without the use of scaffolding or a mobile access platform.

other sprocket provides tension to the rope. The high speed of the disks produces an air stream that fluidizes and entrains the product in airflow until it is centrifugally ejected at the outlet. This method of conveying facilitates capacities up to 120 tons per hour with little power, minimal product degradation and virtually no separation of mixtures.

AMC's are effectively 'mechanical vacuum conveying' and should not be confused with Drag-Link type conveyors. Drag-Link conveyors are slow-moving, heavy duty devices in which cast iron disks linked by rods or chains scrape material along inside the tube.

Over the years, the Aero-Mechanical Conveyor has proven to be a cost efficient and dust free way of conveying materials, dust-free and without the need for filtration. The AMC can move batches and operate at any angle (including vertical) without sacrificing capacity or contaminant free delivery. They can also be supplied with access panels to make cleaning easier.

Besides straight-line operation, AMC's are available in several 'round the corner' configurations. Other than free flowing powders such as acrylics, flour and carbon black, AMC's can also move difficult materials such as titanium dioxide. They also do not have any problem conveying granules, flakes or chips.

A major benefit of this type of conveyor is that degradation to the material is almost negligible. This is because an AMC creates a moving current of air in which the material is carried similar to the effect of a vacuum or pneumatic system. However, unlike vacuum or pneumatic systems, the Aero-Mechanical Conveyor has a very important advantage in that it does not need a cyclone or filter to separate the product from the air. This saves money and reduces maintenance and environmental issues since the air carrying the material is recycled and not released at the outlet. The material is separated from the air that carries it and the unloaded air current is directed down into the return section of the tube where it is retained in the tube circuit.

An AMC should always be started empty and then fed and loaded at a controlled rate. With free flowing products, this can be done with a simple slide gate. In other cases, a controlled feed device, such as a rotary valve or flexible screw conveyor, should be used.

One disadvantage of an AMC is that maintenance can range from moderate to high where costs such as rope and/or discs need replacing depending on usage. The rope tension needs to be adjusted regularly during the all-important start-up period and then checked periodically. Rope life depends on the conveyor length, the number of starts and stops, loading and whether routine inspection and tensioning is properly performed.

Despite this drawback, properly maintained rope and disk assemblies on arduous duties have been known to last 14 years and more.

The effort, worry and cost of this regular maintenance can be minimized by selecting an AMC with an integral automatic rope tension monitoring and adjustment system such as the patented system now offered by Spiroflow Systems. This additional option to the AMC can, for some facilities, literally turn a nightmare into a dream!



Vacuum Conveying System from Spiroflow Systems, Inc. The premise for vacuum conveying is simplicity in operation, inherent reliability and hygienic transfer of material. The basic principle of this type of system is to convey the product from a feed or supply source into a delivery point suspended in a relatively uniform steam.

Vacuum Conveyors

The third conveyor type, Vacuum Conveyors, is the obvious choice where products must be moved over longer distances and torturous routes. Vacuum conveying is usually restricted to throughputs of around 10 tons/hr at distances up to 330 feet. A vacuum conveyor uses air to convey materials through a pipeline. It provides a solution for users requiring a system that is easy to route, has few moving parts, is dust tight in operation and empties a product leaving minimum residue in the storage container and the conveying tubes. Since the air is sucked-in, Vacuum Conveyors are the preferred choice for toxic or otherwise hazardous materials because the tubes contain all materials and minimize release to the atmosphere.

Either an exhaustor or a side channel, high efficiency fan located at the receiving end of the system, provides the motive force. For low capacity conveying, air powered 'Venturi' systems are ideal. "Venturi Systems" offer low capital cost and are not as expensive to operate as many potential customers have been led to believe.

Vacuum systems are normally the only conveying choice for customers when its necessary to suck material out of bags or other open top containers such as kegs and drums. These type systems are also ideal for pulling materials from multiple sources.

Reverse jet self-cleaning filters clean the conveying air and return the air to the atmosphere after use. These type filters reduce maintenance and minimize product loss.



A Pneumatic Conveying System from Spiroflow Systems, Inc. Designed to meet pharmaceutical and food standards, Pneumatic Conveyors are easy to clean with minimal product degradation.

Pneumatic Conveyors

Pneumatic Conveyors are probably the most versatile of all conveying systems but also the most expensive. They have virtually no limit on capacity, product type, distance or routing. Lean phase versions, in which the ratio of product to air is low, can move mountains of material. Lean phase conveying typically moves 1 lb of material for every 1 lb of air. Pressure drops across such systems range between 1.5 to 2.0 psig. The air velocity is high moving at 60 to 75 ft/min. with the entrained typically travelling at 80 percent of speed due to the “slip factor”.

Dense phase or plug flow systems move ‘slugs’ of material at lower speeds with minimal degradation. Here, we are talking up to 100 lb of material for every 1 lb of air but the air pressure can be as high as 100 psig. The slugs move at speeds between 10 and 30 ft/sec.

Positive pressure pneumatic conveying is generally used to move materials from a single source to one of several different locations. Pneumatic conveying systems are normally used for major tasks such as the rapid emptying of road and rail tankers into silos or moving material from silos to large-scale production processes. Capacities of up to 100 tons per hour are not unusual.

The two main disadvantages for pneumatic conveyors is the relatively high initial installation cost and the amount of filtration required. The high cost is a function of the need for an expensive blower or compressor, the cost of larger diameter (up to 6 inches), pressure tested pipe, supporting the weight of such pipe over long distances and then the filtration associated with large volumes of air.

As with vacuum conveyors, self-cleaning reverse jet filters are a big help in reducing maintenance. Maintenance is required to make sure these systems are free of leaks to ensure optimum efficiency and, above all, to avoid the associated health and environmental issues that leaks cause!

OTHER TYPES OF CONVEYORS

Beside these four types of conveyors, there are several types of conveyors available. These include:

- Rigid Screw Conveyors – Beware of the seals and bearings!
- Bucket Elevators – This type of conveyor is ideal for the most delicate products but generally not for those that are dusty.
- Flat Belt Conveyors – This type of conveyor is mainly used in quarries and mines.
- Vibratory Feeders – Vibratory Feeders are ideal if only very short conveying distances are required.
- Air Slides – Air Slides are fine for dense materials that only require downhill conveying.

In some applications, a mix of different conveyor types is appropriate. For example, short easy to clean Flexible Screw Conveyors are often used to provide a long distance Aero-Mechanical Conveyor with a consistent in-feed of material.

CONCLUSION

In selecting a conveyor for your application, the key is to find a conveyor supplier you have confidence in and are comfortable with in providing you with right solution for your conveying application. The supplier should be able to provide you with a performance guarantee for the material you will be moving. After that, it comes down to the usual commercial considerations of price and delivery. Normally, installing a conveyor is part of a larger project that offers commercial savings. Health, safety and environmental benefits also usually outweigh the monetary costs involved. Nevertheless, the conveyor type has to be the right one for the job. That's where your conveyor supplier plays a significant if not a key role.

Spiroflow is a worldwide supplier of a wide range of both standard and custom powder handling equipment, specializing in Bulk Bag Dischargers and Fillers, Mechanical, Flexible and Pneumatic Conveyors and Bag Packing equipment. For more information about this article, contact Spiroflow Systems, Inc. at 704-291-9595, FAX 704-291-9594 or email info@spiroflowsystems.com. Spiroflow can also be found on the web at www.spiroflowsystems.com.