Choosing the best conveyor

Steve Taylor, Senior Mechanical Engineer at Spiroflow Ltd., discusses the merits of four different types of conveyor - flexible screw, aero-mechanical, vacuum and pneumatic.

Suck, blow, entrain or screw? That's the decision we have to make every time a customer approaches Spiroflow with a conveying application. Clearly, the most important thing that any conveyor manufacturer has to do is to provide the optimum solution for the customer - ensuring that the conveyor supplied is the most efficient, most reliable and at the best possible price. Sounds simple but, the best solution can only be determined through a thorough knowledge of the suitability and benefits of each type of conveyor and knowing all the questions to ask. **We have to bear in mind that although conveyor companies are selling their equipment every day, engineers and buyers at end user companies might be buying their very first conveyor!** Being conveyor specialists means that we not only have to have an in-depth knowledge about our own equipment but also the wider picture too - given that, on rare occasions, we have to be in a position to know when to back away from an application and to suggest something outside of our scope. Certainly, potential customers should look to suppliers offering a range of conveyors to avoid the 'one size fits all' syndrome!

This article sets out to clarify some of the key reasons why one type of conveyor is the more obvious choice and highlights the answers that potential buyers will have to provide to their chosen supplier. It may seem an obvious statement but the more information that a customer and supplier share at the start, the less the risk of difficulties later!

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. However, as a starting point, any conveyor manufacturer worth his salt will have a database of conveyor test results, and of actual working conveyors, detailing the products on which they perform well. Most manufacturers will have so much experience on certain products that they can offer performance guarantees without the need to do tests.

The information required

Here is a list of questions that will need to be answered as a minimum before the choice of conveyor can begin:

1. The product(s)?
2. Its/their bulk density(ies)?
3. Its condition (moisture content, average particle size, temperature etc)?
4. Is the product likely to change in anyway in the future?
5. From what is the product being conveyed (silo, big bag, sack tip station)?
6. To what is the product being conveyed (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. The horizontal conveying distance?
9. The vertical height to which the product has to be conveyed?
10. The route of the conveyor (inside, outside, number of bends required etc)?
11. The conveying rate in kg/hour or the batch size over a given time?
12. Is the conveyor to transfer a pre-weighed batch, is it transferring material to a receiver of a given size / on load cells or is it a continuous process?
13. How often / for how long will the conveyor run 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 is maintained?
16. Is the material fragile and how important is it to minimise damage during conveying?
17. What accessories are required (sack tip station, bulk bag discharger, receiver hopper, etc)?
18. Is the conveyor to operate in a dusty or otherwise hazardous area (i.e. do the Atex/Desear regulations apply)?
19. Is the conveyor manufacturer to supply the control panel, level sensors, etc?
20. Will the conveyor be readily accessible for maintenance purposes?
21. For how long is the conveyor expected to run between services?

Dependent upon the manufacturer and type and conveyor being considered, other information may also be required but the above is a good basis from which to start.

Choosing the correct conveyor

Turning now to the choice of conveyor, below are the main parameters, advantages and disadvantages applicable to the types of conveyor manufactured by Spiroflow and, of course, those of other suppliers too.

Flexible Screw Conveyors

These are often the simplest and lowest cost solution for transferring a host of materials from A to B at rates of up to 40 tonnes an hour over distances of up to 20 metres. Multiple, linked units can extend to greater distances as required.

Flexible screw conveyors comprise a special heat treated and tempered carbon or stainless steel spiral rotating within an Ultra High Molecular Weight Polyethylene (UHMWPE) food grade tube. This type of conveyor suits powdered, granular and flaked materials with a bulk density up to 2.5kg/l.

Flexible Spiral Conveyor installation

The term 'flexible' means that the conveyor can be curved to some extent, dependent upon its diameter. This offers the flexibility to route the conveyor around an obstacle between the inlet and outlet. Normally, only one continuous curve is recommended.

For most applications, the spiral has a round cross section but a flat or profiled version can be used for fine materials or for those which are cohesive or have a tendency to smear.

It is desirable to have a head of material in the feed hopper, as this assists the elevation of material when starting. This type of conveyor is designed to run full of material - running empty will lead to excessive noise and wear.

The main advantage of the flexible screw type is its inherent simplicity that results in low initial cost, quick installation times 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 and life with other materials is almost indefinite. Tubes and spirals can be easily replaced. Latest developments include abrasion resistant rubber tubes for applications involving aggregates, sand, cement, glass cullet etc.

Because of the need to maintain product within the conveyor during operation, flexible screw conveyors are not ideal for transferring pre-weighed batches to a receiver. They are best used to deliver product from storage or a sack tip station to a weigh hopper or a vessel with a high level switch. For example, they are ideally suited for maintaining a constant head of material in packing machine hoppers by gently filling to the high level control rather than dumping pulsed batches. Additionally, because the in-flight product is constant, flexible spiral conveyors will give very accurate, highly repeatable batches if controlled by a simple time switch.

Although flexible spiral conveyors need to run full of product, they can however be emptied at the end of a batch operation or at the end of a shift by the removal of an end bung and running the conveyor in reverse at reduced speed if necessary.

Aero-Mechanical Conveyors

Aero-Mechanical Conveyors (AMC's) are the choice for the total transfer of products over distances of 3 to 25 metres a rates of up to 120 tonnes/hr efficiently, cleanly and without the need for an air filtration system.

The AMC has the alternate and more descriptive name of a 'rope and disk' conveyor and comprises several evenly spaced polyurethane disks attached to a wire rope. The rope and disks travel in a continuous loop fashion at a consistent high speed within parallel steel tubes. At each end there are enclosed housings within

Aero-Mechanical Conveyors

which the rope assembly runs from one tube to the other around specially designed sprockets. One of the sprockets drives the rope and disks while the other provides tension to the rope. The high speed of the disks produces an air stream that fluidizes and entrains product in an airflow until it is centrifugally ejected at the outlet. This method of conveying facilitates capacities up to 120 tonnes / hour with low energy requirements, 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 which are slow-moving, heavy duty devices in which cast iron disks are, often, linked with rods or chains and where the product is scraped along inside the tube.

Over the years, the aero-mechanical conveyor has proven to be a cost efficient method of conveying materials, dust-free and without the need for filtration. They offer total batch transfer, operation at any angle (including vertical) without any loss of capacity, contaminant free delivery and can be supplied with access panels for easy cleaning.

Besides straight-line operation, AMC's are available in a multitude of 'round the corner' configurations. Other than free flowing powders such as acrylics, flour and carbon black, they can also convey difficult materials such as titanium dioxide. It addition, they have no problem with granules, flakes or chips.

A major advantage is that degradation to the material is almost negligible with this type of conveyor. This is because it creates a moving current of air in which the material is borne, similar to the effect of a vacuum or pneumatic system. However, unlike vacuum or pneumatic systems, the aero-mechanical conveyor does not need a cyclone or filter to separate the product from the air - this is a seriously important advantage not only saving capital cost but also reducing maintenance and eliminating environmental issues too: because the air carrying the material is not expelled at the outlet. The material is separated from the air that carries it and the unloaded air current is directed down the return section of the tube. It is thus retained in the tube circuit.

An AMC should always be started empty and fed at a controlled rate. With free flowing products, a simple baffle may be all that is required. In other cases, a controlled feed device such as a rotary valve or flexible screw conveyor should be used.

Maintenance needs can be moderate to high. The rope tension must be adjusted regularly during the all important running-in period and then the tension must be checked periodically thereafter. Rope life depends upon conveyor length, the number of starts and stops, solids loading and whether routine inspection and tensioning are properly performed. Even so, rope and disk assemblies on arduous duties have been known to last 8 years and more.

The effort, worry and cost of this regular maintenance can all be avoided by choosing an AMC with an integral automatic rope tension monitoring and adjustment system such as the patented system offered by Spiroflow Ltd. This one addition to the AMC can, for some, literally turn a nightmare into a dream!

Vacuum Conveyors

Vacuum Conveyors are the obvious choice where products have to be conveyed over longer distances and torturous routes. Vacuum conveying is usually restricted to throughputs of around 10 tonnes/hr over 100m.

Vacuum Conveyor

A vacuum conveyor uses air to convey materials through an enclosed 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 of product leaving minimum residue. Vacuum conveyors are the preferred choice for toxic or otherwise hazardous materials because air is sucked-in in the event of accidental damage to the conveying tubes thus minimising the escape of product to atmosphere.

The motive force is provided by either an exhauster or a side channel, high efficiency fan sited at the receiving end of the system. Air powered' Venturi' systems are ideal for low capacity conveying, they offer low capital cost and are not as expensive to run as many potential customers have been led to believe.

Vacuum systems are usually the only choice where customers want to suck material out of sacks or other open top containers such as kegs and drums. They are ideal for applications with multiple inlets too.

Reverse jet, self-cleaning, filters that clean the conveying air, that has to be returned to the atmosphere after use, reduce maintenance and minimise product loss.

Pneumatic Conveyors

They are probably the most versatile of all conveying systems given that other than for cost considerations there is virtually no limitation on capacity, product type, distance or routing. Lean phase systems (where the ratio of product to air is low) can move mountains of product. Dense phase or plug flow systems move 'slugs' of product at lower speeds with minimal degradation.

Pneumatic Conveying System

Positive pressure pneumatic conveying is generally used to convey materials from a single source to one or multiple destinations. Pneumatic conveying systems are normally the preserve of 'big league' applications such as the rapid discharging of road and rail tankers in to silos and the transfer of product from silos to large-scale production processes. Capacities of up to 100 tonnes / hr are not unusual.

The big disadvantage is the initial cost and also the amount of filtration required. Again self-cleaning reverse jet filters are a big help in reducing maintenance. These systems must be maintained free of leaks to ensure efficiency and, above all, to avoid the health and environmental issues that leaks cause!

Other types of conveyors

Rigid Screw Conveyors - beware the seals and bearings!

Bucket Elevators - ideal for the most delicate of products but generally not for those that are dusty.

Flat Belt Conveyors - mainly used in quarries and mines.

Vibratory Feeders - Ideal for very short distances.

Air Slides - okay for dense materials and for downhill conveying only.

There are occasions where a mix of conveyor types is appropriate. For example, short easy to clean flexible screw conveyors are often used as the means to provide a lengthy aero-mechanical conveyor with the consistent in-feed of material.

Conclusion

As usual, the well-worn expression 'horses for courses' could not be more true. The key is to find a conveyor supplier who can prove that he can meet your requirements and who will give you a performance guarantee - after that it's down to the usual commercial considerations of price and delivery. Having said that, the installation of a conveyor is usually part of a larger project that offers commercial savings, heath & safety and environmental benefits that far outweigh the costs involved - therefore confidence in the supplier to meet your requirements is probably the most important consideration of all!

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