Aeromechanical conveying: Simple, versatile, and efficient

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An aeromechanical conveyor reliably transfers powders, granules, flakes, and bulk solid mixtures into the elevated inlets of bins, hoppers, silos, or process vessels. The conveyor's simple mechanical design, dust-tight operation, low energy use, and orientation versatility make it a popular fixture in processing plants. This article explains how the aeromechanical conveyor works and answers some questions commonly asked about it.

An aeromechanical conveyor transfers dry bulk materials at any angle from horizontal to vertical. As a rope mounted with discs moves at constant speed through the conveyor, entering material is suspended in draft pockets generated behind each disc, allowing the material to be elevated through the conveyor to the destination. This simple conveyor typically loads and unloads bulk railcars and trucks, hoppers and bins, bulk bags, and process vessels.

The following sections detail the aeromechanical conveyor's components and operation and provide answers to some common questions about the conveyor.

Some aeromechanical conveyor basics

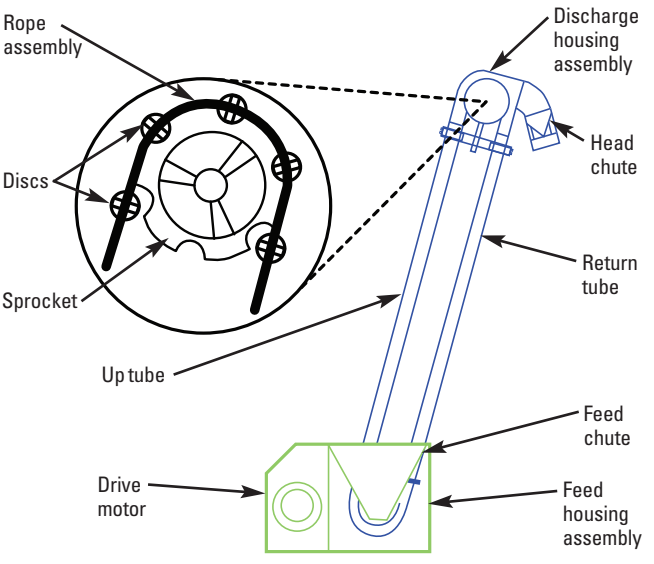
Components. Major components in the aeromechanical conveyor, as shown in Figure 1, include the up and return tubes, rope assembly, feed chute, feed housing assembly, discharge housing assembly, head chute, and drive motor.

The rope assembly, which is completely enclosed by the tubes, consists of a steel rope with plastic discs attached to it at regular intervals. Steel sprockets at each end of the conveyor within the feed and discharge housing assemblies engage the rope assembly. The drive motor can power either the feed or discharge sprocket. The conveyor can be constructed of carbon steel or stainless steel.

The conveyor can be as long as 100 feet. Multiple conveyors can be arranged in series to handle changes in conveying direction.[1] The conveyor can also be mounted on wheels so it can be moved to different locations in a plant.

Figure 1

Aeromechanical conveyor



How the conveyor works. The conveyor is started by turning on the drive motor. The drive motor rotates the sprocket, pushing the rope assembly at constant speed and creating a draft pocket behind each disc. Then material flow is regulated into the feed chute, which funnels the material into the feed housing assembly. As the entering material accelerates to the rope assembly's speed, it enters the draft pockets created by the rope's constant movement through the up tube. The material is elevated through the up tube to the discharge housing assembly within seconds. Here, the material disengages from the draft pockets and is thrown out of the head chute via centrifugal force into a destination bin or other container. The enclosed up and return tubes and feed and discharge housing assemblies provide dust-tight conveying.

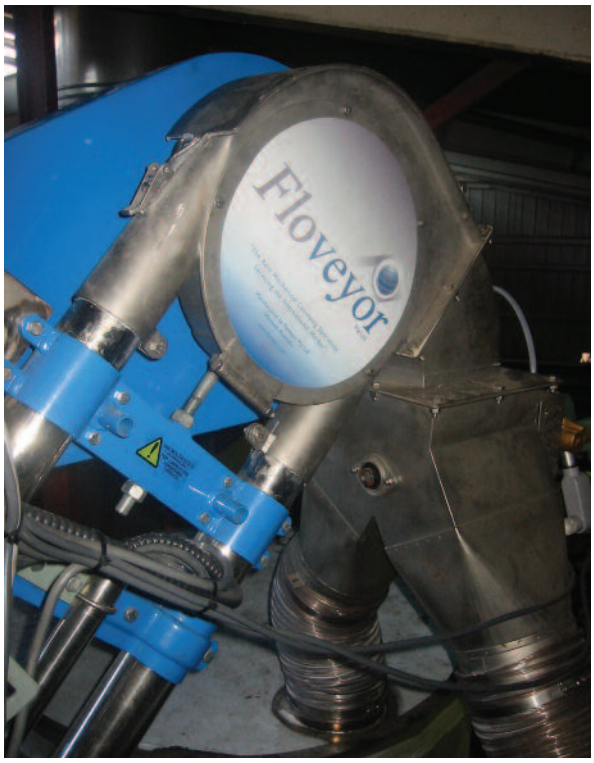
While only a very small amount of material is inside the conveyor at any one moment, the rope assembly's speed allows the conveyor to achieve high throughput rates. The conveyor's minimal horsepower usage for its high throughput rate makes it more efficient than any other mechanical or pneumatic conveyor.

Regulating the incoming material flow. The conveyor's throughput rate is controlled *only* by regulating the material flow into the feed chute. The conveyor transfers virtually all of the material entering at the inlet. Material flow can be regulated into the feed chute by manual pouring or by using a regulating device, such as a volumetric feeder, screw conveyor, belt conveyor, or vibrating tray conveyor. Some manufacturers provide an integral screw feeder with the conveyor to regulate the material flow. Which method is right for an application depends on the process conditions and the material's characteristics.

Discharge. As the material is discharged from the conveyor by centrifugal force, the material exits the head chute in a continuous flow. The destination bin (or other receiving vessel or container) must be suitably sized to accommodate the entire volume of aerated material exiting the conveyor, including dust generated as material impacts the bin walls. The conveyor has no outside air source that would require a dust collector at the discharge to remove material from the air. In fact, the material exiting the conveyor simply displaces an equal volume of air from the destination bin, and this equal volume of air exits the bin through the conveyor's return tube. The discharge housing assembly can also be fitted with a two- or three-way diverter head chute to provide discharge to multiple destinations, as shown in Figure 2.

Figure 2

Two-way diverter head chute providing discharge to two destination bins



Answers to common questions about the conveyor

Does the conveyor truly fluidize materials during transfer? Because no blower supplies high-velocity airflow to the aeromechanical conveyor, the unit doesn't fluidize material in the sense that a dilute-phase pneumatic conveyor does. Instead, the rope assembly's high speed redirects the air that the discs are traveling through to create the draft pockets that suspend material behind the discs.

In fact, the only moving air in the conveyor is the air displaced from the conveyor's destination bin as material exits the conveyor; this displaced air travels back through the conveyor's return tube to the feed housing assembly and exits the feed chute as new material enters. This gentle exchange of material and air at both ends of the conveyor doesn't force air by pressure or vacuum through the conveyor, and so the condition inside the conveyor balances with the atmospheric conditions outside the conveyor. Carefully selecting the conveyor's feed and outlet components to allow this exchange of material and air will prevent problems with discharging material.

Can the conveyor handle difficult materials without particle damage and other problems? The aeromechanical conveyor can successfully transport a wide range of materials with up to ½-inch particles without damaging the particles or otherwise affecting the final product quality. Fine powders, granules, pellets, flakes, and prills, and materials that are lightweight, heavy, dusty, cohesive, floodable, hygroscopic, fluffy, lumpy, heat-sensitive, or otherwise difficult to handle can all be transferred in the conveyor. The aeromechanical conveyor gently handles beans, corn kernels, oats, peas, tea leaves, potato flakes, and many other fragile materials without breakage. The conveyor can also transfer mixtures of diverse materials without segregating them.

An aeromechanical conveyor's versatility, simple mechanical design, dust-tight operation, and low energy use make it popular in bulk solids plants.

The aeromechanical conveyor suspends material behind each disc by moving at a constant speed that is less than that of a dilute-phase pneumatic conveyor but higher than that of a drag conveyor. This provides complete material transfer with virtually no leftover material in the conveyor, even for dusty or sticky materials. In fact, the amount of material left in the aeromechanical unit after conveying will fit into the palm of your hand. This is not the case with a drag conveyor, where the friction created during conveying causes dusty and sticky materials to build up on the conveyor walls. In a dilute-phase pneumatic conveyor, handling dusty or sticky materials requires a very large filter-receiver and greatly increases the air mover's required horsepower.

Does the rope assembly's speed control the throughput rate? No, because the rope assembly's speed is constant as it travels through the conveyor. Instead, the throughput rate is controlled by regulating the material flow to the feed chute, as previously discussed. In fact, there's an optimal rope speed to create the required draft pocket behind each disc. The ability to fill these pockets varies depending on the material's characteristics. The material flow must be regulated so it doesn't exceed the rate at which the draft pockets are filled. Thus the aeromechanical conveyor is always sized to provide a greater transfer rate than the application requires.

Does the conveyor use a lot of energy? No. The aeromechanical conveyor's actual horsepower usage (in terms of amperage) dictates the unit's electrical power consumption and, thus, its energy cost. The aeromechanical conveyor's horsepower usage is lower than that of any other mechanical or pneumatic conveyor for the same throughput rate.

Can stopping and restarting harm the conveyor? If your process is set up correctly, you shouldn't need to stop the aeromechanical conveyor in midstream. But if a power failure or other disturbance halts the conveyor, only a small amount of material will be left inside it, which makes the conveyor easy to restart. Even at a 9,000-lb/h throughput rate, only 5 pounds of material will be distributed along a 25-foot-long aeromechanical conveyor. In contrast, halting a 25-foot-long drag conveyor that provides the same throughput rate will leave about 75 pounds of material in the unit, making a restart more difficult.

One operating note: When you stop the aeromechanical conveyor after a conveying cycle, it's best to halt the material's regulated flow a few seconds before stopping the conveyor. This minimizes material residue and ensures that all material is conveyed to the destination.

Does the rope assembly wear out quickly? No. There's extremely little rope assembly wear. The rope assembly is ruggedly designed to provide many hours of operation and will last for years, even when it operates during much of your plant's production day. The keys to its long service life are regulating the material flow to the feed chute, maintaining atmospheric conditions at the conveyor's inlet and outlet, and ensuring that the destination bin is suitably sized to receive a load of material and achieve a reliable gravity flow into your process.

Is the conveyor hard to clean? No; it's easy to clean. The aeromechanical conveyor operates in a virtually empty condition, so the amount of leftover material in it is minimal. If your application requires cleaning out the conveyor, you don't need to take it apart. While the machine is running, you can use compressed air to blow material residue through the conveyor or run water though the conveyor and then drain it out. **PBE**

Editor's note

1. Similar conveyors that include 90-degree turns are available.

For further reading

Find more information on aeromechanical conveyors in articles listed under "Mechanical conveying" in *Powder and Bulk Engineering*'s comprehensive article index (in the December 2009 issue and at *PBE*'s Web site, www.powderbulk.com) and in books available on the Web site at the *PBE* Bookstore. You can also purchase copies of past *PBE* articles at www.powderbulk.com.

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