Troubleshooting tips for your aeromechanical conveyor

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Many users don't fully understand how their aeromechanical conveyor works, which can lead to several operating problems. After describing the aeromechanical conveyor's components and operation, this article details symptoms, sources, and remedies for four common conveyor operating problems.

The versatile aeromechanical conveyor (also called a *disc-and-rope, hockey-puck,* or *aero conveyor*) can transfer a wide range of dry bulk materials at high speed and can move them vertically or horizontally and around one or more 90-degree turns. These features make the unit a popular batch conveyor in many processing plants. A closer look at how the conveyor works can help you understand how some operating problems occur and what you can do to remedy them.

How the aeromechanical conveyor works

The aeromechanical conveyor consists of two straight, parallel tubes typically 3 or 4 inches in diameter that enclose a continuous-loop rope-and-disc assembly, as shown in Figure 1. One tube forms the conveying leg, and the other is the return leg. The rope-and-disc assembly consists of a wire rope mounted with round plastic discs at regular intervals. The rope is typically ¼ to ⅜ inch in diameter and made of galvanized carbon steel or stainless steel. The disc diameter is slightly smaller than the tube's inside diameter, and the distance between discs is called the *pitch.* At the conveyor's inlet and discharge ends, the tubes are joined to a dust-tight housing that encloses a carbon steel or stainless steel sprocket, as shown in Figure 2; each sprocket engages the rope-and-disc assembly, which is supported by bearings and seals in the housing. Depending on the conveyor's length, either the inlet or discharge sprocket serves as the drive sprocket, and this sprocket is connected to a drive motor that moves the rope-and-disc assembly at approximately 700 to 800 fpm.

An inlet is located on the inlet sprocket housing and is typically a shallow-angled gravity-feed chute with a baffle that deflects material flow into the sprocket's bottom. A discharge spout extends from the discharge sprocket housing and is usually 6 to 8 inches in diameter to allow full discharge.

In operation, the material (typically a powder) enters the inlet, and the high disc velocity at the inlet sprocket draws the material from the inlet. The material occupies a maximum of about 40 percent of the area between the discs. The rope-and-disc assembly's velocity tends to fluidize the material and keeps it suspended during transfer. In general, the easier the material is to fluidize, the easier it will be to convey in the aeromechanical conveyor. The incline (that is, elevation) angle typically doesn't affect conveying, which allows the aeromechanical conveyor to move material vertically. Some models can convey materials vertically and horizontally and around one or more 90-degree bends. The material is carried to the discharge sprocket, where the material's high velocity throws it out of the discharge spout by centrifugal force.

Now let's look at four common aeromechanical conveying problems and their symptoms, sources, and remedies.

1 Material bridging at inlet

The symptoms. Material is probably bridging at the conveyor's inlet when you notice one or both of these symptoms:

- The conveyor runs but doesn't move your material.
- The throughput rate through the conveyor is inconsistent.

The problem's sources. Most aeromechanical conveyor inlets have a gravity-flow chute angled at 45 degrees, and many cohesive, moist, or fatty materials won't flow at this angle without some assistance. Flow problems in upstream hoppers, ductwork, transitions, or other equipment that feeds your conveyor can also produce bridging at the conveyor's inlet. Either problem can cause the conveyor to run without transferring your material or to convey it at an inconsistent rate.

The remedies. Most aeromechanical conveyor suppliers offer an inlet equipped with a vibrator to promote the flow of cohesive, moist, or fatty materials. Some suppliers offer a fluidization membrane that can be mounted on the inlet's shallow slope, which is especially suited to promoting fine powder flow. Figure 3 shows the location of both flow aids in the inlet.

Be aware that these inlet modifications don't remedy flow problems in upstream hoppers, ductwork, transitions, or other equipment. To solve these problems, make sure that your upstream equipment is designed for your material's flow properties so that material can flow consistently into the conveyor's inlet. Consult your conveyor supplier for help designing upstream equipment that will promote reliable flow to the conveyor.

2 Material buildup on interior components

The symptoms. Material may be building up on your conveyor's interior components when you notice one or more of the following:

- The V belts slip.
- The drive motor fails.
- The conveyor stalls.
- The rope-and-disc assembly pulls apart.

The problem's source. A cohesive material that tends to pack or a material that contains a high amount of moisture or fat can build up in the conveyor and cause conveying problems. This kind of buildup often occurs inside the sprocket housings, especially in the discharge sprocket housing, and prevents the discs from freely sweeping around the sprocket. This increases the drag on the rope-and-disc assembly, which can cause the V belts to slip and potentially cause the motor to fail. If the increased drag causes the conveyor to slow down, the situation can deteriorate: Material may now fill more than 40 percent of the space between the discs, even completely filling it. In this case, the conveyor can stall or the rope-and-disc assembly can pull apart.

The remedies. When conveying a cohesive material or a material with a high moisture or fat content, you may be able to relieve some of the buildup problems by polishing or adding a nonstick coating to the material-contact surfaces inside the sprocket housing. Specially designed conveyors with fluidization membranes in the sprocket housings can also relieve buildup problems. In some cases, injecting compressed air into the sprocket housings at strategic areas may help.

Figure 1

Typical aeromechanical conveyor

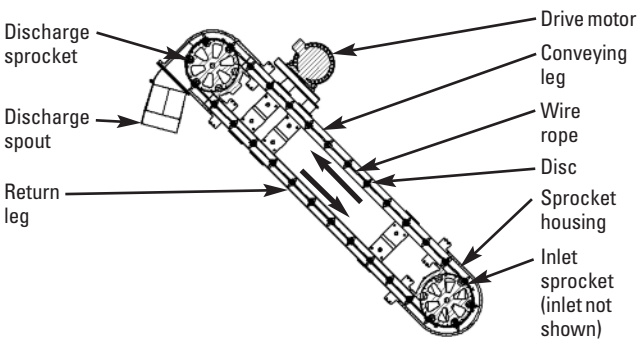
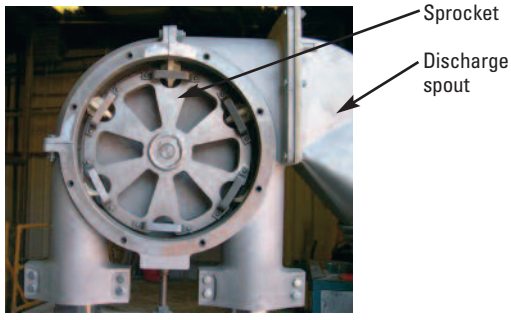


Figure 2

Discharge sprocket housing (with access cover removed)



3 Plugged discharge spout

The symptoms. The conveyor's discharge spout may be plugged with material when you notice one or more of these symptoms:

- The V belts slip.
- The drive motor fails.
- The conveyor stalls.
- The rope-and-disc assembly pulls apart.

The problem's sources. As you can see, these symptoms are the same as those for material buildup, so it's important to check for buildup inside the conveyor and plugging at the discharge to be sure which problem is causing the symptoms before you try to find a remedy.

The aeromechanical conveyor's discharge spout can become plugged with material when the discharge design doesn't allow the material to exit by centrifugal force. While the aeromechanical conveyor's discharge spout typically has a 6- to 8-inch-diameter opening to ensure that the high-velocity material is freely released, the user often adds a discharge connection to this opening to direct the discharged material to a receiving hopper or other downstream equipment. The discharge connection may have a smaller opening or be placed at an angle that prevents the material from discharging freely. As a result, material can back up in the discharge connection and in any ductwork between this connection and the receiving hopper, eventually plugging the discharge spout. Because the material can't discharge, it will recirculate through the conveyor. The resulting heavy load on the conveyor can cause the V belts to slip, stall the conveyor, pull apart the rope-and-disc assembly, or cause the motor to fail.

Another source of discharge plugging is overfilling the receiving equipment, which can happen when the conveyor is filling a storage vessel and there are no safety interlocks to shut down the equipment feeding the conveyor when the storage vessel is full. This will cause material to recirculate through the conveyor rather than discharge, resulting in one or more of the same symptoms.

The remedies. To ensure that your material can discharge by centrifugal force, carefully design the discharge connection: Make the discharge connection the same diameter as the discharge spout's opening and place the spout as close as possible to the receiving hopper, using minimal ductwork between the spout and the hopper, as shown in Figure 4.

When you use the conveyor to discharge material to a storage vessel, install safety interlocks so that the equipment feeding the conveyor stops when the vessel is filled. In most cases, you can simply locate a material level sensor in the vessel and interlock it with the conveyor and upstream equipment so that when the sensor detects a high material level in the storage vessel, the sensor sends a signal to stop the equipment feeding the conveyor.

4 Rope-and-disc assembly failing prematurely

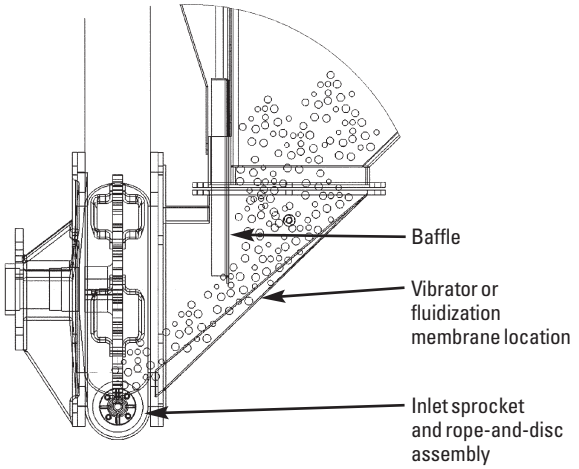
The symptom. In this case, the problem — the rope-and-disc assembly failing prematurely — is also the symptom.

The problem's sources and remedies. Over your aeromechanical conveyor's lifetime, the wire rope travels around the sprockets at high speed millions of times, which will eventually fatigue the rope and cause it to lose flexibility and strength. This is why you must replace the rope-and-disc assembly at regular intervals — typically, every 1,500 to 3,000 hours of conveyor operation — and why the aeromechanical conveyor is best suited for batch operations. Conveying distance also plays a role in the rope-and-disc assembly's service life: In general, the longer the conveyor, the more the rope will stretch, which will change the pitch (the distance between discs). Although rope stretch may not be a problem with a short conveyor, the short conveyor's rope travels around the sprockets more often, which increases fatigue.

If your aeromechanical conveyor's rope-and-disc assembly fails frequently or before its normal service life is up, you'll have to replace worn sections of the assembly or replace the entire assembly. Any of the following factors can contribute to the problem.

Figure 3

Inlet with flow aid location



Conveyor run time: Leaving the conveyor running after the material has been conveyed can wear the rope and cause it to break prematurely. The rope wears as quickly when the conveyor is running empty as when it's filled with material. To remedy this problem, turn the conveyor off as soon as the material batch has been discharged.

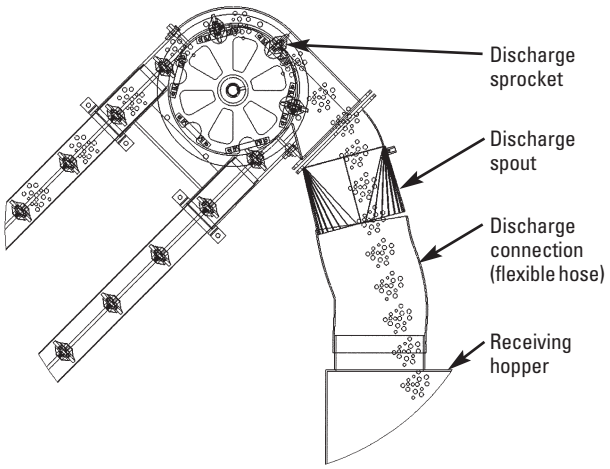
Starting frequency: When the conveyor is started and stopped at frequent intervals, immediately bringing the conveyor motor up to running speed will place high stress on the rope and reduce its service life. Installing a soft-start starter on the motor allows you to gradually increase the conveyor speed at each start, putting less stress on the rope.

Material characteristics: A material containing large, hard particles can be caught in pinch points between the conveyor's discs and sprocket housings, usually where the discs enter the conveying leg tube. This can wear the discs or cause the rope to constantly flex, which fatigues the rope and can eventually cause it to break. A friable material won't cause this kind of problem because it breaks apart into small particles rather than becoming pinched. If your material is hard, you can avoid pinching problems by making sure that the material's particle size doesn't exceed your conveyor supplier's recommended maximum size (typically ⅜ to ½ inch). You may also be able to reduce pinching by reducing the discs' outside diameter.

Sprocket wear: Each conveyor sprocket has disc guides on both sides of its flat disc-seating rim to keep the rope-and-disc assembly engaged with the sprocket, as shown in Figure 5a. Over the sprocket's life, the rim where the rope rides can wear and become grooved, as shown in Figure 5b. This groove can be hard to spot, because it's often so smooth and uniform that it appears to have been machined into the rim by the supplier. The rim diameter is critical in properly seating the rope-and-disc assembly. As this groove deepens, the sprocket rim diameter changes, which may cause the rope-and-disc assembly to wear quickly. Consult your conveyor supplier for help finding a remedy, such as switching to a sprocket made of an abrasion-resistant material.

Figure 4

Discharge spout located as close as possible to the receiving hopper with minimal ductwork



Consult your conveyor supplier for help achieving the proper rope tension and determining how often you should check the tension.

Rope tension: The sprockets typically rotate at about 250 rpm, and an improperly tensioned rope that isn't snug on the sprocket can cause the discs to hit the housing at high speed or even become pinched between the sprocket and the housing. This can damage the discs and cause the rope to break prematurely. The remedy, of course, is to achieve the right rope tension for your conveyor. While adjusting the rope tension to be tighter or looser is fairly easy, achieving the *right* rope tension for your conveyor is another matter. Here are two helpful rules of thumb: 1) It's better to have a slightly slack rope than a rope that's too tight. 2) Avoid tensioning the rope by listening to the running conveyor. (Some users think that discs on a properly tensioned rope won't touch the tube walls, thus making no sound. Under normal conditions, however, the discs on a properly tensioned rope will contact the tubes and make an intermittent "pinging" noise.)

Consult your conveyor supplier for tensioning instructions for your conveyor. In general, make sure that the conveyor is stopped and empty of material. Remove the sprocket access covers so you have full access to both the discharge and inlet sprockets. Then adjust the rope tension in the discharge sprocket (which usually serves as the tensioning sprocket) by sliding the sprocket housing along the tube to stretch the rope until the rope at the inlet sprocket rests snugly on the inlet sprocket's very bottom. Being able to access both sprockets is important: In many cases, users monitor and adjust the rope only at the tensioning sprocket, and on a long conveyor, the rope-and-disc assembly's weight can give a false sense of rope tension at this sprocket. In other cases, the user may have the impression that the tension is correct even when the rope isn't seated on the inlet sprocket. Being able to access the inlet sprocket allows you to spot these problems and correctly adjust the rope tension. Consult your conveyor supplier for help achieving the proper rope tension and determining how often you should check the tension. Then make

checking the rope tension part of your conveyor's regular preventive maintenance program.

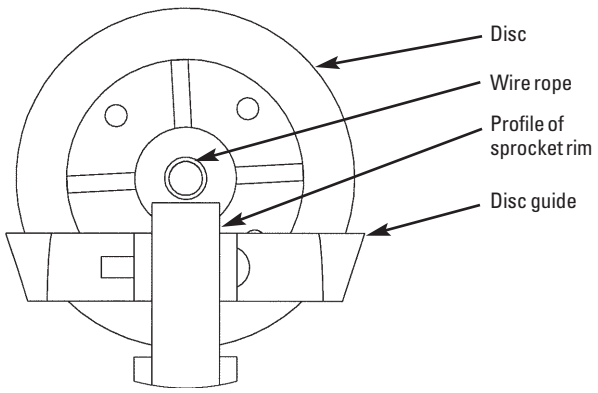
Disc wear: Most aeromechanical conveyor discs are made of plastic, such as polyurethane, nylon, or polycarbonate. These plastics will have minimal wear when handling nonabrasive materials under normal operation. Abrasive materials can rapidly wear the discs because of the discs' high velocity during conveying. This is why an aeromechanical conveyor normally isn't used for conveying abrasive materials. Even some mildly abrasive materials will eventually wear the plastic discs, which shows up as uniform wear around the disc's outside diameter. If your discs have this kind of wear, ask your conveyor supplier to recommend a plastic with better abrasion resistance.

Disc wear can result from other factors too. If the discs are worn almost into an egg shape, the problem can be that the rope is too loosely tensioned, which causes the discs to contact the sprocket housing wall. If the front and back of the discs show wear, the rope tension may be incorrect or the sprockets may be worn. Remedy these problems by adjusting the rope tension and, if necessary, replacing the sprockets.

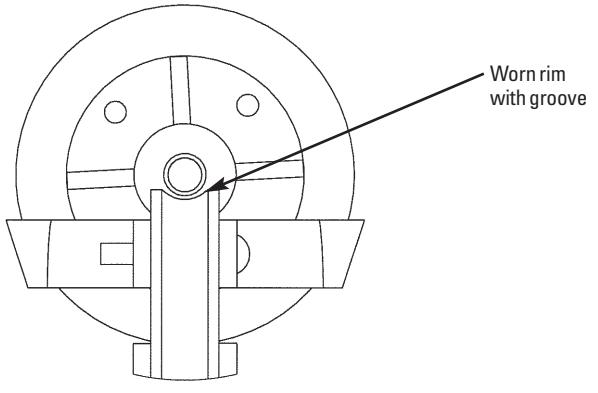
Figure 5

Sprocket wear

a. Unworn, flat rim



b. Worn rim



An ounce of prevention

Testing your material in the aeromechanical conveyor before you purchase it is the best way to avoid problems later. The tests will not only give you a good idea of how well your material can be conveyed in the unit, but may indicate what conveying problems can occur later and how to handle them.

Once the aeromechanical conveyor is up and running in your plant, you can ensure that it provides years of reliable service by following these simple rules: Make sure that the conveyor has a clear path to discharge material. Make sure that the receiving vessel has enough room to prevent material from building up in it and blocking the conveyor discharge spout. Last but not least, regularly check the rope tension. **PBE**

For further reading

Find more information on aeromechanical conveyors in articles listed under "Mechanical conveying" in *Powder and Bulk Engineering*'s comprehensive article index at www.powderbulk.com and in the December 2004 issue.

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