Mechanical conveyors: Eight questions and answers

Mechanical conveyors are available in an enormous variety of types, including belt conveyors, bucket elevators, tubular conveyors using chains or cables and discs, drag (en masse) conveyors, screw and flexible screw conveyors, vibratory and reciprocating conveyors, and others. Different types can be stationary or portable and can serve purposes in addition to conveying, such as heating or cooling, screening, and accumulating. This article sheds light on frequently asked questions about mechanical conveyors by using information from past Powder and Bulk Engineering articles. All referenced articles can be found in the Article Index or Tips section on PBE’s website, www.powderbulk.com. Also see “Conveyor Selection Charts” under Tools & Resources at www.powderbulk.com.

Selecting a mechanical conveyor

Q: We’re going to be starting a new process and will need to convey materials between various parts of our plant. How do we decide what type of conveyor to purchase?

A. A huge variety of conveying equipment is available from bulk solids handling equipment suppliers, and this can make the prospect of choosing the right conveyor for your application a bit daunting. A good place to start is to consider these basic selection factors:

- **Your material’s characteristics.** Consider whether your material is dry or moist, extremely hot or cold, hygroscopic, abrasive, likely to segregate, or has other properties that limit which conveying methods can reliably handle it.

- **The conveyor’s required function and performance.** Will your conveyor require multiple inlets or outlets? Must it elevate material or move it through multiple planes? Must the conveyor provide a variable conveying rate? Will it need to provide gentle handling? Must the conveyor be enclosed to contain dust or prevent material contamination, and will it require a dust collection system?

- **The conveyor’s operating features.** Can the conveyor handle your required conveying distance? Can it handle your required conveying volume? Does the conveyor have high installation costs? Can it be installed in your existing operation?

- **The conveyor’s required service life.** What’s the projected duration of the operation or process this conveyor will serve? Some conveyors are light-duty units suitable for intermittent or short-term operation, while others are heavy-duty machines designed for continuous long-term operation. Consider what service life your conveyor must provide to ensure that it can handle your application.

- **The conveyor’s long-term energy requirements.** Consider how the conveyor’s energy use will affect its operating costs over the long term.

When you’re selecting a conveyor, it’s best to work with a supplier who offers several conveyor types. Such a supplier has the experience to satisfy your conveying performance needs and to ensure that the conveyor you select will withstand your process’s duty level throughout the life of the process. This supplier can offer selection advice based on which unit can not only successfully handle your material, but provide the best combination of low purchase price, low operating cost, and high efficiency.

Ideally, the supplier will also have a test lab with conveyors of various types to help you determine which conveyor can best handle your material and operating conditions. Ask the supplier for references to check whether previous customers with applications like yours are satisfied with the conveyors they’ve purchased.

Finally, make sure that your supplier provides assurances that the conveyor will successfully transfer your material and perform reliably and cost-effectively for the long run.

Conveying a fragile material

Q. We’re processing a fragile, friable material. What mechanical conveyor features should we look for to convey this material?

A. To select a mechanical conveyor that doesn’t cause material degradation or separation, consider the following three factors:

- The conveyor’s speed. The general rule of thumb is that the slower the conveyor speed, the better it will convey material without damage.

- How the material enters the conveyor. Metering the material into the conveyor at a rate slower than the conveyor’s capacity allows the material to settle in the system before hitting a shear point.

- The conveyor’s discharge. The discharge needs to be smooth when in the closed position — no edges or sharp sides will reduce the possibility of pinching. This eliminates any chance of shearing the material when it bypasses the discharge. Also, managing the distance that the material freefalls will reduce damage.

Larry Van Zee, vice president of operations, Cablevey Conveyors (www.cablevey.com). To read more answers to this question, see “Suppliers’ tips,” July 2009, page 68.

Conveying sanitary materials

Q. What mechanical conveyor features should I look for to handle my sanitary product?

A. Fundamentally, mechanical conveying equipment intended for bulk food, dairy, pharmaceutical, and other sanitary products, as well as contamination-sensitive chemical products, should be constructed of Type 304 or Type 316 stainless steel (or higher alloys). The conveyor should have continuous welds and material contact surfaces ground and polished to a finish level required by your application. The control enclosures should be rated NEMA 4 or NEMA 4X, allowing washdown using steam, cleaning solutions, and high-pressure water.

The biggest difference between one sanitary-rated mechanical conveyor and another is the equipment design, specifically in regard to design features that eliminate or minimize contamination and allow quick sanitizing between production runs or batches. For example, the conveyor design should minimize moving parts assemblies contacting one another within the material, which could form crevices and require greater time and attention during washdown. Conveyors without bearings or rotating shaft seals, as well as conveyors that allow tool-free disassembly, offer an advantage.


Improving energy efficiency

Q. How can I improve my mechanical conveyor’s efficiency and reduce energy use?

A. There are only a few ways to reduce energy use for mechanical conveyors. For a belt conveyor, use a high-efficiency gear reducer. Worm gear reducers have an overall efficiency in the 70 percent range, while a helical bevel reducer is in the 90 percent range. Also, gear belts have a higher efficiency than roller chain drives.

Another area to pay attention to is where the slide bed and the belt’s underside come into contact: The higher the coefficient of friction between these two surfaces, the more energy needed to drive the belt. The lowest friction loading is obtained with a roller deck, which can have up to 100 times less friction loading than a slide-bed conveyor.

For a vibratory conveyor, the lowest energy use occurs when the conveyor is tuned and running at the spring system’s natural frequency.

For a screw conveyor (also called an auger conveyor), a high-efficiency gear reducer and a low-coefficient-of-friction plasma coating are two things that can reduce energy use.

Using a high-efficiency motor will help all three conveyor types save energy.


Maintaining a bucket elevator

Q. What are key maintenance steps to keep our centrifugal discharge bucket elevator operating properly?

A. A typical centrifugal discharge bucket elevator consists of a top section (also called a head section), a discharge throat, a bottom section (also called a boot section), and a belt or chain on which numerous buckets are mounted. The head section houses the head pulley (or sprocket), which is linked via a head shaft and bearing to a drive, which powers the pulley, and, in turn, continuously moves the belt or chain in a circuit around the two pulleys. The elevator’s boot section houses a boot pulley (or sprocket), which is supported by a boot shaft and take-up bearing. The boot shaft aids the pulley’s rotation, and the take-up bearing allows the belt or chain to be tensioned.

As the chain rotates, empty buckets move upward from the boot pulley and pass an inlet hopper, where they’re filled with material. As the loaded buckets approach the head pulley, the elevator’s high belt speed and centrifugal force
throw the material out of the buckets into the discharge throat. After rounding the head pulley, the now-empty buckets descend to the boot pulley and continue the circuit.

To properly maintain your centrifugal discharge bucket elevator, establish and follow a preventive maintenance program that includes regularly scheduled inspections of the elevator and buckets. Visually inspect these at least once a month, if not more, depending on how often you use the elevator. Use the following checklist when inspecting your elevator and buckets:

- Check for broken, bent, or missing buckets and replace them.
- Retighten or replace the bolts and nuts that hold the buckets to the belt or chain.
- Verify proper alignment, tension, and physical condition of the belt or chain; check for wear, stretching, or delaminating.
- Check the throat plate and adjust it if necessary.
- Look for wear on the head and boot pulleys.
- Clean inside the boot area and around the elevator and drive equipment.
- Inspect and lubricate all bearings and moving parts in the elevator.

For additional guidance, contact your elevator manufacturer or bucket supplier.

**Alex Kessler,** manager of OEM accounts, Tapco (www.tapcoinc.com). To learn more, read “Bucket elevator: Diagnosing and solving seven common problems,” July 2011, page 35.

**Using a screw conveyor with a fluidizable material**

Q. We’re using a screw conveyor to move a fine, dusty material from one part of our plant to another, but the material runs out of the conveyor just like water. What can we do?

A: Fluidizable materials are materials that tend to flow like liquids when aerated or mechanically agitated and can flow uncontrollably through a screw conveyor. Examples include alumina, Portland cement, powdered cocoa, fly ash, limestone dust, and talc. To handle this kind of material, the screw conveyor should be designed with very low trough loading — typically 15 percent or less — and with a screw of shorter pitch that decreases the distance between flights. The short-pitch flighting will slow material flow through the conveyor. Running the screw conveyor at a slower speed will also reduce the chance of fluidizing the material.

If your material will discharge to a downstream weighing device, you can use a double-flight short-pitch screw (which has two rows of flighting around the pipe) to better control the material’s flow and minimize surging, thus providing more uniform discharge to the weighing device.

**Bill Mecke,** president and owner, KWS Manufacturing (www.kwsmfg.com). To find out how to use a screw conveyor with other challenging materials, read “Tips: Choosing a screw conveyor to handle your tough material,” July 2009, page 23.

**Maintaining a belt conveyor’s efficiency**

Q. What can we do to make sure our new belt conveyor remains efficient and reliable?

A. Although a belt conveyor is a relatively simple and reliable machine, things can go wrong. To avoid problems, do these regular checks:

- Choose the right belt conveyor for your application.
- Keep your belt, sliderbed or rollers, and pulleys clean.
- Check your bearings.
- Check your pulley alignment and wear.
- Check for belt slippage.
- Make sure the conveyor and drive are correctly sized for your application.
- Replace worn parts and keep critical spare parts handy.
- Keep the motor clean.
- Position your conveyor to pull rather than push.
- Implement a regular preventive maintenance program.

Mike Wilks, Bunting Magnetics (www.buntingmagnetics.com).

Improving a drag conveyor’s capacity

Q. We’re using a drag conveyor to transfer a granular material, but the conveyor’s transfer capacity has dropped during the past few months. Is there any way to improve the capacity?

A. A drag conveyor (also called an *en masse conveyor*) is an enclosed mechanical conveyor that handles dry flowable powders, granules, pellets, and even some moist materials, such as sludges. What makes the drag conveyor popular in many bulk solids processing plants is its design flexibility: The conveyor can be equipped with multiple inlets and outlets and can move material horizontally and, for moderate distances, up or down at an angle.

The drag conveyor consists of a trough-like housing that encloses an endless steel chain mounted at regular intervals with flights (also called *paddles*). The chain wraps around sprockets in the conveyor’s head and tail sections, engaging the sprocket teeth. The head sprocket is mounted on a shaft driven by a motor. A feed inlet is near the tail sprocket, and additional feed inlets can be located along the conveyor. An outlet is located under the head sprocket, and more outlets can be located along the conveyor to discharge material to multiple locations.

In operation, the motor drives the rotation of the head shaft and sprocket, moving the chain from the head section toward the tail section. Material enters the inlet and falls between the flights that are moving forward in the housing’s lower conveying portion. As the flights move, they break the friction between the material and housing wall surface, moving the material forward *en masse*. When the material reaches an open outlet, it drops out of the conveyor. The chain travels around the tail sprocket and returns inside the conveyor housing’s upper chain-return portion to the head sprocket.

As for your problem, the drag conveyor needs to be routinely maintained. Sometimes it’s a simple matter of establishing a good maintenance routine to prevent capacity loss. Do the following on a regular basis:

- Make visual inspections of the flights, chain and related parts, conveyor section liners, and safety-monitoring devices for wear, damage, and other problems.
- Maintain proper chain tension.
- Lubricate moving parts.
- Check and adjust belt tension.

If your maintenance is up to date, there are some things you can try to improve the machine’s capacity. But first, you must accurately determine the conveyor’s actual capacity, which is based on the chain speed and the conveyed material’s cross-sectional area. (The conveyor supplier can...
help you calculate this.) If your conveyor’s actual capacity is under its rated capacity, take the following steps:

- **Check the conveyor’s chain speed.** Determine the proper speed (in revolutions per minute) for the head shaft rotating the head sprocket and verify that the chain is moving at that speed. The chain speed may be lower than the rated speed if the drive sheaves were improperly installed during installation or maintenance or if the drive belts are loose and slipping.

- **Verify the material depth inside the drag conveyor.** Various problems can lead to an incorrect material depth. An inclined conveyor that was incorrectly installed at the wrong incline angle can result in a material depth that’s too high or low. After reinstalling the conveyor at the correct angle, make sure that the conveyor now achieves the correct material depth.

Improper and inadequate feeding can also result in an incorrect material depth, either because the feeding device has insufficient capacity, the conveyor inlet is obstructed, or an inlet gate is malfunctioning. Once you’ve corrected the feeding problem, verify that the conveyor’s material depth is correct.

If, after following these steps, the conveyor’s capacity is still too low, consult with your conveyor supplier.


**PBE**

**For further reading**

Find more information on these conveyors in articles listed under “Mechanical conveying” in *Powder and Bulk Engineering’s* comprehensive article index (in the December 2011 issue and at PBE’s website, www.powderbulk.com) and in books available on the website at the PBE Bookstore. You can purchase copies of past *PBE* articles at www.powderbulk.com.