Bucket elevator: Diagnosing and solving seven common problems

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The centrifugal discharge bucket elevator is one of the most commonly used mechanical conveyors for transferring large volumes of dry bulk materials vertically. Typically, plastic buckets are used in this elevator because of their durability, long operating life, abrasion resistance, noncorrosive and nonsparking properties, and other qualities. Plastic buckets that show abnormal wear or damage may indicate that your elevator is running outside standard operating parameters and will require adjustment or different buckets to keep running efficiently. After briefly describing a centrifugal discharge bucket elevator and typical plastic bucket materials, this article provides information that will help you troubleshoot and maintain your bucket elevator and buckets.

A typical centrifugal discharge bucket elevator consists of a top (or head) section, a discharge throat, a bottom (or boot) section, one or more trunk sections, and a belt or chain on which numerous buckets are mounted. The elevator's head section houses the head pulley (or sprocket), which is linked via a head shaft and bearing to a drive. The drive powers the pulley and, in turn, moves the belt or chain that continuously lifts loaded buckets.

The elevator's lifting side is called the up leg. As the loaded buckets move up and around the head pulley, the elevator's high belt speed and centrifugal force throw the material out of the buckets into the discharge throat. After discharge, the buckets move downward along the other side of the head pulley, which is called the down leg.

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 empty buckets round the boot pulley, they move upward along the up leg and pass an inlet hopper, where they're refilled with material. The elevator's trunk sections, which are mounted between the head and boot sections, enclose the up and down legs to control dust and protect the buckets and the belt or chain from the elements.

Plastic bucket materials

The lightweight plastic buckets, which are mounted on the belt or chain, are typically made of polyethylene, nylon, or polyurethane (or *urethane*), depending on the application. Polyethylene buckets are for general purpose applications and for transferring most dry bulk solid materials. Nylon buckets are impact- and abrasion-resistant and are typically used for moving abrasive granular materials such as fertilizers and sand. Urethane buckets are flexible and adhesion- and abrasion-resistant and are typically used with sticky materials or sharp-edged materials such as glass or animal feed.

Using bucket wear to troubleshoot your centrifugal discharge bucket elevator

Properly maintaining your centrifugal discharge bucket elevator maximizes elevator throughput and efficiency, cuts maintenance costs, and keeps your operation running smoothly. To ensure proper bucket elevator operation, you need to be able to identify and distinguish the different types of bucket wear or damage. Since the location and severity of the bucket wear or damage indicates the problem occurring within the elevator, you'll be able to quickly troubleshoot and fix problems. Here are seven common examples of bucket wear or damage, the elevator problems they symptomize, and ways to solve the problems.

Buckets are covered with material after discharge, as shown in Figure 1a, diminishing the elevator's throughput or creating cross-contamination issues. The buckets are made of an inappropriate material for your application, and you'll need to replace them. Often the best material choice is urethane. Urethane buckets resist adhesion and also "flex" to knock out caked-on residue.

Buckets are weakened or degraded, as shown in Figure 1b. This suggests that the buckets can't withstand an extremely hot material from an upstream process. To solve this problem, cool the material before conveying it to the bucket elevator, or install plastic buckets that can handle the material's hot temperature. The average operating temperature range for polyethylene buckets is -60°F to 200°F (-51°C to 93°C). The typical temperature range for nylon buckets is -40°F to 275°F (-40°C to 135°C). And the range for urethane buckets is around -60°F to 212°F (-51°C to 100°C).

Buckets' front lips are worn and have sharp edges, as shown in Figure 1c. This implies that the elevator's belt or chain is improperly tensioned. You'll need to increase the belt or chain tension to prevent the buckets from sliding along the bottom of the boot.

Buckets' sides are worn or scored, as shown in Figure 1d. This shows that the elevator's belt or chain isn't tracking properly. To fix this, adjust the belt tracking across the head pulley's crown by increasing the belt or chain tension to prevent the bucket from scraping along the leg casing.

Buckets' interior surface is worn, exhibiting a sandblast effect, as shown in Figure 1e. This means that the material's feed velocity into the bucket is too high. To prevent this, you'll need to reduce the material's infeed velocity, install baffles at the leg entrance, or replace the existing buckets with more abrasion-resistant urethane buckets.

Buckets' front lips are stretched out or broken, as shown in Figure 1f, or the bolts that secure the buckets to the belt or chain are broken. This suggests that there are obstructions inside the elevator or that the elevator's belt or chain is improperly tensioned. First, check the elevator's boot and throat-plate clearances and each leg casing for any obstructions that the buckets may be impacting, such as an open inspection door or tramp metal. Next, increase the belt or chain tension to keep it taut so that it doesn't flap and allow the buckets to hit the elevator's interior or internal components. If necessary, install impact-resistant nylon buckets.

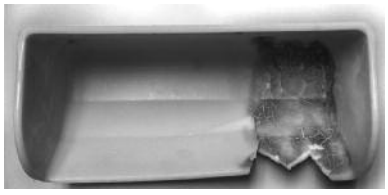
Material doesn't completely fill into the buckets or discharges from them too late or too early (called **backlegging**) or not at all. This indicates that the buckets are filling or discharging inefficiently, which diminishes the elevator's throughput capacity. A solution is to install vented buckets to improve the efficiency of bucket fill or discharge. Figure 2 shows an example of a vented bucket. These buckets are available with various numbers of vents in various configurations, depending on the application. For dense materials such as flour, meals, or mash feeds, the bucket vents allow air to escape as the bucket is filled. During discharge, the vents allow air to return into the bucket, preventing a vacuum from forming that can hold material in the bucket and cause backlegging. For extremely light materials such as alfalfa or bran, the bucket vents decrease

Figure 1

Examples of bucket wear or damage

a. Material stuck to the bucket surface

b. Degraded bucket



c. Worn front bucket lip with sharp edges

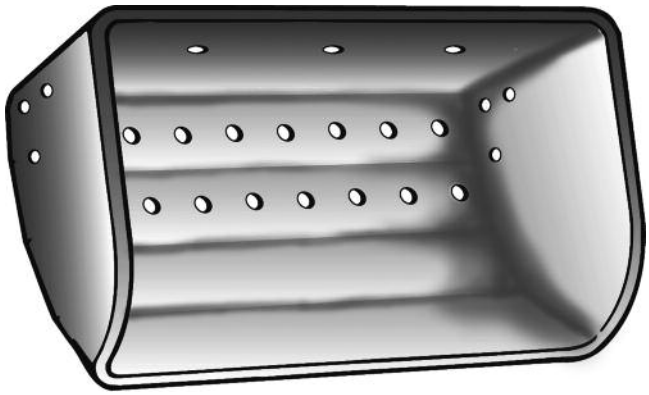
d. Worn bucket sides

e. Worn bucket interior

f. Stretched-out front bucket lip

Figure 2

Example of a vented bucket



the air turbulence that can occur in the elevator up leg. Reducing the air currents minimizes the circulatory pressure within the elevator, which can draw a light material through the down leg and back to the boot. Your elevator manufacturer or bucket supplier can help determine the vent pattern best suited for your application.

Maintaining your bucket elevator

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 delamination.
- Check the throat plate and adjust 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. **PBE**

For further reading

Find more information on this topic in articles listed under "Mechanical conveying" in *Powder and Bulk Engineering*'s comprehensive article index (in the December 2010 issue and at *PBE*'s Web site, www.powderbulk.com) and in books available on the Web site in the *PBE* Bookstore. You can also purchase copies of past *PBE* articles at www.powderbulk.com.

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