Maintenance planning for your positive-discharge bucket elevator

John McDonald UniTrak Corporation

Following a well-designed bucket elevator maintenance plan can pay big dividends by reducing unplanned downtime, extending equipment life, and lowering operating costs. This article provides tips for designing and implementing a maintenance plan for a positive-discharge bucket elevator.

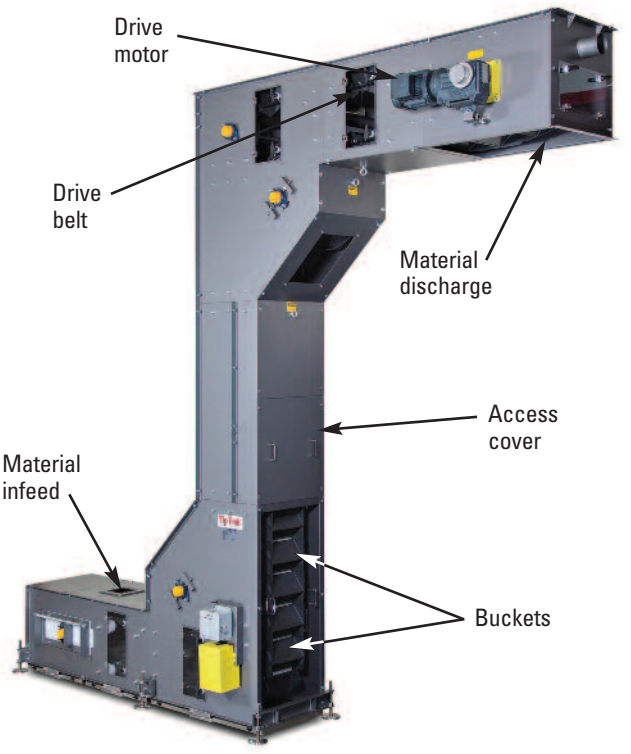
A positive-discharge bucket elevator, as shown in Figure 1, is designed to gently handle bulk solid materials without breakage or spillage. The elevator has buckets that are side mounted between two drive chains or belts, allowing the buckets to remain level while the elevator conveys the material vertically, horizontally, or at any angle and then tip to empty the material only at the elevator's discharge point. The buckets interlock or overlap to prevent spillage during continuous material infeed, and the elevator design can be open or enclosed to prevent material contamination or contain dust. The elevator is commonly configured to form a C, Z, or L shape but can be customized to suit plant layout and application requirements.

A comprehensive maintenance plan for a positive-discharge bucket elevator should cover all the elevator's major components, including the drive unit, bucket assembly, frame, infeed, and discharge. While you should always consult and follow the maintenance plan and schedule recommended by your bucket elevator manufacturer, the following outlines the key areas a well-rounded maintenance plan should cover for a typical positive-discharge bucket elevator.

You should supplement this plan to include maintenance on any optional equipment your elevator

Figure 1

Typical positive-discharge bucket elevator



system may have, either from the initial installation or from post-installation modifications. For example, if your elevator has an optional clean-in-place system, you should adapt your plan to include inspection and maintenance of that system.

Drive unit

A bucket elevator's drive unit powers the elevator and allows the operator to set and modify the elevator's operating parameters, such as speed, torque overload, and ramp-up or soft-start settings. The drive unit typically consists of a drive motor, a power-transmission mechanism that transfers power from the motor to the bucket assembly, and a control system.

Maintenance activities to perform on the drive unit include the following:

Inspect the drive motor. Examine the bucket elevator's drive motor for signs of abnormal wear and excessive heating.

An operator inspects this bucket elevator's drive belts and bucket assembly for signs of wear or damage.

Inspect and adjust power-transmission components. Inspect, clean, and lubricate the drive mechanism, including the drive pulley, bearings, gears, sprockets, chains, guarding, and mechanical torque overload protection as applicable. Make any necessary adjustments and identify and replace any worn parts.

Inspect machine controls. Check electrical connections between the motor and the control panel for integrity. If the system uses torque overload protection or a variable frequency drive, inspect these and check the settings according to the manufacturer's instructions.

Bucket assembly

The elevator's bucket assembly carries the material through the elevator from the infeed to the discharge. Depending on your application and the elevator manufacturer and model, buckets may be made of plastic or metal and may be designed to either interlock or overlap with the adjacent buckets. The entire assembly is driven by either metal or rubber chains guided by drive pulleys.

Maintenance activities to perform on the bucket assembly include the following:

Inspect the buckets. Visually inspect the buckets for signs of abnormal wear or breakage. Excessively worn buckets may be prone to fatigue failure, while broken buckets may cause product spillage and reduced material throughput.

Inspect the assembly components. Inspect assembly components connecting the buckets to the drive chains or belts to identify any missing or worn parts. If the elevator uses interlocking (as opposed to overlapping) buckets, inspect the rubber connecting strips between the buckets to identify any missing or torn strips. Worn or missing bucket components may cause a bucket to detach itself from the drive chains or belts and jam the conveyor. Missing or torn connector strips for interlocking buckets may result in product spillage and reduced material throughput.

Inspect the drive chains or belts. Look for wear to the drive chains or belts and replace or repair if worn. Check the chain or belt tension and alignment and adjust if necessary. Misaligned chains or belts can quickly damage drive pulleys and components and contribute to chain or belt failure.

Elevator frame

The bucket elevator's frame is often overlooked in maintenance planning. Not only should the frame be

structurally sound, but proper elevator operation requires that the frame is square and vertical. A forklift or other vehicle or equipment may hit the elevator and bend the frame. If the elevator system doesn't have overload or torque protection, the torque generated by an extreme breakdown can twist or otherwise damage the frame. Whatever the cause, a misaligned frame can cause the bucket assembly to go off track, resulting in excessive wear and premature component failure.

Maintenance activities for the equipment frame include the following:

Inspect the frame condition and alignment. Check the elevator frame for wear and structural integrity and repair any damage. Verify that the frame is square, vertical, and properly secured to the plant infrastructure.

Inspect and adjust the transitional pulleys. Check the condition of the transitional pulleys and pulley bearings and lubricate and adjust as required. Worn pulley bearings can cause excessive noise and may eventually seize.

Inspect access covers and fasteners. Repair or replace missing, bent, or broken access covers and ensure that all cover fasteners are fully tightened. This is particularly important on fully sealed units conveying hazardous or explosive materials or materials that must not be contaminated.

Infeed and discharge

Be sure to include the elevator's infeed and discharge areas in your maintenance plan. Precisely controlling and monitoring the material feed is critical for successful bucket elevator operation. Improper feeding can result in overfilling or uneven material distribution in the buckets. Visually inspecting the infeed area can reveal material feeding problems that could compromise elevator performance. Excess material accumulation at the infeed, for example, may indicate poor integration with upstream equipment, uneven bucket filling, improper control settings, or possibly that the buckets aren't fully emptying at the discharge end.

Key maintenance activities for the infeed and discharge areas include the following:

Inspect the infeed area. Look for abnormal material accumulation around the infeed area, which may indicate other equipment problems. If your system uses an infeed chute, check the chute's condition and note any signs of abnormal wear or damage.

Inspect the discharge area. Ensure that the buckets are fully emptying during discharge. Many systems use a bucket discharge assist device such as a "knocker" that impacts the back of the bucket to help release sticky material. Incomplete material discharge may indicate that this device isn't working correctly. If your system uses a discharge chute, check the chute's condition and note signs of abnormal wear or damage.

Maintenance schedule

Now that you have a plan for maintaining your bucket elevator, you may be wondering how frequently you should carry out these maintenance activities. While every equipment manufacturer has a recommended maintenance schedule you should follow, you may also want to consider combining this *time-based* maintenance with a *condition-based* maintenance plan.

Time-based maintenance activities are scheduled in advance; your bucket elevator's time-based maintenance schedule should show which maintenance activities you need to do and when. You just need to carry out each

Ensure proper chain or belt tension and alignment to help prevent premature wear or damage to your elevator's chains or belts, drive pulleys, and other components.

maintenance activity when you reach that activity's scheduled date.

With condition-based maintenance, however, the goal is to identify any impending equipment failure and schedule maintenance activities when they're needed and not before. Condition-based maintenance monitors the equipment's *actual* condition to determine what maintenance needs to be done.

Under this approach, maintenance activities are triggered by key indicators of deteriorating performance or potential failure. These indicators include material buildup, elevator misalignment, bucket damage, unusual noises, and unsatisfactory performance data or material throughput.

For a positive-discharge bucket elevator, combining both time- and condition-based maintenance can be the most effective approach. For example, a bucket elevator's time-based maintenance schedule may be:

- After the first 8 hours of operation (following initial equipment installation)
- After 2 weeks of operation (1 week if the elevator operates continuously, 24 hours per day)
- After 60 hours of operation
- After every 500 hours of operation

You can then supplement this time-based maintenance schedule with the following condition-based maintenance activities:

- Perform an oil analysis to determine the oil condition in the speed reducer (if one is installed)
- Check the outer surface temperature of the speed reducer housing
- Check the drive motor temperature
- Check the drive motor current readings
- Perform a vibration analysis to detect a misaligned bucket assembly

You can perform many such condition-based maintenance activities using portable sensing equipment that's easy to carry to the bucket elevator.

Using both time- and condition-based maintenance techniques to develop a well-rounded bucket-elevator maintenance plan can help you reduce operating costs from unplanned downtime, lost material throughput, and unnecessary maintenance. Also, logging your maintenance activities and the elevator's parts failure history can highlight areas and components that are more susceptible to failure, which can help to make your maintenance activities more effective and further reduce unplanned downtime. **PBE**

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John McDonald is the service team leader at UniTrak (jmcdonald@unitrak.com) where he oversees the commissioning and service of the company's products. He is a certified trainer with PMMI — The Association for Packaging and Processing Technologies.

UniTrak Corporation Ltd.
Port Hope, ON
905-885-8168
www.unitrak.com