Playing It Safe at Bunge

Company's Commitment to Safety Starts at the Top

Two of the three Bunge facilities that have gone more than 25 years without a lost-time injury are in Illinois. One is the Albany facility (above) and the other is Fountain Bluff (Grand Tower) (left).

When Bunge North America tallied its results for 2003, one of the most impressive numbers was its safety record. The company exceeded its internal goals to achieve the best safety record in the company's 80+year history.

Bunge often has been considered a leader in safety in the food and agribusiness sector, winning dozens of safety awards from the Grain Elevator and Processing Society (GEAPS). Three facilities have gone more than 25 years without a lost-time injury.

But senior managers decided to aim higher. They wanted a safety record that is comparable to the best in any industry, not just agribusiness. To achieve this goal, managers asked employees from the top down to recommit themselves to improving the work environment in the company's 120 facilities. The decision to raise the bar was not arbitrary.

"When looking at the numbers, it was clear that our facilities with better safety records were also some of our most productive," said Phil Staggs, vice president, Human Resources. "Our commitment to safety is in the best interests of our employees and the company."

Bunge refocused its efforts first by assessing the status of its current safety program. With the assistance of an outside consultant, the company evaluated how managers and supervisors introduced and reinforced safety to their employees and how the employees responded.

That feedback provided the framework for enhancing Bunge's safety program. The first step was to formalize Bunge's commitment into a new safety policy.

Staggs noted, "In a move unprecedented at Bunge, all eight members of the Bunge North America management committee signed the policy that was then distributed to all employees, reinforcing the message that the commitment to safety went all the way to the top."

Senior executives verbalize the commitment as well. Whenever they address employees, safety is always on the agenda.

At the plants, managers and supervisors had always been responsible for teaching employees about safety practices. However, what is taught at safety meetings isn't always reflected on the plant floor. The company wanted to train managers on how to provide positive motivation for employees to improve. For instance, rather than criticizing employees who fail to meet safety expectations, managers are rewarding employees who meet or exceed expectations.

"Ask any employee with any company if they know the proper way to do a task and they probably will. Ask them if they always do the job the safe way and you'll find many employees admit to taking shortcuts," said Bob Marshall, Bunge's safety director. "Employees often believe that they will be penalized if they take the extra time to do a job right. The way to change that perception is to constantly reinforce the company's belief that the only way to do a job is the safe way regardless of how long it takes. Managers and supervisors must include proper safety procedures in the planning of every task. When employees see that commitment is real, they will adopt it as their own."

Marshall points to other steps that Bunge is taking, including providing more resources to improve safety. The company has hired two new safety advisors to assist facilities in training, proper investigation procedures, and the development of new safety initiatives. Bunge is also creating a newsletter committed solely to the company's safety program. Plus, Bunge's safety success is reviewed in quarterly business reviews.

The commitment to safety does not stop at Bunge North America. Bunge's parent company, Bunge Limited, also is evaluating its global safety performance as part of its strategy to pursue operational excellence. The initiative is called PQSE, which stands for productivity, quality, safety, and environment. It is based on Bunge's belief that its people are its most important asset; long-term mutually beneficial relationships with customers, farmers, and communities are essential; and to succeed, Bunge must continually improve its productivity.

Again, actively using senior managers to support the initiative is seen as a key to its success. Bunge Limited created a PQSE senior council with representatives from all of its operating companies, including Fred Luckey, senior vice president of Bunge North America and general manager of Bunge Milling. Through the senior council and working groups, the PQSE initiative is developing a host of measurement criteria as well as sharing best practices among the company's operations throughout the world.

In addition to his safety responsibilities at Bunge North America, Marshall is also the coordinator of the Safety and Health working group for Bunge Limited's PQSE initiative.

"Discussing procedures and incidents with our colleagues from around the world has helped us to spot opportunities more quickly," said Marshall. "Sharing business practices has helped us to evaluate our processes and procedures in Bunge North America. Often, it reaffirms the success of our safety program, but we are always striving for better, more efficient ways of operating."

The PQSE initiative and the revision of the Bunge North America program are still in their early stages, and the company knows it may be a year or two or more before it begins to see the productivity increase that will have a positive impact on the bottom line.

The DeSoto Landing facility in Arkansas has gone more than 25 years without a lost-time injury. This photo was taken at a recognition dinner that the Grain Division held for all of its employees. Shown here are from left to right, Tim Gallagher, senior vice president and general manager, Grain Division; Aaron Taylor; John Klein; Sammy Taylor; Felicia Castillo; Gerald Young; Paul Rancifer; Bailey Ragan, vice president, Grain Division; and Jim Brady.

"As you roll out programs like these, you often actually see productivity dip a little at first," acknowledges Staggs. "But once safety becomes ingrained in the culture, we believe we'll begin to see an increase in productivity as we see a corresponding increase in safety numbers."

The safety improvement is already evident. In 2003, 53 Bunge North America facilities posted no lost-time injuries or illnesses, representing more than 1.4 million hours on the job. The Grain Division had the best overall record, logging only one lost-time injury in nearly a million hours of work at its grain elevators. To show appreciation for the effort it took to achieve these results, senior executives of the Grain Division hosted a series of dinners for employees from all of its facilities. The Oilseed Processing Division also held awards dinners for the facilities that met or exceeded the safety goals for the year.

Bunge's safety effort also was recognized outside of the company. Its facilities in Decatur, Alabama, and Destrehan, Louisiana, were numbers one and two, respectively, on the GEAPS list of cumulative hours without lost-time injury or illness. Seven of the top eight awards for consecutive years of receiving a GEAPS safety award were presented to Bunge facilities in Desoto Landing, Arkansas; Fountain Bluff, Illinois; St. Charles, Arkansas; Hickman, Kentucky; Huffman, Arkansas; LaGrange, Missouri; and Yazoo City, Mississippi.

While the renewed commitment is providing positive results, the leadership at Bunge that continued focus on safety is key.

"We are learning that safety and productivity improvement is a process," said Staggs. "Safety experts tell us that for a safety program to be successful, the policies and procedures have to be second nature, something employees do automatically."

As a follow-up to the initial safety survey, Bunge is bringing in another safety-improvement consultant this fall. The goal is to survey all employees to evaluate how they are receiving the new safety program. They also will be asked to assess how well the company's leadership is fulfilling its commitment to safety. The results will help Bunge look for new ways to demonstrate its commitment to safety.

Staggs says, "Our job won't be complete until all employees understand that no job is so important or urgent that it cannot be performed safely."

Article courtesy of Bunge North America Communications, for the Oil Mill Gazetteer. *Photos provided by Bunge.* ■

Why Are Bucket Elevators Dangerous?

Design and Safety Criteria

Roberto Hajnal

Foreword

The purpose of this article is to emphasize the potential dangers of bucket elevators resulting from poor design, lack of proper maintenance, or failures that can be controlled by means of safety devices.

The solutions for minimizing risks and time losses are discussed, together with bucket-elevator design criteria, choices of materials that improve their performance, reliability, and safety.

Bucket elevators are the most typical equipment used for handling bulk granular material in grain-storage and processing industries. When properly designed and maintained, they represent an essential tool, providing efficiency, reliability, and safety.

But, if design is not appropriate or maintenance is poor, bucket elevators can become a potential loss source, especially when handling combustible material (Figure 1).

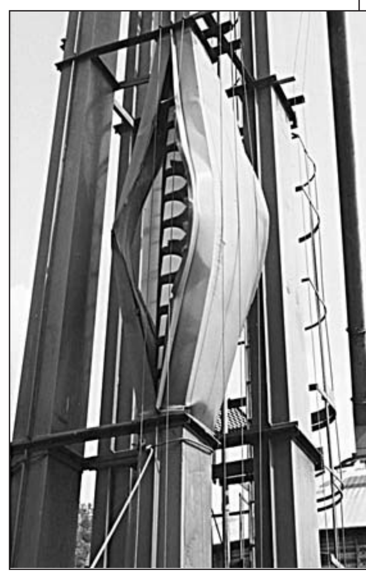
Bucket elevators resemble a turbine moving at high speed, displacing large quantities of air and combustible material that are agitated by buckets that rotate, thus generating a cloud of dust particles in the air confined in the same elevator casing.

After material is completely elevated, it is discharged at great speed. This also generates clouds of dust particles, which, together with the air, are confined inside the elevator casing.

This results in:

Fuel + Oxygen + Confinement = A BOMB

The only thing necessary to detonate the bomb is an ignition source.



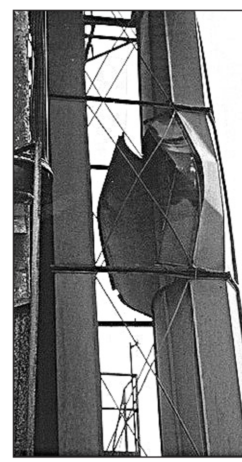


Fig. 1. Bucket elevators after a dust explosion.

Ignition sources

Heat and sparks can be generated in several ways. We will discuss some of the factors that can produce them.

Belt slippage

When installed for the first time, a bucket-elevator belt must be properly tightened so it does not slip. Regular retightening will be necessary; otherwise, belt slipping will produce heat that can turn into flame or fire.

Belt misalignment

The most common cause of belt misalignment is wrong path; however, it is also possible for the elevator to have been incorrectly mounted, i.e., it has been installed "out of line" or "leaning."

While the repositioning of the belt is a simple task, any equipment with an inherent defect can cause endless problems before fault is eventually located.

If belt misalignment is allowed to continue without being detected, it will cause friction that, in turn, will generate overheating and sparks.

Bearing failure

Inside elevators, bearings function in an extremely hazardous environment: under continuous operation, in atmospheres with a certain level of dust, and, in many cases, at high temperature. These conditions are not favorable for a long bearing life. If a failing bearing continues operating, it can generate overheating.

Welding and electric sparks

An additional source of heat and sparks originates when performing maintenance tasks such as welding on bucket-elevator casing, feeding chutes, or loading and discharge spouts. Sparks also can be generated by failing electrical contacts.

Flammable materials and residues

Product being fed into an elevator can contain different kinds of foreign material that may damage the belt and buckets and, even worse, can cause leg choking, thus generating an excessive increase of heat and sparks.

Another risk factor is that people working in the area smoke cigarettes, creating a potential ignition source.

How serious is the risk of dust explosions in bucket elevators?

Statistics are more readily available in the United States, where dust explosions in bucket elevators are a major cause for concern. Between 1992 and 2001, 150 explosions were registered that resulted in 21 dead and 122 injured, apart from $120 million of material damage—56% of these explosions were caused by bucket elevators.

Extensive legislation was introduced by OSHA in the United States and by ATEX in Europe. This legislation includes bucket-elevators' design, compulsory installation of monitoring devices, internal management, personnel training, and procedures implemented by means of specific safety plans.

Bucket-elevators' design: Selecting belts/buckets/cap screws/joints

Belts

While a bucket elevator is loaded or discharged, a certain level of static charge is built up by material rubbing against internal walls. Therefore, "antistatic" belts must be used, and casings must be grounded. Any static charge in buckets is transmitted to the belt through cap screws.

To minimize the risk of buckets causing friction against casing due to belt misalignment, a belt must be at least 10 mm wider to each side of the buckets, and a bit more in the case of higher bucket elevators.

When using modern high-traction belts, necessary tension is frequently obtained with few fabric layers. Choosing a belt must be based on a minimum quantity of fabric layers, enough to be held by cap screws. For a typical belt EP 160, which is made of synthetic rubber and fiber, at least three fabric layers must be used for buckets with a projection up to 140 mm; four fabric layers for buckets with a projection up to 190 mm; and five fabric layers for buckets with a projection of 200 mm.

Low-tightening characteristics are much more significant in belts used for elevators than for conveyors. It is advisable to use a maximum tightening of 1.5%.

Belt coating must be thick enough to keep cap-screw heads underneath; otherwise, cap screws can be torn out by contact with a pulley.

When handling products with high fat content, acryle-nitrile belts must be used to prevent splicing, since splicing also can be the cause of cap screw and buckets loosening.

Buckets—steel or plastic

Quite divergent opinions arise from this issue. The United States successfully has spread the theory that plastic buckets are less prone to become an ignition source than steel buckets (Figure 2). This is because plastic buckets are better in two aspects: they generate less static charge, and they have less possibility of causing sparks if they come into contact with casing due to belt misalignment.

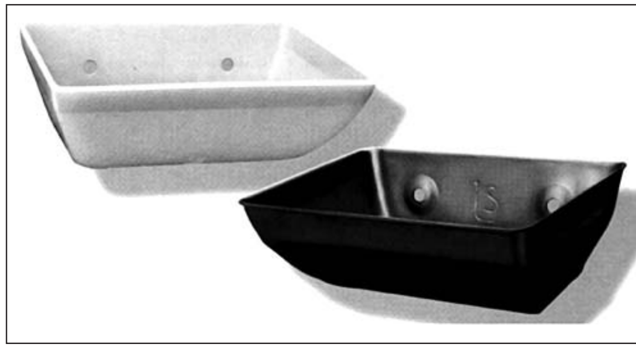


Fig. 2. Plastic and steel buckets.

That is why in the United States more than 80% of bucket elevators are provided with plastic buckets, while in Europe, for the same applications, proportion is the opposite. However, dust explosions did not occur due to bucket material.

The main reasons for belt misalignment, belt slippage, and bearing overheating are associated with deficient design, inappropriate maintenance, and total lack of monitoring of safety devices. This already has been accepted as a fact by legislations of OSHA, the United States, and ATEX in Europe.

People in favor of steel buckets state that static charge generated by moving plastic buckets causes electric sparks, which represent a hazardous potential source. But, research has proven that an increase of static charge is not a problem since, regardless of whether it is generated by a plastic or steel bucket, its energy is not enough to detonate a dust explosion. In any case, it is useful to use antistatic belts and grounded buckets.

Selecting a type of bucket—steel or plastic—should be mainly based on material to be handled and its application rather than on safety aspects.

Steel buckets are more abrasion-resistant, so their life is longer when handling abrasive material. Plastic buckets are better for sticky or wet products, since they do not allow material to adhere easily.

Since in elevators designed for receiving bulk products there is high risk of leg choking due to foreign materials, it is more advisable to use plastic buckets. Under a choked-leg condition, steel buckets resist the impact and are torn out of the belt, thus splitting it up. Since plastic buckets do not resist impact, they break, but the rear part remains attached to the belt, protecting it. This is an advantage at the level of operation rather than safety.

Even though plastic buckets wear out more quickly than steel buckets, when they break they are less likely to cause leg choking and are seldom torn out of the belt.

In fact, most importantly, buckets should be monolithic, i.e., made in one piece only, of injected plastic or stamped steel, avoiding the use of welded buckets.

Steel-welded buckets are very dangerous because any foreign material can cause joints to open, making buckets rub against casing and therefore generating sparks. Metallic pieces rotating in the elevator can be introduced into other equipment, whereas plastic pieces are relatively harmless.

Cap screws

Regarding safety, it is more important to properly choose cap screws for clamping buckets to a belt than to choose the material of buckets. Buckets that loosen can result in a direct ignition source, or they can lead to a choked-leg condition, making the belt slip and generating friction/ignition.

To prevent cap screws from "tearing out," cap-screw heads must have a big diameter. They must not stick out from the back part of the belt or the belt coating must be thick enough to keep cap-screw heads underneath.

In bucket elevators of intensive operation, it is essential to use self-locking nuts. These can be nylon locking inserts, metal locknuts, or double nuts.

Paying attention to these "minor" details results in high profits, since fatalities are reduced and safety is increased.

Bucket-elevator hed/boot/leg sections

Head section

Bearings must be located outside of enclosures. Pulleys must be of the "V" type to automatically align the belt. Pulleys must be coated both when handling wet or sticky material to avoid belt slippage, and also when handling combustible material. Discharge throat size must be carefully calculated according to the type of material that will be handled. When operating at high speed, it is vital for the head section to be properly designed. Material handled at high speed can start being discharged at 30º–40º in respect to the horizontal line. Head-section internal walls must be smooth to avoid interrupting material flow, which can result in leg choking and generation of dust. A consequence of inappropriate design is carry-back material, which reduces capacity and leads to dangerous belt slippage. The head section must be provided with an inspection door at the front and with explosion venting and an outlet for dust aspiration at the rear part.

Boot section

When handling dry or dusty material, a self-cleaning drum pulley is more convenient to avoid plugged conditions and belt slippage. Height and size of feeding inlet require careful calculation, depending on material and elevator capacity. Inspection doors and openings for clean-out must be provided to ensure correct maintenance.

Bucket-elevator legs

Elevator legs must be accurately aligned. It is usual for the belt to deviate from its normal course; this requires special control. For elevators up to 30 m high, belt width must exceed 10 mm to each side of bucket; the pulley must be 15 mm wider to each side of belt; minimum distance from pulley to casing must be 25 mm each side when using buckets with a projection up to 180 mm; and a total clearance of 50 mm must exist between buckets and casing. When using buckets with a projection of 200 mm, total clearance must be increased to 75 mm. Higher bucket elevators need more clearance to allow normal belt deviation, thus preventing buckets from coming into contact with casing and becoming an ignition source.

Monitoring safety devices—explosion prevention

The most common practice is to install only belt-slippage sensors. But, experience and research have proven that the main causes of accidents in bucket elevators are belt misalignment and bearing overheating, and only then, belt slippage.

Currently, in the United States a legal requirement exists for including the three types of sensors in bucket elevators operating in enclosed structures. Whether legal or not, sensors for detecting belt misalignment and bearing temperature can prevent costly accidents and time losses and, what is most important, can save lives (Figure 3).

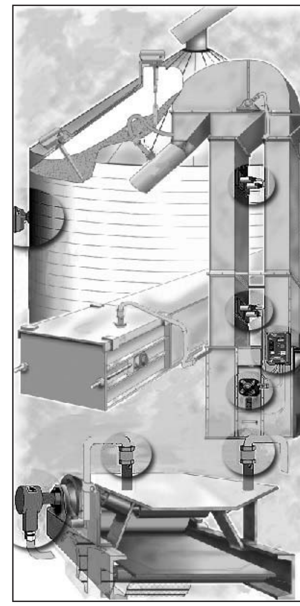


Fig. 3. Monitoring safety devices.

Bearings

Bearing sensors are used to monitor their internal temperature. Some models function actuating an alarm when bearings reach a certain temperature, while others provide continuous monitoring.

Bearing sensors are available in two basic designs:

a. One design has the temperature sensor installed on the top of the bearing block. When the bearing is overheated, its case is overheated as well, thus actuating the alarm.
b. Another design consists of a sensor inserted into the bearing block through the lubrication inlet. Because the probe detects overheating in the bearing core, this design is much more efficient than the previous one. Some temperature sensors are already furnished with a lubrication inlet. This makes their installation easier since the sensor can be screwed into the existent inlet of the bearing, and lubrication is performed directly.

Fig. 4. Electrical device used for monitoring elevators and conveyor belts

Belt-alignment sensor

Misaligned belts can cause friction against bucket elevators' internal walls. Heat generated by friction very quickly can reach a dangerous level of temperature. Belt-alignment sensors (Figure 4) are used to check belt deviation. If a belt moves to one side beyond a certain point, this sensor actuates an alarm, shutting down the elevator if a problem persists.

Belt-alignment sensors are available in two designs: contact and no contact. The contact type consists of a limit switch with an angular lever or, in some cases, a bronze plate containing a thermostat or a thermocouple.

Bronze-plate system

Located at internal walls of an elevator's casing, these devices include a temperature sensor similar to those used with bearings, but calibration of temperature is lower. They are designed to detect heat generated by a belt rubbing against a bronze plate. Unfortunately these systems are dangerous since they have not been updated.

First, they generate overheating, which is exactly what they are meant to prevent. Then, they get worn out very quickly. Sometimes a misaligned belt rubs against a bronze plate for a certain time, but not enough for the sensor to detect temperature rising. As time passes, this sporadic misalignment causes wear of plates, forming a canal in the belt crossing over them, which makes them ineffective (Figure 5). Bronze plates are not fail-safe in design. Just as limit switches monitor belt misalignment, if for any reason bronze plates come off their position, they will not indicate any failure.

Fig. 5. Bronze plate sensor. Wear due to friction.

Limit switch

Installed on one sidewall of casing, these devices are actuated when the belt is set in motion. Maintaining wear of limit switches at a minimum level is achieved by using steel or ceramic rolls to activate them. However, these devices are not updated and can lead to hazardous conditions. When the belt comes into contact with the small roll, this easily can reach a speed over 1400 rpm. So if roll fails, it can cause serious damage to bearings, resulting in dangerous overheating.

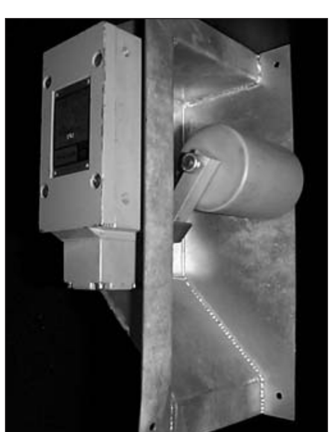


Fig. 6. Typical Limit Switch in mounting housing with bottom at an angle so as to prevent accumulation of material. Unfortunately, the system is not totally fail-safe.

The mechanical part of the switch also can wear out and be affected by material build-up. This system is absolutely not fail-safe (Figure 6). Apart from that, if the sensor gets loose and comes off its position, there is no way of realizing that the system is not operating correctly.

No-contact alignment sensors

Previously described sensors are of the passive type, i.e., they stand by until failure is produced (misalignment). The new concept of total safety (fail-safe) includes active systems.

These systems are another common technique used for detecting belt misalignment. Proximity sensors are installed at both sides of elevator casing, and they continuously detect buckets or cap screws.

When a belt is correctly aligned, under normal operation, each sensor transmits a signal every time a steel bucket or cap screw passes through sensing range. When there is a change in belt course, one of the sensing units starts missing input pulses, and the control unit determines there is belt misalignment. Metallic targets (cap-screw heads or buckets) get out of the preestablished range, actuating an alarm and finally shutting down the elevator. Since there is always a certain level of belt misalignment, which is considered normal since a belt does not come into contact with a casing, the best systems use two sensing units so this kind of "normal" movement of the belt does not actuate false alarms. Sensors also have a user-adjustable range that is calibrated according to normal operation of a bucket elevator. The control unit, to which sensors are connected, also has user-adjustable parameters for an accurate calibration (Figure 7).

Fig. 7. Control unit and no-contact alignment sensors.

Magnetic sensors work over a wider range than inductive sensors. They are not affected by dust, and they are more adequate for a series of large elevators. Alignment sensors must be installed in ascending leg (tightened line), just above the boot section. If installed in a higher position, care must be taken not to do it too far away from the pulley. The farther away from the pulley, the more a belt flutters and rotates, and the more difficult it is for the sensor to consistently detect cap screws passing.

When using steel buckets instead of plastic buckets, sensors installed in a casing leg must be located laterally, so they detect buckets and not cap screws, thus preventing false readings due to detection of steel buckets through the belt. It must be noted that in ascending a line a belt produces less movement, so it is easier to install a sensor and, therefore, obtain a more accurate signal.

The basic concept of an active sensor is that it monitors belt alignment constantly. Sensors emit a permanent signal since they measure pulses as long as a belt is aligned. The pulses' reading can be lost due to misalignment or sensor failure, e.g., damage, coming off position, or lack of electricity. Therefore, this type of sensor provides a warning signal when something is not functioning properly. On the contrary, passive sensors (limit switches, bronze plates, others) stand by until failure is produced, and only then do they react. If a sensor comes off its position, there is no electricity or any other failure occurs, the system does not emit any signal. This sensor does not monitor alignment; it just monitors misalignment.

Constant monitoring of active-type sensors provides the only solution for total and real safety in case of failure ("fail-safe") for detection of belt misalignment in bucket elevators.

Control units are of the "intelligent" type, i.e., they actuate an alarm only if failure (no signal) is detected for more than 20 seconds, or repeats itself three times in a minute. They function this way because it may happen that buckets are missing along the belt and, therefore, there is no monitoring action, or that a belt is deformed in some part and the signal is lost for a certain time, which is automatically corrected because a belt aligns itself again.

Touch switch—a new concept of contact sensor for belt and pulley misalignment

This device, without moving parts, is the most recent development regarding belt misalignment detection and can be used for bucket elevators and enclosed conveyor belts. This sensor measures the pressure of a belt against a hardened stainless steel switch (Figure 8). Even the most minimal bending can be detected immediately, transmitting a signal to the control unit and shutting down the elevator right away.

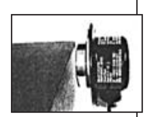


Fig. 8. Touch Switch: New concept of contact sensor for belt and pulley misalignment.

These sensors also can be used to detect pulley edge in case of misalignment. They are not affected by material or dust lying on them, and they never require any adjustment after being installed.

Belt slippage

Bucket elevators consist of two pulleys and one belt capable of generating thermal charges during belt slippage. Slippage over the head pulley can occur when belt gets loosened or overloaded. If the belt was capable of being permanently tight and of carrying an infinite load, then it never would slip; and the power unit operating at constant speed would be eventually stopped when the load is over its total capacity (as load increases, triphasic induction engines seldom slow-down and function at a constant rate when overloaded or stuck). Contrary to what most people believe, engine load current during slippage is, precisely, less than load current under normal operation. Current detector or amperemeters are not good indicators of slippage. Slippage must be detected by controlling belt speed directly or by monitoring rpm of the tail pulley. Sensor can be installed in the tail pulley to detect rpm of a target attached to its shaft.

There are various types of speed switches. "Plug-switches" are inductive sensors that detect a metallic target (e.g., a cap-screw head fixed to the boot shaft) and transmit a signal every time the shaft rotates, providing a unique signal by means of controlling difference of speed between head and tail pulleys. When speed difference is 10% or 20%, depending on calibration, the unique signal actuates an alarm or directly shuts down the elevator.

"Slowdown sensors" consist of a totally sealed and armored unit that can be installed in dusty atmospheres and even under water. It is a transistorized unit, which once magnetically calibrated from outside, provides two signals: one when difference of speed is 10% and the other when it is 20%. The first signal can be programmed to actuate an alarm, indicating that a belt is starting to slip over a pulley, thus allowing operators to shut down the elevator; and the second signal can directly stop the elevator.

Universal "Whirligig" support

This is a new patented supporting device used for every type of speed or motion sensor (Figure 9). It combines a metallic target, sensor support, and housing made of high-resistant plastic to avoid accidents. This makes installation of sensors easier. It is also equipped with a magnet so drilling is not necessary for mounting it on shafts. It is simply attached to the surface and can be easily removed for maintenance. It also has a spider that allows measuring 4, 6, or 8 pulses per revolution.

Fig. 9. Slowdown sensors with tachometer and universal "Whirligig" support.

Multirisk monitoring systems

Some systems, such as Watchdog Elite^{TM}, include several inlets for different sensors to control not only belt speed, but also belt alignment, bearing temperature, leg-choking condition, and pulley alignment. These tested and approved systems are specifically designed to control risks present in grain and oilseed industries.

The Watchdog control unit offers capability for measuring the three risks in a single unit that can be interfaced to a PLC if so required. Alternatively, there are modular systems that allow interchanging and combining devices of individual controls. When compared to industrial-elevator costs, additional cost for comprehensive monitoring is relatively low. And it is, in turn, meaningless when compared with the high cost of shutdowns or property and material losses.

Relief equipment, protection, and suppression of explosions

While there are still doubts regarding explosion relief panels for containers, it is generally accepted that explosion relief panels for legs must be equal in size to the section of leg casing mounted. They must be located at intervals of 6 m along a leg casing. The top surface of the head section also must be provided with an explosion relief panel, and its size must be similar to panels used in a leg casing.

Because the installation of relief panels in a boot is not feasible, it is generally accepted that there is no need for placing them in that section. If a dust explosion occurs, relief panels will allow fire to deflect from the elevator.

Apart from the burned dust cloud dissipating, dust explosion also will generate strong pressure. If the bucket elevator is inside a building, a secondary explosion may occur, causing even more damage and injuries. So as to prevent secondary explosions, first- explosion pressure must be vented to a safe outside location. These devices are made available by specialized suppliers.

Installation and maintenance

After starting-up, special attention must be paid to the belt to ensure it is sliding smoothly and is properly tightened. The belt will require regular retightening.

A specific maintenance program is essential and must include checking the tension, movement, and condition of belts; monitoring buckets; and controlling the head pulley lining condition. The tail pulley must be carefully checked for signs of slippage. Bearings also must be inspected, as well as monitoring devices.

It is extremely important for personnel to be aware of potential risks present in bucket elevators, and they must be duly trained to find out and check for potential failures during equipment operation.

Conclusion

Bucket elevators are typical equipment for handling bulk material and are commonly used worldwide. When properly designed, equipped, and maintained, they are safe and highly efficient. But if wrongly used, this equipment can turn into a gunpowder barrel ready for an imminent explosion.

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