Conveyor Safety

Hazards are ever-present in the steel plant environment, and a heightened awareness and emphasis on safety is a necessary priority for our industry. This monthly column, coordinated by members of the AIST Safety & Health Technology Committee, focuses on procedures and practices to promote a safe working environment for everyone.

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Comments are welcome. If you have questions about this topic or other safety issues, please contact safetyfirst@aist.org. Please include your full name, company name, mailing address and email in all correspondence.

This article presents a real-life scenario of a worker, Willy (name changed), not adhering to conveyor safety and subsequently sustaining a major injury, and provides an analysis of the potential hazards.

Willy was a turn supervisor in a coke plant. He was a little rough around the edges, but completely concerned for his crew's comfort, health, safety and well-being. One cold winter night, he and his small crew were huddled in the supervisor's shanty, keeping warm. A sound familiar to anyone who has ever worked in coal/coke handling areas jolted them alert: the belt slip detector on one of the uppermost conveyor belts. Willy told the crew to stay warm and he would go up and get the belt moving again. It was a common occurrence and the solution was well known.

Willy walked through the galleys until he reached the head pulley of the highest conveyor. It was turning, but the belt had stopped because the pulley was coated with ice. The guarding around the head pulley was more of a warning device than a guard — it was a three-sided steel plate wall about shoulder height that prevented pedestrians from walking into the danger zone. Still, it was close enough to the belt that someone could reach over the wall and touch it.

Willy did what he'd done many times before, as had generations of coke plant workers before him: he followed the unofficial procedure for quickly getting a slipping belt moving again. He picked up some spilled coal from the floor, then reached over the guard and tossed the coal into the nip point of the pulley. The friction caused by the coal usually got the belt moving again.

He didn't get enough coal onto the pulley and the belt kept slipping. Willy reached down and grabbed a big load of coal in his glove. He moved closer to the pulley so he wouldn't miss and tossed in the coal.

The belt started moving again, but not because of the coal. The tips of Willy's glove got caught in the nip point. Then his fingers, his hand and his arm. He wasn't dragged completely into the pulley because the guard/wall held his body back. The arm kept going, though, and was traumatically severed at the shoulder.

Willy was tough. He walked back down the galleys until he got to the shanty. He sat down in his chair and asked the crew to call an ambulance. He recovered, was fitted with a prosthesis, and eventually returned to duty as a turn supervisor, but his life was forever changed.

Safeguarding

Belt conveyors, both large and small, are dangerous, yet they often don't receive the safeguarding attention they deserve. During safety assessments, powerful conveyors are often found to be safeguarded only with emergency pull cables. These, of course, don't provide any protection against entanglement — they just give a chance to stop the conveyor if something gets caught. Just like any machinery, conveyors should be equipped with safeguards that prevent anyone from reaching over, under, around or through to get body parts into a danger zone. Awareness barriers, such as the wall that failed to protect Willy, aren't enough.

Figure 1

A typical belt conveyor installation.

There are some fallacies that may cloud thinking about safeguarding conveyors. For example:

- Fallacy: Return idler rolls don't need to be guarded. If you get your hand in the pulley, you can easily pull it out because there's no weight on the belt. And since the idlers aren't powered, they'll stop if you get caught.
  - Wrong. At a conveyor speed of 300 fpm, your appendage will be carried in about a foot before you even realize you're in trouble. By then it's too late to gather your wits and pull out.
- Fallacy: Conveyors are "guarded by location" because only certain workers are allowed in the space where they're running.
  - Wrong. Authorized or unauthorized personnel all have to be protected. And any machinery that is missing a safeguard is supposed to be locked out.
- Fallacy: There is no practical way to safeguard a large belt conveyor.
  - Wrong. Entire textbooks are written on the subject.
  - There may be no cheap, easy and quick way to retrofit an existing conveyor, but it can be done — and must.
- Fallacy: The conveyor was installed before the Occupational Safety and Health Act (OSH Act) and other regulations were in force — so it's "grandfathered in" and nothing needs to be done.
  - Wrong. There is no "grandfather clause" in the U.S. Occupational Safety and Health Administration (OSHA) standards for safeguarding.

So, what are the options? Safeguards are often categorized into several classes: barrier guards, safeguarding devices and guarding by location.

Guarding by Location

Guarding by location means that it's impossible for a person to come into contact with the dangerous equipment when it's in operation. Conventional wisdom and some standards (e.g., the OSHA standard for pulleys) talk about 7 feet as the safe distance. On a horizontal plane, 7 feet is certainly adequate, but overhead hazards 7 feet from the floor are easily reached by many adults.

Barrier Guards

Barrier guards are just what the name implies: material installed to prevent any unintended contact. They must completely enclose the hazard — the "over, under, around and through" principle. They may be fixed guards — solidly bolted to the equipment in a stationary position. Or they may be adjustable to account for different sizes of material moving through them. They may protect just the point of potential contact or they may protect several danger zones in an area (e.g., a fence). If a barrier guard is hinged or otherwise removable, it must be equipped with a safety interlock that immediately stops the equipment when the guard is displaced. All motion must be stopped quicker than a person can touch the danger point. Trapped-key interlocking is the ultimate in barrier guard interlocking.

Safeguarding Devices

Safeguarding devices can allow a dangerous piece of equipment to remain out in the open, unfettered by barrier guards. These are usually presence-sensing devices — when a worker nears the danger point, the machine automatically stops. Again, the motion must come to a dead stop before any part of the body can meet the danger point. The most familiar of these devices is the light curtain. In the steel industry, light curtains gained a reputation of being unreliable over the years — they were adversely affected by dirt on the lenses, and they couldn't be adjusted to account for sporadic movement or changes in position of the equipment. Modern electronic technology has overcome those issues, and light curtains can now be installed just about anywhere there is a linear space that must not be crossed.

Other presence-sensing devices include laser beams, sonar, infrared detectors and pressure-sensitive floor mats.

Other Hazards

Falling material is a hazard when pedestrians must cross under an elevated conveyor, such as a scrap yard conveyor.

Fig. 2 shows several hazards to individuals crossing under the conveyor:

- The return idler roll is not secured from falling to the ground in the event of bearing or other failure.
- There is nothing preventing material falling from the belt from falling onto persons below (e.g., during start-up or due to an overload).
- Dirt and frozen material stuck on the belt can fall to the ground as the belt makes its return trip under the bed.

Solutions to these hazards are readily available: fencing along the top side of the conveyor, a belly pan under the conveyor at the crossover, and securing of the return idlers with chains or enclosures. Belt scrapers are available to remove material stuck to the belt before it makes its return trip.

Conveyor fires are another hazard. These might be caused by hot material being placed on the belt (e.g., at the coke wharf) or due to overheated bearings on the rollers. A small fire can quickly turn into a disaster — the rubber belt will contribute significant fuel load, as may the material (e.g., pulverized coal or coke) on the belt. By the time emergency forces reach the scene, the fire will be well advanced. Access may be limited for firefighting. The heat of the fire may weaken the structural steel, causing the entire conveyor galley to fall.

Figure 2

Potential hazards to individuals crossing under the conveyor.

Speaking of structural failure, frequent inspections of elevated conveyor structures must be completed. These structures are out in the elements and often in environments that are conducive to corrosion. Stories of workers falling through the galley floor to the ground below are rare but always horrifying.

Conclusion

"Out of sight, out of mind" isn't the way to manage conveyor safety. Incidents involving conveyors don't happen very often, but when they do, they can be catastrophic. Take a walk through the mill today and look for opportunities to improve conveyor safety. ✦

Did You Know?

University of Luxembourg and Paul Wurth/SMS group Create Chair in Energy Process Engineering

Paul Wurth S.A., a company of SMS group, and the University of Luxembourg have entered into an agreement to create and finance the Paul Wurth Chair in Energy Process Engineering. The five-year agreement was signed on 4 March 2021.

The chair will be hosted at the university's Faculty of Science, Technology and Medicine (FSTM) in the Department of Engineering. It aims to conduct cutting-edge research in the field of hydrogen processing and related aspects of carbon-neutral industrial processes. The team attached to the chair will also engage in teaching at undergraduate, graduate and doctoral levels. In addition, the chair will participate in outreach activities to stimulate interest in key challenges in the field of engineering.

The partnership supports Luxembourg's ambition to develop a center of excellence in fields surrounding the emerging hydrogen economy, to stimulate industrial development in process engineering and hydrogen and low-carbon-emission technologies, and to increase the output of skilled engineers.

The chair ties in with the university's strategy to develop research and an educational offer with a focus on sustainability. Hydrogen is a crucial factor in future energy systems and energy transformation and in the transition to greener energy sources. Hydrogen also promises to become an alternative to coal, both as a reducing agent in steelmaking and as a driver of the large-scale transformation of the steel industry. By bundling their respective expertise, Paul Wurth and SMS group strive to lead the transformation of the industry toward carbon-neutral production processes.

"The new chair builds on an existing long-term cooperation between Paul Wurth and the university, in particular in bachelor and master teaching as well as the hydrogen think tank initiated within the Department of Engineering. It will be a catalyst for new research activities related to the future hydrogen economy which is important to industry and to the economy in Luxembourg and beyond," said Jean-Marc Schlenker, dean of the FSTM.