WORLD FERTILIZER®

MAGAZINE | **JANUARY/FEBRUARY 2020**




El Dorado Chemicals Co. - Ammonia Revamp Project • Kickoff 2012

WORLDWIDE ENERGY SOLUTIONS

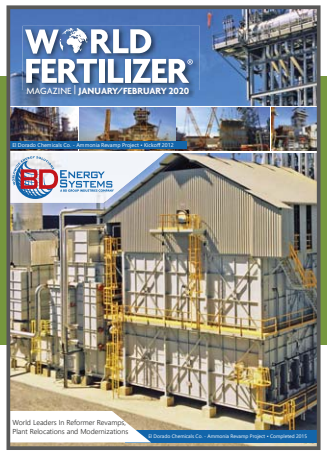
BD ENERGY SYSTEMS

A BD GROUP INDUSTRIES COMPANY

World Leaders In Reformer Revamps,
Plant Relocations and Modernizations

El Dorado Chemicals Co. - Ammonia Revamp Project • Completed 2015

CONTENTS



ON THE COVER

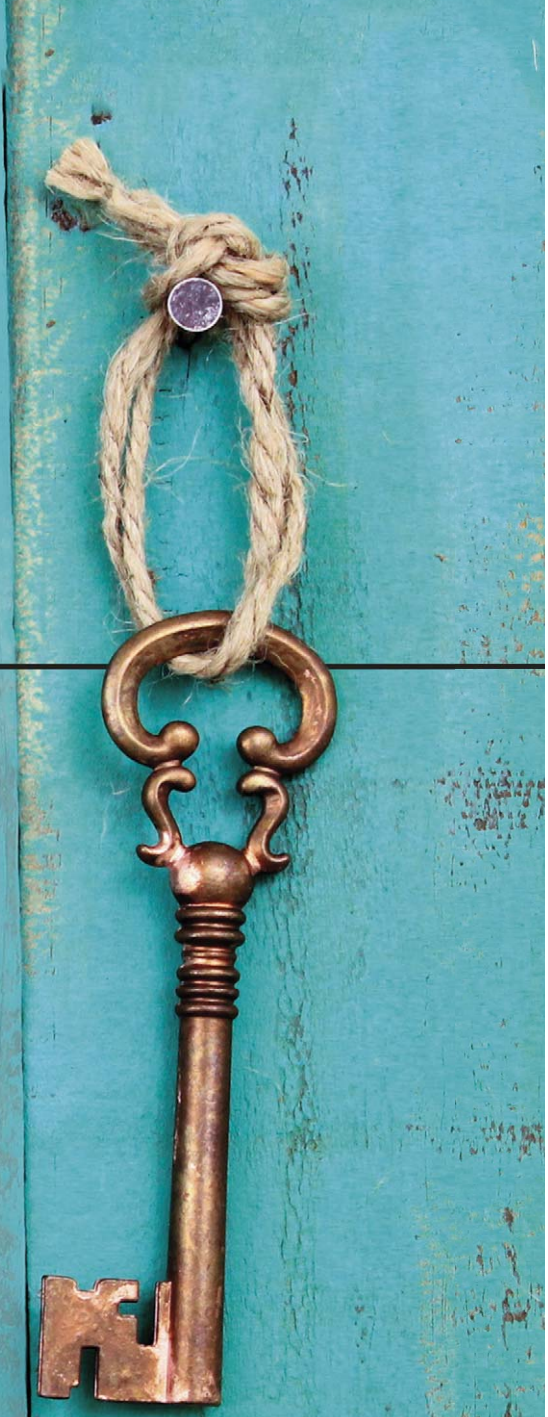
BD Energy Systems, LLC – a leader in turnkey revamp solutions – has executed more than 190 successful projects globally on ammonia, methanol, GTL and hydrogen plants of various licensor designs including refinery furnace revamps. The company's executed projects include: plant relocations, plant relocation economics, furnace revamps and modernisations, furnace and plant optimisation projects – for energy savings, production increase, NO_x reduction. Additional services include plant evaluations, turnaround planning, construction/technical advisory services, training, commissioning and start-up services.

follow @WorldFertilizer

like World Fertilizer

join World Fertilizer

Safety is Key



Daniel Marshall, Martin Engineering, USA, discusses unsafe work practices around conveyor belts.

Due to their size, speed, and high-horsepower drive motors, conveyors pose a number of risks to personnel working on or near them. In addition to all of the physical danger zones, workers can be injured by their own actions or inactions. No one goes to work planning to get injured while performing unsafe acts. When performing accident investigations, the easy way out is to list the cause of the accident as an unsafe act. In reality, the root causes are usually much more complex than a worker simply acting in an unsafe manner.

Accidents are typically a result of a complex combination of probabilities and risk/reward decisions judged against company culture, rather than a single unsafe act. One could say that without the unsafe act, the injury would not have occurred. However, it can equally be said that the accident would not have occurred if the design were safer; if there was adequate maintenance; if there was less pressure for production; if there had not been a time limit on the job; and so on.

Proper, in-depth accident investigations often draw uncomfortable attention to a company's safety culture, management, conflicting rules and goals. The complexity of these factors collectively can result in the worker making a heat-of-the-moment decision that makes sense when every external factor and pressure is taken into account.

Where danger comes from

Company culture, time pressures, and worker training (or lack thereof) are generally absent in accident statistics reports. These are often as much of a contributor to an accident as the unsafe act itself. 'Management by edict' is easy but ineffective. It is human nature to resist authority, and when rules get in the way of completing tasks they can become 'stupid rules' that everybody ignores. As designs and technology change, management teams need to listen to workers and continually update safety rules and practices. A thorough risk assessment is the ideal way to bridge this gap between workers and managers when the rules need to be reviewed.

A belt conveyor is a powerful machine with thousands of moving parts. These moving components can not only severely injure a worker, but inflict an injury within a fraction of a second. A typical conveyor belt

moves at a constant speed, commonly running between 0.5 – 10 m/sec. (approximately 100 – 2000 ft/min.). At the very minimum, a worker who inadvertently touches a running conveyor belt – even with world-class reaction time and total focus on the danger of a conveyor – will come in contact with at least one carrying idler. The chance that the worker will hit return idlers, chute uprights, stringer supports, pulleys, and drives is high and the results are often disastrous.

Figure 1. Working on or around a moving belt can lead to serious injury or death in an instant.

Figure 2. Riding a conveyor is hazardous, even in locations where man-riding is an accepted practice.

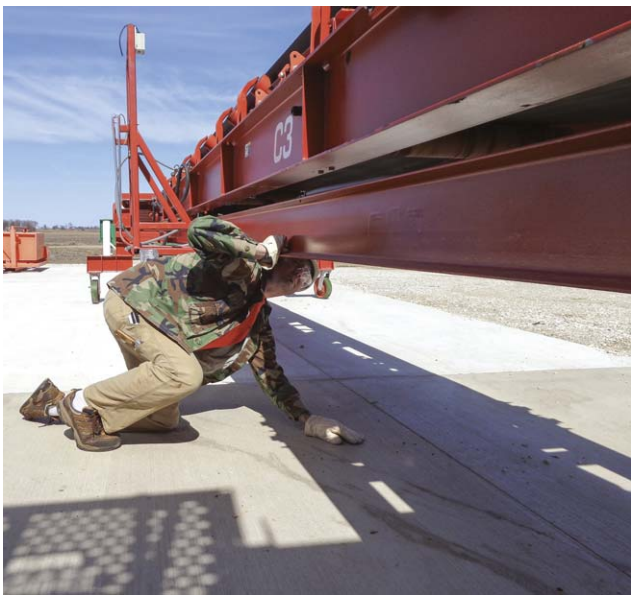


Figure 3. Taking a shortcut by crossing over or under a conveyor can lead to injury.

Conveyors apply large amounts of mechanical energy to what is essentially a giant elastic band, stretched tight and threaded through a maze of components. This stretched band is often loaded with tonnes of material, sometimes using drive motors as large as 600 HP (450 kW). Given the weight, inertia and kinetic energy, enormous forces are involved and the human body – able to generate less than 1 HP – is simply no match.

An element of complacency also influences workers. An unsafe practice repeated becomes an unsafe habit. The habit becomes so ingrained a worker may not even consider it to be hazardous. Human beings have a tendency to take ownership of habits, good or bad, to the point of feeling threatened when the habit is questioned. Forgetting these simple truths about conveyors has contributed to many injuries and fatalities.

Working around a moving conveyor

It has been estimated that two-thirds of the fatalities involving conveyor belts take place while the belt is moving, usually as a result of a worker becoming entangled or crushed by moving equipment. The majority of these take place when maintenance or housekeeping is being carried out on or around an energised conveyor (Figure 1).

These fatalities are generally caused by two compounding practices. The first is performing maintenance without thoroughly locking, tagging, blocking and testing the conveyor. The second is touching a moving conveyor belt with a tool or implement of any kind. When these two choices are combined, the results are severe and often fatal. Even working on a conveyor that is switched off, but not locked out, can lead to injury.

Workaround and shortcuts

An intelligent and creative worker might invent or discover ways to expedite certain functions and make work easier. Unfortunately, some of these shortcuts bypass safety hardware and/or best practices, thereby putting the worker in harm's way.

The most common of these workarounds involves the improper locking-out of a conveyor system. The purpose of a lock-out is to de-energise all sources of energy, whether latent or active. Failure to properly lock out can exist in many forms, varying from disregarding lock-out requirements, to working on a moving conveyor and improperly stopping the conveyor. An example would be pulling the emergency stop cord and assuming that the conveyor is de-energised.

Another common workaround involves entering a confined space without following established procedures. A confined space is any enclosure that is both large enough and configured in a way that allows an employee to enter and perform assigned work. They have restricted means of entry or exit, and are not designed for continuous employee occupancy. Very specific rules apply to workers when dealing with confined spaces. Failure to follow those rules can result in increased danger or death. Common mistakes around confined spaces include:

- Entering the space alone.
- Not checking gas levels.
- Failure to ensure that systems within in the confined space are de-energised.

In some countries (where not prohibited), a tempting shortcut involves a practice called 'man-riding'. Rather than walking a lengthy distance, a worker may be tempted to ride a conveyor to be transported to other parts of the plant quickly (Figure 2). This transportation is without the benefits of restraints or even seats. The worker has no control of speed and has no ability to stop the conveyor in the event of danger. Man-riding workers may also strike any stationary obstruction in the conveyor's path.

The problem of exiting the conveyor can be a serious hazard. A jump from a moving conveyor may result in fall injuries. Momentum means that when a person jumps from the conveyor, that person will land and keep moving in the direction of the conveyor, at approximately the same speed. There are countries, including Germany, South Africa and the UK, where some facilities use 'man-riding conveyors' as the appropriate method for workers to reach their work stations. In the interest of safety, these facilities should have specially-designed conveyors, or at least special boarding and disembarking stations. In addition, special training should be provided to teach workers how to board, ride and disembark in a safe manner.

Another potential unsafe behaviour involves crossing a conveyor in a risky manner. Conveyor belts are often lengthy systems that bisect a production facility (Figure 3). Workers are often required to cross a conveyor line to get to an area that is in need of service or maintenance. To save time, a worker might step over, or cross under, the conveyor. 'Crossing under' involves multiple hazards. Return idlers may be considered guarded by their location, but what if the crossing path is over a pile of spillage or carryback?

If any of the worker's body comes into contact with the moving conveyor, it will either act like a grinder and abrade the skin, or pull the worker toward rolling components. Crossing under also places the worker at risk from falling objects. Material from the belt's cargo or conveyor components could fall on a worker, causing injury or death. More likely, the spillage or carryback will cause a trip that results in a muscle strain, twisted knee or fall injury.

'Crossing over' a conveyor without using a designed and designated crossover structure also presents dangers. Typically, a conveyor structure is not designed to have humans climb on it; it is engineered for mounting and supporting components and cargo. There is a high risk of a slip and fall. If they are lucky, the worker may fall on the ground; if not, the worker will fall onto the conveyor belt. If the conveyor is in operation, the worker may be carried downstream, which can result in contact with the conveyor structure and rolling components, or being thrown from the conveyor at the discharge. Travelling on a conveyor along with the load is highly likely to result in injury. Falls may be from significant heights, which frequently result in permanent disability or death. The safe approach to crossing a conveyor is to use specifically engineered, designated crossover or crossunder points (Figure 4).

Anything in a worker's line of travel is a potential obstruction. These can range from piles of spillage, items

Figure 4. A designated crossover designed for that purpose is the only safe path to the other side.

Figure 5. Safety equipment such as pull stops and emergency switches are vital to conveyor safety.

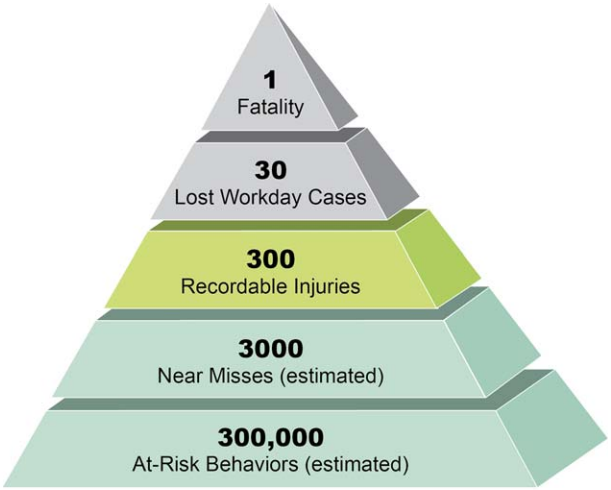


Figure 6. The most effective way to reduce fatalities is to minimise unsafe behaviours.

lying on the walkway or work areas, or low overheads. An obstruction can cause several hazards; it can present the opportunity for a trip or fall. If the obstruction is in the middle of the walkway, a worker will have to walk around it. If that revised path brings the worker closer to a conveyor, the worker is situated closer to the hazards of the conveyor.

Neglected safety and control mechanisms

Emergency stop pull cords are the last line of defence if the belt needs to be stopped quickly in response to an entrapment or impending equipment failure. The reaction window when such an event occurs is usually extremely brief, so workers need a way to stop the conveyor as fast as possible. In addition, the belt will not halt immediately; it must coast to a stop. If the cord or switch are broken, or the system is disabled in any way, workers will have lost the final tool they have to protect themselves (Figure 5).

Unfortunately, it is common practice to disconnect or bypass safety and control devices which cause nuisance stoppages of the conveyor. Most common of these bypassed controls are chute-level and wander switches. A bypassed plugged-chute sensor is most likely the result of frequent high levels of material in the chute. However, when it is not a simple case of an overfull hopper and the chute overflows, many additional hazards are possible. These include belt slippage (resulting in a fire), belt breakage (resulting in a major outage), or large amounts of spillage.

The multiplying effect of unsafe practices

Often an accident occurs due to a combination of several poor work practices. A Mine Safety and Health Administration (MSHA) fatalgram from 1999 recounts a fatal event at a mine, when a worker entered an unguarded area alone, near an operating conveyor that was not locked out. The worker's clothing became trapped in the conveyor's operating tail pulley. Four unsafe practices and two unsafe areas combined to produce a catastrophic event. Any individual factor may have led to injury or even death, but a combination of all factors sealed the worker's fate.

In a 2003 study, ConocoPhillips Marine found a correlation between fatalities and unsafe practices. The study showed that for every fatality there are an estimated 300 000 unsafe behaviours (Figure 6).

The research also quantified lost-time accidents, recordable injuries, and near misses. These are independent variables, so the numbers do not mean that lost day incident no. 31 will be a fatality. But they do indicate that there is a statistical probability of a fatality for every 30 lost work day incidents. Therefore, statistically speaking, an effective way to reduce fatalities is to reduce unsafe behaviours.

Conclusion

While even one unsafe practice has the statistical potential to lead to serious repercussions, conveyor accidents are rarely the result of a single action. More often, they result from a combination of company culture and unwise decisions, some of which have been covered in this article. If workers can avoid these unsafe practices and minimise their presence in danger zones, their chances of avoiding an accident will rise considerably. WF