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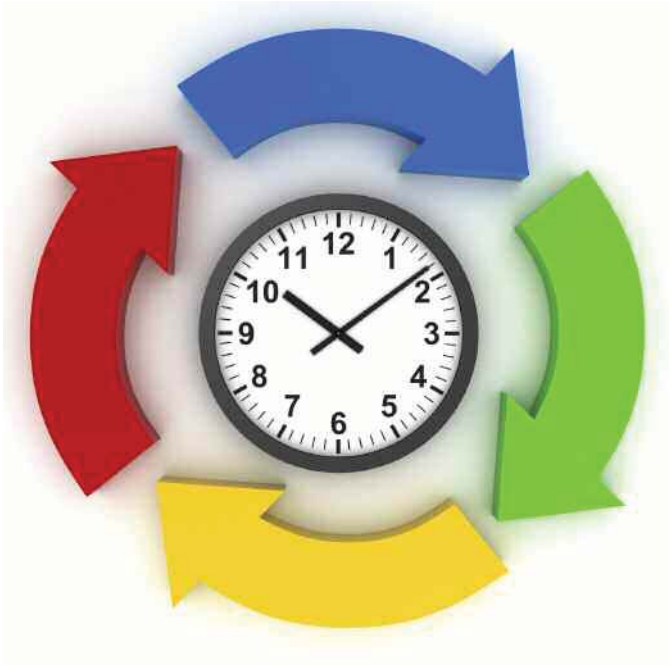

Safety & Health Effects of Shift Work

BY CHARLOTTE DORRITY

A considerable amount of research has been done on the effects of shift work on the safety and health of employees who work outside the standard work hours of 6:00 a.m. to 7:00 pm. In modern society, people work 24 hours a day. Employees who may be required to work night, evening and rotating shifts include public safety personnel, such as police officers, medical workers, power plant operators, oil and gas drilling and production personnel, manufacturing personnel and store and restaurant workers.

With shift work an established element of modern work life, it is necessary for employers to look at ways that the effects can be mitigated.

Parker, et al. (2007) state that just over 27% of the American workforce works shift work or extended hours. With this number of employees working outside normal work hours, it is important to explore what effects shift work may have on the health and well-being of workers. Does

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ADMINISTRATOR'S MESSAGE

Safety By Hope

Are pieces of your safety and health management system managed by hope? "I hope nobody gets caught in that machine." "I hope they lock out the equipment before they work on it." "I hope our employee on the graveyard shift who works by himself will be okay."

I see too much safety by hope, especially on the last issue mentioned. Most manufacturing sites have someone who works alone, out of contact or out of view of co-workers or the public for a period of time. It could be the person repairing the HVAC unit on the roof by himself or herself. It could be the lab employee who provides quality control. It could be the wastewater treatment plant operator on the day shift. It could be the warehouse worker or even security on the night shift. Therefore, instead of hoping the employee is okay, most manufacturing sites need a procedure to safeguard, reasonably, those who work alone.

David F. Coble

Most Canadian provinces and Europe have legislation that requires employers to safeguard those who work alone. OSHA has eight or nine standards that prohibit employees from working alone, such as permit confined space entry, hot work, work on high-voltage systems, etc., but no specific standard to safeguard those who work alone. NIOSH has investigated cases where in its FACE report, working alone without safeguards in place was one of the root causes.

Work-alone policies should include elements, such as defining who works alone, the risks they face and the amount of time they work alone. Once that is determined, procedures for communications, first aid, emergency response, check-out/check-in procedures, procedures to call in regularly or to check on the employee regularly, mandown indicators and training can be implemented.

During my days as an OSHA inspector, I investigated cases where the employee working alone was caught in a machine without a way to signal for help; where the forester was working in the woods alone and had no way to communicate; where the painter in the tank farm was overcome by heat and lay there for several hours.

What does your work-alone procedure look like? What does it include? How effective is it? Let me know. The Canadians and Europeans are ahead of U.S. workers on this issue, so let's share best practices. ✪

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By Brian Edwards, P.E. & P.H. Haroz

Keeping Hazards in the Box

Minimizing the Risks of Combustible Dust

It has been more than 3 years since OSHA issued the combustible dust national emphasis program (NEP). The NEP has been effective in at least one goal—to increase industry awareness of the hazards of combustible dust. However, dust fires and explosions continue to occur at an alarming rate. One possible reason for the continued occurrence of dust incidents is the lack of clear and concise rules by OSHA. The NEP provides background information on the hazards of combustible dust and gives inspection guidelines for compliance safety and health officers (CSHOs), but it does not clearly define what an employer must do to protect its employees and processes. This article provides an update on OSHA's ongoing activities and discusses the major actions facilities can take to minimize the risks from combustible dust.

Photo 1: Dust accumulating on overhead surfaces.

Preventing the dangerous accumulation of dust inside facilities is often an endless, seemingly unwinnable battle.

Status of OSHA's Combustible Dust Rulemaking

In late 2009, OSHA released an advanced notice of proposed rulemaking (ANPR), officially beginning the process to create a regulation specifically addressing combustible dust. The ANPR provided data about combustible dust and requested information from industry. However, it did not include any details on what OSHA plans to include in the rule.

Since the ANPR was published, OSHA has held three stakeholder meetings on the topic of combustible dust. OSHA wanted to gather information from industry, labor and experts to be used in developing the proposed rule. In addition, OSHA held a web chat June 28, 2010, with the same goal. The most recent step taken by OSHA was an expert forum on combustible dust held May 13, 2011.

The expert forum was held to discuss possible options for developing a comprehensive rule to address the hazards associated with combustible dust. OSHA's stated intent was to both protect employees and be cost-effective for employers. It is impossible to predict exactly how OSHA will use the data, but a few main points made by the experts are summarized here:

•The scope of the rule should cover all facilities that generate and handle combustible dusts.

•The rule should make preventing hazardous levels of fugitive dust accumulation a priority. This should be achieved by proper engineering and maintenance of equipment and dust collectors, safe housekeeping and training.

•The rule should require some level of hazard/risk assessments.

•Some engineering controls should be required retroactively, but there should be some flexibility in how facilities decide what controls are required.

•The rule must contain multiple types of controls, both administrative and engineering, to be effective in reducing the hazards associated with combustible dust.

Preventing Hazardous Levels of Fugitive Dust Accumulation

A major discussion point during the OSHA expert forum was that the greatest hazards from combustible dust stem from the accumulation of fugitive dust in the work environment. By one expert's account, more than 90% of serious injuries and deaths associated with combustible dust occur from flash fires and explosions fueled by fugitive dust. Because of this, the OSHA rule is certain to focus on minimizing the amount of dust that accumulates on surfaces outside of process equipment. Already, OSHA has issued many citations for excess dust accumulation. According to OSHA's Status Report on Combustible Dust National Emphasis Program, 20% of the citations issued under the NEP were for inadequate housekeeping.

The most severe hazard associated with combustible dust comes from the threat of secondary explosions. Secondary explosions occur when a primary explosion, often inside process equipment or in an isolated area, sends pressure waves through a facility that dislodge fine dust that has accumulated on floors, walls and overhead surfaces. This fine dust then forms a cloud that spreads into a large area. If this dust cloud is ignited, a large, potentially devastating flash fire or explosion can occur.

Preventing the dangerous accumulation of dust inside facilities is often an endless, seemingly unwinnable bat-

tle. Housekeeping programs are the most common method used to combat this, but this can require much labor and are often not effective. Also, the act of housekeeping can present many hazards by creating dust clouds while cleaning and by requiring work in elevated and confined areas.

Many serious industrial accidents have begun when dust clouds created by housekeeping activities were ignited. One such incident occurred at CTA Acoustics, Inc. in Kentucky. According to the U.S. Chemical Safety Board's investigation report, a dust cloud created by line cleaning was ignited by a nearby oven. This was followed by a devastating series of dust explosions throughout the plant, resulting in 7 deaths and 37 injuries.

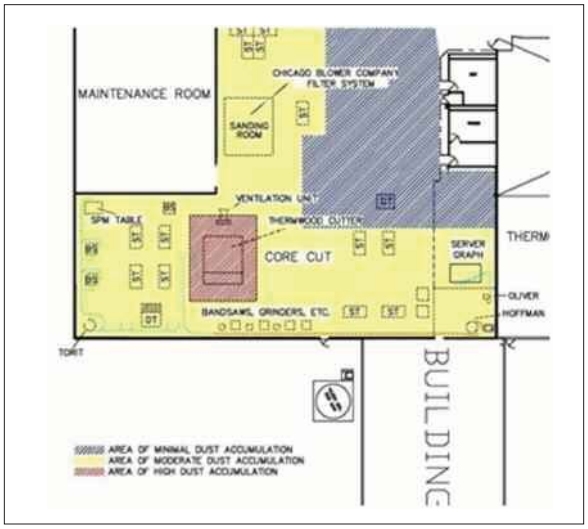
The first step in reducing fugitive dust accumulations should not be housekeeping; rather, it should be containment and collection of dust. Keeping the dust inside the equipment and using well-designed dust collection systems to capture any dust that escapes significantly reduces the housekeeping effort needed. In other words, the goal should be to keep the hazard inside the box (inside equipment) where explosion protection controls are much more effective.

Using mechanical design to reduce dust emissions from process equipment has been proven to be an effective control. In OSHA's respiratory protection rules, engineering controls are the preferred method to reduce employee exposures to toxic chemicals. The same holds true for combustible dust, but unlike industrial hygiene, the goal here is to reduce the risk of exposing employees to flash fires and secondary explosions. It is often stressed that increased housekeeping and increased maintenance can be used to reduce the hazards in an area. However, the last part of that statement (increased maintenance) is often overlooked. Think about it, where is the dust coming from? It is normally ineffective seals, poorly maintained equipment and often improper design.

"Improper design," in this context, does not necessarily mean bad engineering. Many process systems have great designs in terms of productivity and efficiency, but they were not designed with fugitive dust prevention as a high priority. Too often, facilities look at dust releases from process equipment as only "lost money" either due to lost product or increased labor. They do not see dust leaks as significant process hazards.

Photo 2: Dust leaks at a material transfer point in a wood planer mill.

Figure 1
Diagram Showing Dust Accumulation Levels in a Manufacturing Operation



When dealing with flammable liquids and gases, a loss of containment is a huge concern, and it is understandable that plant engineers are not as worried about dust emissions. In most cases, fugitive dust releases are not an immediate hazard. It may take days, weeks or maybe even months for a hazardous level of dust to accumulate in the work environment. It is nothing like flammable vapors and gases where a leak can result in imminent danger.

A major issue lies in the plants where dust is constantly accumulating, where housekeeping just cannot keep up. Plants will often move directly to electrical classification as the solution without looking at the root cause—dust leaks. Electrical classification (i.e., installing electrical equipment rated for safe use in areas with flammable or combustible liquids, vapors, dust or flyings) is important in hazardous locations, but electrical classification alone does not remove all ignition sources. A primary explosion inside a piece of equipment can generate sufficient energy to disturb accumulated dust and ignite it. In addition to limited effectiveness, electrical classification can be extremely expensive, especially for existing equipment.

The most effective course of action is to remove the source of fuel by preventing the fugitive dust leaks into the work environment. Often, this requires less equipment than plant engineers fear, and the return on investment goes beyond just increased safety and reduced housekeeping—it can pay off in higher efficiency and less product loss.

The first step is to evaluate where fugitive dust is being released. There are many "usual suspects." Some types of equipment to pay special attention to include:

- pneumatic and mechanical conveying systems;
- sifters and screens;
- bins and silos;

Photo 3: Phenolic resin dust accumulation due to inadequate dust collection.

- •material feeders and transfer points;
- •dryers and coolers;
- •grinders and hammermills;
- •bag loading and unloading;
- •truck and railcar loading and unloading.

Once the sources of fugitive dust have been identified, each piece of equipment must be evaluated to determine how the leaks can be eliminated. This is typically accomplished by mechanical redesign of existing equipment, but sometimes it might require changing the type of equipment used. For example, a vibrating screen might need to be replaced with a centrifugal separator.

For some processes and equipment, eliminating the release of dust is not possible. Therefore, properly designed and maintained dust collection systems are essential to capture dust that cannot be contained in the equipment. It is imperative that properly designed pickup points, hoods, ductwork and dust collectors are used. Inadequate airflow, overloaded dust collectors and improperly sized ducts can prevent efficient dust collection. The major culprit for bad dust collection is facility expansion. The most common occurrences are new ducts tied into existing systems or existing ducts being blanked-off, resulting in bad airflow in the lines.

Addressing the Hazards in the Equipment

Even if a facility is able to eliminate fugitive dust in the work environment, combustible dust hazards will continue to exist inside equipment. Contained fires and primary explosions in process equipment pose a significant risk to employees and property, so addressing secondary explosion hazards alone cannot be the only answer. To fully understand the hazards at a specific facility, a detailed hazard analysis is required. The entire nature of the process and the layout of the equipment, structures and utilities need to be evaluated.

Once the hazards in the equipment have been identified, appropriate fire and explosion prevention and protection controls should be selected. Many types of controls are available, so it is important to have qualified professionals prepare the selection and design of the protection systems. Often, this will require several layers of protection.

As an example, consider the protection required for a baghouse dust collector connected to a hammermill (a high-likelihood ignition source). The first layer of protection would be a spark detection and suppression system to extinguish a spark before it reaches the dust-laden air in the baghouse. A second layer of protection could be deflagration vent panels in the baghouse. A final layer of protection could be isolation devices, such as backblast dampers or fast-acting slide gates, installed on the upstream ducts to prevent a deflagration in the baghouse from propagating throughout the facility. No one layer of protection completely eliminates the combustible dust hazard, but by combining multiple layers of protection, the risk associated with the system has been lowered to an acceptable level.

Conclusion

OSHA is working diligently to develop a formal rule that addresses combustible dust. This rule will certainly place significant emphasis on minimizing dust accumulation in the workplace. By far, the most cost-effective means of reducing dust accumulation is to contain and capture the dust before it is released. Modifying and maintaining equipment and dust collection systems so that dust does not accumulate in the work environment can eliminate the need for electrical classification and can greatly reduce the amount of housekeeping required. Fire and explosion protection systems will often be needed to eliminate the hazards in some equipment, but if the potential for uncontained fires and secondary explosions can been reduced, the level of risk at a facility will drop dramatically. ✪

Brian Edwards, P.E., *is director of engineering for Conversion Technology Inc., Norcross, GA, where his responsibilities include managing SH&E-related projects for clients, with a focus on process hazard analysis and fire and explosion protection design. He holds a B.S. in Civil and Environmental Engineering from the Georgia Institute of Technology.*

P.H. Haroz *is president of Conversion Technology Inc., Norcross, GA, where his responsibilities include business development, project management and mechanical design of material handling, processing and combustion systems. He holds a B.S. in Mechanical Engineering from the University of Texas and an M.S. in Mechanical Engineering from the Georgia Institute of Technology.*