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Take a Key Step Against Combustible Dust Hazards

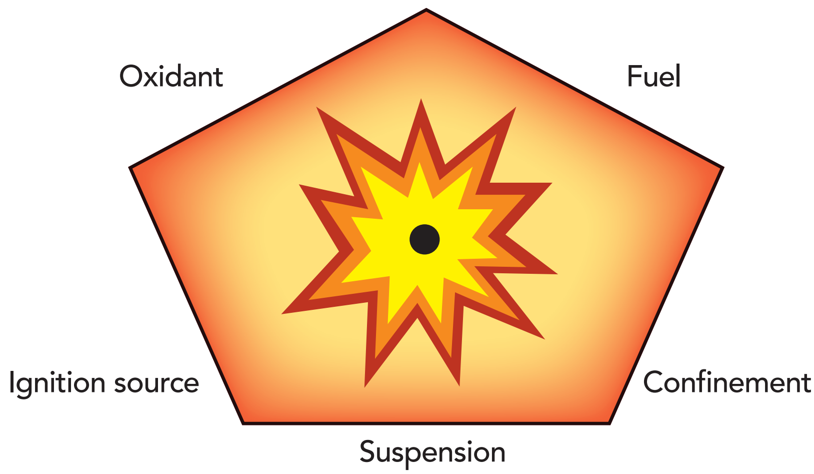
Having a sound mechanical integrity program in place is crucial

By Robert Gaither, DEKRA Process Safety

EFFECTIVELY MANAGING fire and explosion hazards posed by combustible dust can be a challenging task. After all, this requires not only a detailed understanding of the fuel/combustible material (dust) but also an understanding of the process equipment, operating conditions, maintenance practices, engineering and administrative controls currently in place, process design strategies, hazards analysis methods and the site's safety culture. It's not unusual to find facility management with a good understanding of a process but a limited understanding of the hazards posed by the combustible dust in the process.

Most organic solids are capable of burning when all three elements of the familiar fire triangle — fuel, heat and oxygen — are present at the same time. Any appropriate source of energy can supply the heat, and high enough concentrations of fuel and oxygen must exist to support combustion.

On the other hand, if a sufficiently large concentration of combustible dust is suspended and ignited in an enclosed space, the resulting combustion would develop pressure that can cause injuries and fatalities as well as damage or destroy equipment and buildings. The elements of dust suspension and combustion confinement commonly are added to the fire triangle to depict the "dust explosion pentagon" (Figure 1). If any element of the pentagon is missing, an explosion won't occur. However, in the absence of confinement, suspended dust still can combust, creating a "flash fire" or fireball that can



DUST EXPLOSION PENTAGON
Figure 1. An effective mechanical integrity program can prevent conditions that can lead to an explosion.

create a hazard to people and potential property damage.

This article outlines an effective approach to addressing combustible dust hazards by implementing a proactive and robust mechanical integrity (MI) program.

PROGRAM ESSENTIALS

Generally speaking, an MI program aims to manage the maintenance of all processing equipment and control systems of a facility to ensure the process is operating safely and within its intended parameters. If equipment or systems are run outside their safe operating limits, the potential for equipment failure clearly is much higher.

At minimum, MI includes the inspection, testing and preventive maintenance of "safety critical" equipment, i.e., those units whose failure or malfunction could result in a combustible dust fire or explosion. A more-comprehensive approach to MI would cover all process equipment that could contain combustible dust during normal or abnormal conditions, along with instrumentation and alarm/interlock systems used to prevent combustion. Equipment in the scope of the MI program must remain "fit for service" for its entire lifecycle, from procurement and receiving to installation, maintenance and decommissioning.

Three brief examples demonstrate the importance of MI to the control of combustible dust hazards:

1. Overheated bearings are a well-known ignition source for combustible dust. Depending on the specific service, equipment may require an anti-friction bearing

design. The bearings must be maintained per manufacturer recommendations, with proper lubrication and cleaning at a frequency that would prevent a hazardous buildup of dust. Alternatively, the design should provide for bearings that are outside the dusty environment.

An effective MI program would include temperature monitoring of the bearings, either by manual or automated means, to verify the bearing temperature remains at a safe margin below the layer minimum ignition temperature (LMIT) of the powder. LMIT typically is determined by a laboratory test according to ASTM E2021. For an automated monitoring system, maintenance must ensure a high degree of reliability.

2. Poorly maintained equipment in combustible dust service may leak or spill powder to the floor and onto equipment surfaces in the work area. Besides the obvious hazard of providing fuel in the form of a combustible dust layer, an additional hazard exists if a dust layer accumulates on equipment that can develop temperatures that could cause ignition of the powder.

Containment of dust within equipment will depend on frequent inspections or audits to detect incipient failures that could lead to leakage or spills. Also, equipment that could be exposed to combustible dust accumulation must operate with a surface temperature well below the LMIT of the powder according to ASTM E2021. In addition, it may make sense to determine the minimum ignition temperature of the dust cloud according to ASTM E1491 for the powder of interest.

An effective mechanical integrity program includes manual or automatic temperature monitoring of bearings.

3. To protect personnel, the facility and the community from the effects of an explosion should an explosive rupture of equipment occur, some processes call for special measures to minimize the consequences. The options are explosion relief venting, explosion suppression or explosion containment in a vessel that can withstand the maximum dust explosion pressure. The design of any explosion protection measure (venting, suppression or containment)

requires appropriate data concerning the severity of the dust cloud explosion (maximum explosion pressure and K_{st}). These data are obtained by performing a laboratory test on a representative dust sample in accordance with ASTM E1226. The MI program should include regular inspection of explosion vents, quarterly tests of explosion suppression systems, and periodic checks of vessel integrity according to recognized and generally accepted good engineering practices (RAGAGEP) such as API 510 and API 570, and FM Global Data Sheet 7-43 [1,2,3]. Inspections and non-destructive tests should be performed by personnel with appropriate training and experience, and at a frequency that would ensure fit-for-service performance during the interval between the inspections and tests.

MI program and housekeeping requirements appear in NFPA 652 [4] and in industry/material-specific standards such as NFPA 654 [5], NFPA 61 [6] and NFPA 484 [7].

CRUCIAL DIFFERENCE

Developing and implementing an effective MI program for managing combustible-dust fire and explosion hazards builds on an understanding of the maintenance activities required to minimize such hazards. These MI activities may differ from ordinary maintenance performed to keep the equipment operating as designed.

A dust hazard analysis by competent personnel will identify locations where combustible dust fires and explosions could occur. These would include process equipment where dense clouds of dust and ignition sources could form, and process areas where loss of containment of combustible dust from equipment could happen (or is happening). By focusing on combustible-dust fire and explosion prevention, a site can much more easily identify and address equipment and locations needing additional maintenance.

To the extent practical, to prevent release of combustible dust, set up maintenance activities and a maintenance schedule to ensure the MI of process equipment. In some cases, changes in equipment design or in operating conditions may reduce the necessity for maintenance. In other cases, periodic maintenance won't suffice to prevent accumulation of combustible dust inside and outside the process equipment. For these cases, implementing an effective housekeeping program is essential. This may require shutting down equipment periodically to check for and remove dust accumulations inside equipment and connecting ductwork.

Finally, subject any process changes, even if they appear to be insignificant, to a management-of-change process to determine if the change could increase (or decrease) the likelihood of ignitable dust clouds. A rise in likelihood may require an increase in maintenance effort and more frequent housekeeping.

EQUIPMENT ISSUES

Let's now look at four areas — ductwork, flange and fitting connections, process interlocks and hybrid mixtures — that often require attention, and some fixes that effectively address issues identified.

Implementation of a sound mechanical integrity program starts at the design phase.

Ductwork. Accumulation of combustible dust in exhaust ductwork or ductwork connecting equipment can pose a multifaceted combustible-dust fire and explosion hazard. First, the dust accumulation can be the source of a primary dust explosion under the right conditions; and second, the connecting ductwork can foster a secondary explosion by conducting the flame front and pressure wave from a primary explosion.

Always keep in mind that implementation of a sound MI program starts at the design phase. Knowing the bulk density of the powder that the ductwork will convey is important for designing the conveying system to prevent accumulation. This means maintaining a velocity sufficient to keep the dust from settling and minimizing the number of sharp bends in the ductwork. The ductwork requires periodic inspection for dust accumulation and thorough cleaning (using appropriate tools and methods) at intervals determined by the amount of accumulation. A check of the velocity with an appropriate anemometer provides a level of confidence that the ductwork is performing as designed. You many need to rebalance a combustible dust ventilation system to account for changes, e.g., addition of a branch exhaust duct.

Flange and fitting connections. I have seen numerous examples of operating equipment visibly leaking large quantities of combustible dust into the surrounding work area. In the worst case, I observed dense dust clouds. Such issues most commonly occur at plants that don't have high standards of sanitation and housekeeping. In one case, a gasket designed to seal two 10-in.-dia. flanges in a combustible dust transfer line had failed and was replaced by copper mesh cut to size. Needless to say, this seal offered less-than-optimal integrity;

the flange connection continually leaked powder onto the equipment and floor. The solution here was to continuously clean fugitive dust while the equipment was in operation until the plant procured and installed a gasket of appropriate material of construction.

At a different location, I noticed that the MI of a flange connection was compromised by the deliberate removal of approximately half the number of bolts that held the flanges together. This reportedly was done to ease disassembly of the equipment for maintenance. In this case, the nominal equipment inspections for sources of fugitive dust obviously weren't effective. The short-term fix was to stop operation of the equipment until the plant could locate and install replacements for the missing bolts. The longer-term solution recommended to site management involved requiring accountability that flange disassembly had taken place per written procedures and recognizing the increased exposure of personnel to flash fire and explosion hazards resulting from failure to follow written procedures.

Process interlocks. I've frequently visited sites with combustible dust processes that ignore maintenance of safety-related interlocks or assume it's unnecessary. Such interlocks include devices such as quick-closing valves in transfer piping and explosion-protection units on vessels where a combustible dust cloud could arise. This deficiency typically occurs at sites with relatively high turnover of personnel responsible for process safety and ones with relatively low awareness of combustible dust hazards.

At one pharmaceutical plant, a fluid-bed granulator was "protected" by quick-acting explosion isolation valves in the inlet and outlet piping and an explosion-suppressant device. Yet, I couldn't find any inspection or maintenance records for this equipment. So, I recommended the site contact the vendors of the equipment to ensure that qualified personnel perform inspection and non-destructive testing of all protective devices per RAGAGEP.

Hybrid mixtures. The hazard of hybrid mixtures (i.e., a combustible dust suspended in a flammable liquid vapor) is well known [5]. Processes with the potential for a hybrid mixture require considerable analysis at the design stage to discover and address hybrid mixture explosion scenarios. Such mixtures often require layers of protection (preventive and protective measures) against an explosion that exceed the standard methods to reduce the fire and explosion risk of the flammable liquid vapor alone or the combustible dust alone.

I led a process hazard analysis team in a design-stage review of a batch reaction process to manufacture a skin care product.

One step in the process involved introducing a raw material into a reaction vessel. The material was a) a combustible dust and b) wet with aqueous ethanol solvent. The team made numerous recommendations for engineering and procedural controls to minimize the risk of a fire or explosion. Key recommendations included:

- using static dissipative bags to hold and transfer raw material, with bags grounded before transfer of material;
- charging raw material to the vessel under vacuum through the bottom valve;
- limiting the batch quantities of flammable and combustible material in the vessel; and
- monitoring the temperature inside the vessel to ensure the mixture remains at least 10°C below the nominal flash point of the solution.

RISK-BASED INSPECTIONS

A relatively recent development in ensuring MI involves risk-based inspections (RBI) and risk-based maintenance (RBM) actions that follow the inspections. The RBI approach utilizes a qualitative or quantitative determination of risk for a facility's equipment or assets. The level of risk drives the allocation of resources (time and money) to perform RBM activities. The risk determination should be made by a suitably qualified team of process experts who have comprehensive knowledge of equipment operating conditions and failure modes.

A KEY ELEMENT

A sound MI program is an essential component for effective control of combustible-dust fire and explosion hazards. Using appropriate process information, material (powder/dust) combustibility data, and industry standards, a site-specific MI management system can be designed and implemented to address these hazards efficiently and effectively with the resources available. ●

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Make the Right Moves With Belt Conveyors

Understand important factors in their selection, design and operation

By Amin Almasi, rotating equipment consultant

Many plants require a material handling system to transport bulk solids and powders. These solids may come from stockpiles of material transferred from ship, rail, truck, etc., or directly from process operations (e.g., intermediates or finished products). A variety of conveyors can move such solids. However, plants most commonly select a belt conveyor because of its reliability. The overall material handling system also includes transfer points (or towers), trippers and chutes to discharge materials from one belt conveyer to another or to equipment.

A belt conveyor contains many rotating and vulnerable elements such as a drive system, gear reducer unit, pulleys, idlers, etc. All these components rely on rolling element bearings, manufacturer's standard seal, lubrication system, etc. Even when using the best technologies and most durable components, the overall reliability and availability of a single belt conveyor line won't match the availability required for many critical processing units. Therefore, redundancy usually is essential.

A single belt conveyor line might suffice for some routes, for instance, from the unloading system to stockpiles. However, for most services, installing two separate conveyors is prudent. For example, recommended practice is to transport material from a major stockyard into the processing area via a dual conveyor system. Likewise, critical lines, especially those where a conveyor trip can result in a costly shutdown of a crucial chemical processing unit, demand two independent conveyor systems to ensure

> Consider all operating cases and scenarios when designing and sizing the conveyor.

that a breakdown doesn't affect flow to the unit.

THE BASICS

A belt conveyor system consists of two or more pulleys and a belt that rotates around them. One or two powered (drive) pulleys move the belt and the material on it forward; the unpowered (idler) pulley maintains tension on the belt. The belt consists of multiple layers of specially selected materials. Underlayer(s), called the carcass, provide linear strength and shape, and often are made of a woven fabric. The overlayer(s), called the cover, typically consist of various rubber or plastic compounds specified to suit the material being handled. Unusual applications can call for covers composed of more exotic materials. Conveyor belts should be made continuous by hot vulcanizing. Mechanical fastening traditionally was used in some applications but has caused many operational problems; it is not recommended for modern conveyors.

As an indication, the maximum inclination of a belt conveyor should not exceed 15° to the horizontal. A greater angle might be possible but requires special design. As a rough guide, limit the speed of a conveyor belt to 3.2 m/s; there are successful high-speed conveyors but many of them use special designs. The distance of the belt line including pulleys from the supporting floor should allow easy maintenance; I generally recommend a minimum clearance of 800 mm below the return side of the belt.

Consider all operating cases and scenarios when designing and sizing the conveyor. A conveyor should be capable of accepting a 10–15% surge; therefore, power calculations usually incorporate 10–20% surge capacity for the full length of the conveyor. Carefully check calculations related to all starting/start-up cases, including restart of a fully loaded conveyor. The method of restart and adequacy of power for the restart of a fully loaded conveyor are important, but sometimes overlooked, factors. Each conveyor should be capable of being started under all load conditions without any slip occurring between the drive pulley and belt.

A common requirement is to limit the maximum belt tension at normal operating condition to around 10–14% of the tensile strength of belt to ensure sufficient margin for belt mechanical strength. Some specifications set the limit at 8% for special cases (for instance, for a nylon carcass belt); lower limits might be prudent sometimes. On the other hand, conveyors have operated successfully for many years with tension exceeding 14%. So, higher limits might make sense in some situations. Carefully evaluate and verify each case. The starting and braking tensions imposed on the belt may cause problems over time.

Starting characteristics of the drive unit and the braking effects during deceleration should be such that the maximum tension in the belt is limited to somewhere around 130–150% of the belt tension at normal operating condition. In other words, limit maximum transient tension to 14–20% of the tensile strength of belt. Again, these are rough figures; detailed evaluation may show that deviations are acceptable.

KEY COMPONENTS

Conveyors commonly use pulley shells, end discs and hub assemblies of all welded construction and manufactured from suitable grades of carbon or low-alloy steel. Do not employ pulley shells made from pipe or tubing. The pulley face width usually is 50–100 mm wider than the belt. To be on the safe side, the maximum combined stress in the shell and end discs should not exceed 20–30 MPa. Reported shaft failures often stem from fatigue failure; a common culprit has been a far greater loading on the shaft than theoretical expectations. Shaft deflection usually is limited to a maximum of 0.05% (1/2,000) of the end disc span and an angular deflection of five minutes at the shaft/hub connection.

Idlers bear the load of material on the conveyor. Idler assemblies should have heavy duty construction with roller shells made from precision-finished steel tube with end discs securely welded to the shells. Limits usually are specified for the idler diameter — e.g., 100, 115, 125 or 150 mm depending on application. Transition idlers at both the head and tail end feature an adjustable trough angle. Buffer idlers are installed at the material receiving point. Idler spacing on the carry strand should limit the belt sag to the lowest of either 1% of the idler spacing or 1.2 m, and on the return strand to the lowest of either 2% or 3 m. As a general rule, feed points to conveyors need great attention and robust design because these points must withstand great dynamic loads and harsh conditions. Impact idlers are installed at the skirted feed points of all conveyors; they are spaced at a nominal pitch of 0.3 mm and should be designed to allow retraction of the idler supporting base to assist maintenance without the need to remove skirt plates or structures in the load area.

Gear reducer units lower the speed of electric motors driving conveyors. Gears are designed for infinite life, with power rating equal to the full motor rated power multiplied by the relevant factors, often above 1.25 or 1.35.

A backstop device (also known as a holdback) prevents back moving due to material weight in case of any malfunction or accident such as sudden power failure. This device usually is fitted to the drive pulley shaft extension opposite the drive end; it should have the capacity to hold as a static load 100% of the stalled torque of the electric motor (including a suitable service factor, often 1.4 or 1.5).

Flat belts sometimes are used in material handling; they are simple to engineer and probably the most widely used type of conveyor belt for low capacity applications or for short distances. However, they have limited capacity to transport materials and pose some disadvantages. Obviously a completely flat belt would not work well for handling granules or powders on any angle of incline for a distance; materials would spill right off the edges. Trough belts commonly are chosen; they are very suitable for relatively long distance paths where materials have some time to settle down into the trough. These belts are concaved to create a suitable groove or trough for material to ride along the conveyor path. This allows for high capacity. Self-aligning mechanisms installed at suitable intervals correct any belt wander. Belts are required to bend and stretch lengthwise as well as laterally at the end wheels. Carrying idlers come in different designs and various trough (or groove) angles such as 20°, 30°, 35° and 45° from the horizontal. The most common option has been carrying idlers of three equal rolls with trough angle of 35°.

> Bearings cause the most reliability issues and failures.

Bearings cause the most reliability issues and failures. So, all aspects of bearing selection and sizing demand great care to ensure adequate bearing life and reliability. Some specifications stipulate a service life of 100,000 hours (say, 10–11 years). Simulating worst possible loadings on each bearing is important. Make allowances for shock loading when calculating the design load on bearings; an impact factor of 1.25 (or more) usually is needed for calculating bearing life. Bearing selection depends on many factors such as application, overall loadings, etc. Good options for pullies are self-aligning spherical roller bearings, and for idlers, deep groove bearings; evaluations may suggest choosing other appropriate options. Another important component is the bearing seal. A poor seal can't prevent dust and material from entering the bearing, and can't properly manage the grease and lubrication in a bearing. A multi-cavity labyrinth seal in conjunction with a rubber lip seal fitted between the labyrinth and bearing chamber often is a good choice.

CASE STUDY

A chemical plant needed a 3,250-t/h belt conveyor to transfer solids (density of around 852 kg/m^3) a distance of 385 m while lifting the material around 10 m. The selected speed is 3.15 m/s and belt width is 1.8 m. The conveyor design features four segments: a horizontal length; a length with 4.5° inclination; a third length with 7° inclination; and a final horizontal length from which material discharges through a chute. The design incorporates carrying idlers of three equal rolls with trough angle of 35°. Calculated drive force is around 100 kN; estimated shaft power of the drive pulley is about 310 kW and the selected electric motor is 450 kW. Drive pulley diameter and idler diameters are 1,300 mm and 160 mm, respectively. ●

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Don't Blow Your Safety Rating

Industrial vacuum cleaners should be part of your dust control program

By David Kennedy, Vac-U-Max

Sweeping or blowing of fugitive dust during housekeeping is widely discouraged by OSHA and the NFPA for almost all industries. Seemingly benign, dusts create an assortment of hazards that include flying particles that can lead to eye injury, slip hazards and ergonomic injuries. The most serious hazards surrounding the sweeping and blowing of dust threaten lives and include respiratory ailments and explosion hazards.

The use of vacuums almost always is recommended as a preferred method of removing fugitive dust. Rather than redistributing dust, industrial vacuum cleaners remove dust, thus reducing or eliminating the previously mentioned hazards.

Certainly, the most dramatic hazard associated with dust is secondary explosion — so dramatic that it captured the attention of Congress and led to bill that directed OSHA to "issue an interim combustible dust rule and an amendment to the Hazard Communication Standard (HCS) in 90 days, and a final rule in 18 months," according to OSHA's Combustible Dust: Advance notice of proposed rulemaking.

NEP VIOLATIONS AND COMPLIANCE EFFORTS

With more than 4,900 violations associated with OSHA's Combustible Dust National Emphasis Program (NEP), recent fines at four companies ranging from $63,000 to $137,000, and increasing local television coverage of combustible dust violations, it is clear that OSHA is serious about enforcing current standards.

There is no single standard, or one industrial vacuum cleaner, that can meet the requirements for all combustible dusts.

In response to OSHA's NEP, many facility and safety managers have revamped their housekeeping practices and added industrial vacuum cleaners approved for use in Class II, Div. 2 areas to mitigate the possibility of secondary explosions caused by fugitive dust.

However, of the 1,000+ inspections that OSHA has completed, only 18% to 22% of the facilities demonstrated compliance with OSHA requirements.

"It can sometimes be tough for facilities," says David Kennedy, business development manager for Vac-U-Max's Industrial Vacuum Cleaning Division. "They may have gotten approval from the authority having jurisdiction (AHJ), but OSHA can still come in and fine them if they deem that the facility doesn't meet up to combustible dust standards."

CURRENT AND PROPOSED RULEMAKING

Although it can be argued that current OSHA standards are ambiguous — hence OSHA's proposed rulemaking on combustible dust — the standards, however daunting to sift through, are noted clearly in OSHA's Safety and Health Information Bulletin (SHIB) entitled *Combustible Dust in Industry: Preventing and Mitigating the Effects of Fire and Explosions.*

Because OSHA is taking strong enforcement actions to address combustible dust hazards, facilities must make reasonable efforts to mitigate those hazards as well as fully understand the OSHA requirements and documentation referencing dust hazards and compliance.

According to the status report, housekeeping ranked second in citations under the NEP "with respect to combustible dust-related hazards." In addition to accumulations of combustible dust being prevalent among the violations, blowing dust with an air compressor and not using electrical equipment that was designed for hazardous (classified) locations also were among the top violations related to combustible dust-related hazards.

There is no single standard, or one industrial vacuum cleaner, that can meet the requirements for all combustible dusts.

Companies really need someone who has intimate knowledge of how chemicals react in certain environments and is experienced in NFPA standards to help them choose the right combustible-dust vacuum cleaner.

Although OSHA's 1910.22 has no specific wording that addresses fugitive dust specifically, the status report states, "housekeeping standard at 29 C.F.R. 1910.22 not only applies to typical housekeeping hazards but also applies to dust accumulation hazards."

Other standards and publications, such as the *Dust Control Handbook for Industrial Minerals Mining and Processing*, OSHA's *Grain Handling Facilities Standard* or the Mine Safety and Health Act regulations for coal mines, do address fugitive dust and suggest that operations "eliminate the use of compressed-air jets to clean accumulated dust from the equipment or clothing and substitute a vacuum cleaning system" and "use a vacuum cleaning system to clean spills and dust accumulations. Avoid brooms and shovels."

Furthermore, as mentioned earlier, OSHA's SHIB recommends vacuum cleaning as the preferred first defense method for controlling fugitive dust. (See, "Combustible Dust in Industry: Preventing and Mitigating the Effects of Fire and Explosions".)

In the NFPA 654 (2017) standard, paragraph 8.2.2.2 states, "Vacuuming shall be the preferred method of cleaning."

Paragraph 8.2.2.4 further states, "Blowdowns using compressed air or steam shall be permitted to be used for cleaning inaccessible surfaces or surfaces where other methods of cleaning result in greater personal safety risk. Where blowdown using compressed air is used, the following precautions shall be followed:

(1) Vacuuming, sweeping, or water washdown methods are first used to clean surfaces that can be safely accessed prior to using compressed air.

Dust accumulations in the area after vacuuming, sweeping, or water washdown do not exceed the threshold dust accumulation.

(3) Compressed air hoses are equipped with pressure relief nozzles limiting the discharge gauge pressure to 30 psi (207 kPa) in accordance with the OSHA requirements in 29 CFR 1910.242(b), "Hand and Portable Powered Tools and Equipment, General."

(4) All electrical equipment potentially exposed to airborne dust in the area meets, as a minimum, the requirements of NFPA 70; NEMA 12 as defined by NEMA 250, Enclosures for Electrical Equipment; or the equivalent.

(5) All ignition sources and hot surfaces capable of igniting a dust cloud or dust layer are shut down or removed from the area."

INDUSTRIAL VACUUM SYSTEMS

With so many standards advocating the use of vacuum cleaners in the housekeeping process, it is surprising to find so few being used in facilities, especially as the first air-operated industrial vacuum cleaner was developed in 1954 specifically to prevent dust explosions in textile mills.

However, when most people think of vacuum cleaners in an industrial setting, they often think of shop-type vacuums that they have in their garages. Sometimes facilities have attempted to use those types of vacuums and find that they not only create sparking hazards but also are ineffective at sucking up fine dust particles or heavy materials and often create their own dust clouds when operating.

Those shop-type vacuums are no comparison to industrial vacuum cleaners that have five times the suction power than commercial or personal-use shop-type vacuums.

Air-powered industrial vacuum cleaners (Figure 1) that meet NFPA 77 requirements for groundings and bonding also meet the definition of an "intrinsically safe system" because they do not use electricity and do not generate any heat from operation.

Implementing industrial vacuum cleaners is one of the most cost-effective methods to handle fugitive dust and avoid some of the most cited OSHA violations regarding combustible dust as well as to protect facilities from catastrophic dust explosions.

COMBUSTIBLE DUST VACS
Figure 1. These compressed-air driven vacuums require no electricity that could generate sparks and are ATEX tested and certified.

DUST EXPLOSIONS

Three recent dust explosions — two outside the United States and one in Douglas County, Oregon — that killed a total of 19 people and injured 53 serve as a reminder that secondary dust explosions are more destructive than primary explosions. The reason for this is increased concentrations of dispersed combustible dust that is activated from the initial explosion.

CENTRAL VACUUM CLEANING
Figure 2. System for continuous dust control helps reduce the possibility of dust explosions as well as respiratory, slip and ergonomic hazards.

Beyond creating dust clouds that have the potential to ignite, sweeping or blowing dust during housekeeping routines causes powders to become suspended and settle in hard-to-reach areas, including beams and walls or areas that are hidden behind equipment or in very small spaces that may be inaccessible during daily housekeeping routines.

The accumulation of combustible dust in areas such as this are among some of the most cited violations by OSHA. The use of industrial vacuum cleaners in hazardous location areas not only removes dust particles as small as 1 micron but, when part of a regular housekeeping routine, minimizes the amount of dust that can collect in hard-to-reach areas. Reducing the amount of dust that is suspended in the air leads to lower housekeeping costs because fewer labor-hours are required for the task.

The business of working with powders is fascinating. We work with so many different chemicals that have such wide-ranging reactions — it never gets boring. Some chemicals don't get wet with water; in fact, they can even become more flammable when exposed to water. We are working on an application that is a waste product of three different chemicals. There is no name for this chemical, but we are helping our client deal with the explosive nature of this waste.

Using industrial vacuum cleaners (figure 2) to reduce the amount of combustible powder that is suspended in the air not only mitigates the possibility for dust explosions

> When dusts hang in the air for longer periods, they can exacerbate respiratory threats.

but also can lead to a better respiratory environment for workers, reduce slip hazards and even prevent back injuries caused by cleaning heavy dusts.

RESPIRATORY, SLIP AND ERGONOMIC HAZARDS

Some powders, such as silica, when blown with air compressors, have the ability to hang in the air for days. Others, such as graphite, are slippery; and, some are very heavy, like cement that can weigh 100 lb/ft^3, or even steel shot that weighs 250 lb/ft^3, both of which can cause back injuries when sweeping them.

When dusts hang in the air for longer periods, they can exacerbate respiratory threats. Silica exposure can lead to silicosis, a lung disease caused by continued inhalation of siliceous minerals that are prevalent in glass, brick, cement, asphalt, ceramic and metal fabrication industries in which sand is used as a component or for blasting, as well as in tunneling operations.

Silica, of course, is only one of the powders that pose respiratory threats to workers. To combat those, Vac-U-Max provides a second HEPA filter rated 99.97% on particle size to 0.3 microns.

Fugitive dust and debris are housekeeping issues that plague most industries. Working with a vacuum cleaner manufacturer that is intimate with chemical characteristics produces the best outcome for facilities combating fugitive dust. Most vacuum cleaning systems used to combat fugitive dust are considered capital expenditures and can be purchased as pre-engineered solutions designed for specific powder characteristics. By working with knowledgeable cleaning system manufacturers, facilities can be brought into compliance not only for explosion hazards but for other dust- and debris-related housekeeping issues that pose respiratory, slip and ergonomic hazards.

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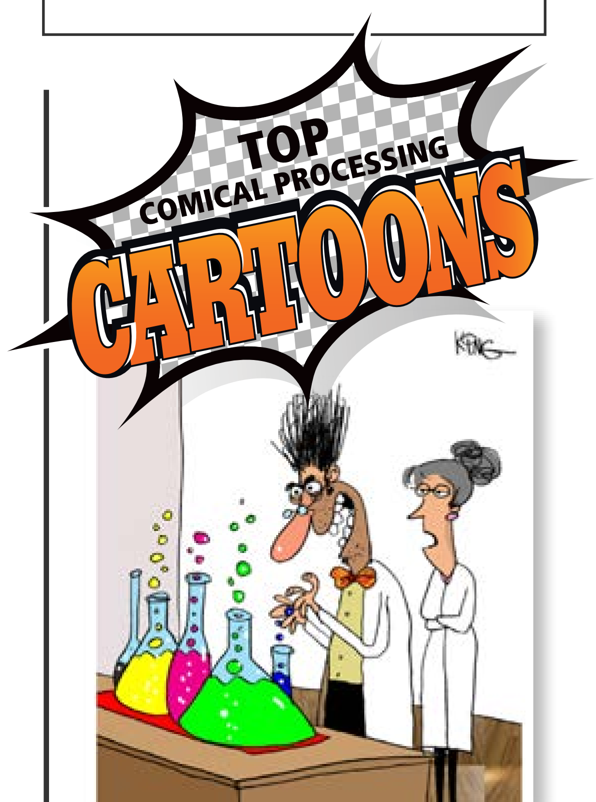

Visit the lighter side, featuring drawings by award-winning cartoonist Jerry King. Click on an image and you will arrive at a page with the winning caption and all submissions for that particular cartoon.