CHEMICAL PROCESSING
LEADERSHIP | EXPERTISE | INNOVATION

DETER DANGER FROM

PutmanMedia®

TABLE OF CONTENTS

PRODUCT FOCUS

FILTER RECEIVER DUST COLLECTOR HANDLES DRY PARTICULATE

A new product addition, called a Filter Receiver, completes this line of dust collection equipment for dry particulate. The Filter-Receiver is a high vacuum device used in processing as a collection device in pneumatic material transfer. These special baghouses can handle pressures up to 14 psi or 7 Hg, and can be manufactured in either stainless steel or painted carbon steel.

The equipment incorporates the company's patented supersonic nozzle-based cleaning technology systems for reverse pulse jet dust collectors. A cleaning nozzle provides an improvement in cleaning technology that achieves superior performance when compared to existing technology, says the company.

In addition, nozzle-based cleaning systems on reverse pulse jet collectors reportedly provide even more induced cleaning air into the filter media than any other system now available. Special nozzle designs also allow for the company's collectors to operate at lower compressed air rates, thus saving compressed air usage.

Scientific Dust Collectors | 708-597-7090 | www.scientificdustcollectors.com

AD INDEX

Take Key Steps Against Combustible Dust Hazards

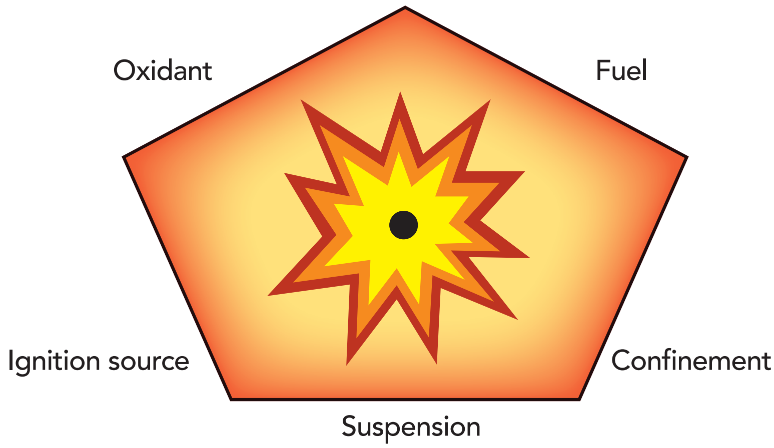
Having a sound mechanical integrity program in place is crucial

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.

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/

A properly performed dust hazard analysis will identify locations where combustible dust fires and explosions could occur.

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.

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

> Many sites with combustible dust processes ignore maintenance of safety-related interlocks.

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.

ROBERT GAITHER is a senior process safety specialist for DEKRA Process Safety, Princeton, N.J. Email him Robert.gaither@dekra.com.

Defuse Dust Dangers

Carefully consider and then counter risks of fire and explosion

By Dirk Willard, Contributing Editor

When the West Fertilizer Company in West, Texas, blew up on April 17, 2013, killing 14 people, it must have taken Donald Adair, the owner of the plant, by surprise. In his 2011 emergency plan, Adair described the worst-case scenario for his plant as a 10-minute release of gas! Perhaps we chemical engineers don't appreciate the risks posed by dust as well as we do those of flammable fluids.

One way to bolster your understanding of dust's risks is to check out *Chemical Processing*'s free on-demand webinars on dust control via http://bit.ly/2KGm4vo.

You must estimate the severity of the risk and then its probability. NFPA 499, "Recommended Practice for the Classification of Combustible Dusts and of Hazardous Locations for Electrical Installations in Chemical Process Areas," lists many compounds that produce combustible dusts. If yours isn't on the list, test according to ASTM E1226, "Standard Test Method for Explosibility of Dust Clouds."

In simplified terms, ASTM E1226 involves disturbing a small volume of dust with a pulse of air, followed, after a prescribed time delay, by ignition with a small electrical charge. The dust must contain < 5% moisture by weight and have particles smaller than 420 microns in diameter (i.e., ones that pass through a U.S. No. 40 standard sieve). The test takes place in a bomb of at least 20 liters at ranges of dust concentrations, fuel/air ratios, and electric charges. The goal of this test is to estimate the maximum

Unfortunately, it's not as easy to assess the danger from heat.

pressure, the rate of pressure rise with time, and the dust deflagration index, K_{st}, a measure of relative explosive severity; these parameters also are useful in designing deflagration vents. OSHA defines a dust as a hazard if its K_{st} exceeds zero; this definition won't protect you if your process produces fines, especially those smaller than 15 microns, which easily are converted to an aerosol. A K_{st} between 0 and 200 (when measured in bar-meters/sec) indicates a weak explosive risk typical of sugar.

ASTM E1226 can pose several problems: measuring the dust density accurately; accounting for the pressure spike from the igniters; maintaining a dry sample; mixing issues affecting dust and air combustion; and, perhaps, comparisons between bombs of different volumes. So, get as much data as you can on dust properties, do more bomb runs, evaluate the equipment and procedure for systemic faults, and compare your test data against a known standard.

With the severity estimated, it's time to consider the probability that a spark or heat could initiate a fire or explosion. Probability tests involve measurement of the minimum ignition energy (MIE), the minimum explosible concentration (MEC), the auto-ignition temperature (AIT), and the limiting O_2 content (LOC). Except for the AIT, tests are for dust clouds. ASTM E2019 covers measuring the MIE of a dust cloud; ASTM E1515 the MEC of a cloud; ASTM E1491 the AIT of a cloud; and ASTM E 2021 the AIT of layered dust. No LOC test is approved in the US; ASTM has WK41004 in the works but Europe has DIN EN 14034-4:2004.

The spark risk is measured in milliJoules (mJ). OSHA states that "materials that ignite above 0.50 joules (500 mJ) are not considered sensitive to ignition by electrostatic discharge." Between 500 and 100 mJ, equipment and people must be grounded to reduce the risk of ignition. An MIE less than 25 mJ is extremely hazardous, posing a risk during bulk operations, e.g., pneumatic conveying, silo storage, etc.

German data from 1965–1985 show that electrical discharge represents only 10% of the ignition sources in 426 accidents. Unfortunately, it's not as easy to assess the danger from heat. Fire caused by grinding or another physical action, drying or even self-heating represents the greatest potential, and is poorly understood. I couldn't find any correlation directly connecting MIE and fire risk; it's more of an article of faith that a low MIE is a fire risk.

So, let's move on to mitigation. Here're some ideas: 1) keep surface temperatures 170°F below the AIT; 2) avoid rubbing of rotating parts; 3) reduce rotating speed; 4) maintain strict grounding policy (see: "Move Against Static Electricity," http://bit.ly/2Sguqxm); 5) measure and decrease available oxygen; and 6) cut the quantity of dust by good housekeeping. Also, read the article, "Dust Explosion Standard Gets Significant Revisions," http://bit.ly/2U23Tpq, which highlights important revisions to that standard for prevention of fire and dust explosions.

Hopefully, by focusing on temperature as well as electricity we can avoid more surprises for plant managers.

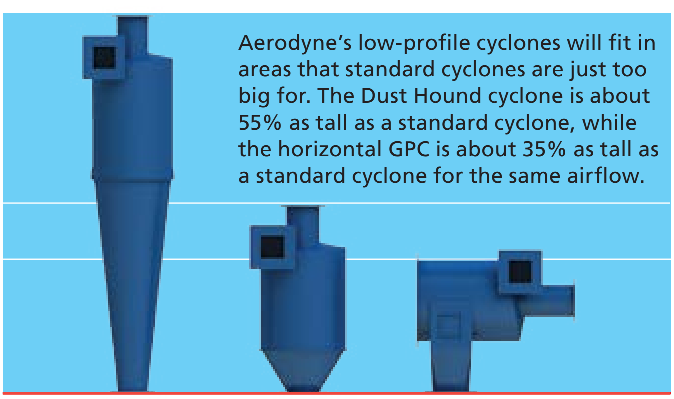
SPECIALISTS IN SMALL.

Compact Industrial Cyclone Dust Collectors

At last, highly efficient cyclones that fit your available space. Cyclones that fit indoors without expensive renovations. Cyclones small enough for point-of-use dust collection that achieve NFPA compliance without costly ductwork.

At Aerodyne, we make a big deal out of small, by specializing in small cyclone solutions. No one else offers cyclones as small that are as efficient. To save even more headspace, check out our uniquely designed horizontal cyclones.

- As small as 20 inches tall
- As efficient as 99% at 20 microns
- Up to 85K CFM
- Horizontal versions
- NFPA compliance



Standard Cyclone **Dust Hound** **Horizontal GPC**

Ask Aerodyne about our six models under 8 ft^3!*

*Per NFPA-654 7.13.1.1.2 (2), air separators with a dirty side volume less than 8 ft^3 can be located indoors.

Aerodyne® ENVIRONMENTAL

17387 Munn Road • Chagrin Falls, OH 44023
(440) 543-7400 • FAX: (440) 543-7404
www.dustcollectorhq.com

Prevent Dust Explosions with Pressurization Systems

Technology provides safe, economical option for installing electrical equipment in a hazardous location

By Chris Romano, Pepperl+Fuchs, Inc.

As long as there have been industrial environments, dust has caused explosions. In the last 20 years alone, dust explosions have resulted in hundreds of deaths and injuries around the world, as well as massive property damage.

All it takes is one small spark to ignite dust under the right conditions, and a wide range of everyday materials can cause an explosion. Examples include sugar, corn, steel wool, aspirin, coal, aluminum, paint pigment, cornstarch, pasta, tapioca, tea and cocoa. Almost every industry, from agricultural to automotive to refining, faces dust explosion hazards.

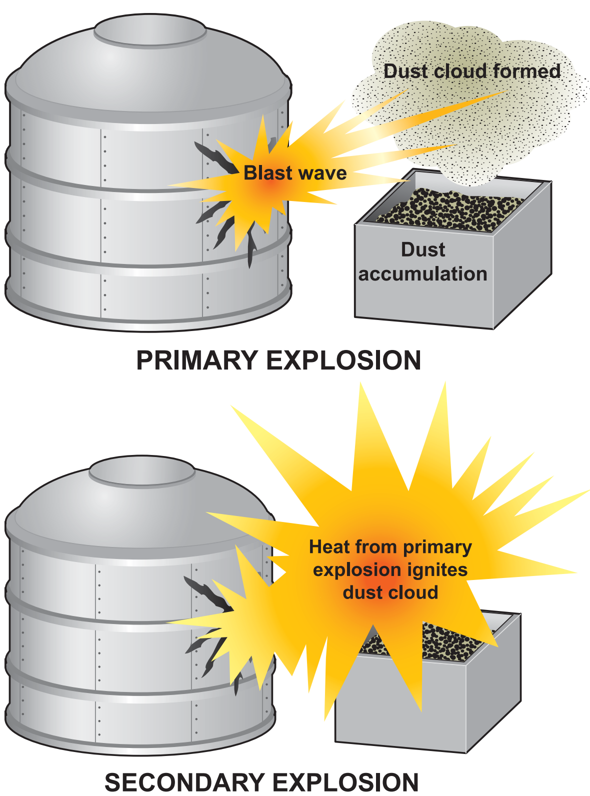
Fortunately, explosion prevention techniques are readily available for use in industrial and agricultural applications. Pressurization provides an economical way to use electronic devices in a range of hazardous locations without putting employees and equipment in danger.

WHAT IS A DUST EXPLOSION?

A dust explosion occurs when a fine dust suspended in the air is ignited, causing rapid burning. In milliseconds, gaseous products are released with a subsequent pressure rise of explosive force. Dust explosions can be categorized into two phases: primary and secondary.

A primary explosion takes place in a confined atmosphere, such a as a silo or part of the manufacturing plant, with the resulting shock wave damaging and often rupturing the plant. This allows the products of the explosion (burning dust and gases) to be expelled into the surrounding area. This disturbs any settled dust and initiates a larger secondary explosion. The secondary explosion can cause severe damage to surrounding plant buildings. Most large-scale dust explosions result from chain reactions of this type (Figure 1).

For a dust explosion to occur, the following conditions are necessary:



PRIMARY AND SECONDARY EXPLOSIONS
Figure 1. A primary explosion takes place in a confined atmosphere, expelling the products of the explosion — burning dust and gases — into the surrounding area. This disturbs any settled dust and initiates a larger secondary explosion.

TYPICAL DUST PARAMETERS	
Cloud ignition energy	5 mJ and higher
Minimum explosive concentration	0.02 oz/ft^3 and higher
Maximum pressure developed	30 ... 150 psi
Rate of pressure rise	less than 15,000 psi/sec
Ignition temperature—cloud	200 °C and higher
Ignition temperature—layer	150 °C and higher

Table 1. Values reported by the U.S. Bureau of Mines. *Source: Ernest C. Magison, Electrical Instruments in Hazardous Locations, 3rd ed. (Pittsburgh: Instrument Society of America, ca. 1978), 317, Table 11-1.*

1. The dust must be combustible.
2. The dust must be fine. The finer the dust, the more explosive it is likely to be.
3. The dust cloud must be of explosive concentration, i.e., between the lower and upper explosive limits for that particular dust.
4. There must be sufficient oxygen in the atmosphere to support and sustain combustion.
5. There must be a source of ignition.

Table 1 further explains the typical dust parameters.

HOW TO REDUCE THE HAZARD

One common method to reduce the hazard of dust explosions is to prevent the combustible material from reaching an explosive concentration by removing the combustible material and pressurizing the area. This prevents the accumulation of a

How to Prevent and Control the Hazard

1. Maintain effective housekeeping. If dust is not there, it cannot ignite as a layer or be dispersed as a cloud. Maintain handling equipment to keep dust inside. Clean up any dust that escapes. Even small accumulations of dust (as small as 1/32 of an inch) can create a dust explosion hazard if spread over sufficient surface area.
2. Conduct workforce training and education courses regarding recognition and control of combustible dust hazards.
3. Design machinery and plants to minimize damage if an explosion occurs. Use flame arresters to prevent flame spread and vents to relieve pressure and reduce structural damage.
4. Use intrinsically safe wiring practices.
5. House electrical equipment in pressurized cabinets.
6. Detect the early pressure rise when an explosion occurs in a closed system and quench it with an inerting material.
7. Safety data sheets (SDSs) rarely address how explosive materials are; they merely state that the materials may explode. Moreover, not all SDSs can be relied on to address even the possibility of explosion, leading to eventual mishandling of materials if users assume that they cannot explode. Frequently, product manufacturers are not sufficiently aware of their materials' volatility, so they do not test them. Sometimes, a product may not be explosive in the form in which it is supplied, but it can become explosive once a user processes it. This can happen in grinding and pulverizing operations or through abrading by friction in pneumatic handling systems.
8. Knowing materials' minimum ignition energy and temperatures (MIE and MIT) often is fundamental to arriving at HAZOP and risk management decisions. Materials with high ignition energy or temperatures are much more difficult to ignite than materials with low values, except in the event of open flames or welding incidents. The minimum ignition temperature for dispersed dust is principally used to ensure that surface temperatures cannot cause the dust to ignite. The MIT value measurement of the dust cloud is one criterion for selecting suitable electrical equipment in dusty atmospheres. The MIT value of the powder layer is also a relevant parameter.
9. Many accidents happen during maintenance on a machine or area. Make sure the area is clean of all combustible dust and all material that could catch ignite. Accidents often happen when a minor fire starts from welders in an area that is clean, but the process of controlling the fire causes a dust cloud from another area to migrate to the fire, leading to secondary explosions. Ensure that all suspended lights, beams, etc., are cleared of combustible dust.

flammable atmosphere. Other ways to minimize the risk of explosion include reducing the oxygen content and adding moisture or a dry inert material. In coal mines, it is common practice to coat the galleries and shafts with rock dust to reduce the likelihood of coal dust explosions. The inert material adds thermal capacity without increasing the energy released by combustion. Adding the inert material also increases the amount of energy required to ignite the combustible elements of the atmosphere — much like holding a lit match to a wet log.

There are two objectives in Class II locations:

1. Keep dust away from ignition sources.
2. Prevent ignition of dust that accumulates on the device.

Pressurization effectively handles both of these scenarios for Division 1 and Division 2 areas.

PRESSURIZATION — WHAT IS IT?

Unlike containment or prevention protection, pressurization separates general-purpose electrical devices from the surrounding hazardous atmosphere by placing them inside a common, lightweight enclosure. This enclosure is then cleaned and pressurized with industrial-grade air, or an inert gas, and maintained at a pressure higher than the dangerous external atmosphere, preventing the combustible material from coming in contact with the internal components. Only pressurization is required in a Class II dust atmosphere. Purging is used in Class I or gas applications. If purging is used in a Class II area, the vent will be blocked and cause a dust cloud, leading to an unsafe condition.

Most pressurization enclosure applications (Figure 2) require a minimum enclosure pressure of 0.10 in. (2.5 mm) of water. One psi is equal to 27.7 in. of water. In some circumstances, a minimum enclosure pressure of 0.5 in. (12.7 mm) of water is required to protect against the ingress of ignitable dust. But in all cases, a higher enclosure pressure should be maintained to create a reasonable safety factor. In rare circumstances, enclosure pressures as high as 2.5 in. (63.6 mm) of water may be required to

PURGE AND PRESSURIZATION SYSTEMS

Figure 2. Purge and pressurization systems, such as the Bebco EPS, help keep dust away from ignition sources as well as help prevent ignition of dust that accumulates.

offset sudden atmospheric pressure fluctuations, such as those created near missile launchings or other applications with quick atmospheric pressure changes.

For Division I applications, loss of pressurization requires disconnect of power to the enclosure. For Division 2, loss of pressurization allows power to remain on, provided an audible or visual alarm notifies the operator of the condition. Motors, transformers, and other devices subject to overload must be provided with automatic means to deenergize them if temperature exceeds the design limits. Using cooling devices in the enclosure should also be considered. Vortex coolers provide an inexpensive solution.

The need to place general purpose equipment in hazardous locations is not new, yet in the last three decades the need has intensified dramatically. Most modern electronic equipment is expensive and delicate, requiring environmental protection that cannot be provided by explosion proof enclosures or intrinsic safety barriers. Purge and pressurization technology offers the safest and most economical means of installing electrical equipment in a hazardous location, as well as protecting this delicate equipment from corrosive environments. ●

CHRIS ROMANO is product portfolio manager for Purge and Pressurization at Pepperl+Fuchs, Inc. He can be reached at cromano@pepperl-fuchs.com.

ADDITIONAL RESOURCES

EHANDBOOKS

Check out our vast library of past eHandbooks that offer a wealth of information on a single topic, aimed at providing best practices, key trends, developments and successful applications to help make your facilities as efficient, safe, environmentally friendly and economically competitive as possible.

UPCOMING AND ON DEMAND WEBINARS

Tap into expert knowledge. Chemical Processing editors and industry experts delve into hot topics challenging the chemical processing industry today while providing insights and practical guidance. Each of these free webinars feature a live Q&A session and lasts 60 minutes.

WHITE PAPERS

Check out our library of white papers covering myriad topics and offering valuable insight into products and solutions important to chemical processing professionals. From automation to fluid handling, separations technologies and utilities, this white paper library has it all.

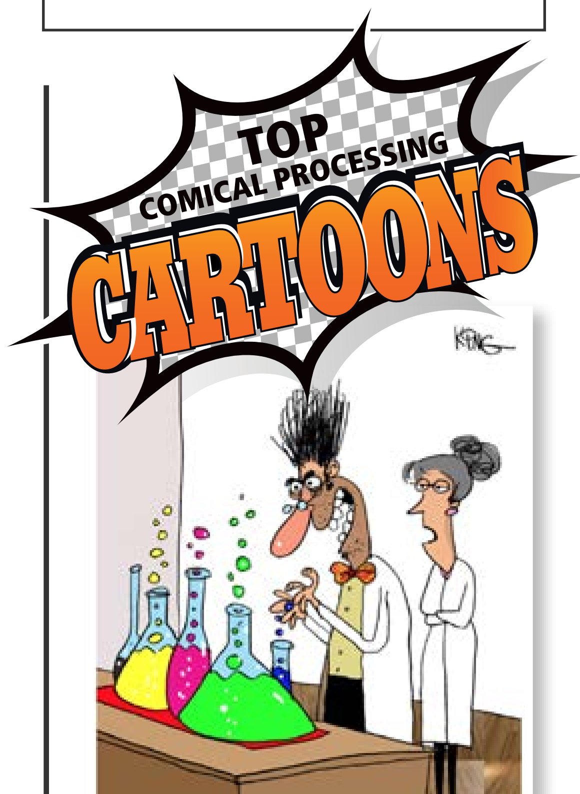
MINUTE CLINIC

Chemical Processing's Minute Clinic podcast series is designed to tackle one critical issue at a time — giving you hard-hitting information in just minutes.

ASK THE EXPERTS

Have a question on a technical issue that needs to be addressed? Visit our Ask the Experts forum. Covering topics from combustion to steam systems, our roster of leading subject matter experts, as well as other forum members, can help you tackle plant issues.

JOIN US ON SOCIAL MEDIA!



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.