Industrial Hygiene in the Workplace

May/June 2021

Monitoring Workers in CONFINED SPACES

pages 8 & 10

ALSO IN THIS ISSUE:

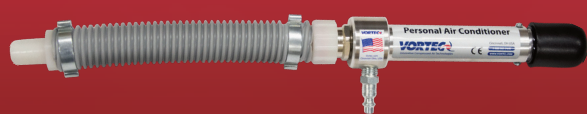
Presorted Std
US Postage
PAID
Permit 93
Birmingham MI

rdgmedia PUBLICATION
www.IndustrialHygienePub.com

Keep Workers Safe, Cool and Productive in Hot Conditions

VORTEC Cooling Vest

- ✓ Newly redesigned for greater comfort, same great cooling
- ✓ Available in three sizes
- ✓ Adjustable temperature
- ✓ Can be worn under other PPE



The Vortec Cooling Tube uses compressed air to generate cold air that is 45–60°F cooler than ambient.

1-800-441-7475
WWW.VORTEC.COM

Table of Contents - May/June 2021

12

36

Front cover photo courtesy of TSI Incorporated

NOISE

This Level of Noise Monitoring Was Unheard of...

UNTIL NOW.

NoiseCHEK
Dosimeter

SoundCHEK Essential
Sound Level Meter

SoundCHEK Connect
Sound Level Meter

AcoustiCHEK
Calibrator

Learn more at our **AIHce EXP virtual booth** or visit **skcinc.com!**

SKC

Note from the Editor

"Tell me and I forget. Teach me and I remember. Involve me and I learn."
—Benjamin Franklin

One of the world's greatest writers, orators, inventors and thinkers, Ben Franklin was onto something. Clearly, the goal of an industrial hygienist or safety manager encompasses far more than just "telling" employers and employees what needs to be done to make their facilities safe and in compliance. Training, education, hands-on learning—involving workers and engaging them to be present and making them a part of the safety culture is key to its success.

Investment is a word often bantered around as a way to ensure that success. But in this case, it holds true. If we make employees feel invested in their own health and well-being, they will not only comply with standards and procedures—they will often go the extra mile and make sure others are also following the program.

IHW for May-June 2021 deals with so many issues facing the industrial hygiene world. Our cover topic includes two different looks at confined spaces: The first focuses on monitoring workers' exposure, and the second discusses gas levels within those spaces and how to determine the best way to safeguard your facility.

We also feature two facets of combustible dust control. One demonstrates the best way to identify combustible dust risks that might be lurking in your facility; the other provides a brief overview of questions to consider when assisting a facility with respirable dust hazards—and how to determine the potential for combustible dust risks.

Other topics include how to safely clean equipment, including fall protection gear; how functional redundancy in fire prevention is essential for preventing and detecting fires; and atmospheric hazards at commercial cannabis grower and processor facilities. There are also features on respiratory fit testing, vision protection, emerging technologies workers can access with their own phones, water pollution compliance and more.

Our regular column, "Listen Up!," provides information from the NHCA on machinery noise control, as well. Before you leave the issue, be sure to check out the "Products that Protect" section for the latest in new products and processes.

So, there you have it: Information at your fingertips. Our job is to tell, inform and hopefully educate, but the next big step is to involve workers in the learning process. I hope this issue helps you along that path.

Regards,

Barbara Nessinger, *Editor-in-Chief*

P.S. If you are interested in contributing an article or "Perspectives" piece, contact me at bnessinger@workplacemhs.com.

Industrial Hygiene *in the* **Workplace**

A RDG Media, Inc. Publication
P.O. Box 893
Fort Dodge, IA 50501
586-227-9344
www.IndustrialHygienePub.com

PRESIDENT/GROUP PUBLISHER
Randy Green

EDITOR-IN-CHIEF
Barbara Nessinger

SENIOR ACCOUNT EXECUTIVE
Jacob Swindell

ACCOUNT EXECUTIVE
Lydia Stewart

ACCOUNTING MANAGER
Tara Scanlan

SYSTEMS ADMINISTRATOR
Angi Hiesterman

OPERATIONS/CUSTOMER SERVICE
Jody Kirchoff

PUBLICATION COORDINATOR
Lacey Scanlan

WEB DESIGN
Josh Scanlan

LIST RENTAL
Angi Hiesterman

By: **Kevin Chase**, *Contributor*

Monitoring Workers' Exposure in Confined Spaces

photo courtesy TSI Incorporated

Monitoring workers for exposure to respirable particulates, including dust, metals, crystalline silica, welding fumes and diesel particulate matter, is being driven by tighter regulations in almost every industry. Employers must be more attentive than ever to the personal exposure of workers. Workers also need to be educated on the potential dangers and health risks of respirable, fine and ultrafine particles in confined space—and be professionally trained in how to avoid exposure.

What is a Confined Space?

OSHA's definition of a confined space is an area that is large enough for a worker to enter and do work; has limited means for entry and exit; and is not designed nor intended for continuous occupancy. Examples of confined spaces include storage tanks, silos, reaction vessels, enclosed drains, maintenance holes, ship holds, sewers, mines, and utility or furnace rooms with facility operating systems.

Dust and Particulates Explained

Work such as welding, cutting, grinding, drilling, sanding or any high-energy activity creates respirable particles or toxic aerosols. These can build up to hazardous levels in confined spaces. Any particles 10 microns in size or smaller become airborne quickly and can potentially be inhaled into a worker's respiratory system. Even more dangerous, particles 4 microns or smaller can enter the human respiratory tract and penetrate deep into the lungs' gas exchange region.

Health Dangers: Respirable Particulates

Respirable particles are detrimental to workers' health and safety. Airborne dust and particulates are often made up of hazardous materials, including hexavalent chromium, lead, manganese, iron oxides, nickel, cadmium, silica and diesel particulate matter. Many of these materials cause damage to internal organs, including lungs, kidneys, liver, brain, nervous system and eyes. Especially dangerous are materials like silica, which is known to cause cancer. In confined spaces, these particulates can build up quickly. It is essential to monitor the particle concentration to which a worker is exposed, so you can act to reduce contact to protect the worker.

Personal Monitoring in Breathing Zone

The leading method for rapidly determining exposure levels is with the use of direct-reading solutions. Real-time instruments provide instant data to determine if the concentration of respirable particles is too high or if it is increasing in the worker's breathing zone. Immediate access to test data also allows you to follow the exposure path to determine the source of the problem and act. Real-time monitoring also provides rapid feedback of the corrective actions implemented to ensure you are reducing worker exposure.

The leading method for rapidly determining exposure levels is with the use of direct-reading solutions. Real-time instruments, such as the SidePak™ AM520 Personal Aerosol Monitor, provide instant data to determine if the concentration of respirable particles is too high or is increasing. *(photo courtesy TSI Incorporated)*

Increased Focus on Silica Dust

Silica exposure is a significant concern in confined spaces. The potential of limited air movement and minimal ambient air circulation can result in particulate concentrations to build quickly. In confined spaces, respirable silica levels can accumulate over a shorter period with higher concentrations. In response to the elevated risk from silica, OSHA reduced the personal exposure limit of silica dust to 50µg/m3 averaged over eight hours. This level is half of the limit of the previous standard revision. OSHA also added an action level of 25µg/m3 averaged over eight hours.

Silica exposure is a significant concern in confined spaces, as respirable silica levels can accumulate over a shorter period with higher concentrations. *(photo courtesy TSI Incorporated)*

Safety in Underground Mining

One of the most common confined spaces is underground mining. Underground mining operations have increased concerns over the level of respirable crystalline silica dust generated. Continuous mining extracts high silica-content rock from the coal. Large quantities of silica dust can be generated during cutting and can become entrained in the ventilating air, carrying the harmful dust to the breathing zones of mine workers. For coal miners, respirable dust monitoring must be performed to avoid black lung disease, also called coal workers' pneumoconiosis (CWP), which is a result of long-term exposure to coal dust.

The increased use of diesel-powered equipment in underground mining also produces ultrafine diesel particulate matter (DPM). DPM is classified as a possible carcinogen by the National Institute for Occupational Safety and Health (NIOSH) and the U.S. Environmental Protection Agency (EPA). The operation of diesel-powered equipment in underground mines poses an additional need for real-time personal exposure monitoring of particulates in workers' breathing zones.

Continued on page 11

By: **Dante Moore**, *Contributor*

Acceptable & Dangerous Gas Levels in Confined Spaces

Confined spaces present unique dangers that workers must be prepared to handle. Despite tight regulations and technological advancements, permit-required confined space entry accidents and fatalities remain a problem.

According to OSHA, confined spaces are responsible for around 200 deaths every year, and 60% of those deaths are workers who were attempting a rescue. What is the key to mitigating the risk of working in confined spaces?

In some cases, it could be as simple as reminding workers of acceptable and dangerous confined space gas levels. After all, low oxygen levels are the most frequent culprit of gas-related deaths in confined spaces.

Common Confined Space Gas Levels

Awareness of oxygen and combustible gas levels is essential for anyone tasked with entering a confined space, but those are not the only two confined space gas levels to be aware of; carbon monoxide and hydrogen sulfide also are common concerns. However, workers must understand the particular hazards of any environment they are entering and take appropriate measures.

1. Oxygen: OSHA dictates that the minimum "safe level" of oxygen in a confined space is 19.5%, while the maximum "safe level" of oxygen in a confined space is 23.5%. With low oxygen levels being the biggest cause of death in confined spaces, accurate oxygen level measurements are essential. Workers must sample the oxygen level prior to entering a confined space and should monitor it continuously throughout the work.

If a confined space's oxygen concentration surpasses 23.5%, the space is too oxygen-rich and could result in the ignition of combustible gases. On the other hand, low oxygen levels impair judgment and coordination. Extremely low levels of oxygen cause nausea, vomiting and loss of consciousness.

When oxygen levels are too low, that typically means another gas is displacing it. In these instances, it's important to know what gas is displacing the oxygen—and why.

2. Combustible Gases: Since gases cannot combust without enough oxygen, a confined space's oxygen level can give you an idea of the concentration of combustible gases.

There are two levels to pay attention to when measuring combustible gases:

- Lower Explosive Limit (LEL): This is the lowest concentration of a gas in the air that can combust or produce a flame when paired with an ignition source.
- Upper Explosive Limit (UEL): This is the highest concentration of a gas in the air that can combust or produce a flame when paired with an ignition source.

If a gas concentration is below its LEL, it cannot ignite, and the confined space is considered safe. If the gas concentration is above its UEL, the gas is too rich, and there's not enough oxygen for combustion.

Awareness of oxygen and combustible gas levels is essential for anyone tasked with entering a confined space, but those are not the only gas levels to watch. Workers must understand the particular hazards of the environment they enter and take appropriate measures. (photo courtesy Industrial Scientific)

Of course, LEL and UEL differ for each gas. Methane, for example, has an LEL of 5% vol and a UEL of 15% vol. Methane combustion is possible when the gas level is at or above 5% but below 15%. Gas detectors display a gas's presence as a percentage of its LEL. An atmosphere free of methane would show 0% LEL on the gas detector, but an atmosphere containing 5% methane would display 100% LEL.

It's essential to be constantly aware of combustible gas levels while in confined spaces, because they could change over time. A gas far above its UEL won't ignite, but ventilation could dilute the gas, and its concentration could quickly enter a combustible range.

3. Carbon Monoxide and Hydrogen Sulfide: Multi-gas monitors are frequently configured for carbon monoxide and hydrogen sulfide, but these two gases aren't necessarily the most common in confined spaces. In fact, because carbon monoxide is the result of incomplete combustion, it's uncommon in most confined spaces unless machinery is used inside.

While both of these gases are extremely toxic, confined space workers need to understand the hazardous gases they are most likely to encounter based on their specific application. Workers may be better protected by monitoring for other common gases.

It is still useful to be aware of the acceptable and dangerous levels of these gases. If carbon monoxide and hydrogen sulfide are gas hazards your workers could encounter, be sure they know the LEL/UEL for the hazards, as well as OSHA's permissible exposure limit (PEL) for each gas, which sets a limit on the amount of exposure for a worker within an 8-hour period.

Hydrogen sulfide has a PEL of 20 parts per million (PPM) and an LEL of 4.0%. Carbon monoxide has a PEL of 50 PPM and an LEL of 12.5%. Keep in mind that permissible exposure limits can vary by jurisdiction, so the PELs OSHA lists for hydrogen sulfide and carbon monoxide are not universal.

The Importance of Direct-Reading Portable Gas Monitors

Gas hazards are unpredictable and confined spaces are dangerous, making it very important for confined space workers to continuously monitor gas levels with a direct-reading portable gas monitor. Direct-reading monitors not only tell workers whether the atmosphere in a confined space is safe, but also how safe. Is the oxygen concentration just barely above 19.5%, or is there enough margin to allow work to continue uninterrupted?

Safety laws require a pre-entry test just prior to a worker entering a confined space, and workers are only required to test again after leaving the space and preparing to re-enter. Naturally, this leaves a lot of room for error if atmospheric conditions change while a worker is within the confined space—which is likely why confined space injuries and fatalities occur so frequently.

Periodic testing throughout the entry may be required if the confined space has a history of changing gas conditions, but "periodically" leaves room for interpretation by workers or the company. A safer procedure is to arm all confined space workers with direct-reading personal gas monitors and ask them to continuously monitor for gas hazards throughout the work period. If conditions begin to trend toward danger, workers will have the notice they need to exit the confined space safely. If you rely on alarm-only monitors, this wouldn't be possible. Because alarms are set to go off at predetermined thresholds, alarm-only instruments won't give workers a head's up to potential dangers.

A direct-reading gas monitor displays gas levels, so workers can see the exact reading, allowing them to make more informed decisions about whether entry is a wise choice and whether they can continue their work safely.

Adding continuous monitoring to your confined space entry procedures is a simple way to improve worker safety. You can achieve continuous monitoring by asking workers to wear personal monitors or by using an area monitor inside the space. You can improve safety even further by connecting personal monitors or area monitors to a hole watch through local connectivity, thus enabling monitors to share gas readings and alarms. This way, the attendant always knows exactly what's happening within the confined space. IHW

Dante Moore is a senior applications engineer at Industrial Scientific.

Monitoring Workers' Exposure in Confined Spaces

Continued from page 9

Require Intrinsically Safe Certification

Confined spaces in the underground minerals, metals and coal mining industries have the added complexity of workers performing duties in potentially volatile or explosive environments. In these conditions, gases, fuels or other potentially combustible materials are likely contained in the air.

In work areas designated as explosive or potentially volatile, intrinsically safe instruments (IS) certified by IECEx/ATEX or CSA are required in the work area. Certifications for real-time personal exposure monitors require specific design requirements with rigorous testing and verification. Real-time particle monitoring instruments, such as SidePak™ AM520i Personal Aerosol Monitors from TSI® Incorporated, meet the "EX" certification standards for applications requiring intrinsically safe devices.

Summary

The need to monitor workers' exposure to respirable particulates from potentially harmful particles is imperative. Employers must be attentive to workers' personal exposure and educate them about the potential dangers and health risks of respirable, fine and ultrafine particles. Failure to do so can ultimately be measured in lives lost. IHW

Kevin Chase is with TSI® Incorporated.

By: Andy Thomason, *Contributor*

Identify Combustible Dust Risks Lurking at Your Facility

Many manufacturing and processing operations generate dust particles that can ignite and cause a fire or explosion. Combustible dusts include food ingredients, seed and grain, metals, paper, pulp, plastics, textiles, biosolids, wood, rubber, dyes, pharmaceuticals and pesticides.

Examples of combustible dusts

Because each plant, factory and facility is different, identifying and understanding unique combustible dust risks is necessary to design and implement an effective safety strategy. Here are a few considerations to help you determine your combustible dust risks.

Understand What Triggers a Dust Explosion

A dust explosion occurs when oxygen, heat (ignition source), fuel (combustible dust), dispersion of dust particles and confinement come together. A primary explosion is the first point where an explosion occurs and is often an isolated incident.

A secondary explosion occurs when the primary explosion pressure disturbs dust that has collected in the workplace, resulting in a much more extensive explosion. Rapid combustion resulting from this combination of factors is known as a deflagration. Think of it as an expanding ball of flame that is rapidly consuming a cloud of dust. If the event is confined by an enclosure, the resulting pressure rise may cause an explosion.

Dust explosion pentagon

Determine if Dust is Combustible

To determine whether the dust is combustible, you need to have explosibility testing done, in accordance with ASTM test methods, as stipulated by the National Fire Protection Association (NFPA). Unless the dust is completely inert (Kst = 0), you must incorporate explosion protection into the dust collection plan. This dust testing will tell you if your dust has a Kst and Pmax value; how much pressure an explosion will generate; and how fast the explosion will travel.

The NFPA requires owners of facilities that engage in dust-producing activities to conduct a combustible dust hazard analysis (DHA) to assess risk and determine the necessary fire and explosion protection. You can conduct the analysis internally or use an independent consultant. Whichever you chose, the authorities having jurisdiction will review the findings and grant approval. These can include federal, local or state inspection or fire officials, and your insurance company.

Identify Potential Ignition Sources

Because ignition is one of the ingredients for a dust explosion, you want to identify heat sources near areas where dust could be present. Look for potential ignition sources, like friction heat

Welding sparks

on surrounding equipment, open flames, smoking, sparks, static electricity, and malfunctioning wiring or electrical equipment.

Clean Dust Properly

Do not attempt to remove dust by using compressed air, air wands or brooms. These methods will disperse the particles into the air, allowing them to settle again on surfaces at your facility and remain an explosion hazard. A high-efficiency dust collector, equipped with full explosion protection designed specifically for your application, is an accepted and proven engineering control that will filter hazardous contaminants and combustible dusts to make indoor environments safer.

Industrial dust collector with explosion vents

All images courtesy of Camfil

Take a Look Around

A simple, yet effective way to identify possible combustible dust danger is to look around the facility. Train personnel to regularly check obvious areas for dust accumulation, such as equipment and floors. Also check any hidden areas where dust may build up—i.e., inside ductwork and on ceiling joists. Dust thickness of 1/32 of an inch, about the thickness of a dime, is a warning sign that the accumulating dust is becoming a potential explosion or fire hazard. Keep in mind that the smaller the dust particle size, the greater the danger or volatility of the explosion.

Dust accumulation in the workplace

Implement Dust Safety Measures

A dedicated dust management program must include employee education that includes training equipment operators, maintenance personnel and other workers in dust hazard awareness, and job-specific safeguards. In addition to the dust hazard analysis mentioned above, safety measures should include:

DUST COLLECTION SAFETY GAMEPLAN

*[**Editor's Note:** This sidebar first appeared as a blog on Camfil APC's website. For the original article, go to: https://bit.ly/2OYAw9Z .]*

If your facility's manufacturing processes generate hazardous dust, one of your priorities is ensuring air quality. Dust, especially airborne dust particles, must be safely collected and contained to protect worker safety and meet regulatory compliance. Here are key considerations for your dust collection safety game plan.

Comply with OSHA PELs

Your dust collection system must enable your facility to meet OSHA's permissible exposure limits (PELs) for the dusts produced at your facility. OSHA established these PELs based on an eight-hour, time-weighted average (TWA) for hundreds of dusts—ranging from nonspecific or "nuisance" dust to highly toxic substances. They are listed in OHSA's annotated PELs tables. Note that:

- The OSHA PELs requirements determine the minimum level of filtration efficiency your fume collector must achieve.
- It's important to request a written guarantee from your dust collector supplier stating the maximum emissions rate for the equipment over an eight-hour TWA. Filter efficiency stated as a percentage is not an acceptable substitute, even if the supplier promises 99.9% efficiency. That's because OSHA only cares that the quantified amount of dust in the air is below the PEL.

Address Combustible Dust Issues

If your facility produces or processes combustible dusts, chances are you already have a dust collector. This dust collector must be equipped with deflagration protection, such as explosion venting. The National Fire Protection Association (NFPA) 68 Standard on Explosion Protection by Deflagration Venting provides stringent and mandatory requirements for dust collection applications involving explosive dusts. Note that:

- NFPA 68 focuses on explosion venting of combustion gases and pressures resulting from a deflagration within an enclosure or dust collector.
- The safety objective of NFPA 68 is to prevent structural failure of the enclosure and minimize injury to personnel in adjacent areas outside of the enclosure.

To determine if your particular dust is combustible, you must have it tested for explosibility, following ASTM test methods. The explosive power of a dust is denoted as "Kst," the rate of pressure rise. Any dust with a Kst value greater

- A detailed program to deal with combustible dust hazards in the facility
- A defined process on how to execute and manage the changes required to meet the life-safety goals set in place by the combustible dust program
- A process hazard analysis, which OSHA requires on each process point generating dust
- A plan specifying how you will remove the dust hazard from each process
- A housekeeping strategy outlining cleaning processes to keep combustible dust from becoming a problem
- An ongoing maintenance and inspection plan to keep equipment operating properly, inspected and in compliance

Add It All Up

Dust control is one of the most difficult challenges in industrial manufacturing and processing. Keys to managing combustible dust include implementing the proper controls and procedures, as well as educating personnel to recognize and address warning signs of a potential dust explosion. Regular housekeeping and operating a dust collection system that is designed for your specific operation can significantly reduce airborne dust in the work environment and help to mitigate the risk of a primary or secondary explosion. IHW

Andy Thomason is Senior Applications Specialist at Camfil Air Pollution Control (APC).

than "0" is considered to be potentially explosive.

Explosive dusts can be organic or metallic in nature. They are present in a long list of manufacturing industries including agricultural, chemical, food, paper, pharmaceutical, textile and woodworking.

Optimize for Safety

In addition to having systems to safely collect and contain hazardous dusts, make sure to install equipment that ensures safe operation. Here are some examples:

- OSHA-compliant railed safety platforms and caged ladders can prevent slips and falls when workers access the dust collector for service.
- Lockout/Tagout doors prevent injury or exposure caused by inadvertently opening doors during a pulsing cycle.
- Where highly toxic dust is being handled, a bag-in/bag-out (BIBO) containment system may be required to isolate workers from used filters during change-out.
- Filter cartridges should be positioned for ease of access, and they should readily slide in and out of the housing. Pulling out a 100-lb, dirty overhead filter can result in neck, back and foot injuries, so make sure the collector you choose is service-friendly.

To optimize fire and explosion protection, you can use a range of features and technologies. These include using flame-retardant filter media; installing spark arrestors; and installing sprinkler systems.

You might also want to equip your collector with a safety monitoring filter. This high-efficiency air filter prevents collected dust from re-entering the workspace if there is a leak in the dust collector's primary filtering system. A safety monitoring filter is a required component of a dust collection system that recycles air downstream of the collector.

Consider Vertical Cartridge Mounting

Some pleated filter cartridges are mounted on their sides inside the dust collector. This can be a safety hazard, because a cake of dust often remains on top of the filters. Also, heavy or abrasive particles often don't get separated from the air stream. This situation can shorten filter life. But more importantly, in spark-generating applications, horizontal filters can pose a fire or explosion hazard. It is safer to use vertically mounted cartridges, which reduce the load on the filters and make the system safer and more efficient. IHW

By: Mark Yukich & Ashok Ghose Dastidar, *Contributors*

Is the IH Respiratory Hazard also an Explosion Risk?

photo courtesy stock.adobe.com

As a professional, the importance of identifying respirable industrial hygiene hazards and taking the steps necessary in reducing the amount of exposure to encourage a safe atmosphere for workers is vitally important. However, when tasked with reducing respirable dust hazards within a facility's process, it is recommended to identify the potential explosibility and/or combustibility of the dust generated within the process line. Our aim is to provide a brief overview of questions to consider when assisting a facility with respirable dust hazards and how to determine the potential for combustible dust risks.

Safety Assessments

When you are conducting a safety assessment at a facility where dust is airborne within the process area, the question that should be asked of the facility operator is: "Have you ever had this dust tested for explosibility or combustibility?" The dust generated in many different processes can be found to be explosible and/or combustible, but the first step is to test a representative sample from the process by running the Explosibility and Combustible Screening Tests. These tests will provide a "yes" or "no" result for each test result.

NFPA 652 Standard on the Fundamentals of Combustible Dust mandates that, if a facility has a combustible and/or explosible dust, the facility operator must complete a Dust Hazards Analysis (DHA) of the process are that handles these materials.

There is a difference between explosible and combustible. The explosibility screening test determines if the material is explosive within an airborne dust cloud. Any pressure rise greater than 1 bar (approximately 15psi gauge) is deemed an explosible material. The combustibility screening test determines if the material will propagate a flame while in a pile or layer. A material can be explosible and may not be combustible. For example, sugar is explosible in a dust cloud, but is not combustible. When tested in a layer, the material will melt, where there may be a hazard of a subsequent pool fire from the melted sugar—which should also be evaluated.

Now that it has been determined the sample is either explosible and/or combustible, NFPA 652 requires the DHA be completed. The DHA is a risk-identification exercise, performed by an experienced engineer, of the process areas where these reactive materials are generated and/or handled. The result will provide recommendations to help reduce risk within the current operation. Prior to the site visit taking place, obtaining the explosion and combustion characteristics that will demonstrate how the material reacts under different hazard conditions will prove to be the most efficient use of your time.

Earlier, we talked about the screening tests giving a "yes" or "no" answer, but there are other tests commonly referred to in NFPA codes that would be helpful to have on hand. Some of those data points that are key to developing a mitigation strategy are found below:

Explosion Severity Test (KSt Pmax) – This test is used to determine the appropriate size/strength of the dust collector that supports the process line and what type of explosion protection is required. This explosibility test demonstrates how strong and how fast of a reaction can occur within a dust cloud when initiated by an ignition source.

Minimum Ignition Energy (MIE) – This test demonstrates the minimum amount of ignition energy needed for a reaction to occur. The result of this test is measured in the minimum amount of energy that is measured in millijoules (mJ). As a point of comparison, when you receive a shock when going to touch a doorknob, this is a spark that is generating about 30-40mJ of energy. In fact, there are some materials that can react with as little as 1mJ. Part of the impetus of a DHA is identifying potential ignition sources. Understanding the MIE will go

The dust generated in many different processes can be found to be explosible and/or combustible; the first step is to test a representative sample from the process by running the Explosibility and Combustible Screening Tests. *(photo courtesy Fauske & Associates, LLC)* a long way in guiding the process of identifying the hazards that may be present due to the presence of an ignition source.

Minimum Explosible Concentration (MEC) – This test will illustrate the level of dust concentration needed within a dust cloud to have an explosible reaction. There are mitigation strategies to keep airborne combustible dust concentrations below the MEC value, so as to take steps necessary to reduce risk within the operation.

On-Site Analysis & Management

Once you have the test data compiled, schedule the on-site Dust Hazards Analysis (DHA) to be completed with the assistance of a qualified engineer to guide the risk-identification process by following applicable NFPA codes, specifically NFPA 652 and NFPA 70 National Electrical Code. The DHA is a hazard-identification assessment with recommendations in reducing risk within the operation. The recommendations could include any need for explosion/deflagration protection, grounding and bonding, ignition source control, electrical area classification and training personnel to identify hazards, just to name a few items.

When the recommendations are put into place, it is important to develop a Combustible Dust Management Program (CDMP) to ensure that the key findings uncovered in the safety audit are understood and implemented. The CDMP will have to address a regular maintenance schedule to confirm that the applied safety measures are properly maintained. Also, there needs to be key personnel identified that will help keep the facility on track with these safety strategies. Part of this will include a "management of change" program to ensure the safety steps taken are part of a group collective mission, rather than left to one individual, and that modifications to equipment and processes do not compromise the designed safety profile.

Overall, the practice of good housekeeping on a regular schedule is a fundamental recommendation towards reducing the risks related to combustible and explosible dust within any process. As an IH professional, you understand how important it is to reduce the airborne hazards present, so you play a key role in the primary recommendation that is found for any facility handling combustible dust. Airborne dust found to be explosive and/or combustible will be recognized as a primary fuel source, just like any other flammable fuel like acetone or gasoline.

Whenever you find yourself within a facility focusing on the IH hazards, take a moment to ask them the question, "Have you ever tested your dust for explosibility and combustibility?" Every facility operator has the duty to know what combustible dust risk, if any, is present to protect the safety of their people and facility. Fauske & Associates, LLC can assist with all facets of the testing and on-site process safety support. IHW

By: David Ivey, *Contributor*

How to Clean Safety Equipment

(Image courtesy of Malta Dynamics)

These are strange times, with the idea of worker safety now coming to include a whole new dimension of minimizing contact with others and limiting the spread of germs among work crews. This new reality and the many challenges brought on by the current health crisis force us to rethink how we clean and maintain our facilities and gear—including personal fall protection equipment.

We've been fielding a lot of inquiries about how best to clean our safety equipment, so we wanted to address some of the most common questions and concerns.

Best Cleaning Products for Safety Equipment

We recommend you check the manufacturer's product instructions for care and maintenance, but here are some guidelines you can follow. Thankfully, you generally don't need any special products—the best option is usually cleaning with tap water and mild soap, such as liquid dish detergent. This combination is effective in killing the COVID-19 virus; is inexpensive; and it's safe for the integrity of the equipment.

You can use either cold or warm water, but avoid using hot water above 130° F (54.4° C), as this can damage the equipment. You don't need to soak or submerge equipment—wiping it down with soapy water using a damp sponge will do the trick. Rinse with clean water to remove any soap residue. After cleaning, allow the equipment to hang-dry in an open, ventilated area to prevent mold or a musty odor. Do not machine-dry the equipment; this can also damage it.

The best option for cleaning fall protection/safety equipment is tap water and mild soap, such as liquid dish detergent. This combination is effective in killing the COVID-19 virus, as well as inexpensive and safe for the equipment. *(Image courtesy of Malta Dynamics)*

Harsher cleaning products, such as rubbing alcohol, bleach, hydrogen peroxide, naphtha, turpentine or acetone, are not necessary and can damage the integrity of the material—these are NOT recommended for cleaning personal fall protection equipment of any kind. Avoid sanitizers, bleach and other industrial cleaning supplies.

How Often Should I Clean Safety Equipment?

Especially in this time of heightened risk from a potentially dangerous contagion, we recommend making cleaning your equipment a habit. Make it part of your process by adding it to inspection forms or work checklists.

Ideally, you can make cleaning part of the pre-use process, but the need to allow time for the equipment to air-dry can make this challenging—if you need to begin using it right away. You might consider adding a cleaning step to the process after you finish using the equipment each time. This should ensure that equipment is clean when you're ready for it the next time. (As a bonus, any dirt, paint and debris that has soiled the gear will be that much easier to clean off, while it's fresh.)

Relying on a cleaning regimen begs another question—how do I know the equipment was cleaned after its last use?

Should Employees Share Equipment or Have Their Own?

Normally, we recommend being fitted and having your own fall protection equipment; now it might be more important than ever for each worker to have and maintain his or her own personal fall protection equipment and other safety apparel (safety glasses, gloves, hard hats, etc.), in order to minimize contact between employees. If workers must share equipment, we recommend cleaning the gear between each use, before passing it on to the next employee.

Treating low-cost personal safety equipment, such as gloves and safety glasses, as disposable items may be another

Cleaning of equipment should be part of your process by adding it to inspection forms or work checklists. *(Image courtesy of Malta Dynamics)*

approach to minimizing the spread of germs via your team's safety equipment. These items can be cleaned regularly, of course, but it might prove more cost-effective to simply discard inexpensive items at the end of a shift—instead of investing the time into disinfecting after each use.

Best Practices to Follow During The Pandemic

In general, we recommend workers follow the safety guidelines provided by the Centers for Disease Control (CDC) and the World Health Organization (WHO). Wash your hands regularly with soap and water for 20 seconds, or use hand sanitizer with an alcohol content of 60% or more. Whenever possible, maintain a physical distance of at least (2m) from other workers, even those who do not appear to be sick. In the meantime, practice good cleaning habits with your personal fall protection equipment to protect yourself and others from the danger presented by COVID-19 and, as always, stay safe. **IHW**

About the Author

David Ivey is the Product Engineering Manager for Malta Dynamics, where he oversees the engineering of all mobile fall protection and custom fall protection systems. For more information or with questions about OSHA compliance of fall protection systems, contact divey@maltadynamics.com.

By: **Paula Shovels**, *Contributor*

(photo courtesy GfG Instrumentation, Inc.)

Atmospheric Hazards at Commercial Cannabis Grower & Processor Facilities

The use and possession of cannabis is still officially illegal under federal law. The Controlled Substances Act of 1970 lists cannabis as a Schedule I drug, which prohibits even medical use. However, at the state and local level, it is a different story. The laws in many states are increasingly at variance with federal law.

With a doctor's recommendation, medical use of marijuana is legal in 36 states, and the Rohrabacher–Farr amendment of 2014 prohibits federal prosecution of individuals in compliance with state medical cannabis laws. Twelve additional states have laws that allow access to cannabidiol (CBD) products that are very low in THC, the primary psychoactive chemical in cannabis. Recreational use of cannabis is legal in 16 states; another 14 states have decriminalized its use.

In states where possession has been legalized, production and distribution have been legalized, as well. Growing, extracting and manufacturing cannabis products has gone from a clandestine, illegal activity to a licensed, highly regulated enterprise with numerous requirements for monitoring and mitigating atmospheric hazards.

Grower Hazards

Carbon dioxide (CO_2) is necessary for photosynthesis and, without it, plants can't grow. Cannabis "grow" areas (greenhouses) are controlled environments where light, temperature, humidity and CO_2 concentration are tightly controlled to optimize growth and the production of cannabinoids and other active chemicals. Cannabis greenhouses are typically tightly sealed and enriched by adding CO_2. The optimal CO_2 concentration for growth is between 1,200-1,500ppm.

CO2 sensors detect gas by means of infrared absorbance. Readings from the **GfG IR-22** transmitter can be displayed at the sensor, as well as remotely at the controller. *(photo courtesy GfG Instrumentation, Inc.)*

Carbon dioxide is a byproduct of living organisms and is naturally present in the earth's atmosphere. The average concentration in fresh air is about 400ppm. At this concentration, it's harmless but, at higher concentrations, CO_2 is toxic. The OSHA exposure limit for unprotected workers is 5,000ppm measured as an 8-hr, time-weighted average (TWA). The IDLH (Immediately Dangerous to Life and Health) concentration is 40,000ppm. Even 30 minutes of exposure at this concentration can lead to irreversible harm. At very high concentrations, even a breath or two can be lethal.

CO_2 is colorless, odorless and about 1.5 times heavier than air. It can easily displace the oxygen in fresh air if it is released in an enclosed space. But, because CO_2 is also a toxic gas, it's not enough just to measure the oxygen concentration. In fact, it takes about 67,000ppm CO_2 to displace enough oxygen for the concentration to reach 19.5% oxygen—the concentration below which the atmosphere is oxygen-deficient. This is the reason cannabis "grow op" regulations require direct measurement of CO_2 levels in the greenhhouse, with readings and alarms visible from the outside. You need to know if a hazardous condition exists before you enter, not after!

In commmercial grow ops, CO_2 is typically introduced using CO_2 generators or a compressed gas delivery system. CO_2 gas delivery systems are often quite sophisticated, using sensors in the greenhouse to control the release of the gas. In non-commercial operations, controls are less rigorous, and CO_2 may be generated by open flame burners, fermentation, dry ice, vinegar + baking soda, or even composting. Regardless of the means used, regulations still require a fixed detection system to directly measure CO_2 with an alarm set at the toxic exposure limit of 5,000ppm.

Cannabis plants produce more than the active chemicals and oils that are extracted from the plant material for sale. Terpenes are the aromatic compounds that give plants and extracts their distinctive flavors and aromas. Many of the terpenes and canabinoids produced by cannabis plants have a strong odor. Many greenhouses are equipped with scrubber systems to remove nuisance odors and keep the smell from reaching nearby neighborhoods.

Terpenes play many different roles in plant physiology. They can be used to attract pollinaters; to inhibit competing plants; or to discourage animals and insects from foraging. (Think poison oak.) The dominant chemicals that produce the characteristic cannabis odor are myrcene, pinene and limonene. Different strains produce different ratios of these chemicals, but the largest fraction usually comes from myrcene. Many terpenes are known to be respiratory irritants, but exposure limits for most terpenes remain to be determined.

The **GfG GMA 200 MW-4** controller is used for smaller, one to four measuring point systems and includes a high-intensity horn and strobe. It is usually positioned at the entrance to the room or area being monitored. *(photo courtesy GfG Instrumentation, Inc.)*

Pinene is an exception to this general rule. Pinene is the largest component in turpentine (about 65%). The current OSHA PEL for pinene is 100ppm (as turpentine), and the threshold limit value (TLV®) is 20ppm averaged over an 8-hr workshift. The IDLH concentration is 800ppm.

Many of the terpenes in cannabis, such as limonene, are nose-detectable by human beings at concentrations as low as 1.0ppm. The best way to measure terpenes is by means of a photoionization detector (PID) type sensor. Stationary PID sensors can be installed within the greenhouse as part of an integrated, fixed gas detection system. PID detectors can also be positioned downstream from air-scrubbing systems to alert operators if there is breakthrough and odors have started to escape.

Processor Hazards

Cannabis can be sold in the form of leaf or buds, but the most valuable products are essential oils and extracts. Extraction is the process of separating the active chemicals from the raw material and turning it into a usable form. Medical extracts are mostly based on cannabidiol (CBD), while recreational extracts are based on tetrahydrocannabinol (THC). The most common extraction techniques involve the use of flammable gas or solvents to separate the chemicals from the plant material. Extraction rooms are hazardous locations where explosive concentrations of gas or vapor can easily develop.

GfG Visualization Software allows readings and system information to be displayed wherever it is needed. The touch screen PC behind the technician's head shows that readings throughout the facility are in the green. *(photo courtesy GfG Instrumentation, Inc.)*

Biochemical techniques and high-tech equipment have led to new forms of cannabis extracts, such as vape oils, oral tinctures, crumbles and wax concentrates. Common extraction techniques utilize propane or butane; alcohols like ethanol or methanol; organic solvents like hexane or heptane; and CO_2 or water. Each method has its particular benefits, and different methods may be used in sequence. The most common recreational extract is BHO. Butane hash oil (sometimes referred to as butane honey oil) is extracted with butane. Butane extraction is relativelly easy and lends itself to smaller operations. However, it's also easy for a mistake or leak to lead to an explosion.

The extraction rooms where gas and solvents are used are Class I Division 1 Hazardous Locations; these are required to be continuously monitored for combustible gases. Rooms that are immediately adjacent to extraction rooms are Class I Division 2 areas, which must also be continuously monitored for the presence of combustible gas.

Extraction techniques need to separate the active molecules from the plant material without causing them to "deactivate" or lose their bioactive potency. Supercritical CO_2 extraction is the most expensive extraction method but also the safest—as it avoids the use or creation of explosive gases or vapors. It is highly efficient and allows for selective purification of the rough extract into multiple products.

In certain pressure and temperature conditions, CO_2 behaves as both a gas and a liquid at the same time. This "critical" point is reached at around 1,071psi (the critical pressure) and 90°F (the critical temperature). The temperature is well below the deactivation temperature for the cannabinoids and terpenes that are targeted for extraction. The supercritical CO_2 is forced through the macerated plant material. The liquid passes through separators where CO_2 is removed and the various fractions of the extract are collected.

Subcritical CO_2 extraction, known as winterizing, requires less pressure and uses a lower temperature, non-supercritical liquid form of CO_2 . Winterizing takes longer, is less efficient and produces lower yields, but it is easier on the fragile molecules being extracted, which can produce higher quality (and higher priced) extracts. The winterization process usually uses ethanol to further separate the pure cannabinoids and terpenes from other byproducts. Constituents that are not soluable in alcohol or water can be extracted using a range of other solvents, such ether, naphtha, benzene, butane, methanol, isopropyl alcohol and even olive oil.

Use of Portable Gas Detection Instruments

All of the sensors used in fixed gas detection systems are available for use in portable instruments, as well. Which sensors to include depends on your responsibilities and the chemicals and processes in use at the site.

Grower instruments should minimally include CO_2 and oxygen sensors. If burners are used to produce the CO_2 used to enrich the greenhouse atmosphere, the instrument also should include a carbon monoxide sensor. For terpene measurement and odor investigation, the instrument should additionally include a PID sensor. Be alert for other specific chemicals that may be present. For instance, if sulfur pots are used for fumigation, it might make sense to include an SO_2 sensor.

Extraction or "manufacturing" instruments should minimally include sensors for oxygen and lower explosive limit (LEL) combustible gas measurement. Either catalytic or infrared LEL sensors can be used for butane measurement, but exposure to alcohol can be rough on the miniaturized catalytic LEL sensors in portable instruments. Infrared LEL sensors are highly responsive to alcohols, and the response tends to be quicker. A PID sensor can be included in the same instrument, or a separate analytical photoionization detector can be used for ppm measurement of solvents and terpenes.

Inspectors and emergency responders don't always know what to expect. Even though the activitiy is legal and licensed, the facility can share many of the same characteristics as a clandestine laboratory. So, it's better to be safe than sorry. Emergency response instruments should include the same five sensor combination used for general HAZMAT response: O_2, LEL, CO_2, PID, CO and H_2S sensors. IHW

Paula Shovels is Director of Marketing for GfG Instrumentation, Inc., in Ann Arbor, Mich.


G888


G999

FOR THE
OEHS PROFESSIONAL

Air Sampling Solutions
For nearly 60 years, SKC has been the leader in manufacturing the quality air sampling pumps, sorbent tubes, filters, bags, size-selective samplers, and other tools you trust. Moving forward, we remain committed in our mission to offer even more air sampling innovations that solve problems, make your job easier, and ultimately serve the health and safety of people at work, at home, and in our communities.
Visit www.skcinc.com!

On-the-Spot Surface/Dermal Testing Solutions
Exposure is more than inhalation! According to U.S. Bureau of Labor statistics, the number of cases and rate of skin disorders exceed recordable respiratory conditions. More than 60% of all regulated chemicals carry a skin notation, yet skin exposure is often considered a secondary exposure pathway. THE GOOD NEWS is that worker exposure through skin is becoming more recognized in the U.S. and there are tools to help make invisible contamination visible. SKC offers easy-to-use, on-the-spot Skin and Surface SWYPE indicators and PERMEA-TEC PPE breakthrough detectors to help you determine appropriate PPE and other controls. Nothing could be easier or more reliable.
See more at www.skcinc.com/surface-and-dermal

Noise Monitoring Solutions: A Level of Ease Unheard of ...Until Now
Monitoring noise on a daily, weekly, monthly, or even yearly basis? SKC has you covered with ease. The SKC NoiseCHEK personal dosimeter provides incomparable ease of use and more data than any Class 2 dosimeter available. All models come standard with these features (just to name a few):
- 1/1 and 1/3 octave band filters
- FOUR virtual dosimeters for simultaneous compliance monitoring to multiple standards
- LOCKING windscreen
- Largest front-lit display on a cable-free dosimeter
- Bright LED collar indicator,
- Bluetooth
- Unique voice recording feature for quick notes

The SKC SoundCHEK Essential sound level meter (SLM) offers easy walk-throughs and environmental surveys and provides the basic, accurate data you need at a high value. SoundCHEK Connect adds expanded data options, octave band modules, and connectivity for more complex investigations. Both SLMs feature ergonomic operation and huge full-color display for easy field access to data with cloud-based and PC options. For easiest accuracy, the SKC AcoustiCHEK Calibrator is designed for direct calibration of all SKC Noise instruments without adapter.
Learn more at www.skcinc.com/noise

Coming soon...Biomonitoring of Benzene in Urine
Benzene is a hot topic in the petrochemical industry and biomonitoring provides insights into body burden that can inform controls to reduce further exposure. HOWEVER...current biomonitoring methods are not sensitive enough to meet changing guidelines, and results take too long for rapid implementation of controls. SKC has developed the highly sensitive InsightX point-of-care benzene in urine testing system—consumables kit and reader—to solve these issues. Within 1 to 2 hours, OEHS professionals can have the on-site answers they need to take the next steps in reducing further exposure.
Registered for AIHce EXP? Check out Poster 1444!
More information to come at www.skcinc.com

SKC Science is Always Available to Help You!
Visit our SKC Knowledge Center—online resource hub—at www.skcinc.com or email skctech@skcinc.com. Our scientists and technical services team are always ready to help you.

SKC Inc. is a U.S. company headquartered in Eighty Four, PA that specializes in manufacturing sampling solutions and providing expertise and support for OEHS industry professionals.

SCIENCE.
SERVING PEOPLE.

SKC

By: Ben Kanner, *Contributor*

Going Mobile: Next Frontier in Employee Safety

Mobile device use is now ubiquitous in the working world, allowing everyone to stay connected, whether employees are at home or on-site. This is especially important for those on the frontlines. According to a report by IDC, frontline workers account for 57% of American workers. They are continuously on the move—loading and driving trucks; re-stocking shelves; and doing everything they can to ensure that the rest of us get the products and services we need.

And yet, per the IDC report, only 49% of frontline workers are enabled with mobile devices. Separately, a report by Skedulo found that less than half (39%) of deskless workers use software that's built for their specific needs, and only 13% feel their needs are being met by solutions that were developed for their roles.

There is clearly a disconnect between what frontline workers need and what they receive, but there is still much to gain from empowering these individuals with tailor-made software and mobile devices. The proliferation of smartphones means that vital information can be delivered directly to employees on the job. From how-to videos and step-by-step guides to entire books and endless webpages of information, mobile devices have brought a world of education into the palm of their hands.

Smartphones also make it possible for organizations to deploy microlearning modules—which consist of compact bursts of information—that can be accessed by workers whenever and wherever they want. The information can be tailored to an individual employee's specific job role or function, and may be quickly absorbed and easily understood when time is short and urgent tasks need to be completed. And, given the speed and efficiency with which microlearning modules can deliver the right knowledge at precisely the right moment, organizations may be tempted to dive in as soon as possible. But, before taking the plunge, they should consider the best ways to approach a frontline employee mobile learning program.

Save Time, Empower Staff with Relevant Microlearning

Safety training is ineffective and inefficient if it is not specifically built for each job role and even each individual—and then appropriately delivered to the right employees at the right time. At a time when frontline worker demands are high and uncertainty about the future is holding strong, employees have to contend with the added stress of an ongoing pandemic. They may be worried about the risk of exposure and what that means for their health or the health of their loved ones.

With these and other concerns, and few moments to spare, organizations cannot afford to take up employee time with education that isn't applicable to their job. Learning has to be specific, efficient, effective and fit with how companies and employees work, because the number-one priority is getting the job done.

This is particularly important for highly efficient and distributed workforces, in which every minute matters. By taking the time to do it right from the start, microlearning can offer the fast, targeted approach that employees need to learn quickly and get back to work.

But that's just one piece of the puzzle. To ensure that workers have an optimal learning experience, employers should consider using a dedicated app.

Amplify Microlearning with the Right Application

Not surprisingly, mobile users tend to prefer dedicated apps that were designed

There is much to be gained from empowering workers with tailor-made software and mobile devices. *(photo courtesy Worklete)*

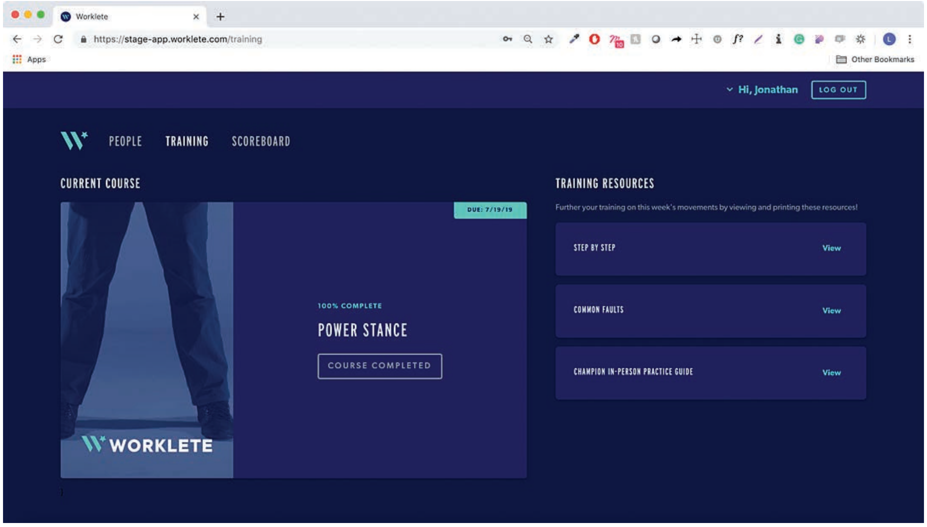
for a specific use case. This was highlighted in *Ericsson's Mobility Report*, which found that web browsing only accounted for a sliver of overall mobile traffic, with app-based usage taking up the rest. Users have come to appreciate the simplicity and added functionality of having all of an app's content in one common destination. By using an app to distribute a microlearning program, organizations can better serve and more seamlessly educate their employees.

After putting the program into place, employers should then consider how it will reach end-users: via personal or company-owned devices?

Increase Productivity with a BYOD Approach

Mobile devices are just that—mobile—so most employees are likely to carry their personal devices while on the job. In fact, more than four fifths (81%) of Americans now own a smartphone. Take advantage of that (and encourage it) by implementing a Bring Your Own Device (BYOD) policy. The benefits are quite significant: BYOD provides employees with easy access to resources that unlock accelerated skill-building and increase productivity, on and off the job.

Most notably, a BYOD policy means that employers aren't forced to acquire new devices for each individual employee. This reduces the bottom line, while enabling employees to choose exactly which device to use—instead of having managers who make that choice for them. And, when employees use the device they want, they are more likely to be engaged and ready to embrace their safety training.



To ensure workers have an optimal learning experience, employers should consider using a dedicated app. *(photo courtesy Worklete)*

Deploy a Microlearning Program That Works

Employees don't have to work from home in order to take advantage of a training program that provides valuable information at any time and from any location. They can learn in real time – on the job, at home or wherever they may be—while the microlearning module provides managers with the user engagement metrics and feedback they need to build better, stronger and more resilient enterprises. This level of flexibility means that workers are more likely to engage with their safety training on a more frequent basis. And, when they do, their employers can expect to see a decrease in injuries. IHW

[Ben Kanner is Co-Founder and CEO of Worklete.]

By: Dave Risi, *CIH, CSP, Contributor*

Breathing Safely:
Simplifying Complex Respirator Fit Test Requirements & How Technology Can Help

Respirators are the last line of defense between workers and harmful air contaminants, irritants and other workplace respiratory hazards. Yet, simply wearing a respirator isn't enough. If respirators don't fit properly, they provide little or no protection for workers. That's why regulations like OSHA's Respiratory Protection Standard require employers to perform and document respirator fit tests (RFTs) for every worker who wears a respirator—and for every respirator type they may use in their workplace—to make sure workers are protected to the highest possible degree.

The challenge is that OSHA's RFT regulations are complex, and the lack of awareness (and understanding of its requirements) among employers is why testing is done incorrectly or not completed at all. At the same time, respiratory hazards are unique to every workplace. Depending on the work activities performed; the respiratory hazards that workers are exposed to; the types of respirators in use; and the respiratory protection requirements that apply at each work site, EHS professionals may need to perform multiple tests on individual workers to ensure compliance. Simply stated, workers must be tested on each and every respirator type and brand they wear in the workplace.

The following is a breakdown of OSHA's RFT requirements and information about the tools available to help ensure tests are accurate, consistent, on-time and in compliance.

Fit Test Protocols

Appendix A of OSHA's Respiratory Protection Standard contains the agency's approved fit test protocols, which are the testing methods and evaluation criteria employers are permitted to use when performing fit tests. There are a variety of approved protocols, and they represent some of the more technical aspects of the Respiratory Protection Standard. Generally speaking, the RFT protocols you select will be determined by the type of respirators used in your workplace, and the test reagents/substances and testing equipment appropriate to those types of respirators.

The various RFT protocols can be broken down into two methods: quantitative fit testing and qualitative fit testing.

Qualitative fit testing is a non-numeric pass/fail test that uses the wearer's response to a substance to determine respirator fit. In qualitative fit testing, after performing user seal checks, the respirator wearer stands in an enclosure or wears a hood, and a test agent is introduced for them to detect. These test agents include:

- Isoamyl acetate (banana oil)
- Saccharin
- Bitrex
- Irritant smoke

OSHA's Respiratory Protection Standard requires employers to perform and document respirator fit tests for every worker who wears a respirator—and for every respirator type they might use in their workplace. *(photo courtesy Adobe Stock)*

If the individual can detect the test agent, this indicates that the agent leaked into the facepiece and the respirator has failed the test, because a good seal has not been achieved. Also, if the employee cannot successfully complete the qualitative test with a particular respirator, the employee must then be tested with another make, size or model of respirator—until they find one that passes the fit test.

For quantitative testing, a machine or computer is used to measure leakage into the facepiece. During this test, a probe is attached to the facepiece and connected to the machine by a hose. The OSHA-acceptable quantitative tests are:

- Generated aerosol
- Ambient aerosol condensation nuclei counter (CNC)
- Controlled negative pressure (CNP)
- Controlled negative pressure (CNP) (REDON)
- Modified ambient aerosol condensation nuclei counter for full- and half-facepiece elastomeric respirators
- Modified ambient aerosol CNC for filtering facepiece respirators

OSHA approved the last two testing protocols in 2019, which are variations of the original ambient aerosol CNC protocol but have fewer test exercises, shorter exercise duration and a more streamlined testing sequence.

It's important that RFTs aren't confused with user seal checks. This quick test verifies the respirator has been properly positioned on the user's face and should be performed each time the user puts it on. Ensuring a proper seal also improves the likelihood of passing the RFT, therefore saving time. Instructions for completing the user seal check can be found in the respirator manufacturer instructions.

OSHA gives employers quite a bit of flexibility when it comes to choosing the RFT protocol that's right for them. In general, qualitative protocols are only used to fit test either powered air-purifying respirators (PAPRs), self-contained breathing apparatuses (SCBAs) or negative pressure air-purifying respirators (APRs) that must achieve a fit factor of 100 or less. Quantitative protocols are used in all situations where a negative pressure respirator is intended to protect workers from contaminant concentrations greater than 10 times the permissible exposure limit (PEL). When quantitative testing protocols are used to fit negative pressure respirators, a minimum fit factor of 100 is achieved for tight-fitting half facepieces and 500 for full facepieces.

One advantage of quantitative testing is that it doesn't rely on the wearer's response to a substance to determine whether the respirator fits and a good seal has been achieved. The *NIOSH Guide to Industrial Respiratory Protection* recommends quantitative testing be implemented when facepiece leakage must be minimized for work in highly toxic atmospheres or those immediately dangerous to life or health. Such tests, though, require more expensive equipment and more training for test administrators compared to qualitative tests.

Regardless of what protocol you use, all RFTs must be conducted with the same make, model, style and size that the employee will be expected to use at the worksite. Also, following the initial RFT, subsequent fit tests must be performed at least annually and whenever an employee switches to a different type of tight-fitting facepiece respirator or their facial structure changes enough to potentially affect the seal of the respirator. Examples of this are significant weight gain/loss and facial scaring.

Scheduling & Recordkeeping

One of the most difficult parts of compliance with OSHA RFT requirements is scheduling and sufficiently documenting results for all tests performed on all employees who require them, for every covered respirator type used in your workplace. Sounds like a big task, right? The more employees that require the use of respirators—especially temporary workers who are enter and leave the workplace on a frequent basis—the greater this challenge becomes.

OSHA requires employers establish a record of the qualitative and quantitative fit tests administered that includes:

- Name or identification of the employee tested
- Type of fit test performed
- Specific make, model, style and size of respirator tested
- Date of test
- Test results (pass/fail results for qualitative tests, or fit factor and strip chart recording or other recording of the results for quantitative tests)

While OSHA only requires these records be retained until the next test is administered, it is good practice to have some form of long-term record storage for tests performed. This could prove to be beneficial should there be any future litigations.

How Technology Can Help

Employers should consider implementing an all-in-one industrial hygiene software solution that standardizes the scheduling, documentation and follow-up for all RFT protocols and activities. This is particularly true for employers who need to manage RFT compliance across multiple locations or for large numbers of employees who use respirators in the workplace. If you can quickly and easily determine which employees use which types of respirators; what fit testing protocols are required for those respirator types; when tests must be performed; and then quickly document results, you'll be well on your way to ensuring compliance with OSHA RFT requirements.

Employers should consider implementing an all-in-one industrial hygiene software solution that standardizes the scheduling, documentation and follow-up for all RFT protocols and activities. *(photo courtesy Adobe Stock)*

Today's IH software solutions are especially beneficial at easing the complexities and time needed for RFTs. Normally, RFT protocols can take as much as 7-8 minutes per worker, and documenting test results using paper forms takes an additional 3-5 minutes. However, software solutions like VelocityEHS greatly improve fit test efficiency by allowing users to quickly select from OSHA-approved protocols and document results using pre-built data collection forms, reducing total test times to just 2.5 minutes when using the modified CNC protocols.

Failure to provide necessary respiratory protection is one of the most common workplace safety violations, often resulting in significant noncompliance fines and devastating effects on employee health. The more familiar you are with RFT requirements—and with the right tools in place—the easier it is to implement an efficient and effective respiratory protection program that keeps your workers safe and your organization compliant. IHW

Dave Risi, CIH, CSP is a Principal Solutions Strategist, Industrial Hygiene, at VelocityEHS, the global leader in cloud environment, health, safety (EHS) and sustainability software. To learn more about how software can help you build a world-class IH program, visit www.EHS.com.


SWISS AIR
RESPIRATORY PROTECTION UNLIKE ANY OTHER
Infinitely adjustable headband
Adjustable neck strap
Ventilated half mask
optrel
TH3
99.98%
Powerful HEPA filter
Ergonomic shoulder harness
ULTIMATE PROTECTION.
REVOLUTIONARY COMFORT.
Spark protector
Pre-filter
99.8% HEPA Filter
optrel®
swiss made
SEE
WHAT YOU
CAN DO
Book a live demo at www.optrel.us


© Sergey Nivens - stock.adobe.com

By: Shelby Jenuwine, *Contributor*

Creating Eye Wellness, On and Off the Screen

Eye injuries in the workplace are fearfully prevalent. The National Institute for Occupational Safety and Health (NIOSH) reports that every day, nearly 2,000 workers in the U.S. alone sustain job-related eye injuries that demand medical attention. Safety experts and eye doctors believe that using correct eye protection can decrease the severity or even prevent up to 90% of these injuries.

Nearly 1 million Americans have lost some degree of their vision due to an eye injury. More than 700,000 Americans injure their eyes at work annually, and 10-20% of all work-related injuries will result in temporary or permanent vision loss. Luckily, 90% of all workplace eye injuries can be avoided by using safety eyewear. The best defense against eye injuries at home and in the workplace is by knowing the hazards and using proper eye protection.

Here is a closer look at how eye injuries can take place, both on the screen and off, and address injury prevention options.

On the Screen

Digital eye strain, also known as computer vision syndrome, is a group of eye- and vision-related complications that result from prolonged exposure to blue light. The largest source of blue light is sunlight. However, several other sources include digital screens (televisions, computers, laptops, tablets and smartphones), other electronic devices, as well as fluorescent and LED lighting.

There is concern about the long-term effects of blue light exposure, as too much exposure can damage the light-sensitive cells in the retina. Because the eyes are working particularly hard to cope with the high-energy visible light, individuals may begin to experience eye strain. Eye strain can cause changes that are similar to those of macular degeneration, which can result in permanent vision loss.

Extended use of computers and other digital devices is one of the most common causes of digital eye strain. Individuals who stare at displays for two or more consecutive hours every day have an increased risk of this condition. Many individuals might experience one or several symptoms, including dry eyes, blurred vision, headache, increased sensitivity to light and difficulty focusing.

To help prevent digital eye strain, consider adjusting the lighting in the room; taking occasional breaks to rest the eyes; limit screen time; use artificial tears to keep eyes from becoming dry; improve the air quality by using a humidifier; and choose the correct eye-wear, such as lenses designed specifically for computer work. Eyeglasses are available with lenses to enhance magnification, plus anti-reflective and blue light-filtering capabilities, as well as select contact lenses to help reduce symptoms of digital eye strain.


© Atstock Productions - stock.adobe.com

Extended use of computers and other digital devices is one of the most common causes of digital eye strain.

Individuals who work at a desk, using a computer for prolonged periods of time, can take additional self-care steps to help diminish eye strain. These steps include, but are not limited to:

- Blinking more frequently to refresh the eyes;
- Adjusting the lighting to reduce glare;
- Positioning the computer monitor to eye level; and

- Adjusting the contrast and brightness to a comfortable level.

Off the Screen

The most common work-related eye injuries include chemicals or foreign objects in the eye, as well as cuts or scrapes on the cornea. Other common eye injuries include:

- Splashes from grease and oil
- Ultraviolet or infrared radiation exposure
- Burns from steam
- Airborne wood or metal chips

Workers experience eye injuries in the workplace because they either fail to wear eye protection or are wearing the wrong type for the job.

In addition, healthcare workers, laboratory and janitorial personnel, and many other workers are at an increased risk of acquiring infectious diseases from eye exposure. Many infectious diseases are transmitted through the mucus membrane of the eye. This transmission can occur through direct exposure to blood; respiratory droplets produced during coughing; or touching the eyes with fingers or other objects that many be contaminated.

Workers experience eye injuries in the workplace for two major reasons:

1. Failure to wear eye protection
2. Wearing the incorrect form of protection for the job

A Bureau of Labor Statistics survey of workers who endured eye injuries revealed that nearly three out of five workers were not wearing eye protection at the time of the injury. Many of these workers reported that they believed eye protection was not mandatory for the job.

OSHA requires workers to wear face and eye protection whenever there is reasonable likelihood of injury that could be prevented by implementing safety equipment. PPE, such as safety glasses, goggles, face shields or full-face respirators, must be used when an eye hazard exists.

Continued on page 37

RESOURCES AVAILABLE

Prevent Blindness is the people's advocate for healthy vision. They work to bring awareness to vision and significant health issues, through observation, access, prevention messaging, service integration, and program development and replication. Prevent Blindness supports the development of effective, state vision health systems across the U.S. An array of resources is available and can be found by visiting www.preventblindness.org, including:

- *The Focus Initiative*—a virtual forum for those working in vision and public health. This professional network encourages the sharing of resources among the vision and health community.
- *Publications and Resources*—includes current vision problems in the U.S., the cost of vision problems, the future of vision, public health reports and more.
- *Initiatives*—a variety of events that aide in awareness of vision health and preserving sight. These include the Focus on Eye Health National Summit, which elevates the national dialogue around vision and significant public health issues; the Award of Excellence and Investigator Awards; and The National Center for Children's Vision and Eye Health.
- *Training and Education*—helps build awareness about eye and vision basics, common eye disorders, eye safety precautions and proactive behaviors to maintain healthy eye vision. Patient education materials, online training and certifications are available. IHW

Protect Your Workers

Comprehensive Grade D Breathing Air Solutions

Grade D Breathing Air Systems

- CO-Guard CO compressed air monitor
- AFS-100 air filtration system

- ProAir 2200 four gas monitor
- AFS-50 air filtration system

Custom Designed Systems

- AFS-50 air filtration system
- Custom stainless-steel enclosure

- CO-Guard CO compressed air monitor
- AFS-50 air filtration system
- Custom steel enclosure with warning light and alarm

Portable Solutions

- AirGuard portable breathing air system
- CO monitor & air filtration

- AFS-100 air filtration system
- Custom portable carrying cradle

ENMET

Creative Gas Detection Solutions

800-521-2978 • www.enmet.com

By: Barbara Nessinger, *Editor-in-Chief*

Eyes On This: *Prevent Eye Injuries at the Workplace*

According to the U.S. Bureau of Labor Statistics, it is estimated that more than 2,000 people a day injure their eyes in the workplace, resulting in an average of 19,000+ lost workdays a year. In about 90% of incidents, minor to severe eye injuries and permanent vision loss could have been prevented by properly fitted (and appropriate) PPE, as well as education and training.

Because of its prevalence on the job, awareness of what can cause eye injuries is more important than ever for both workers and safety managers or industrial hygienists. Eye injury hazards include:

- Exposure to flying objects, dust particles, heat, chemicals and optical radiation
- Working overhead or with moving parts when welding; using power tools; or handling live circuits, pressurized air, liquids or gas
- Liquids or foreign bodies in the eye, flash burns and corneal scratches (some of the most commonly occurring injuries)
- Blows to the face from accidents and contact sports and objects, such as firecrackers, ammunition, darts and materials with springs or elasticity

People in certain occupations must also take precautions to reduce exposure to contagious diseases that can be spread through contact with infected blood or respiratory droplets via eye mucous membranes or from touching eyes with contaminated fingers. This is, obviously, why so much emphasis has been put on "don't touch your face or eyes" during the Covid era.

Situational Awareness & The Right PPE

PPE selection really depends on likely exposure hazards. Protective eyewear can be made of glass, plastic or polycarbonate. Glass is scratch-resistant and is suitable for prescriptions; it can be used around harsh chemicals. However, it can fog and be heavy or uncomfortable. Plastic lenses are lighter weight, protect against splatter and are less likely to fog, but they are

WAYS TO PREVENT WORK-RELATED EYE INJURIES

Prevent Blindness (www.preventblindness.org) recommends the following 10 measures to preventing eye injuries at work:

1. Assess: Inspect all work areas, access routes and equipment for eye hazards. Study eye accident and injury reports.

2. Test: Uncorrected vision problems can cause accidents. Include vision testing in employee physical exams.

3. Protect: Select protective eyewear that is designed for the specific duty or hazard. Protective eyewear must comply with OSHA standards.

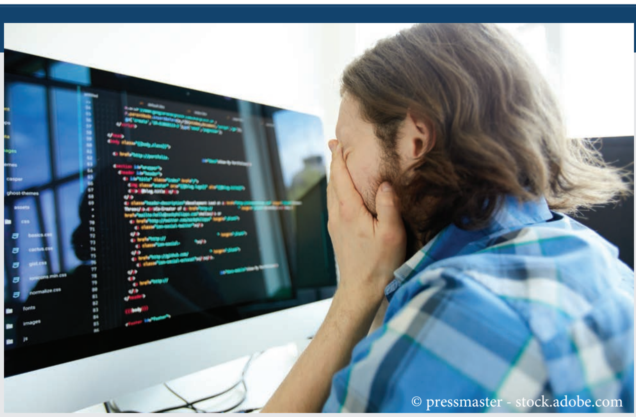
4. Participate: Create a 100% mandatory program for eye protection. A broad program is more effective than one that limits eye protection to certain departments, areas or jobs.

5. Fit: Have protective eyewear fitted by an eye care professional or someone trained to do this. Provide repairs for eyewear. Require employees to be responsible for their own gear.

6. Prepare: Have an emergency response plan, including eyewash stations, and provide training in basic and advanced first aid.

7. Educate: Conduct ongoing eye safety awareness programs and include related information in employee orientation programs. IHW

COMPUTER USE GUIDE


© pressmaster - stock.adobe.com

Protective eyewear is not required for people who spend most of their day on computers and other electronic devices. However, there are some recommended ergonomic and personal adjustments to reduce the likelihood of vision-related complaints, i.e., headaches, fatigue, tired eyes, difficulty focusing. Especially given the increase in working remotely, due to the pandemic and likely beyond, these suggestions make more sense than ever.

- Wear glasses prescribed for computer use
- Adjust the computer monitor height and distance
- Reduce glare caused by lighting and sunlight
- Drink plenty of water
- Follow the 20-20-20 rule: Take a 20-second break to view something 20ft away every 20 minutes IHW

more prone to scratches. Polycarbonate lenses are often preferred, because they have higher impact-resistance than glass or plastic, but they are not as scratch-resistant as glass.

Optimally, face and eye protection selected for work-related or personal use is durable and comfortable—and able to be easily cleaned. Eye protection PPE should never restrict vision, movement or use of other equipment. The following face and eye protection equipment is recommended for specific conditions:

Impact Hazards

Goggles: Provide eye protection from hazards coming from above, below and the sides

Safety glasses: Can look similar to regular eyewear, but they have impact-resistant frames and lenses that have optional, transparent side shields blocking access to the outer perimeter of the eye

Face Shields: Offer frontal protection, but they should only be used in conjunction with safety glasses, because they don't sit close to the eyes to provide adequate protection

Heat/spark Hazards

Safety Glasses: Primary protectors intended to shield the eyes from a variety of heat hazards

Goggles: Primary protectors intended to fit the face immediately surrounding the eye

Face Shields: Secondary protectors intended to protect the entire face, in addition to the eyes, from certain heat hazards

Chemical Exposures

Goggles: Primary protectors intended to shield the eyes against liquid or chemical splash, irritating mists, vapors and fumes

Face Shields: Secondary protectors intended to protect the entire face against exposure to chemical hazards

In addition, for other hazards, such as dust exposure, goggles are intended as primary protectors to guard against airborne particles and harmful dust. For optical radiation, a worker must wear protection that has the correct filter shade number that helps protect the eyes from radiant energy sources.

Providing the correct safety gear and enforcing safety protocols protects workers from personal injury, saves money and creates a professional workplace atmosphere. If, indeed, "the eyes are the window to the soul," it's up to professional safety managers to do their utmost to keep them that way. IHW

Creating Eye Wellness, On and Off the Screen

Continued from page 34

The type of eye protection individuals should wear is dependent on the hazards in the workplace; circumstances of exposure; other protective measures in place; and the individual's vision needs. If working in an area that has particulates, air-borne objects or dust, individuals must wear safety glasses with side protection, also known as side shields. When working with chemicals, safety goggles must be worn.

To prevent an eye injury in the workplace, it is important to know the eye safety dangers. To help better understand the dangers, an eye hazard assessment can be completed. IHW

*[**Editor's note:** This article first appeared in* Workplace Material Handling & Safety*'s March 2020 issue.]*


© Quality Stock Arts - stock.adobe.com

Healthcare workers, laboratory and janitorial personnel, and many other workers are at an increased risk of acquiring infectious diseases from eye exposure.

Wastewater Compliance Techniques for Food Processors

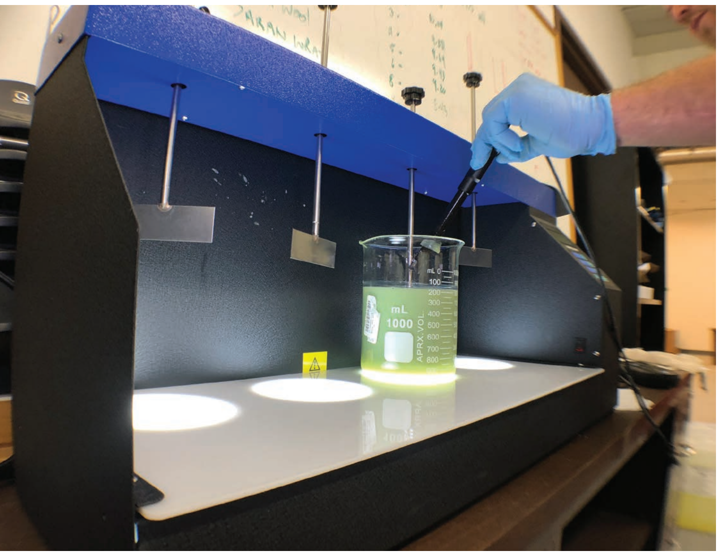
By: **Kevin Summ**, *Contributor*

Performing regular and routine maintenance on water treatment centers keeps small problems from becoming maintenance nightmares. (photo courtesy Anguil Environmental Systems)

In the face of rising surcharges from Publicly Operated Treatment Works (POTWs), an aging workforce and changes in demand from the global COVID-19 pandemic, food manufacturers are looking for cost-effective strategies to stay in compliance while keeping operating costs low.

Food production has always been a demanding and competitive process, and the global COVID-19 pandemic only exacerbated these pressures. Executives are constantly challenged by demand fluctuation, slow product development cycles, competition from healthier alternatives and even food fraud. Like many other industries, food producers must also be cognizant of their environmental footprint and social persona. In fact, some retail chains refuse to stock brands from producers with damaged reputations until they make intensive and expensive changes.

When it comes to wastewater processing, food producers are being hit hard by failing and overcapacity POTWs. Wastewater previously discharged with little care may now be subject to volume and contaminant surcharges, as POTWs repair infrastructure and struggle to meet increased EPA discharge regulations.



A testing lab can validate all potential treatment systems to ensure they are compatible with the customer processes. Wastewater samples can be evaluated in a wet lab to validate potential treatment protocols. *(photo courtesy Anguil Environmental Systems)*

Even companies with existing environmental technologies and procedures in place are faced with an aging workforce and subsequent retirements. That means decades of experience and tribal knowledge on treatment systems retires with them. This leaves owners and executives wondering how to replace that knowledge base and ensure they remain in compliance.

Traditional wastewater treatment solutions have not adequately addressed these regulatory, environmental and operational challenges food producers face in a comprehensive and cost-effective way.

There are companies in the environmental technology space taking a new, holistic approach to clients with these unique set of challenges. One such company, Anguil Environmental Systems, provides highly engineered environmental equipment and service solutions that solve complex industrial air and water challenges. When aiding companies with water projects, it's important to follow a simple but effective process—one that can help producers address economical, operational and compliance challenges.

Evaluate Infrastructure & Systems

Before any work is done on a potential project, a complete evaluation of the current infrastructure and treatment systems is recommended.

- Does the facility need new equipment, or will a systems upgrade suffice?
- What are the changing POTW discharge requirements that will affect them most?
- Are producers thinking about increasing production or adding new product lines, and how will this affect their wastewater chemistry and volumes?

- Are they making any changes to their Clean-In-Place (CIP) operations that could impact volumes and water chemistry?
- Does re-using water make any sense?

Nail Down the Requirements

The first (and often overlooked) step is to understand the business case. It is imperative to know what compliance is currently costing. This will give a clearer view of objectives and help determine return on investment (ROI). For example, are you willing to spend more on controls and automation to minimize operator involvement or to better deploy staff in other areas of the facility? What are the costs of doing nothing?

One customer was looking at a total suspended solids (TSS) surcharge cost increase of $40,000 per quarter and a surcharge of $20,000 per quarter for acidic discharge waters. The client was essentially looking at $240,000 in increased operating costs per year. For some food processors, this may be manageable, but for others it is not. Knowing the company's threshold for these costs is critical.

The second step is to explore and validate process contaminants in a controlled environment. Suppliers with an in-house testing lab can validate all potential treatment systems to ensure they are compatible with the customer processes. One recent company wanted to determine if a solution for TSS removal would get them below discharge requirements. Wastewater samples were evaluated in a wet lab to validate potential treatment protocols. They quickly determined pH/polymer protocol resulted in TSS removals well below the discharge requirements. After bench-testing confirmed the treatment option was viable, Anguil generated a simple Process Flow Diagram (PFD) to illustrate the primary equipment integrated into the treatment train. This train included the appropriate equalization and buffer tanks, pump logistics, clarifier and a filter press for solids handling.

Whenever possible, the third step should always be an onsite pilot system to test waters *in situ*. Pilot testing is the best way to validate the treatment approach. The operator gets a chance to see how the full-scale system will perform and what maintenance may be required. Often, a pilot system can identify customer specific enhancements to the system design that can improve usability.

Design for Low Maintenance

Most water treatment systems require several technologies inline to meet their effluent treatment goals. Remediation of a light non-aqueous phase liquid (LNAPL) plume, for example, may require an oil/water separator, air stripper and carbon adsorption system to meet discharge requirements. However, it is often wise to add other components to protect the primary treatment equipment—but not necessarily directed at the primary contaminants of concern. For example, installing a cone bottom inlet equalization/feed tank, rather than using a flat bottom tank, allows settleable solids to be captured in the cone prior to further treatment. The cone bottom can be easily accessed to pump out the sludge without draining the entire tank.

Before any work is done on a potential project, a complete evaluation of the current infrastructure and treatment systems is recommended. *(photo courtesy Anguil Environmental Systems)*

Materials of construction are another important consideration related to maintenance and food processing. Care should be taken to choose not only those materials compatible with water contaminants, but also where maintenance activities are likely to occur. For example, the coating or painting of equipment surfaces is not recommended. As these housings are accessed during maintenance, painted surfaces will chip and crack. Though stainless-steel construction may represent larger initial capital cost, the equipment will require less lifetime service.

General equipment layouts should also incorporate regular maintenance activities. Pipe runs should not be located across access hatches and adequate clearance must be given to fully access the trays in low profile air strippers. Large basket strainers must be located high enough from the ground that the baskets can be removed. Instruments that need to be regularly calibrated (such as pH sensors) should not be in elevated duct or pipe runs. Adequate space around commonly maintained areas (pumps, blowers, actuators, belts) should be allowed, if possible, to ensure operators have their boots on the ground and are not working in tight conditions. Deposits, both organic and inorganic, can cause either premature equipment replacement or major maintenance costs to restore full functionality.

Deposit Control

Inorganic deposits are well-known. Hardness scale and iron deposition are the two most common culprits. However, there are other equally problematic but more industry-specific ones, such as struvite precipitation in landfill leachate systems. Biofouling from bacterial growth can also quickly gum up a system, but this is often not accounted for in the initial design process. This is either an oversight or because the influent waters are not characterized properly beforehand. Fouling can also occur from the process stream itself, especially when the water contains fat, oil or grease in significant quantities. Inorganic deposit control can be handled in several ways.

Organic deposit control is often overlooked since the potential for biofouling is not commonly characterized during the design phase, especially for pump and treat systems. However, bacterial growth can clog bag filters, foul carbon systems, encumber pipes and blind off membranes. To control biogrowth, operators can either disinfect or discourage bacterial growth by removing environmental conditions which would promote growth (e.g., removing food sources, or adjusting redox potential). Disinfection can be accomplished by the addition of chlorine, sodium hypochlorite, chlorine dioxide, biocides and UV radiation, to name a few. However, each of these systems brings unique operator challenges, especially in terms of chemical handling, health and safety, and disinfection byproducts.

Disinfection should occur as soon as possible in the system to provide maximum protection. It can also be used to shock a system back into compliance when biogrowth is out of control. Long-term management, as well as removal of bioscum, can also be accomplished by injecting biodispersants, which can remove food sources, weaken cell walls and inhibit bacterial reproduction. Most biodispersants are typically safer to handle than biocides or corrosive chemicals and do not react with the treatment system itself.

Continued on page 43

AIHA UNIVERSITY™

Certificate Programs

AFFORDABLE OEHS TECHNICAL TRAINING

AIHA certificate programs are a convenient and affordable way to invest in your staff.

Improve your operations with two online programs perfect for OEHS technicians:

Field Use of Direct Reading Instruments for the Detection of Gases and Vapors – Operations Level
[Earn 4 Contact Hours]

Occupational Exposure Assessment – Technical Level IH 1
[Earn 4 Contact Hours]

Learn more at **bit.ly/IHWPcertificate**.

By: Albert E. Ketler, *Contributor*

Functional Redundancy: The Ticket for Fire Detection

Functional redundancy (FR) is essential for reliably and quickly detecting fires

Carbon monoxide (CO) sensors on 1,000ft centers are used in U.S. coal mines for "early detection" of conveyor belt fires caused by bearings overheating, electrical arcs or spontaneous combustion of coal dust. Temperature detection was phased out decades ago when the faster CO detection became available. Even so, CO gas from a fire still needs to migrate to the sensor for alarm activation and alarming to occur. With ventilation air speed along belts being typically 50ft per minute, the worst-case time delay time delay can amount to 20 minutes—a lot of time for the fire to progress to a destructive inferno before detection.

Optical flame detection has now surfaced as an available fire detector, providing instantaneous detection by line-of-sight to the fire. Having a detection range of at least +/- 300ft, bi-directional optical flame detectors can be installed at each CO sensor, plus one in between, to cover 1,000ft of conveyor belt.

Smoke detectors can also be added to the fire sensor mix to respond to belt fires involving synthetic belt materials that break down at lower temperatures; producing little heat; little or no CO; and no visible flame.

To expand on the functional redundancy (FR), we can add back temperature sensors on 50ft centers to bring back this tried-and-true technology used in home and office fire detection. So, now we have three functionally dissimilar and redundant fire detector types to monitor a conveyor belt for many types of fires.

Frequent Fires

Let's look at the frequent fires that occur at recycling operations. Piles and bales of combustible refuse spontaneously sometimes develop "heatings" that, if not discovered in a few hours, can result in a massive, hard-to-subdue fire. Heatings can be caused by exothermal oxidation of metals (particularly iron) or by discarded and overlooked Li-Ion batteries. Some fire detection is offered by optical IR cameras, but this only responds to the outside of the pile or bale, while the fire is developing inside the pile, out of sight.

Here's where FR can play a big part by the use of CO, smoke, flame and temperature sensors. Install the temperature sensors on long, slim rods that can be inserted into each bale periodically to monitor and log any internal temperature buildup. CO sensors outside the pile or bale will detect heating from spontaneous combustion, as CO diffuses out of the pile or bale. Also, add smoke detectors. CO and smoke can be detected externally, well before a flame or surface heating is identifiable. If the fire emerges, then the instantaneous optical flame detector takes over.

Thermal imaging is another choice, although line-of-sight demands many units, and that might be a crushing cost.

FR is Key

The key to safety and reliability is functional redundancy. I spent years in aerospace and lunar landings where FR was employed in every engineering decision. More recently, I designed a surge protector that used seven different FR surge-suppressing components. Lightning strikes are devious and can find an infinite number of paths to your sensitive electronics. So, I threw the book at it. I used multiple resistors, multiple fuses, multiple bi-directional power zeners, multiple gas discharge tubes and design tricks to generate Rel-Tek's TS-100 transient suppressor. To this day, the U.S. Navy relies on these units to protect their critical radar and communication equipment.

Optical flame detection, smoke detectors, CO sensors and thermal imaging are just some of the ways functional redundancy can aid a company's fire detection system and help save lives. *(photos courtesy Rel-Tek Corp.)*

Fire detection in buildings, factories, schools, warehouses, mines, tunnels, gas-wells, vehicles, etc., should not rely on just one type of fire detection. Thermal is a good starting point, but add something faster, such as flame detectors. This is an immediate, instantaneous response. Carbon monoxide sensors are extremely responsive to fires. CO is an active molecule that migrates rapidly. Adding smoke detectors is also good thinking.

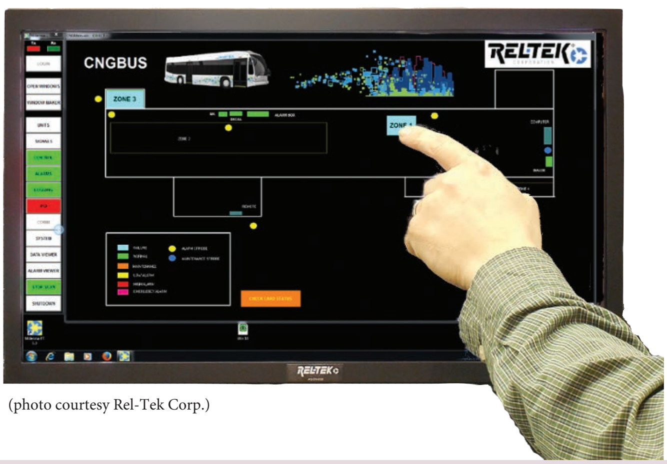
Alarms and Monitoring

Audio/visual alarms are important for alerting workers and residents of the fire just as soon as detected. However, there are alarms and there are alarms. A horn needs to be louder that ambient noise. Many are wimpy and can't get much attention. For a noisy factory, a triple-loud warbler can be the ticket.

You also need a monitoring system to supervise all the sensors; log the data with time and date stamps; and activate alarms, dialers and radio transmitters. Use a supplier with a history of experience, as well as a line-up of compatible sensors and telemetry products. For example, Rel-Tek's economical Millennia-ePC processor has HMI visuals, graphs, controls, alarms, data and alarm logging. One unit can handle 1,000+ sensors of any type. The data-acquisition speed is at 120 sensors per second, virtual real-time. For redundancy, you can add a hot standby computer to take over, if the primary ever fails.

Gas sensors need periodic attention to maintain reliability and accuracy. You can eliminate the bother and cost of recalibrating gas sensor by installing a fully automatic gas sensor calibration utility. The computer keeps track of schedule and recalibrates all your gas sensors in a few minutes, weekly, monthly, whatever—all without human intervention. Documenting is automatic. The cost savings, compared to manual calibration, can return the price of the fire detection system over five-seven years of ownership.

Also, for ultimate synergism, you can combine environmental control with fire detection. Add CO and CO2 sensors to monitor indoor air quality. Temp and RH sensors can be used to pre-emptively control the HVAC. Monitor outdoor air temp and RH to regulate louvers and fans. Air-velocity monitoring is also useful. The computer software can accommodate even complex control strategies, as well as numerical calculations.



(photo courtesy Rel-Tek Corp.)

If there are hazardous (flammable) areas to be monitored, look for in-depth sensor approvals: MSHA for mining and UL for non-mining. Rel-Tek has pioneered in high-speed data acquisition systems and sensors of all types, accumulating about 200 Intrinsic Safety approval actions to date.

Fires are too destructive for you to cut corners at the outset. A good, high-speed FR fire detection system can save lives and property. Using just one type of fire sensor doesn't make sense. FR helps cover all the bases: Plan for high-speed detection and worst-case conditions. You will appreciate the extra safety provided by the modest initial cost of a FR system with automatic calibration.

[Albert E. Ketler, PE, is President of Rel-Tek Corporation (www.rel-tek.com).]

PERSPECTIVES: Interested in having your company highlighted in a future issue of *Industrial Hygiene in the Workplace*? Our new "Perspectives" column invites thought leaders in the IH industry to share knowledge, present industry updates or highlight a new process/idea. Contact Barbara Nessinger, Editor-in-Chief, at bnessinger@workplacemhs.com.

Wastewater Compliance Techniques for Food Processors

Continued from page 40

Lastly, operators should have a preventative maintenance plan in place on the first day of operation and should be aware of all the manufacturers' maintenance recommendations and warranty exclusions. This includes a complete schedule of mechanical, electrical and controls checks. Performing regular and routine maintenance keeps small problems from becoming maintenance nightmares—and inflating operation and maintenance budgets beyond acceptable levels.

The operations and maintenance costs for large wastewater treatment systems often eclipse the initial capital expenditures. Poor attention to design details can turn a routine maintenance schedule into an oppressive task. Many such maintenance headaches can be avoided if experienced plant personnel are consulted when the system is still on paper.

About the Author

Kevin Summ, Director of Marketing for Anguil Environmental Systems, has 25 years' experience with the marketing and sales application of environmental systems into various industrial markets. Anguil Environmental provides highly engineered, environmental equipment and service solutions that help clients solve complex industrial air and water challenges across the globe. kevin.summ@anguil.com/www.anguil.com/800-488-0230

Machinery Noise Control: The First Step

Before time and money are invested in implementation of noise controls, the first step should be to ensure the noise concern is not due to improper equipment setup and/or maintenance related. The recommended step here is to meet with engineering and maintenance representatives to ascertain their opinions on the matter as it relates to elevated noise levels.

Most manufacturing equipment is computer-driven, using programmable-logic controllers (PLC) to actuate various component input and output devices. These devices include servomechanisms (e.g., servo-drives and motors), relay switches, logic relays and other software-controlled mechanisms. When the timing is optimized, the motion of the machine is smooth and relatively impact-free, and compressed air cylinders or solenoids are effectively managed to prevent wasted energy through excessive or extended blowing cycles—all of which results in the lowest noise output potentially available for the machine. For example, Fig 1 shows the "retracted" and "extended" positions of a push bar used to help form cases. Initially, due to excessive driving force, the push bar experienced a hard impact at each end of its stroke (extension and retraction), resulting in a noise level of 94 dBA. After the PLC was optimized to deliver slightly less air pressure, the noise level dropped by 10 dBA, as exhibited in Fig 2.

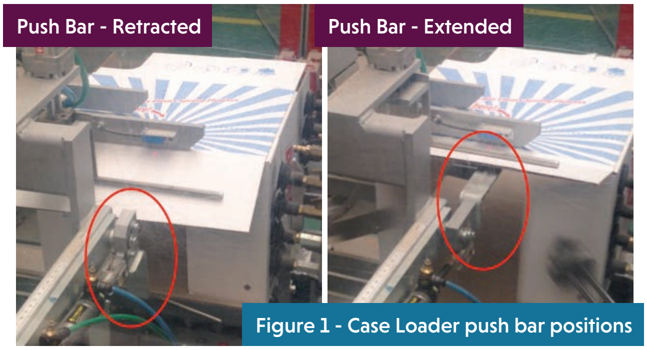


Figure 1 - Case Loader push bar positions

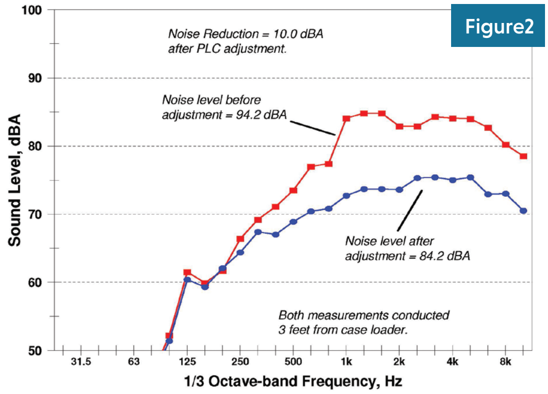


Figure2

One of the most significant and cost-effective noise control measures can be to review with facility engineering the parameters used to operate these PLC devices. When necessary, modify the logic to keep equipment functioning within its "sweet spot." This process alone will yield significant benefits in both the long-term life of the equipment and in minimizing noise exposure risk to employees. IHW

[Dennis P. Driscoll, P.E. (retired), Board Cert. Noise Control Engineer, Driscoll Acoustics LLC]

AccuFIT 9000®PRO Quantitative Fit Testers

AccuFIT 9000®PRO Quantitative Fit Testers are OSHA, ANSI, CSA, and HSE compliant for ALL tight-fitting respirators, including series 95, 99, 100, FFP1, FFP2 and FFP3 filtering facepiece respirators, using OSHA's streamlined 2019 CNC protocol and other accepted protocols. Utilizing 'gold-standard' CNC Particle Counting, these units operate in freestanding mode or with PC/tablet, running 4 tests simultaneously with individual start/stop control.

Accutec-IHS,
https://accutec.com/accufit9000-pro/

Grow Your Knowledge as an OEHS Expert

ACGIH offers the OEHS expert many resources to excel in their careers. Membership gives professionals many money-saving benefits, including continuing education hours at no additional cost. The knowledge you gain from continuing education opportunities comes from webinars and courses presented by experts in their fields. The many publications to choose from are enough to put together a comprehensive library. Explore the ACGIH possibilities!

ACGIH, www.acgih.org, 513-742-2020

Indispensable Dispensers

The FP-017 Face Mask Dispenser–Cone–Bulk, from Bowman Dispensers, holds cone masks, eye protection or miscellaneous items in bulk. Keeps masks or other PPE items dust-free and accessible. Hinged lid, keyholes for wall mounting. Clear Durable PETG Plastic. Made in the USA. Dimensions: 6.04" L x 6.7" W x 8.98" H.

Bowman Dispensers, www.BowmanDispensers.com

New 12" Certified Explosion-Proof Axial Fan

Air Systems introduces our new 12 Inch CSA C/US certified explosion-proof Axial Fan, CVF-12EXP. The rugged, conductive polyethylene fan is designed to accommodate a variety of hazardous locations such as manhole entry, petrochemical tanks, shipbuilding & repair, and tank cleaning. A conductive duct canister is available with 15 or 25 foot ducting.

Air Systems International, www.airsystems.com

Smallest Portable Multi-Gas Analyzer

The Gasmet GT5000 Terra is the world's smallest portable FTIR multi-gas analyzer. It measures 50 gases simultaneously at sub-ppm levels and identifies "unknowns" using the Calcmet software along with the NIST/EPA© reference library of over 5,000 gases. Provide near-instant results and resolve worker air quality issues on the floor!

Gasmet Technologies Inc.,
www.gasmet.com

Take Two to Tango

Industrial Scientific's Tango® TX2 is a new, two-gas monitor that increases site safety by allowing users to detect two gases with one small, reliable monitor. The Tango TX2 helps organizations reduce project shutdowns from false alarms; increase worker trust in gas monitors; and minimize time spent on monitor charging and maintenance. With individual sensors for each gas, the Tango TX2 is the most accurate two-gas monitor on the market. Lightweight and wearable, it is now available globally with sensors for carbon monoxide, hydrogen sulfide, nitrogen dioxide and sulfur dioxide.

Industrial Scientific, www.indsci.com/tango-TX2

Enjoy Safe Breathing Air

The Optrel Swiss Air respiratory protection system brings you clean breathing air with 99.8% HEPA filtration. Many workplaces and public spaces produce pollutants, such as smoke, soot particles, nitrogen oxides, ozone or viruses that can enter the lungs—causing asthma, chronic cough, bronchitis or other respiratory diseases, including lung cancer. With the Optrel Swiss Air, you enjoy fresh air, completely independent of your activity and your other protective equipment.

Optrel, www.optrel.us, 401-398-7240

High-Flow Air-Sampling Pump

Casella has launched the Vortex3 high-flow air-sampling pump. Completing its range of air-sampling pumps, this innovative pump is right at home! With 12L/min with a typical filter and unique interlocking design to enable easy transportation, the Vortex3 is built to impeccable standards. Compatibility with Casella's Airwave App and Bluetooth connectivity (Pro model only), allows for remote control and monitoring of the unit.

Casella, https://www.casellasolutions.com/us/en/vortex3-launch.html

Let us focus on your thoughts! *Industrial Hygiene in the Workplace*'s **"Thought Leadership"** column is a great way to get the word out about a new process, technology or approach that serves the industrial hygiene space.

For more information or to talk about participating in an upcoming issue, contact Barbara Nessinger, Editor-in-Chief, bnessinger@workplacemhs.com.

High-Res Thermal Imaging

ATEC carries a comprehensive inventory of thermal and infrared cameras from leading manufacturers, like FLIR and Fluke, that capture pristine, thermal images. The FLIR T640 Thermal Imaging Camera is a thermal imaging device that captures pristine 640 x 480-pixel images, providing 307,200-pixel high-resolution pictures and precise, long-range temperature measurements at once.

ATEC, https://www.atecorp.com/category/thermal-cameras, 800-404-2832

Revolutionary Respirators

CleanSpace Respirators are a revolution in respiratory protection. Designed to provide a high level of protection, they're lightweight and have no belts or hoses. Being reusable, they reduce costs and reliance on supply chains and stockpiling. Four models: CleanSpace EX is intrinsically safe; CleanSpace ULTRA is IP 66 rated, water-tolerant; CleanSpace2 is suitable where intrinsic safety & water-tolerant is not required; and CleanSpace HALO specifically for healthcare. NIOSH-approved.

CleanSpace Technology Pty Ltd., www.cleanspacetechnology.com/us

Cold Comfort for Heat Stress

Workers in hot environments wear Vortec Cooling Vests to minimize heat stress and fatigue while improving comfort and productivity. Cold air circulates through the Cooling Vest to distribute even, adjustable cooling over the upper body. The vest is newly redesigned for greater comfort and can be worn under other protective PPE. Available in three sizes.

ITW Air Management, https://info.itw-air.com/acton/media/43375/vorteccoolingvest, 800-441-7475

Noise & Vibration Monitoring

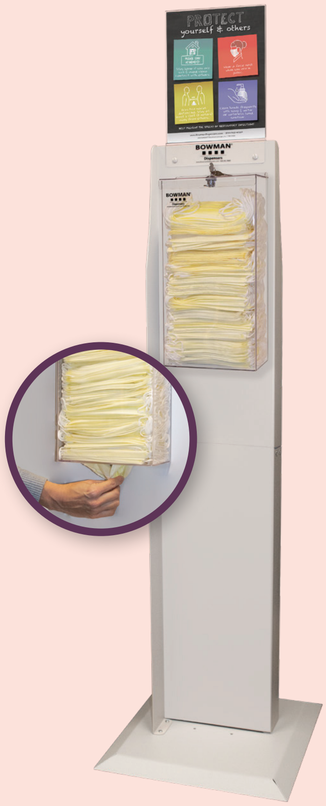
OHD is now proud to be the master distributor for the Svantek line of noise and vibration monitoring tools in the U.S. With 30+ years of experience, Svantek has established itself as innovators with a global reputation for producing some of the most accurate and reliable instruments on the market. IHW

OHD, LLLP, www.OHDGLOBAL.com

Advertisers Index

HELPING PROTECT WORKERS

health and safety



BD119-0000
PUBLIC SAFETY KIT

KIT INCLUDES:

- **Stand**
  KS022-0012 Dual Sided Floor Stand
- **Bulk Mask Locking Dispenser**
  FM403-0111 PETG
- **Sign Holder with Signage**
- **Mounting Tape VHB**
  To attach mask dispenser to stand

Stay in compliance with OSHA safety recommendations and minimize worker exposure by using accessible face mask, glove and eye protection dispensers from Bowman.

Visit us online or call to learn more about our PPE dispensing solutions for any space.

BOWMAN SUPPLIES THE DISPENSERS, YOUR DISTRIBUTOR SUPPLIES THE PPE!

www.BowmanDispensers.com • 800-962-4660

BOWMAN®
Dispensers
Organize • Contain • Comply®

All consumable items are for demonstration purposes only and are not available for purchase through BOWMAN®


MORE MONITORING POWER, LESS BULK.
Get two-gas monitoring in a single-gas package with Tango® TX2.
The Tango TX2 is a lightweight, easy-to-wear two-gas monitor that simplifies gas detection management by eliminating the need for charging with a two-year runtime and replaceable battery.
Learn more at
www.indsci.com/tango-tx2
TANGO TX2
INDUSTRIAL SCIENTIFIC