BULLETIN

HOLMES SAFETY ASSOCIATION

E PLURIBUS UNUM

SAFETY EFFICIENCY

MINERAL INDUSTRIES

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KEEP US IN CIRCULATION

The Holmes Safety Association Bulletin contains safety articles on a variety of subjects: fatal accident abstracts, studies, posters and other safety-related topics. This information is provided free of charge and is designed to assist in presentations to groups of mine and plant workers during on-the-job safety meetings.

Welcome new members

NAME	CHAPTER NUMBER	LOCATION
Fox River Minerals, Inc.	9428	Seneca, IL
Ken Measel Supply	9429	Almont, MI
TNT Coal Company	9430	Joliett, PA
Eastern Rock	9431	St. Johnsville, NY
Vermont Marble	9432	Danby, VT
Santos Construction	9433	Amsterdam, NY
Hudy & Williams	9434	Wells, VT
Rick's Fire Extinguisher	9435	Ballston Spa, NY
Delhotal Quarry & Mill	9436	Lee Center, IL
Emerson Quarry & Mill	9437	Emerson, IL
Big (4) Pit	9438	Moore, OK
Quickway Pit	9439	Oklahoma City, OK
Desha	9440	Desha, AR
Amerimex, Inc.	9441	Bryan, TX
Logan County Safety Training	9442	Paris, AR
Razorback Training	9443	Fort Smith, AR
Kellen & Streit, Inc.	9444	Yankton, SD
Nickels Sand & Gravel	9445	Bloomfield, NE
Nelsen Construction Company	9446	Vermillion, SD
Cheto Mine	9447	Sanders, AZ
Williams Detroit Diesel-Allison	9448	Phoenix, AZ
Intermountain Mine Service	9449	Superior Pinal, AZ
Cape Bucton Development Corp.	9450	Sydney, Nova Scotia
Martin Stone Quarries, Inc.	9451	Bechtelsville, PA
Jackal Mining Company, No. 1	9452	Virgie, KY
T and W Coal Company, Inc.	9453	Meta, KY
Monticello Chapter	9454	Mt. Pleasant, TX
Barbara D. Mining Inc.	9455	Bryant Store, KY
Revloc Reclamation	9456	Revloc, PA
International Materials	9457	North Lake, MI
Quality Sand & Gravel	9458	Walnut, IL
Barton Coal Company	9459	Smithfield, PA
Pentagram Mining Company	9460	Dorton, KY
Trail Motors	9461	Minersville, PA
Tri-City Aggregates, Inc.	9462	Holly, MI
Quality Aggregates, Inc.	9463	Claverack, NY
Harold Lyons & Sons, Inc.	9464	Fishkill, NY
Thalle Industries, Inc.	9465	Fishkill, NY
Naples Claims Management	9466	Buffalo, NY
Colored Slate Co., Inc.	9467	North Poultney, VT
Wallinford Plumbing & Heating, Inc.	9468	Wallingford, VT
Harmony Mine	9469	Conyngham Twp., PA
Mauer & Scott	9470	Northampton, PA
Central Plains Contracting Co.	9471	Longview, TX
Colby Coal Co., Inc.	9472	Kingwood, WV

MSHA hits pay dirt with JSA

MSHA combines JSA with increased enforcement to eliminate mine-related deaths by the year 2000.

By J. D. Shults

The mining industry has been fabled in song and story for danger and disaster. Death is all too common a memory for many mining families—in some cases spanning several generations. The environment—underground or in deep pits—has traditionally attracted workers with a fatalistic attitude about their work environment and the chances for any improvement.

"The tools and techniques of accident-free mining are all out there."

William Tattersall, assistant secretary of the Mine Safety and Health Administration (MSHA), wants to change all that. MSHA has announced a goal of zero fatalities in the mining industry by the year 2000. As recently as 1970, 425 people died in mining accidents. By 1980, that number was reduced to 236. In 1989, it dropped even further to 116, but then jumped in 1990 to 123.

"I am profoundly disturbed by the increasing trend I see in mining deaths," Tattersall says. "There is no level of fatal or other serious accidents that is acceptable as a cost of mining coal or any other mineral."

In every industry, the goal has always been zero fatalities now, not 10 years from now. But, because of the danger inherent in mining in general and the history of mining, the goal of zero fatalities in 10 years is a reasonable and achievable goal, Tattersall notes.

There are about 16,000 mines in America: 11,500 are metal and nonmetal mines and 4,500 are coal mines. Last year 119 mines had fatalities. Incidents at two mines resulted in two deaths each. In all, 123 people died. Although this is a very low percentage, it is still unacceptable. The cost, whether measured in dollars, lost production or human terms, is staggering.

To achieve the goal of zero fatalities, Tattersall says MSHA has instituted a three-stage program. The agency is encouraging mine operators to adopt job safety analysis (JSA), techniques at both underground and surface operations. The agency also has developed a computerized program to identify mines with a history of excessive violations of safety procedures and regulations and will increase financial penalties for safety violations at these mines. MSHA also has identified geographic areas that have historically accounted for the greatest number of coal mining fatalities. The agency has launched a four-state initiative in Kentucky, West Virginia, Pennsylvania and Virginia in cooperation with the respective state mine safety agencies. These four states historically account for 70 percent of all mining fatalities as well as an overwhelming percentage of all coal-mine operations and will he the

object of special attention to reduce serious accidents.

"The tools and techniques of accident-free mining are all out there. All that is needed to eliminate most of the rest of the fatal accidents in this industry is the conviction that we can do it, better training in accident-prevention techniques, and the will to make it happen," Tattersall says.

"The JSA process will help to identify those singular incidents that result from inattention, lapses of memory, and failure to apply known safe practices."

No new regulations

"Voluntary application of JSA is the prudent approach," notes Bobby J. Jackson, vice president of the American Mining Congress, a trade association of mine operators and related businesses.

"The JSA process will help to identify those singular incidents that result from inattention, lapses of memory, and failure to apply known safe practices," says Jackson.

Tattersall agrees with Jackson and adds, "JSA won't be regulated because it is too varied. There are too many variables in the equation, and to try to reduce it to a standard regulation would kill a lot of the programs that are very effective. We will sell the concept of JSA—soft sell, hard sell, whatever it takes to get this concept into many mines, if not all mines in the country."

When asked about the costs to implement the JSA program, Jackson says, "We see some costs up front, but disabling injuries and fatalities are very expensive to mining operators. If we can reduce injuries and fatalities, certainly there will be cost benefits."

Safety problems, people problems

Key to Tattersall's proposals is JSA, a training technique widely used in many industries that has proven benefits. The cornerstone of JSA is an agreement between the worker and supervisor to identify all the components of the worker's job and then analyze each for potential hazards and practical solutions to those hazards. An advantage of JSA is that it is grounded in what the worker actually does rather than an "ivory-tower" job description. Because the worker has actively participated to help identify the hazardous behaviors and alternative practices that eliminate or minimize the risks, the worker psychologically "owns" the new safe-operating procedure and is more likely to integrate the recommended practices into his or her day-to-day activities. This reality-based approach to job definition has advantages for the successful implementation of JSA.

In addition to the 123 fatalities in the mining industry last year, coal miners suffered more than 10,000 injuries that involved lost time. More than 7,000 lost-time injuries occurred in metal and non-metal mining. The use of JSA across the industry is projected to cut these figures dramatically.

MSHA has developed a new computer-based program to identify specific mining operations. The program, which is just coming on-line, will identify mines with violations and mines with a pattern of violations, that is, a pattern of repeated violations of the same type.

"We are looking for repeat violators," Tattersall says. "Only about 7 percent of all mines have an excessive violation history, but those mines have a disproportionate number of mine safety and health violations," he observes. "Mine operators should do everything they can to keep off the list, because once they are on it, it will be difficult to get off."

MSHA makes at least four complete safety and health inspections annually at each underground mine and two per year at each surface mine. Under the new program, state and federal inspectors will make joint visits to mines that have a history of excessive violations. Injury records will be audited, training programs will be reviewed, and inspectors will make "walk and talk" inspections during which they will review safe procedures with the individual miners.

Tattersall notes that the enforcement teeth have been sharpened for those few mine operations that still haven't gotten the message. MSHA has proposed increased civil penalties for mine safety and health violations and additional increases for mines that have a history of excessive violations. Under this proposal, the maximum penalty for any mine safety or health violation would increase from $10,000 to $50,000.

"Increased penalty assessments and enforcement scrutiny at mines with excessive violations should serve as a more effective deterrent and help reduce the number of violations at these mines," notes Tattersall.

The principal thrust of MSHA's program is JSA, a process that has proven its effectiveness. Although there are some initial costs associated with the implementation of JSA, these costs are relatively minor. If one weighs them against the lost lives, lost work time due to disabling injuries and related costs, the price of a JSA program shrinks to infinitesimal. The only thing we will miss with zero fatalities in the mining industry are those quaint old ballads about mine disasters.

Sources: William Tattersall, assistant secretary of labor for Mine Safety and Health; Bobby J. Jackson, vice president of the American Mining Congress; Randy Logsdon, mining section administrator, National Safety Council.

Holmes Safety Association Monthly safety topic

Fatal machinery accident

GENERAL INFORMATION: A 20-year-old conveyorman, with 1 year of experience, was fatally injured when he either fell or was pulled through a 20- by 30-inch screen discharge chute into a combination paddle-and-screw log washer about 16 feet below.

The mine is a multiple bench, open pit, sand and gravel operation. The plant at the mine was new, having been put into production only a few days before the accident. Using a computer, the plant operator controls an apron feeder and jaw crusher in the pit, 8,000 feet of conveyors, 12 vibrating screens, three cone crushers, five washing apparatuses, 21 feeders, three compressors, 11 pumps, splitters, electric gear, and eight load-out bins.

DESCRIPTION OF ACCIDENT: On the day of the accident, the conveyorman reported at his normal starting time of 1:00 p.m. His duties included general maintenance at the plant.

The victim and another conveyorman were assigned to work together during the shift. At 6:00 p.m. when the foreman assigned them to clean out a buildup of clay that had accumulated inside a three-deck screen on the top level of a screening, sizing, and washing tower.

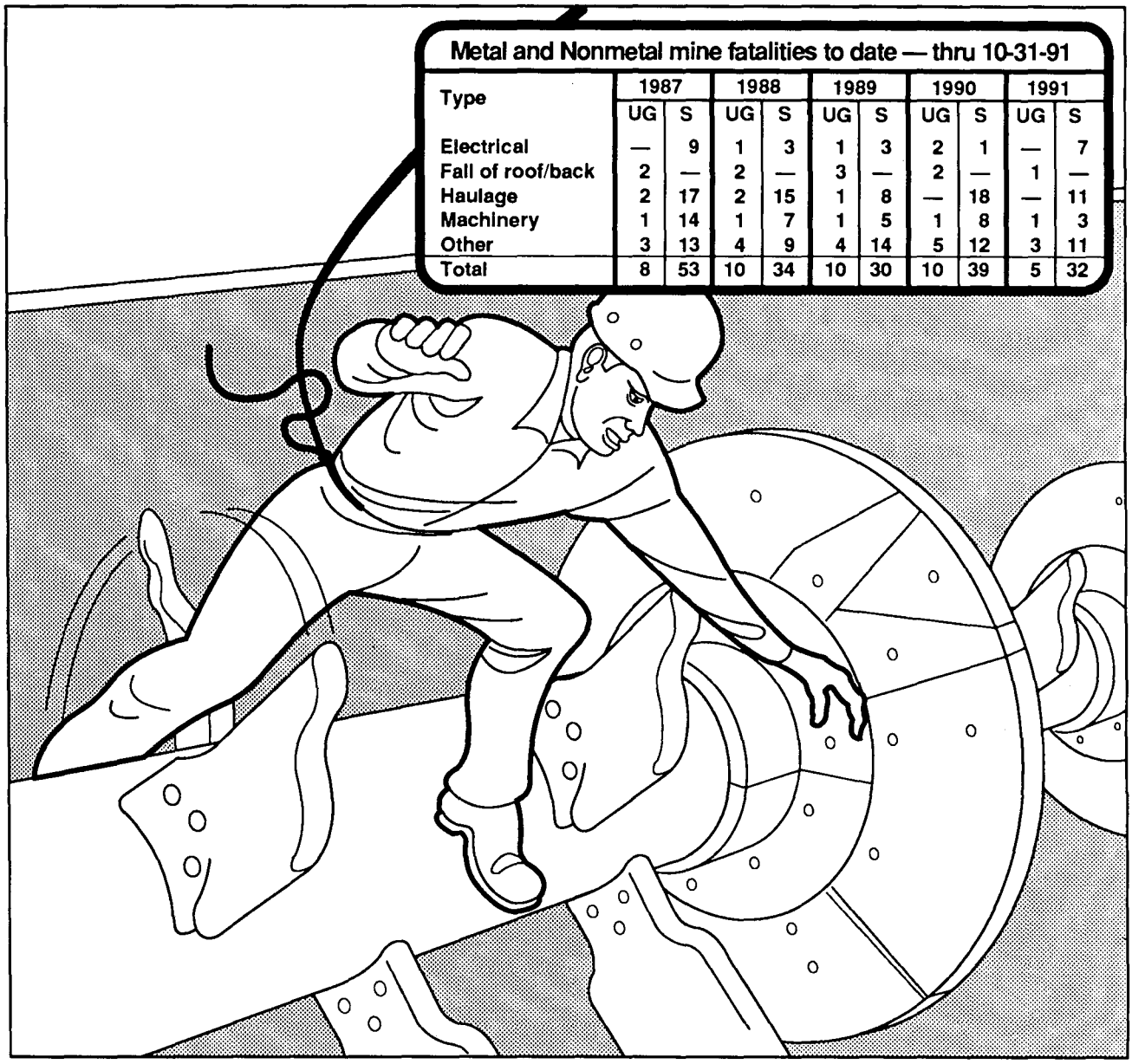
The 2 conveyormen proceeded to gather the equipment needed to remove the clay.

Preparations took so long that they never began the work. At 8:15 p.m., the foreman came by and told them there was not enough time to clean the whole chute. Instead, he told them to bar the accumulated clay from the upper corners.

As the other conveyorman was laying out the hose and air hammer, he saw the victim tie one end of the nylon rope to the triple-deck screen and the other end around his waist. A short time later he heard the victim yell. By the time he looked, the victim had disappeared into the log washer. Unable to see the victim, he started calling for help. The plant operator heard him and shut the log washer down. The foreman heard him as well and deenergized the complete tower. The foreman then went up the tower and was told that the victim had fallen in the log washer.

The foreman jumped into the washer which had about 2-1/2 feet of water in it. He located the victim and tried to pull him out but the body was wedged between the paddles. After several unsuccessful attempts to free the trapped victim, the foreman went to the office to place an emergency call.

The county rescue squad responded. The water was drained from the washer, drive belts were removed, and eight paddles from the shafts were detached



Metal and Nonmetal mine fatalities to date — thru 10-31-91

Type	1987		1988		1989		1990		1991	
	UG	S	UG	S	UG	S	UG	S	UG	S
Electrical	—	9	1	3	1	3	2	1	—	7
Fall of roof/back	2	—	2	—	3	—	2	—	1	—
Haulage	2	17	2	15	1	8	—	18	—	11
Machinery	1	14	1	7	1	5	1	8	1	3
Other	3	13	4	9	4	14	5	12	3	11
Total	8	53	10	34	10	30	10	39	5	32

to free the victim. The county coroner pronounced the victim dead at the scene at 8:30 p.m.

CONCLUSION: The cause of the accident was the assignment of two employees to a task that they were too inexperienced to perform. Both the victim and the other conveyorman, had worked at the new plant only 2 days. None of the company's other operations were similar to this new, highly automated, computerized operation.

The company had not developed a procedure for training employees in safe methods for accomplishing this task. Interviews with four employees who had cleaned the screen and chute areas disclosed four different ways to access the area.

There is a possibility that the victim did not slip, but was pulled through the chute by the rope attached to his waist—part of the rope could have become entangled in the log washer below and a paddle could have grabbed the rope and pulled him through the chute.

Hazardous materials on mining sites

By Randy DeVaul, Technical Instruction Supervisor, Commonwealth of Virginia

Introduction: Many of the materials handled daily on mine sites are classified as hazardous. We become so accustomed to using them, however, we often overlook or ignore basic safety and health practices when using these products. As MSHA enacts the Hazard Communication Standard, it is important to know what common materials being handled are hazardous to our health and the environment. We need to understand how to properly protect ourselves from these hazards.

Part I

With the handling of any hazardous material, there are six potential personal hazards that exist, depending on the specific material. We can remember these hazards by using the acronym **T-R-A-C-E-M.**

Thermal injury. A chemical may cause thermal burns due to a chemical reaction with another material, including air and/or water; it may also be caused by its physical property, such as pressurized carbon dioxide, which when released from a fire extinguisher is often below -150 degrees F. So whether from extreme heat or fire or from extreme cold, thermal burn injuries may occur.

Radiation injury. Radiation energy may be released from certain forms of minerals or products which can result in a burn from exposure to the energy being emitted. Such energy can be released one of three ways—alpha or beta particles or gamma rays. The alpha and beta particles are actual solid matter which can be spread through personal contact. Except for a nuclear explosion, it is unlikely a person would become contaminated by airborne alpha or beta particles due to their size and limited ability to travel through air. Gamma rays are pure energy. Though it cannot be spread through personal contact, it can cause exposure by the energy passing through a person. In large enough quantities along with time, a person could receive radiation burns and even have cells in the body become altered or mutated.

Asphyxiation. This can occur either from producing an oxygen-deficient atmosphere or by actually displacing the oxygen from the air. An oxygen deficient atmosphere is a result of too high of a concentration of a vapor or substance. An oxygen-displaced atmosphere is a result of the material actually bonding to the oxygen and causing it to become removed from the air. This is what happens when using a halon fire extinguisher. When the halon is released, the oxygen is removed, hence removing a vital side of the "fire triangle."

Chemical or Corrosive Injury. A material that has a pH of less than 7.0 is classified as an acid; greater than 7.0 is a base (also called an alkaline or caustic). The further a material moves away from 7.0 the greater the risk of having a corrosive affect on skin or steel, regardless of it being an acid or base. Significant skin tissue damage can occur if exposed to these strong chemicals, such as sulfuric acid (commonly found in batteries) or sodium hydroxide (an alkaline also called lye or caustic soda).

acid < 7.0 < alkaline

Etiological Injury. This type of injury is unlikely in the mining industry. It occurs from exposure to a living or biological organism, often used in laboratories and medical research. Common etiological agents includes the AIDS virus, strains of influenza, etc.

Mechanical Injury. This usually results from a reaction, such as an explosion, in which shock and sound waves are emitted and cause actual skin and internal tissue damage. For example, in an explosion or pressurized container rupture, flying debris or shock waves may hit a person who is directly in the path of the debris or waves.

With these six types of potential personal injury, think for a moment about the material handled regularly by you and determine how many of these hazards to which you expose yourself routinely. Do you wear the proper personal protective equipment when around these materials? Do you handle these materials in a safe manner? Do you know what safe steps to take to minimize your potential exposure and hazard(s) when working with the material(s)? A Job Safety Analysis of each task performed when using these materials will provide a good starting point for identifying and, therefore, reducing your exposure to these potential hazards.

Part II

In Part I, we identified common types of hazards that exist when handling hazardous materials; however, are the materials routinely handled on mine sites "hazardous?" To determine this, we must define specific categories of materials using the U.S. Department of Transportation (USDOT) definitions. USDOT is the agency responsible for classifying materials that are shipped for use in commerce. Placards seen on transport vehicles and shipping labels on containers follow the USDOT classification system.

Flammable and combustible liquids

To understand the difference between these two types of liquids, we must briefly define some important terms:

Flashpoint—the minimum temperature at which a liquid gives off vapors, which when in contact with an ignition source (heat, flame), will ignite;

Ignition temperature—the minimum temperature at which a material will self-ignite.

In other words, the flashpoint of a substance is the temperature at which enough vapor is present or given off so that if an ignition source is introduced, such as a flame or spark, the substance will flash or ignite. This differs from the ignition temperature, which is the temperature at which a substance, once heated sufficiently, will ignite without an ignition source having to be present.

A simplified definition of a flammable liquid, then, is a substance that has a flashpoint of less than 100 degrees F (fp < 100 dF). This substance produces enough vapor at or below normal atmospheric temperature to become a potential flammable hazard if an ignition source is introduced to it. For example, gasoline has a flashpoint of -45 dF. So if the fuel/air mixture, referred to on a Material Safety Data Sheet (MSDS) as the Upper and Lower Flammable Limit (UFL and LFL), is in the range for combustion and a spark or flame is introduced, the gasoline

vapor will flash or ignite at any temperature higher than -45 dF.

A simplified definition of a combustible liquid is a substance that has a flashpoint of between 100 dF and 200 dF (fp $\leq$ 100 dF $\leq$ 200 dF). USDOT considers any substance with a flashpoint greater than 200 dF as not posing a major hazard when transported in commerce. Examples of combustible liquids are diesel fuel (fp of 100 - 110 dF) and Varsol or other types of mineral spirits cleaning solvents (fp of 104 dF).

Due to the nature and temperature range of a flammable liquid, it should never be used as a cleaning agent.

Using the **T-R-A-C-E-M** acronym (from Part I), what potential personal hazards exist when handling flammable or combustible liquids? What personal protective equipment should be worn? What other precautions can be taken to ensure safe handling of such substances?

Corrosives

By definition, a corrosive is any substance - liquid or solid - that causes visible destruction or irreversible damage to human skin tissue, or, a liquid that has a severe corrosion rate on steel. As stated in Part I, a corrosive may be either an acid or an alkaline.

How rapidly it reacts with skin or steel depends on the concentration and strength of the substance. The concentration of the substance is based on the percentage of the substance in solution; that is, the ratio of the substance to a given volume of water. The strength is based on its ability to form ionized hydrogen or ionized hydroxides (whether an acid or base, respectively) when dissolved in water. In other words, a strong acid like hydrochloric acid (pH 1.0), when mixed with water, separates and gives off hydrogen ions and chlorine ions. A weak acid like acetic acid, or vinegar (pH 3.0), retains its identity as a unit. When mixed with water, acetic acid mainly exists as molecules of acetic acid rather than the hydrogen ions separating from the molecule. This results in a lower corrosive factor than hydrochloric acid, giving it a pH closer to 7.0 or neutral. A strong acid in a diluted concentration may be as damaging as a weak acid in a high concentration. If a substance is classified as a corrosive, it has corrosive characteristics based on its concentration and strength.

A specific acid often encountered in mining is sulfuric acid. A person's exposure to this is commonly from a battery exploding while being recharged. Sulfuric acid liberates heat and absorbs water from the air. When the acid comes in contact with skin, it reacts with the water from perspiration, creates and gives off extreme heat, and dehydrates the skin surface which causes a severe burn. If water is added to the acid, the extreme temperatures produced may cause boiling and violent spattering of the acid. It is recommended that personal protective clothing be used and eyes flushed if exposed to 1% or greater concentrations.

A common alkaline substance is sodium hydroxide, often referred to as lye or caustic soda. Commercially, it is created by passing an electric current through solutions of sodium chloride (brine). For comparison purposes, this is the main ingredient in the household product DRANO. As an alkaline, it is designed to react with fat cells, where acid reacts with water. Sodium hydrox-

ide also releases considerable heat when dissolved in water (by giving up the hydroxide [-OH] ions). This is why some pipes in plumbing fixtures are damaged when using this substance to unclog the animal fats/grease from the line. Concentrated solutions corrode aluminum, zinc, lead, and glass.

As a sideline, when using sodium hydroxide in the home, it is well known that the substance unclogs kitchen plumbing lines better than those in the bathroom. Why? Most kitchen lines become clogged with fats/grease from normal cooking, which readily reacts with this substance. Most bathroom clogs are a result of hair, which is protein, not fat. This is why ammonia poured down a bathroom drain works better to unclog the protein than sodium hydroxide products.

To regain our focus, what personal potential hazards exist when handling corrosives (using the **T-R-A-C-E-M** acronym)? If they release heat in chemical reactions, can these substances also create a fire or explosion hazard? What type of protective equipment should be worn when handling these substances? What preventive measures can be taken to reduce the potential exposure risk?

Part III
Explosives

According to USDOT, explosives are classified by the reaction that occurs when used in commerce.

Class A explosives are those substances that detonate, causing supersonic shock waves and projection/missile hazards. In other words, when the substance explodes, the resulting shock wave will cause mechanical damage before the explosion is heard since it travels faster than the speed of sound (supersonic). Examples of Class A explosives include commercial dynamite, TNT, amatol, blasting caps, nitroglycerine, commercial boosters, and black powder.

Class B explosives are substances that deflagrate (burn), causing subsonic shock waves and rapid, almost instantaneous combustion or burning. The reaction occurs quickly, so it cannot be distinguished by the naked eye as to whether the substance detonates or burns. The difference is that one will usually hear the explosion just before the shock waves cause the injury. Examples include special fireworks and liquid/solid propellant explosives.

Class C explosives contain restricted quantities of Class A or Class B substances. Examples include flexible detonating cord, some detonating primers, small-arms ammunition, and common fireworks.

Blasting agents are materials that are designed for blasting, but so insensitive that there is little probability of accidental explosion or going from burning to detonation. Examples include prilled ammonium nitrate-fuel oil mixtures (ANFO) and slurry.

Since ANFO is probably the material used in greatest quantity on mine sites, we will look at the properties of blasting agents first.

When compressed, blasting agents break down from a chemical reaction and release a tremendous amount of heat. This heat release with the compressed state of the ANFO causes it to become explosive. As it ages, a chemical breakdown also occurs, releasing oxygen and heat. This will also create explosive conditions.

ANFO should never be stacked too

high in its storage magazine. Storing it in this manner compresses the bottom bag(s) and reduces ventilation. A chemical breakdown occurs, oxygen and heat are released and, due to restricted ventilation and compression from the stacking, an unplanned explosion may occur. Though not a common incident, the potential hazard still exists.

When preparing for a shot, those loading the boreholes often complain of headache, dizziness, and/or general weakness while handling ANFO. This can be attributed to the fact that a nitrogen-base product is a vaso-dilator, meaning that when absorbed through the skin or taken internally, it causes the blood vessels to dilate. This is why nitroglycerine tablets work for patients with angina pectoris. When the blood vessels dilate, more oxygen is allowed to get to the heart muscle and the chest pain diminishes. This is not what a person wants to have happen, though, when loading a shot! Care must be taken to prevent inhaling the powder, but also wearing longsleeve shirts, long pants, etc., to minimize absorption of the substance through the skin is very important.

Nitrates in general, when not in prilled ANFO, are classified as oxidizers. An oxidizer is simply a material that readily yields oxygen to support combustion when it chemically breaks down. This break-down occurs from excessive heat, friction, or time. Though not actually combustible in and of themselves, they provide an on-going supply of oxygen so the fire will continue to burn. The reaction can cause violent burning as it releases oxygen as well as generate extreme heat. This additional heat can cause other materials in close proximity to self-ignite.

Now evaluate T-R-A-C-E-M with explosive materials and determine what potential personal hazards exist beyond the obvious explosion hazard. What do you find those hazards to be? What personal protective equipment should be used when handling explosives? What safety steps can you take to minimize your exposure level to those hazards?

PCBs

Known as poly-chlorinated biphenols, these substances are classified by USDOT as ORM-E, Other Regulated Materials. The Environmental Protection Agency (EPA) classifies PCBs as a hazardous substance. This means PCBs cause serious environmental hazards as well as personal hazards.

PCBs weigh approximately 12 pounds per gallon. EPA requires a company to report to them any spill in excess of one pound! PCBs are most commonly found on mine sites in electrical transformers and capacitors. A typical transformer contains 200 gallons of fluid with a PCB concentration of 50-60% by volume.

PCBs are very stable at high temperatures, which is why they work so well as insulating fluids for high-heat environments. Being so stable, however, also means they do not break down and persist for long periods of time in the environment. They are bio-accumulators, meaning they pass from animal to animal by means of the food chain; thus they adversely affect many varieties of animal life. Once ingested, they distribute themselves into various receptor tissues of the thymus, lungs, spleen, kidneys, liver, brain, muscles, and testes. They remain stored in these organs rather than purge them-

selves from the body like many other substances do. They can cause cancer as well as skin dermatitis and throat and nose irritation.

PCBs can still be used, but only under strict regulations. The production and manufacture of PCBs were banned by EPA in 1979. They may be used only in totally enclosed systems, which must be labeled to identify presence of PCBs. The use of PCB-containing waste oil as a sealant, coating, or dust control agent is totally prohibited.

EPA now requires the registration of PCB-containing transformers with the appropriate local fire department. When electrical transformers catch fire, the resulting soot and smoke may be inhaled by firefighters or others. Registering the transformers with the fire department allows their personnel to know where such transformers are located within their jurisdictions. EPA also requires the isolation of these transformers from flammable and combustible materials as well as from locations near ventilation equipment and ductwork inside buildings.

Aside from PCBs themselves, a fire involving these substances poses yet another threat—the incomplete combustion of PCBs may form other toxic compounds, like dioxin, one of the most toxic of all substances today. Hence, a PCB fire may represent one of the most dangerous fires to which firefighters are exposed. Fortunately, these fires are not that common.

Using T-R-A-C-E-M, what potential personal hazards exist when handling PCBs? What personal protective equipment should be worn? What safety steps can be taken to reduce or minimize the risk of such exposure?

As a last word on PCBs, remember these substances are highly regulated. Failure to comply with EPA regulations involves stiff financial penalties in addition to the detrimental environmental affects caused by an accidental or careless spill. Should you have PCB transformers on your site, make sure you are familiar with your responsibilities to the government, your employees, and to our environment.

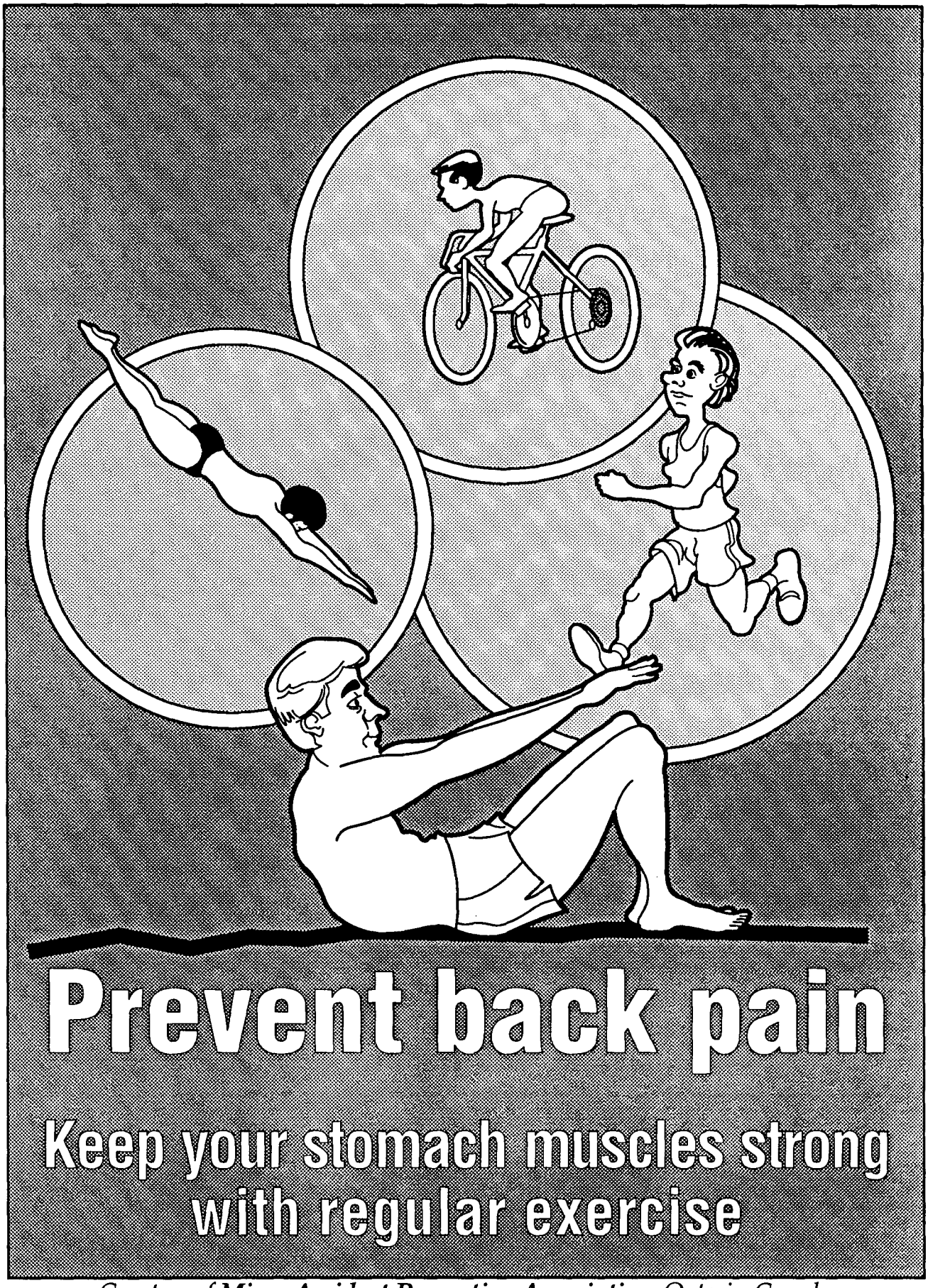
Summary

It is obviously difficult to discuss all the various materials handled on all mine sites. While this discussion has not been all inclusive, it is hoped the information provides for safer work habits around these and other materials.

There are products used daily on mining sites that are classified as hazardous materials. With the enactment of the Hazard Communication Standard by MSHA, known as the Employee Right-to-Know Standard, each person with the potential of handling these materials should review the obvious and not-so-obvious personal hazards that exist. Using something similar to a Job Safety Analysis, specific hazards can be identified and reduced or eliminated. The appropriate personal protective equipment should always be used. By knowing the hazards and reducing them, wearing the appropriate protective equipment for each type material, and ensuring that safe practices are being performed, mining personnel can reduce the overall work hazards which, in turn, reduce the potential for accident and personal injury.

Hazards of certain materials used in mineral mining

Material	Hazard	Affects	Target organs	PPE
Gasoline	Flammable	Headache, chemical pneumonia, eye irritation, nausea, known carcinogen, reduces oxygen in blood stream	Lungs, central nervous system, skin, bone marrow, blood, eyes	Rubber gloves, goggles over safety glasses, soap and water for clean-up, rubber suit and respiratory protection if subject to prolonged exposure
Diesel fuel	Combustible	Similar to gas, dermatitis, toxic fumes if burning, contaminates environment (water and soil)	Similar to gasoline	
Varsol/ solvents	Combustible	Irritation to eye/ nose/throat, dizzy, dermatitis	Skin, eyes, lungs, central nervous system	
Sulfuric acid	Corrosive	Eye/nose/throat irritation, choking, cough, skin/eye burns, temporary loss of hair, pneumonitis	Lungs, eyes, skin, teeth	Goggles, rubber gloves, cover exposed skin, rubber boots or shoe covers
Sodium hydroxide	Corrosive	Nose irritation, skin/ eye burns, temporary loss of hair, pneumonitis	Eyes, skin, respiratory system	
ANFO (prilled)	Blasting agent	Toxic dusts/fumes if burning, eye irritation, rash	Lungs, eyes, skin	Cover exposed skin, respiratory filter protection, eye protection
Nitrates	Oxidizier	Eye/skin irritation, bronchitis, dental erosion	Teeth, skin, eyes, respiratory system	
PCBs	ORM-E hazardous waste	Environmental hazards, dermatitis, throat/nose irritation, known carcinogen	Thymus, lungs, spleen, kidneys, liver, brain, muscle tissue, testes	Rubber gloves, boots, goggles, rubber suit to prevent damage to exposed skin



Courtesy of ***Mines Accident Prevention Association****, Ontario, Canada*

Relieving workplace stress

As the cost of job stress mounts, experts say stress management should apply not just to workers, but to the workplace itself

By Stephen G. Minter

As part of the promotion program at a large company, Veronica Vaccarro used to put on stress management classes. The only problem, recalls Vaccarro, who now works for the Washington Business Group on Health, was that she wasn't allowed to call the classes stress management. Company executives were afraid that bringing attention to stress would cause employees to blame a host of health problems on job pressures.

Vaccarro's experience reflects a widespread unease among businesses in regard to discussing occupational stress and mental health issues in general. For the most part, companies prefer to view stress as a fact of life that employees must learn to cope with. To help them do so, many companies offer stress management classes as part of their health promotion program, or provide counseling services through employee assistance programs. These programs may provide a valuable service to employees, but according to an increasing number of mental health experts, they don't go far enough.

The "assumption of stress management," claims Lee Schore, a social worker with the Center for Working Life, Oakland, is that "stress lies within the worker, not within the workplace." Instead, she said, available research data indicate that frequently the "stress is in the workplace."

Stress management classes "really are only a band-aid approach," says Vaccarro. Companies need to look, she says, "at what are the worksite factors that may be antecedents for workers feeling very stressed" and then see if anything can be done to alleviate the problem.

Rather than avoiding the issue, occupational health experts say there is good reason for companies to combat stress. According to the American Institute of Stress, businesses now spend more than $150 billion annually on stress-related diseases.

"Mental-mental stress claims in workers' compensation are clearly on the rise in several states and fairly prevalent in a number of other states," Donald T. DeCarlo, senior vice president and general counsel of Commercial Insurance Resources Inc., New York, told an American Bar Association meeting last spring. According to the National Council on Compensation Insurance, claims for "gradual mental stress" now account for about 11 percent of all workers' compensation claims.

Workplace factors

Just as ergonomists are working to identify factors in the workplace that lead to physical stresses, psychologists and other researchers have been working to identify emotional stressors in factories and offices.

"We know that there are some things that are fundamental about the design of work that lead to stress," notes Frank Landy, Ph.D., a professor of industrial psychology at Pennsylvania State University. "Most people that are put into particular kinds of jobs, for instance where they have no information, no control, no predictability, and severe time demands, are going to experience stress."

Examining the elements of job design is a fairly recent phenomenon, notes Landy. Ten to fifteen years ago, research tended to focus on the characteristics of individuals. Why did some workers have an almost "toxic" reaction, to use Landy's term, to certain kinds of workplaces? But having eliminated most individual differences says Landy, researchers found that "we're left with an enormous amount of strain that seems to result from work, structure, conditions, and tasks, regardless of who is in there. I'm not sure that managers and organizations believe that quite yet."

After coming through a decade when terms such as downsizing, takeover, restructuring, and riffed became commonplace, it's probably not surprising that there is more talk about stress in the workplace than there has ever been before. Job and career path uncertainty, according to Dr. Richard Earle, president, Canadian Institute of Stress, is the number one cause of stress in corporations.

Technology is also contributing to increased stress levels. "The nature of work is continuing to change technologically, the most obvious symptom being the computer revolution," explains Landy. "As computers continue to encroach on more traditional jobs, the pressure on people to learn new skills becomes greater and greater. Also, the speed with which things happen is increasing substantially. If you consider time to be a resource, people have less of that than they had before, and I think the demands may be more substantial."

Referring to the work on "scientific management" done by Frederick W. Taylor at the turn of the century, Landy says there is evidence of a "new Taylorism" in many electronic workplaces. "The average computer input person, the one who is inputting data into a system for an insurance company or a bank or a telephone company, is monitored on virtually every keystroke and told when they are slipping and when they're doing okay. It has been transformed into a piece-rate form of work without people knowing it," he says, adding: "People are under the control of, rather than controlling, this new technology."

While workload itself can cause stress, NIOSH explains that the amount or rate of work does not appear to be as important as the amount of personal control or discretion that employees have over their jobs. Psychologist Earle adds: "It's not so much the volume of work; it's perceptions of workload inequity." He says problems occur when workers see that coworkers are doing less work, but that supervisors or the company's performance appraisal system don't pick up on this.

Earle says poor communications are also a major workplace stressor. He recalled an incident at an airport when

he gave a credit card to a reservation clerk to pay for his ticket. She put it in the verification machine and asked a coworker if it handled that type of card. Her coworker replied, "Yes, but it always comes back valid." When Earle asked how long they had been going through this useless verification process, they said it had been 9 or 10 months, and that it was really bugging them.

"I asked, 'Have you talked to your supervisor?' They said, 'Yes, three or four times, but nothing has happened. We're not going to bother anymore."

According to Earle, many such stressors occur daily in any organization. "We find them everywhere. It's like reducing the drag coefficient in a car. They're a real drag or drain on employees and, very clearly, on the company's profitability."

Why do these situations occur? Earle says that in an effort to streamline operations, companies "cut out one very vital piece of muscle when they cut out the fat. They cut out the upward feedback loop from employees about what can be done better."

Earle says he frequently hears complaints about internal communications in companies, but that the communication problem is rarely defined concretely. He said companies need to be practical about their communications needs, and an important first step is to find out what questions employees have. "I see so many of our clients that have two or three internal newsletters, and information sessions, and they all amount to virtually zero because the questions haven't rolled in, so the answers that come down are irrelevant."

First step

Like other aspects of occupational health, getting a handle on a company's stress level requires the "patient" to undergo an examination so that problems can be identified and baseline measurements can be established.

"You need a full corporate analysis and evaluation of the employee relations systems, the grievance systems, the cognitive workload and emotional workload, and the organizational structure," says O. Bruce Dickerson, M.D., president, Dickerson Occupational Health Services, New Canaan, Connecticut. "It has to be the top person saying, 'This is what I want, I want feedback, and I want us to take it seriously, team.' Then you really see things that happen for the better of everybody. Putting on a stress management program may make top management feel better, but in my experience, rarely does it make the problem go away by itself."

Dickerson said occupational health professionals should use whatever channels are available to measure a company's stress level. Employee satisfaction or motivation surveys are one source, as are medical symptoms, workers' compensation reports, and OSHA-related problems. So are the symptoms of stress in evidence —"arguments, absenteeism, union activities, collective resistance, managers hearing from employees."

From this information, Dickerson says, the investigator determines where the "pressure points" are and then performs a worksite analysis, looking at factors such as employee input into job design, employee control over jobs, and

available support systems for managers and employees. With this information, the investigator can then develop recommendations for management.

Companies such as Pacific Bell employ a variety of programs to battle stress. Corporate Psychologist Paul Hersch, Ph.D., said Pacific Bell provides employees "clear information about stress so they can understand what it is and how it can affect our bodies and our lives." Hersch estimates he has presented stress management programs to about 20,000 employees over the past 9 years. The company also offers an employee assistance program with eight full-time counselors to help employees deal with job or family matters .

Pacific Bell also has a program called "Hot Spots" designed to identify and help organizational entities that may be sources of stress. Hersch works with departments or other business units to help reduce stress. Another approach to stress reduction, he said, is through company efforts to provide ergonomically sound work-stations .

Hersch said the company periodically offers a number of training courses focusing on leadership, empowerment, and other work skills. The company also offers a tuition assistance program to employees. "All those things have an impact on stress because they provide people with the tools to deal more effectively with the current environment," said Hersch.

Stress can manifest itself in a number of physical and behavioral problems such as fatigue, back pain, overeating, and sleep disorders. Pacific Bell's wellness program offers employees a health risk assessment that lists their major lifestyle risk factors, computed their health (as opposed to chronological) age, and provides recommendations to improve their health. The company offers a variety of health promotion programs such as smoking cessation and weight loss, and is in the process of installing a number of well-equipped health facilities at its major sites.

Hersch admits that when he started offering stress programs, some supervisors feared he was opening a Pandora's Box. "My position was that that was ridiculous. That's assuming our employees don't read newspapers, don't talk to people, and haven't got any brains, "he said, "the fact is, they're getting information about stress all over the place and I think we have an obligation to provide them with scientific, up-to-date, correct information."

More stress?

Are workers exhibiting more stress, or are we just more aware of the problem? Experts differ in their response.

"Across the board, I don't think it's getting worse," says James Quick, professor of organizational behavior at the University of Texas at Arlington, explaining: "Culturally, we have become dramatically more aware of how a stress response in our mind-body system plays a role in both our health and in our disease processes. Because we are more aware, we think the actual stress has increased dramatically, but that has probably not been the case."

"Workplaces probably used to be much more oppressive, much more difficult, but probably not quite as

stressful because they reflected a larger community, "says Schore. "People grew up and went to work together. You could count on other people and there was a level of protection. Now, people work in more isolation. They drive long distances. They don't have that level of community outside of the workplace. It's part of the nature of our society."

Within 5 to 10 years, forecasts Dr. Dickerson, workplace stress guidelines will be developed, based on worksite analyses and other stress research. "We'll have a system where companies have to pick up the symptoms, record them, and provide feedback to the

Depression on the job

With the medical bill for mental health and chemical dependency problems skyrocketing, you'd expect that companies would have studied these problems ad nauseam. You'd be wrong.

"Companies in general have paid very little attention to the mental health of workers," asserts E. Carroll Curtis, M.D., corporate medical director for Westinghouse Electric Corp., Pittsburgh. "We don't even know how often major mental health problems occur in the workforce. That's particularly true of the white-collar workforce."

Like other major corporations, Westinghouse sponsors employee assistance programs (EAPs), which over the past decade had become increasingly comprehensive. Though the company felt its investment in EAPs was beneficial, it had little data to back up its decisions.

Curtis, in conjunction with colleagues at the University of Pittsburgh School of Medicine, decided to try to get a better picture of the psychological health of Westinghouse. With a grant from the National Institute of Mental Health, a study was conducted involving 1,870 Westinghouse managers and professionals. Eighty percent of the employees were male; over half had graduate-level education.

Mental health professionals conducted 2-hour interviews with the employees, primarily at their homes, to find out the prevalence of alcohol abuse and major depression, and the relationship of home and work stress to these problems.

Before starting the study, Curtis recalled, the research team had been warned that they were unlikely to find many mental health problems among this group of well-educated, stably employed people. Instead, the study found that 23 percent of the men and 36 percent of the women had suffered from major depression, about twice what would have been expected based on general population studies. In addition, the study found a higher than expected rate of alcohol abuse among the women employees—8.6 percent compared to general population rates of 4.2 to 4.8 percent.

The Westinghouse study also overturned warnings that the allegedly nonverbal engineers being studied would clam up in front of interviewers. "It worked out precisely the opposite," Curtis recalled. "The biggest problem the interviewers had, after completing the questioning, was getting away." Employees found it so refreshing, Curtis explained, that it had the unanticipated benefit of providing some therapeutic value.

employees about those symptoms," said Dickerson. He also foresees efforts to profile both worker personalities and jobs, and more counseling by employers to try to ensure that workers and jobs "fit" each other.

"Ergonomics is the issue of the 1990's," says Dickerson. "Stress will be the issue of the decade beginning in the year 2000."

Westinghouse historically has been viewed as a people oriented employer with a very loyal workforce, Curtis pointed out. So, why the high rates of depression? Curtis said a number of factors were at work. One, the company had announced layoffs among its white-collar workforce the month the interviews began. Second, he said the Westinghouse study was very carefully conceived and conducted, making it more sensitive than previous studies performed in the community at large. But perhaps most importantly, according to Curtis, is that the study reflected changes in the American workforce in the 1980s—a period when employment became less stable and work and family life became increasingly intermingled.

Curtis said conclusions about cause and effect could not be drawn from the study. "If somebody is having trouble at work and they become depressed, did the trouble at work give rise to the depression or did the depression give rise to the trouble at work? We can't tell that from our study," he said, adding that there was a "good prospect" that a follow-up study would be conducted.

Help for 'gatekeepers'

One "strong association" the study was able to draw was between negative work events, particularly conflicts with a supervisor, and episodes of depression. In order for Westinghouse to sensitize its corporate culture toward problems of mental health, said Curtis, it was important for the company physicians and nurses to be more aware of mental health issues that affect workers, and better prepared to recognize psychological problems and refer troubled employees to mental health professionals.

Curtis said there is still considerable stigma attached to mental health problems, but he contends that one of the reasons mental health and chemical dependency costs are rising is that people are becoming more willing to seek help.

"I don't mind the costs going up if people are getting the help that they need," he said. "Medical costs are like a balloon. If you squeeze it in one place, then it bulges out in another." If workers have mental health problems and don't seek treatment, Curtis said, they are likely to manifest physical problems such as ulcers or high blood pressure. "You're going to pay for it one way or the other," he said.

Reducing back injuries through task redesign

Each year, accidents resulting in low back pain cost the mining industry tens of millions of dollars—and much disability and suffering for the affected miners and their families. Traditionally, the approach used to reduce the risk of lower back injuries has been to train miners to cope with existing conditions. Unfortunately, the effectiveness of this method has been limited.

To better address the need for improved methods for reducing back injury risk, the Bureau of Mines Pittsburgh Research Center (PRC) has recently published Information Circular 9235 entitled "Reducing Back Injuries in Low-Coal Mines: Redesign of Materials-Handling Tasks." This document describes how the redesign of tools/tasks can be used to reduce the risk of injury to underground coal miners.

The publication describes a practical method that can be followed when analyzing and redesigning hazardous lifting tasks, and involves identification of materials-handling problems through analysis of accident records and task analysis. For example, careful planning of a supply-handling system can dramatically reduce the number of times that materials have to be manually lifted. Mechanical-assist devices often can be used or developed at relatively low cost to perform hazardous lifting tasks.

Another strategy is to ensure that lifting tasks performed by workers do not exceed their physical capabilities. Lifting studies performed at PRC's Ergonomics Laboratory have shown that lifting capacity is significantly lower if a miner has to handle materials in a kneeling posture, which is a common practice in low-coal mines.

If tasks cannot be eliminated, mechanized, or designed according to worker capabilities, worker selection and training procedures may be used instead, the report says. However, care must be exercised so that the procedures used are directly related to task demands and are non-discriminatory.

Despite the benefits that can be derived from these redesign techniques, the report notes that management must realize that back injuries can occur. If they do occur, management's policy for dealing with the injury can significantly affect the duration of the disability and the costs incurred by the company. For example, if an adversarial relationship between management and the worker develops, costs may increase for both the worker and the company. On the other hand, enlightened management can often reduce or prevent the disability associated with low back pain through a program of positive acceptance of back injury, early intervention, good communication and followup procedures, and encouraging worker fitness.

Sean Gallagher, (412) 892-6445; Christopher A. Hamrick, (412) 892-6673; Richard L. Unger, (412) 892-4372.

ATTENTION

Bulletin Readers

In the October issue, we stated that a response card for updating our mailing list would be in the November Bulletin. Due to a publishing error, this card did not appear in November. Instead of the card, we are using this tear-out sheet in this issue. We are requesting your cooperation in updating our mailing list and to continue receiving the Bulletin. Please complete this sheet and return it to the address listed below.

Chapter Number: _____

Chapter Name: _____

Chapter Address: _____

_____

_____

☐ Yes, I want to continue receiving the Bulletin

☐ No, I do not want to receive the Bulletin

Return to:

Holmes Safety Association
c/o Mine Safety & Health Admin.
4015 Wilson Boulevard, Room 537
Arlington, Virginia 22203-1984

ATTENTION
Bulletin Readers

Please *DON'T FORGET* to fill out and return the form on page 23!

Effectiveness of surface seals on coal-seam fires tested

Surface seals are the main coal-seam fire-control method used in the western United States.

The seal is usually constructed by placing a mantle of soil, 4 to 10 feet thick, over a coal-seam fire area to exclude air from the fire. The soil is then compacted to increase effectiveness of the seal. A soil cement may be used to augment the soil. Research sponsored by the Bureau of Mine's Denver Research Center has led to the development of a technique to track temperature trends at coal-seam fire projects to get a better and earlier analysis of surface-seal effectiveness.

The Lowell C. Hanson Company, under an Abandoned Mine Land research contract, tested the effectiveness of surface seals at 13 coal-seam fire sites in Montana. Nine of these sites were sealed during the 1950s, and four were sealed during the 1980s. Underground temperature and soil test data collected at the sites were correlated to find information that might indicate successful surface seal methods.

To conduct the evaluations, boreholes were drilled, temperature probes were lowered into the boreholes, connected to the surface with extension wires, and backfilled with grout or soil to exclude oxygen. The temperatures monitored by the probe are usually influenced by a small area within 3 to 4 feet of the probe. Temperatures were monitored to determine temperature trends, compared with the baseline normal ground temperatures for the area, and then correlated to signs of possible fire activity.

For the sites treated during the 1950s, present temperature readings were far below active burning temperatures, but, in some cases, were still somewhat above normal ground temperatures. The data showed that the seals had been successful in containing the fires, but complete extinguishment may not have been achieved in all cases.

Temperatures at sites treated during the 1980s were monitored during the 1- to 2-year critical period after the seals had been installed. Researchers found that a decrease in the rate of temperature rise or an acceleration of temperature reduction was an early indicator of a successful surface seal.

Les A. Beckett, Bureau of Mines.

Holmes Safety Association
Monthly safety topic

Multiple fatal roof fall accident

GENERAL INFORMATION: A 45-year-old continuous miner operator, with 17 years of mining experience, and a 29-year-old continuous miner helper, with 7 years of mining experience, were fatally injured in a massive roof fall.

The mine has one section which is performing pillar recovery mining at the present time. Coal is produced with a Simmons-Rand 500 continuous miner equipped with remote control. Coal is transported by shuttle cars to the section loading point and then by belt conveyor to the surface. The mining method at the time of the accident involved extraction of the main line pillars eight crosscuts inby the portal. The roof was supported by 30-inch conventional roof bolts and timbers. Employees and materials are transported by scoops and battery mantrip cars. The mine operates one production shift and one maintenance shift per day, 5 to 6 days per week with 21 underground employees and 4 surface employees.

DESCRIPTION OF ACCIDENT: The first shift employees, under the supervision of the section foreman, entered the mine at approximately 6:30 a.m. and traveled to the 001-0 working section. Production activities started at approximately 7:00 a.m. in the No. 7 pillar and continued without incident until approximately 11:15 a.m.

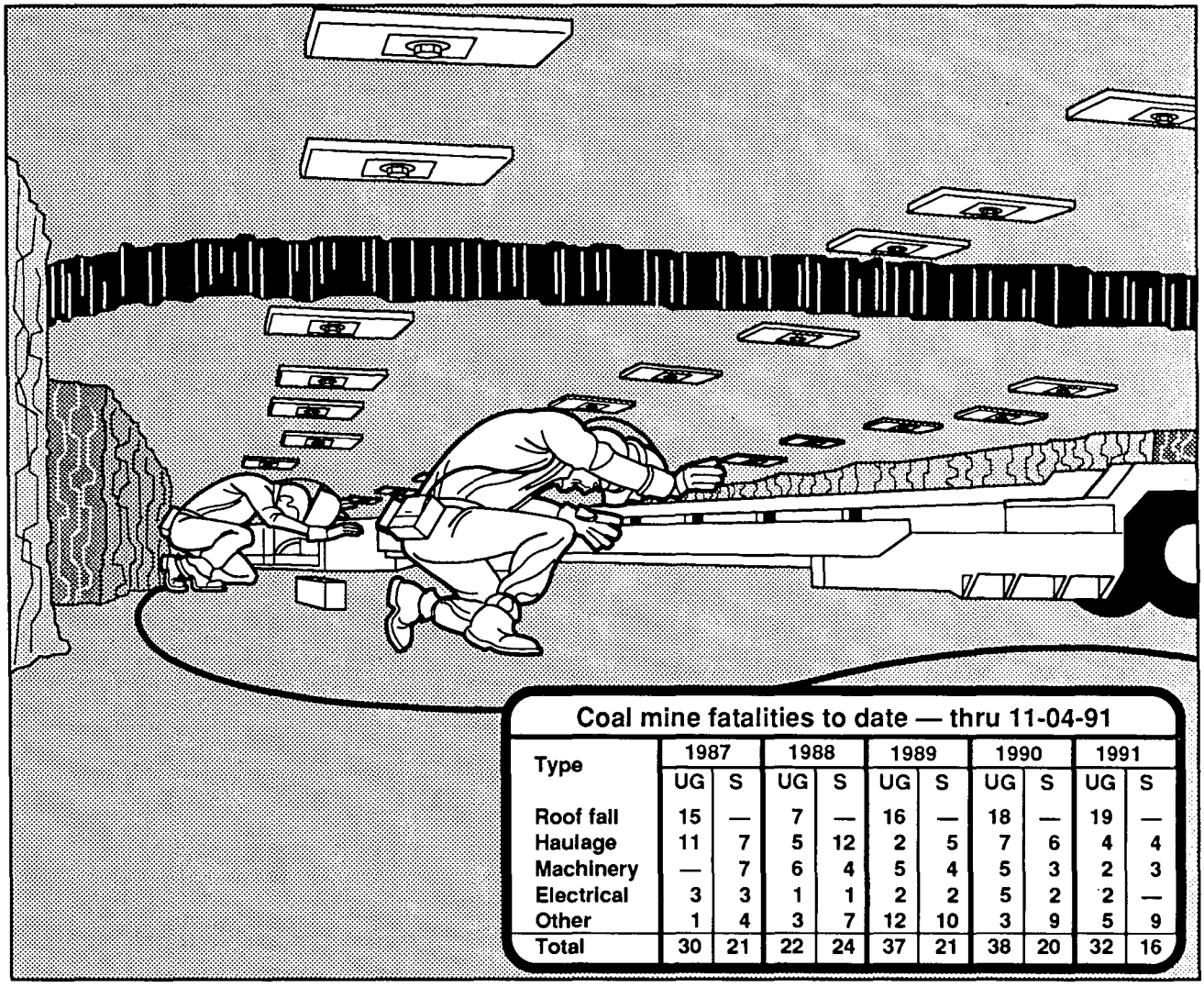
Coal had been mined from the pillar line starting in the No. 7 pillar and continuing across to the No. 2 pillar one cut before the accident occurred. The fourth cut was being removed from the No. 3 pillar when the roof fall occurred, fatally injuring the victims.

The victims were located on the right side of the continuous mining machine, which was operated by remote control. The section foreman stated that he observed the continuous miner operator reversing the machine to remove it from the No. 3 pillar, just before the roof fall occurred. A section of roof measuring 80 feet in length, 20 feet in width, and 24-36 inches in thickness, fell trapping the victims.

Recovery efforts began immediately and personnel were dispatched to the mine. Unstable roof conditions required that additional roof supports (cribs and timbers) be obtained and installed throughout the recovery efforts.

The victims were recovered from the fall during an 8-hour period. The coroner was present at the mine site and pronounced them dead upon arrival on the surface.

CONCLUSION: The consensus of the investigating committee is that the accident occurred due to management's



Coal mine fatalities to date — thru 11-04-91

Type	1987		1988		1989		1990		1991	
	UG	S	UG	S	UG	S	UG	S	UG	S
Roof fall	15	—	7	—	16	—	18	—	19	—
Haulage	11	7	5	12	2	5	7	6	4	4
Machinery	—	7	6	4	5	4	5	3	2	3
Electrical	3	3	1	1	2	2	5	2	2	—
Other	1	4	3	7	12	10	3	9	5	9
Total	30	21	22	24	37	21	38	20	32	16

failure to fully recognize the changing roof conditions in the affected area and to provide adequate roof supports. The following factors contributed to the occurrence:

1. The mine is located in the Hazard No. 4 seam with the immediate roof being composed of sandy, gray shale, and the main roof being sandstone. The seam height in the area of the accident was 54 inches.

2. The roof had been supported with 30 inch conventional roof bolts. The mine was developed on 60 foot centers for entries and crosscuts with the entries and crosscuts being driven a maximum of 20 feet in width (22 feet in belt entry only).

3. The area where the pillars were being extracted was developed in 1978 by a previous mine owner.

4. The roof fall occurred in an area where the immediate roof was changing from sandstone to sandy, gray shale.

5. The 30-inch conventional roof bolts used for primary support did not anchor securely into the main sandstone roof.

6. Visible, inadequately supported hillseams, and cracks were present in the mine roof in the fall area and the adjacent right crosscut prior to the accident.

Worker training: an investment in safety

Training can help hourly workers and managers think and act in safer, more environmentally responsible ways. Here are three companies that have learned that lesson well.

By Gregg LaBar

Occupational safety and health professionals at Bell Helicopter Textron Inc., Ft. Worth, have never had a hard time justifying the need for extensive worker training. The company's industrial safety and hygiene department and the in-house training office strive to go beyond the Occupational Safety and Health Administration (OSHA)-mandated minimums for safety and health training. But, if there ever had been any doubt about the need for top-notch safety and health training, an OSHA inspection about 18 months ago put it to rest.

OSHA inspected the company's main plant in Ft. Worth to check for compliance with the agency's hazard communication standard. The OSHA inspector requested a copy of the written program and documentation of training. Then the inspector toured the plant, asking workers if they knew what chemicals they were working with and what the hazards were. He asked if they knew what "MSDSs" were and where they were located. Then he asked employees to show him the MSDSs (Material Safety Data Sheets) and explain them to him.

Fortunately for Bell, employees had received hazard communication training. They were able to use the company's microfiche system to access the requested MSDSs and then explain them.

"OSHA wanted to see if our employees knew how to use the system," said James "Skipper" Kendrick, a Bell safety engineer specialist. "Running people through a film or giving them a book to read and making them sign a form [that documents their participation] is not enough. OSHA really wants to know if the people learn the material." Although more than 100 current OSHA standards contain training requirements, training should do more than just keep a company in compliance. It should provide employees with the knowledge and motivation to do their work in safe, healthy, and environmentally responsible ways. The three companies profiled here—Bell Helicopter Textron, Witco Corp., and Will-Burt Co.—report success in these areas.

Bell's bosses

Bell Helicopter Textron Inc. has 7,000 employees at eight major facilities in North America. The helicopter manufacturer also has more than 1,200 front-line supervisors and department managers. They are the key to the safety program, according to safety engineer Kendrick.

"If you can get supervisors and

managers turned on to safety and involved in the training programs, you'll have the workers interested," Kendrick said. On the other hand, he noted, supervisors and managers who don't understand safety and complain about safety precautions and safety meetings are likely to have workers who share those views.

Less than 2 years ago, more than 600 managers and line supervisors, divided into small groups, went through an 8-hour safety training program. It covered everything from what OSHA stands for, how it works, and what it requires, to company policies on basic safety matters, industrial hygiene, and accident prevention and investigation.

For most people, the information was not new; it was designed as a refresher and as a way to motivate the managers to be more conscious of safety and health matters. So attendees didn't get the same old story, the information had to be packaged differently.

For example, most of the Bell supervisors were familiar with the pyramid theory regarding accidents: that for every one serious accident, there are 10 minor ones, 30 with only property damage, and 600 incidents that could have been accidents had it not been for luck. They had never played Kendrick's "pill game," however.

He took a jar of pills and asked attendees to pick one out and swallow it, while warning them that one was deadly, 10 would cause diarrhea, 30 would lead to flu-like symptoms, and 600 would have no effect. Only about 5 percent of the people reached into the jar.

"The point is, they don't like the risk," he said. "But those are the same odds they're facing back in the workplace.

"The training focused on their responsibilities for using good judgment and investigating each incident with vigor to prevent accidents. We challenged them to manage the safety business exactly like they manage production costs and quality control," Kendrick explained.

For people who have moved into management positions since then, Bell has offered the program several times on an as-needed basis. The company is planning to set up a program for supervisor training updates next year.

Hourly workers, meanwhile, have had annual OSHA compliance training on hazard communication, lockout/tagout, emergency evacuation, crane operation, and respiratory protection. The company uses OSHA's "Training Requirements in OSHA Standards and Training Guidelines" (OSHA Publication 2254) as a guide.

Kendrick said Bell's training covers the basics of each topic. With hazard communication, for example, employees are told that reaching the permissible exposure limit for a chemical is not reason for panic; the PEL, according to OSHA, is a *safe* (permissible) level of average exposure over an 8-hour shift. In addition, training covers job-specific considerations, including instruction on how a chemical might become a hazard, that is, leaks or spills.

When evaluating the success of a training program, Kendrick never asks workers if they understand the material. He says, "Show me." That can be done through an oral or written test, a

simulated application, or an on-the-job activity. When possible, Bell safety staff use more than one type of evaluation. Because people tend to learn in different ways, they also tend to have different ways of showing if, and how much, they've learned.

The on-the-job application is the ultimate test, though. If employees are using their knowledge to work in a safer manner, the training has succeeded.

Witco and the environment

Witco Corp., a New York-based manufacturer of specialty chemicals and petroleum products, employs some 6,000 workers at 50 sites in the United States. As a member of the chemical industry, the company has been under intense scrutiny for its safety, health, and environmental performance. That fact is not lost to the people who do the training at Witco.

"Environmental training is not new at Witco," reported Dean M. Sibert, director of safety, health, and environmental affairs (SH&EA). "We recognize the overlap between safety and environmental training. Running a pro-

URGENT!

Training must be improved

Worker training is a critical element in a company's ability to successfully compete in the national and international economy. Unfortunately, according to two national reports, American companies don't spend enough time, effort, or money on worker training.

Ninety percent of U.S. workers get no formal training from their employers, according to "America and the New Economy," a report by the American Society for Training and Development (ASTD) in cooperation with the U.S. Department of Labor. According to the report, U.S. companies spend an average of 1.4 percent of payroll on training while foreign competitors spend three times as much or more.

According to the report, U.S. companies have come to rely on their ability to out-produce their competitors to maintain an edge. That's no longer enough because there are new standards—quality, variety, customization, convenience, and timeliness—by which products and services are being judged. Only properly trained workers can consistently produce to meet these new standards, according to the study.

Another report, "Worker Training: Competing in the New International Economy," by the Congressional Office of Technology Assessment (OTA), said, "Employee training, once a minor concern... must move toward center stage. Inadequate training costs firms and workers—in downtime, defective parts or equipment, wasted material, health and safety risks, late deliveries, and poor customer service." OTA said companies must realize that providing poor training or none at all is no longer cost-effective.

cess and doing it safely are as much environment-oriented concerns as they are safety." New Witco employees receive up to 8 hours of formal safety, health, and environmental training during their first week on the job. The safety and health training covers such topics as hazard communication, confined spaces, lockout/tagout, and personal protective equipment. Environmental training discusses spill prevention and cleanup, waste-reducing work practices, and emergency procedures. In some cases, safety and environmental topics can be combined (how to use appropriate personal protective equipment in an emergency).

Refresher training generally is provided annually, either because it's mandated by law or because industry or company standards contain such a stipulation. The company's requirements for safety, health, and environmental protection are contained in its accident prevention and environmental control manuals.

No one source or department is responsible for conducting the training. At the corporate level, safety engineer Ed Korol develops training guidelines

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That's the message also being offered by training consultant Phil Edwards, former director of ASTD's technical and skills training group and a senior partner in WE Partners Co., a Houston-based training consulting firm.

"The vast majority of production workers, way more than 50 percent, are still trained on the job by other production workers—pure OJT—the oldest and most ineffective way to train," Edwards said. "Companies don't do a real good job in safety training or operator training. They tell workers what to do, but never why to do it or what to do if something goes wrong."

According to Edwards, each job should have a "training curriculum," which would tell workers what training is required, why it is needed, how long it will last, how it will be evaluated, and how often it will be repeated.

Even then, he said, you need competent trainers to execute the program. A good trainee, he said, is going to ask questions, so the trainer better be prepared to answer them.

"It's the questions that will kill you," he said. Unanswered questions and lack of time for questions and answers, according to Edwards, are a tip-off to employees that management doesn't really regard the information just presented as that important. Why then, he asked, should employees be expected to take the training seriously?

According to Edwards, bad trainers, bad approaches to training, and lack of long-term management commitment are all responsible for America's current training woes. "It takes a long time to train people to be super-qualified," he said. "There are no one-week wonders."

and provides background materials to regional safety and environmental professionals. The information then trickles down to plant-level officials, supervisors, and workers.

"We get a lot of people involved, but we try to make their life a little bit easier by providing basic programs, videos, overheads, and course outlines," Korol said.

Sometimes the training is conducted in formal sessions of an hour or more. However, Witco, in adopting total quality and continuous improvement concepts, is moving toward a more immediate approach to training. For example, supervisors are required to make a monthly "safety contact," pointing out an unsafe work practice or reminding someone to wear eye or hearing protection, with each employee. Contacts must be documented and are used as part of the performance appraisal of each supervisor.

Witco has also instituted Du Pont's "STOP" program, which encourages supervisors and workers to stop a worker who is doing something incorrectly and get him to do it right. That's a "mini-train," according to Korol.

"There's no reason to wait to bring that up at the next safety meeting," he said. "It may be a very individual thing that can be corrected on the spot." However, he added, if other workers are having similar problems, that indicates the need for general retraining, whether or not government regulations or company rules say so.

Although the responsibility for training workers rests with each facility, corporate officials are still very much involved. Witco is currently putting all of its plant-level safety and environmental engineers through a 52-week correspondence-type course, which covers a full-range of safety, health, and environmental topics. Participants spend a couple of hours a week on course work, plus they are required to take written exams and complete practical exercises.

Also at the corporate level, Witco reviews the training programs of every plant annually and conducts SH&E audits of Witco facilities as well as facilities operated by on-site contractors and offsite waste treatment and disposal facilities. In 1990, Witco's corporate staff conducted 66 official safety and health audits and 91 environmental audits.

"A lot of what we're looking at is the quality of the training program," Sibert said. "Because we're not there all the time, it's one of the best ways to get a feel for what goes on." Training done right, Sibert said, usually translates into safety and environmental practices done right.

Education at Will-Burt

Six years ago, the Will-Burt Co., an Orrville, Ohio, steel fabricator and parts manufacturer, was struggling. Low profits, too many product defects, and steep workers' compensation and medical costs were hurting the company.

That's when new President and Chief Executive Officer Harry E. Featherstone stepped up and instituted an employee training and education program that covers everything from basic math skills to blueprint reading, from standard operating procedures to

quality control. Will-Burt is a markedly different—and more successful—company today as a result.

Naturally, employees get their share of safety training, including lift truck operation, hazard communication, hearing protection, and lockout/tagout, as part of Will-Burt's overall commitment to education.

The hazard communication program, for example, is a 10-hour (2 hours a day for 5 days) course that covers not only chemical hazards but also physical hazards like those from punch presses. "We use it not just for compliance with the OSHA standard but as a total basic safety course," said Jack Bednarowski, director of human resources for Will-Burt, an employee-owned company with 300 workers.

Lift truck training is another important program at Will-Burt. Almost all production workers are required to take the 10-hour course, even if they drive only occasionally. The training is provided by the state of Ohio, and workers that complete it are licensed by the state department of hygiene and safety.

Training in safety as well as a variety of other technical skills doesn't stop with these programs, however. Will-Burt machine operators, for example, take an 8,000-hour machinist apprenticeship that covers setup, safe operation, and maintenance of milling machines, lathes, presses, and grinders. It includes 4 hours of classroom instruction each week, in addition to extensive on-the-job experience. General safety precautions, use of personal protective equipment, and lockout/tagout for machine maintenance are all components of the training.

In addition, 23 management and production employees recently completed an optional 2-year production/operations management program (a so-called "Mini-MBA") focusing on such topics as job design, inventory control, quality control, and maintenance. Issues such as safe operating and maintenance procedures, ergonomics, and emergency response were covered.

"All of our training programs have a piece of safety in them," explained Bednarowski. "Sitting people down in a safety meeting and telling them what to do and what not to do has some merit— and we do it—but the overall training program is what's important." Don't get the idea that Will-Burt has unlimited resources to spend on education and training, however. The company does not have a certified trainer (nor a safety, health, and environmental professional) on staff. Instead, Will-Burt relies on a variety of outside sources.

For example, the company has contracted with the Wayne College Div. of the University of Akron to provide instructors and curriculum outlines for a number of the training courses. They are held on the Will-Burt site, and employees are paid for their time. The company also makes use of the state of Ohio's OSHA consultation program.

Optimism is running high now at Will-Burt. Profits are up and product defects are down compared to 1985. Worker safety and health figures have also improved—all the result of education and training, according to Bednarowski.

In 1990, workers' compensation costs were one-tenth what they were 5

years ago. Health insurance costs rose less than 1.5 percent during the same time period, while increasing more than 83 percent elsewhere.

More education and training are on the way too, as Will-Burt moves toward a participatory management style.

Several operating units are in the process of eliminating supervision and instead allowing workers to elect their own leaders, set their own schedules, and hire their own coworkers. Under Will-Burt's "Star" program, which will be implemented later this year, workers will elect a leader and four other people to be in charge of specific key issues—employee relations, cost performance, quality, and safety. Naturally, additional training in these areas will be necessary.

"We're making people responsible for their own areas, but we're making sure they have the knowledge to know when something's wrong and how to change it," Bednarowski said. "Our overall attitude toward education, including safety training, is that we can't afford not to do it."

Seven steps to better training

1. Determine if training is needed.

Problems with lack of knowledge about a work process, unfamiliarity with equipment, or incorrect execution of a task usually can be addressed with training. Training may not always be the solution; sometimes hazard abatement or engineering controls may really be what's needed.

2. Identify training needs.

A job analysis will help you identify what the employee is expected to do and in what ways, if any, his performance has been deficient. Determine training topics by referencing regulations, company accident and injury records, and employee questionnaires. This will help you provide training to employees most at risk.

3. Identify goals and objectives.

Know what it is you want your employees to do, do better, or stop doing. Use action-oriented language, such as "The employee will be able to describe how a respirator works and when it should be used." Training should be designed to educate, motivate, or both.

4. Develop learning activities.

These should enable employees to demonstrate that they have acquired the desired skills and knowledge. Training can be group-oriented, with lectures, role play, and demonstrations; or designed for the individual, as with self-paced instruction. Training of significant length should incorporate a variety of devices.

5. Conduct the training.

The actual training is done in three basic steps: provide short overview of the information to be learned; do the training with an eye on relating it directly to the workplace; reinforce what was learned by summarizing the key points. Keep people interested by pointing out the benefits of training—it helps people become more skilled—and working in a safer manner.

6. Evaluate program effectiveness.

Methods include participant surveys, supervisors' observations, and workplace improvements.

7. Improve the program.

If training appears to fall short, don't keep giving the same subpar program. Use these questions to determine what improvements need to be made: Were parts of the content already known and, therefore, unnecessary? What material was confusing or distracting? Was anything missing from the program? What did employees learn, and what did they fail to learn?

Source: "Training Requirements in OSHA Standards and Training Guidelines" (OSHA Publication 2254).

Hazardous air: monitoring common gases

Don't expect your sense of smell to warn you of potentially harmful concentrations of certain common gases. Workplace evaluation and gas monitoring are a much better measure of the hazards.

By Gregg LaBar

When industrial hygiene consultant Terry W. Krug goes into a confined space, he takes at least two multigas monitors with him. It's not that he doesn't have faith in his instruments; rather, he has a great deal of respect for such common gas hazards as oxygen deficiency and high concentrations of carbon monoxide, carbon dioxide, hydrogen sulfide, and combustibles. Together, these gases claim several hundred victims (some of whom die) each year.

These gases have varying properties, hazards, and sources. They can, for example, occur because of leaks in pipes, decomposition of organic matter, combustion or oxidation, chemical mixing, or cleaning operations. The formation of these gases becomes an especially serious problem when ventilation is inadequate, such as in a confined space or in a small job shop with no fresh-air supply.

These gases can be difficult to detect with the human senses, even as they're having adverse effects. Nonetheless, some people dangerously take them for granted and assume they'll be able to tell when concentrations approach unsafe levels.

"You never want to trust your senses," said Krug, CIH, president, Industrial Hygiene Technical Consultants, Bartlett, Illinois. "These gases have very poor warning properties or none at all. They can affect you and put you down before you know it."

"Even with hydrogen sulfide [which at low concentrations initially smells like rotten eggs], it's dangerous to depend on warning properties," added Steve Levine, Ph.D., CIH, professor of industrial health at the University of Michigan School of Public Health. "At higher concentrations [and with prolonged exposure], hydrogen sulfide takes away your sense of smell. You may not smell it—indeed you may think it's gone away—at a time when you may be most exposed."

Profiling the gases

You don't have to rely on your senses to warn you of these hazards. Monitoring instruments are widely available, and there are agreed-upon sampling methods. A basic understanding of the properties, sources, and hazards of these gases is essential. Here's a brief profile of each one:

Oxygen (O_2) is an odorless, colorless, tasteless gas that supports life and makes combustion possible. Under ideal conditions, oxygen makes up one-fifth (20.99 percent) of the atmosphere by volume. Too much (oxygen enrichment) or too little (oxygen deficiency) oxygen in the air can be hazardous.

Oxygen deficiency, characterized as

any percent by volume less than the minimum permissible oxygen level of 19.5 percent, is the more common of the two problems. Oxygen can be displaced by a number of other gases, including carbon monoxide and carbon dioxide. The concentrations of the new gases may not be enough to harm workers, but their displaccment of oxygen might be. In confined spaces, for example, asphyxiation (lack of oxygen) is the No. 1 cause of death.

Most people won't know they're in an oxygen-deficient atmosphere until after they begin feeling physiological effects. By then, it may be too late. At 15-19 percent oxygen, workers may have a decreased ability to work strenuously and impaired coordination. As the percentage dips into the 10-14 percent range, significant respiratory problems can develop. Few people recover from spending more than 5 minutes in an atmosphere containing less than 8 percent oxygen.

Carbon monoxide (CO) is an odorless, colorless chemical asphyxiant with toxic and flammable properties. The 1991-1992 Threshold Limit Value (TLV) is 50 parts per million (ppm) over an 8-hour shift. (There is a proposal to lower the standard to 25 ppm, but the new limit won't take effect until next year at the earliest.)

The gas is most often associated with internal combustion engines.

It is also a byproduct of certain mining, iron production, and chemical processing operations.

CO acts toxically by preventing the hemoglobin of the red blood cells from getting needed oxygen to the rest of the body. When exposure is in the hundreds of parts per million, workers will have headaches and feel tired and uncomfortable. At 1,500 ppm (considered immediately dangerous to life and health), confusion and nausea will set in. Exposure to 4,000 ppm for less than 1 hour is fatal.

Carbon dioxide (CO_2) is the least life-threatening of the gases discussed here, as reflected by its current TLV of 5,000 ppm. As a normal product of human and animal metabolism, $C0_2$ is relatively nonreactive and nontoxic. Although generally colorless and odorless, CO_2 may be felt by some people to have a slight pungent odor and biting taste.

CO_2, because it is 1.5 times heavier than air, can settle at the bottom of confined spaces, open pits, and swimming pools. It can be a concern in some types of industry operations—the bottling of soft drinks, for example. $C0_2$ is capable of displacing oxygen, but there has to be a lot of it to cause an oxygen deficiency.

The levels of CO_2 are a key parameter in indoor air quality. In office and commercial buildings, higher-than-normal levels of CO_2 are seldom hazardous on their own. However, they usually signal that the ventilation is poor, which can create exposure to other gases such as carbon monoxide and formaldehyde.

Hydrogen sulfide (H_2S) is the most toxic and asphyxiating of the gases discussed here. It's known for its rotten-egg smell. However, at about 100 ppm, the gas desensitizes the olfactory nerves in 2-5 minutes. The smell appears to go away even as the concentration may stay the same or increase. The TLV is 10 ppm over an 8-hour shift.

H_2S is produced by the decomposition of organic matter. This occurs in a variety of work environments, includ-

ing coke ovens landfills, mines, breweries, sewers, natural gas production and processing, and papermaking operations. Because H_2S is four times heavier than air, it sinks to the bottom of the workspace.

H_2S is instantly fatal if inhaled in very high concentrations (1,000 ppm or more), acts on the nervous system at intermediate concentrations, and irritates the eyes and upper respiratory tract in low concentrations (50-100 ppm).

As with oxygen deficiency and high levels of carbon monoxide, personal protection from overexposure to H_2S requires at least a supplied-air respirator and often a self-contained breathing apparatus.

Combustible gases, or vapors, can combine with oxygen and a source of ignition to create a fire or explosion. Each combustible has its own lower explosive limit (LEL) and upper explosive limit (UEL), between which conditions are ripe for an explosion or fire. Methane (CH_4), for example, has an LEL of 5 percent by volume and a UEL of 15 percent.

Combustibles are a major concern in confined spaces where welding, sparking tools, or static electricity may serve as an ignition source. Some combustibles are nontoxic (methane), while others, such as H_2S, are extremely toxic. However, the LEL and UEL for each combustible or mixture of combustibles only reflect the explosive range of the gases. They do not say anything about their toxic nature, which has to be considered separately.

Monitoring

Being aware of the gases' properties and hazards can make monitoring for them a more scientific, less risky job, according to the University of Michigan's Levine.

"You really should know what you're looking for," he said. "It's less expensive, faster, and easier to monitor for a couple of specific gases that are associated with an area, industry, or process. It's better than saying, 'I'm going to look for anything that might be there.' That's an expensive, time-consuming, and usually impossible proposition."

Still, Levine said, there are times when you won't know what you're looking for. "You really don't know what you might find at a hazardous waste site," Levine pointed out. "Part of the reason for being there may be to find out what gases are present. That's a ghastly difficult job."

A good starting point for monitoring is always oxygen, said Bill Perry, CIH, an industrial hygienist in NIOSH's Division of Training and Manpower Development. It should be monitored for first and most often, if not continuously, he said.

"You have to answer the question about oxygen adequacy first," Perry explained. "The concern about exposure to specific toxic gases over an 8-hour shift is useless if there isn't enough oxygen to start with. That's the most immediate concern."

Oxygen sensing devices are available on their own or as a component of multigas detectors. As noted before, Krug takes two 3-in-1 detectors with him into confined spaces. Both detectors monitor for oxygen. One also has carbon monoxide and combustible gas sensors; the other monitors for hydrogen sulfide and combustibles, in addition to oxygen.

Effective monitoring of oxygen, toxics, and combustibles means knowing where to look for workers as well as the gases. For example, some workers may move in and out of possible exposure areas during the day. Therefore, where possible, you should use a combination of personnel and area monitoring, advised Chris Strang, Ph.D., CIH, corporate industrial hygienist, Monsanto, St. Louis, and chairman of the American Industrial Hygiene Association's gas and vapor detection committee.

"Area monitors on the wall or in a certain area can offer an early indication of what people may be exposed to," Strang said. "However, you also need to know what concentrations are reaching the worker at the time. People have a way of getting into situations, such as in corners or in direct line of leaking pipes, that you don't anticipate. Continuous monitoring should supplement, not replace, your personal air sampling."

In confined spaces, the problem can be locating the gas. Detection probes should be placed at the top, middle, and bottom of vessels, Krug advised. Gases that are heavier than air (hydrogen sulfide) are likely to be found near the bottom of tanks and vessels, while gases lighter than air (methane) will rise to the top.

Krug stressed that a gas sensor used in a confined space should not come in contact with the sides of a vessel or with liquid or sludge in the bottom of the space. That will contaminate the sensor.

The workplace evaluation and gas monitoring guidelines above apply to a broad range of industries. But while these techniques and approaches are widely employed, our respondents also cited a number of commonly observed pitfalls and fallacies:

• **Reliance on time-honored unscientific methods.** Years ago, canaries were sent into a mine to check for oxygen adequacy. Other "common-nonsense ideas" still exist, such as looking for signs of life, such as cockroaches, in a confined space before deciding it's safe to enter; and throwing a burning newspaper into a space to see if there is enough oxygen.

Why are cockroaches a poor barometer of the space's ability to support life? "They are the creatures that are supposed to be able to survive just about anything," pointed out Allan McNeill, president and CEO, McNeill International, a Chardon, Ohio-based supplier of gas detection instruments.

What's wrong with the lighted newspaper method? The paper burning will indicate if oxygen is present. However, as McNeill noted, the lighted newspaper just might be the ignition source needed to start an explosion or fire if the space contains combustible gases.

• **Tendency to automatically ventilate spaces where there isn't enough oxygen.** "When people get an oxygen reading of 16 or 17 percent, the first thing they want to do is ventilate," Krug said. "That can drive a combustible like methane right into the explosive range [5-15 percent by volume]. Then all you need is an ignition source, and it's not unusual for workers smoking cigarettes to be sitting outside a space waiting for it to be ventilated."

Krug said the proper procedure is to sample for both oxygen and combustibles, then evaluate the situation. If

there is an explosion hazard, use an inert gas like nitrogen to lower the flammability hazard. Then ventilate, Krug said.

• **Failure to calibrate the instrument in known fresh air before beginning monitoring.** "Many people think they're working with magic little boxes and they forget about calibration," Levine said. "I think it's good industrial hygiene practice that whenever you're making measurements that are critical—where the result is going to lead to some decision—you calibrate your instrument first."

• **Not doing enough sampling, nor at the right times.** Strang's advice: "You want to sample as many conditions as you can. The routine running of the process usually isn't generating very high levels. But, in your sampling schedule, you have to specify that some monitoring be done during startup and during and after process maintenance."

• **Not anticipating mixtures that may result in a gas hazard.** Krug recalls doing a fatality investigation in which workers had poured concentrated sulfuric acid (H_2S0_4) into a drain to unplug it. The solution into which it was poured was waste oil from engines. The oil contained finely divided metals, which caused the breakdown of H_2S0_4 into H_2S. A worker trying to unplug the drain from the other end was gassed.

• **Failure to understand the meaning of combustible gas readings.** There are two potential problems here. Both of them stem from the instantaneous nature of fire and explosion hazards.

First of all, Strang said, some people mistakenly interpret that a reading under the lower explosive limit indicates that the area does not contain a hazard from any of a number of combustible gases. However, it only indicates that there is no fire or explosion hazard. It doesn't tell you what gases (some of which may be toxic on their own) are present and in what concentrations .

The other problem involves setting alarms for combustibles. Alarms for combustibles should be set at between 20 and 40 percent of the lower explosive limit, our respondents advised. That's different than the approach for toxic gases, for which an alarm is usually set at 100 percent of the 8-hour permissible exposure limit or just below it.

• **Failure to understand the use and limitations of gas monitoring equipment.** Levine said these instruments are nothing like the "do-everything" devices that some people think they are.

"We all want a 'Tricorder,'" said Levine of the handheld box used by Mr. Spock on the television series "Star Trek."

"The Tricorder told Spock what was in the air, what was in the water, what the rock was made out of, and if anyone was hiding behind that rock. But I never saw him calibrate it. That's in the 23rd century. The instruments we have are not yet Tricorders."

Until such devices become available, Levine said, it will be up to the user to have some basic knowledge of where, when, and how to look for gas hazards.

Catch the spirit of safety

by David T. Couillard

Considering the advances made in mine safety during the twentieth century, the catastrophic events of December 1907, are difficult to comprehend. Seven hundred twenty one miners died that month at six different underground coal mines as the result of explosions and fires. Bloody December appalled and shocked the public, but it also motivated the federal government to create the Bureau of Mines in 1910.

Dr. Joseph A. Holmes, the Bureau's first director, his successors and followers in government, and like-minded allies from industry and labor crusaded tirelessly to improve safety conditions for miners. They achieved much through the years, with many of their dreams reaching fruition with the passage of the Federal Mine Safety and Health Act of 1977. Dr. Holmes would undoubtedly have cheered the Act's first words: "Congress declares that...the first priority and concern of all in the...mining industry must be the health and safety of its most precious resource-the miner."

But those of us who continue to honor Dr. Holmes through our participation in this Association know that legislation alone cannot eliminate mine accidents, injuries, and fatalities. Laws can be broken. Safety procedures can be ignored. Unanticipated hazards can appear despite careful planning and compliance with regulations. Equipment can break down. People can make mistakes.

To prevent accidents in today's mines we need to become as committed to safety as Dr. Holmes and the other safety pioneers. In some ways the challenges we face are even greater, because modern miners often feel fairly safe in their working environments. Experienced production truck drivers might even feel, sometimes, that they have easy jobs, especially if their cabs are air-conditioned. But if brakes fail on a loaded run down a decline; if ground gives way beneath rear tires at the top of a stockpile; if a backed-over "big rock" turns out to be a service truck—suddenly an "easy job" can become life-threatening.

The accomplishments of the mine safety movement since 1907 have given us the knowledge to prevent mining accidents. What we lack is the will to use that knowledge consistently. Safety does not occur "by accident." It takes work. The best way to fill ourselves with the commitment and dedication of Dr. Holmes and the safety pioneers - the very "spirit of safety" - is to work as hard as we can doing the things they taught us:

Look at the tasks being performed at your operation. Have all tasks essential for safe production been identified? Have job safety analyses been conducted on these tasks? Have employees been trained in safe job procedures?

Do your supervisors have clearly defined safety tasks, such as conducting safety meetings, on-the-job training, safety observations, and inspec-

tions? Does management measure and reward supervisory performance of these tasks?

Are your hourly employees actively involved in the safety program? Are they provided with sufficient information and resources to make safe decisions? Do they believe that the safety program helps them to perform their jobs safely?

If you can answer "yes" to all of the above questions, then Dr. Holmes would be proud of you. Keep up the good work! If you find your organization falling short in some areas, then by all means get busy correcting those shortcomings. Someone's life may depend on your efforts. Do you really need any more motivation than that?

Begin Anew in 1992:
Catch the Spirit of Safety!

The National Stone Association supports JSA

Following are excerpts from the National Stone Association's brochure on JSA called: "Job Safety Analysis: A Better Way of Doing Business"

What is Job Safety Analysis?

Job Safety Analysis (JSA) is a method of studying the safest, most efficient way to accomplish a job. It directly carries out two basic safety principles: 1) determines potential accident causes (related to detecting the hazards inherent in a job); and, 2) eliminates potential accident causes (related to eliminating identified potential hazards).

The JSA process has four basic components: selecting a job to be analyzed, determining the basic steps of a job or task; identifying potential hazards that are associated with each step; and developing solutions for control of the hazards. Once these phases are complete, the result is a written end-product — a JSA — that describes the sequence of basic job steps, the potential accidents or hazards, and the recommended safe job procedures.

How are JSAs designed?

JSAs should be tailored to an individual operation's job assignments, employee structure, and company policies. They should always reflect the safety policies mandated by the Mine Safety and Health Administration's regulations (30 CFR Part 56) and training requirements (30 CFR Part 48). The amount of detail included in a written JSA should be determined by its intended use.

There are two types of JSAs:

- Basic JSA: used in safety and health training observations. Although the basic job steps are listed sequentially, the procedures for each step are only those necessary for safety reasons.
- Detailed JSA: used in safety and health and skills training and observations. It combines all procedures necessary to get the job done efficiency, with those necessary for safety. A detailed JSA can be used as a "Standard Operat-

ing Procedure" for the job.

How do I use JSA in the workplace?

Some companies reproduce copies of completed JSAs and distribute them to the supervisors whose employees do the jobs. Others prefer to file copies of completed JSAs in locations where supervisors have ready access to them.

The maximum benefits of a JSA are obtained only when the finished product is used. To be sure, many benefits are gained during the development of JSAs. Supervisors invariably learn more about the jobs they supervise as a result of preparing JSAs. The safety attitudes of employees improve when they are asked to help develop a JSA. Ideas about improving safe working conditions are frequently generated. Cost-reducing improvements are often suggested by the JSA.

What are the major advantages of using JSA?

The primary advantages of JSA fall into the following categories:

• *Initial job safety training.* When new employees are assigned to do hazardous jobs, common sense dictates that they should be adequately trained to carry out the jobs safely. A completed JSA is ideal for this purpose. It lists the potential hazards, in order of occurrence, and provides instruction on how to avoid injury resulting from the hazard.

• *Regular safety contacts.* One way a supervisor can keep employees safety-minded and knowledgeable about job safety is through regular safety contacts. JSAs provide material for these regular sessions and can form the basis of meaningful discussion and instruction. The topics covered are closely related to the jobs being performed by the employee and therefore will generate increased interest.

• *Pre-job safety instructions.* Some hazardous repair or service jobs occur infrequently or irregularly. The employees assigned to the task may not necessarily be the same workers who performed the function on the last occasion. When such jobs are assigned, pre-job safety instructions are advisable to remind workers about the hazards and precautions that are required. In providing such pre-job safety instructions, a supervisor can review the JSA for the task with the assigned employees. This is an excellent way to prepare employees for an unfamiliar, exceptionally hazardous work assignment.

• *Getting cost-reduction ideas.* A completed JSA can be an important source of cost reduction ideas. Since it provides a step-by-step account of how a job is done, it is an excellent ready-made basis for questioning the current method, tools, equipment or materials used to do the job. Supervisors trained in principles of cost reduction, through methods improvement, will arrive at dollar-saving ideas quickly when they can refer to a JSA.

Where can I obtain information on the JSA process?

The National Mine Health and Safety Academy has many materials that can be ordered by calling (304) 256-3247. They include:

• *Instruction Guide.* The Job Safety Analysis Process: A Practical Approach

• *Videotape.* The Job Safety Analysis Process: A Practical Approach (15 minutes)

• *Safety Manual.* Job Safety Analysis

• *Instructional Programs.* Structuring Effective On-the-Job Training Programs; How to Tailor Off-the-Shelf Training Materials

• *On-the-Job Training Series.* Publications include modules for Sand, Gravel and Crushed Stone; Metal and Nonmetal Dredges; Cement; and Surface Metal and Nonmetal

Other JSA training materials can be obtained from the National Safety Council by calling the Cement, Quarry and Mineral Aggregates Section at (708) 285-1121.

Secretary's message

On October 16, 1991, the HSA Executive Committee met in New Stanton, Pennsylvania. There were 25 members of the Executive Committee present at this meeting.

At this meeting, the Executive Committee authorized the Secretary to print 20,000 substance abuse stickers for distribution. They also authorized the development and production of two new stickers (Larry Longwall and Mike Miner) for distribution by the Secretary.

The Executive Committee developed a tentative agenda for the National HSA meeting at Split Rock, Pennsylvania. Some of the topics selected for discussion at the conference are as follows:

1. Substance Abuse
2. Safety Around Abandoned Mines
3. Wellness Program
4. Loss Control
5. Seat Belt Safety
6. Developing an Effective Safety Program
7. Train the Trainer
8. Stress Management
9. Hazard Communication
10. Safety Around Stock Piles
11. Personal Protective Equipment
12. Clean Air Act

The Executive Committee will complete the suggested conference agenda at the next meeting in February. I would like to have comments from the HSA Bulletin readers about your thoughts on the conference agenda. If you agree with the suggested topics or would like to see other topics discussed at the conference, please let me know by January 15, 1992, at the following address:

Robert Glatter, Secretary
Holmes Safety Association
4015 Wilson Boulevard
Room 537
Arlington, Virginia 22203-1984
Phone Number (703) 235-8264

HSA has moved forward in making the new substance abuse and safety around abandoned mines videos available to several district councils. Many of the district councils have scheduled showing these tapes to their membership at their next meeting.

During the last week of October, I addressed two district councils in southern Illinois. There were 84 participants at the Du Quoin meeting and 116 participants at the Marion meeting. I requested and received support from both district councils about the National Conference agenda.

In closing, I want to welcome our newest HSA State Council, the Commonwealth of Kentucky. This state council was formed on November 7, 1991, and is the fifth state council in HSA.

Robert Glatter, Secretary.

The last word...

"Doctors will tell you that if you eat slowly you will eat less. Anybody raised in a large family will tell you the same thing."

"Happiness isn't found in searching for it. It can come quietly while you are helping others."

"The quickest way to have a family reunion is to win a lottery."

"The average man is always waiting for something to happen to him instead of working to make things happen. For one person who dreams of making a fortune, a hundred people dream of being left a fortune."

"Promises may get you friends, but it is performance that keeps them."

"There were almost no accidents on the road when people traveled by horse and buggy. Of course, in those days, the driver didn't have to rely on his own intelligence."

"Most people don't want great wealth—just enough to make the neighbors jealous."

"Often cheerfulness is simply the capacity to ignore your unhappiness."

"Today's teenagers believe they have the right to life, liberty, and a car suitable for the pursuit of happiness."

"Talking about your diet won't take the pounds off. You have to keep your mouth shut."

NOTICE: We welcome any materials that you submit to the Holmes Safety Association Bulletin. We cannot guarantee that they will be published, but if they are, we will list the contributor(s). Please let us know what you would like to see more of, or less of, in the Bulletin.

REMINDER: The District Council Safety Competition for 1991 is underway – please remember that if you are participating this year, you need to mail your quarterly report to:

Mine Safety & Health Administration
Educational Policy and Development
Holmes Safety Association Bulletin
4015 Wilson Boulevard, Room 537
Arlington, Virginia 22203-1984

Phone: (703) 235-1400