Hazardous Material Management and Hazard Communication

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HAZARD COMMUNICATION BENCHMARKING AND PERFORMANCE CRITERIA

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LEARNING OBJECTIVES

- Know and understand the basic components of the *Hazard Communication Standard* (HCS) and what is required for compliance.
- Be able to evaluate the quality of hazard communication program practices as well as the level of their compliance with OSHA directives.
- Understand the steps with which one may institute a hazard communication program within a company.
- Recognize the upcoming changes in the Globally Harmonized System (GHS).

THE *HAZARD COMMUNICATION STANDARD* (HCS), also referred to as HazCom or Workers' Right to Know, was established by OSHA in 1983 (OSHA 1996) to protect workers' safety and health in the United States. Following the establishment of the HCS, in 1986, the EPA established the Emergency Planning and Community Right-to-Know Act, also known as SARA Title III (EPA 1986). HCS, found in 29 CFR 1910.1200, is a performance-based standard, which means that it allows flexibility in meeting its expectations. Requirements, rather than being ironclad, can be adapted to meet the needs of particular workplaces. However, this flexibility also makes it difficult to know exactly what should be done to be in compliance with various aspects of the standard or to follow the overall intent of the standard in various safety and health issues. Each company must use its own judgment in implementing an appropriate and effective program that adequately protects its employees.

Benchmarking means identifying, understanding, and adapting best practices from other organizations in order to improve the operation's performance. Benchmarking in the HCS area is a little more difficult, however, because the HCS is an OSHA standard, and it exerts a strong influence over companies' practices, regardless of their "best practice." Therefore, this chapter will frequently list a best practice in a particular area that is the generally accepted way companies comply with the particular issue while protecting their employees.

INTRODUCTION

According to OSHA, the HCS "is based on the simple concept that employees have both a need and a right to know the hazards

and the identities of the chemicals they are exposed to when working. In addition, they need to know what protective measures are available to prevent adverse effects" (OSHA 1993). Although the concept is simple, complying fully with the technical requirements of the standard—as well as meeting the spirit of the standard—can be much more difficult. This is generally not because the requirements are obscure, or hard to understand, but because consistent implementation of necessary policies can prove a challenge. This difficulty is illustrated by HCS's consistent citation as one of the most common violations encountered in OSHA compliance inspections, especially in terms of lack of training and of inadequate record keeping (Galt 2006).

Compliance with HCS requires continuous effort. It is unlikely that one would find every one of a group of fifteen randomly selected chemicals within a company in full compliance. Compliance with HCS comes by means of firm policies understood by all employees and management that are continuously kept in mind and updated or revised when necessary. Information in this chapter will help companies stay in compliance and aid safety, health, and environmental (SH&E) practitioners in designing and implementing HCS programs, as well as help workers protect themselves from chemical hazards at work sites.

The following sections of this chapter address what to look for when auditing for compliance, and outline what best practices are for maintaining material safety data sheets (MSDSs), labeling, training, and measuring, and what changes to expect in the HCS.

OSHA is pursuing changes in the HCS through implementing the Globally Harmonized System (GHS), which is being promulgated by the United Nations. As this chapter is being written, OSHA is taking comments on the proposed rule, making it impossible to specifically address the actual changes here. OSHA has stated that it does not intend to adopt all of the GHS but will adopt the portions applying to labeling and MSDSs, and these changes will also affect training. In the final part of this chapter, the upcoming Globally Harmonized System (GHS) is addressed. OSHA is currently proposing a two-year adoption period for GHS with complete adoption to be in place potentially by 2015 (OSHA 2010b).

Safety Audits

OSHA Guidelines

It is always a good idea to review or audit a program periodically to make sure that policies and procedures are being properly implemented and are working as intended. Compliance checklists are available from many sources. Federal—and some state—OSHA programs publish checklists, which are also available from commercial sources and from certain noncommercial sources, such as universities. OSHA publications are available at the OSHA Web site: www.osha.gov.

Every audit is best when conducted systematically. Initially, review the written program for needed changes, and then review the various aspects of the written program to ascertain levels of compliance. Review training to ensure that the proper subjects are being taught, and talk to employees to discover how well they comprehended their training. Inspect labels in work areas for appropriateness. Finally, inspect inventory areas where chemicals are stored or used and compare their contents to MSDS sheets to discover if proper MSDSs are available.

OSHA publishes *Hazard Communication: A Compliance Kit* (OSHA 1999a). This publication gives detailed information about all aspects of hazard communication and is broken into sections. OSHA also publishes its inspection procedures in the document CPL 02-2-038 (OSHA 1998a). This document provides a sample written hazard communication program as well as inspection criteria. The following information is based on OSHA's inspection criteria document, which is a good guideline for program compliance. After highlighting each item of concern, an example will be given of best practices.

The Written Program

Exactly who, what, and how the company HCS program will be conducted must be stated in the written program. Other companies' written programs may be useful as well. Obtain these by networking with other safety professionals. But be very cautious about using another company's plan—do not automatically assume that it is correct or that it will meet your

needs. Always tailor others' ideas to your company's needs to ensure that your written program complies with regulations.

A written program must contain the following elements. Best practice: use copies of programs from other companies and follow the guidelines in the hazardous communication compliance kit (OSHA 1999a).

Labels and Other Forms of Warning

Designate, whether by name or by position, the person(s) responsible for ensuring labeling of in-plant containers. Also designate, by name or position, the person(s) responsible for ensuring the labeling of shipped containers (likely individuals in the receiving section).

Describe the labeling system(s) used by the company, specifying the elements of a label and any graphic symbols used. Although generally best practice is to use the labels that come with products, do not use inadequate product labels.

SIDEBAR

The written program should not be a document that exists merely to fulfill government requirements; it should match the company's way of business and overall culture. The more realistic a plan is, the more likely it will be followed, and the more useful it will be. Use the your company's personnel titles and the actual names of departments, buildings, and areas. If your company uses the term "foreman" instead of "first-line supervisor," then use "foreman." If a building is named, use its most commonly recognizable name. If the building has an official name but is commonly known under another name, use both. Clarity is essential.

If your company operates in a more streamlined manner and does not have front-line supervisors, give responsibilities to workers that are consistent with the company's daily business—but realize that this may require additional training so that workers can fully understand and perform their duties. A plan works best when it fits in with the company culture.

Describe any written alternatives to labeling of in-plant containers, such as tanks, where applicable. For more information see "Exceptions" under "Best Practices of Labeling." Best practice is to simply describe what is done. Because many operations do not need alternative labeling systems, this section may not be applicable.

Establish procedures for reviewing and updating label information. Best practice is to state exactly how the company updates information when changes occur. In many cases, information will be from an MSDS.

Material Safety Data Sheets

Material safety data sheets are a significant part of the HCS and must be correctly handled to maintain compliance. The person(s) responsible for obtaining/maintaining the MSDSs must be designated in the written program by name or position, and by area of responsibility if applicable.

How the data sheets will be maintained is important (such as in three-ring binders in work areas, in a pick-up truck at the job site, or available via fax, email, or internet) and what procedures govern the electronic retrieval of MSDSs (be very specific in stating how someone can get an MSDS), including back-up systems used in the event of failures in primary electronic equipment (many companies have a master paper copy maintained in a specific place against just such an occurrence), and how employees may obtain access to MSDSs. Best practice is to specifically address how the data sheets are maintained and how employees gain access to them. If MSDSs are kept in notebooks next to a hazardous material cabinet, it should be stated where employees can find the notebooks as well as how to find a specific MSDS. Although there are many ways of doing this, one common method is to number MSDSs and compile an index sheet in the front of each notebook listing MSDSs by names and numbers. A good reference guide for MSDSs can be found in *Hazard Communication: A Compliance Kit* (OSHA 1999a).

If the list of MSDSs is not received with the initial product shipment, the best practice is to refuse

shipment. If this is impossible, a designated space should be labeled as a repository area where items without MSDSs are stored unused until MSDSs are received. An individual must be designated as responsible for acquiring the MSDSs for such products. It is also a good idea to establish the length of time products can be held without MSDSs before being either returned or properly discarded.

Training

Training is an important aspect of the HCS, and its requirements are very specific (OSHA 1999a). The person responsible for training must be identified by name or position and should be someone with comprehensive knowledge of the standard and the company procedures, as well as someone who understands the hazards posed by the chemicals. This will commonly be someone responsible for managing safety (OSHA 2004).

The format of the training program must be explained. The best practice is to detail how training will be conducted (whether by means of audiovisuals, classroom instruction, or similar methods). Initial instruction should primarily use a face-to-face instructor in a classroom environment. Although other means may be suitable during refresher training, someone must be readily available to answer employees' questions.

List the procedures used to train new employees at the time of their initial assignment as well as the procedures for training employees when new hazards are introduced into the workplace. Both best practice and OSHA require training prior to any chemical exposure. Because MSDSs can be complex and confusing documents, employees must understand how to read them, even when they do not understand all the technical terms. Employees do not need to be introduced to every MSDS. The same MSDS for a chemical the workers use should be presented when demonstrating how to read an MSDS. Address how employees will be trained when new chemicals are introduced. If chemicals pose new hazards to workers, it may be best to conduct a training session for employees who will be affected. If a chemical with similar hazards is already used, it may be sufficient to inform employees of the new chemical orally or in a memo. No matter how training is done, companies are responsible for ensuring that their employees understand chemical hazards and how to protect themselves from them (OSHA 2004).

As applicable, write procedures to train employees about new hazards to which they may be exposed when working on or near another employer's worksite (in other words, hazards introduced by other employers than their own). Best practice is to address the standard operation procedure used in such a scenario.

The written training plan should address:

- Safe work practices for conducting operations in work areas where hazardous chemicals are present. This will vary from company to company and will depend entirely on the hazards posed by the chemicals that are present.
- The location of the written hazard communication program and general information regarding the company program. Best practice is to state where the document can be found and to provide a general overview of the program.
- The location of the listing of hazardous chemicals and MSDS sheets, and how to get an MSDS. The best practice is to clearly state where these documents are kept in the company and to explain the specific procedure for obtaining an MSDS.
- How to detect the presence, or release, of a hazardous chemical. This will depend upon the chemicals present.
- The physical and health hazards of the various chemicals in the work area. This will depend upon the chemicals present.
- How employees can protect themselves from hazards, such as by safe work practices, emergency procedures, and PPE. This will depend upon the chemicals present.
- The labeling system and what its terms and graphic symbols mean. Best practice is to directly address the specific terms and graphic symbols, explaining what they mean in understandable terms.

Additional Topics to Be Reviewed

According to OSHA standards, a *hazardous chemical* is any chemical that poses a physical hazard or a health hazard. A *physical hazard* is posed by any chemical that scientifically valid evidence identifies as a combustible liquid, a compressed gas, an organic peroxide, or an oxidizer, or is explosive, flammable, pyrophoric, unstable (reactive), or water-reactive. A *health hazard* is posed by a chemical that statistically significant evidence, based on at least one study conducted in accordance with established scientific principles, associates with the occurrence of acute or chronic health effects in exposed employees. Health hazards include chemicals that are carcinogens, are toxic or highly toxic agents, or are reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents acting on the hematopoietic system, or agents that damage the lungs, skin, eyes, or mucous membranes (29 CFR 1910.1200). Appendix A of 29 CFR 1910.1200 provides further definitions and explanations of the scope of health hazards covered by the standard, and Appendix B describes the criteria to be used to determine whether or not a chemical is considered hazardous for purposes of this standard.

The best source of information about hazards posed by a chemical is its MSDS, where its health and physical hazards will be listed. This is also the best source of information for employees along with labeling on containers.

For the company to best protect its employees, additional topics may need to be addressed in training. Hazardous chemicals must be listed on site. Best practice is to use the list of hazardous chemicals as the starting point for developing a written plan. A program cannot be properly written until all on-site chemicals are identified and the hazards associated with those chemicals are known. This list must be updated as each new chemical is introduced into the workplace.

Outline methods by which the employer will inform employees of the hazards of nonroutine tasks. Best practice is to ensure that these methods include procedures addressing how employees will be informed of potential hazards at other worksites they may visit, including multiemployer worksites.

Inform employees of the hazards associated with chemicals contained within pipes in their work areas. Best practice is to start with the MSDS for the chemicals and add any other appropriate issues, such as stating the chemical's behavior under pressure or heat.

Ensure that the written plan includes the methods the employer will use at multiemployer worksites to inform other employers of any precautionary measures necessary for the protection of employees. Best practice is to address this in the written plan and during employee training. Normally the management personnel of the company should inform the management personnel of the other employers of the hazards posed by chemicals in use, although the exact procedure may vary from employer to employer.

The methods an employer will use to inform other employees about the labeling system in use should be clearly described. The best practice is to provide written documentation and to document who received it and when it was provided.

The written program should be made available to employees and their designated representatives upon request. Best practice is to specifically address who is responsible to respond to such a request and to answer questions.

Labels and Other Forms of Warning

Labels or other markings on each container must include identification information and appropriate hazard warnings describing the effects of the hazardous chemical on vital organs. Labels on shipped containers must also include the name and address of the chemical manufacturer, importer, or otherwise responsible party.

Containers must prominently display legible labels written in English, and optionally in other appropriate languages. Labels must be cross-referenced with MSDSs and with the list of hazardous chemicals. Best practice is to ensure that some key term, such as a chemical name, is used both on the MSDS and the hazardous chemical list. This name may be a generic (i.e., common) name, such as "Acetone," or a trademarked name, such as "Super Purple Solvent." To differentiate between similar common names, it is a good

practice to indicate the manufacturer, as in "Acme Acetone 1402."

Containers of unusual shape or proportion that do not easily accommodate a legible label may take alternative labels, such as a tag on a collapsible plastic container.

It is a good idea to occasionally evaluate the effectiveness of labeling systems in the organization, the training programs, and the MSDS procedures. Evaluation should include the presence of labels on containers and the presence of necessary information. Interviews with employees should be conducted with the purpose of determining their familiarity with the hazards posed by the various chemicals in their workplace. This evaluation should be done at least annually and affect all potentially exposed employees. An effective labeling system ensures that employees are aware of the hazardous effects (including those upon target organs) of the chemicals to which they may be exposed (OSHA 1999a).

Material Safety Data Sheets (MSDSs)

This section will discuss material safety data sheets and their specifications. Employers must have an MSDS for each hazardous chemical on site. Best practice is to use the list of chemicals as a guide to what MSDSs are necessary. Although MSDSs are only required for hazardous chemicals, it is a good idea to have an MSDS for every chemical, confirming that it is not hazardous and providing information to answer employees' questions.

Each MSDS must contain information accurately addressing *at least* the twelve elements required by the standard at 1910.1200(g)(2)(i)–(xii), which include chemical identity, components, physical and chemical characteristics, physical hazards, health hazards, primary routes of entry, PEL and TLV, whether listed as a carcinogen, safe handling methods and precautionary measures, control measures, emergency and first aid procedures, and the date of preparation of the MSDS. The name, address, and telephone number of the manufacturer, importer, or party otherwise responsible for preparing the MSDS should be provided. Best practice for seeing if any information is missing or incorrect is to contact the manufacturer or distributor for a current MSDS.

Employers who work on a multiemployer worksite and bring hazardous chemicals onto that site must inform other employers of the presence of those chemicals and the availability of appropriate MSDSs. If the employer uses a general contractor or other employer as an intermediary for storing and providing MSDSs, and that intermediate employer has agreed to hold and provide ready access to MSDSs, the intermediate employer becomes the controlling employer and is responsible for ensuring the availability of the MSDSs. If MSDSs are not available because a subcontractor failed to make them readily accessible, that subcontractor is responsible for any OSHA violations.

Employee Information and Training

The HSC requires that certain information and training be provided to all employees exposed or potentially exposed to hazardous chemicals. Employees must be informed and aware of the hazards to which they are exposed. They must know how to obtain and use information on labels and MSDSs, and must know and follow appropriate safe work practices established by the company.

According to OSHA's *Inspection Procedures for the Hazard Communication Standard* (1998a), compliance officers should ask the following questions to determine the adequacy of a company's training program. These questions are also a good guide for companies.

- Has a training and information program been established for employees exposed to hazardous chemicals?
- Is this training provided at the time of an employee's initial assignment and again whenever a new hazard is introduced into work areas?
- Have all new employees at this location received training equivalent to the required initial assignment training?
- If electronic access to MSDSs is relied upon at a workplace, have employees been adequately instructed how to retrieve the information?

Information and training must be provided to employees about the hazards or potential hazards posed by all chemicals in their work areas. The information should include hazards associated with by-products and hazardous chemicals introduced by another employer, provided that these are known to be present in such a way that employees may be exposed to them under normal conditions of use or in a conceivable emergency situation.

Exceptions

There are several exceptions to MSDS requirements in the OSHA standards that are listed in this section.

Hazardous waste. Hazardous waste is exempted from the standard when subject to regulation by the Environmental Protection Agency (EPA) under the Resource Conservation and Recovery Act (RCRA). If the waste is not regulated under RCRA, then the requirements of the standard apply. More information can be viewed on the EPA's Web site at www.epa.gov.

Consumer products. A substance is considered a consumer product if it is (1) defined as such under the Consumer Products Safety Act, (2) used in the workplace as intended by its manufacturer, and (3) used with the same frequency and duration of exposure expected of a typical consumer. Chemicals that do not satisfy all these requirements are not exempt from the HCS; instead, they need to be included in the HCS program. One area that commonly does not meet the requirements is the third requirement "duration of exposure expected of a typical consumer." Using a chemical product to clean a single desk in a residential environment results in a different level of exposure than if the same product is used to clean multiple desks in a company setting. Best practice is to incorporate the chemical into the HazCom program if there is any doubt about its status.

Articles. By definition, a manufactured item is exempted as an article if "under normal conditions of use it does not release more than very small quantities, e.g., minute or trace amounts of a hazardous chemical . . . and does not pose a physical hazard or health risk to employees" [29 CFR 1910.1200(c)]. An item may appear to meet the definition of an "article" but may produce a hazardous by-product during normal processing. If cutting, burning, heating, or otherwise processing the article results in exposure of employees to a hazardous chemical, but such processes are not considered part of its normal conditions of use, the item is an article under the standard and is therefore exempted.

Conditions of use. Because of their conditions of use some products otherwise considered articles are not exempt. Examples include:

1. Bricks for use in construction operations, because, under normal conditions of use, bricks may be dry cut, drilled, or sawed, and the clay slurry of wet cutting (when dried) releases dust containing crystalline silica.
2. Switches with mercury in them that are installed in a maintenance process when it is known that a certain percentage break under normal conditions of use.
3. Lead acid batteries having the potential to leak, spill, or break during normal conditions of use, including conceivable emergencies. Lead acid batteries also have the potential to emit hydrogen, which may result in a fire, or an explosion, upon ignition.

Wood and wood products. Wood and wood products, including lumber that will not be processed, in cases when the chemical manufacturer or importer can establish that the only hazard they pose to employees is inherent in their flammability or combustibility, do not require MSDSs. However, the wood and wood products exemption was never intended by OSHA to exclude wood dust from coverage (OSHA 1998a). The permissible exposure limits for wood dust in the HCS program must be included on the MSDS, which will usually be developed by the sawmill, the distributor, or the first employer to handle or process the raw material in such a way that the hazardous chemical is "produced" and released into the work environment. After an MSDS is created for a wood product, retailers or distributors are required to pass on the MSDS to employers just as they would for any other chemical. Further, any chemical additives present

in the wood that present a health hazard must also be included on the MSDS and labeled as appropriate [29 CFR 1910.1200 (b)(6)(iv)].

Particulates not otherwise regulated (PNOR). Particulates not otherwise regulated are exempt unless evidence exists that they present a health or physical hazard, as determined by studies or research performed by the manufacturer or by others. For these chemicals, the PNOR PEL must be included on the MSDSs. OSHA includes in PNOR "[a]ll inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name" [Footnote(f) (29 CFR 1910.1000; Table Z-1–Table Z-3, Limits for Air Contaminants)].

Best Practices for Maintaining a Material Safety Data Sheet

An MSDS for Every Hazardous Chemical

A hazardous chemical is one associated with a physical or health hazard [29 CFR 1910.1200(c)]. The employer is required to have an MSDS for each hazardous chemical in the workplace, except when these chemicals are only handled in sealed containers, as in a retail store. Manufacturers, importers, or distributors are required to provide an MSDS with each hazardous chemical they sell to a commercial company. Best practice is to establish policies requiring an MSDS the first time a product is received on company property. When products are shipped to the company, the shipper is required to provide the MSDS with the first shipment and the most recent MSDS with the first shipment after an update [29 CFR 1910.1200(g)(6)(i)]. In cases where products are purchased and brought onto company property by company personnel, firm procedures must require trained personnel to acquire the MSDS upon product purchase [29 CFR 1910.1200 (g)(7)]. MSDSs are not required to be maintained for any chemicals that are not covered by the *Hazard Communication Standard*, such as those in food, drugs, and cosmetics.

Some items, such as office supplies, may not arrive with an MSDS. Retailers of office supplies should be able to provide the MSDSs for products they sell, or manufacturers will provide MSDSs if requested. MSDSs for products such as whiteout and copier toner are almost always available at manufacturers' Web sites.

Although some products do not require an MSDS because they fall under the exceptions previously mentioned (being a consumer product or an article; see exceptions under "Safety Audits" above), best practice is to incorporate all chemicals into the HazCom program and to have MSDSs available for each, allowing the company to review all products for hazards and acting as reassurance for any employee dubious about the safety of a particular chemical.

Sometimes incomplete MSDSs will be received. If a piece of missing information is deemed critical by the company, the product should be retained unused until the missing information has been supplied by the manufacturer or distributor. If the information is not forthcoming, the company will need to decide whether to use the chemical or to dispose of it and find a substitute. Best practice is to refuse to use any chemical not accompanied by all critical information, allowing the company to stay in complete compliance with the HCS.

Immediate Employee Access to an MSDS

MSDSs are maintained either as paper copies or in electronic storage. If a company has only a small number of chemicals, paper copies will likely be easiest. Electronic storage raises considerations of the availability of computer terminals and the ability of employees to use them, as well as the expense involved in operating them. Both methods are acceptable to OSHA, so companies will have to determine which is most appropriate and useful for them.

According to 29 CFR1910.1200(g)(8), the employer is required to make MSDSs readily and immediately accessible to all employees. This accessibility may be in the form of a hardcopy of each MSDS, or through other means. The employer may use electronic storage, microfiche, or other methods to maintain and provide access to MSDSs so long as no barriers to immediate employee access exist in any workplace (OSHA 1995). Immediate access to MSDSs means that employees must be able to access them without

involving an intermediary of any sort (OSHA 1999b). Regardless, although MSDSs *must* be in English, languages in addition to English need not (but may) be used.

Periodic chemical inventories (at least annually) must ensure that MSDSs for all chemicals are available, that all unlabeled chemicals are eliminated, and that unneeded chemicals are removed. After the inventory is completed, a current MSDS for every chemical must be verified as available and up to date. Best practice is to reduce chemical inventories as much as possible, which can greatly assist in reducing the MSDS maintenance and storage burden. Small quantities of chemicals should be especially questioned.

Paper Copies

The most common method of keeping MSDSs available for all hazardous chemicals is to keep paper copies of MSDSs specific to a particular area in 3-ring binders in the area so that all employees on each shift and in each location always have access to the MSDSs. Although making MSDSs available in binders is both simple and effective, the need for employees to *easily* find any particular MSDS requires the provision of some type of indexing system. The easiest index system is to list the chemicals alphabetically.

Large work areas or multiple buildings will require additional sets of binders, making it difficult to keep all the binders updated. Companies should have someone designated in each department or work area to maintain the MSDS binders and to coordinate them with the company safety office. A good rule of thumb is that an employee should not have to walk more than one minute to access one of the binders. Separate buildings must have their own sets of binders, as should separate operations (for example, a paint shop or the maintenance division).

Electronic Storage

More and more companies are storing MSDSs electronically. In cases of electronic storage, the terminals necessary for accessing the information must be located in employee work areas in such a way as to provide ready access to each employee. Furthermore, employees must know how to look up, and be able to look up, a particular chemical's MSDS at any time without assistance. This requirement will affect employee training.

Database software, such as *Microsoft Access*, may be used to store the information, and several companies provide software for just this purpose. Some software scans the original MSDS and stores the resulting images for retrieval. Many companies make their MSDSs available on their Web sites for download, most commonly in Adobe Acrobat (*.pdf) format. These can then be indexed by other software. Some software companies, after receiving a list of chemicals, will set up a custom electronic database of MSDSs, updating it as necessary. Other software requires manual entry of information from MSDSs into a database. However, this is very time-consuming and disconcertingly prone to error in its transference of liability to the company if an error in data entry occurs. It is considered a best practice to use electronic systems that use and display the manufacturer's original MSDSs.

Another example of a software-based solution uses an automated chemical inventory management system that not only keeps a real-time record of the chemical inventories but also automatically searches for the latest MSDS for each chemical. These systems are much more likely to result in accurate chemical inventories and proper MSDS availability if properly implemented and maintained. This type of service has to be customized to some extent for each company and, if the company has many MSDSs, may require specialized scanners and other hardware, making this a somewhat expensive solution. Yet this type of chemical inventory and MSDS system management is currently the best system for total chemical control and compliance.

Because electronic methods are constantly changing, any recommendation regarding specific software will quickly become outdated, so the best way to approach this is to find out what other companies are using and to research the variety of software solutions currently available. What works best will depend upon the company and resources available.

When electronic means are used, an adequate back-up system for rapid access to hardcopies of

MSDSs must be available and accessible in case of a failure of the primary system. Employees must know what the back-up system is and know how to use it. Transmission of information via telephone is not adequate. Best practice is to have paper copies of all MSDSs available for back-up and emergency purposes. The back-up files should be indexed for rapid identification of specific chemicals. How items are indexed is not important so long as individuals understand the indexing system and how to use it. Alphabetical indexing is most common; or each MSDS could be numbered and then appear on a master index with the numbers listed after the product names or manufacturer or other organizing item.

Access of MSDS by Mobile Employees

Employees who work at more than one site during a work shift must be able to obtain MSDS information immediately in an emergency. MSDSs may be kept at the primary workplace facility so long as the employer has a representative available at all times to ensure ready access to this information. Mobile employees, such as linemen, who move frequently from location to location, are the employees to whom an employer is allowed to transmit hazard information via voice communication. The employer must address, in the written hazard communication program, the means by which MSDS information will be conveyed to remote worksites.

Best Practices of Labeling

This section will discuss some best practices of labeling, including basic requirements, exceptions, sealed containers, and labeling of laboratories.

Basic Requirements

Every container of hazardous chemicals in a workplace must have a legible label written in English (and in other languages if desired) identifying the chemical name and the health hazards associated with it, including its effects on target organs. It must also display the supplier's name and address.

Exceptions

This section will discuss the exceptions to the HCS's labeling requirements. Portable containers are exempt if they are intended for immediate use by employees transferring hazardous chemicals into them from labeled containers. Therefore, a mechanic could use an unlabeled quart container to hold a small quantity of solvent for use in a job. Although it is best to label containers frequently used in this manner, such labeling is not mandatory.

Stationary process containers are exempt if the employer uses signs, placards, batch tickets, or other written materials identifying the containers and conveying the information normally required. For example, a stationary 200-gallon tank containing a hazardous chemical needs only a sign mounted on the container that displays the information outlined in the "Basic Requirements" section above.

Products regulated by the federal Food and Drug Administration (FDA) or the U.S. Department of Agriculture (USDA) are also exempt, including food, drugs, insecticides, cosmetics, medical products, distilled spirits, and common consumer products. Although the labeling requirements of HCS do not apply to these types of products, the labels that come affixed to these products should be left intact and may be required by other regulations.

Sealed Containers and Laboratories

Other rules specifically address sealed containers—containers in storage or handling that will not be opened—and laboratories. Warning labels must remain on the containers in the state in which they are received. Any MSDSs received should be retained by employers and made available to employees in the manner previously discussed. If an employee so requests, obtain an MSDS for a sealed container, even if the chemical is not being used. Fortunately, because most labels supplied by manufacturers tend to meet federal labeling requirements, best practice is for the company to retain original labels on containers. If labels must be generated at the work site, refer for information to the chemical's MSDS, or request a new label from the manufacturer.

Training and Measuring Worker Comprehension

OSHA has specific requirements regarding employee training, some of which are intended to ensure that trained workers comprehend the training they receive. This section will discuss training considerations, the sources of training material, required training content, and measurement of employees' comprehension of their training. Another source for training information can be found in ANSI/ASSE Standard Z490.1, *Criteria for Accepted Practices in Safety, Health, and Environmental Training* (ANSI/ASSE 2009).

Training Considerations

MSDSs alone are not sufficient to ensure that workers understand chemical hazards. On average, the information on a typical MSDS was found to be about one-third incomprehensible to workers (Kolp et al. 2007). Furthermore, a study by Houts and McDougall (2007) demonstrated that "Workers' response to notification about health effects from exposure to toxic materials is determined not just by the content of the message but also by the 'context' within which notification occurs . . . [which includes t]he workers' prenotification knowledge, attitudes, and experiences concerning environmental health risks in general as well as the health problem that is the subject of the notification." Hence, what workers already "know" affects how they perceive and act upon the information presented. Thus, knowing one's audience, knowing the training that has occurred before the upcoming session, knowing the prevailing organizational culture and management philosophy, and knowing as much about what does and what does not work in a particular organization is critical to effective training.

Training is usually more effective when it is interactive and uses trainer-intensive delivery methods in small group settings. A study performed by Robins et al. (1990) showed that using these methods in hazard communication training increased employee knowledge and improved work practices over a 2-year period after training. An excellent health information program operated by AT&T Bell Laboratories found that the keys to a successful program are involving appropriate subject-matter experts and receiving strong management support (Brooks et al. 1994).

Sources of Material

Training material is readily available for worker HCS training. Products may be purchased from commercial sources, and the government publishes materials that are made freely available. OSHA has quite a bit of useful training material. One publication, entitled *Draft Model Training Program for Hazard Communication* (OSHA 2004), has very detailed suggestions for training, including transparency masters. The Mine Safety and Health Administration (MSHA) publishes a training guide, OT 49, *Telling Miners About Chemical Hazards*. The State of Oregon's safety program offers guideliness to hazard communication compliance and training materials (OR-OSHA 2004), and many other states make similar materials available. Appendix E of the HCS Standard (20 CFR 1910.1200 Appendix E) is entitled "Guidelines for Employer Compliance" and is available at the OSHA Web site.

Appendix E contains the following sections, which have been adapted from the OSHA guidelines.

Required Training

Effective training and information must be provided to all employees about the hazardous chemicals in their work areas. In order to be effective, OSHA requires that employees, after completing their training, will understand the hazards of chemicals they are working with and how to protect themselves (PPE use), will know how to read and use labels and MSDSs, and will know where to obtain substance-specific information on labels and MSDSs.

Information and training may be provied either regarding individual chemicals or categories of hazards (such as flammability or carcinogenicity). If only a few chemicals are used in the workplace, discussing each one individually may be as practical as it is appropriate. In cases where large numbers of chemicals are used, however, or in which the chemicals in use change frequently, training may be addressed

instead to general categories of hazards (flammable liquids, corrosive materials, carcinogens, and so on) [29 CFR 1910. 1200 AppE (4)(c)]. When deciding exactly how to train, best practice is to keep in mind that the purpose of the training is for the employees to know the hazards and how to protect themselves, and then to conduct training in such a way that employees will be able to safely work with the chemicals in use.

Training must be provided when an employee is assigned to an area with chemical hazards, whether temporary, short term, or long term, and when a new physical or health hazard is introduced into a work area. Training records must be kept that note when each employee was last trained.

Required Training Content

OSHA requires that certain items be covered in training. The general requirements of the OSHA *Hazard Communication Standard*, as per 29 CFR 1910.1200(h)(2), include covering the physical and health hazards of the chemicals in an employee's work area and how these chemicals may be detected (by monitoring devices, by smell, and so forth). Workers must be informed about how they can protect themselves (by using safe work practices, emergency procedures, or PPE). An explanation of the chemical labeling system, of MSDSs, and of how to get hazard information as well as general information about the employer's hazard communication program, must be provided. Workers must also be made aware of the location and availability of MSDSs, of the list of hazardous chemicals in the workplace, and of the employer's written hazard communication program.

Measuring Comprehension

Chemical hazards are communicated to workers to ensure that they fully understand the risks and hazards of the chemicals they work with and are thus able to make informed decisions to protect themselves (Nicholson 2000). Cox and Tait (1998) state that risk communication has no value unless it actually informs or changes behavior in order to ensure safety and is thus about "winning hearts and minds," not merely about providing information.

According to Sadhra et al. (2002), the best results of communicating hazard information are subject to several considerations. Individuals communicating the information must be credible, skillful, and knowledgeable, and the message should directly address the needs and circumstances of employees. The perceived importance of the message affects how employees receive it.

The form in which a message is delivered makes a difference—and face-to-face delivery is the most effective approach. Characteristics of the receiver, such as age, intelligence, and personality, affect the way training is received. These characteristics must be taken into account when training is being planned and is underway. The values, needs, and interests of employees affect how they receive training. The better employees are understood, the more specifically training can be designed for maximum effectiveness.

How individuals and groups of employees (subcultures) perceive safety affects how receptive they are to safety messages. Individuals unfamiliar with hazardous activities, as well as individuals so familiar that they are blasé about the hazards, may not truly understand aspects of training, or may believe it does not apply to them. Becoming familiar with the way employees think about the hazards connected with their jobs will allow trainers to adapt training to each group of employees for maximum effect.

Each worker may react uniquely to HazCom training, even when given the same information about workplace hazards (Cox et al. 2003). Although these differing behavioral responses result from a variety of factors, many of which are outside the workplace, the company is responsible for ensuring that individuals understand hazard information. In a study performed by Sadhra et al. (2002) of electroplating workers working with chromium, nickel, and hazardous chemicals, it was shown that various workers in the same company had different understandings of the hazards of their work environment, including misunderstandings of words such as "long-term" versus "short-term" and "acute" versus "chronic." This demonstrates the need to use terms and language that workers understand. Workers also tended to be

concerned most about short-term, immediate risks, such as acid burns, whereas safety experts were more concerned about the long-term, carcinogenic nature of chemicals. This study also showed that the workers tended to learn much more from each other than from written information or training provided by company management. Because new workers learned most of what they knew about the hazards of their jobs from their senior workers, if the senior workers had incorrect understandings of workplace hazards, new workers likely adopted the same erroneous views.

Methods of measuring individual work comprehension can vary. Written tests or quizzes may be given, but in industry settings these types of instruments may not provide optimum feedback and may only indicate how good an individual is at taking a test or how well an employee can read—not what employees really know and can do. If written quizzes are used, it must be remembered that the purpose is not to see how well someone does on a test, but whether they understand key information. Only questions about essential information should be asked; trivia should be ignored. A passing score must be established. Note that if questions are asked only about essential information *and* one or more questions are missed, an employee is demonstrating a lack of understanding of an essential safety issue. Because of this, a passing score may need to be 100 percent. One way to achieve perfect scores on tests of essential information is to perform a post-test review that can ensure that employees understand the information they previously failed to comprehend.

A more reliable way to measure comprehension (see "Required Training Content" for topics workers should understand) is to talk to workers in their work areas. A few weeks later, ask individual workers questions at their job sites. Ask them to identify the hazards of a particular chemical, and ask them how they can protect themselves against those hazards. Ask them what particular symbols or terms on chemical labels mean. Identify chemicals and have them demonstrate how to find MSDSs. Ask questions using variable phrasings and from different points of view to accurately determine whether incorrect answers are merely based on misunderstandings of terms. If workers do not understand key points, it is best to briefly inform them at that time, keeping a positive attitude and a friendly, open approach.

Training must be provided to employees at the time of their initial assignment and again whenever new physical or health hazards are introduced into their work area [29 CFR 1910.1200(h)(1)]. No records are required to be kept documenting training, but best practice is to keep such records for monitoring purposes [29CFR 1910.1200, App E(4)(C)]. Record keeping will vary by company policy, but it should minimally keep track of names, work units, and dates of training.

Globally Harmonized System (GHS)

In 1992, at the United Nations Conference on Environment and Development (also called the Rio Earth Summit), an initiative was taken to design a system to protect human health and the environment by establishing a single global system to classify chemical hazards, to provide standard hazard labeling, and to provide uniform safety data sheets (SDSs). This initiative turned into action and soon became known as the United Nations' Globally Harmonized System for the Classification and Labeling of Chemicals (GHS) (UNECE 2009b). The GHS evolved through a series of international meetings of the Committee of Experts. At this point, the third revised edition of the GHS was published in July 2009 and is available (UNECE 2009a).

Although international organizations and governments are the primary audience for the GHS, industry and other private and public entities will eventually implement requirements that will be developed and adopted in the future. The GHS also provides a basis for harmonization of rules and regulations on chemicals at the national, regional, and worldwide level. It is also an important factor for trade facilitation.

The GHS will have a significant impact on the U.S. OSHA *Hazard Communication Standard*, and on the chemical industry that manufactures and supplies chemicals; it will also impact the users of chemicals. From their production to handling, transport, and use, chemicals present potential dangers to human health and

the environment. People of any age all over the world with different languages, cultures, and social and economic conditions, including illiterates, face dangerous products daily (chemicals, pesticides, and so on).

Why Is the GHS Needed?

It is impossible for each country to identify and specifically regulate every hazardous chemical product. For instance, in the United States, it is estimated that there are about 945,000 such products. Regulating requirements for identification and information to accompany such products should provide needed protection. Global systems that have adopted harmonized requirements for hazard definition and information will impact not only this protection, but also trade between countries.

How Does the GHS Impact the HCS?

The United States currently has regulatory requirements that address concerns in different agencies; several agencies will therefore be affected by adoption of the GHS—for example, the Pesticides Program in the Environmental Protection Agency, the Hazardous Materials Regulations in the Department of Transportation and the Consumer Product Safety Commission, as well as the Occupational Safety and Health Administration. Currently, each of the above-mentioned agencies has adopted independent regulations that differ from the others, creating a rather cumbersome and inefficient process for domestic producers who must classify and label the same hazardous product multiple times.

Since OSHA's HCS has performance-oriented requirements for labels and material safety data sheets, communication should address inconsistencies among the users of labels and the MSDSs. Labeling provisions are the major difference between the HCS and the GHS. Adoption of the GHS should help comprehensibility and facilitate compliance. There will be a substantial impact on OSHA, since HCS requires labels and MSDSs for over seven million workplaces and about 945,000 hazardous chemical products.

It should be also noted that the HCS refers to lists of chemicals in hazard determination and uses them to establish a "floor" of covered chemicals. The floor was included in the HCS to address concerns about self-classification by manufacturers. However, the GHS does not have similar provisions. There are more detailed hazard determination provisions in the GHS addressing those concerns, which is the reason for removing the floor provisions.

The Scope of the GHS

The GHS covers all hazardous chemical substances, dilute solutions, and mixtures. The substances that would be directly impacted by adoption of GHS are: pharmaceuticals, food additives, cosmetics, and pesticide residues in food. These substances will not be covered at the point of intentional intake but will be covered where workers may be exposed, and in transport. There are some exceptions regarding the acute toxicity and environmental effects. The GHS includes five categories of acute toxicity effects for each route of entry, which are intended to protect children from consumer products. However, it is not likely that OSHA will cover all five categories when adopting the GHS. In addition, it covers aquatic toxicity, which requires environmental information on MSDSs. OSHA does not have jurisdiction on environmental information; therefore, it may not adopt aquatic toxicity criteria or require environmental information on MSDSs. However, all of the other criteria seem to be relevant to the workplace, and OSHA expects to adopt them.

Testing of Chemicals

Under the current HCS requirements, chemical manufacturers can base their evaluations on currently available data. However, the GHS does not require any testing of chemicals to determine their hazards. The criteria for classification of health hazards are test-method neutral. Any scientifically valid test data can be used.

Mixture Provisions

The HCS is based on either test data for the mixture as a whole, or a percentage cut-off approach. The GHS employs a tiered approach, allowing extrapolation

of data from similar mixtures, an additivity formula for acute toxicity, and a varied cut-off approach.

Labels

HCS has performance-oriented labels that allow almost any method of conveying hazards. However, the GHS has specific harmonized provisions for pictograms, hazard statements, and signal words. The GHS also has suggested precautionary statements that are not yet harmonized, but are expected to be in the future. Manufacturers and importers should expect substantial change from current requirements. Labels must include: (1) product identifier, (2) signal word, (3) hazard statement(s), (4) pictogram(s), (5) precautionary statement(s), and (6) supplier information (OSHA 2010c).

Material Safety Data Sheets

The HCS allows any order of information on MSDSs. However, the GHS specifies the order of information, which is consistent with industry approaches in ANSI and ISO. This should help to improve comprehensibility and issues regarding accuracy of the information (OSHA 2010c).

Advanced Notice of Proposed Rulemaking (ANPR)

The ANPR presents information relevant to the provisions of the GHS that OSHA expects to adopt. The ANPR covers background and history of the *Hazard Communication Standard* and the Globally Harmonized System of Classification and Labeling of Chemicals. A comprehensive document with information regarding GHS can be found on the OSHA Web site at www.osha.gov/dsg/hazcom/ghs.html.

Summary and the Future

The major elements of hazard communication consist of proper labeling, MSDS availability, and effective training. Understanding what has to be done to comply with the HCS is not difficult. A little study and review of this OSHA standard and its interpretations will provide a good understanding of its requirements. Where it becomes more difficult is in creating and keeping a good inventory of chemicals and in properly continuing management of the MSDS program, including training. As stated in the beginning of the chapter, compliance with OSHA, as well as best practice, indicates that anyone in the company having anything to do with hazardous chemicals must always follow established procedures in procuring, storing, using, and disposing of them. Because of this, effective training is essential.

As of this writing, OSHA has issued proposed rulemaking and held informal hearings to make the HCS consistent with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) adopted by the United Nations in 2003 (OSHA 2009, 2010a, and 2010b). Modifying the standard will change the criteria for classifying health and physical hazards, will lead to adoption of standardized labeling requirements, and will require a standardized order of information for safety data sheets (SDSs). Part of this modification is a concept called *control banding*, which identifies chemical risks based on the process, task, material characteristics, control, and quantity used ("Control Banding" 2005). If all these proposed changes occur, employees may be able to more easily understand labels and MSDSs and more clearly explain chemical hazards present at their work sites. Employers will have access to new standardized MSDS formats and label requirements and, after retraining employees, benefit by simplified compliance requirements and improved chemical safety.

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Reading Assignments

Chapter 4:
Hazard Communication Benchmarking and Performance Criteria

29 CFR 1910.1200 Hazard Communication Standard: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10099

Supplemental Reading

See information below.

Suggested Further Reading

See information below.

Learning Activities (Non-Graded)

See information below.

Key Terms

1. Benchmarking

Course Learning Outcomes for Unit VI

Upon completion of this unit, students should be able to:

1. Recall and discuss the basic components of OSHA's Hazard Communication Standard and the requirements for compliance.
2. Evaluate the quality of hazard communication programs and provide recommendations to improve compliance and effectiveness.

Unit Lesson

As we noted in Unit IV, the Hazard Communication Standard has been one of the standards most frequently cited by OSHA for more than 20 years (Occupational Safety and Health Administration [OSHA], 2012). It is not that organizations ignore the standard but rather that it is a very complex and difficult standard to implement effectively. There may be a good written program in place, but not all chemicals have been identified. Perhaps there are safety data sheets missing, or employees have not been well trained.

OSHA has long recognized that each workplace is unique and that there may be more than one way for an organization to achieve compliance. Accordingly, much of the HazCom Standard is a performance standard; that is, it states the goals and objectives, but in many aspects it does not give specifics on how to achieve those desired end points. Remember, the purpose of the standard is to ensure that employees know and understand the hazards of the chemicals they work with and how to protect themselves (Haight, 2012). Simple concept, difficult execution.

Do these workers know the hazards of the containers with which they are working? Have they been properly trained? Are the containers clearly marked? Are they in compliance with the HazCom Standard?
(Henshall, 2008)

An entire industry has developed around HazCom compliance. If you search the Internet you can find a never-ending list of HazCom Websites, consultants, and sample programs for free or for sale. A temptation is to get a copy of a HazCom program template and simply fill in the blanks, but that will not

address any of the unique features of your organization and likely will not result in compliance. This does not mean you should not look at what other organizations are doing.

However, what you want to find are documented *successful* programs and use them as benchmarks as you develop yours.

There are four major building blocks to a HazCom program:

Written program: This is where all programs start. It outlines all the other program elements and describes who is responsible for each of the HazCom efforts. It will be the first thing a compliance officer will ask to see.

Labels and warnings: Unit V covered the labeling requirements under the new GHS concept. This part has become much easier. Most of the requirements for creating labels fall on chemical manufacturers and importers. Users of chemicals only have to be sure that labels are on containers when received. Do you look for correct labeling as you walk through workplaces?

Safety Data Sheets (SDS): Creation of SDSs also falls on the shoulders of chemical manufacturers and importers, but all employers must maintain a file of SDSs for all chemicals used in their operations. The challenge is meeting the "readily available" requirement of the standard. As technology improves, this task may become a bit easier. Think networks, smartphones, and tablet computers.

Training: This is possibly the most challenging aspect of any HazCom program. Not only must training be provided, but employees must demonstrate comprehension. OSHA compliance officers may not be as interested in seeing your training documentation as they are in talking to employees and asking them about the chemicals they work with. Remember the goal: "know and understand." Routine worksite inspections by safety practitioners should always include discussions with the employees to determine if the HazCom training has been effective.

Haight (2012) discusses each of these elements in Chapter 4 and provides some best practices that have helped organizations achieve the HazCom program goals. In the next unit, we will discuss additional best practices and benchmarks that can be helpful in developing an effective and compliant program.

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Supplemental Reading

CSU Online Library

Learn more about this week's topics by researching in the databases of the CSU Online Library. For example, the following articles can be found in the Business Source Complete database:

- "Hazcom 2.0," by Maureen Paraventi, is a 2012 article in *Industrial Safety & Hygiene News* that discusses the revisions to OSHA's Hazard Communication Standard, including the Globally Harmonized System, major changes in HCS, and employee training requirements.
- "Strategies to Implement GHS: Bringing Order Out Of Potential Chaos," by Kami Blake, discusses the adoption of the revised Hazard Communication Standard (HCS), including factors contributing to the extension of the timeline for completion of the Globally Harmonized System for Classification and Labeling of Chemicals (GHS). The article appeared in the August 2012 issue of *Industrial Safety & Hygiene News*.
- "Turn the Page," by Susan B. McLaughlin, discusses key provisions of the 2012 OSHA Hazard Communication Standard (HCS). This article appeared in the December 2012 issue of *Health Facilities Management*.

Surfing the Web:

- OSHA's webpage has a wealth of additional information about the HazCom Standard and how to bring an organization into compliance. Start your exploration at this link: https://www.osha.gov/dsg/hazcom/index2.html

OSHA provides guidelines to its compliance officers for inspections of HazCom programs at this link. Learn more about them at this link: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=1551. There are several appendices on this site; you should pay close attention to Appendix E, which contains a sample written HazCom program.

Suggested Further Reading

Valuable Source for Additional Information

Hazard Communication- A Compliance Kit (OSHA 3104); this is a reference guide to step-by-step requirements for compliance with the OSHA standard. It is not available online, but it can be obtained from the Government Printing Office. (www.gpo.gov) Order No. 029-016-00147-6; cost is $18.00 domestic; $22.50 foreign.

Learning Activities (Non-Graded)

Improve the HazCom Program

Obtain a copy of your organization's written HazCom program, and review it for compliance with the benchmark elements listed in Chapter 4 of the course textbook. Does it meet the basic requirements? If not, try rewriting the sections that fall short.

Discuss the program's contents and any suggested improvements in a minimum two-page document. Use APA formatting when writing your paper.

Safety Data Availability and Accuracy

OSHA states that Safety Data Sheets (SDS) must be "readily available" to employees. Locate the SDS for one of the chemicals used in your workplace or somewhere else in your organization. How long did it take you to find it? Would you consider it readily available? Is the SDS current?

Document your efforts to find the SDS and whether or not it meets OSHA requirements, both in availability and content. Organize and present your findings as if you were writing a memorandum that you would submit to your supervisor.

Expand on Your Assignment

Read paragraph one of the Unit VI case study provided in the course syllabus as the unit assignment. For the company described, develop a written hazard communication program that addresses all the critical elements.

Appendix E on the following site contains a sample written HazCom program: https://www.osha.gov/dsg/hazcom/hazcom-appendix-e.html

Non-graded Learning Activities are provided to aid students in their course of study. You do not have to submit them. If you have questions, contact your instructor for further guidance and information.

Unit VI Assessment

Hazardous Material

Question 1

What information must be on labels of containers holding hazardous chemicals?

Your response must be at least 75 words in length. You are required to use at least your textbook as source material for your response. All sources used, including the textbook, must be referenced; paraphrased and quoted material must have accompanying citations.

20 points

Question 2

According to the Hazard Communication Standard, what employees need to be trained, and when do they need to be trained?

Your response must be at least 75 words in length. You are required to use at least your textbook as source material for your response. All sources used, including the textbook, must be referenced; paraphrased and quoted material must have accompanying citations.

20 points

Question 3

What does OSHA mean by employee "immediate access" to SDSs?

Your response must be at least 75 words in length. You are required to use at least your textbook as source material for your response. All sources used, including the textbook, must be referenced; paraphrased and quoted material must have accompanying citations.

20 points

Question 4

List and briefly discuss four exceptions to the Safety Data Sheet (SDS) requirements of the Hazard Communication Standard (HCS).

Your response must be at least 75 words in length. You are required to use at least your textbook as source material for your response. All sources used, including the textbook, must be referenced; paraphrased and quoted material must have accompanying citations.

20 points

Question 5

For hazard communication training to be considered effective, what does each employee need to understand upon competing training?

Your response must be at least 75 words in length. You are required to use at least your textbook as source material for your response. All sources used, including the textbook, must be referenced; paraphrased and quoted material must have accompanying citations.

20 points

BEST PRACTICES IN HAZARD COMMUNICATION

5

Sharon Campbell

LEARNING OBJECTIVES

- Identify best practice standards.
- Understand the administrative issues involved in hazard communication (hazcom).
- Identify training issues for different types of work sites and learn how to prepare training, education, and/or instruction programs.
- Understand the development, use, and limitation of material safety data sheets (MSDSs).
- Understand the complexities of labeling and signage.
- Develop some strategies for evaluating the quality of training programs.
- Recognize when to do training of first responders and clinical emergency responders.
- Explain the strengths and weaknesses of different training formats.
- Understand some of the strategies for evaluating the quality of training programs.

THERE ARE MANY issues involved in hazard communication, including providing adequate information at the work site; training workers effectively and efficiently; obtaining, maintaining, and providing 24/7 access to MSDSs that actually have useful information; and properly labeling and storing hazardous chemicals. As all safety professionals know, the *Hazard Communications Standard* (HCS) regulations are minimum standards, and there are a host of other issues that need to be considered as well to meet best practice standards. And now, the *Globally Harmonized Standard* (GHS), *REACH*, *control banding*, and *responsible care* are all considerations.

But first, what are *best practice* standards? Keep in mind that best practices can change regularly, with new benchmarks being set as safety professionals constantly go beyond minimum standards or as government changes the laws. The following are some criteria:

1. The program meets the basic legal requirements set by the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA).
2. The program goes beyond the basic requirements to include the realities of the workforce: varied languages and cultures; different levels of literacy, ages, concerns, and abilities.
3. The program goes beyond the basic requirements to include everyday realities:
   - international work sites and workforces
   - transport of hazardous materials
   - the emergence of terrorism
   - biological hazards
   - the need to deal with chemically, biologically, and radiologically contaminated disaster sites

- the emergence of new technologies
- the education of various people beyond the workforce

There are other measures of excellence, and many safety professionals, especially members of the Voluntary Protection Program Participants Association (VPPPA), strive for and attempt to achieve these standards of excellence. It is recommended that an organization check the criteria and actions of like companies and safety professionals to increase the organization's own practices over time.

These practices will change over time, and what works for one organization may or may not work for another. As technology, knowledge, materials, education levels, management techniques, tools, and the rest of the work world change, the safety professional must continually reevaluate *best practices* and how they can and must change and improve.

First, this chapter looks at administrative issues; next, it discusses the available educational materials and processes, such as MSDSs, other publications, and training programs. The section after that looks into training practices, labeling, symbols and language; and, finally, the chapter looks at emerging issues traditionally not addressed in the hazcom training materials.

Administrative Issues

Basic compliance is not difficult. O'Brien (2001) has a checklist for HCS compliance:

- Know the regulations.
- Identify responsible staff.
- Identify and list all chemicals.
- Write the plan.
- Maintain good labeling on containers.
- Provide quick access to MSDSs for all employees on all shifts.
- Train all employees on all possible chemical exposures.
- Frequently review and revise the program.

No sweat, right? But to go further and become world class, using best practices, look at each of the above in detail.

Know the Regulations

Obviously, to comply with the HCS, safety professionals first have to know and understand the regulations. Any set of regulations has its own ambiguities and gray areas that, in any given situation, could "sort of" apply. Also, like any set of regulations, these will change from time to time. Keeping up is essential. Safety professionals with questions can ask OSHA for advice on compliance. OSHA provides free, confidential expertise, which is primarily aimed at smaller businesses.

The OSHA consulting branch is separate from the enforcement branch, which changes the dynamics from an OSHA-complaint inspection. When called, the consulting branch does require some commitment for compliance. "Your only obligation will be to commit yourself to correcting serious job safety and health hazards—a commitment which you are expected to make prior to the actual visit and carry out in a timely manner" (OSHA 2007a). Be aware, though, that "In rare instances, the consultant may find an 'imminent danger' situation during the walk-through. If so, you must take immediate action to protect all employees. In certain other situations that would be judged a 'serious violation' under OSHA criteria, you and the consultant are required to develop and agree to a reasonable plan and schedule to eliminate or control that hazard. The consultants will offer general approaches and options to you" (OSHA 2007a). It is also advisable to look to the future. Many countries have specific standards for their MSDSs and they are not the same. Because of the difficulty multinational companies or those selling to a large international market experience in complying with every single variation, an international mandate to develop a globally harmonized system for hazard classification and labeling was adopted in 1992 (OSHA 2009). It is clear now that MSDSs will eventually reflect whatever standard the global-harmonization project sets.

SHE practitioners responsible for writing MSDSs or labels need to look at the proposals and see if they can implement the probable requirements now. Is there new technology for delivering MSDS information quickly and easily on the horizon? If a new computer

system is needed, it would be farsighted to identify the availability of new technology now to maximize future access, as would planning training programs with an eye on the future.

Any SHE professional required to write MSDSs needs to be properly trained to do so. There are training courses available from numerous sources, such as the Society for Chemical Hazard Communication; Interactive Learning Paradigms Incorporated, which offers advice but no courses; Chemical Plant Safety Resources, which offers a book with templates; Denehurst Chemical Safety, Ltd.; and others. The American National Standards Association (ANSI) has a publication that gives the current standards. Any course taken should include the GHS and other relevant standards.

Identify Responsible Staff

Choose carefully. Make sure the person selected is qualified for the hazcom position. Consider also whether or not this person is qualified to do the labeling as well. What if nobody is particularly qualified? Some good options include hiring a qualified consultant, at least for providing oversight on the program. If the designated employee is approaching qualified status, have the person get the additional training needed to fill in knowledge gaps. If the employee knows chemistry but not the regulations, that situation could be correctable. If the employee knows the regulations, but not chemistry, team the person up with someone who does, or find someone else, because it would take too long to turn a regulatory specialist into a chemist. These staffers do not have to be on site all the time, as long as the entire program is running correctly.

Identify and List All Chemicals

This can be a daunting task, and one that also requires competent personnel. It may not seem that way to a nonchemist, but someone unfamiliar with chemical nomenclature making chemical lists can make all kinds of mistakes, necessitating a major or complete redo of the inventory. Facilities with only a relatively small number of chemicals on site are in good shape. The logistics are pretty easy, and the extent of chemical expertise needed is limited. On the other hand, large research facilities, where each lab has thousands of different chemicals, most in very small quantities, *definitely* require someone competent. Either way, make sure all the MSDSs for all the chemicals are on site, or provide continuous access to them.

Consider finding some system—a bar-code system, for instance—for maintaining lists of chemicals if there are a lot of them, so that what has been consumed, discarded, or acquired is frequently updated. Centralizing purchasing, if practical, would be helpful for the acquisition department.

Write the Plan

It is not necessary to reinvent the wheel. Available prewritten plans from various vendors can be customized. Be sure to check the credentials of the plan developers, though, and make sure that the plan is appropriate for the facility. Whether or not a premade plan is selected, Pinto has simplified the plan's requirements (Pinto 1999):

- a list of the employees in charge of all the various responsibilities
- a list of all hazardous chemicals
- the source and methods for obtaining MSDSs, including a protocol if the MSDS is not received with the initial purchase; list precisely how employees can access them and how they can review and update procedures and schedules
- labeling procedures for generic containers with hazardous chemicals
- information and training procedures for workers so they can protect themselves from the hazards
- procedures for informing workers about the hazards of nonroutine tasks
- a respiratory protection program, including detailed standard operating procedures (SOPs) for selection and use of respirators
- a personal protective equipment (PPE) program, including the provision of and training in the use of PPE other than respirators

- a blood-borne pathogen (BBP) program (29 CFR 1910.1030 requires such a program if safety professionals can "reasonably anticipate skin, eye, mucous membrane or parenteral contact with blood or other potentially infectious materials that may result from the performance of an employee's duties")
- a confined spaces program
- any other OSHA standards that apply to the operation

Whoever writes the program should keep in mind that OSHA inspectors should find the program easy to evaluate, which would also make it easier for people to use. They will evaluate the plan to verify compliance. To that end, 3E safety and transportation specialists Burns and Beckel recommend including copies of posters, signs, and training materials, or at least referencing their location in the plan (Burns and Beckel 2001). The virtue of referencing such materials within the written program instead of inserting them is that it eliminates the need to include extensive details.

Keep in mind that any program must be updated as problems, changing conditions, and changing personnel require. At the least, establish a schedule and procedure for updating. Some mechanism for reporting problems, glitches, and suggestions that will filter up to the person/people responsible is essential to optimize the Hazard Communication Program.

As part of the continual reevaluation of HCS compliance, use safety inspections to monitor the effectiveness of the program as well as the training and understanding of individual employees (whether they are "getting it") (IOMA, Inc. 2001). Test individual employees on inspections: ask if they know the hazards of the chemicals they use; what PPE they need; what to do if chemicals are spilled; how to decontaminate themselves and/or the facility, if necessary; and so on. Get specific, and make sure they understand what the rating scales actually mean, for example. If an employee, because he or she is not working with hazardous chemicals, happens not to be wearing PPE when the safety professional is making rounds, make the employee demonstrate the wearing of the PPE. As gaps in knowledge are discovered, revise the training program.

In addition, consider performing systematic job safety analyses (JSAs) in order to regularly ensure that job descriptions adequately identify inherent hazards and that employees have adequate understanding to be able to avoid those hazards.

Training Materials and Requirements

Requirements and Optional Training

The requirements for chemical safety training are pretty much laid out by federal and state OSHAs, the Department of Transportation (DOT), and the EPA in their regulations based on the chemical inventory. (See appropriate references in this book.) However, do not forget to find out what other legal requirements may apply to the organization's operations. There may be local fire department and even city environmental and safety regulations to consider.

Another training issue to consider is the need to train, or at least inform, local emergency responders and medical providers in the event of an emergency, disaster, or terrorist attack. While they may not need the same training as employees, appropriate people who are kept informed of chemicals and other hazards on site, could make a big difference in an emergency. Consider offering more detailed training to selected responders. Invite them to see the layout and quantity of hazardous materials so they are prepared in the event of an emergency.

Do not forget contractors doing work on the site. For example, in one lawsuit, a contractor, Hydroblast, was hired to pressure test the tubes in a heat exchanger system with the chemical solvent, Selexol, in it ("Nobody told *me* . . . ," n.d.; 10th U.S. Circuit Court 1998). The owner of Hydroblast was told of the hazards of Selexol. The contractor's foreman asked a plant employee if there was anything harmful in the tubes and was told there was not. The warning did not get to the foreman and crew from the president of Hydroblast. Relying on the employee's word, the crew did not wear protective coveralls when working, and used only face or eye protection. Selexol was blown from the tubes during testing for some unspecified and possibly unknown reason, drenching the plaintiffs. As they did not realize it was hazardous, they did

not know to promptly get cleaned off and thus sustained unspecified ill effects. Had the foreman insisted on seeing the MSDS he would have had the crew wear PPE. Had the employee who assured the foreman the chemical was not hazardous also insisted on seeing the MSDS, accurate information would have been given to the contractor's employees. The take-home lesson here is that every party should carefully read the MSDSs and not take anyone's word on the actual level of hazard.

Participating on the local emergency planning committee (LEPC) can be a good way to get to know the local fire and police departments. The committees are made up of local emergency responders, with representatives from the fire department, the sheriff's department, the police department, and so on, as well as industry representatives, citizens, and others. Safety professionals may also want to let local emergency providers know what resources can be contributed to them if needed, in terms of equipment, supplies, and trained and willing people. Consider cross-training between companies if each company's people might get involved in a nearby company's emergency involving hazardous materials they do not have on site. It would be a good idea to investigate potential legal liabilities in planning these activities in case unwanted events occur during training or other activities.

Medical providers may or may not be aware of the acute and chronic effects of exposures of a company's major hazardous materials and processes. Local emergency providers should know at least how to get crucial information quickly, and how to gain access to the pertinent MSDSs. Knowing how to read them could make a difference in a serious emergency. In addition, enhancing one's emergency management plan and emergency response capabilities can be a direct result of working with your local LEPC.

Barriers to MSDSs and Other Safety Information

A *barrier* does not necessarily mean a locked door. As Geller has pointed out repeatedly for years, and as one knows from personal experience, safety needs to be convenient (Geller 2003). It was not until this author, a certified safety professional who relies on her eyes to hear, due to her lifelong hearing loss, put a set of chemical splash goggles in each bathroom (for cleaning agents), laundry room (for bleach), garage (for solvents, paint, etc.), and kitchen (for splattering hot oil) that she finally started using eye protection every time it was required. Why would any SHE professional think his or her employees will do any better when it is inconvenient to get to the MSDSs?

Geller recommended in 2003 that companies set up "a behavioral inconvenience scale" ranging from one (very easy) to 10 (most difficult). Ask the employees to rate the ease of access to the MSDS locations (and other safe work behaviors—the technique has broad applications) on all shifts, at all locations. Consider asking other parties that might need fast access to them, such as emergency responders and medical personnel, to do the same. Identify the barriers and eliminate them if feasible and reasonable. Hanging a pile of MSDSs from each cleaning cart eliminates access barriers for the cleaning staff, but it is clearly excessive. And if they cannot read or understand the MSDSs hanging there, that is still a profound barrier.

MSDS Issues

Who Wrote this Thing, Anyhow?

Good question! Perhaps more pertinent is the question of the qualifications of the person who wrote the MSDSs that people are relying on in a facility (OSHA 2004b). Another issue to consider is whether the document is actually complete. Thomas G. Grumbles, CIH, president of The American Industrial Hygiene Association (AIHA), testified to the Committee on Health, Education, Labor and Pensions Subcommittee on Employment Safety and Training of the United States Senate at the March 24, 2004, Hazard Communication hearing (henceforth referred to as the Enzi Hearing); he pointed out that the HCS does not address that issue. Reasonably enough, the AIHA believes that the quality of MSDSs will be increased if the authors are competent and are provided with guidelines on the preparation and maintenance of MSDSs. While it is not currently possible to demand that suppliers reveal the bona fides of their MSDS writers, participation in the lengthy process of developing standards, or at least offering strong suggestions, for the qualifications of

MSDS creators and on the preparation and maintenance guidelines will improve the quality of MSDSs in the future, and make them more useful and reliable. Consider joining such committees to have a voice in this important issue.

Fortunately, there are sources for training materials and courses on MSDS writing. The Society for Chemical Hazard Communication offers courses on MSDS preparation, REACH, GHS, and many other pertinent areas. Interactive Learning Paradigms Inc., offers a very useful MSDS "Frequently Asked Questions"page, and OSHA and the Canadian Centre for Occupational Health and Safety make information on this topic available.

Why They Need to Be Correct and Understood by Users

Testimony at the Enzi Hearing by Carolyn W. Merritt, former chair and chief executive officer of the U.S. Chemical Safety and Hazard Investigation Board (CSB) was stark. She testified that "Our investigations show that lives continue to be lost in accidents because chemical hazards are not being effectively communicated in the workplace. Among accidents we have investigated, faulty communication of material hazards contributed to 12 deaths among workers and 79 injuries to workers, first responders and members of the public" (Merritt 2004).

In two of nineteen major accidents, no MSDSs were provided at all; in two more, MSDSs were provided but employees were not trained in their use. Two other accidents resulted from a failure to provide product-flammability data; three more were caused by lack of information on reactivity; one resulted from language barriers; and three major dust explosions in 2003 resulted from failure to warn of that hazard.

A two-year study from 2000 to 2002 found that, over the past twenty years, unreliable reactive hazard information led to 167 serious incidents, resulting in 108 deaths and extensive injuries and property damage. The problem is that information on the hazards from mixing or blending chemicals is not included in the MSDSs (Merritt 2004).

Some of the more spectacular cases investigated by the CSB include:

- A complete lack of MSDSs led to the BLSR Operating, Ltd., blast, when two tanker trucks delivering flammable gas condensate waste for disposal allowed the waste to run over open ground into a trench, which is the usual practice for nonflammable drilling mud. Nobody knew the waste was highly flammable. Three workers died and four were seriously burned.
- Waste chemicals reacted in the basement of a mixed-use building in the Chelsea neighborhood in New York City, causing damage as high as the fifth floor of the building, and injuring 36 people, including 14 members of the public. Not only were there no MSDSs, but even if there had been, many of the workers would not have understood them due to language barriers.
- Four workers died and six were injured when a worker restarted a mixer containing solidified explosive material at a company that reclaimed military munitions. MSDSs were only available in English, and most employees understood only Spanish.
- A fine plastic powder used to make rubber goods exploded in a medical rubber plant, killing six, injuring dozens, and causing hundreds to lose their jobs. The dust, which nobody knew was potentially flammable, had accumulated over a manufacturing area at the plant. In this case, the manufacturer of the powdered polyethylene included a warning in its MSDS, but the plant's source was a formulation company, which turned powder into a water-based slurry and neglected in its MSDS to inform end users that, when dried, the product could release potentially explosive dust.
- Another dust explosion involved powdered resin used as a fiberglass insulation binder. The MSDS understated the hazard, indicating that its powder was "combustible," but did not mention that the powder's catastrophic potential was the dust allowed to accumulate. Seven people died and more than 30 others were injured.

Far too many people have died or been maimed because of controllable hazards caused by chemicals they did not understand for a variety of reasons.

Lack of Clarity

OSHA has long required employers to provide MSDSs for all the chemicals on the premises and in use, but what good are these MSDSs to the average employee, particularly in an emergency, if they are written in technical language unfamiliar to most employees, and the formats are confusing at first glance? Language barriers can also exist. These issues have been addressed repeatedly, and OSHA requires training, not merely the handing out of MSDSs (OSHA 2007b). While employees can be trained to read them, safety professionals cannot give them the chemical, medical, and technical background to understand what they read (Campbell 1992, Pullen 2003).

OSHA-sponsored research confirmed that workers understand only about 60 percent of the health and safety information presented (Fugoto and Fung 2002). This is not particularly disturbing, but what is scary is the results of a 1990 study by the Printing Industries of America, which found that workers with fifteen or more years of education (i.e., at least some college and more) were able to understand only two-thirds of the MSDS information (Fugoto and Fung 2002).

Under the HCS, all chemicals produced in or imported into the United States that could harm employees who are exposed to them under normal conditions of use or in a foreseeable emergency must have MSDSs that are readily available to employees. There should be no *barriers*, such as having to ask a supervisor for it, not having easy access to it, or not being trained to access electronic MSDSs (Ernst 2003). Backup systems and power must be available for electronic access.

Some confusion results from the fact that there is no single, approved, standard format for the MSDS, and there are a variety of other complaints (Minter 2003):

- "A specific improvement would be to actually write them to help the user in their use of the chemical rather than as lawsuit protection . . . " (safety consultant).
- "They should be written in 'plain, layman's English' because most employees do not understand some of the technical language in MSDSs" (industrial hygienist in the petrochemical industry).
- "They are too general and include boilerplate phrases with little useful information, such as specifying the use of 'chemical-resistant gloves'" (industrial hygienist).
- "PPE requirements should be specific for large or small quantities of a substance. . . . A worker would need skin protection against phenol regardless of the quantity used because it can be absorbed through the skin, but PPE levels would vary for methyl alcohol, depending on the amount in use" (safety professional).
- " . . . they simply are not consistent. . . . When training employees, it is difficult for them to understand why they cannot just go to section 'X' in every MSDS to find PPE and section 'Y' to find physical properties" (safety professional).
- Errors in MSDSs were responsible for at least one explosion—at the Morton International plant in Patterson, New Jersey—that injured nine people. In that particular case, a chemical with a reactivity rating of "4" (most reactive) was described as a "0" on the MSDS, and the boiling point was off by 230°C. Doubtless other errors in MSDSs have caused many less spectacular mishaps.

OSHA and Industry Response to MSDS Problems

Some of these concerns are being addressed directly by OSHA, which is developing an enforcement initiative on the adequacy of MSDSs. OSHA will select certain chemicals, identify some critical phrases, words, and so on, that should be in accurate MSDSs; OSHA will also train compliance officers to inspect the MSDSs they find ("Hazard communication via material safety data sheets," 2004). If they find deficiencies, the employer will *not* be fined; OSHA will instead notify the manufacturer of the chemical and order a correction. If the manufacturer fails to correct the MSDS, it can be cited under the HCS, but the employer relying on the accuracy of the MSDSs is not culpable.

Of course, safety professionals who spot something wrong, or confusing, or who have other reason

to question the MSDS should contact the source of the erroneous MSDS immediately and resolve any problem ("Questions and answers . . . " 2004). Certainly, if a compliance officer found out that a safety professional had misgivings about an MSDS and failed to attempt to resolve them, the safety professional could risk being cited.

Often the issue concerns a lack of clarity rather than outright error. Many safety professionals are tempted to rewrite or create a *summary sheet* for their employees. It is a risky thing to do. As Glenn Trout of MSDSonline pointed out in a series of questions and answers, " . . . if you edit, augment, or change an MSDS you may become liable for the content of the MSDS" ("Questions and answers . . . " 2004). Do it right and there is no problem. Do it wrong and bad things could happen. In addition to the risk of unexpected consequences, there is a risk of incurring an OSHA citation or fine, and the potential for civil and criminal liability for any errors introduced. Safety professionals who go beyond their personal level of expertise could even incur individual liability.

Creating Simplified MSDSs

As Judy Hoffman, manager of public affairs for a chemical manufacturer, pointed out, "In the case of the chemical industry, [effective communication with the press and public at large] will be required at the time of a chemical incident" (Hoffman 2003). She found a single-page Chemical Information Sheet, or Layman's Language MSDS on benzene very useful when addressing a local citizens' meeting on benzene's possible impact on groundwater. The company continued the practice for twelve other chemicals of public concern due to either toxicity or the quantity used.

Hoffman addressed the concern about the correctness of the information quite simply: three chemical experts took her, a chemical layperson, through each section and explained what they meant. She wrote down what they said and drafted her Layman's Language Chemical Information Sheet using a simplified format, which they used for all thirteen of the chemicals.

Just five categories were addressed:

1. ***Product name.*** This included the common name, phonetic pronunciation guide, and other names of the chemical, as well as physical properties, such as appearance and odor. Both company and everyday uses are described; and if the product was commonly used by the public, that information helped people see why the chemical was important.
2. ***Storage.*** Besides the quantity of chemical on site, the safety measures used to keep it safe are included. For instance, if the liquid is in double-lined vessels with dikes equipped with foam fire protection system and storage-tank vents connected to a vapor-collection system, people feel a lot better about having it relatively close to them.
3. ***Exposure limits.*** Besides the numbers, they have an explanation of what an exposure limit is and the typical worker exposure at the facility and the amount measured at their fence line.
4. ***Health hazards.*** No sugarcoating here! But adding safety precautions and reassurance that the public is very unlikely to be exposed to harmful levels helps soothe anxiety.
5. ***Emergency response.*** First-aid measures and when to seek medical attention are key points here. The option of giving firefighting techniques here is not always used, because the authors assume that fire fighters can read actual MSDSs and make the right decisions. It is not known how valid this assumption might be in areas with a small volunteer firefighting force; when deciding what to include, consider the sophistication of local fire companies likely to get involved in an incident.

At the bottom of each form is information on contact persons who can provide more details or explanations, preferably a direct-dial number rather than the general switchboard. This approach for educating em-

ployees requires contact information on people who can be reached at any time.

This concept has not caught on since it was first proposed. Clearly, it would be impossible to do this for everything. However, for special situations, such an approach can be quite valuable—for example, if the entire concept was developed to aid in communications during a crisis. Should an unwanted event occur involving just one or a few chemicals, this would be very useful in communicating with reporters and the general public.

It could also be useful for communicating effectively with cleaning crews, clerical staff, and others with extremely limited exposure to hazardous chemicals.

How to Evaluate MSDSs

Look at the company's MSDSs and see if they meet everyone's needs. As this venture can require expertise beyond that of the average safety professional, and could involve scrutinizing thousands of documents, many safety professionals choose to leave this chore to experts in chemical safety and hazardous materials information management ("Questions and answers [on MSDSs]" 2004). However, there are aspects that safety professionals can, and should, evaluate.

- Do they clearly communicate the hazard characteristics of the material?
- Do they address preventive measures?
- Do they address PPE, if pertinent? Do they address first aid in enough detail in the event of exposure?
- Are they available in the employees' languages? If not—and they probably are not, unless only English speakers are in the workforce—make sure that a truly bilingual employee is on site at all times, one who can translate *accurately and completely*. Alternately, arrange for an offsite professional translation provider to be readily available at all times, advises Michael Beckel, supervisor of training at the 3E Company (Burns and Beckel 2001).

Still using hardcopy MSDS? As long as they are readily and immediately available without barriers to all employees in event of an emergency, there is nothing wrong with that, especially if only a small number of people are involved. They do present problems, though ("Questions and answers . . . " 2004). David Lochridge, General Manager of Production of Dolphin Software, advises a regular audit for accuracy and completeness. Are all pages still readable? Photocopies and printouts deteriorate, get holes punched in them, have stuff spilled on them, and can become otherwise illegible or lose information. Are they complete, with all the pages there? Are they current? Have a system for regular updating and replacement of MSDSs. Consider requiring an annual updating from all manufacturers. Lochridge does suggest that electronic text is the best option for utilizing MSDSs, though. It is possible to do a quick electronic search of the document for pertinent information rather than having to read through the whole thing, to mention but one advantage.

Make sure that every other legal entity that needs the MSDSs has them. Local fire regulations may require that the fire department have access to them, and the EPA's SARA Title III requires that they have the company chemical inventory. It is not that much harder to give them the MSDSs (Ernst 2003). If there are plants in other countries, they may have requirements for providing chemical inventories and MSDSs to some of their agencies.

Look at the MSDS collection in light of the following suggestions for people who develop them, and contact the sources to improve their MSDSs in future drafts. Feel free to send them a copy of these pages to help them in the future.

Who Should Be Developing MSDSs?

Anyone asked or assigned to develop MSDSs should first consider carefully if he or she is qualified. If there is any question or doubt, do not do it (Grumbles 2004). Seek out a qualified consultant instead. There are too many poor-quality MSDSs out there. As John Henshaw, Assistant Secretary Of Labor for Occupational Safety and Health, testified before the Subcommittee On Employment, Safety and Training Committee on Health, Education, Labor and Pensions for the U.S.

Senate in 2004 (Henshaw 2004), "Disparity in the qualifications of those who prepare MSDSs is another significant reason for variability in quality. OSHA's HCS does not address the qualifications needed to prepare an MSDS. Those who write MSDSs come from a wide variety of educational backgrounds, and there is little training available that is specific to this task. Accurately depicting the health effects of chemicals requires a technical background to review relevant scientific literature. Large chemical manufacturers often have multidisciplinary staffs of experts devoted to this task, but smaller manufacturers may not have such resources. Thus, the disparity in qualifications can lead to differences in the quality of information included in an MSDS."

Generally expertise comes from backgrounds such as toxicology, chemistry, or industrial hygiene. The Society for Chemical Hazard Communication has a series of professional development courses on labels and MSDSs, and it would be reasonable to insist that whoever writes the MSDSs is qualified. For those who do have the technical qualifications, DeChristopher and this author have some suggestions for them ("Questions and answers . . . " 2004).

- Select and use one standard format. The American National Standards Institute (ANSI) developed a format in 1993, ANSI Z4001-1993, that has sixteen parts to it. There may be others that work better for a particular company's products, and the movement for a globally harmonized hazcom system needs to be considered in selecting a format.
- Do not leave out any information for a particular section; if it is not relevant to the chemical in question, leave it in the form but enter N/A (not applicable) since it is not. That way the user does not have to wonder if the writer was just spacing that section out or if it really is not applicable.
- Format the document so that the margins allow for fax lines and holes for binders.
- Use a sans-serif font large enough for folks with aging eyes to read. The document does not have to be kept to the fewest possible number of pages. Trees are a renewable resource, employees are not. Besides, most people are accessing the information electronically, so there are not many trees involved any more.
- Clearly mark the manufacturer name, the product name, and the revision date on the top of the MSDS. Consider adding the appropriate categories as well, as this is the future of making MSDSs readily usable.
- Be sure to include page number and the total number of pages on multipage MSDSs. A notation like "Page 1 of 3 pages" lets the reader know how many pages are involved and if any of them are missing. If there is only "Page 1" and "Page 2," the reader cannot know that page 3 is missing without that information.
- Did the product name change? Be sure to put the former name up there, too, for ease of updating. Also, the user may still have a stock of the older version in the storeroom.
- For all ingredients, make sure the chemical name(s) are listed under "CAS #" (which must be carefully verified at www.chembiofinder.com or some such Web site before listing); the annotation should include the percentage or range of percentages of chemicals in the product. Using the range allows the actual formula to be kept a trade secret if necessary. Some food manufacturers who vary the source of particular ingredients, such as sugars, list all the possible sugars that they might use on their labels to avoid having to produce new labels for each batch that varies. This tactic may work for MSDS for products that vary slightly from batch to batch.
- Include units of measure for physical data. If the MSDS says that the density = 4, that does not tell the user much. Four what? lb/gal? gm/l? If the melting point = 100 degrees, is that Celsius or Fahrenheit? It makes sense to list both temperatures since Americans have resolutely avoided going metric, unlike the rest of the world. Similarly, volumes and weights would be better understood by more

CASE STUDY

The BP Approach to MSDS Generation

BP, a chemical-manufacturing company, now sees the need for generating MSDSs as a company core competency and even a competitive advantage (Buxbaum 2001). The Swindon, a UK-based company, cuts costs, increases efficiency, and supports its marketing efforts by incorporating concepts of hazardous material regulations and handling in the product design process. The commitment of BP to be an environmentally sensitive oil company made hazardous material compliance so important that it acquired and implemented an e-business system that ensures compliance with the assorted environmental regulations worldwide.

Burmah Castrol, before BP acquired it, had developed a single MSDS system to eliminate the need for seventeen different systems deployed around the world. BP has implemented this system, now known as the ClearCross Materials Compliance System, for all its global MSDS requirements.

The software lets the companies generate MSDSs in more than twenty languages and in compliance with the regulatory requirements of 30 countries. Instead of taking days to produce an MSDS, it takes minutes, and eliminates the previous $100 translation costs. By combining access to current regulatory requirements with a database of product-formulation templates that are used to generate the forms, language translation, and document-management functions, ClearCross not only ensures regulatory compliance, but lets the company develop its products so that they are acceptable worldwide. They might formulate a product for, say, Germany, and find that it cannot be used in the United States. This situation led to additional costs to reformulate the product.

BP chemists now first use Clear Cross to cross-reference ingredients against the worldwide regulations and work problems out *before* developing the product, which provides even more of a competitive advantage.

users if they are given in both English and metric units.

- Tell the user if the product is a solid, liquid, or gas. That way, MSDS reviewers do not have to go hunt down the actual product if it is not in front of them or they do not know that information. It also helps emergency responders, medical providers, and LEPCs.
- Fagotto and Fung recommend watching the level of the language used as well (O'Brien 2001). Keep it simple for the reader. Slicing onions causes lacrimation, as do many chemicals. People without a medical background probably will not understand that it just means that they cause tears. Use standard and basic language, so that such words as "poison" mean the same thing for every MSDS regardless of source.
- New discoveries regarding hazards of various chemicals are made frequently. If new information comes out about something with an MSDS, it absolutely, positively must be updated to reflect that discovery within three months ("Hazard Communication via MSDSs" 2004). Distribute the update promptly to all customers; do not just wait until an annual updating comes around.

Due to the imminent implementation of the Globally Harmonized Standard (GHS), MSDSs will need to comply with those new regulations. While OSHA has not yet (as of the publication of this Handbook) adopted the GHS requirements for their HCS, it is this safety professional's opinion that they certainly will do so. (EHS World.net 2010). It is easier to implement them into an MSDS now then to have to go back and redo what has already been written.

Areas of Frequent Confusion about the HCS and MSDSs

Robert A. Ernst, associate editor at J. J. Keller and Associates, answered some common questions about MSDSs (Ernst 2002).

- Who else needs the MSDSs? Under EPA's SARA Title III, MSDSs must be available as part of compliance. Some states and municipalities have additional requirements.
- Is a specific format required? No, but ANSI Z400.1-1993 is recommended; with the global standardization movement, any such format would minimize work in future revisions.
- Which MSDSs must be kept? Under the HCS, an MSDS should be kept for chemicals defined

as hazardous, but before throwing away the MSDS for nonhazardous chemicals, keep in mind that medical records, air sampling, and other exposure data must be retained for 30 years. MSDSs are identified as exposure records. Considering that many chemicals not initially recognized as hazardous are eventually found to be so, it is not a bad idea to keep all the MSDSs. Also, sometimes certain populations are found to react badly to "nonhazardous" chemicals, or to hazardous chemicals at exposure levels far below those that harm most other people.

- MSDSs for consumer products are not required if used only for the intended purpose and for the expected duration. If bathroom cleaners are used to clean the bathrooms daily, no problem. If it turns out that one brand of bathroom cleaner solves some problem and an employer is buying it in 55-gallon drums for constant use, then MSDSs must be obtained and retained.
- Must MSDSs be produced when catastrophes happen? Not under HCS, as access is required only under "normal conditions" or in the event of foreseeable emergencies. OSHA does not expect people to foresee major fires, earthquakes, or other catastrophes, such as planes flying into the facility. However, EPA's SARA Title III does require that at least local emergency responders have a list of chemical stocks, and preferably the MSDSs themselves. With modern computers this need not be an onerous requirement.
- There are many ways to get MSDSs, including by fax, e-mail, database access, and hardcopy. However, manufacturers cannot require customers to, for instance, buy the latest computer and software, which is the only way they can access the manufacturer's shiny new database. If the MSDSs are needed in some other format, the manufacturer must supply it.
- If a company chooses to add or substitute its name and remove the manufacturer's name from the MSDS or product label, the company can do so. There may be copyright issues, though. Buying two chemicals from two different manufacturers and combining them along with some other stuff into a new product makes it mandatory to change the name to a new brand and write a new MSDS. But it better be right, because the manufacturer is now the responsible party if there are any deficiencies or errors on the MSDS or labels.
- What if the chemical in question is a drug? The manufacturer needs to evaluate the hazard level, and if the level is of concern, safety professionals need to maintain the MSDS, with one exception: if the drug is a solid and packaged for direct administration to the patient.

How Should Employee Access to the MSDS Collection Be Arranged?

In the good old days, the MSDSs were in a binder (or two, or three, or a dozen, or more), arranged in alphabetical order, and put in the safety office or some central location where they gathered dust. Some intrepid souls tried putting them on microfiche to save space, but if the power was out when someone needed to access them, the person was out of luck, unless he or she had very good eyesight. Every now and then, when someone thought of it, the MSDS would be updated, certainly every decade or so. The EHS professionals would try to remember to remind Purchasing to request the company in question for the MSDSs and get them to the safety professionals, but such intentions mostly got buried in the urgent business of the day. Then the safety office was locked as everyone went home for the day and nobody would be able to get to them or remember where they were kept, unless someone stuck around for some reason. If the dust did not get too thick because someone actually looked at the MSDSs occasionally, pages went missing, got ripped, and got coffee stains on them, rendering parts of them illegible. And, of course, the one that was urgently needed was either missing or completely out of date because there was no system in place to ensure the collection woud be complete and current.

This scenario might be why OSHA instituted the MSDS access requirements for the HCS. Such mismanagement was not acceptable then, and similar mismanagement of MSDSs today can lead to serious citations. The paper-binder method of access remains an option. If there are relatively few chemicals and the work site is small, with only one shift, that method is a very reasonable solution. Of course, that is not often the case!

Establish a system that provides

- access to all MSDSs by all employees at all times
- the ability to access and send information to places such as fire departments and emergency rooms in minutes
- a plan that keeps all MSDSs current
- a way to ensure that MSDSs are accurate and complete

Luckily, this burden is not one OSHA can issue citations for; nevertheless, everyone needs accurate information for obvious reasons.

If this sort of record keeping sounds complicated, it is, and a perfect job for a computer. Indeed, electronic access is the only reasonable solution for workplaces with large chemical inventories, multiple shifts and languages, and lots of square footage. There was some confusion as to whether some form of electronic access met OSHA requirements, but OSHA regulation 29 CFR 1910.1200(g) permits alternatives to paper copies as long as there are no barriers to immediate employee access (Galt 2003). Keep in mind that local jurisdictions, which may require access to a company's MSDSs, may still require paper copies on site (Hoffman 2003). Check with them to see what they require and whether a planned electronic-access system will be acceptable to them.

There are many ways to electronically access MSDSs:

- fax on demand
- Web sites
- CD-ROM
- e-mail

Each of these has its strengths and weaknesses. With the fax-on-demand service, which requires a subscription, the only equipment required are a telephone and a fax machine, or a computer equipped with fax capabilities. Making the system accessible for employees requires only that the service number be on each telephone and that there is a way to get the fax with reasonable ease. In a large facility, a single fax machine per building or department might be enough, or one in each room might be required. Telephones should be much closer to employees than the fax machine. The fax service is responsible for keeping the data sheets current and may have professionals who can answer questions medical personnel might have for treating exposed employees.

Web sites and CD-ROMs require computer access (and subscriptions), with all the potential issues involved. The right machines, printers, and software must be selected, and all employees must know how to use them. There are many vendors of MSDS electronic access to select from. Weadock points out, "the trick is finding one that does not create more work or require an extensive orientation to operate" (Weadock 2003).

Here are some factors to consider in selecting a vendor for electronic MSDSs:

- How easy is it for the average employee who may only have occasion to use this system once a year to learn and retain?
- How easy is it to actually find the information needed? What if only a trade name is available, or an internal number, or just the CAS number? What if the person looking cannot quite remember how to spell the darned thing?
- Can it be found by location on the site?
- Can the user know when the MSDS was last revised?
- How often is the subscription database updated? Monthly? Weekly? Daily?
- How can the MSDS be transmitted? Can it be e-mailed, printed, and saved to create an internal MSDS database?
- Does it provide a reasonably complete ingredient list of the product (within trade-secret limitations)?

- Is there a link to click on to get the same information in simplified form, or in another language?
- What is the procedure if the subscription database does not have an MSDS requirement? Can one be ordered, and if so, can the status of the request be determined?
- Is there a number to call to get questions answered? How about faxed information? How many calls are included in the subscription, and what happens if it is necessary to go over the allotted number of calls?
- Is there a way for disabled employees to access the information? Can a deaf employee use the TTY to call? Can a visually impaired employee get a large-type printout or magnify the image on screen?
- What happens if the computers crash, or the electricity goes out? Can the binders be dusted off, or is there some provision for other access to the MSDSs? One solution might be to ensure that someone off site can access the subscription service, so if the power is out in one location, the information can be transmitted by telephone, if nothing else.
- What happens if the electronic information supplier's computers go down? Do they have a viable back-up system?

When selecting an electronic MSDS vendor, be sure that the information can be readily accessed no matter what else is going on. Safety professionals need to be confident that their provider will be able to give the most up-to-date information when needed, in whatever language that may be required.

Labeling Issues

How hard can it be to make a label? Surprisingly, it can be quite a challenge according to Ernst (2003), who explained the general requirements. Labels cannot conflict with the requirements of the Hazardous Materials Transportation Act (49 U.S.C. 1801 et seq.) and with OSHA requirements in 29 CFR Subpart Z. There might also be potential DOT and EPA labeling requirements to be aware of.

In 1910.1200, OSHA requires that hazardous material containers be "labeled, tagged or marked" with the identity of the hazardous chemical, directions for recommended use, and information on handling and storage. The requirement also calls for appropriate hazard warnings or words, pictures, symbols, or a combination of these, to provide information regarding the hazards of the material in the container and the name and address of the manufacturer. There is a labeling exemption for when employees take some of the material in a portable container that will be used *immediately* without being passed on to another worker. While this may be legal, it is not necessarily very smart. Should an emergency occur during the shift, it may be necessary for someone else to know what the material is, and it is generally a bad idea to let someone change his or her safety behavior for specific occasions.

Employers cannot remove or deface labels on incoming containers unless they are immediately relabeled. Burns and Beckel suggest keeping a supply of duplicate labels near the containers so that employees who spot a problem can immediately apply a clean, legible label (Burns and Beckel 2001). A similar approach to applying labels to transfer containers would keep employees from developing two different labeling procedures and doing the wrong thing at the wrong time.

None of this happens without planning, though. James E. Roughton (2002), M.S., C.S.P., a safety professional for Safety Management Systems, recommends the following:

- designating specific individual(s) responsible
- describing the labeling system used
- describing written alternatives to labeling the containers
- creating procedures to review and update labeling information when necessary

Even though all this sounds straightforward, the nuts and bolts of exactly what needs to be on the label is not. The list of colors, symbols, and pictograms that are mandated vary according to country, and there is little information on how effective these colors and symbols are in conveying crucial information. Concerns about these and other issues were addressed in

the Report of the Hazard Communication Workgroup to the National Advisory Committee on Occupational Safety and Health (NACOSH) from 1996 (NACOSH 1996). Two specific concerns with graphics and color coding could arise. Aside from the different standards for graphics and symbols in different countries, one symbol study by the National Bureau of Standards for the National Institute of Occupational Safety and Health (NIOSH) in 1982 (Publication Report No. NBSIR 82-4285) found that several widely used symbols, some mandated by DOT, had a relatively poor performance. A similar study in 1986 found that only four hazards were recognized by the symbols used, and not all symbols for the same hazard were understood. The hazards studied were toxicity, corrosivity, oxidation, flammability, sensitization, explosivity, reactivity, and irritation. The take-home message for safety professionals is that it is necessary to train people on the meaning of these symbols.

Fortunately, the GHS simplifies both training and actual label-making. Symbols, signal words, and hazard-statement words are all specified, so only one version needs to be trained for or used.

Color coding is a good idea and generally effective, but it only works if the individual can perceive the color. Color alone is not sufficient; a symbol must be included, or words, or both. When considering the additional complications of literacy and languages, labeling issues, and global-harmonizing issues, it is clear that those responsible need to stay on top of the new requirements being developed. There may well be future changes down the road, but with the dust settling on the GHS, things should be fairly calm in the next few years. After all, the GHS was first proposed in 1992 and even OSHA has not yet finished adopting it as of the publication of this Handbook.

In the meantime, the ANSI Z535, 2002 standard on effective warnings provides specific guidelines for setting up signs and labels (Cheatham, Shaver, and Woglater 2003). It suggests specific colors, backgrounds, and words as follows:

- ***Format:*** large enough to be seen; text left-justified; messages oriented to read left to right; and the most information put on top
- ***Wording:*** avoid unnecessary words; use short sentences; be explicit with instructions; use short, familiar words; avoid jargon and abbreviations unless users are trained to recognize them; use bulleted lists; use active voice rather than passive voice; use concrete words; and avoid ambiguity
- ***Signal words:*** danger = immediate hazard that will cause death or serious injuries; warning = potentially hazardous situation that may cause death or serious injuries; caution = potentially hazardous situation that may result in minor or moderate injury
- ***Pictorials:*** use only tested symbols
- ***Color:*** Red panel should be used with "Danger." Orange goes with "Warning," and yellow with "Caution." If human injury is a concern, use an alert or signal icon, which is a triangle surrounding an exclamation point in the panel. There is software that will let safety professionals print their own signs and labels quickly, economically, and in compliance with most regulations. Put safety instructions in green with white lettering (Wagshol 2003).

The ANSI Z535 series of standards have been updated, different sections in 2006, 2007, and 2008 (ANSI 2006–2008). It is reasonable to assume that the committee responsible for these standards will be revised to incorporate the GHS provisions in the future, so safety professionals need to make sure that they are meeting the future requirements.

Do not forget the National Fire Prevention Association signs (Wagshol 2004). The familiar blue/red/yellow/white signs with the numbers 0–4 in the first three, and assorted letters clarifying the exact hazard in the white are lifesavers for employees and fire fighters. Blue means health hazard, red represents fire hazard, yellow stands for reactivity or instability, and white reflects a specific hazard, such as an oxidizer. The higher the number, the more severe the hazard.

One can assume that the NFPA standards will be aligned with the GHS as well. Dr. David Michaels, the Assistant Secretary for OSHA, indicated that he

and NFPA President Jim Shannon can collaborate on formal feedback on each other's standards development. ("We're in the business of protecting working people" 2010.) That suggests that safety professionals can look for a similar alignment of NFPA standards with the GHS where applicable.

Safety professionals in charge of developing pictorial symbols should check out the Wolf and Wolgarter paper from Human Factors (Wolff and Wolgarter 1998). Where the GHS do *not* apply, these considerations should be applied. They detail research-evaluating methods for testing comprehension of pictorial symbols, and look at context and test methods. In this case, *context* means the presence or absence of photographs depicting the probable environments where the symbol would be seen. This is not a task to be approached casually. ANSI's Z535.3 (1991) and the Organization for International Standardization's ISO 3864 (1984) advises that symbols must be, respectively, at least 85 percent or 67 percent correctly recognized by users ("reach a criterion of").

Warnings are important, but they often fail. Even with the best warnings, with symbols and pictorials understood by 100 percent of employees, people will not go against their innate predisposition to use the easy way of doing things just because a sign warns against something (Green 2004b). The workplace needs to be engineered for maximum safety.

It is also important that safety professionals be aware of some of the many reasons why warnings will fail. Some decisions that potential sign readers make are mentioned by Marc Green, a cognitive psychologist who consults on accidents and safety. People see a sign and ask themselves the following questions:

- Should I invest the effort to read the warning? Mental costs are calculated, and if the font is too small and difficult to read, or it has low contrast or too little white space, or if it is too long or in all capitals, then some will decide that the effort is not worth it and ignore the written warning.
- How risky do things actually appear? If direct observation reveals obvious hazards, such as open flames, sharp edges, moving mechanical parts, etc., then the observer is more likely to read the warning. But if the observer does not see anything obvious, then the person probably will not read the warning. This is counterproductive, as posted signs are more often about the hidden hazards than the obvious ones.
- Will compliance with the warning hinder the easy attainment of my goal? If so, is the gain in safety worth the hindrance? The user will consider if there is an alternative means for reaching the goal. The easier the alternative, the more likely the user is to use it. This is all a matter of perception, but it is also a valuable tool for increasing compliance. For instance, Green cites a library with "do not use cell phone" signs all over, but on each floor they have a small room into which a phone user can step. If the person had to leave the building to make a call, compliance would probably be much less likely. Make the safety connection. For instance, if people need to wear safety glasses before entering an area, put a box of them under the sign telling them to put the glasses on.
- Is there any risk? Many people simply fail to perceive the risk that is present, and if they have done something unsafely repeatedly and gotten away with it, they will disregard warnings.
- Is the risk immediate? If it is not, the likelihood of compliance with warnings plummets. Green cites the example of the warnings for health consequences of cigarette smoking. As syndicated humorist Dave Barry suggested, cigarette smoking would likely end overnight if the package warnings read "WARNING: cigarettes contain fat!" (Barry 2007).
- Are there too many warnings around here? The more warnings for low-probability events, the less likely people are to heed any of them.
- Some people may decide that they can "control" the risk. For instance, someone might dive in a no-diving area under the illusion that they can do a shallow dive and avoid the hazard.

- People use *cognitive shortcuts* that affect decision making and lead to erroneous decisions. People will seek out *confirmation bias* and look for information that confirms their preconceived belief and avoid contrary evidence. If the person decides there is little risk, the person will ignore warnings.
- Adaptation leads to the literal inability to perceive the signs. They can focus on the task and see nothing around them, actually look at a sign but fail to see it, and/or start reacting automatically to situations and quit seeing things around them to varying degrees.
- For a really effective sign program, and to maximize the impact of signs, working with the way people really are is the place to begin. Certainly, changing signs periodically is a good starting place, and consulting experts to help maximize the program could be a good investment.

International Issues

Global Harmonization System

Rare is the workplace whose chemicals come entirely from U.S. manufacturers who sell only to local markets. For everyone else, this can be a big headache. The United States is not the only country requiring MSDSs, and any manufacturer in any country with an international market has difficulties with the different requirements of different countries. The logical solution is for the stakeholders to come together and develop a single worldwide standard.

This logic was recognized long ago, and the United States and many other countries have endeavored to reach some consensus on a globally harmonized system for the classification and labeling of chemicals since 1992 (Markiewicz 2003c). In 2002, the United Nations adopted the GHS. Now available for worldwide implementation, the goal was for the system to be fully operational by 2008. ("MSDS Global Harmonization Legislation Planned" 2004). While that goal has not been met, imminent adoption of the GHS is coming, and SHE professionals need to plan on it becoming the worldwide standard.

The United States is not alone in adopting and adapting the GHS into their regulations. Canada and Mexico are working diligently to do so—and apparently so is the rest of the world. The North American Free Trade Act (NAFTA) is putting pressure on the United States, Canada, and Mexico to adopt the guidelines. Other countries are using the GHS because of international trade and the United Nations' adoption of it. This will affect every safety professional to some degree.

REACH

GHS is not the only international issue of concern for looking at best practices in hazard communications. The U.S. EPA and the European governments lack basic safety data on more than 85 percent of chemicals in commerce, which is a concern to both the United States and the European Union (Working Group on Community Right-to-Know 2007). The European Commission is taking a new approach called REACH (Registration, Evaluation, and Authorization of Chemicals), which will require the chemical industry to prove that chemicals are safe before they can be used or marketed, regardless of how long they have been in use.

- ***Registration*** will require manufacturers and importers to present basic data on the health and environmental hazards of the chemicals.
- ***Evaluation*** will require European Union member countries to assess the chemicals against basic safety standards.
- ***Authorization*** will require that chemicals failing to meet basic safety not be used unless specifically authorized.
- ***Chemical safety*** must be proven before a chemical or product can be marketed—no data, no marketing.

These data will be invaluable in selecting chemicals for continued use, and in refining further understanding of any necessary precautions once they are available.

Luckily, the standardized sixteen-section format for the GHS safety data sheets is very similar to the ANSI Z4001-2004 MSDS standard. Two headings are

reversed as the sole change. As OSHA has not mandated the ANSI form, when the United States adopts the GHS, there should be little logistical difficulty (OSHA 2004b).

However, there will be some problems that the International Chemical Safety Card (ICSC), the equivalent of the MSDS, will pose because of reproductive hazard listings (Markiewicz 2003c). In the United States there are strict legal prohibitions against treating pregnant employees in a discriminatory fashion, but the ICSCs emphasize the reproductive hazards and use the words "unborn child" in the warnings. The final upshot was that the GHS kept this terminology, however unpopular it is in the United States (Markiewicz 2009).

The other problem is that the ICSCs use as exposure limits the MAK, which are used in Germany and several other countries (Markiewicz 2003c). This is on top of the other exposure standards.Threshold-limit data are used worldwide, from Great Britain (MEL), France (FR-VLE and FR-VME), Germany (MAK), Japan (JP-OEL), Sweden (SE-STEL), and the United States (TLVs) (Ovid.com 2010). It is possible that all exposure-limit systems may need to be used in MSDSs, or a reconciliation of all the systems can become another great global standardization task.

Another consideration is that, due to genetic differences, different populations may actually require different exposure levels. This is quite challenging, since people from different parts of the world do not stay home. Safety professionals, particularly toxicologists, need to team up with geneticists and learn to identify the genes associated with heightened susceptibility to specific chemicals. Once this is done, and people are properly tested, there can be much more confidence that the exposure limits are actually providing the safety employees need. There is much more work to be done with global understanding and standardization for all safety professionals.

The REACH legislation applies only to chemicals made in quantities greater than one ton per year, which have "proven or suspected hazardous properties" (Durodié 2003). Writers for the Society for Risk Analysis have raised some valid concerns.

- What logistical resources are needed to do this?

While the costs to industry were not addressed in this particular paper, British researchers commissioned by the UK government pointed out that some 30,000 substances are covered and required to be tested by 2012. If, as expected, the number of chemicals with "suspected hazardous properties" grows dramatically, the problem will be worse. This is not logistically feasible, as there are only sixteen contract research organizations within the EU able and willing to do the testing. Furthermore, the number of graduate chemists is falling. The report cited by Durodié suggests that if the legislation were narrowed to the 10,000 chemicals produced in quantities greater than 10 tons per year, testing could be completed by 2017. While the United States has more testing facilities and chemists, it will doubtless have proportionally more chemicals to be tested as well should this idea spread.

Then there is the matter of the sheer number of animals needed for the testing, which is estimated to be 45.8 million rodents and 4.4 million fish. Since 1981, testing for all new substances and those older ones on the priority list required only about 870,000 vertebrates. This report does not mention the need to deal with the animal rights organizations that would doubtless become very loudly involved.

Financially, the initial testing is estimated to be 8.7 billion Euro. This does not include verification and reporting. The real question here is whether this animal testing will reveal anything that is not already known. Consider that most of these chemicals have been in use for a quarter-century or more and have been consumed or used for billions of hours by humans. The science of epidemiology has become very sophisticated, and it stands to reason that if there was a large amount of damage to human health, it would have become very apparent by now. The bottom line is that our life expectancy has increased dramatically, which would not be the expected result if the entire population was showered with large amounts of toxins daily. One of the expressed concerns is toxicity due to endocrine disruption, which is not tested for in the proposed program. Data are

showing increasing numbers of young people reaching puberty at younger and younger ages, but this development can easily be explained by the improvement in nutrition of the present generation over that of previous ones. It is possible that environmental chemicals that interfere with or enhance this process may even be beneficial. Clearly, this will neither be easy nor inexpensive to research, and the matter has not even been addressed by the current legislation (Durodié 2003):

- Is REACH going to benefit society?

What happens if people are given hazard information that ends up labeling contact-lens solution and toothpaste as *explosive* because the products include small concentrations of hydrogen peroxide? In this author's opinion, generally speaking, nothing good can come of it. As it is, people are sometimes literally "worried sick" about very tiny risks, and society has a poor grasp of the effects of the psychosocial environment on physical and mental health. This opinion is supported by a great deal of research on the effects of warnings. There is the problem of "crying wolf," which leads people to disregard warnings of such things as potential tsunamis. Thousands of Japanese ignored evacuation orders after a massive earthquake ("'Cry Wolf' effect" 2007). One town, Kushiro, had just 0.25 percent of its 13,400 coastal residents report to evacuation centers. Apparently, the rest stayed home and monitored the situation on TV, which is clearly a recipe for disaster, given the rapidity and catastrophic consequences of these giant waves.

Human-factors research also consistently finds that warnings are often ineffective in changing people's behavior. There are a variety of reasons for this, but it boils down to the fact that people are not rational, logical animals. As was pointed out earlier in this chapter, they figure out the cost of obeying versus the benefit of ignoring the warning, have a very poor grasp of statistics, think they have more control over a situation than they do, and quit seeing the warnings in short order (Green 2004a, b). The bottom line for the average person is that warnings are common, while accidents are rare. Most people go through life bombarded by warnings but have few major accidents (Green 2004b).

Also, consider the level of education of the average person, which seems to be trending downward in the United States, particularly with respect to science education. Furthermore, most of those responsible for bringing the news to the general public have a poor understanding of science, leading to even more distortion of risk and hazard information. The difference between correlation and causation seems to be a particularly difficult concept for both the news media and the average person to grasp, a concept that is absolutely crucial for making educated decisions.

Finally, putting resources into tests of doubtful significance could mean they will not be available to tackle real and known risks and problems. This safety professional believes that it is inevitable that the REACH program will be proposed in some form for the United States, and all safety professionals should consider lending their considerable expertise to the debate to follow.

The manufacturers' costs of the REACH program are huge. In 2008, new fees were established for the registration process. "The basic registration fee will range from 1600 for substances produced in volumes below ten tonnes to 31000 for those above 1000 tonnes. Joint registration charges are somewhat less, from 1200 for substances produced in volumes below ten tonnes to 23250 for those above 1000 tonnes. SMEs' fees are further reduced, depending upon whether the company is 'small,' 'medium,' or 'micro-sized' and whether it notifies alone or jointly with other similarly-sized companies." (New REACH fees expensive, 2008). These fees are actually lower for non-EU companies, but the economic impact will be substantial.

It would be reasonable for safety professionals to anticipate disruption in supplies down the road, as some companies decide it is too expensive to sell to and through the EU. Other companies will make substitutions to reduce costs, which will be another concern for safety professionals.

Control Banding

Rather than controlling employee exposures chemical by chemical, control banding is designed so that people with less expertise in toxicology and industrial hygiene are able to make better decisions about how and how much to prevent employee exposure to chemicals (Jackson 2002). Developed in the United Kingdom and adopted by some European countries, the *R phrases* (risk phrases), which describe the most important hazards of a chemical that must be assigned to potentially harmful chemicals by the manufacturer of the chemical in Europe are used to determine control measures. The user finds the R phrases for the chemical using the label or MSDS supplied by the chemical supplier and looks for the R phrases in the list of hazard groups. Exposure potential is then assessed, taking into consideration the quantity and the dustiness/volatility. Considering both hazard level and exposure potential, a simple table suggests either control measures or that the users consult an expert. The controls are described in control guidance sheets, which comprise both general information and, for commonly performed tasks, more specific advice. The options, aside from consulting an expert, include "Employ good industrial hygiene practice," "Use local exhaust ventilation," and "Enclose the process."

One problem is that users may not always know when they need to consult an expert. The ASSE testimony in the Enzi hearing commented that "[s]ome chemicals, though included in certain bands, may cause reactions outside the norm of the band and require unique responses that banding simply will not address. Care must be taken to ensure that control banding is used with this kind of warning always in mind" (ASSE 2004). Another problem is that OSHA's permissible exposure limits (PELs) are not incorporated into the European scheme. Should this be incorporated into U.S. regulations, that would need to be remedied. It also appears that idiosyncratic reactions between chemicals are also not considered.

Control banding is one effective tool for those individuals with little education to understand the risks of the chemicals and processes they work with. The ASSE Board of Directors, in a position statement adopted in 2005, stated (ASSE 2005):

> It is suggested that, as OSHA and MSHA proceed, work should be initiated to revise the HazCom Standard to incorporate the model of Control Banding. One key element currently excluded in the Control Banding models is the issue of physical hazards such as flammability. The agencies should investigate and propose a model to incorporate this information.

In January 2005, an article by Paul Oldershaw stated that control banding has an important place in this world (Oldershaw 2005).

According to Oldershaw, some experts do not like control banding because they see it as an attempt to carry out a risk analysis without the necessary expertise. This is incorrect, as the process defaults to directing the user to seek expert advice. Others see it as not how toxicology should be carried out. Control banding builds on much of the same information for limit-setting and chemical classification. And "[o]thers say it is an 'interesting idea, but couldn't work here,' while still others see control banding as cutting across legal duties linked to compliance with exposure limits.

Yet, Oldershaw concludes, "If this position, frozen by tradition or law, prevails then we will never be effective in addressing the risks to many workers, in most of the world, who have no access to the skills and resources to turn exposure limits into effective control" (Oldershaw 2005).

There is little evidence that much progress has been made in implementing control banding since then, certainly not in the United States. Safety professionals may be under the impression that U.S. employers have the resources to educate/train employees and do not need control banding. This is a flawed assumption. Small businesses may have MSDSs available, but owners seldom understand them and certainly cannot train their employees. Nor do they generally hire safety professionals on a consulting basis to fill in their personal knowledge gaps. The United States is also full of employees for whom English is not a first language, or who have poor literacy skills, or who are simply too busy with other things in their lives to acquire the expertise they need.

Organizations Working to Unify and Simplify Regulation Compliance

Life for chemical companies became more difficult with increasing sales to international customers. The regulations for any one product depends on the point of sale rather than origination, and hazard communication information needs to be in more and more local languages. As the increasing complexity of the hazard communication challenges becomes apparent, at least one organization has been formed to deal with the confusion of differing regulations (Harries and Baker 2004). Worldwide Environmental Regulatory and Compliance Solutions (WERCS) came into being in 1984 with the aim of providing software tools and services to automate the authoring, distribution, and management of MSDS and other hazard communication documents. This is no small challenge, as it involves some 1500 sets of regulations worldwide and no fewer than 4500 information phrases in over 40 languages.

Currently based in New York City, WERCS now has an office in Belgium, and is partnering with a UK-based company, MAP80, which is a market-leading software developer. The new company is called Prisym Chemica.

Health Canada, OSHA, the American Society of Safety Engineers (ASSE), the National Safety Council (NSC), the Society for Chemical Hazard Communication (SCHC), and the American Chemical Society (ACS) are among the many organizations that are helping members to comply with the new international regulations. Safety professionals with questions do not have to look far to find them.

If any person or organization has a particular stake in the outcome of the reconciliation of the assorted regulations, they should definitely get involved with an organization working on the many issues.

MSDS Training Materials

A cursory search showed a dearth of books on the subject. However, there is a great deal of software and interactive Web-based training materials available, each with its own strengths and weaknesses. Safety professionals need to carefully evaluate their choice based on the information in the next section of this chapter on effective training as well as in other appropriate chapters of this Handbook.

Training Issues and Techniques

What Is Really Going On?

A lovely, refined, middle-aged woman, a native of the Philippines, learned English as her second language. One day at a party, she was struggling to use the line "Let me live in the house by the side of the road and be a friend to man" that comes from the Sam Walters Foss poem, "The House by the Side of the Road."

She mentally plugged in a literal translation of the words and said she would like to "live in the house by the side of the road and be friendly to men." It was an accurate translation by dictionary definition, but did not convey the meaning found in the poem. Similarly, because the thesaurus lists the words "training," "instruction," and "education" as being roughly equivalent, one could easily confuse the three and commit an equivalent faux pas in hazcom training programs.

Education is a long-term process, dependent on the life experiences of the trainee (Tapp 2004). Most people go through life doing unsafe things and having nothing untoward happen. Safety professionals need to continue training and try to overcome the difficult burden of good luck.

Instruction teaches the learner not just the "what" but the "why" and "how," points out that employees not only need to be taught how to lift safely, but how to apply that information to their actual job and in unusual situations (Tapp 2004).

Training is what is done when the goal is to get an employee to do something specific, such as drive or operate a machine. However, the ultimate goal is to create a change so that the learner continually does what the trainer wants him or her to do. Besides knowing how to read an MSDS, safety professionals also need trainees to read and heed them on a regular basis. People should practice as well as train successfully.

While OSHA only requires *training*, safety professionals need to remember to use instruction and education as well. This requires frequent reinforcement, successive training sessions, and overcoming good luck.

Markiewicz addressed the issue of whether training is actually the solution to the problem (Markiewicz 2003a). While in this case OSHA mandates training, it is important to look beyond the regulatory requirements and analyze whether the training will *fix* the safety hazards. Markiewicz uses the example of a request by a plant manager to *train* the employees to use the bonding strap when filling transfer containers with flammable fluids. The safety professional needs to look deeper and ask questions. Can the hazard be eliminated by substituting a nonflammable fluid? If bonding straps are required, who is responsible for maintaining them? Is anyone? Is there a procedure for this? Is there accountability for failure to do so? How does the entire system work? Are all the related issues covered?

With MSDS training, it is important to start at the top, questioning the need for the hazardous materials and identifying their handling and disposal processes as well as their use. When the entire system has been addressed, then it is time to work on the mandated training.

Planning the Training Content

While some specifics are mandated, dig deeper. The following are some questions to ask (Lewis 2003):

- What is needed? Who needs to be trained and what do they need to know? How will a "successful performance" be defined? Under what conditions will the trainees have to work? Are there different populations that will need different approaches and materials?
- What are the characteristics of the trainees? How much experience do they have? Are they literate? Is English their first language? Do they have disabilities?
- What constraints are there? What is the deadline? Must training be done in relays or can everyone go at once? Are there different locations? What training resources and equipment is available?

Define the Objectives

Anne Lewis, a developer of safety training materials, lists five to consider:

- ***Terminal Objectives:*** what the trainee needs to be able to demonstrate at the end
- ***Critical Objectives:*** things that the trainee absolutely, positively needs to master or risk causing injury to people or property
- ***General Objectives:*** things that the trainee needs to know to avoid causing operational interruptions
- ***Minor Objectives:*** things that are not critical to safety, property, or operations but are good to know
- ***Enabling Objectives:*** objectives within a set of objectives that support the attainment of the terminal goals. As everyone has time constraints, it is important to prioritize; hence, the minor objectives should be at the bottom of the pile.

How does all of this apply to hazcom training? Luckily, safety professionals do not have to reinvent the wheel because OSHA has published its "Draft Model Training Program for Hazard Communication" (OSHA 2004a). Most things need to be adapted for specific circumstances, but this is a good template to begin with.

Look beyond the training mandates for hazcom, others apply, and there may be some overlap in requirements (McKinnon 2003). McKinnon suggests that all the training needs be analyzed and combined into an integrated whole. If respirator training is on the list, perhaps it can be part of the hazcom training, for example. Or perhaps confined space training can be combined with the hazcom training for the chemicals in question.

McKinnon also says it is important to ensure that the trainers be competent and prepared for all segments of the training. It may require a team training approach.

As a final step in planning a training program, a decision should be made between teaching the haz-

ards of each chemical, or hazard-category training (Sapper 2002). Sapper points out that it is not legally necessary to train employees on every single individual chemical. It is not practical to train employees in each of hundreds or thousands of different chemicals, if that many are present.

Despite this, some OSHA compliance officers have given citations based on the assumption that the requirement is for chemical-specific training. The source of the confusion lies in paragraph (h)(3) of the *Hazcom Standard*, which states that the training must include "[t]he physical and health hazards of the chemicals in the work area," the "measures employees can take to protect themselves from these hazards," and "the [m]ethods and observations that may be used to detect the presence or release of a hazardous chemical." What they miss is paragraph (h)(1), which states that "Information and training may be designed to cover categories of hazards (e.g., flammability, carcinogenicity) or specific chemicals. Chemical-specific information must always be available through labels and material safety data sheets." Even in 1983 the preamble to the original version of the training provision also stated that the option of training by categories of hazards was always available.

The 1994 amendment should keep OSHA compliance officers from issuing erroneous citations, but confusion remains as a result of some decisions made by the Occupational Safety and Health Review Commission on cases that occurred before 1994. In addition, OSHA compliance directives and training materials that are at odds with the plain language of the regulations have been issued, much to the consternation of employers. In a hotly disputed case, *Secretary of Labor v. Cagle's, Inc.*, OSHRC Docket No. 98-485, which attracted many *amici curiae* briefs supporting Cagle's, Inc., the seven-member OSHRC unanimously decided in 2006 that chemical-category training complies with the OSHA requirements (Sapper 2006).

Planning the Training Methods

There are a variety of options for training employees to read MSDSs. There is the old standby, classroom training, which is rapidly falling into disfavor as new technologies are developed. Videos are also popular, and there is the newer computer-based training using either CDs or the Web. Which is best? All of them! Just not necessarily for everyone. How to decide? Look at the trainees and their issues.

Trainee Characteristics to Consider

Language Issues

Perhaps the most important characteristic is the native language of the trainees. If it is not English, which is the language most MSDSs are in, there is a twofold problem. First, safety professionals in the United States still usually attempt to train in English, the language that such trainees will understand to varying degrees. Second, the content of the information is such that they literally may not be able to understand it even if it were presented in their native language. The obvious solution is to get the MSDSs in their native language, which is quite easy. A fast Internet search of "MSDS translation" turned up 94,500 hits, with at least two dozen companies that offer the service. Now comes the problem of selecting the vendor. It is best to hire a consultant fluent in both languages, and, ideally, also familiar with the technical terms used in MSDSs to evaluate the quality of the translation. It would also be a good idea to hire someone fluent in both languages to actually do the training.

One such service is LanguageLine Services, www.languageline.com (Schierhorn 2002). Using a speakerphone, the supervisor explains to the translator what she needs the employee to understand, and after that translation is complete, she has the translator ask the worker to repeat what was said. She stresses the importance of confirming employee understanding, whether the training is done in person or by telephone. Besides simply having the employee verbally repeat, she has the employee actually demonstrate his or her understanding of working with chemicals. Along with safety manuals, safety signage and labels need translation as well.

Luckily there are more and more paper and online bilingual resource materials, particularly in Spanish. OSHA has a Web page, www.osha.gov, and a toll-free number that links employees to Spanish-speaking

OSHA officials; the site also has a Spanish version of the OSHA 10-Hour Construction Outreach course, among others.

Of course, Spanish is not the only language found in the U.S. workplace. Here are the top ten foreign languages spoken by U.S. residents over five years old (Tompkins 1996):

- Spanish
- French
- German
- Italian
- Chinese (which has many dialects)
- Tagalog (Filipino)
- Polish
- Korean
- Vietnamese
- Portuguese

Although it is important to use bilingual training materials, keep in mind that translated materials are often scaled-down versions of the English materials. The New York State Health Department has reduced MSDS information to generic terms in the employee's native language, and it provides the sheets in both English and Spanish. Neville C. Tompkins (1996), safety and health consultant and trainer in Cedar Run, New Jersey, has some additional suggestions to maximize understanding:

- Use line drawings, sketches, and photos to emphasize key points.
- Use examples with videos or photos taken on the job.
- Use real-life examples or accidents at the trainees' workplace.
- Include safety signs and symbols with the training presentation.
- Use non-English teaching materials with minimal technical jargon and matching key English words side-by-side with the translated word.
- Put English words on the left-hand side of the page and the second language on the right, so workers can quickly spot the corresponding English word.
- Use native-speaking "buddies" to reinforce training.
- Use trainers who are fluent in the trainee's native language. A safety trainer with the Labor Occupational Health Program at the University of California, Berkeley, advises against using simultaneous translations, as it is slower and reduces interaction with trainees.

Weissman (2003) has some additional suggestions:

- Speak slowly, not loudly. Repeat important points using different words. Make sure the trainer can understand the questions from trainees with heavy accents before they answer them.
- Use simple language, avoiding acronyms, jargon, and slang.
- Demonstrate, do not just tell. Consider using one skilled employee to demonstrate during the explanation period.
- Use props. This livens up the presentation and makes difficult concepts clear. For example, Weissman uses balloons and cookies to illustrate the difference between inhaling and ingesting.
- Encourage class participation. Have class members pair up and practice what was taught, and ask leading questions of observing employees who might not want to speak up and comment on errors. For instance, if the exercise is putting on respirators and one of the pair does not put his straps on properly, ask the other "How should he have put that on?" This will show whether they have understood the exercise even if they do not speak up.
- Use pictures and diagrams.
- Give handouts.
- Make the information relevant to the trainee, both on and off the job. Tell them that hazard communication skills can help them keep their family safe at home, for example.
- Conduct follow-ups a day or two, a week, and a month later. Call, e-mail, or visit and ask them questions. This will not only show whether they have learned and retained the material, but it will also reinforce the idea that what they have learned is important.

Cultural Issues

Language can be the least of the problems (Kalaroa 2004). There can be cultural issues as well. For instance, in some cultures, asking questions in a training class can cause loss of face. Willingness to wear PPE can be derailed by cultural machismo. Asking questions, or, worse, a trainer correcting an error can be a formidable challenge in the Japanese culture. While the easy way out is to refuse to hire someone in the first place, on safety grounds, Nancy Kalaroa, loss-control coordinator for The Protector Group Insurance Agency, Inc. advises against it. Some courts have found language discrimination to be the same as discrimination based on race or national origin. She suggests working with the community in question in a holistic manner, including offering English as a second language (ESL) classes to the employees. Safety professionals need to recognize that language barriers will be a continuing problem as the pool of available English-speaking employees continues to shrink for many types of jobs and locations (Pierce 2003).

Pierce, a safety consultant with more than 30 years of experience, worked with a company that tried the above measures in vain. They found that their undesirable statistics, such as high injury rates—as high as five times the average injury rate for its SIC—failed to go down, and they had increasing quality issues and personnel-relations problems. Pierce decided to see if low English proficiency was really the source of the problem. He concluded that the "fixing the worker" approach of trying to more or less force workers to learn English was a failure. It was definitely time to try something new.

Looking at the entire work environment and the work itself proved to be the key. The workers continued with the ESL classes, but this time with concrete objectives tied to the specific language the employees needed to know for work. Other crucial system strategies designed to reduce the problems at the worker/work interface include the following:

- removing barriers to leadership and information that created confusion, ignorance, and lack of companywide focus
- removing environmental and cultural barriers to good team dynamics
- removing work barriers that make workers unable to be successful in doing the work
- removing individual barriers to worker progress and success

Notice that the last item on the list focuses on the individual. The specifics of implementing these strategies were complicated and are detailed in Pierce's paper. The results: English proficiency went up eight percent, monthly injuries were cut in half, error rates decreased by 15 percent, turnover leveled off, productivity rose 7 percent, and employee-relations issues decreased by half.

While getting employees to look at problem solving from a systems viewpoint was expected to be difficult, that factor proved to be minimal as employees became excited and energized by the process. However, management proved to be the big barrier, as it was difficult to get some of the middle managers to let go of traditional problem-solving techniques, but upper management was committed to the new systems approach and prevailed (Pierce 2003).

Clearly, simply assuming that the problem is language barriers is not the route to safety or business success. Language barriers do need to be addressed, but within a more comprehensive framework.

Literacy Issues

Just because trainees speak English, even fluently, it does not necessarily follow that they read well. Trainees may have issues such as dyslexia or some other learning disability, poor vocabulary, or just poor reading skills. They may also be learners who absorb information best if they hear it as opposed to see it. Some people not only need to see or hear, or both, but they also need to actually handle things to learn. They need to see, hear about, and feel the PPE needed. Actual practice donning the PPE is essential for them. The simple solution here is to offer the information in all the ways that people learn. Using standard techniques for people who do not speak English as their native language will address these issues easily.

True Comprehension of Terms

Unfortunately, hazard communications contain adverbs and adjectives that are *fuzzy* in meaning. In a complicated

CASE STUDY

A Successful Construction Safety Program for Hispanic Workers

The safety training program instituted in 2002 at the Dallas-Fort Worth Airport (DFWA) has proven to be successful in reversing the trend of Hispanic workers' increasing on-the-job death rate (Nash 2004). The urgency of the situation was undeniable; of the 277 Hispanic construction workers killed in 2002, 81 died in Texas, 36 in California, and another 20 in Florida. While the construction fatality rate for all workers has increased by only 1.2 percent since 1997, the increase for Hispanic workers was a frightening 46.9 percent, prompting the Hispanic Contractors Association de Tejas (HCAT) to declare a "state of emergency." Javier Arias, chair of HCAT, declared a special state of emergency for the Dallas-Fort Worth area because more construction fatalities had occurred there since 2000 than in any other metropolitan area.

The DFWA Capital Development Program implemented a special training program for all its employees, but the emphasis was on making sure that each person understood the training so they could apply it on the job. While the safety training program was not the only reason for the success, the program has been very successful. Where the incident rate of total OSHA recordables nationally has been 6.9, at DFW it was 4.2 per 100 full-time workers. The lost-workday case rate at DFW is a mere 0.4, compared with 3.4 nationally. The average cost of a Workers' Compensation claim is more than 15 percent lower than the Texas average.

Perhaps the most important step, said Keith Smith, EHS manager for Dallas-based Austin Commercial, one of the two general contractors for the project, was that they enforce a single, universal safety program for all subcontractors on the site, as Pierce had advised in his first system strategy. This eliminated the problems of confusion, ignorance, and a lack of projectwide focus. This they accomplished via a "wrap-up" insurance program, and they enforced a mandatory 40-hour bilingual safety training program for each and every employee regardless of which contractor they worked for.

Training is conducted in both Spanish and English, using both instructors and curriculum developers who are not only bilingual but also from the culture of the workers, and, preferably, who have also worked in construction. English speakers are taught some crucial, life-saving Spanish terms, such as "peligro" (danger) and "cuidado" (be careful). Training materials include printed material workers can take on the job, too. Workers get cards with Spanish-to-English on one side and English-to-Spanish on the other.

Due to language issues, written tests for comprehension were not an option, so each student was made to demonstrate his or her understanding. For instance, the instructor might demonstrate the proper use of fall-protection equipment, and students must then demonstrate that they can also use it properly in a special classroom "laboratory." A similar approach can be used with hazcom and MSDS training.

The cultural issues are equally important in the outstanding safety record of this project. Arias explained one particular cultural issue that has huge safety implications. "Maybe it's machismo, maybe it's because our fathers told us if you want to help someone you do not say no, or maybe its fear we'll lose our job, but often we do not want to say, 'No.'" More practically, Dean Wingo, OSHA's area director for the Fort Worth office, explained, "If a hammer falls apart, you'll find the Latino has found a way to tape it back together, whereas an American worker will come up to you and say, 'You give me this piece of crap and I can't do my job!'" An important part of the training program is to overcome the cultural aversion to saying "no" and make it clear that they will not get fired for reporting unsafe acts or conditions. To further clarify that it is safe, the airport set up a confidential hotline so workers could report problems safely.

These people do not make the mistake of thinking that all Latino or Hispanic workers share the same cultural customs, either. Javier Maldonado, a manager of field engineers who also took the 40-hour course, pointed out that "Some workers, such as those from Panama, may want to be greeted first instead of just told, 'You are doing something wrong!'" Come to think of it, this is not a bad approach for every employee! A little courtesy goes a long way in any culture.

Similarly, all Oriental workers do not share the same culture. Take the time to learn about the cultures that the employees come from to maximize safety for all of them.

All this training does not come cheaply. They spend about $500 per employee on tuition for the 40-hour OSHA course, plus the wages earned. Nor is it a one-time thing. Using a continuous quality-improvement process, they determine how the training is affecting the workers' safety behavior on the job, and when they identify a weakness, they provide additional training. They also have weekly safety meetings to reinforce the lessons and address emerging job hazards. Pre-task, they communicate in English and Spanish, sometimes in writing.

If safety professionals analyze this program, they will see that it follows Pierce's four systems steps. Since this company went far beyond simply addressing language barriers, that accounts for some of their success.

and lengthy paper, Lehto, House, and Papastavrou (2000) discuss the degree to which people understand the meaning of such phrases as "prolonged exposure, safe, weak, strong, extremely, lightly, poorly or adequate." The purpose of using such fuzzy qualifiers is to convey more information with fewer words, but how much information they actually convey to the readers of MSDSs or other safety information is virtually unknown. One very important issue that needs to be considered is context. "Small shrimp" and "small whale" convey very different visual images, for example.

If providing extensive contextual information on MSDSs were required, it would make content that is already long, even longer, if not far too long for most readers. One question addressed in this paper is whether it is necessary to provide this very bulky contextual information to clarify the meaning of these and similar terms. Luckily, these authors conclude that training and worker knowledge can eliminate the need to provide contextual information. People designing hazcom training programs might find it worthwhile to use this paper to help them clarify the fuzzy terms in their programs.

Disabled Trainees

Another concern is disability among the trainees. This author has spent fifteen years studying disabilities and their impact on safety. She also has personal expertise in several disabilities, including hearing loss. Generally speaking, the older the workers, the more likely it is that they have some disabilities. Successful training will be most impacted by hearing loss. People with serious hearing loss, particularly deaf people, are not the biggest problem, as they know they have a problem and take steps to deal with it. They may not know the best ways to address their hearing loss and maximize understanding in a variety of situations, though. They may still be bluffing and pretending to understand. Post-training testing will assist safety professionals in detecting these problems.

One problem that presents a real challenge is training those people with moderate or mild hearing loss, people who are still in denial about the fact. Since the average person spends seven years that way, this is a significant problem. They pretend to understand when spoken to, and when they finally get hearing aids they often continue to pretend. They seldom know about the strategies and equipment available for maximizing understanding and remain at a serious disadvantage, especially in noisy situations. Providing them with equipment and communication strategies will greatly help increase their comprehension. Clearly, the level of denial of hearing loss shows that the use of *captioned* training materials only should be a minimum requirement when evaluating possibilities. Again, testing is essential to verify that they have heard and understood what was actually said.

There are many other disabilities that can impact the ability of a trainee to learn. Vision impairment, diabetes, heart disease, multiple sclerosis, and other serious illnesses and conditions can all affect the ability to learn and may necessitate accommodations, such as needing shorter training sessions, large-print materials or recorded training materials, and additional memory aids. Safety professionals need to identify individual concerns that can affect training and work around them. Work with disability experts to determine accommodations both for training and for doing the job.

If there is an employee who needs to use a wheelchair or other mobility device, such as a scooter, do not assume that the training setup is accessible. What is accessible for one person using a wheelchair may not be for another. Often, people can get into the training room but not the bathroom, or they may not be able to reach or use the computer keyboard, if some training is done that way. Have each individual do a roll-through of all the training facilities before the training session and test them to make sure they can do everything they need to do and get everywhere they need to. *Hint:* if some part of the training facility is inaccessible, get it fixed or move the training session!

Do not assume that the company does *not* have employees with disabilities in the workforce. Most disabilities are invisible, so the trick is to identify them. In many cases, the employee will have to let safety professionals know they have special needs. This, in turn, requires an employer who will not proceed to find excuses to fire them after they identify themselves. Even though this is highly illegal, it does happen, and disabled people are very aware of such situations even if others do not recognize them. If this is the situation, there will be people who do not understand all the training because their needs are not accommodated.

Other Training Issues to Consider

Communicating Risk and Hazard Information to First Responders and Clinicians

If there are some extraordinarily hazardous materials that could end up affecting employees, first responders, and/or members of the public, consider training at least the first two groups in the hazards, how to protect themselves in event of a problem, first aid, and treatment for exposures. This population should be relatively easy to train as they have professional expertise. Under the Emergency Planning and Community Right to Know Act of 1986, safety professionals must establish an emergency planning program where the total amount of any extremely hazardous substance is equal to or exceeds the threshold planning quantity, which is specified in the Act (House 2002). Including formal training would be a worthwhile exercise so that bad situations are not made worse.

One should think long and hard about the training of the public, as most have a great deal of difficulty understanding the difference between hazard communication and risk. If there is an unusual situation, such as that of the Chemical Depot in Pueblo, Colorado, which houses very large quantities of mustard gas, there is no choice. However, this is not a job for amateurs; get a consultant who has expertise in educating without unduly alarming the public. To evaluate the consultant, or if someone without the necessary expertise must do the job, Petroff (2004) has written an outstanding paper on making risk communication effective without scaring people unnecessarily. This is strongly recommended reading.

Petroff advises accepting and involving the public as a partner, planning carefully and evaluating those efforts, listening to their specific concerns, being honest, frank, and open, working with other credible sources, meeting the needs of the media, and speaking clearly and with compassion. This author recommends addressing the misinformation put out by the ignorant and those with other agendas. They will likely surface and must be neutralized to prevent panic.

In this post-9/11 world, security considerations may also influence what and how much to say to whom.

Storage Issues

One weakness in most labeling and MSDS information is a failure to make clear what should not be stored near what. How near is "near"? What should be in ventilated hazardous material storage cabinets? According to Brown, most of the information needed is in state, city, or even county fire codes. Safety professionals do need to be in contact with local officials, but Brown provides some guidelines (Brown 2005).

One commonly overlooked requirement of fire codes is keeping "incompatible materials" separate. Incompatible materials are defined as "materials which, when in contact with each other, have the potential to react in a manner that generates heat, fumes, gases or by-products which are hazardous to life or property" (Brown 2005). Separation options include the following:

- segregation by a distance of not less than 20 feet
- isolation by a noncombustible partition, extending not less than 18 inches above and to the sides of the stored materials
- storage in hazardous materials storage cabinets
- storage of compressed gases in gas cabinets or enclosures with exhausts

However, incompatible materials cannot be stored within the same cabinet or enclosure with exhaust.

Hazardous material storage and areas where they are used and dispensed have other requirements as well, including:

- the use of noncombustible, liquid-tight doors

- appropriate spill control and secondary containment
- high-level, low-level temperature and pressure-limit controls
- standby and emergency power
- other requirements, such as signage and lighting

Larry Garcia, hazmat instructor at the OSHA Region 10 Education Center in Seattle, advocates making this part of the training very memorable (Nightswonger 2000). To that end, he demonstrates what can happen when storing an oxidizer with a reactive material. He mixes incompatible materials, fire breaks out, and, as he says, "It's a pretty visual recollection for the students."

Conducting Training

Knowing what information the training needs to cover, pertinent characteristics about the trainees, and just who needs training means it is time to tackle this project. There are many techniques:

- face-to-face classroom training
- videotapes
- computer-based training
- hands-on training
- Web-based training
- video- or audio-conferencing

As most readers work with adults, it is important to understand a bit about how people learn. Generally, people remember

- 10 percent of what they read
- 20 percent of what they hear
- 30 percent of what they see
- 50 percent of what they both see and hear
- 70 percent of what they say when they speak
- 80 percent of what they actually do
- 90 percent of what they say as they actually do it (Grieff 2003)

This is the reason why the advice was always "to learn something, teach it!" And do not overlook the "forgettery" factor, either. Many students have had the experience of taking an exam and realizing directly afterward that they would fail it if they had to take it again; the details had disappeared from memory the moment the exam was over. They may have retained a portion of the information, but they would have to relearn much of it. The average student forgets as much as 47 percent of what he or she just learned in the classroom in as few as twenty minutes, and 80 percent just 31 days later. Classroom training alone hardly seems worthwhile, does it?

Also, consider these four key principles from Malcolm Knowles, a leader in the field of adult education (Tapp 2004):

- ***Readiness:*** The students need to open their minds to what they have to learn. In essence, Knowles suggests "selling" them on the importance of the information.
- ***Experience:*** What do they already know? Present the training so it is neither over their heads nor insultingly simple.
- ***Autonomy:*** While the training may be mandatory, increase their freedom of choice by making the training interactive and providing opportunities for them to make their own decisions.
- ***Action:*** Successful on-the-job applications.

In-Person, Classroom Training

If the option to do classroom-type, in-person training is selected, numerous experts have all kinds of suggestions. This topic is discussed extensively in the chapter on conducting and documenting training. Trainers who are not comfortable presenting in front of groups must do something about it. Join Toastmasters. Take a course. Get a coach. In the meantime, get someone with appropriate expertise and presentation skills to do the classroom training until presentation skills are acquired. Safety and hazcom training is too important to let it be diluted by a poor instructor.

One good source of off-the-shelf training materials is the Texas-based Association of Reciprocal Safety Councils, which has developed a 4.5-hour course to meet the classroom training requirements of OSHA standards (OSHA 2007a). One senior OSHA compliance officer who was invited to see the training saw only one very minor error, and very highly recommended this course. Local safety councils will offer this training, or know how to contact someone who does this type of training.

One innovative approach to training is to transform a hot-work-permit training program to make it specific to the unique needs of the workplace (Donnelly 2003). Instead of routinely discussing the permit process and answering a few questions, Donnelly found a doll-house designer who helped him make an accurate scale model of the workplace from a mid-range-cost doll house. The artist included miniature items such as employees, welding equipment, 55-gallon drums, welding blankets, and fire extinguishers. The designer even came to the work site to make the model more accurate. They put in safety signs and posters, labels, and so on, even overhead wiring! This could be applied to the hazcom training. Instead of standing in front of the class and talking, Donnelly arranged the model to reflect problems for the students to identify.

Interestingly, the students in the exercise even spotted safety problems that the instructor had not included in the exercise! Training in groups of two or three, intensive discussions on different ways to address the safety problems while filling out the company hot-work permit were very educational. Best of all, the students described the experience as "cool," "fun," and a "great idea."

Web-Conferencing

Web-conferencing has some complicated technological requirements, but it can save considerable travel time. The interactive component is maintained. However, keep in mind that many people need to see the speakers' faces, as the audience is relying on speechreading. When considering audio-conferencing, remember that this shuts out everyone with even a small hearing loss. Generally, this author strongly advises against considering this technology for hazcom training.

If the infamous PowerPoint training is selected, here are some important tips from Tapp (2003b):

- Use both PowerPoint and interactive training. Use the slide to illustrate, then have the trainees "do."
- Do not overuse it! Instead of putting all the information on the slides, use the slides as reminders of what needs to be covered.
- Print out the slides and use them as handouts. This lets the trainee make notes as they go.
- Use interesting templates and backgrounds. However, be sure that the printed handouts are still legible. It may be necessary to use both an interesting template for the presentation and a simple one for the handouts.
- Make the reading easy. Use a few words in large print. This is where the handouts let the trainee make notes as the trainer comments on the few words on the screen.
- Use contrasting colors. Do not get too fancy or make the presentation difficult to read. Get some feedback on legibility *before* the presentation.
- Use pictures! Use, for instance, clip art, plant-site photos, or cartoons. These can be animated, too. But do not get carried away. If it does not add to the message, pass it up.
- Use the slides as the outline, rather than the entire content. Although this was recommended earlier, it is important.
- Add movies and animation to increase interest.
- One nice thing about PowerPoint is that it can be e-mailed to let people go through the training on their own time. Obviously, if this option is selected, there must be much more information on the slides than if the slides were just notes to remind the presenter what to say. Alternately, talking characters that can lead others through the training can be added in the absence of a trainer.

PowerPoint can also be put on a laptop for road trips, or burned onto a CD for distribution. This lets trainees work through it on their own time. However, they miss out on the opportunity for interactive training.

Videos are very important training tools, but it is not reasonable to expect that safety trainers can just sit people down in front of the monitor and leave. As a part of a well-planned hazcom training program, videos can provide variety to the training sessions. Be very sure that *all* of the videos are open-captioned, and in Spanish if needed. The majority of videos this author has seen have extensive portions that show everything but the face of the speaker, and this situation makes it highly unlikely that anyone with even a

slight hearing loss will understand everything. Even if the face is shown all the time, the ability to speech-read varies greatly. Do not rely on closed-captioning, either. Not every trainer knows to turn it on, so just having every video open-captioned takes the whole issue off the table. At the very least, insist on closed-captioning, and that all trainers turn the captioning on every time, whether someone requests it or not.

An experienced and knowledgable person should screen the video for accuracy and relevance before use as well. Look for parallels in the video with this particular workplace, and do not hesitate to stop the video to point those out.

If there is a video with errors in it, what should safety professionals do? It could serve as a bad example, so be sure to notify the producer. Once training is done using other materials, showing the trainees the video with the error on it should demonstrate if they learned what they should have. Just in case they did not, of course, be sure to point out the error if nobody else does.

Computer-Based (CBT) and Web-Based Training (WBT)

Online training is an increasingly popular option, and the quality of some of these training programs is outstanding. There are some advantages to these, not the least of which can be cost. Perry compares multimedia and classroom instruction in three areas: cost, instruction, and administration (Perry 2003).

Instruction refers to how the instruction is accomplished. *Cost* refers to the impact of training on the bottom line, or the cost of training. *Administration* refers to tasks related to managing the logistics of training, such as scheduling, making training accessible, tracking student progress, and posting results.

Multimedia appears to be the big winner in terms of apparent cost. Savings result from less money spent on instructors, renting facilities, and travel and lodging for students. Training takes less time, productivity is not lost due to travel, and many administrative costs, such as grading tests by hand, are bypassed. Using computer-based training simulations avoids taking expensive or scarce equipment out of service, or risking damage, and also reduces student exposure to hazardous training environments.

The bottom line is that the U.S. Coast Guard found the HH60J helicopter CBT flight-simulator training program saved more than $11 million in a three-year period (reported in 1992). Federal Express estimated savings of over $100 million in a 1990 publication. However, it is interesting that these examples are over ten years old, and few companies have to train their employees to fly choppers. This raises questions as to the cost-effectiveness of simulation training for situations where failure is far less catastrophic and/or expensive. It is possible that the improvements in computers, software, video games, and related expertise could make simulators less expensive to develop and use in the future.

Perry explains that custom multimedia courses developed for a specific company are cost-effective after about 1000 students. Off-the-shelf courseware can have a much lower break-even point, depending on the cost of the software and the computer systems required (Perry 2003).

What about instructional quality? Obviously, pre-programmed courseware is consistent, so there is no worry about the quality of the trainers or the completeness of the content. Employees can go through it at their own pace, reviewing as needed when they might not be willing to ask questions of an on-site trainer. Attendance is documented by the employees' log-on information, and in both cases the students need to take and pass tests to verify understanding. Perry also reports that students who used multimedia retain 25–50 percent more content than those who had classroom learning.

Provided that the material is completely accessible to every trainee, even those with hearing and/or vision loss, multimedia instruction can be superior in imparting information. It keeps people interested as the media changes, it provides immediate feedback for effective reinforcement, and student-progress monitoring not only documents the ability of the student to understand but also the effectiveness of all the components of the training. If something is not working, it is quickly apparent, which is not always the case with in-person trainers.

In terms of administration, life is simpler as long as the training technology does not require massive investment in new computer hardware and software. It is not necessary to get enough people together to form a cost-effective class, rent space, and set up schedules around production needs. And tracking and reporting features are built into the multimedia software. Training can be done anywhere the student and a computer can connect. Students are also reported to be more satisfied and motivated to use the multimedia learning tools.

Whether or not multimedia is superior for the average student, this author is not aware of any studies involving people training multilingual and multicultural employees, particularly those who are not already pretty comfortable with computers and generally literate. When comparing CD-ROM training versus Web-based training, Perry (2003) points out the strengths and weaknesses of each:

- CD-ROM training allows for a wider range of sophisticated teaching designs; it has fewer restrictions on media such as video and audio due to lack of bandwidth (not every location has high-speed Web access!); and it allows for more types of interactivity in test questions and exercise types

Web-based training, on the other hand:

- costs less to develop and distribute
- allows immediate updates and revisions to courseware
- makes the content available on a wider range of computer platforms, such as Windows, Mac, O/S 2, and Unix
- makes assessment and certification easier, and harnesses the use of electronic conversations to increase interactivity
- improves access to useful Web sites that could not be accessed via CD-ROM
- makes courseware more accessible as a resource and reference

Switching from Classroom to Computer

Anyone considering making the move from classroom-based to computer-based training needs to think carefully. Tapp (2003a), CSP, suggests starting with ten questions:

1. Does the content require interaction? If so, Tapp recommends using CBT, provided a method of interaction with a qualified trainer is provided. OSHA approves of access via a telephone hotline. If students must demonstrate their ability to put on and remove PPE, it will not do the job alone.
2. Would employee understanding of training materials be improved if they learned in a group? For instance, if the training group is a mix of experienced and new employees, the new employees can learn a lot from the experienced employees, and hence CBT is not a good solution.
3. How motivated are the trainees? They need to *want* to learn to make the effort. At least an in-person instructor can serve as a motivator, and a good one will ensure that the least motivated still learn.
4. Does the training need to be given in a convenient location? If there are different workplaces and shifts to consider, CBT solves a lot of logistical issues.
5. Will there be resistance to CBT? Some people do not know how to use a computer, and are afraid of embarrassment. Others like the social aspects of classroom training, and do not want to feel isolated at a computer. Consider incorporating some CBT with the classroom training to decrease resistance for future training.
6. Will the managers be resistant? They may not feel confident that their employees will be adequately supervised or trained, so they may need to be educated about process and effectiveness.
7. How disparate is the safety education level between trainees? If there is a great gap, CBT can let the more advanced students skip to their level of knowledge and the beginners slog through the rest of it without boring the advanced students to tears.
8. How permanent is the information of the course? If it changes fast, it can be expensive to make changes to some CBT technologies,

but not Web-based. The logistics of tracking whether the trainees are updated appropriately do become an issue, however.

9. Is the workforce multilingual? Tapp recommends CBT in their native language. However, make sure the translations are accurate, and if some of the less-often required languages are involved, it may be difficult to find appropriate CBT. Another concern is if the student truly understands the content.
10. How many people need to be trained? The larger the class, the more cost-effective CBT can be.

Whatever the decision, Tapp emphasizes that it is important to evaluate the training and the methods and document how it is all working. If the decision to transition to CBT is made, Perry concurs with Tapp, who recommends taking it slowly (Perry 2003). Perry suggests conducting pilot projects, which will build momentum and support in the organization by proving the technology. His paper includes a chart for deciding if and when to move to multimedia training.

As with any other change, there can be some organizational challenges, most of which have already been discussed. One additional, very important piece of advice for getting through the transition is to provide troubleshooting guides (Hall 2003). There will be questions, glitches, and other problems. Have both paper/computer information and a phone number or e-mail address of someone who can get back to users. However, this author strongly recommends providing phone contact *at all times* if that is when the training is happening. Waiting for an e-mail response when students are angry and frustrated is not the way to make friends and influence trainees, or trainers, for that matter.

Situated Learning

Before leaving the issue of hazcom training, readers should be made aware of a very interesting paper in *Professional Safety* (Machles 2003). In this thought-provoking paper, Machles suggests approaching safety training from the standpoint of the learner rather than the teacher, using the apprentice model instead of the training model. Rather than training with learning principles added, focus on learning with teaching principles added. Clearly, Machles points out, only 10 to 15 percent of the content from training conducted in the workplace is retained after one year, yet most workers are safe. Where are they getting the other 90 percent of the information? Not from the classroom. Rather, they learn through *situated learning*, the term Machles uses to describe the learning that occurs while interacting with other, more seasoned members in the situation.

OSHA requires classroom and/or e-learning, but the degree of situated learning that occurs in the rest of the trainees' world would be worth considering. This paper discusses a pilot biotech respirator-use situational training program that may or may not have applications to other hazcom training programs. Interestingly, the approach taken by John Donnelley in the hot-work-permit training discussed above is situated learning.

Evaluating the Training

With the hazcom training program set up and running smoothly, it is time to move on to the next item on the company's "to-do" list.

Not quite. As Roger D. Evans asks, "Employee training absorbed? Or water off a duck's back?" (Evans 2003). As a safety consultant, he has interviewed many employees and found that trainees were too often made to sit down in front of videos and left alone, after being given a ten-question multiple-guess test that he describes as "so ridiculously easy that, even without seeing the video, a person of average intelligence could pass with a seven out of ten score." Worse, too, many employers have no system to retest those who fail or to provide—never mind require—additional training. In some cases, the company does not even have a pass-or-fail policy.

The solution? Evans recommends that management representatives take the training, preferably unannounced, with the new employees, and grade the content and the trainer. Regularly review the materials and upgrade them if needed. Evans emphasizes that employers need to set training requirements based on what is needed for a safe operation, not just what is required by law.

Somewhat more tangibly, Leese (2004) offers a checklist to evaluate safety training. Her checklist covers such issues as:

- ensuring that regulatory requirements are met
- planning meeting content in terms of what the students need to comprehend
- varying the training formats
- measuring against specific training goals

This is a useful beginning list to set up a more comprehensive checklist for workplace-specific needs.

Security Issues

Back in the good old days before 9/11, the real concern was making sure the public knew what sort of nasty stuff was in their neighborhood so they could, in theory, protect themselves in the event of an unwanted incident. Now, however, safety professionals need to be aware that the right-to-know information can be, and has been, tragically abused. The EPA used to require that "worst-case scenarios" be available to the public, but that has been changed because of concerns that the information would serve as a recipe for disaster (Sissell 2004). There is currently some litigation on the matter, but the EPA still does require an executive summary.

Unfortunately, safety professionals must also cope with the fact that hazardous materials can be stolen and used to wreak havoc, death, and mayhem if steps are not taken to prevent this theft. While it is beyond the scope of this chapter to discuss in detail, clearly safety professionals need to work with their security counterparts.

As with safety, a certain amount of common sense goes a long way when it comes to security issues. Consider that someone intends to cause harm using the organization's materials that have been released. These people can embrace a wide variety of causes. Petroff, in a paper on hazardous materials, military policing, and military intelligence addresses this con-

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Using Hazcom Training to Sell Safety

Terry L. Mathis (2004), safety consultant and software expert and president of Integrated Performance Technologies, Inc., advocates some major paradigm shifts in hazcom (and other) training. Mathis reports on how a safety consultant, who stepped in at the last minute for a stranded trainer, used the mandated hazcom training session to also get employee input and stress the importance of helping the organization reach its goal. The result? Trainees reported feeling engaged in the training for the first time in years, several stated goals for applying the training, and most mentioned "being more serious about safety" after the experience.

Obviously, the one-time training would not sustain the effect, so Mathis' client had the consultant train his supervisors in the same materials and assigned them to discuss both the materials and vision in weekly toolbox training. He also made posters and wrote a letter in the company newsletter about the training and plans to involve the site manager in the next annual training. This company moved from "going through the motions" to using training to sell safety.

How do they do this? First, training sessions include a brainstorming session on how improving safety benefits both employees and the company, with real data from accidents, near misses, and unsafe acts. The workplace-specific training and personal benefits to the trainees make the safety strategies more relevant to the trainees.

Second, the company coupled mandated training on a specific subject with organizational needs around the subject, and used the training to accomplish both goals. One chemical plant planned to modify its MSDS program for computer access, so the organizers took the opportunity to include the new system and, importantly, to gather worker feedback on the proposed changes. Final modifications reflected the worker feedback. This can be inverted as well. If a new situation requires training, couple the needed training with any mandated regulatory training.

Third, look at training as only an initiation tool. Reminders and refreshers must be provided at least monthly. Furthermore, provide on-the-job reminders that translate classroom training into safe behavior.

Finally, make the training more or less continuous. Use regular meetings, communication tools, and even casual conversations to maintain focus and attention on organizational goals. One tool a company is using toward this end is a *shirt-pocket checklist*, which includes three or four safety-focus items over which the workers have control. Using a behavior-based safety approach, employees fill out the card based on what s/he sees fellow workers doing during the shift and turns the cards in so the company can measure progress on safety strategies.

cern (Petroff 2003). Some people he suggests worrying about include:

- criminals
- disaffected persons (insider threat)
- paramilitary forces such as militias and hate groups
- protesters for causes such as politics, the environment, or animal rights
- terrorists with political, religious, or single-issue motives, such as above

Consider the physical safety and protection from theft of the hazardous materials. Check Web access to ensure, at least, that people with malevolent intentions cannot access information from the outside. Work with Web security experts. Work with Human Resources to see if there are unstable employees who may pose a security hazard. Be sure that the safety department has input regarding security issues. The usual conflicts of security wanting doors locked and safety wanting people to have an escape route generally play out in a variety of ways.

Petroff recommends that companies integrate security into the hazardous materials management plan in a methodical, deliberate, and ongoing manner, utilizing local security experts such as the police or sheriff's departments, or the expertise of the Local Emergency Planning Committee. The goal is to implement measures that deter, detect, delay, or defeat the threat. Deterrence is improved by using highly visible measures and randomness. Use the same general procedure as risk management:

- Assess the threat.
- Assign specific physical security duties.
- Conduct security planning, both personnel and physical.
- Conduct risk analysis.
- Identify essential or vulnerable areas.
- Designate restricted areas.
- Coordinate security efforts.
- Establish physical security responsibilities for the operating staff.
- Employ physical and procedural security measures.
- Conduct inspections and surveys.

Regulations from Homeland Security will continue to evolve as terrorists use different tactics and strategies. Safety professionals must work with their counterparts in security to make sure that both are complying with the current regulations.

If, for some reason, someone is suspicious of a fellow employee, or someone else, do not just brush it off. Refer the concern to the security department, and let them check it out.

Emerging Concepts and Issues

Data Sheets for Processes and Tools

The concept of hazard communication can be extended beyond using the MSDS concept just for *hazardous materials*. How about *hazardous processes*? Morse, Warren, Cherniack, Fletcher, and Peterson (2001) described a process for creating ergonomic data sheets to battle work-related musculoskeletal disorders (WRMSDs). In this very interesting paper, the authors developed a six-part ergonomic data sheet (EDS) for hand tools. The sections include:

- tool description
- basic information on ergonomics
- a warning of known and suspected WRMSDs associated with both general hand tools and the specific ones addressed in the EDS
- recommended work practices for risk reduction
- a checklist of potential ergonomic risk factors associated with the specific tool, combined with relevant design features of the tool
- results of several standardized tests quantifying ergonomic risk factors, comparing this tool with similar tools

The concept could be extended to other situations, such as climbing ladders, working at heights, entering confined spaces, and more. Taking the opportunity to generalize the MSDS format and concept and applying them to other types of safety data sheets would bring the benefits of continuity across all the safety education programs. Consider engaging employees in expanding the data-sheet concept.

Unfortunately, there is no evidence as of August 2010 that this particular concept has been followed.

If it has, it has not been written about in the safety trade magazines. On the other hand, these data sheets look an awful lot like a job safety analysis (JSA), so perhaps this is the case of a redundant concept.

Unknown Risks from New Technologies

Innovation will never cease, and one will always have unknown hazards with new technologies and inventions. When the semiconductor industry developed, it seemed that, with the clean-room technology, it was a very safe industry. Time has proven us wrong, as unexpected health effects resulted from the use of new chemicals.

One area of current concern is nanotechnology. NIOSH officials are currently working on guidelines for best practices in handling nanotechnology materials ("NIOSH working on safety guidelines for nanotechnology" 2004). Under research are issues such as predicting the types of exposure and the exposure routes of nanomaterials; this information will help determine the control measures. As nanotechnology is used more and more, the safety research in this area is heating up. Safety professionals involved in this particular area need to be diligent in keeping abreast of the new research.

As new materials and technologies develop, safety professionals need to be alert to the development of new hazardous materials and processes and need to anticipate solutions as well.

Handling Major Disasters and Their Clean Up

The collapse of the World Trade Center Towers taught safety professionals both short-term and long-term lessons on hazard communication. Given the magnitude of the task of the initial rescue, recovery, and clean up, there were remarkably few serious, immediate injuries. The teamwork of safety professionals, fire fighters, construction and operating engineers, safety equipment suppliers, and so on, was outstanding. However, the long-term health effects of the clean up have been significant, and are still not clearly understood. They may not be clearly understood for decades, particularly the health effects on residents near the site who were exposed to unknown quantities of who knows what (Lyman 2003; "September 11, 2001, Ground Zero" 2003).

It has become clear that many of the people working both in rescue and clean up are suffering from long-term lung injuries. What additional steps beyond providing PPE safety professionals could have taken in that awful tragedy and afterwards are unclear, but there are always lessons to be learned.

The *opportunity* to learn from this tragedy and plan for safer managing of serious disasters is one that safety professionals must not miss. Learning how to better evaluate hazards and communicate them is important so that immediate and long-term casualties can be minimized. Safety professionals must remember to balance accurate communication of hazard and risk with the concern for needless panic that would only compound the problem.

Biological Terrorism

Both the nation and its organizations do not really have much of a handle on coping with biological terrorism, and it is necessary to do so soon. The logistics of vaccinations and tracking disease incidence seem to have been reasonably well planned for, but the political and military need to control population movement very early in a bioterrorism incident appears not to have been addressed at the local, state, or federal level. Should such an incident occur, it would be a good idea for Homeland Security and emergency management experts, regulators, the media, and safety professionals to have considered ways to restrict the movements of their own employees to protect them from exposure.

This consideration could include setting policies in conjunction with the safety professionals' security counterparts, establishing ways to enforce the policies (potentially up to and including at gunpoint), and stockpiling and rotating supplies and materials to shelter the work population on site for a reasonable period of time. Should the biological organism be particularly virulent, a situation that will be evident within a few days, the shelter planning need not include much time beyond that.

A communication system for employees to contact loved ones is essential, and there are many more

concerns. Working with local medical, military, and law-enforcement personnel, plus a good lawyer or two to address potential concerns about the legality of forcing employees to remain on site via policies and enforcement plans may save many lives in the future.

Whatever policies and procedures are selected, it is crucial that the employees *and their families* understand the necessity of the decisions and how those decisions can save the lives and health of everyone involved. As usual, the more employee input there is in these plans, the better.

One possible application for an HCS does apply to the selection of PPE against the possibility of a bioterror attack. Steve Williams, CHMM, founder and president of Bighorn Environmental Safety and Health, LLC, in Oregon, is a former state trooper and fire chief who develops and delivers antiterrorism curriculum for the U.S. government. As an expert on emergency planning and response, Williams points out that by analyzing the biological agent involved, it is possible to decide what level of protection first responders need to use (Williams 2003). Until the actual hazard is identified, Williams suggests using EPA Level A, fully encapsulated chemical protective clothing and self-contained breathing apparatus. Afterward, this can be modified to what is actually required. For example, consider the mailed anthrax attack of September 18, 2001. Five people died and at least thirteen others were sickened, and there was a great deal of confusion nationwide ("Anthrax Attack" 2007). Mail was cross-contaminated, Capitol Hill was severely disrupted, and people were frightened and inconvenienced; a

CASE STUDY

Hazard Communication Plan Pays Off Big at a Small Company

A comprehensive hazard communication plan that involves employees, the community, and the fire department has paid off for the Cary Company, a 42-employee chemical distributor in Addison, IL (Smith 2002). This 107-year-old company has a comprehensive hazcom program that includes

- extensive new employee training in Right-to-Know, OSHA, and DOT regulations
- an extremely well-maintained library of some 2500 MSDSs
- a partnership with the Addison Fire Department
- training for each new chemical or hazard as it is introduced into the workplace
- employee training in reading MSDSs
- a complete chemical labeling program
- ongoing education for both employees and management

What has been particularly valuable to the company is its ongoing relationship with the Addison Fire Department. The Cary Company has provided the fire department with a facility for emergency response training exercises. They also notify the fire department when regulations they must comply with change, which Logistics and Regulatory Coordinator Dave Meehan makes sure he keeps up with. To do this, he attends "train the trainer" courses each year. The company has complete credibility with the fire department as a result. They know that the company has never tried to get around regulations.

In return, the fire department conducts approximately biannual inspections of the emergency shut-off valves for the gas and electricity, chemical storage locations, emergency-response equipment, and MSDSs. In addition, new fire fighters are brought out to look over the facility as they are hired. The biggest favor the fire department did was assist the company when it decided to construct a new 140,000-square-foot warehouse building with a HAZMAT room that could store 300,000 gallons of chemicals in 55-gallon drums. The National Fire Protection Association (NFPA) Code 30 has stringent regulations. In this case, they called for explosion-proof lighting, explosion-proof outlets, and an explosion-proof heating and cooling system that would add $100,000 to the construction costs. By telling the local fire department what they were going to store in the room, the fire fighters helped design the room so that it met NFPA standards but did not have to be explosion-proof.

Instead of the explosion-proof equipment, the room contains an in-rack foam suppression system and an early suppression system in the general storage area designed to spray twice as much water as a normal fire protection sprinkler sprays. Besides a dike in the HAZMAT room to contain any spills, the warehouse has heat sensors, eleven hose stations, 54 fire extinguishers, and a fire protection room with a dedicated phone line, alarm, and electrical circuits. The fire department keeps a key to the fire protection room so emergency responders have 24-hour access to the MSDSs, maps showing electrical power switches, and emergency-contact phone numbers.

Besides saving a substantial amount of money when building the new warehouse, the company sees many other advantages. Company president Bill Cary points out that their hazcom program "helps differentiate us from many of our competitors, . . . reduce[s] accidents and injuries, saving us money, and our customers trust us to provide them with the most current, accurate information available for the chemicals they purchase from us."

great deal of money was spent cleaning up contaminated locations. Some confusion lay in the question of what PPE was needed to protect people from this? Protection levels finally moved down from EPA Level B clothing to Level C with N95 air-purifying respirators with HEPA filters (Williams 2003).

The HCS needs to discuss what level of protective gear is needed, how to decide this, what is appropriate for different organisms, and what guidelines and equipment are needed for dealing with the heat-stress problems of the chemical protective clothing. Methods for decontamination should also be included. As always, the necessary respirator-fit tests, as well as tests for any PPE, are required in advance of the need to use them.

Effects of Chemicals on Reproduction and Nursing

Dan Markiewicz, CIH, CHMM, CSP, an occupational health, safety, and environmental consultant, wrote an outstanding series on reproductive hazards and breastfeeding in *ISHN*. While these are not *new* issues, they are reemerging. In March 2004, IBM settled a lawsuit over whether or not a child's birth defects were caused by on-the-job exposure of the pregnant mother (Markiewicz 2004a). Even though the amount of the settlement was not revealed, the lawsuit called for $100 million in damages. Then there is the popularity of breastfeeding, which is causing some concern about the presence of chemicals in breast milk (Markiewicz 2004b). Markiewicz points out that safety professionals have no idea what the answers to very important questions are. Some of those questions are:

- Will breast milk be safe for infant consumption if the employer is in full compliance with OSHA chemical exposure standards?
- Do MSDSs provide enough information to determine if a chemical may concentrate in breast milk?
- Are there any recommended biological exposure indices for workplace chemicals in breast milk?
- Has the FDA set "safe limits" of industrial/environmental chemicals in breast milk?

These questions and the complicated legalities need to be addressed by employers. And these issues cannot be resolved by simply firing or refusing to hire pregnant women and nursing mothers. That would be difficult to explain to the Equal Employment Opportunity Commission and then to a judge and jury. Markiewicz suggests a set of flow charts to help evaluate the level of concern in worker populations and workplaces and a series of proactive steps for protecting both workers and company resources (Markiewicz 2003b). At some point, safety professionals may need to put this type of information into their hazcom training.

Biological Hazards

Molds and bacterial organisms such as *Legionella*, which causes a lung infection fatal in 15 percent of cases, popularly known as Legionnaires' disease after the famous outbreak, are recurring problems that are relatively easy to prevent (Morris and Shelton 2003, Pinto and Fennema 2003). Some 10,000 to 100,000 cases occur per year, according to the Centers for Disease Control and Prevention (CDC). Estimating 25,000 cases per year, Morris and Shelton (2003) point out that while they are no longer media-worthy, they are almost entirely preventable.

Two illnesses are caused by *Legionella*: Legionnaire's and the milder but more virulent Pontiac fever (Morris and Shelton 2003). Even though fewer than 5 percent of exposed individuals develop Legionnaire's, the flu-like Pontiac fever develops in approximately 95 percent of exposed individuals. None of these patients has died, but the cost of having so many employees out with an entirely preventable disease is high in terms of both business continuity and suffering.

Water is the growth medium here, and when it is aerosolized it can infect people. Cooling towers, evaporative condensers, humidifiers, potable water heaters and holding tanks, pipes containing stagnant warm water, showerheads, faucet aerators, decorative fountains, nebulizers, mister reserves, and whirlpool baths need to be monitored. The prevention is pretty simple: good, routine, preventative maintenance programs.

Of course, routine, preventative maintenance can be one of the first things management will let slide or even cut when money gets tight and emergencies occur.

Consider putting together a Hazard Control Sheet on this and other biological hazards, complete with the health hazards, costs, if available (consult Human Resources for costs of absenteeism), information on the maximum acceptable bacteria counts, any maintenance procedures required to prevent the problems and at what required intervals. This will emphasize the importance of maintenance for both management and the employees who need to carry it out.

Similarly, mold is a water-related biohazard. One particularly devastating form, *Stachybotrys*, is responsible for profound health effects (Pinto and Fennema 2003). Clearly, it is crucial to take complaints of health problems, such as frequent illnesses in the employees, seriously and resolve them quickly. Unfortunately, too many building managers, insurance companies, and builders do not take water leaks and indoor air-quality complaints seriously enough. Here, too, an HCS spelling out the potential consequences of ignoring and under-remediating water in the building would be called for. It should also include the proper procedures for ensuring that all the water is thoroughly dried out in the event of a water problem, which will ensure that proper procedures will be followed and mold problems prevented rather than having to raze the building later, which is the worst-case possibility. The HCS may or may not have much influence with insurance companies whenever water leaks occur.

The threat of a pandemic flu is increasing as the world shrinks. The H1N1 strain of flu (known as swine flu) was extremely virulent, as well as the H5N1 or avian flu—especially in countries where livestock (such as swine), birds, and people mix together. Combined with ever-cheaper air travel, the potential for a pandemic increases. There was a worldwide scare in 2009 of an H1N1 pandemic that could have been as disastrous as that of 1917–1918. Because of massive inoculation programs and public health actions to prepare and protect especially the most at-risk individuals, such as the young, elderly and those with preexisting conditions, the outbreak was far less serious than it might have been (CDC 2010). In any case, safety professionals need to stay aware of future potential for pandemics and epidemics and be prepared to manage that risk.

Conclusion: The Future of Hazard Communication

Nobody can say for sure what direction hazard communication will take, but safety professionals can rely on the hazard-communication aspect of their jobs becoming more and more complex as knowledge expands on the health and safety hazards of various new and existing materials, processes, and organisms; on effective adult education; and on effective communication skills. Safety professionals do not just have to *keep up*, they have to *stay ahead*!

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Appendix: Additional Resources

International Hazard Communication

American National Standards Institute (ANSI), www.ANSI.org. They have current information on the status of the U.S. adoption of the GHS.
Canadian Centre for Occupational Safety and Health, www.ccohs.ca
Chemical hazard communication site lists Web sites from all over the world at www.unitar/org/cwm/GHS-CD/cat5.html
ChemicalPlantSafety.net is a chemical plant safety blog. It includes a lot of information, and one entry, http://chemicalplantsafety.net/msds/writing-msds-using-msds-template is particularly valuable. You can also get quite a few MSDSs.
Denehurst Chemical Safety, Ltd., www.denehurst.co.uk/. This is a consulting firm that offers help to the chemical industry.
Globally Harmonized System for the Classification and Labeling of Chemicals. International Labor Organization Draft Integrated Proposal, www.unece.org/trans/danger/publi/ghs/implementation_e.html. This has all the information on which countries have implemented the GHS.
Global MSDS, Ltd., Environmental Insight. www.globalmsds.com
Interactive Learning Paradigms, Inc., www.ILPI.com, offers custom training programs.
Samples of International Chemical Safety Cards. They do not replace MSDSs (NIOSH version: www.cdc.gov/niosh/ipcs/icstart.html) (OSHA version: www.osha.gov, under the index for "Hazard communications." Also includes OSHA's explanation for the GHS.)
Society for Chemical Hazard Communication, www.schc.org
United Nations Economic Commission for Europe, www.unece.org/trans/danger/publi/ghs/officialtext.html
The Wercs, Ltd., e-mail: info@thewercs.com; Web site: www.thewercs.com

MSDS Databases

3E Company of Carlsbad, CA, provides services for environmental, health, and safety (EH&S) related compliance management, including: global regulatory research; MSDS authoring, distribution, and management; transportation; emergency

response; training; regulatory reporting; and hazardous waste management.

Environmental Support Solutions of Tempe, AZ, provides software in two integrated suites.

OHS-MSDS-SUM, just the summary sheets; and PESTLINE-OHS, agricultural chemical product ingredients (MSDS-PEST). All are updated weekly.

STN International offers Occupational Health Services databases, MSDS-OHS, complete identification.

Risk Communication

Sheldon, Keith. 1996. "Credibility Is Risky Business." *Communication World*, April 1, 1996.

This is an interview with Vincent T. Covello, an expert on risk communication and media relations, who has advice on communicating with members of the public in a credible way.

Reading Assignments

Chapter 5:
Best Practices in Hazard Communication

29 CFR 1910.1200, Hazard Communication Standard, Appendix D, Safety Data Sheets: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10103

Supplemental Reading

See information below.

Learning Activities (Non-Graded)

See information below.

Key Terms

1. Best practice standards
2. Control banding
3. Registration, Evaluation, and Authorization of Chemicals (REACH)

Course Learning Outcomes for Unit VII

Upon completion of this unit, students should be able to:

1. Identify and apply best practice standards for hazard communication.
2. Analyze the administrative issues involved in hazard communication programs.
3. Discuss the issues associated with standardized and non-standardized safety data sheets (SDS).
4. Identify and examine training concepts related to hazard communication.

Unit Lesson

In the last unit, the focus was on hazard communication regulations and compliance. In this unit, we expand our discussion and examine the importance of finding and using "best practices" in pursuit of safe handling and use of hazardous materials in the workplace. Best practices are simply procedures, methods, and programs developed to comply with standards, but typically, they go beyond the requirements of the standards and provide an additional level of protection for the employee.

Best practices are particularly important in the study of hazard communication, since many sections of the OSHA HazCom Standard are performance-based; that is, they describe the desired end state but do not necessarily explain how to get there. The reasons for this type of standard originates in the huge number of chemicals and diversity of workplaces in which they are used. A regulator could not possibly provide a single solution for everyone. Hazardous materials are much more complicated than, for example, the prescribed height of a stair railing (32-34 inches). Changes in the HazCom Standards over the past 25 years have resulted in more efforts at standardization, such as we have seen for labels and Safety Data Sheets under GHS, but there are still many areas that leave safety practitioners searching for the best route to compliance and injury/illness reduction.

Not all best practices are created equal, and some industry practices may not be "best" or even "good." Haight (2012) offers some criteria that can be used as benchmarks:

- The practice meets the basic legal requirements set by OSHA and EPA.
- The practice goes beyond the basic requirements to include the realities of the workforce.
- The practice goes beyond the basic requirements to include everyday realities.

Where do we find best practices? Often, you will not need to look farther than your own industry. Trade associations, labor unions, and professional associations are all possible sources, as well as safety-related organizations such as the National Safety Council, American Society of Safety Engineers, and even OSHA itself.

Regardless of what best practice is found to be the best fit, remember that it still must be tailored to your organization, as well as continually evaluated and updated.

Developing an effective HazCom program can be overwhelming, so it is helpful to break it down into sequential steps (Haight, 2012). For most steps, you can find many best practices from the sources mentioned above.

- **Know the Regulations:** There are no best practices that can be substituted here. You must read and understand the applicable regulations. This may seem obvious, but is often overlooked by those looking for a cookie-cutter HazCom program.

- **Identify Responsible Staff:** If you do not have knowledgeable in-house staff, consider hiring one or more consultants. The cost will likely be offset by the cost avoidance of not being cited and fined by regulators.

- **Identify and List All Chemicals:** The operative word here is "all." There are some chemicals excluded from the standard, but the exclusions should be applied after the full list is prepared.

- **Write the Plan:** OSHA has compiled best practices on written programs, which can be accessed at this link: https://www.osha.gov/dsg/hazcom/solutions.html

  Remember, these are all guidelines and must be adapted to your organization. For example, a compliance officer would probably notice that your written program discusses welding processes, even though no welding is done.

- **Maintain Good Labeling on Containers:** This has become much simpler with the adoption of the GHS standards, but remember that the new labels will appear over the course of several years. Until the transition is complete, be sure your old labels contain the needed information. You may have to resort to the pre-2012 HazCom Standard, which is still available on the OSHA website.

- **Provide Quick Access to Safety Data Sheets (SDS) for All Employees on All Shifts:** Most organizations have gone to computer-based or web-based SDS retrieval systems. One of the keys is to keep it simple. It may be cost-effective to subscribe to an SDS retrieval service if you have large numbers of chemicals. Standardization of SDS data in GHS will greatly improve the usefulness of the information.

- **Train All Employees on All Possible Chemical Exposures:** Again, note the use of the word "all." Your HazCom training may benefit most from best practices. Be sure your training takes into account the diversity of your workforce and the realities of your day-to-day operations. International trade, transportation of hazardous materials, potentials for terrorism, contaminated worksites, and new technologies can all impact the training needs.

- **Frequently Review and Revise the Program.** This is perhaps one of the most important steps but is most often the one that is left out. All safety activities need to be part of an active continuous improvement loop in order to keep up with changes in regulations, changes in the workforce, and changes in technology. Why would you take the time to develop and implement such a complex program and then not examine it to see if it is effective? Leaving the program unattended on the shelf is likely one of the reasons that the HazCom has been in OSHA's top ten list of most frequent citations for decades.

Haight (2012) offers this thought: "Safety professionals do not just have to keep up, they have to *stay ahead*!" (p. 191). Researching and using best practices for HazCom is, in itself, a best practice that will help achieve a sustainable, world-class occupational safety and health program.

Reference

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Supplemental Reading

Learn more about this week's topics by researching in the databases of the CSU Online Library. The following are examples of what you will find in the Business Source Complete database:

- "Situated Learning," by David Machles, is a 2003 article that appeared in *Professional Safety*. It discusses the situated learning concept that is discussed in the course textbook.
- "OSHA's Revised Hazard Communications Standard: Globally Harmonized System," by William Atkinson, discusses the adoption of the GHS in an effort to improve its hazard communications standards.
- "What You Can Learn from Safety Data Sheets" is an August 2013 article in *Journal of Protective Coatings & Linings* that discusses product and hazards identification, ingredient information, first aid and fire-fighting measures, and several other topics related to SDSs

The Internet can also be a rich source of information, such as the following site:

- Read more about the European Union's REACH initiative at this link: http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm

NOTE: Be cautious when searching on the Internet; not all sites are accurate and trustworthy.

Learning Activities (Non-Graded)

Construction Safety Program

Read the case study about Construction Safety for Hispanic Workers on page 178 in the course textbook. Examine the cultural diversity in your current organization or one where you used to work, and develop a plan for addressing these issues in a HazCom program. Include labeling, safety data sheets, and training in your plan.

Best Practices

Conduct Internet research on HazCom best practices that could be applied to your current organization or one with which you are familiar. Compare these practices to the existing HazCom program.

Could your organization benefit from implementing the best practices? Develop a list of improvement recommendations that could be presented to management.

Non-graded Learning Activities are provided to aid students in their course of study. You do not have to submit them. If you have questions, contact your instructor for further guidance and information.

Unit VII Assessment

Hazardous Materials

Question 1

On page 154 of the course textbook is a checklist for HCS compliance. Of the eight items listed, which do you feel is the most important? Which one do you feel would be the most difficult to achieve? Support your discussion with examples from your personal experience or additional research.

Your response must be at least 400 words in length. You are required to use at least your textbook as source material for your response. All sources used, including the textbook, must be referenced; paraphrased and quoted material must have accompanying citations.

50 points

Question 2

Discuss how cultural and literacy issues can impact the effectiveness of a HazCom training program. Suggest ways that these issues can be addressed.

Your response must be at least 400 words in length. You are required to use at least your textbook as source material for your response. All sources used, including the textbook, must be referenced; paraphrased and quoted material must have accompanying citations.

50 points