OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) Standard (29 CFR 1910.120).

HAZWOPER

Preparation

1. Read Applicable Background information and related Company Policy Chapter.
2. Make _____ Copies of this Lesson Plan for Personnel
3. Make Transparency, procure transparency pens, etc.
4. Coffee, tea, snacks

Other:

Material

1.
2.
3.

Objective

By the end of this session, personnel shall be able to:

- Explain the difference between a work area spill response and a **HAZWOPER** spill response.
- Identify the initial response actions required when a spill occurs.
- List the methods used to identify a hazardous material and the associated hazards.
- Identify the key factors necessary to the selection of personal protective equipment.
- Identify the types of personal protective equipment available at the Company for spill clean-up and when they should be used.
- Demonstrate the techniques available to contain, control, and clean up spills at the Company.
- Explain the level of decontamination required for work area & laboratory spills and the methods available.
- Describe the appropriate procedure for handling hazardous waste generated during a spill clean up.
- Identify the appropriate contacts at the Company for reporting spills.

Notes

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Background

The Hazard Communication Standard is intended to warn workers of the hazards associated with the chemicals in their work area. Knowing the hazards is critically important when responding to a spill in your work area. This course is designed to assist you in properly responding to hazardous materials spills in your work area. It is not intended to train you to respond to spills outside your work area or to respond to spills requiring respiratory protection.

Lesson

Your response to a chemical spill in the work area should include these steps:

1. Secure the spill area.
2. Identify the material.
3. Identify the hazards.
4. Contact the Company Safety Department.
5. If trained, select and don appropriate personal protective equipment.
6. Contain and clean up the spill.
7. Decontaminate the spill area.
8. Dispose of the waste generated by the clean up.
9. Report all spills to the Company Safety Department.

This training course will discuss each of these steps and identify relevant information necessary to the safe and efficient clean up of work area & laboratory chemical spills.

Initial Response

Section Overview

The initial response of a Company worker to a chemical spill is critical to the success of the clean up.

The first step of the initial response is to address personnel safety. If the spill has contaminated work area & laboratory personnel, their well being must receive primary attention. If appropriate, wash affected areas under a safety shower and remove contaminated clothing. Move the exposed person to a safe area. Notify the Company Safety Department of the exposure and summon medical attention if necessary.

Notes

If no one is contaminated or exposed to the spill, immediately secure the area around the spill. This should be done to ensure that no other workers inadvertently enter the area and are contaminated or exposed. Controlling access ensures that no one will walk through the material. Securing the area can be accomplished by posting barrier tape around the spill area or controlling access to the room through a doorway. If there is more than one entrance to the work area, obtain assistance and assign responsibility for controlling access through each of the entrances.

If the spill involves a flammable liquid such as acetone, eliminate sources of ignition in the spill area.

Identification of the Material / Hazards

If you are present when a spill occurs, you will likely know what material has been spilled. If you are not present when a spill occurs, such as a chemical reaction causing a bottle to break, the material must be identified before proceeding with the clean up. Chemical hazards are created by the inherent characteristics of a material, such as its toxicity, flammability, and reactivity. Risk deals with the probability of suffering harm through exposure to a hazard. Risk varies, depending on the hazardous characteristics of a material and the quantity of the material. Evaluation of risk increases in complexity as the number of chemical compounds involved increases.

Labeling

The first step in the material identification process is to read the label on the container. This can only be done if it is safe to be near the container after the spill. The label will provide you with the name of the chemical, the name and address of the manufacturer, and appropriate hazard warnings. The hazard warnings may take the form of words such as "DANGER", "WARNING", "CAUTION", "POISON", "TOXIC", "CORROSIVE" or "FLAMMABLE". Other label warning systems include the National Fire Protection Association's (NFPA) Hazard Identification System and the Department of Transportation (DOT) Hazard Class System.

Notes

A number of gases at the Company are stored and transported in compressed gas cylinders. Although there are several voluntary color schemes for identifying cylinder contents, none are mandatory. The only reliable way to identify cylinder contents is to check the attached label.

When faced with a spill involving hazardous materials, obtain a material safety data sheet (MSDS) or label for reference whenever possible.

Markings / Colors

Identifiable container markings and colors can provide valuable information if used correctly. The most important marking on any container is the name of the contents. Many chemicals in use at the Company are identified by their trade names, not the chemical name. If only the trade name is known, additional information about a substance may be found on an MSDS.

NFPA 704M Hazard Identification System

The marking system developed by the NFPA is used on containers at fixed facilities to convey hazard information. Several chemical manufacturers are using the NFPA labeling system on their containers as a visual indication to users of the hazards. This marking system utilizes numbers and colors, with colors indicating the type of hazard and numbers indicating the degree of hazard. The color codes are red for fire, blue for health, yellow for reactivity and white for special hazards. Table 3- 1 shows the definition of hazard at each numerical level. The greater the hazard is, the higher the number.

See Next Few Pages For Color Coding

Notes

Health (Blue)	4	Materials that on very short exposure could cause death or major residual injury even though prompt medical treatment is given.	Acrylonitrile Bromine
	3	Materials that on shortexposure could cause serious injury on a temporary or residual basis though prompt medical treatment is given.	Sodium hydroxide Sulfuric Acid
	2	Materials that on intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical treatment is given.	Pyridine Styrene
	1	Materials that on exposure would cause irritation but only minor residual injury even if no treatment is given.	Acetone Methanol
	0	Materials that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible material.	
Fire (Red)	4	Materials that (a) rapidly or completely vaporize at atmospheric pressure and normal ambient temperatures and burn readily or (b) are readily dispersed in air and burn rapidly.	1,3-Butadiene Propane Ethylene oxide
	3	Liquids and solids that can be ignited under almost all ambient temperature conditions.	Phosphorus Acrylonitrile
	2	Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur.	2-Butanone Kerosene
	1	Materials that must be preheated before ignition can occur.	Sodium Red phosphorus
	0	Materials which present no fire hazard.	

Reactivity (Yellow)	4	Materials that in themselves are readily capable of detonation or of explosive decomposition or reaction at normal temperatures and pressures.	Benzoyl peroxide TNT
	3	Materials that (a) in themselves are capable of detonation or explosive reaction, but require a strong initiating source or (b) must be heated under confinement before initiation or (c) react explosively with water.	Diborane Ethylene oxide 2-Nitropropadene
	2	Materials that (a) in themselves are normally unstable and readily undergo violent chemical change, but do not detonate or (b) may react violently with water or (c) may form potentially explosive mixtures with water.	Acetaldehyde Potassium
	1	Materials that in themselves are normally stable, but which can (a) become unstable at elevated temperatures or (b) react with water with some release of energy but not violently.	Ethyl ether Sulfuric acid
	0	Materials that in themselves are normally stable, except when exposed to fire, and that do not react with water.	

Special Information (WHITE)

The white block is designated for special information about the chemical. For example, it may indicate that the material is radioactive by displaying the standard radioactive symbol, or unusually water- reactive by displaying a large W with a horizontal slash through it.

DOT Hazard Class System

The Code of Federal Regulation, Part 49 (49 CFR), outlines the Department of Transportation (DOT) hazardous materials labeling requirements for commercial transportation between states. The Hazardous Materials Transportation Administration of the DOT requires labels on small containers (non- bulk containers less than 110 gallons). These labels must be present on DOT shipping containers and packages found in the work area & laboratory.

DOT labels are 4 inches square and are applied to individual hazardous materials packages. They are generally found near the contents name or are printed on the manufacturing label. When DOT labels cannot be applied directly to the container because of a non-adhesive surface, they are placed on tags or cards attached to the package.

The DOT label displays a color, a symbol, and a United Nations hazard class number. There are a total of 9 DOT hazard classes. Although classified by DOT as a package/ container marking, the four- digit United Nations (UN) identification number may be present on cases used to package multiple bottles of solvent or corrosives. The DOT "Emergency Response Guide Book" can be used to cross reference UN numbers with chemical names. The proper DOT label(s) are determined by the product's hazard class. Some chemicals have more than one hazard, so multiple labels may be required. For example, concentrated nitric acid found at the NHMFL may be labeled as "CORROSIVE" and "OXIDIZER."

Labels are simply another clue and should not be considered as a definitive source of hazardous materials identification.

Shipping Papers and Documents

Should your work area receive a package that is leaking, immediately contact the Shipping Department for assistance. The shipping documents accompanying the package can be a very important source of chemical information. Although various terms are used for shipping papers, such as "bill of lading," all such papers contain the same basic entries, including:

- Proper shipping name according to DOT regulations.
- Hazard classification according to DOT regulations.

Notes

- Four- digit identification number(s), as required.
- Type of packages (container, boxes, cylinders, etc.).
- Total quantity by weight, volume and/ or packaging.

Shipping papers may also include the following entry:
If the lading is a poison and that fact is not obvious from the proper shipping name, the word "POISON" and/ or the technical name of the poison must be displayed near the shipping name. When the lading poses an inhalation hazard, "POISON-INHALATION HAZARD" must appear.

Senses

The human senses are valuable assets and can offer immediate clues to the presence of hazardous materials, so the senses should never be ignored, but they should be used cautiously. For our purposes, "senses" refers to any personal physiological reaction to or visual observation of the release of a hazardous material. Smells, dizziness, unusual noises (e. g., hissing containers), or sights (e. g., fuming liquids) are some examples. It is very difficult to teach people to identify correctly clues based on human sensory perception because of differing individual physiological reactions to the same substance. The large number of hazardous materials and perceptual differences caused by variations in amounts released adds to the difficulty. For example, one chemical may have identifying characteristics that a second material in the same chemical family does not have, even though they are both equally hazardous. Other chemicals have characteristics that can be insidiously misleading. Hydrogen sulfide, for example, can deaden the sense of smell and lead workers to believe they are operating in a safe environment when they are not.

Sense of smell can be used as an indicator of potential exposure if the odor threshold and the OSHA Permissible Exposure Limit (PEL) are known. If the odor is distinct and the threshold below the PEL, then odor can be used as an initial qualifier when determining if it is safe to respond to a spill without respiratory protection. Table 3- 3 provides examples of odor thresholds, PELs, and characteristic odor for chemicals typically found at the Company.

Except for vision, the senses are not a primary identification tool. In most cases, if a worker is close enough to smell, feel, or hear a problem, the worker is probably too close to work safely.

Notes

Unknowns

In the event that the material spilled in your work area is unknown, you should:

- Evacuate all workers from the area.
- Secure the area so no one else can enter.
- Notify the Company Safety Department.
- Provide the Company Safety Department with any information you may have on the spill and the conditions in the work area (ventilation, ignition sources, etc.).

Personal Protective Equipment

Selection of the appropriate PPE is critical to the protection of worker's cleaning up spills. PPE must be purchased and stored in your work area prior to the spill occurring. This involves planning and determining ahead of time what PPE will be necessary to clean up the spill. Company workers must receive training on the use and limitations of PPE prior to responding to a spill.

The method by which a hazardous material can compromise the integrity of chemical protective equipment depends upon the material's physical, chemical, and toxicological properties. Workers must protect themselves from these properties or they take the risk of being exposed. Harm could range from simple irritation of the eyes for a short period of time to long- term illness, cancer, or sudden death. This section will provide the basic information needed during a hazardous materials spill to make appropriate decisions concerning safety gear. The following is a discussion on selection and general use of personal protective equipment and respirators used during work area & laboratory spills.

Preliminary Concerns

To adequately protect Company personnel, it is necessary to learn as much as possible about the particular spill material(s) of concern. It is important to ascertain:

- The identity and quantity of the material(s) present. If more than one material is present, the products of any reaction.
- The physical state of the material(s), i. e., liquid, vapor, gas, solid, or combination.
- The material's interaction with surfaces contacted.

Notes

- The duration of possible exposure during the spill clean up.
- The routes of entry by which the material can enter the body.
- The warning properties, early symptoms and possible delayed or desensitizing effects of an exposure.
- Other pertinent factors such as the probability that a fire, explosion, or violent reaction may occur while you are in close proximity to the material.

All of this information is often available from background information, including MSDS and reference books.

Respirators

Respirators provide protection for the inhalation route of entry. If a spill in your work area requires the use of respiratory protection, you should evacuate the area and contact the Company Safety Department. There are two methods available to workers to determine the need for respiratory protection. The first method is the use of odor threshold as described in Section 3. The second method is prior knowledge of the chemical. Company workers must know if a chemical releases hazardous vapors when spilled. This can only be accomplished through a detailed understanding of the chemicals you work with and their physical properties. Refer to the MSDS for information on respiratory protection requirements. The use of respirators is regulated by OSHA and requires training, medical examinations, and fit-testing.

Chemical Protective Clothing

Chemical protective clothing shields against the direct contact route of entry. There is no universal protective garment, that is, no one material provides the best, or even adequate, protection against all chemicals and in all situations. For this reason, many manufacturers are developing or have developed multi-layer fabrics. This layering may tend to increase the stiffness of the complete fabric which reduces the dexterity and agility of the wearer. The advantage of multi- layer fabric is that it can provide an increased level of protection. Different types of chemical protective clothing used at the Company will be shown by your instructor.

Selection of Protective Clothing

The Company Safety Department will assist with the proper selection of PPE for specific jobs. Personal protective equipment shall be made available prior to performing any work requiring its use.

Notes

The types and amounts of protective clothing will vary with each individual case. Some of the articles available at the Company include:

- Boot protectors (booties)
- Gloves
- Splash goggles
- Splash shields
- Chemical protective aprons

Type of Chemical and Concentration

The contaminant involved must be identified before chemical protective clothing is chosen. Also, consider possible reactions among the materials spilled. Chemicals can react, emitting dangerous by- products which are not always compatible with the chosen material. Once the contaminant is identified and the hazards are assessed, contact the Company Safety Department for assistance with the selection of PPE.

Work Functions

What must you do to contain, control, and clean up the spill? Will you have the dexterity to easily handle and maneuver spill clean up tools? Will you have to pick up pieces of broken glass that could penetrate the gloves, exposing hands to lacerations or chemicals?

Failure of Protective Clothing

Protective clothing can fail through at least three mechanisms: degradation, penetration, and permeation.

Chemical degradation results from chemical reactions between the protective clothing material and the chemical. Corrosion is a common example of chemical degradation. Degradation can be reduced by wearing materials resistant to the specific chemical. Penetration occurs through a physical hole in the protective layer. Points of penetration include unsealed seams, porous spots, as well as tears, rips, or punctures. Penetration can be remedied by a regular inspection program to detect damage and by physical hazard aversion. Leather work gloves over chemical resistant gloves can be used to prevent penetration.

Permeation can be described as the tendency of a chemical to reach equilibrium once a concentration gradient has been established across the fabric of the chemical protective gear. The rate at which the chemical permeates through the material is referred to as the permeation rate.

Notes

Permeation can be reduced by avoiding unnecessary contact with chemicals. Once a compound permeates a material, it usually remains in the material until it evaporates or is removed by thorough decontamination. Often, permeation results in a garment that is impossible to decontaminate, and thus the garment must be disposed of.

In addition to chemical resistance, physical compatibility of the protective garment must be considered. For example, polyvinyl alcohol (PVA) has good to excellent resistance to a large variety of chemicals. It has good resistance to heat and tears and is fairly resistant to punctures, cuts, and abrasion. Unfortunately, this material is soluble in water. Another example of incompatibility is diethylamine, which attacks the polycarbonate lens used in safety glasses, goggles, and face shields. The reaction causes the lens to become extremely brittle and to shatter at the slightest stress.

Choosing your Protection

The selection of PPE is a determination that should be made by a qualified individual considering the hazards and risks. Contact the Company Safety Department for assistance in selecting PPE for your work area appropriate to the chemicals you handle.

Hazards: The physical form of the potential contaminant must be considered. Airborne substances are more likely to be inhaled or contact the skin. Skin contact and contamination of laboratory coats and street clothing can be avoided by wearing chemical protective suits.

Effect of the contaminant on skin:

- Highly hazardous substances are those that are easily absorbed through the skin, causing systemic effects or causing severe skin destruction.
- Less hazardous substances are those that are not easily absorbed through the skin to cause systemic effects, or that do not cause severe skin destruction.
- Contact time also effects the degree of damage to the skin. The longer the material contacts the skin, the more likely it is to damage the skin.

Risks: Concentration of the contaminant: The higher the concentration, the higher the probability of injury.

Notes

Work function: Clean up activities dictate the probability of direct and indirect skin contact.

In situations where the type of chemical, concentration, and possibility for contact are not known, or where the proper PPE is not available, workers must notify the Company Safety Department for assistance with the spill. The safety department will make the determination if adequate resources exist within the work area & laboratory to respond to the spill or if an outside agency (Fire Department Hazardous Materials Team) must assist with the response.

Spill Containment / Control / Clean Up

Overview

This section provides a brief overview of several techniques that are designed to be utilized within short periods of time with equipment and materials readily available to the worker. This section specifically addresses chemical spills in Company chemical laboratories and other work areas where small quantities of hazardous materials are used.
Response to spills in the work area & laboratory can be broken down into three phases; containment, control, and clean up.

Containment

Containment is prevention of the spread of hazardous materials from the site of the spill. This is usually accomplished by using a physical barrier to contain the material to the spill area. If the spill cannot be approached and the material is spreading, the barrier can be established downgrade from the spill. This will contain the material once it reaches the barrier. Barriers should also be established around floor drains to prevent hazardous materials from entering the drains. A spill of a flammable material such as acetone or hexane into a drain could result in a serious explosion if an ignition source is present. Sink drains should also be guarded from hazardous materials if the spill occurs on a work area & laboratory bench top.

Containment of a spill is needed to ensure protection of personnel, property and the environment. The more efficient the containment, the greater the protection.

Notes

The advantages of prompt containment of hazardous materials spills are:

- Minimizes damage to Company property.
- Minimizes opportunity for contaminant to reach a floor or sink drain, and leave the facility.
- Prevention of dispersion of the contaminant, thus decreasing the potential for worker exposure and reducing cleanup costs.

Weighted drain covers and absorbent socks or pillows are the items most commonly used to contain a spill or prevent it from reaching a sensitive receptor (floor drain).

Some chemicals, such as ethyl ether, are extremely volatile and evaporate very quickly. When spills of extremely volatile chemicals are contained to the inside of a work area & laboratory hood, allowing the material to evaporate is a response that should be considered.

Each hazardous materials spill is unique, so no hard and fast rules are possible. However, techniques using weighted drain covers and absorbent socks or pillows for reducing the migration of contaminants have been successful. These techniques can be used as stop- gap measures to reduce migration of contaminants until other aid can arrive, or, if situation warrants, to provide adequate cleanup of situations that the workers at the scene know can be handled safely with available equipment. In order to determine the best method of containment using the available resources, the clearest assessment possible of the situation must be made. At a minimum, this assessment should include: identification of all involved materials; the physical properties of the materials being released (specifically vapor density, vapor pressure, specific gravity, flashpoint, boiling point, compatibility's, reactivities, and solubility); and the conditions in the work area & laboratory (floor drains, ventilation systems, etc.).

Control

The control phase of a spill response involves stopping an ongoing spill or leak. In the work environment, this may include tightening the cap on a container that was tipping over to stop the leak or turning a can containing a liquid upside down to prevent leakage along the bottom of the container.

Notes

Leaking containers can also be controlled by overpacking in larger containers. When overpacking, it is critical to select an overpack container that is compatible with the leaking material. The overpack container should be filled with a compatible absorbent material.

If you have a leaking container and must transfer the liquid to another container, be aware that a static electricity charge can build up from the movement of the liquid against the sides of the container. This charge can act as an ignition source in the case of flammable liquids. Containers should be grounded whenever a substance is being transferred to safely discharge the static electricity and to reduce the risk of fire or explosion.

Clean Up

The clean up of a chemical spill requires specialized equipment and trained personnel. Workers can perform several mitigative measures which do not involve contact with the spilled material, such as covering floor drains in the area of the spill. Evacuation of nearby workers and access control can be utilized to help reduce the dangers to workers. The total mitigation of such an episode, however, will require work within the area of the spill by trained personnel.

Liquid Spill Clean Up

Liquid spills are typically cleaned up using absorbents. Absorbents can include simple items such as paper towels, sawdust or vermiculite, to complex chemicals which treat the spill, thereby reducing the hazard in addition to absorbing the spill.

There are both advantages and disadvantages to the use of absorbents.

<u>Advantages:</u>

- Very easy to use; materials readily available.
- Some absorbents can reduce the hazard.

<u>Disadvantages:</u>

- Possible adverse reactions between sorbent and material.
- Impractical on large spills.

Notes

Clean up kits are present through out the work area & laboratory to address liquid spills of acids, caustics, and solvents. These kits contain neutralizing chemicals for the acid and caustic materials. Also included in the kit is a sorbent material similar to ground charcoal used to absorb organic solvents and lower the flash point. The Company uses _____ neutralizing and absorbing compounds.

The Cleanup Kits include containers of acid, caustic, and solvents absorbents. The kit also includes the basic equipment needed to clean up a spill, such as gloves, a plastic scoop, and plastic bags for containing waste material generated by the clean up. Familiarize yourself with the location of the nearest spill kit and the directions for the kit before a spill occurs.

After containing and controlling a spill, follow these basic clean up steps:

1. Remove the appropriate Cleanup Kit absorbent from the kit. Shake the absorbent container like a salt shaker, spreading a even layer of absorbent over the entire area of the spill. Watch for hazardous reactions to the absorbent such as heat, spattering or emissions of gases, vapors, or smoke. If hazardous reactions occur, stop the application of the absorbent and notify the Company Safety Department.
2. After the material has been completely absorbed, scoop the material into a plastic bag. Then place the scoop into the bag and seal the bag with a wire tie. Label the bag with the contents, date, and your name, and contact the Company Safety Department for removal of the waste.
3. The next step is to decontaminate the affected area. The decontamination process is detailed in the Decontamination section.

Fabric spill pillows are also available in the work area & laboratory and are an alternative to the Cleanup Kit absorbents for absorbing small spills. Spill pillows should only be used on aqueous liquids that are not corrosive or flammable. It is critical to ensure that the spill pillow is compatible with the spilled material.

Manufacturers will list the types of chemicals compatible with their pillows. Never use fabric pillows on a hydrofluoric acid spill. Special pillows have been developed which are compatible with hydrofluoric acid.

Mercury spills at the Company require special clean up procedures. The Company Safety Department has a mercury spill kit and is trained in the cleanup of mercury spills.

Notes

Solids Spill Clean Up

Spills involving solids in a work area or laboratory will generally include solid chemical reagents. Solid chemical reagents are not necessarily inert. Solids can be corrosive (sodium hydroxide and ammonium hydroxide pellets) or a poison (mercuric chloride or potassium cyanide). Therefore, extreme care must be taken to prevent exposures by the inhalation, ingestion or absorption routes of entry.

Solids spilled on the floor or bench tops should be cleaned up as soon as possible. This is important to ensure that the material is not spread throughout the work area. Generally, plastic scoops work best. A dust pan and brush are also useful in the work area & laboratory for clean up of solid materials. The use of brooms, brushes or shop vacuums is to be avoided if the material is toxic. Typical shop vacuums do not have filters capable of removing very small particles. The use of a shop vacuum could cause the material to become airborne resulting in worker inhalation exposures and dispersion of the material. Avoid the generation of airborne particulates when cleaning up a spill. If you expect that the material will become airborne and respiratory protection will be needed, contact the Company Safety Department immediately. The safety department has personnel trained in the use of respiratory protection who can safely respond to the spill.

To sanitize a piece of portable equipment, employees shall:

- Unplug electrically powered equipment, such as meat slicers.
- Remove fallen food particles and scraps.
- Wash, rinse, and sanitize any removable parts using the manual immersion method described in above.
- Wash the remaining food-contact surfaces and rinse with clean water. Wipe down with a chemical sanitizing solution mixed according to the manufacturer's directions.
- Wipe down all non-food contact surfaces with a sanitized cloth, and allow all parts to air-dry before reassembling. Sanitize cloth before and during sanitizing by rinsing it in the sanitizing solution.
- Re-sanitize the external food-contact surfaces of the parts that were handled during reassembling.
- Scrub wooden surfaces, such as cutting boards, with a detergent solution and a stiff-bristled nylon brush, then rinse in clear, clean water, and wipe down with a sanitizing solution after every use.

Notes

Decontamination

Section Overview

After the spill has been cleaned up, both you and the affected surfaces may require decontamination. Decontamination is the process of removing contamination from personnel, protective clothing, equipment, and work surfaces to prevent the spread of hazardous materials and the associated risk of exposure.

How do Personnel Become Exposed?

A person may become contaminated when hazardous materials enter the body through one of the following routes of exposure:

- **Inhalation**
  - Contact with vapors, gases, or particulates in air may allow contaminants to enter the respiratory system.
  - Removal of contaminated clothing may generate vapors in the breathing zone around the nose and mouth.
- **Direct Contact/ Absorption**
  - Contact with hazardous materials may permit contaminants to penetrate protective clothing.
  - Involvement in a hazardous materials incident may allow vapors to penetrate clothing and skin tissue.
  - Direct skin contact may allow chemicals to enter the bloodstream.
  - Clean up tasks increase the possibility of contamination.
  - Avoiding contamination, for example, not walking through spilled material, can reduce risk of exposure.
- **Ingestion**
  - The risk can be reduced by proper decontamination of hand and mouth areas and good hygiene.
- **Injection**
  - Avoiding contact with sharp objects that can puncture or cut through protective clothing and skin.

Notes

Prevention of Contamination

By practicing safety procedures which minimize the risk of contamination, workers can increase their protection factor against exposure to hazardous materials. The following are some examples of safe work practices.

- **Prevention of inhalation of hazardous materials:**
  - Avoid using clean up and decontamination methods which generate airborne particles, vapors, and gases.
- **Prevention of direct contact/ absorption of hazardous materials:**
  - Minimize personal contact with the hazardous material. Do not walk through puddles or spills.
  - Use remote clean up tools such as plastic scoops to prevent contact with protective clothing .
  - Use splash aprons to minimize contamination during clean up. They can be easily removed, and decontaminated and packaged for disposal.
- **Prevention of ingestion of hazardous materials:**
  - Keep food and beverages out of chemical handling areas. Be sure to wash your hands and face after cleaning up the spill.
- **Prevention of injection of hazardous materials:**
  - Exercise care near broken glass and other sharp objects. Many types of chemical protective clothing are easily penetrated by sharp objects. The protection of chemically-resistant materials is good only as long as the materials are not punctured or torn.

Notes

Methods of Decontamination

The decontamination method selected depends on the type of material that has been spilled. MSDS and chemical reference books can provide information on the selection of an appropriate method. The method of decontamination selected must be compatible with the material spilled and the conditions in the work area or lab.

Both the physical nature and toxicity of contaminants must be considered when choosing the appropriate decontamination methods. Utilizing soft- bristle brushes to wash with a mild detergent solution, followed by rinsing with water is the most common form of decontamination. However, the method chosen should be based on specific spill conditions. The following are the three most commonly used decontamination methods.

Dilution - The use of water to flush hazardous materials from the contaminated surface. It is the most common form of decontamination.

Advantages

- Readily available at most work area & lab. locations.
- Will not generate toxic fumes.
- Safe for personnel, protective gear, work surfaces and equipment.

Disadvantages

- Reduces contamination, but does not change chemical makeup.
- Complications with soluble compounds.
- Creates large amounts of potentially hazardous waste.
- Material must be soluble in the cleaning solution.
- Reaction with incompatible or water reactive materials such as heavy metals.

Chemical Degradation - The altering of the chemical structure of a contaminant to make it less hazardous.

Advantages

- Can permanently reduce the effects of a hazardous material.
- Can limit cleanup costs.
- Remaining material may be non-hazardous.

Disadvantages

- Should not be used directly on personnel.
- Requires chemical expertise.
- May produce other types of hazardous materials.

Notes

Neutralization - The introduction of another chemical to cause a chemical reaction, resulting in a less hazardous product.

Advantages

- Can eliminate the original hazardous properties of a material.
- Common neutralization materials are often readily available.

Disadvantages

- Will result in some form of heat exchange, sometimes posing an additional risk.
- Decontamination reagents may be hazardous.
- May give off toxic gases

Decontamination Equipment

The equipment available for decontamination will vary depending on the work area & laboratory and the types of chemicals handled in the work area or laboratory. Below is a list of equipment recommended for use in decontamination:

- Wash solutions, generally industrial strength detergents and water used on work surfaces and equipment.
- Rinse solutions to remove contaminants and contaminated wash solutions.
- Soft- bristle brushes to help wash and rinse off contaminants from work surfaces, gloves, and booties.
- Paper or cloth towels for drying protective clothing, work surfaces, and equipment.
- Collection containers, such as drums or lined trash cans, for storing disposable contaminated personal
- Containers to hold wash and rinse solutions for characterization prior to disposal.

- **Decontamination of Work Surfaces**
  Work surfaces must be thoroughly cleaned after removing the gross contamination during spill clean up and prior to reuse. Soft- bristle brushes and soap and water are the most typical method for cleaning work surfaces. Care must be taken to contain all wash and rinse water to the affected areas only. When possible, limit the volume of waste being generated, including liquids (wash and rinse waters) and solids (paper towels, sponges, brushes).

Notes

Decontamination of Protective Clothing

Expendable - Those pieces of protective gear which can be discarded should be decontaminated prior to disposal. Special disposal bags should be set aside for disposal of these materials. Final disposal must be arranged through the Company Safety Department.

Non-expendable - Clothing which will be reused must not only be decontaminated, but also sanitized.

- Instructions for sanitation by clothing manufacturer must be followed.
- Permeability and shelf- life data must be recorded.
- Seams must be thoroughly scrubbed.
- After cleaning, reusable protective clothing must be leak-tested according to the manufacturer's instructions.

Spill Reporting

Section Overview

All spills must be reported to the Company Safety Department by telephone after clean up. This is important to ensure that you have not been exposed or injured, and that the spill has been cleaned up in a manner that does not present future harm to Company workers or the environment.

Minor spills which are handled quickly are considered near miss accidents and may be an indication of potential for more significant incidents. Reporting these minor spills to the Company Safety Department will provide information regarding trends in the work area & laboratory and where remedial actions should be taken, such as modification of work practices, additional training on chemical handling and storage, and spill response.

Closure

In this lesson, we have reviewed:

- The differences between small scale spills and spills requiring assistance from a spill team.
- The initial response actions to be taken in the event of a spill.
- How to identify a hazardous material.
- Selection of PPE.
- Techniques to contain, control, and clean up spills.

Notes

In this lesson, we have reviewed: (continued)

- Decontamination required for work area & laboratory spills.
- Procedures for handling hazardous waste generated as a result of work area & laboratory spills.
- Reporting requirements for work area & laboratory spills.

The information presented in this lesson is designed to reduce the potential for injuries, illness or property damage in the event of a spill. If you have any questions concerning work area & laboratory spill response, contact the Company Safety Department.

What questions do you have?

Notes