Summary 10 – Accident prevention, safety training, personal protective equipment, legal aspects, safety inspections

Read Prudent Practices – Ch 6 p.131-7; Ch 8 p. 175-195
Read Safety in Academic Labs, Vol. 1, p.33-36
Read paper 11: “Managing Regulatory Compliance,” by Ralph Stuart

Chemical Safety Information on the Internet
1. The EPA issues safety alerts and bulletins
   http://yosemite.epa.gov/oswer/ceppoweb.nsf/content/ap-chsa.htm

The US Chemical Safety and Hazard Investigation Board is an independent federal agency which investigates chemical accidents
http://www.chemsafety.gov

Prudent Planning of Experiments – Accident Prevention

The risk associated with an experiment should be evaluated before the laboratory work begins. The hypothetical question "What would happen if... ?" should be asked before beginning an experiment and plans for appropriate emergency actions should be made. Four general rules are plan ahead, minimize exposure to chemicals, don’t underestimate risks, and be prepared for accidents.

Safety Training

Personal Behavior

Professional standards of personal behavior are required in any laboratory:

- Avoid distracting or startling other workers.
- Do not allow practical jokes and horseplay at any time.
- Use laboratory equipment only for its designated purpose.
- Do not allow visitors, including children and pets, in laboratories where hazardous substances are stored or are in use or hazardous activities are in progress.
- Make sure that teaching materials and publicity photographs show people wearing appropriate safety gear, in particular, eye protection.

Personal Protection Equipment - Minimizing Exposure to Chemicals

Eye Protection - Safety glasses with side shields must meet American National Standards Institute (ANSI) standard Z87.1-1989, the Standard for Occupational and Educational Eye and Face protection at a minimum. This standard sets minimum lens thickness and impact resistance requirements. Goggles are preferable over regular safety glasses. Full-face shields may be necessary for particularly dangerous lab
situations. Glassblowing, welding, the use of lasers or UV light sources demand special goggles.

**Minimize Ingestion** – lab glassware should never be used for food handling or storage. Ingestion of anything by mouth or chewing gum should not occur in the lab.

**Minimize Inhalation** – when necessary work in the hood to avoid inhaling dust or other hazardous substances. Hoods should not be used to dispose of hazardous chemicals via evaporation. Keep items at least six inches from the sash and never put your head inside the hood. Keep the hood open in the lowest position. The hoods should be free of clutter and should not be used for storage. They should be inspected regularly to make sure they are working properly.

**Minimize Injection** – properly dispose of sharps and broken glass

**Minimize Skin Contact** – wear appropriate gloves when handling hazardous chemicals, sharp objects, hot or cold materials and substances of unknown toxicity. Frequently inspect gloves for holes or tears. Wash gloves before removing them and before touching object such as doorknobs and pens. Take gloves off inside out with one glove inside the other. OSHA hand protection requirements are given in 29CFR 1910.132-138. Personal clothing, including shoes, should be fully covering. Lab coats should be fire resistant, removed before leaving the lab, and washed separately.

**GLOVE SELECTION** from http://www.allsafetyproducts.biz/site/323655/page/74172

- Select gloves which are resistant to the chemicals you may be exposed to. Consult the relevant Material Safety Data Sheet (MSDS) which may recommend a particular glove material.
- Select gloves of the correct size and fitting; gloves that are too small are uncomfortable and may tear whereas overlarge gloves may interfere with dexterity. In some cases, such as use of HF, it may be advisable to select gloves that can be removed very rapidly in an emergency.
- Before use, check gloves (even new ones) for physical damage such as tears or pin holes and for previous chemical damage: this is especially important when dealing with dangerous materials such as HF.
- When working, it may be advisable to wash the external surface of the gloves frequently with water.
- Some gloves, especially lightweight disposables, may be flammable: keep hands well away from naked flames or other high temperature heat sources.
- When removing gloves, do so in a way that avoids the contaminated exterior contacting the skin.
- Wash hands after removing gloves.
- Dispose of contaminated gloves properly.
- Do not attempt to re-use disposable gloves.
- Never wear possibly contaminated gloves outside of the laboratory or to handle telephones, computer keyboards, *etc.*
Selection Key:

4  Excellent, breakthrough times generally greater than 8 hours.
3  Good, breakthrough times generally greater than 4 hours.
2  Fair, breakthrough times generally greater than 1 hour.
1  Not Recommended, breakthrough times generally less than 1 hour.
?  Not Tested or Information unknown. Use known tested glove type.

GLOVE SELECTION GUIDE

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Safety and Emergency Equipment
Safety equipments such as spill control kits, fire extinguishers, respirators, safety showers, eye wash fountains and any other emergency equipment should be well-marked in a highly visible location. Fire alarms and emergency telephone numbers should be easily available.

Respirators – from:
http://www.ccohs.ca/oshanswers/prevention/ppe/respslet.html#top

Workers should use respirators for protection from contaminants in the air only if other hazard control methods are not practical or possible under the circumstances. Respirators should not be the first choice for respiratory protection in workplaces. They should only be used:

- when engineering or administrative controls are not technically feasible
- while engineering controls are being installed or repaired
- when emergencies or other temporary situations arise (e.g., maintenance operations).

How should you control respiratory hazards? Respiratory hazards can include airborne contaminants such as dusts, mists, fumes, and gases, or oxygen-deficient atmospheres. Well designed and maintained engineering controls are the preferred methods of controlling worker exposure to hazardous contaminants in the air. These control methods include:

- mechanical ventilation
- enclosure or isolation of the process or work equipment
- proper control and use of process equipment, and
- process modifications including substitution of less hazardous materials where possible.

Things that you should know before you choose a respirator: Employers should have a written respirator program that describes the proper procedures for selecting and operating respiratory protective equipment. The correct use of a respirator is just as important as selecting the proper respirator. Parts of the respirator program deal with finding out what hazards are present and how much protection that the workers will need. Other parts should describe how to wear and look after the respirator.

Without a complete respiratory protection program, people will probably not receive the best protection from a respirator even if it is the correct choice for a specific job. A respiratory protection program includes several components such as:

- hazard identification and control
- exposure assessment
- respirator selection
- respirator fit-testing
- training program
- inspection and record keeping
- cleaning and sanitizing respirators
- repairing and maintaining respirators
- proper storage of respirators
- health surveillance
- standard operating procedures (available in written form)
- program evaluation.

A physician should examine the medical and psychological fitness of workers. This should be done before they are assigned to work in areas where respirators may be required. The workers must be physically fit to carry out the work while wearing respiratory equipment. They must also be psychologically comfortable (e.g., not claustrophobic) about wearing respirators.

Workers with beards, long sideburns, or even a two-day stubble may not wear respirators because the hair breaks the seal between the skin and the respirator mask. Wearing eyeglasses would also break the respirator seal. This means that the respirator mask will "leak" and will not provide the needed respiratory protection. Also, if a worker has facial scars or an acne problem, the facial skin may not be able to form a good seal with a respirator mask.

**What are the different classes of respirators?**

The two main types are air-purifying respirators (APRs) and supplied-air respirators (SARs).

Air-purifying respirators can remove contaminants in the air that you breathe by filtering out particulates (e.g., dusts, metal fumes, mists, etc.). Other APRs purify air by adsorbing gases or vapours on a sorbent (adsorbing material) in a cartridge or canister. They are tight-fitting and are available in several forms:

- mouth bit respirator (fits in the mouth and comes with a nose clip to hold nostrils closed - for escape purposes only)
- quarter-mask (covering the nose and mouth),
- half-face mask (covering the face from the nose to below the chin), or
- full facepiece (covering the face from above the eyes to below the chin).

Respirators with a full facepiece also protect the eyes from exposure to irritating chemicals.

Supplied-air respirators (SARs) supply clean air from a compressed air tank or through an air line. This air is not from the work room area. The air supplied in tanks or from compressors must meet certain standards for purity and moisture content (e.g., CSA Standard Z180.1-00: Compressed Breathing Air and Systems).
Supplied-air respirators may have either tight-fitting or loose-fitting respiratory inlets. Respirators with tight-fitting respiratory inlets have half or full facepieces. Types with loose-fitting respiratory inlets can be hoods or helmets that cover the head and neck, or loose-fitting facepieces with rubber or fabric side shields. These are supplied with air through airlines.

Examples of these classes of respirators include:

Air-purifying respirators (APRs):

- particulate respirators (previously called dust, fume, and mist respirators or masks),
- chemical cartridge respirators that can have a combination of chemical cartridges, along with a dust prefilter: this combination provides protection against different kinds of contaminants in the air
- gas masks (contain more adsorbent than cartridge-type respirators and can provide a higher level of protection than chemical cartridge respirators)
- powered air-purifying respirators (PAPRs).

Supplied-air respirators (SARs):

- self-contained breathing apparatus (SCBA),
- airline supplied-air respirators,
- protective suits that totally encapsulate the wearer's body and incorporate a life-support system.

Laboratory Safety Inspection Programs

Good housekeeping is always a priority. Clean glassware and benchtops before leaving the lab.

**Items to Include in an Inspection Program**

1. Keep water in drain traps, especially infrequently used floor drains or sinks – this can be done by running water in a drain for 20-30 seconds. This minimizes vapors emitted from dry drains which may actually cause explosions.
3. Check for frayed cords and improper electrical connections.
4. Inspect gas tubing
5. Verify flammable materials are not near potential ignition sources.
6. Check safety devices on rotating equipment.
7. Test safety showers and eyewash stations. Inspect fire extinguishers and other safety equipment such as first aid kits, fire blankets and spill control kits.
8. Verify hoods are working correctly. Face velocities should be 80-100 feet per minute. If the face velocity is too small, vapors are not removed. If it is too large, turbulence, which reduces capture efficiency occurs.
9. Review the Chemical Hygiene Plan annually

Inspection programs can be conducted by supervisors or peers.