


Industrial Hygiene



Industrial hygiene

Concerns conditions related to workplace injury and sickness
e.g: exposures to toxic vapors, dust, noise, heat, cold, radiation, physical factors, etc.

ANTICIPATION	Expectation of hazard existence
IDENTIFICATION	Presence of workplace exposure
EVALUATION	Magnitude exposure
CONTROL	Reduction to acceptable levels

Chemical labs: requires co-operation from industrial hygiene, safety & lab operations people

Identification

Requires study of

CHEMISTRY	←	• Operating instructions
OPERATING CONDITIONS		• Safety reviews
OPERATING PROCEDURES		• Equipment description
		• Chemicals description MSDS's

<p>POTENTIAL HAZARDS</p> <ul style="list-style-type: none"> • liquids • vapors • dusts • noise • radiation • temperature • mechanical 	<p>HAZARD DATA</p> <ul style="list-style-type: none"> • physical state / vapor pressure • TLV's • temperature sensitivity • rate and heat of reaction • by-products • reactivity with other chemicals • explosion limits
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RISK ASSESMENT: potential for hazard to result in an accident

Evaluating Volatiles

Monitoring air concentrations ↔ Variation in time and place

Time Weighted Average


Continuous: $TWA = \frac{1}{8} \int_0^8 C(t) dt$ ppm or mg/m³

Intermittent: $TWA = \frac{1}{8} \sum_1^i C_i T_i$


Additive effect multiple toxicants: $\sum_1^i \frac{C_i}{(TLV - TWA)_i} < 1$

Mixture: $(TLV - TWA)_{mix} = \frac{\sum_1^i C_i}{\sum_1^i \left(\frac{C_i}{(TLV - TWA)_i} \right)}$ Equivalent

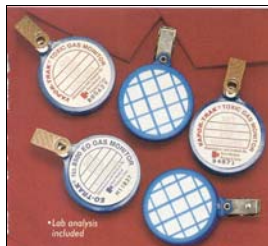
Colorimetric Tubes for Volatiles

Air Sampling Unit for Volatiles



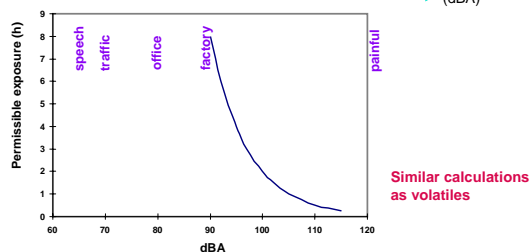
Badge Units for Volatiles



Evaluating Noise

NOISE PROBLEMS ARE COMMON IN CHEMICAL PLANTS

Relative Noise Intensity = $-10 \log \frac{I}{I_0}$ (dB) I_0 = hearing threshold (dBA)



Evaluating Noise



Hearing Conservation Program

Required by OSHA if noise exposure exceeds 90 dba.

Worker must have an annual physical.

Hearing Protection must be provided.

High noise area must be marked with signs.

Control

LABORATORY CONTROL TECHNIQUES

Environmental

- | | |
|----------------------|---|
| Substitution | Less toxic solvents, higher flash points |
| Attenuation | Boiling point reduction by vacuum |
| Isolation | Separate laboratories |
| Intensification | Reduce chemicals, small continuous reactors |
| Enclosures | Contain experiment in hood |
| Local ventilation | Hoods |
| Dilution ventilation | Ventilation in general laboratory |
| Good housekeeping | Keptoxics contained |

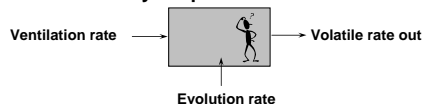
Personal protection

Last defense: always compromises workers

Ventilation

DILUTION Dilution below target concentration

Problems: Requires high air flow, high energy costs and workers always exposed



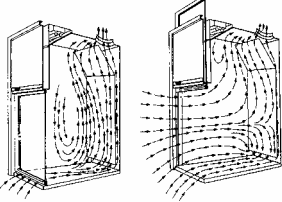
LOCAL Remove contaminant before exposure workers

Minimal air flow

Ventilation - Hoods

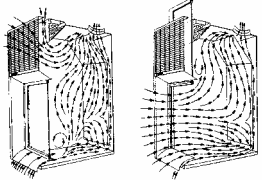
Face Velocity: Air velocity through hood opening.
Use 100 - 125 feet per min (fpm).

Standard Hoods




- * Sash and hood itself can be used to contain process.
- * Positive indication of hood function required by OSHA.
- * Hoods should not be used for storage of equipment or chemicals.

Ventilation - Hoods




Bypass Hoods: Air flow is adjusted as sash is moved. Some hoods have dynamic dampers to adjust airflow.



Ventilation - Hoods

Ventilation - Hoods




Hoods must have positive indication of hood function.

This is a manometer type indicator.

Colored fluid moves higher as air flow increases.

Ventilation - Hoods



Hoods must have positive indication of hood function.

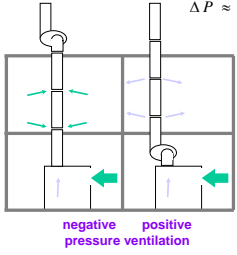
This is an electronic type indicator.

An alarm sounds if air flow is too low. This can be a problem if Physical Plant turns off hood.

Ventilation Systems

Must use negative pressure to insure no contaminant leakage.

$\Delta P \approx 0.01 \text{ atm}$



Ventilation - Airflow Measurement



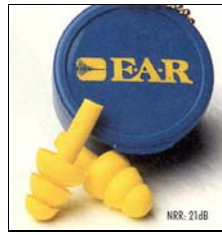
Velometer - can accurately measure air velocity.
For hoods, must measure at several locations and with different sash locations.

Ventilation – Elephant Trunks

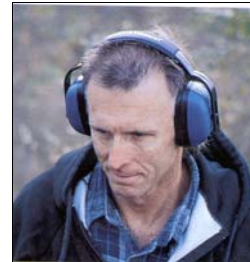


Provides a movable ventilation source that can be located very close to emission sources.

Noise Control - Earplugs



Noise Control - Ear Muffs



Noise Reduction Ratio (NRR)

Used for Personal Protective Equipment:

A particular hearing protector has an NRR of 18.
If the noise is 95 dba, what is the worker exposure?

$$95 \text{ dba} - 18 \text{ dba} = 77 \text{ dba}$$

Safety Showers / Eyewashes



Useful for fires and chemical spills.
For chemical spills, clothing must be removed.
Must be used, with assistance, for 15 min.
Minimum flows: Eyewash: 4 gpm
Shower: 30 gpm

Both must be tested regularly.

Area around unit must be unobstructed.

Required within the lab if chemicals are used.

Safety Showers / Eyewashes

Water must continue to flow once handle is released.

Current OSHA standard requires water temperature control.

Problems with:

- Dirty water
- Rust from pipes
- Water temperature



Flammable Storage Cabinets



Offers protection from external fire.

Must be electrically grounded to prevent static accumulation.

Vent hole is left closed, unless stored materials have an odor, in which case the vent is connected to the ventilation system.

Do not store anything on the top.

Store only flammables, nothing else.

Corrosive Storage Cabinets



Used to store acids and other corrosives.

Do not store anything on top of cabinet.

Safety Cans



Use to store bulk flammable solvents.

Container provides protection from external fire.

Difficult to pour into and out of.

Eye Protection



Provide eye protection against flying objects, liquid chemicals, light radiation, etc.

Safety glasses must be ANSI rated (ANSI Z87).

Must include permanently affixed side shields.

Must be worn at all times in the lab.

Contact lens usage is unclear.

Eye Protection - Goggles



These provide additional protection over safety glasses.

Can be worn over safety glasses.

Come in vented and unvented styles.

Eye Protection - Face Shield



Provides additional, full face protection.

Eye Protection - Accessibility



This storage rack is mounted near the door of the laboratory. It provides access to safety glasses for all who enter.

Skin Protection - Gloves



Gloves protect the hands against chemical, mechanical, electrical and thermal hazards.

Come in many styles, shapes and materials.

Must be compatible with chemical used. See chart in Safety Manual.

Spill Kits



Provide materials to clean up chemical spills. Required if you use chemicals in the laboratory.

Spill Kits



- Usually includes:
- * Absorbent spill blankets
 - * Spill dams or pigs.
 - * PPE for cleanup.
 - * Disposal materials.

Fire Extinguishers



Several Types:

- A: Wood, cloth, paper.
- B: Gas, liquid, grease
- C: Electrical fires

Our labs have type ABC.

Must be sized correctly for lab area

Must be inspected monthly.

Must be free of obstructions.

Fire Extinguisher Usage



Must direct fire extinguisher discharge at base of flames, not at the flames.



Broken Glass Disposal



The box is disposed of directly so that the janitor is protected from the broken glass contents.

Get box from Chemical Stores.

Glass Storage



Labeling of All Power Boxes



MSDS Library



Required by regulation.

Labeling of All Chemical Storage

