# Chemical Safety

## What you don't know can hurt you

Michael J. Russell

Director

Dept. of Environment, Health & Safety

University of Kansas – Lawrence Campus

# Introduction 1

Chemicals are all around us.

- In the food we eat.
- The clothes we wear.
- The vehicles we drive.
- In the products we use everyday.

Chemicals can help us live better lives, but we must understand and respect their potential hazards.

Otherwise, they can harm us.

# Introduction 2

More than 30 million workers are potentially exposed to one or more chemical hazards.

There are an estimated 650,000 existing hazardous chemical products, and hundreds of new ones are being introduced annually.

This can pose a potential serious problem for exposed workers and their employers.

# Introduction 3

Are you at risk because you work with chemicals?

The answer is: Yes

How much risk?

It Depends! (Sorry, but it is not a simple answer.)

This program will attempt to provide some basic information to address your concerns about working with hazardous chemicals. Hopefully, it will help you better understand them so you can use them safely and limit your risks.

# Chemical Safety

Chemical - any element, chemical compound, or mixture of elements and/or compounds.

Safety - being secure from undergoing or causing hurt, injury, or loss.

Hazard - An item or condition which poses potential risk to safety or health.

**Chemical Safety** - being secure from undergoing or causing hurt, injury, or loss when working with elements, chemical compounds, or mixtures of elements and/or compounds.

**Chemical Hazards** - elements, chemical compounds, or mixtures of elements and/or compounds which poses potential risk to safety or health.

# Regulations

OSHA Hazard Communication Standard

29 CFR 1910.1200 - Hazardous Chemicals in the Workplace - “Employee Right to Know”

OSHA Chemical Hygiene or Lab Standard

29 CFR 1910.1450 - Occupational exposure to hazardous chemicals in laboratories

Also 30 OSHA Substance Specific Standards

Also OSHA Air Contaminants (500+)

# "Hazardous Chemical"

Simple Definition - elements, chemical compounds, or mixtures of elements and/or compounds which poses potential risk to safety or health.

Regulatory Definition - means any chemical which presents a physical hazard or a health hazard.

# Hazardous Chemical

## What is a physical hazard?

"Physical Hazard" means a chemical for which there is scientifically valid evidence that it is a:

- Combustible liquid
- Explosive
- Organic peroxide
- Pyrophoric
- Compressed Gas
- Flammable
- Oxidizer
- unstable (reactive) or water-reactive.

# Hazardous Chemical

## Physical Hazard Categories

***Fire Hazards***

- Flammable gas
- Flammable aerosol
- Flammable solid
- Flammable liquid
- Combustible liquid
- Oxidizer
- Pyrophoric

# Hazardous Chemical

## Physical Hazard Categories

***Explosion Hazards***

- Compressed gas
- Explosive

***Reactive Hazards***

- Organic peroxide
- Unstable (reactive)
- Water-reactive

# Hazardous Chemical

## What is a health hazard?

"Health Hazard" means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. Includes:

| | | |
|---|---|---|
| Carcinogens | Toxic or highly toxic agents | Reproductive toxins |
| Irritants | Corrosives | Sensitizers |
| Hepatotoxins | Nephrotoxins | Neurotoxins |

Hematopoietic system agents

Agents which damage the lungs, skin, eyes, or mucous membranes.

# Hazardous Chemical

## Health Hazard Categories

### *Systemic Effects*

- Carcinogen
- Toxic agent
- Highly toxic agent
- Corrosive
- Irritant
- Sensitizer

# Hazardous Chemical

## Health Hazard Categories

***Target Organ Effects***

- Hepatotoxin - liver
- Nephrotoxin - kidneys
- Neurotoxin – nervous system
- Blood/hematopoietic toxin – hemoglobin/oxygen
- Respiratory toxin – pulmonary (lungs)
- Reproductive toxin – organs, chromosomes, fetus
- Cutaneous hazard – dermal layer (skin)
- Eye hazard – eye or visual capacity

# Hazardous Chemical

## Health Hazard Categories

**Other Health Effects**

- Cardiovascular toxicity
- Immunotoxicity
- Connective tissue effects
- Sensory organ toxicity (sight, hearing, taste)
- Gastrointestinal toxicity
- Skeletal/muscular effects
- Endocrine system toxicity

# Hazard Information 1

How can you tell if the chemical you are working with is hazardous?

- Perform a Hazard Determination
- Review the Container Label
- Review the Material Safety Data Sheet
- Contact EHS Dept.

# Hazard Determination 1

## Hazard Determination

Chemical manufacturers and importers are required to evaluate chemicals they produce or import to determine if they are hazardous.

This includes assessment for both physical and health hazards.

# Container Labeling 1

The chemical manufacturer, importer, or distributor is required to ensure that each container of hazardous chemical leaving their workplace is labeled, tagged or marked with the following information:

- Identity of the hazardous chemical(s);
- Appropriate hazard warnings; and
- Name and address of the responsible party (manufacturer, importer, other).

# Container Labeling 2

In the workplace or lab, each container of hazardous chemicals must be labeled, tagged or marked with the following information:

- Identity of the hazardous chemical(s) contained therein; and,
- Appropriate hazard warnings,

# Container Labeling 3

If it is in its original container as provided from the manufacturer, then maintain the original label.

If you dispense it into another container, then make sure it is immediately, appropriately labeled with:

- Identity of the hazardous chemical(s) contained therein; and,
- Appropriate hazard warnings,

# MSDS Information 1

## What is an MSDS?

"Material safety data sheet (MSDS)" means written or printed material concerning a hazardous chemical which is prepared in accordance with the OSHA Hazard Communication Standard {29 CFR 1910.1200(g)}.

# MSDS Information 2

Chemical manufacturers and importers shall obtain or develop a material safety data sheet for each hazardous chemical they produce or import.

Employers shall have a material safety data sheet in the workplace for each hazardous chemical which they use.

They shall be “readily accessible” during each work shift to employees when they are in their work area(s). (Electronic access, microfiche, and other alternatives to maintaining paper copies of the material safety data sheets are permitted as long as no barriers to immediate employee access in each workplace are created by such options.)

# MSDS Information 3

MSDS Format

There are basically two formats for MSDS's, neither of which are mandatory yet (required by regulation).

- OSHA Non-Mandatory MSDS Format (OSHA Form 174).
- ANSI Recommended MSDS Format (ANSI Z400.1-1998)

# MSDS Information 4

OSHA FORM 174 - MSDS Format (non-mandatory)

- Section I - Manufacturers Information
- Section II - Hazardous Ingredients/Identity Information
- Section III - Physical/Chemical Characteristics
- Section IV - Fire and Explosion Hazard Data
- Section V - Reactivity Data
- Section VI - Health Hazard Data
- Section VII - Precautions for Safe Handling and Use
- Section VIII - Control Measures

# MSDS Information 5

**ANSI MSDS Format** (Recommended in ANSI Z400.1-1998)

- SECTION 1: PRODUCT AND COMPANY IDENTIFICATION
- SECTION 2: COMPOSITION/INFORMATION ON INGREDIENTS
- SECTION 3: HAZARDS IDENTIFICATION
- SECTION 4: FIRST AID MEASURES
- SECTION 5: FIRE-FIGHTING MEASURES
- SECTION 6: ACCIDENTAL RELEASE MEASURES
- SECTION 7: HANDLING AND STORAGE
- SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

# MSDS Information 6

**ANSI MSDS Format** (Recommended in ANSI Z400.1-1998)

- SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES
- SECTION 10: STABILITY AND REACTIVITY
- SECTION 11: TOXICOLOGICAL INFORMATION
- SECTION 12: ECOLOGICAL INFORMATION
- SECTION 13: DISPOSAL CONSIDERATIONS
- SECTION 14: TRANSPORT INFORMATION
- SECTION 15: REGULATORY INFORMATION
- SECTION 16: OTHER INFORMATION

# Hazardous Chemical

How do they harm or affect us?

***Must be an Exposure***

Routes of Exposure

- Inhalation
- Ingestion
- Body Contact
- Body Absorption

Physical Hazards – body contact via fire, pressure

Health Hazards – all the above

# Hazardous Chemical Exposure

***Dose x Exposure = Toxicity (Harm)***

Potential for experiencing adverse health effects from hazardous chemicals is dependent on the amount (dose or concentration) we are exposed to over the time we are exposed to it.

# Hazardous Chemical Exposure

## Exposure Limits

- Permissible Exposure Limits - (PEL's)
- Recommended Exposure Limits – (REL's)
- Threshold Limit Values - (TLV's)
- Short-Term Exposure Limits - (STEL's)
- Threshold Limit Value Ceiling - (TLV-C)

## Exposure Assessment

- Contaminant Sampling
- Air Monitoring
- Medical Surveillance

# Hazardous Chemical Protection

## Hazard Control

Methods, measures, practices, or procedures utilized to remove, prevent, or reduce employee exposure to safety & health hazards and environmental hazards (i.e., hazardous chemicals).

# Hazardous Chemical Protection

## Hazard Control Measures

Engineering Controls

Administrative Controls

Personal Protective Equipment

# Hazardous Chemical Protection

## Implementation of Hazard Controls Plan or Program

Defer to UNL Virtual Manual

Contact your

Environmental Health and Safety (EHS) Department !

# Chemical Safety 1

Because of the large number of chemicals in use on a campus, it is impractical to state how to properly store each one or what potential adverse health effects each chemical may have if mishandled.

For information on a specific chemical, you should consult the container label, MSDS, your supervisor or EHS.

Contact EHS Dept. if further assistance or information is needed.

# Chemical Safety 2

## Flammable Liquids

Solvents!

**Flammable Liquid, Class 1A**

flashpoint < 73 F, boiling point < 100 F

Ethyl Ether, Methyl Ethyl Ketone, t-Butyl methyl ether

**Flammable Liquid, Class 1B**

flashpoint < 73 F, boiling point > /= to 100 F

Acetone, Acetonitrile, Alcohols, Ethyl Acetate, Hexane, Petroleum Ether, Tetrahydrofuran

**Flammable Liquid, Class 1C**

flashpoint > 73 F, < 100 F, no bp limits

Amyl Acetate, Xylene

# Chemical Safety 3

## Combustible Liquids

Solvents!

**Combustible Liquid Class II**

flashpoint >/= 100 F, < 140 F, no bp limits

Dimethyl Formamide

**Combustible Liquid Class IIIA**

flashpoint >/= 140 F, < 200 F, no bp limits

Dimethylsulfoxide

**Combustible Liquid Class IIIB**

flashpoint >/= to 200 F, no bp limits

Chloroform, Methylene Chloride,
Propylene Glycol, Pump Oil

# Chemical Safety 4

## Corrosives

"A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. "

### Acids

Hydrochloric, Sulfuric,
Nitric, Perchloric
Hydrofluoric

Aqua Regia (HCl/HNO3)
Acid Pirahna (H2SO4/H2O2)
Acetic

### Bases

Sodium Hydroxide
Potassium Hydroxide

Base Pirahana (NH4OH/H202)
Ammonia

# Chemical Safety 5

## Highly Toxic Chemicals

1) LD(50) </= 50 mg/kg (oral) albino rats.

Sodium Cyanide 6.4 mg/kg

2,4 – dinitrophenol 30 mg/kg

2) LD(50)) </= 200 mg/kg (contact) albino rabbits.

Nicotine 50 mg/kg

3) LC(50) in air </= 200 ppm (gas/vapor) or

LC(50) in air </= 2 mg/l (mist/ fume/dust) inhalation albino rats.

Phosgene 3ppm

# Chemical Safety 6

## Toxic Chemicals

1) LD(50) >50 mg/kg </= 500 mg/kg (oral) rats.

Acrylamide 124 mg/kg

Formaldehyde 100 mg/kg

2) LD(50)) >200 mg/kg </= 1,000 mg/kg (contact) rabbits.

Phenol 630 mg/kg

3) LC(50) in air >200 ppm </= 2,000 ppm (gas/vapor) or

LC(50) in air >2 mg/l </= 20 mg/l (mist/ fume/dust) inhalation rats.

Hydrazine 570 ppm  Hydrogen Sulfide 444 ppm

Methanethiol 675 ppm

# Chemical Safety 6

## Carcinogens

OSHA Carcinogens

4-Nitrobiphenyl,

methyl chloromethyl ether,

bis-Chloromethyl ether,

Benzidine,

Ethyleneimine,

2-Acetylaminofluorene,

N-Nitrosodimethylamine,

alpha-Naphthylamine,

3,3'-Dichlorobenzidine (and its salts)

beta-Naphthylamine,

4-Aminodiphenyl,

beta-Propiolactone,

4-Dimethylaminoazo-benzene,

IARC List (102 Known, 68 probable, 245 possibles)

NTP List (58 Known, 188 reasonably anticipated)

# Chemical Safety 7

## Teratogens & Mutagens

Teratogens - can cause malformations of an embryo or fetus.

Acetaldehyde, Acetonitrile, Adriamycin, Heavy Metals, Cannabis, Dimethyl sulfoxide, Ethylene oxide, Formaldehyde, Ketamine,

d-Limonene, Methylene chloride, Naphthalene, Nicotine, Phenol, PCBs, Tinactin, Tropacaine hydrochloride, Zinc oxide, etc.

Mutagens can cause an increase in the rate of change in genes (subsections of the DNA of the body's cells). These **mutations** (changes) can be passed along as the cell reproduces, sometimes leading to defective cells or cancer.

| | | |
|---|---|---|
| Sodium azide, | Ethidium bromide, | Nitrous acid, |
| UV Radiation, | Gamma and Alpha Radiation, | |
| Transposons, | Bromine and some of its compounds, | |
| Bromouracil, | Vinca Alkaloids, | |

# Chemical Safety 7

## Irritants & Sensitizers

"Irritant:" A chemical, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

"Sensitizer:" A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical