

## Module 4: Hazards in the Work Environment Occupational Hazards

### → Types of Hazards

**Safety hazards:** Based on the nature of the work, safety hazards are due to material handling, machines, energy, work practices, and confined spaces.

**Material handling hazards:** These can lead to muscle strains due to lifting and carrying materials. The use of devices such as forklifts, cranes, etc. exposes the worker to accidental contact with the moving equipment.

**Machine hazards:** Rotating shafts, moving belts, presses, etc. can cause very serious injuries. Energy hazards: All energy sources such as electricity, steam, hydraulic pressure, etc. can lead to serious injury.

**Work practice hazards:** Failure to follow safe operating procedures may lead to serious injuries.

**Confined space hazards:** In such spaces (for example, silos, storage tanks, pipelines etc.) hazards arise due to difficulty of entry and exit, build-up of hazardous materials and oxygen deficiency.

**Health hazards:** The extent of occupational health hazards varies with the type of activity. However, such hazards may have the potential to cause severe discomfort, illness, and lack of efficiency among workers. Based on the nature of the causative agent (or factor), occupational health hazards can be classified as physical, chemical, biological and ergonomic.

**Physical hazards** are due to the presence of physical agents such as pressure and temperature extremes, excessive noise and vibration, and exposure to radiation. **Chemical hazards** are due to the presence of chemical agents such as dust, fume, gas, mist, smoke and vapor.

**Biological hazards** are due to the presence of biological agents such as bacteria, molds and viruses.

**Ergonomic hazards** are due to ergonomic stresses such as fatigue and repetitious work.

### → Physical and Chemical

**Physical agents:** Radiation, vibration, heat, noise.

**Chemical agents:** Vapor, gas, fume, dust.

### → Physical Agents

**Hyperbaric:** defined as a pressure **higher** than normal atmospheric pressure. Mining and underwater workers may be exposed to hyperbaric conditions.

**Hypobaric:** defined as a pressure **lower** than atmospheric pressure. Hypobaric conditions are encountered by those working at high elevations such as ski instructors and airline pilots.

### → Chemical Agents

**Chemical hazards:** compressed gases, flammable and combustible materials, oxidizing materials, poisonous materials, corrosive materials, reactive materials.

**Chemical agents in the air:** fine particles, gases and vapors.

**Compressed gases:** chlorine gas are compressed and stored in cylinders under high pressure. Chemical and pressure hazard.

**Oxidizing materials:** fire hazards, destroy biomolecules in living systems (potassium permanganate, hydrogen peroxide)

**Poisonous materials:** dangerous to life in very small amounts (potassium cyanide, mercury)

**Corrosive materials:** cause detonation of materials also living tissue on contact (sulfuric acid, potassium hydroxide)

**Reactive materials:** may undergo rapid and violent reactions. Alkali metals react with water producing flammable hydrogen gas.

**Fine particles:** less than 5 microns ( $5 \times 10^{-6}$ m), effective entry in lungs (dust, fume, smoke, mist), spray painting (mist), welding (fume), incomplete combustion of oil (smoke), gridding (dust)

**Gases and vapors:** Enter bloodstream through lungs. Solvent degreasing (vapors), spray painting (vapors), welding (gaseous combustion)

### → Biological agents

Biological agents are living organisms, or substances produced by such organisms, that can cause illness or disease in humans. The adverse health effects due to biological agents may range from allergic reactions to serious medical conditions and even death. Food poisoning, rabies, tuberculosis and hepatitis are some of the infections caused by biological agents.

**These include:** bacteria, fungi, viruses and other micro-organisms and their associated toxins

**Workplace Exposure:** many micro-organisms pose a potential danger in a variety of workplaces due to their ability to: Reproduce rapidly Survive with minimum resources

### → Ergonomic Stresses

**It has been established** that ergonomics, properly applied, can help: **reduce** workplace injuries and illnesses; particularly back injuries and cumulative trauma disorder (CTD) affecting joints, muscles, nerves and tendons that can cause pain and swelling **improve** productivity and quality of work **increase** job satisfaction **satisfy** government regulations

### → Questions

1. An underwater worker working at a depth of 6,000 meters may be subjected to pressure conditions described as: Hyperbaric
2. Noise is a form of irregular vibration
3. Hazard posed by exposure to a virus is classified as Biological
4. Hazard posed by exposure to excessive noise is classified as: Physical
5. The hazard posed by metallic sodium (a dangerously reactive material) is classified as: Chemical
6. Incomplete combustion of oil generates: Smoke

## Toxicology

### → What is Toxicology?

**Toxicology** is the science that studies the properties and interactions of physical, chemical or biological agents.

**Toxicity** is the degree of danger of a material to injure a living organism by other than mechanical means.

### → Dose and Exposure

**Dose** is defined as the amount of toxicant(s) actually delivered to the target organ. The units used to express dose are mg/kg (mass of toxicant/body mass).

**Exposure** on the other hand is the total amount of the toxicant(s) present in the workplace. However, exposure does provide an indication of the dose. Higher the exposure, greater the probability of larger amounts being delivered to the target organ and hence higher the dose.

**The units:**  $\text{mg}/\text{m}^3$  and  $\mu\text{g}/\text{m}^3$  (mass of toxicant/volume of air) for particles ppm (parts per million); ppb (parts per billion) and percent (%) for gases and vapors.

### → Threshold Limit Values

In order to provide guidelines for controlling occupational health hazards, Threshold Limit Values (TLVs) for various physical and chemical agents have been developed by the American Conference of Governmental Industrial Hygienists (ACGIH).

*Example:* Which of the following statements is true based upon the information that the TLVs for two chemicals X and Y are 15 ppm and 5 ppm respectively? Y poses more risk than X  
*Therefore, the lower the TLV value, the more potentially dangerous (or high risk) the substance is.*

### → Duration of the Effect

**Acute:** effect appears soon after exposure, brief exposure to a high concentration.

**Chronic:** effects observed much later after exposure. Low repeated exposure over long period.

### → Physiological effects

**Hepatotoxins** affect the liver.

Asphyxiants, irritants, anesthetics, narcotics, systemics (organ damage), lung scarring agents, teratogens (mutations in newborns). Carcinogens (cause cancer), mutagens (DNA)

**Asphyxiants:** hinder the body in maintaining enough oxygen supply. Suffocation. (carbon monoxide, cyanides).

**Irritants:** cause eye, skin and mucous membrane irritation (ozone, hydrogen sulfite)

**Anesthetics:** these act as depressants (chloroform, alcohols)

**Narcotics:** habit forming depressants (morphine, demerol)

**Systemics:** cause organ or system damage (benzene, phenol)

**Lung scarring agents:** cause lung damage, lung cancer (mineral dust, asbestos)

**Carcinogenic:** cause cancer (ethylene, dibromide, vinyl chloride)

**Mutagenic:** change DNA (benzene, ethylene oxide)

**Teratogenic:** cause malformations in newborns (organic mercury, compounds, anaesthetic gases such as nitrous oxide)

→ **Questions:**

1. The units used to express dose are: mg/kg
2. The organization responsible for developing TLVs is abbreviated as: ACGIH
3. Science that deals with the properties and interactions of physical, chemical and biological agents is called: Toxicology
4. Habit forming depressants are classified as Narcotics
5. The lower the TLV value, the more potentially dangerous (or high risk) the substance is.

**Workplace Hazardous Materials Information System (WHMIS)**

Is a Canada-wide system developed over several years through the collective efforts of Labour, Industry, and Federal, Provincial, and Territorial Governments. Published in January 1988, it became legislation in October 1988.

→ **Workplace Hazards**

**The system consists of three key elements:** 1. cautionary labeling of containers of hazardous materials 2. provision of Material Safety Data Sheet (MSDS), which provides more detailed information on the hazardous nature of the material 3. provision of worker education program

→ **Hazard Symbols**

Class A: Content under high pressure.

Class B: May catch fire when exposed to heat, spark or flame.

Class C: May cause fire or explosion when in contact with wood, fuels.

Class D1: Poisonous substance, may be fatal or cause serious damage.

Class D2: Poisonous and infectious material. May cause irritation, cancer, birth defect.

Class D3: Poisonous and infectious material. May cause disease or serious illness.

Class E: Corrosive material. May cause burns to the eyes, skin.

Class F: May react violently causing explosion, fire or release of toxic gases, when exposed to light, heat, vibration or heat.

→ **The Material Safety Data Sheet (MSDS)** provides basic information on a chemical product.

→ **The Globally Harmonized System (GHS) for Hazard Classification and Labeling:** In 1992, the United Nations Conference on Environment and Development (UNCED) agreed to develop a Globally Harmonized System (GHS) for hazard classification and labelling. It is anticipated that such a system will facilitate safe use of chemicals and reduce trade barriers.

→ **Questions:**

1. WHMIS was developed through the collective efforts of: Labour, Industry and the federal, provincial and territorial governments
2. WHMIS was implemented with the goal of: Reducing the incidences of illnesses and injuries caused by the hazardous materials in the workplace
3. The acronym GHS (for hazard classification and labeling of hazardous materials) stands for: Globally Harmonized System
4. In the implementation of WHMIS, suppliers must provide hazard information through: Labels and MSDSs
5. In a successful implementation of WHMIS, employees handle controlled products safely and inform supervisors of damaged or missing labels and missing MSDS information.
6. In the workplace, employers must ensure availability and accessibility of MSDS information to employees
7. Confined space hazards arise due to: Oxygen deficiency
8. Potassium hydroxide is an example of a corrosive substance.
9. Oxidizing materials can contribute strongly to fire hazards and may possess the ability to oxidize and thus destroy the biomolecules in living systems.
10. Which of the following agents/factors have the potential to adversely affect a worker's health and/or well being? Physical, Chemical, Biological and Ergonomic
11. Which of the following statements is true for acute toxicity? Results from brief exposure to high concentrations of the contaminant
12. Substances hindering the body from maintaining an adequate supply of oxygen are classified as: Asphyxiants
13. Which of the following is a biological agent that can cause illness in humans--> Fungi