

Industrial Safety

For 4 class

Environmental and Pollution Engineering Techniques

From

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UNIT ONE

Fundamentals of Occupational Safety

Definition of Occupational Safety :Is a very important science designed to protect factory workers and work facilities from potential accidents that may cause injury to the worker or death and also damage , or the damage of the property of the establishment.

Why Safety ?

safety intervention in all areas of life, for example: when dealing with electricity and household appliances is necessary to follow the conditions of public safety and must read the manual in the devices to be used when dealing with it safety is always (first).

General Safety Steps.

- 1- The need to use protective equipment and personal safety during work.
- 2- The need for a first aid kit in the workplace.
- 3- The need to keep chemical substances and flammable materials away from the places where workers gather as a real threat to factories, facilities workers gather as a real threat to factories, facilities and workers.
- 4- The necessity of activating the concept of occupational safety within factories and establishments.
- 5- Training employees on the basics of occupational safety in emergencies such as evacuation and dealing with accidents as they occur.
- 6- The need to maintain coordination between the owners of factories or those responsible for them with the civil defense apparatus.
- 7- The need to work on the issuance of leaflets, posters and posters periodically and keep pace with developments in the work environment in the field of public safety.

General objectives of occupational safety.

1. Protecting the human element from occupational hazards.
2. Preserving the elements of the physical component of the establishments and the equipment they contain from damage and loss as a result of accidents.
3. Provide and implement all occupational safety and health requirements to ensure a safe environment for the prevention of risks to the human and material components.
4. Occupational safety and health as a scientific approach aims at establishing safety and security in the hearts of employees while carrying out their duties.

In order to achieve safety goals, you must ...

- 1- The proper and objective technical planning for the foundations of prevention in the establishments.
2. Legislation stemming from the need to implement this technical planning
- 3- Implementing the building based on the sound scientific foundations in the construction process, while providing specialized technical equipment to ensure the continuous implementation of occupational safety and health services.

UNIT TWO

Classified of occupational safety

1. Industrial toxicology
2. Gases, vapors, and solvents
3. Particulates.
4. Thermal radiation.

1-Industrial toxicology: Is the application of the principles and methodology of **toxicology** to understanding and managing chemical and biological hazards encountered at work. In other words, is the investigation of the toxicity of chemicals found at the work place.

Toxicity : the capacity of substance to harm or injure a living organisms ,when the substance reaches a sufficient concentration at a certain site in the body.

The sources of toxicity

A-Natural resources:

- 1- Animal sources such as snakes, scorpions, insects, fish and spiders
- 2- Vegetable source:
 - 2-1-High-end plants such as datura, poppy, poppy, cannabis, cocaine and tobacco.
 - 2-2-Stale plants such as algae, bacteria, fungi.
3. Metals: such as mercury, arsenic, copper lead, cobalt.
- 4- Some cosmic radiation such as ozone gas.

B-Industrial Sources>

Insecticides such as D.D.T This material is available on the market and is used to kill mice and insects and comes in the form of powder, folded, poisonous gases such as hydro-hydrogen, carbon monoxide, radiation from nuclear explosions, plastic materials and others.

There are three types of Toxic Hazardous Materials:

- Chemical Agents (poisons)
- Physical Agents (dusts, fibers, heat, noise, corrosive)
- Biological Agents (pathogens)

How toxicants enter organism?

- ❖ Inhalation (mouth or nose to lungs) then into blood.
- ❖ Ingestion (mouth to stomach) then into blood.
- ❖ Injection (cuts, punctures in skin) into blood.
- ❖ Dermal absorption (through skin) into blood.

Different toxic responses may arise from different:

Routes of exposure.

Frequencies of exposure.

Duration of exposure.

Effects of Toxicants.

Irreversible Effects

- Carcinogen - causes cancer
- Mutagen - causes chromosome damage
- Reproductive hazard - damage to reproductive system
- Teratogen - causes birth defects

May or may not be reversible

- Dermatotoxic – affects skin
- Hemotoxic – affects blood
- Hepatotoxic – affects liver
- Nephrotoxic – affects kidneys
- Neurotoxic – affects nervous system
- Pulmonotoxic – affects lungs

What are toxic control procedure?

Environmental Engineers must understand the potential toxicity (hazard) posed by a substance. They must then assess the risks to human health in specific occupational settings, considering the level duration and route of exposure and any other factors that influence the way that workers handle the substance. To evaluate the risks of adverse health effects from chemicals, one must be aware of the routes of entry into the body, duration of exposure, toxicity of the chemical, exposure limits, and odor threshold of the chemical.

2.Gases, Vapors, and Solvents

❖ A substance is a GAS if this is normal physical state at room temperature (25 degrees C) and one-atmosphere pressure.

Examples: CO, Cl, Oxygen, and Nitrogen.

❖ If substance is normally a liquid at normal temperature and pressure, then the gaseous component in equilibrium with liquid state is a VAPOR.

Examples: CCl₄, HCOH, and Benzene.

❖ Solvents are liquids in which a solute can be dissolved.

-Volatility

-Polarity (“like dissolves like”)

-Solubility

EVALUATION OF HAZARDS

- Toxicity of the substance
- Concentration in the breathing zone
- Manner of use
- Length of time of the exposure

- Control in place
- Employee susceptibilities

Health effects

1. direct contact with acid or alkaline chemicals can cause skin burns or irritation. If the chemicals are inhaled, they will cause harm to the lung tissues
2. Toxic metals (such as lead, cadmium, manganese and mercury) and organic solvents (such as benzene, toluene, etc) may affect the functions of the liver, kidneys and central nervous system of our body, resulting serious diseases
3. Some people may feel unwell or develop hypersensitive symptoms even if they are exposed to non-pathogenic microbial agents or chemical substances of a low toxicity (such small amounts of chemicals like ozone, dilute acids or alkalis)

CONTROL OF HAZARDS:

1. Assessment of risks to health - Employers should assess the risks to the health of their employees caused by exposure to air impurities at work
2. Implementation of control measures - employers should take appropriate measures such as replacing hazardous chemicals and processes with less hazardous ones, and reducing their employees' exposure by segregation or other means
3. Use of personal protective equipment such as(respirator, gloves, eye wear)

3-Particulates:

❖ Airborne particles have been identified as potential health hazards. With the rise of modern science, medical scientists have demonstrated the relationship between the chemical and physical characteristics of airborne particles and respiratory diseases

Generally, airborne particles are categorized into three main types:

1. Large particles: Particles greater than 100 microns in diameter include such things as hail, snow, room dust, and soot aggregates.
2. Medium particles. Particles that lie between 1 and 100 microns in diameter consist of pollen, large bacteria, coal dust, as well as dust
3. Small particles. Small particles are less than 1 micron in diameter include viruses, small bacteria, metallurgic fumes and dust, as well as paint pigments

Health Concerns

- ❖ Industrial workers are exposed to hazardous airborne particles on a daily basis. Given that there are an estimated 400,000 workers in the welding industry alone
- ❖ Airborne particles pose a variety of health concerns to workers in the welding industry, including:
 - Increased risk for developing lung cancer
 - Damage to nose, throat, and lungs
 - Metal fume fever

Control Methods

1. Air ionizers operate by creating negative ions and changing the polarity of airborne particles. By changing polarity, particles magnetically attract together, becoming too large to remain airborne and as a result falling out of a worker's breathing zone.
2. Fume arms, or lab hoods, are another option. These units are typically self-contained, 8- to 12-foot arms (snorkels) attached to a filtration system
3. Downdraft tables are self-contained units that draw air from the workplace in a downward direction through perforated tabletops. They maintain a powerful suction in an open workspace as the filtration system filters dust, fumes, and smoke away from operators' breathing zones

4-Thermal radiation:

- ❖ Heat is a form of energy and can produce heat in the working environment from natural sources such as sunlight or industrial furnaces such as others. The heat between these sources and objects in the working space is exchanged in known heat exchange methods (radiation-contact-load).
The temperature is meant to raise the temperature around the human being to an intolerable level, exposing it to many risks, the death of which may be its final stage.

Principles of Heat Control:

- ❖ Automation of work.
- ❖ Increase rest periods.
- ❖ Protect workers from exposure to high temperatures.
- ❖ Dimensions of workers with heart disease and kidneys to work in places where the temperature rises.
- ❖ A system for the exchange of workers who are exposed to heat in their workplaces, for example, a group works in front of the furnaces and then moved to work within the workshops and work group workshops in front of the furnaces and thus reduce the exposure to heat.
- ❖ Use personal protective equipment for workers to prevent high temperature.

Non-Ionizing Radiation

Non-Ionizing Radiation: Radiation is relatively low energy, so it does not have enough energy to ionize atoms or molecules and is present at the end of the electromagnetic spectrum. However, they are considered to be less dangerous than ionizing radiation, and increased exposure to non-ionizing radiation may cause health problems.

Examples about Non-Ionizing Radiation and there sources:

1. Ultraviolet: Comes from the sun, welding.
2. Visible Light: can be seen by humans, animals and other organisms. This type of light consists of seven colors: red, orange, yellow, green, blue, indigo and violet.
3. Infra-red: Everything on Earth gives off some amount of infra-red (IR) radiation. The human eye can't see most of the IR spectrum, but we can feel it as heat
4. Microwaves: comes from microwave ovens, radar, satellite
5. Radio Frequencies: AM and FM radio, Wi-Fi signals, cell phones
6. Extremely Low Frequencies: come from power line

The NIR Effect or Risk

The Damage from this type of radiations is largely confined to the eye and skin. Single photons of ultraviolet radiation can damage tissue through disruption of bonds within DNA molecules and give a long-term risk of cancer.

NON-IONIZING RADIATION HAZARD CONTROL:

a. Administrative control measure

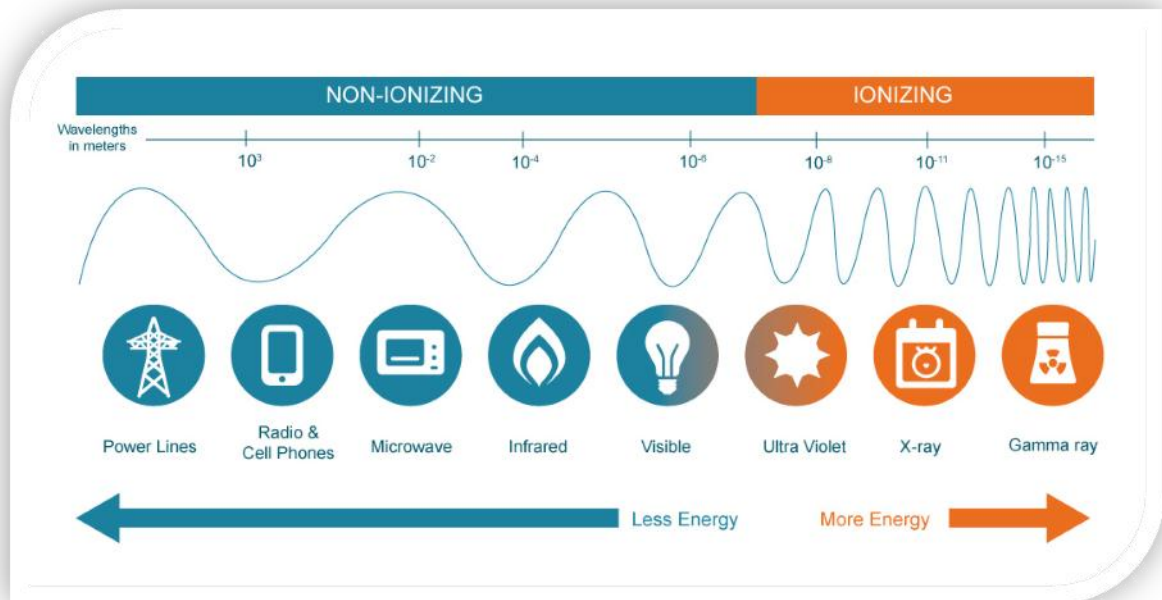
1. Hazard warning signs and lights
2. Distance as a safety factor
3. Limitation of exposure time

b. Engineering control measures

1. Shielded areas
2. Elimination of reflected non-ionizing radiation

c. Personal protection

1. For skin, the areas usually at risk are the backs of the hands, the forearms and the face and neck. The hands can be protected by wearing gloves. The arms should be covered with long sleeves of material with low radiation transmission. The face, on the other hand, can be protected by a face shield and this will also provide eye protection.
2. The eyes can be protected from the radiation by wearing goggles, or face shields.



Ionizing radiation:

- ❖ Carry positive and negative charges of high chemical activity, which leads to interaction with the components of living cells, causing damage to cells and death, and their types are
1. Alpha rays: It is possible to cause harm and damage to the health of the tissues during the simple path and the absorption of these rays on the outer part of human skin and therefore is not considered the particles of alpha damage outside the body, but can cause significant damage if inhaled or swallowed.
 2. Beta radiation: The penetration and penetration power of beta particles is greater than that of alpha rays. And some beta particles can penetrate the skin and damage it is very dangerous if inhaled fumes or swallowing the material that emits beta radiation.
 3. Gamma rays: have a very high penetration power and can easily penetrate the human body or absorption by tissue and therefore poses a high radiation risk to humans.
 4. X-rays: is one of the most exposed human sources of radiation as it is used in many industrial-medical processes.

Name	What is it?	Penetration depth in air	What blocks it?	Health effects
Alpha	Helium nucleus: 2 proton and 2 neutrons	8cm	paper, skin, clothing	can cause significant damage if inhaled or swallowed
Beta	High energy electron	1cm	3mm of aluminum, wood, glass	can penetrate the skin and cause skin burns
Gamma	Part of the Electromagnetic Spectrum	Unlimited	several meters of concrete or lead	high radiation risk such as cell damage
X-ray	Form of electromagnetic radiation	Unlimited	Lead	children are more sensitive to x-rays than adults

Radiation protection

❖ There are three ways to protect against the risk of radiation:

1. Time: If the exposure time is reduced, the amount of radiation to which the person is exposed will decrease.
2. Distance: The greater the distance between the person and the radioactive source, the lower the exposure.
3. Shields: Increasing the barriers around the radioactive source will reduce exposure. Each type of radiation has the appropriate barriers to isolate it by its ability to penetrate.

Laboratory Safety Procedures

- ❖ All workers in the laboratory must be aware of the dangers of radioactive materials that are dealt with.
- ❖ Prohibits eating, drinking and smoking as well as using cosmetics in the laboratory.
- ❖ The radioactive materials should not be handled by hand and the tweezers used for this should be used.
- ❖ Hands should be washed with soap and water after work is done.
- ❖ Radiation detection devices should be used by laboratory personnel.
- ❖ The appropriate warning signs must be installed at the laboratory entrance (CAUTION RADIO ACTIVE MATERIAL)
- ❖ The use of personal protective equipment needed to protect against radiation hazards (gloves, glasses, etc.)

UNIT THREE

BIOLOGICAL HAZARD

What is a biological hazard?

- Biological hazards, also known as biohazards, refer to biological substances that pose a threat to the health of living organisms, primarily humans.

Sources of biological hazards may include:

1- Bacteria 2- viruses 3-insects, 4-plants. 5-birds, 6-animals 7-humans.

These sources can cause a variety of health effects ranging from skin irritation and allergies to life threatening infections and illnesses.

Biological agents enter the body effect by being inhaled, injected or absorbed.

1-Once inside the body, these agents can multiply quick and can be spread from person to person.

2- Population in urban area is rising at a rate of 1 million people per week: with people living in close proximity, pathogens can more quickly spread as was experienced during the plaque and epidemics.

3-Urbanization causes for land and forest areas to be cleared: microorganisms living in the forests are forced to enter populated areas.

Classification of biological agents:

- Category A- infections substances affecting humans and animals
- Category B- infections substances affecting animals only
- Category C- biological substances transported for diagnostics or investigative purposes
- Biohazard level 1: bacteria and viruses with minimal precautions
- Biohazard level 2: bacteria and viruses causing mild disease
- Biohazard level 3: bacteria and viruses causing severe to fatal des ease to humans
- Biohazard level 4: bacteria and viruses that cause fatal disease to human with no available treatment

Some of the biggest;

- Influenza, or Spanish flu
- Yersinia pestis
- Avian influenza virus, or bird flu
- HIV/AIDS
- Severe acute respiratory syndrome, or SARS
- Ebola
- The plague

Prevention: How to Protect yourself?

1-Wash to Hand 2-Washing clothes 3-Use your get rid of the tools of acute.

4-Use of the tasks of the prevention of individual. 5-Procedures hygiene.

6-The organization of the process of waste disposal.

The limits of tools control engineering

- Gloves-Not the anti-doubt needles.
 - Needles secure-Only works if the user run the property of safety.
 - Containers needles- Could not work if the worker threw other things in the container such as paper or gauze or adhesive tape.
 - Gloves - must be wearing them for all purposes.
 - Glasses and protective face - must be wearing it at the presence of the risk of scattering liquid contaminated and his arrival membranes mucosa.
- All items that you be re-use - such as glasses, must be cleaned using liquid detergent and water.

UNIT FOUR

AIR SAMPLING

DIRECT-READING INSTRUMENT FOR GASES, VAPOURS, AND PARTICULATE

what is air sampling?

- Air sampling :- is capturing the contaminated in a known volume of air and measuring those contaminants as a concentration , all of which can cause potentially life threatening illnesses.
- Air sampling is a vital method of protecting workers from these potential hazards . By consistently measuring the concentration of airborne contaminants workers are exposed to, ensure that they remain at a safe level, preventing chronic respiratory diseases such as Asthma and Pulmonary fibrosis.
- Strict limits for exposure to hazardous substances published by regulatory authorities such as HSE , NIOSH, OSHA , or EPA.

AIR SAMPLING METHODS

- Filter sampling inhalable (total) dust
- Sampling repairable dust
- Filter sampling repairable (alternative method)
- Sorbent sampling
- Bag sampling
- Impinger /bubble sampling
- Other methods

1_Filter sampling inhalable (total) dust

When air drawn through a filter paper traps the solid particulate like dust, aerosols, fibers then measure its weight gain of filter

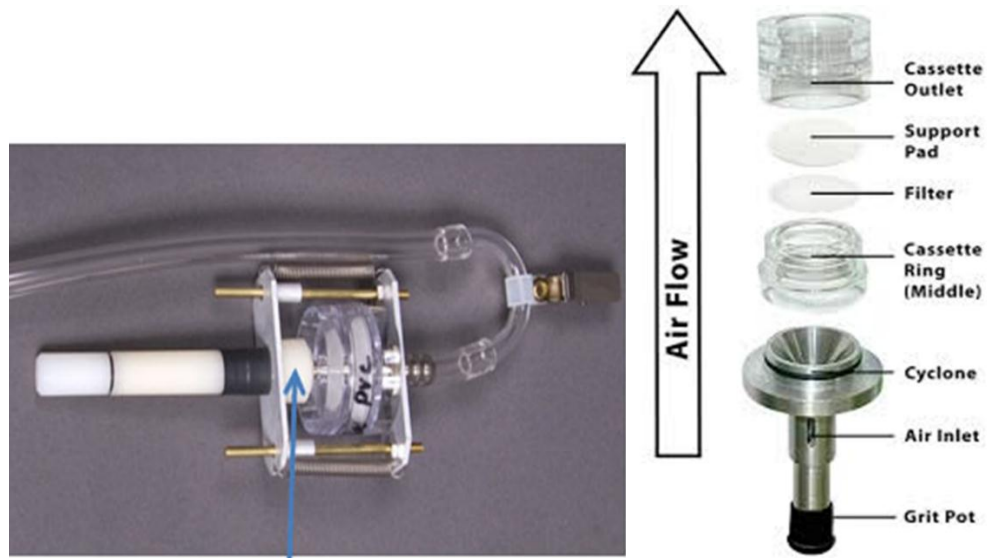


2_Sampling repairable dust

Sampler with a foam plug placed in the cassette inlet is capable of sampling repairable dust. Foam separates the repairable fraction it collected on the filter.

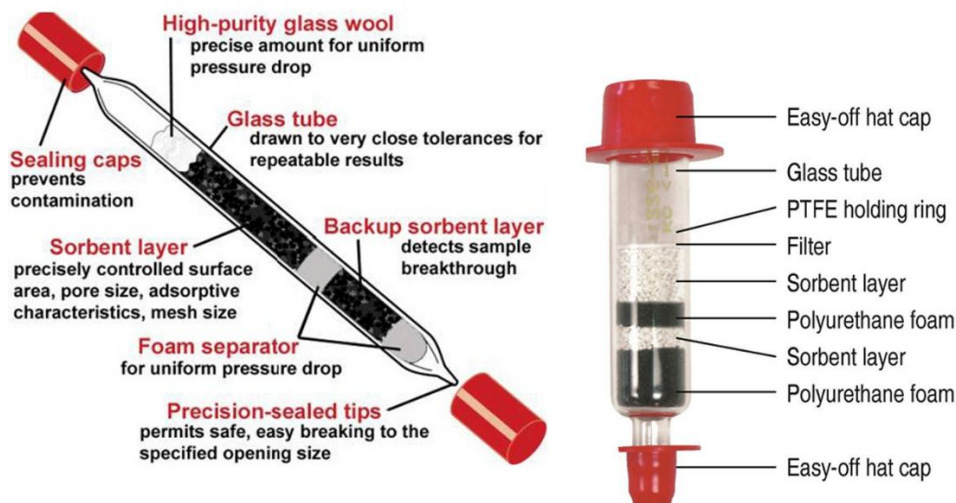
3_filter sampling respirable (alternative method)

The cyclone sampler uses a filter contained in a cassette, which separates out the respirable fraction of dust sample.



4_Sorbent sampling

Normally contained in small glass tube, when air reach it captures gas or vapor molecules



5_Impinger/ bubble sampling

Air drawn by force into the nozzle, which covered by high purity water. Pollutant dissolved into liquid the analysis by colorimetric techniques



6_Bag sampling

Suitable for 'grab' or short term samples (STS), to fill it use air passed through a pump. It'll contain a large volume of air samples.



There are three types of contaminants according to their physical properties:

- Particulate
- vapour
- Gases

Particulates can be further subdivided into five types:

- ❖ Aerosols
- ❖ Dusts
- ❖ Fumes
- ❖ Smokes
- ❖ mists

Calculations:

- **The volume of air sample:**

Volume of air sample = sample flow rate * sample time

- **Conversion of ppm (part per million) to mg (milligram):**

$Mg/m^3 = ppm * (\text{molecular weight} / 24)$

- **Time weighted average (TWA):**

$TWA = ((C1 * T1) + (C2 * T2) + \dots + (Cn * Tn)) / n$

Where C is the occupational exposure T is the time for that exposure.

UNIT FIVE

Noise pollution

Definition

Noise :- is a heterogamous mixture of sound with undesirable continuity, usually occurring due to industrial progress, the auditory or auditory pollution is closely related to the developed places and especially the industrial places. It is usually measured by volume standards, and the dB is the world-renowned unit for sound measurement and noise intensity.

Noise pollution: is defined as the unwanted sound dumped into the atmosphere that leads to health hazardous, Noise pollution or sound pollution any kind of human, animal or machine-generated sound that negatively affects human or animal life and distorts the balance. One of the most common forms of noise pollution is pollution, especially caused by motor vehicles.

According to the report of the world health organization (W.H.O) the global noise rate is as follows:

- from 25 to 40 acceptable in residential areas.
- from 30 to 60 acceptable in commercial areas.
- from 40 to 60 acceptable in industrial areas.
- from 30 to 40 acceptable in school districts.
- from 20 to 35 acceptable in hospital areas.

Causes of Noise Pollution:

1-**Industrialization:** Most of the industries use big machines which are capable of producing large amount of noise.

2-**Poor Urban Planning:** In most of the developing countries, poor urban planning also play a vital role.

3-**Social Events:** Noise is at its peak in most of the social events. Whether it is marriage, parties, pub, disc or place of worship.

4-Transportation: Large number of vehicles on roads, aeroplanes flying over houses, underground trains produce heavy noise and people get it difficult to get accustomed to that.

5-Construction Activities: Under construction activities like mining, construction of bridges, dams, buildings, stations, roads, flyovers take place in almost every part of the world.

6- Effect on Wildlife: Wildlife faces far more problems than humans because noise pollution since they are more dependent on sound. Animals develop a better sense of hearing than us since their survival depends on it. The ill effects of excessive noise begin at home. Pets react more aggressively in households where there is constant noise

The types of noise pollution

***Traffic noise pollution**

- 1.Road traffic noise pollution.**
- 2.Rail traffic noise pollution.**
- 3.Aircraft noise pollution.**
- 4.Transportation vehicle.**

***Natural noise pollution**

- 1.Solar noise.**
- 2.Cosmic noise.**
- 3.Wind noise.**
- 4.Animal sounds.**
- 5.Volcans and earthquakes noise.**

***Electronic noise pollution**

- 1.Tones noise.**
- 2.Microphons.**
- 3.loud speakers.**
- 4.shot noise.**

***Noise by period**

- 1.Continuous noise.**
- 2.Intermittent noise.**

***man made noise pollution**

1. Residual and community noise.
2. Firecracker noise.
3. Fire cracker.
4. Factories and industries.
5. Domestic noise pollution.
6. Consumer products noise pollution.
7. Noise in building.
8. Impulsive noise.

***Noise by frequency**

1. Low frequency noise .
2. High frequency noise.

Treatment of noise pollution

- 1- Prescribing noise limits for vehicular traffic.
- 2- Ban on honking (usage of horns) in certain areas.
- 3- Creation of silence zones near schools and hospitals.
- 4- Redesigning buildings to make them noise proof.
- 5- Reduction of traffic density in residential areas.
- 6- Giving preference to mass public transport system.
- 7- nanotechnology noise reduction.

THE CONCEPT OF SOUND

$$\lambda = \frac{c}{v}$$

where

λ = wavelength (m),

c = velocity of the sound in a given medium (m/s) , and

v = frequency (cycles/s).

Sound travels at different speeds in different materials, depending on such physical properties of the material as its modulus of elasticity.

EXAMPLE :

In cast iron, sound waves travel at about 3440 m/s What would be the wavelength of a sound from a train if it rumbles at 50 cycles/s and one listens to it placing an ear on the track?

$$\lambda = \frac{c}{v} = \frac{3440}{50} = 69m$$

the four important characteristics of sound waves are as follows:

1. Sound pressure is the magnitude or amplitude of sound.
2. The pitch is determined by the frequency of the pressure fluctuations.
3. Sound waves propagate away from the source.
4. Sound pressure decreases with increasing distance from the source.

The most important recommendations to reduce the impact of industrial noise :

- 1 . Attention to the periodic maintenance of machines that produce noise and installed on absorbent materials and soundproofing.
- 2 . Increase the distance between the worker and the machine.
- 3 . The use of sound absorbent materials in the walls and ceilings.
- 4 . Require employees to use personal protective equipment (earplugs), which reduce the sound intensity about 20 dB .
- 5 . The use of ear covers (consisting of two layers between the material absorbs sound) leads to a lack of sound intensity of about 35 dB

UNIT SIX

Control of Hazard in work place

What is a hazard control program?

A hazard control program consists of all steps necessary to protect workers from exposure to a substance or system, the training and the procedures required to monitor worker exposure and their health to hazards such as chemicals, materials or substance, or other types of hazards such as noise and vibration. A written workplace hazard control program should outline which methods are being used to control the exposure and how these controls will be monitored for effectiveness.

How do I know what kind of control is needed?

Selecting an appropriate control is not always easy. It often involves doing a [risk assessment](#) to evaluate and prioritize the hazards and risks. In addition, both "normal" and any potential or unusual situations must be studied. Each program should be specially designed to suit the needs of the individual workplace. Hence, no two programs will be exactly alike.

Choosing a control method may involve:

- Evaluating and selecting temporary and permanent controls.
- Implementing temporary measures until permanent (engineering) controls can be put in place.
- Implementing permanent controls when reasonably practicable.

For example, in the case of a noise hazard, temporary measures might require workers to use hearing protection. Long term, permanent controls might use engineering methods to remove or isolate the noise source.

What are the main ways to control a hazard?

1. **Elimination (including substitution):** remove the hazard from the workplace, or substitute (replace) hazardous materials or machines with less hazardous ones.

2. Engineering Controls: includes designs or modifications to plants, equipment, ventilation systems, and processes that reduce the source of exposure.

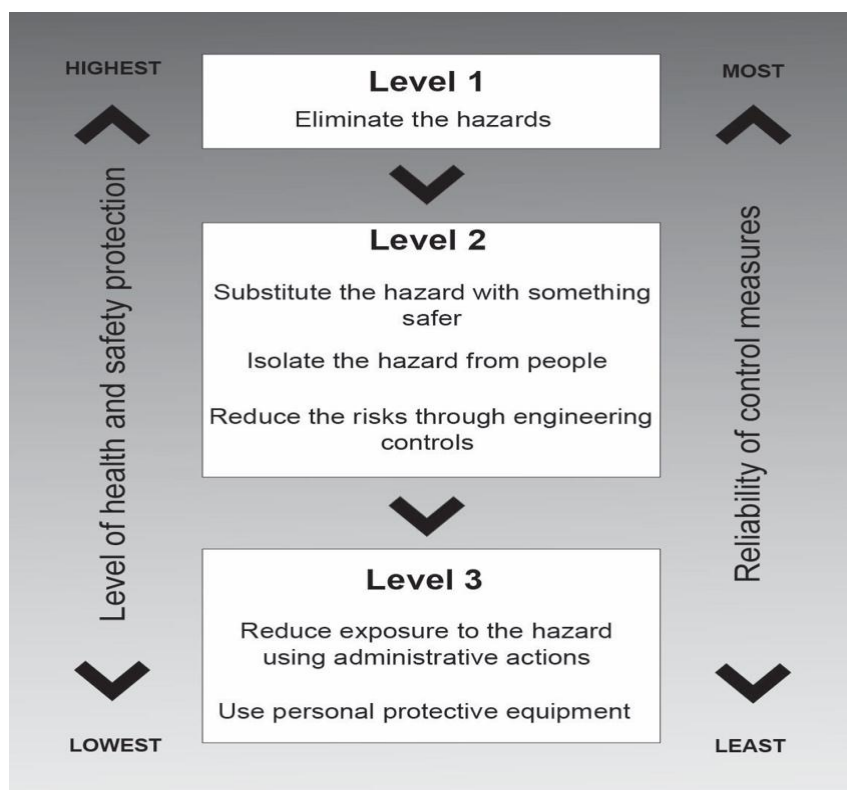
3. Administrative Controls: controls that alter the way the work is done, including timing of work, policies and other rules, and work practices such as standards and operating procedures (including training, housekeeping, and equipment maintenance, and personal hygiene practices)

4. Personal Protective Equipment: equipment worn by individuals to reduce exposure such as contact with chemicals or exposure to noise

These methods are also known as the "**Hierarchy of control**" because they should be considered in the order presented (it is always best to try to eliminate the hazard first, etc.).

The Hierarchy of risk control

The ways of controlling risks are ranked from the highest level of protection and reliability to the lowest as shown in the Figure. This ranking is known as the hierarchy of risk control.



What is meant by Elimination?

Elimination is the process of removing the hazard from the workplace. It is the most effective way to control a risk because the hazard is no longer present. It is the preferred way to control a hazard and should be used whenever possible.

What is Substitution?

Substitution occurs when a new chemical or substance that is less hazardous is used instead of another chemical. It is sometimes grouped with elimination because, in effect, you are removing the first substance or hazard from the workplace. The goal, obviously, is to choose a new chemical that is less hazardous than the original.

Benefits of risk management

Managing risks helps businesses to:

- 1.Prevent and reduce the number and severity of workplace injuries, illnesses and associated costs.
- 2.promote worker health, wellbeing and capacity to work
foster innovation, quality and efficiency through continuous improvement.

UNIT SEVEN

Accident investigation in work place

Accident investigation: is a factor in determining the causes of similar incidents in the future and determine the preventive work and continuous improvement of the work environment and safety system.

Reasons to investigate a workplace incident include:

- 1.** Most importantly, to find out the cause of incidents and to prevent similar incidents in the future.
- 2.** To fulfill any legal requirements.
- 3.** To determine the cost of an incident.
- 4.** To determine compliance with applicable regulations (e.g., occupational health and safety, criminal, etc.)
- 5.** To process workers' compensation claims.

Who should do the investigating?

Ideally, an investigation would be conducted by someone or a group of people who are:

- 1.** experienced in incident causation models,
- 2.** experienced in investigative techniques,
- 3.** knowledgeable of any legal or organizational requirements,
- 4.** knowledgeable in occupational health and safety fundamentals,
- 5.** knowledgeable in the work processes, procedures, persons, and industrial relations environment for that particular situation

Why look for the root cause?

An investigator or team who believe that incidents are caused by unsafe conditions will likely try to uncover conditions as causes. On the other hand, one who believes they are

caused by unsafe acts will attempt to find the human errors that are causes. Therefore, it is necessary to examine all underlying factors in a chain of events that ends in an incident.

What are the steps involved in investigating an incident?

1. Report the incident occurrence to a designated person within the organization.
2. Provide first aid and medical care to injured person(s) and prevent further injuries or damage.

The incident investigation team would perform the following general steps:

1. Scene management and scene assessment (secure the scene, make sure it is safe for investigators to do their job).
2. Witness management (provide support, limit interaction with other witnesses, interview).
3. Investigate the incident, collect data.
4. Analyze the data, identify the root causes.
5. Report the findings and recommendations.

The organization would then:

- Develop a plan for corrective action.
- Implement the plan.
- Evaluate the effectiveness of the corrective action.
- Make changes for continual improvement

The simple model shown in **Figure 1** attempts to illustrate that the causes of any incident can be grouped into five categories - **task, material, environment, personnel, and management**. When this model is used, possible causes in each category should be investigated.

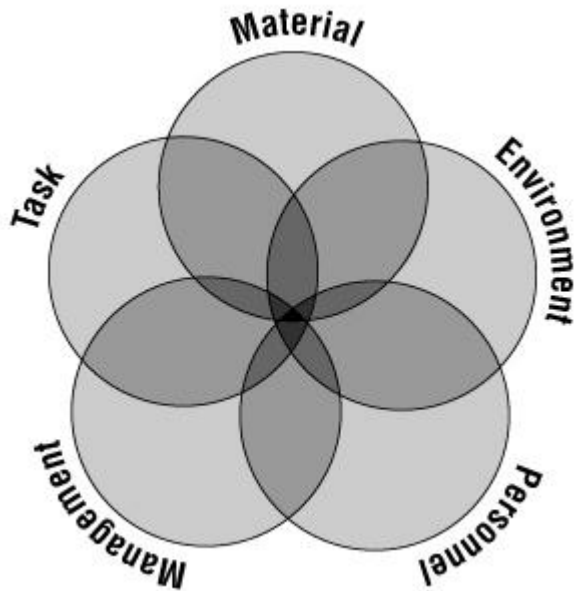


Figure 1

Purpose of investigation of accident and work injuries

- 1.meet the requirements of occupational safety and health legislation
- 2.determine the cost of the accident

The steps required the investigation of accidents and injuries.

- 1-report the incident
- 2-provide first aid and medical services for the injured
- 3-accident investigation
- 4-identify the causes of the accident
- 5-write a report on the results reached
- 6-prepare an action plan to implement the corrective steps

Outcomes of accidents:

- .Negative aspects
 - injury and possible death
 - disease
 - damage to equipment and property
 - lost productivity
 - litigation costs , possible citations
- .Positive aspects

- prevent recurrence
- change to safety programs
- change to procedures
- change to equipment design
- accident investigation

What causes the most accidents?

- .hazardous conditions for 3% of all workplace accidents
- .unsafe/inappropriate behaviors account for 95% of all workplace accident
- .uncontrollable acts account for 2% of all workplace accident
- .management is able to control , to some degree , the factors that produce 98% of all workplace accident

Benefits of investigation:

- 1-To understand what happened and why
- 2-To identify corrective actions that will prevent a reoccurrence
- 3-To determine trends and turn a reactive situation into a proactive opportunity
- 4-Why investigations are important?

Incident are often a warning that the workplace health and safety system isn't working properly. Safety-conscious employers investigate any incident that causes , or could have caused , an injury , illness or damage.

Effective incident investigation prevent recurrences and make the workplace safer and healthier. To make the workplace healthier and safer

How to get incidents reported:

- react in a positive way
- give more attention to loss control
- recognize individual performance
- develop awareness of the value of incidents
- show personal belief by action

Unit Eight

Personal protection in work place

Personal protective equipment is a protective means used by the worker to ensure his safety during the work period of the facility or common premises, from helmet to head protection, hand protection gloves, eye protection glasses, and sun protection paints that protect the skin from extreme weather conditions In the region

What is the importance of personal protection equipment?

Even if the best control mechanisms are applied, some hazards can continue to pose serious risks to the health and safety of the workforce. For example, when dealing with glass frequently in the workplace, and despite the necessary engineering control measures such as fencing to prevent entry, Some of the risks of broken glass will remain impenetrable, so workers should use gloves, glasses and shoes to prevent injury.

Type of personal protection equipment

The risks that are expected to occur at the workplace will determine the type of personal protective equipment that should be used,

- 1_work allowances
- 2_Protective glasses
- 3_Protective hats
- 4_Gloves
- 5_ ear protectors
- 6_ - Face protectors
- 7_Foot protectors

In order for personal protective missions to achieve their objectives effectively, the following factors must be considered:

1. The appropriate choice of means of prevention that give its tasks and purposes. 2_Ease, simplicity, quick use and comfortable feeling when wearing..
3. The need for measures to ensure their use should be highlighted.
- . 4. The validity and suitability of the production process to overcome them by the

UNIT NINE

Occupational health program

Occupational safety and health concept:

Occupational safety : A science that is concerned with protecting the safety of the person from the risks that may be exposed to him because of the work performance by providing a safe environment and free from the causes of accidents or diseases.

General Objectives :

1. Protecting human from injuries caused by work environment hazards.
2. Preserving the elements of the physical element such as installations of equipment from damage.
3. Provide and implement all occupational safety requirements that ensure a safe environment.
4. Stabilize safety in the hearts of workers during the work.

Foundations of occupational safety program :

The achievement of the occupational safety program should be based on certain principles, regardless of the number of personnel employed or the nature of work in the workplace, these are :

1. Work site.
2. The right environment for work.
3. Training and supervision.
4. involvement of working personnel.

Occupational safety officer : The person responsible for supervising all matters related to the provision of occupational safety requirements.

Basic factors must be taken into account when choosing the person responsible for occupational safety and health :

1. Qualifications and required training.
2. Personal and ability to plan and implement occupational safety programs.

The worker's responsibility to achieve professional safety :

1. The employee's obligation to follow the instructions and the signals given to him.
2. Taking care and caution when carrying out the tasks entrusted to him.
3. Obligation to wear personal protection measures when doing any work.

4. Informing the employer of the dangers to prevent them from happening.

Measuring the effectiveness of occupational safety and health program : there are several ways, including :

1. Average number of death : the number of deaths occurring within 100 million hours of work, and measured by the following equation :

Average number of deaths = no. of deaths occurring during work * 100,000,000 / total no. of hours worked

2. Frequency of injury rate : known as the number of injuries sustained within one million hours in work, and measured by the following equation :

Frequency of injury rate = no. of injuries sustained * 1000,000 / total no. of hours worked

3. Severity of injury : known as the sum of days that represent the lost time in a million hours.

Severity of injury = no. of days lost due to injury * 1000,000 / total no. of hours worked

Personal protective equipment that the worker must wear to achieve a professional safety program :

1. Head protection (helmet)

2. Eye & Face protection (protective glass)

3. Ear protection (ear plugs).

4. Foot protection (special safety shoes).

5. Respiratory system protection (breathing apparatus).

6. Protective belt and rescue rope.

7. Hand protection (rubber gloves).

8. Body protection (suits and protective coats)

UNIT TEN

Laboratories Safety

What is lab safety

Lab safety is to make certain that no any adverse effect will be Cause by any of potential hazard or agent in the laboratory.

Lab safety procedure make sure that the Individuals in laboratory can work safely with Freedom from danger, risk or injury

Why does it matter ?

Safe working protects:

You ,Other lab workers, Cleaners, Visitors .Your work

Safety programme.

- 1-Safety officer/chair of safety committee.
- 2- chemical hygiene officer
- 3-General laboratory safety manual – to be given to all new employees.
- 4-Continuing education program for laboratories – should include periodic talks on safety .
- 5-Ensure that laboratory environment meets accepted safety standards.

Laboratory hazards

Hazard is anything that may cause injury , harm or damage. The hazards encountered in a laboratory are many and varied and may result in short term or long term health effects if individuals are exposed to these hazards.

General Hazards in laboratory

- 1-Physical hazard,2- Chemical hazards,3- Infectious hazards,4- Electrical hazards
- 5-Radiation hazards, 6- Breakage of glassware spillages

Laboratory hazards -factors

Factors determining the impact of hazards:

- 1-Exposure levels
- 2-Duration of exposure
- 3-Safety controls
- 4-Number and types of contact with the hazard
- 5-Host factors – age , health

Lab safety rules

General safety

- 1-Listen and follow directions, 2-No monkey or horseplay,3- Wear your goggles
- 4-Measure carefully,5-Do not eat or drink without permission,
- 6-Handle animals with care and respect,7- Be careful with hot or electrical appliances
- 8-Tell your teacher if anything breaks or spills,
- 9-Clean your desk before and after experiments, 10-Wash your hands

What you should never Do in laboratory You should never.....

- 1-Take any chemicals from lab or store room.
- 2-Touch any equipment, chemicals, or other materials Until instructed to do so

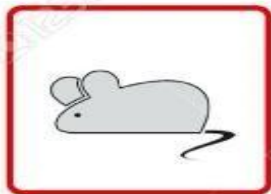
3-Apply cosmetics

4-Touch your face, mouth or eyes

5-Rough house

6-Do an unauthorized experiment

Lab safety rules and symbols summary



Animal hazard



Sharp instrument hazard



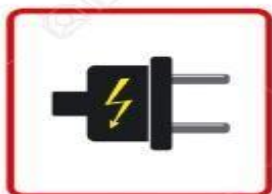
Heat hazard



Glassware hazard



Chemical hazard



Electrical hazard



Eye & face hazard



Fire hazard



Biohazard



Laser radiation hazard



Radioactive hazard



Explosive hazard

Laboratory quality management system :

1- Quality control

2-Quality assessment

3-Quality management

UNIT ELEVEN

Choice of suitable work-place Location

What is the workplace

The workplace is an important component of the success of any organization or institution that is of global interest on the basis that the satisfaction of employees and employees within the organization about the place or the work environment is reflected in their performance, efficiency and effectiveness of production, which leads to the success of this institution.

What is a workplace emergency?

A workplace emergency is an unforeseen situation that threatens your employees, customers, or the public; disrupts or shuts down your operations; or causes physical or environmental damage. Emergencies may be natural or manmade and include the following:

- + Floods,**
- + Hurricanes,**
- + Tornadoes,**
- + Fires,**
- + Toxic gas releases,**
- + Chemical spills,**
- + Radiological accidents,**
- + Explosions,**
- + Civil disturbances, and**
- + Workplace violence resulting in bodily harm and trauma.**

How do you protect yourself, your employees, and your business?

The best way is to prepare to respond to an emergency before it happens. Few people can think clearly and logically in a crisis, so it is important to do so in advance, when you have time to be thorough.

- + A preferred method for reporting fires and other emergencies**
- + An evacuation policy and procedure**
- + Emergency escape procedures and route assignments, such as floor plans, workplace maps, and safe or refuge areas**
- + Names, titles, departments, and telephone numbers of individuals both within and outside your company to contact for additional information or explanation of duties and responsibilities under the emergency plan.**

- + Procedures for employees who remain to perform or shut down critical plant operations, operate fire extinguishers, or perform other essential services that cannot be shut down for every emergency alarm before evacuating.**
- + Rescue and medical duties for any workers designated to perform them.**

Why are workplace inspections important?

Workplace inspections help prevent incidents, injuries and illnesses. Through a critical examination of the workplace, inspections help to identify and record hazards for corrective action. Health and safety committees can help plan, conduct, report and monitor inspections. Regular workplace inspections are an important part of the overall occupational health and safety program and management system, if present.

How we can choose a safe work location?

- 1.The place should be away from places with high concentrations of pollutants, whether air, water or radiation.
- 2.Location is not so large that there is a significant risk to the lives.
- 3.It is better to be away from residential areas close to humans, because companies have contaminated pollutants that harm humans.
- 4.Do not have to be close to hot spots, which are areas where wars and workers safety.
- 5.It is large and close to the suburbs of cities and away from the population, because of the possibility of expanding companies or laboratories.

UNIT TEVLEVE

Planning of operation unit , Human relationship

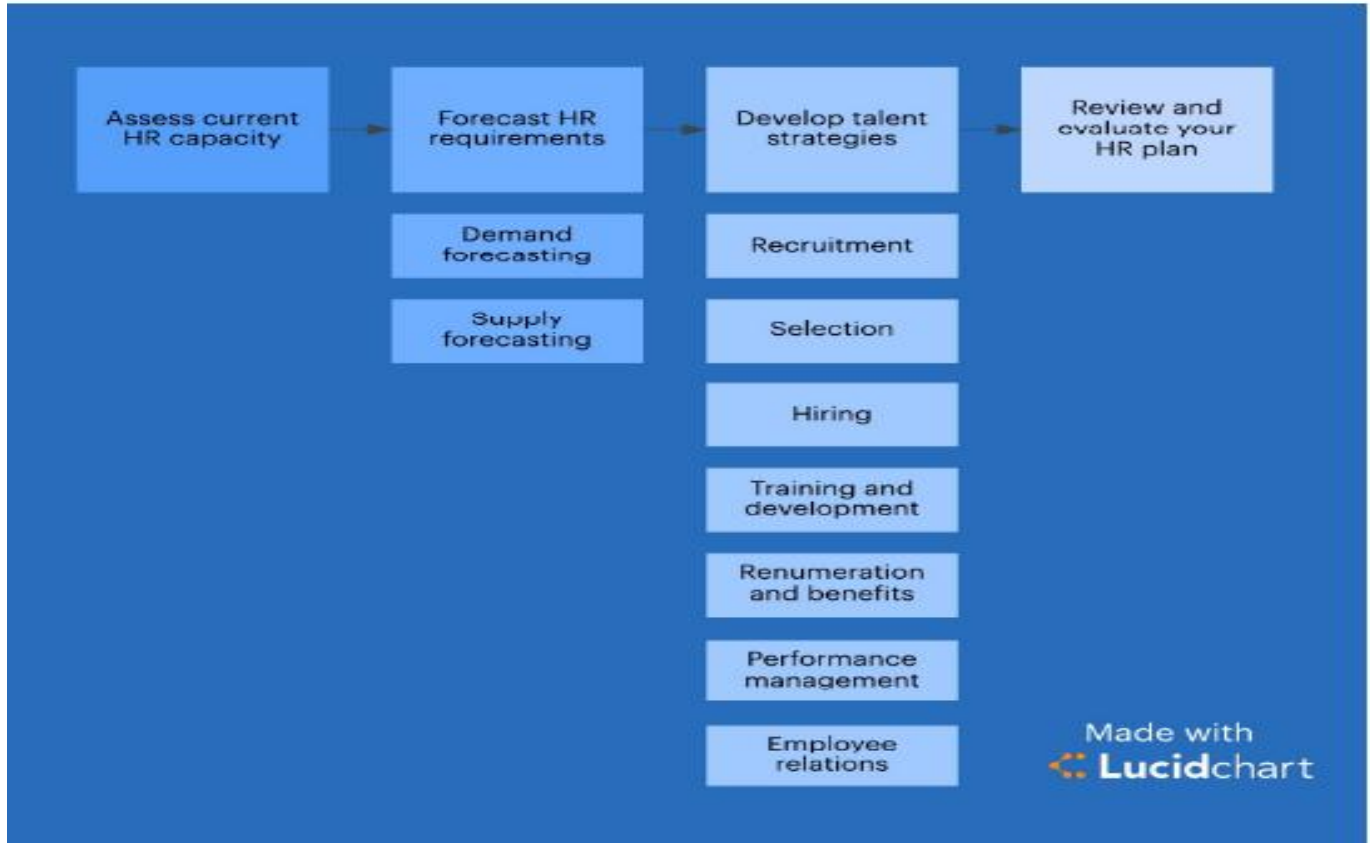
-Planning: - represents the future course of action by developing goals and objectives and identify indicators, activities, and schedules needed to achieve the goals and objectives, and is considered evidence in decision-making.

The role of Manager of operations include identifying sub-goals of the organization and shaping policies and measures to achieve these goals, as well as clarify the role of operations in the General Strategy of the Organization of the planning and design of the products and processes required conversion.

This phase contains the following tasks Setting objectives / policies and procedures / forecasts / programs / decision-making

There are some rules that should be taken into consideration when developing plans:

- 1 - Access to goals at the lowest cost and minimal use of resources.
- 2 - to ensure coordination between the departments of the organization and between the organization as a whole with other organizations.
- 3 - the realization of the principle of homeopathy, flexibility and sustainability.
- 4 - Determine the time dimension of the plan, note that there are three types of plans:
 - A - a short-term plan: stretching the length of time for such a plan three months.
 - B - a medium-term plan: stretching the length of time for such a plan three months to three years.
 - c - a long-term plan: stretching the length of time for such a plan three years or more
- 5-Taking into account the objectives of the organization
- 6-Should be taking into account the factor of forecasting demand for products the organization and the volume of sales in the market



UNIT THREETEEN

INDUSTRIAL PSYCHOLOGY

What Is Industrial Psychology?

Industrial psychology combines the principles of psychology with a methodical investigation of various work settings. Often referred to as industrial-organizational psychology, this discipline analyzes numerous aspects of the working world and the attitudes of individuals toward their respective careers. The following article defines the main aspects of industrial psychology. Schools offering Industrial & Organizational Psychology degrees can also be found in these popular choices.

functions and goals industrial psychology are:

1. Increase worker productivity
2. Design safe work environments
3. Train new employees
4. Help organize the company's management structure

Working Conditions:

There are basic criteria used to assess the working conditions in any research or study of these conditions ..

- (A) PERFORMANCE criterion
- (B) Physiological criterion.
- (C) Psychological criterion.
- (D) Accident criterion

The interests of psychology in the industrial field can be summed up in the following areas

- Proper selection of workers by tests to place the appropriate worker in the right place depending on his or her own abilities and abilities
- Identify and train workers on the appropriate professional assets for their potential.
- Study and treatment of mental disorders among workers and handicap of work and production.
- Study of work accidents and their causes.

- Study and improve human relations between presidents, subordinates and workers to avoid problems that hinder production and progress of work.
- Vocational rehabilitation for people with disabilities and invalids.
- Analyzing the types of businesses and professions with a view to economizing on effort and reducing boredom and fatigue, which increases production and achieves psychological comfort

Important Facts About Industrial Psychologists:

1. Worker Productivity

One of the main goals of industrial psychology is to improve worker productivity. Industrial psychologists research workplaces to find ways of increasing worker satisfaction and boosting productivity. These professionals design and implement workplace procedures in order to improve employee efficiency. They also consult with employees to find practical ways to improve working conditions in the hope that content employees will be more productivity.

2. Workplace Safety

Another function of industrial psychology is to design safe workplaces. Industrial psychologists study the company's operating procedures, equipment used, and types of work performed in order to determine ways to make employees safer. Professionals in this field can recommend new equipment such as ergonomic chairs or updated machinery, if needed.

3. New Employee Training and Orientation

Industrial psychologists are often in charge of creating orientation and training programs for new employees. They apply concepts of industrial psychology to create programs that teach new workers about a company's operating procedures and business philosophies in ways that make employees feel welcomed and valued .

4. Organizing Management Structure Organizing Management Structure

Those who work in industrial psychology often participate in organizing a company's management structure. Industrial psychologists can encourage companies to reduce redundancy and increase accountability. They can create organizational structures that clearly define the job duties and responsibilities of each position.

Description and Applications of Industrial Psychology

Industrial psychology concerns itself with the application of psychological concepts to the work environment. Professionals who hold degrees in the discipline often perform consulting work for companies.

UNIT FOURTEEN

Occupational Health and Storage Safety

First: safety requirements during the establishment of stores

1. All storage facilities shall be constructed of non-flammable materials and the store shall have more than one outlet.
- 2- Provide suitable openings for ventilation and natural ventilation with a double steel wire tight tissue to prevent the dumping of any foreign objects inside the store
- 3- All electrical connections and equipment inside the warehouses should be installed in accordance with the technical specifications and specifications that guarantee the safety of the stores from the danger of fire. No modifications or additions shall be allowed except under the supervision of those responsible for electricity.
- 4- Stores shall be equipped with fire extinguishers and equipment that are suitable for the spaces allocated to them and the quality of the materials to be stored in the stores,
- 5- Floors should be suitable for the nature of the equipment used to transport and store materials within warehouses
- 6- Warehouse keys must be kept after work in glass-enclosed cabinets in a safe and guarded place to open these stores when fires or emergencies occur.
- 7- Cleanliness, arrangement and regulation within warehouses and disposal of storage waste should be observed on an ongoing basis to prevent injury to employees or fires,
- 8- Provide safe stairs for use instead of climbing on the booklets or tables to store materials or taken from the shelves and must provide personal protective tasks for workers and commensurate with the nature of the work they do to keep them from work injuries.
9. Air cylinders and compressed gases shall be stored in vertical position and shall be held up.
- 10- Regular maintenance and maintenance of firefighting equipment in stores should be carried out in clear and accessible places.
- 11- Maintenance of fire alarms shall be carried out periodically and delivered to the control room by civil defense and fire, and shall be operated from time to time to ensure their validity.
- 12- Guidance instructions on how to use fire extinguishers and how to behave in cases of fire, escape routes and evacuation operations in emergencies should be suspended in order to be recognized and kept as a result of continuous vision.
- 13- First aid equipment must be provided in the stores according to the decision of the Minister of Health and placed in a visible place inside a box written on it (ambulance and red crescent symbol).
- 14- Rodents and insects must be continuously combated with pesticides or any other method to ensure the preservation of stored materials and ensure the safety of electrical installations and equipment intact since the presence of rodents may damage stored materials or loan electric cables, which may cause fires.

15- Do not raise stacks or near stored materials for industrial lighting sources to ensure that fires do not occur in these materials due to high temperature.

SECOND : Measures to be taken to prevent the spread of fire

1. The erection of barriers or walls around the storage area. These barriers and fences shall be erected at an appropriate height to ensure that no outsiders who may cause the fires enter stored materials or theft.
2. The storage area should be free from dry herbs and waste. Take away the herbs and the satanic plants not only in the storage area but also as far away as possible around the storage area.
- 3 - The covers of the stored materials must be fire resistant .. Covers that are used to protect the stored materials from the effects of the air of non - flammable types or as much resistance as possible to flammability
- 4-Arrangement of placing stakes and dividing storage areas ..
- 5-Providing fire extinguishers with storage sites.

Unit Fifteen

Ergonomic (Human engineering)

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance."

"Ergonomists contribute to the design and evaluation of tasks, jobs, products, environments and systems in order to make them compatible with the needs, abilities and limitations of people."

"Derived from the Greek ergon (work) and nomos (laws) to denote the science of work, ergonomics is a systems-oriented discipline which now extends across all aspects of human activity."

Domains of specialization within the discipline of ergonomics are broadly the following;

- Physical ergonomics is concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity.
- Cognitive ergonomics is concerned with mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system.

Organizational ergonomics is concerned with the optimization of sociotechnical systems, including their organizational structures, policies and processes.

The Human-Factors Approach To Design

Two general premises characterize the approach of the human-factors engineer in practical design work.

The first is that the engineer must solve the problems of integrating humans into machine systems by rigorous scientific methods and not rely on logic, intuition, or common sense. In the past the typical engineer tended either to ignore the complex and unpredictable nature of human behavior or to deal with it summarily with educated guesses.

The second important premise of the human-factors approach is that, typically, design decisions cannot be made without a great deal of trial and error.

Applications Of Human-Factors Engineering

Applications of human-factors engineering have been made to such simple devices as highway signs, telephone sets, hand tools, stoves, and to a host of modern, sophisticated complexes such as data processing systems, automated factories and warehouses, robots, and space vehicles. Push-button telephone, Space suit, Typewriter keyboard

What two elements are at work?

1-Static work: musculoskeletal effort required to hold a certain position, even a comfortable one.

Example: sit & work at computers; keeping head and torso upright requires small or great amounts of static work depending on the efficiency of the body positions we chose.

2-Force: amount of tension our muscles generate

Example: tilting your head forward or backward from a neutral, vertical position quadruples the amount of force acting on your lower neck vertebrae

Increased force is d/t increase in muscular tension needed to support head in a tilted position

Main Ergonomic Principles

1-Work activities should permit worker to adopt several different healthy and safe postures.

2-Muscle forces should be done by the *largest appropriate* muscle groups available

3-Work activities s/b performed with joints at about mid-point of their ROM (esp. head, trunk, UE)

What causes Nerve Compression or Entrapment?

- 1) Repeated motions
- 2) Tight muscles
- 3) Inflammation of surrounding tissues.
- 4) Misalignment of the nerve.

Unit Sixteen

Occupational health and safety professions

Health Safety Professional role:

Point person that must anticipate, identify and evaluate hazardous conditions and practices.

Leader that brings supervisors and employees together to develop hazard control methods, procedures and programs.

Serve as the advisor to management on hazard controls and be the author of hazard control programs.

Teach the company by preparing, conducting, and coordinating effective training classes

Duties

Lead environmental and safety committees and teams

Stays abreast of current (EPA, OSHA) and emerging laws, regulations and trends

Arrange for annual medical monitoring

Ensure first aid management through first aid and follow up to injuries

When things go wrong – the cost of accidents

You may have insurance to cover the cost of accidents, but you'll have to pay the indirect costs. These are often greater and include:

1-sick pay

2-extra wages or overtime

3-fines and legal costs

4-repairing damage to machines, equipment or property

5-increased insurance premiums

When things go wrong –
the cost of ill health

When things go wrong – the cost of ill health

Work-related ill health caused by common illnesses and medical conditions can:

- > reduce productivity
- > increase the cost of hiring new staff
- > result in civil claims or retirements with enhanced benefits
- > These will all have an impact on your budget
- > The Chartered Institute of Personnel and Development estimates that for local government sickness absence costs over £584 per worker per year
- > The biggest single cause of absence in local government is attributed to common mental health problems including anxiety, stress and depression, accounting for around 23 per cent of all days off work

The case of Barrow Borough Council

In 2002, an outbreak of legionnaire's disease at an arts and leisure centre run by Barrow led to seven deaths The Council was fined £125,000 plus £90,000 costs

The design services manager was personally fined £15,000

Getting health and safety right...

- > saves lives
- > keeps people from harm
- > improves morale among the workforce
- > saves money
- > improves efficiency
- > sends out a positive message to others, including employees, contractors and the electorate
- > sets a good example

How can you help to get health and safety right?

Policy

Make sure your authority has a policy that:

1-defines the structure of health and safety risk management

2-says how it should function

3-identifies the people who have specific roles and responsibilities

4-is communicated to all employees

5-is reviewed periodically

Management

It's recommended that your cabinet or executive should:

- > set targets for reducing injuries and ill health
- > get reports on specific incidents or accidents
- > get regular reports on health and safety performance
- > report publicly on health and safety performance

Advice

Make sure you and your authority get:

- > the right advice from competent health and safety professionals
- > sound occupational health advice

Training

- > Training makes people safer and reduces accidents and incidents
- > Everyone needs some form of health and safety training:
 - > elected members need to know their broad strategic responsibilities and recognise the resources needed
 - > managers and supervisors need training to help them plan work safely and understand the implications if they don't
 - > 'frontline' employees need basic training, eg on safe systems of work

Sensible risk management

... isn't about:

- > stopping activities for trivial reasons and where the risks have been assessed
- > generating useless paperwork

- > creating a totally risk-free environment
- > scaring people by exaggerating trivial risks
- > protecting workers and the public
- > balancing benefits and risks – reducing risks that have serious consequences and those that come up more often
- > making sure that those who create risks manage them responsibly
- > helping people understand that, as well as having a right to protection, they have to take responsibility for themselves and others

What are the major health and safety issues in your authority?

- > Construction
- > Transport
- > Fire
- > Mental health problems
- > Musculoskeletal injuries
- > Waste management

Health and safety is part of everything you do

Health and safety is relevant to every department in your authority, and to every activity

Unit Seventeen

Safe storage principles

- Store heavy and frequently used items in the ideal zone - between shoulder and mid thigh.
- Store smaller, lightweight or infrequently used items in lower or higher areas.
- Organise cupboards and storage areas to lessen clutter and allow easy access to shelves. Plan for regular audits of storage areas. Assign responsibility within a work group for maintenance of storage areas.
- Frequently handled items should be within easy access and reach.
- A sturdy step or stepladder should be easily available to access items stored above shoulder height.
- If a ladder is required an intermediate support point may be necessary to allow lifting and lowering of items safely in stages.
- Keep a clear bench for delivery of goods to avoid lifting from ground level (if applicable).
- Consider current and likely future storage needs in any workspace redesign or before new equipment is purchased.

UNIT EGIHTEEN




Chemist of fire

What is fire?

- Rapid chemical process that produces heat and usually light
- Fire is neither solid nor liquid.
- Wood is a solid, gasoline is a liquid, and propane is a gas—but they all burn.



Types of Energy:

- Chemical
 - Mechanical
 - Electrical
 - Light
 - Nuclear
- | | | |
|---|-------------|-----------------------|
|  | ELECTRICITY | Electric motor |
|  | GASOLINE | Propel a vehicle |
|  | NATURAL GAS | Heat furnace or stove |

Chemistry of fire:

- Understanding how fire ignites and grows will assist in the fire fighter's ability to extinguish fire situations.
- Being well trained in fire behavior will allow the fire fighter to control a fire utilizing less water.

The Fire Tetrahedron Fires start when a flammable and/or a combustible material, in combination with a sufficient quantity of an oxidizer such as oxygen gas or another oxygenrich compound (though non-oxygen oxidizers exist that can replace oxygen), is exposed to a source of heat or ambient temperature above the flash point for the fuel/oxidizer mix, and is able to sustain a rate of rapid oxidation that produces a chain reaction. This is commonly called the fire tetrahedron. Fire cannot exist without all of these elements in place

and in the right proportions. For example, a flammable liquid will start burning only if the fuel and oxygen are in the right proportions. Some fuel-oxygen mixes may require a catalyst, a substance that is not directly involved in any chemical reaction during combustion, but which enables the reactants to combust more readily. Once ignited, a chain reaction must take place whereby fires can sustain their own heat by the further release of heat energy in the process of combustion and may propagate, provided there is a continuous supply of an oxidizer and fuel. Fire can be extinguished by removing any one of the elements of the fire tetrahedron. Consider a natural gas flame, such as from a stovetop burner. The fire can be extinguished by any of the following: • turning off the gas supply, which removes the fuel source; • covering the flame completely, which smothers the flame as the combustion both uses the available oxidizer (the oxygen in the air) and displaces it from the area around the flame with CO₂; • application of water, which removes heat from the fire faster than the fire can produce it (similarly, blowing hard on a flame will displace the heat of the currently burning gas from its fuel source, to the same end), or • application of a retardant chemical such as Halon to the flame, which retards the chemical reaction itself until the rate of combustion is too slow to maintain the chain reaction. In contrast, fire is intensified by increasing the overall rate of combustion. Methods to do this include balancing the input of fuel and oxidizer to stoichiometric proportions, increasing fuel and oxidizer input in this balanced mix, increasing the ambient temperature so the fire's own heat is better able to sustain combustion, or providing a catalyst; a non-reactant medium in which the fuel and oxidizer can more readily react. In contrast, fire is intensified by increasing the overall rate of combustion. Methods to do this include balancing the input of fuel and oxidizer to stoichiometric proportions, increasing fuel and oxidizer input in this balanced mix, increasing the ambient temperature so the fire's own heat is better able to sustain combustion, or providing a catalyst; a non-reactant medium in which the fuel and oxidizer can more readily react.

Unit Nineteen

Handling and storage of radioactive materials

Store waste in only approved bags and container.

Bags – Yellow with Radiation label

Boxes – Line with yellow bag

Bottles – Attach Radiation label

• **DO NOT** use anything that can be mistaken for an ordinary trash container

• Attach full label with user's name and dept., isotope, activity, fill date and seal with a liquid tight tie-off



- Do not mix aqueous and organic waste.
- Do not mix liquid and dry waste, i.e., do not dispose of such items as pipette tips in liquid waste; empty scintillation vials are dry waste
- Segregate dry waste by half-lives equal to or less than 120 days from half-lives greater than 120 days (eg: P-32 vs H-3).
- Do not mix scintillation vials that contain different radionuclides.
- Do not use coke bottles, milk bottles and etc. for liquid waste.

Legal Methods of Disposing of Radioactive Waste

- **Decay in Storage (DIS)**
- **Dump to Sanitary Sewer**
- **Only RSO may Ship to Disposal Site**

- **Dispose as if not radioactive**
- **Decay in Storage (DIS)**
 - **Store waste in the laboratory if the half-life is no more than 120 days.**
 - **“DIS” Isotopes must be held for decay for at least 10 half-lives.**
 - **Survey monitoring of material must read close to background.**
 - **All radioactive labeling must be defaced.**
 - **Document in log**
 - **Dump to Sanitary Sewer**
 - **Must be water soluble or readily dispersible biological material in water.**
 - **Concentration per month is limited by the regulations, check with the Radiation Safety Officer.**
 - **May obtain permission from the Radiation Safety Office prior to dumping**
- **Only way to know if other people are dumping.**
 - **Only Radiation Safety Office may Ship to Disposal Site.**
 - **Contact Radiation Safety Officer when you have a full container of dry or liquid waste**
 - **Disposal Site waste will be stored in the radiation shed until scheduled pick-up.**
 - **Dispose as if not Radioactive**
 - **Scintillation medium containing no more than 0.05 microcuries per ml of H-3, or C-14 may be discarded as if it was not radioactive. If chemical solvent is disposed of properly the radioactivity will not pose a problem.**
 - **A record shall be kept of each such disposal for the life of the license; it may be sent to the RSO**

Unit Twenty

Statistics of Occupation

Indicators of safety and health at work provide the framework for assessing the extent to which workers are protected from related hazards and risks.

Types of OHS

1-Indicators of outcome: number of occupational injuries and diseases, number of workers involved and work days lost.

2-Indicators of capacity and capability: number of inspectors of health professionals dealing with occupational safety and health.

3-Indicators of activities: number of trainee days, number of inspections.

Current international statistical guidelines on occupational injuries are found in the "Resolution concerning statistics of occupational injuries"(resulting from occupational accidents), adopted by the Sixteenth International Conference of Labour Statisticians in 1998

The unit of observation should be the case of occupational injury, the case of one worker incurring an occupational injury as a result of one occupational accident.

If a person is injured in more than one occupational accident during the reference period, each case of injury to that person should be counted separately.

Uses of injury statistics

a)-to identify the occupations where injuries occur, along with their extent, and severity, as a basis for planning, setting priorities for preventive measures

b)-to detect changes in the pattern and occurrence of occupational injuries, so as to monitor improvements in safety and reveal any new areas of risk.

c)-to inform workers and workers organizations of the risks associated with their work and workplaces, so that they can take an active part in their own safety.

d)-to evaluate the effectiveness of preventive measures.

e)-to estimate the consequences of occupational injuries.

f)-to assist in developing training and programmes for accident prevention.

g)-to identify possible areas for future research

Terms and definitions

a)occupational accident:

an unexpected and unplanned occurrence, including acts of violence, arising out of or in connection with work which results in one or more workers incurring a personal injury, disease or death.

b)-commuting accident:

an accident occurring on the habitual route, in either direction , between the place of work or work –related training and :

- ❖ The workers principal or secondary residence.
- ❖ The place where the worker usually takes his /her meals.
- ❖ The place where he or she usually receives his or her remuneration, which results in death or personal injury.
- ❖ Occupational injury: any personal injury, disease or death resulting from an occupational accident; an occupational injury is therefore distinct from an occupational disease, which is a disease contracted as a result of an exposure over a period of time to risk factors arising from work activity.
- ❖ Case of occupational injury: the case of one worker incurring occupational injury as a result of one occupational accident.
- ❖ Incapacity for work: inability of the victim, due to an occupational injury, to perform the normal duties of work in the job or post occupied at the time of the occupational accident

UNIT TWENTY ONE

Government regulation and their impact to regulation of occupational safety

Maintaining safe and healthy working conditions are required by government regulations and also make sense for business economic reasons.

There are plenty of good reasons why any business would want to maintain a safe workplace. Other than the basic human desire to avoid pain and suffering, workplace accidents can destroy your business!

Thousands of Americans are killed each year in on-the-job accidents, and many more suffer work-related disabilities or contract occupational illnesses. Some of the high monetary costs attached to workplace accidents include:

- the inability to meet your obligations to customers
- wages paid to sick and disabled workers
- wages paid to substitute employees
- damaged equipment repair costs
- insurance claims
- workers' compensation claims
- administrative and recordkeeping costs

In addition, while both humanitarian desires and economic good sense have encouraged employers to create and maintain safer and healthier working conditions, employees, unions, and government agencies have applied pressure for greater efforts.

Federal Occupational Safety and Health Administration (OSHA) regulations govern workplace safety and no matter what business you are in, you should know and comply with the rules that apply to that business. General rules apply to just about any business and fines and penalties for violations can be severe!

Once you understand the government's role in regulating workplace safety, familiarize yourself with major workplace safety issues, including newer types of risks, such as workplace automation hazards, AIDS and biohazards, that your business may have to deal with.

With the necessary knowledge of your responsibilities and the safety issues involved, you can then access available resources to develop and document a safety program and train your employees to avoid workplace accidents.

The Occupational Safety and Health Act (OSHA)

Your legal obligations to provide a safe work environment for your employees arise primarily from a federal law known as the Occupational Safety and Health Act (OSH Act). OSHA was enacted in 1970 to address the uneven patchwork of state laws regarding workplace safety, and to respond to the growing number of serious injuries and deaths

occurring in the workplace. OSHA is administered by the Department of Labor under the direction of the Assistant Secretary of Labor for Occupational Safety and Health.

Absent an accident, a small business owner isn't likely to be visited by federal health and safety inspectors very often, if at all. Unfortunately, if an accident does occur and you're found to be in violation of applicable safety rules, the consequences of the accident can be compounded. Not only must you bear the consequences of the accident (such as being unable to meet your obligations to customers), you may also have to pay government fines and other costs. So, it's worthwhile to have a general understanding of the legal underpinning of the safety standards that apply to almost every employer:

- **All** businesses have a duty to comply with some general rules under what's called a general duty clause.
- **All** businesses must also comply with industry-specific requirements and guidelines, known collectively as OSHA standards.

State safety regulation. Although your safety obligations originate directly at the federal level, states have the right to develop their own standards under a federally approved state plan. The standards under a state plan may differ from federal OSHA regulations, but must be at least as effective as the federal standards. Some states have established and administer their own state plans for workplace safety. If your business is in a state that has a state plan, you must comply with it. If your state does not have a state plan, you must comply with federal OSHA laws. For more information about these plans, contact your particular state labor department.

Are You an Employer Subject to OSHA?

The Occupational Safety and Health Act is a comprehensive law — it covers most employers. Unless you are **sure** your business is exempt, you should assume that the law applies to you.

Generally, if you have employees, you are probably covered by OSHA. If you have none, you usually aren't covered, although in some cases businesses who use workers such as independent contractors are still subject to OSHA.

Specifically an employer under the Act is a person engaged in a business affecting commerce who has employees, but does not include the United States or any state or political subdivision of a State. You are probably subject to OSHA requirements if you:

- are in control of the actions of your employee
- have power over the employee
- are able to fire the employee

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Some of the usual indications of an employment relationship, such as who pays the employee, are **not** part of the definition of an employer under OSHA. There are special circumstances if you are one of multiple employers or if you have workers other than employees.