First lecture

Industrial safety

Industrial safety refers to the management of all operations and events within an industry in order to protect its employees and equipment's by minimizing hazards, risks and accidents.

The importance of industrial safety

Industrial safety is important as it safeguards human life, especially in high risk areas such as nuclear, aircraft, chemical, oil and gases, and mining industries, where a fatal mistake can be catastrophic. Industrial Safety reduces risks to people, and processes.

Objectives of industrial safety:

1 - to prevent accidents in the plant by reducing the hazard to minimum.

2 -to eliminate accident caused work stoppage and lost production.

3 -to achieve lower workmen's compensation, insurance rates and reduce all other direct and indirect costs of accidents.

4 -to prevent loss of life, permanent disability and the loss of income of worker by eliminating causes of accidents.

5 -to evaluate employee's morale by promoting safe work place and good working condition.

6 –to keep the factories and the equipment's from damage and loss as a result of accidents

Steps of industrial safety

1 – The necessary to use personal protective equipment at work .

2 – The necessary to provide initial aid kit in the workplace in order to deal with minor injuries quickly .

3 - Keep chemicals and flammable material away from the places of workers gathered as a source of real danger to the factories and their employees .

4 – Activate the concept of occupational safety at factories and plants by providing a supervisor for the occupational safety .

5 – Focus on raising the readiness of workers in factories and plants by implementing exercises .

6 – Coordination between the factory owners with the civil defense system for occupational safety and health by workshops for supervisors and employees.

7 – Work on educational posters periodically .

industrial safety system

industrial safety system is a counter measure crucial in any hazardous plants such as oil and gas plants and nuclear plants. They are used to protect human, industrial plant, and the environment in case of the process going beyond the allowed control margins.

As the name suggests, these systems are not intended for controlling the process itself but rather protection. Process control is performed by means of process control systems (PCS) and is interlocked by the safety systems so that immediate actions are taken should the process control systems fail.

The main types of industrial safety system

1- Process Control Systems (PCS)

They are installed for the monitoring of the manufacturing environment and they control the manufacturing process electronically. A laser diode is used for the detection of liquid or gas present in the environment. If the gas or liquid is detected then their particular frequency signature is converted to a digital signal and the processor identifies the signal received.

2- Safety Shut-down Systems (SSS)

These systems are particularly helpful in the state of emergency as they automatically shut-down a system to a safe state whenever they sense a danger. They can be connected to the fire and gas systems to achieve securer working environment.

3- Fire and Gas Systems (FGS)

These systems are highly sensitive and intelligent. They sense the inflammable gas, material or liquid spill at an early stage. They also detect the fire within the working environment and give audible and visual signals of the threat detected. These systems can be activated automatically or manually.

4- Pressure safety valves (PSV)

Pressure safety valves PSVs are mechanical devices and are usually used as a final safety solution when all previous systems fail to prevent any further pressure accumulation and protect vessels from rupture due to overpressure

Safety measures in Industries

Safety measures are taken in industries to prevent accidents and to improve the productivity. Safety measures are essential for the welfare of the people working in the industry and for the overall benefit of the organization. By incorporating safety measures at various levels, the awareness on safety will improve. It is possible to prevent accidents. It is possible to handle emergencies in a better way. There will not be a breakdown of machines. Employees will be able to work without being exposed to conflicting conditions.

*Safety policy

In order to take safety measures effectively, organizations should have a safety policy. The safety policy statement will give direction to the management. The management is responsible for the implementation of safe methods and practices. The organization should realize that worker's health and safety takes precedence to the job or task to be accomplished. If there is any threat of safety in the way the worker is performing the job, there should be concerted effort to finish the task with least health effect on the worker. The procedures implemented in the organization should be verified, inspected and subjected for improvement if there is any requirement for the enhancement of safety.

If a job cannot be done in a safe method, the job should not be attempted. The place of work should be safe to perform various tasks. There should be proper lighting, ventilation and no congestion of things.

*Importance of safety

Training plays an important role to implement safety policies in an organization. Training brings uniformity among various levels of employees. There will not be any confusion or conflict. By imparting training on a regular basis, it is possible to impart the basic and specific skills to perform the job in an efficient manner. It is the responsibility of each and every employee to follow the guidelines laid by the management. Unsafe working conditions should be reported to the supervisory

and management staff. Employees should work in a professional way by taking all the necessary precautions.

*Safety & Training

Safety and training in the company should be monitored by the safety director. Safety director should train foremen so that they will be able to know the procedures to investigate accidents. Machine operators should be trained both in the classroom environment and in the workplace. Training at various levels should comply with the state and regulations. It should be ensured that no employee will work on unguarded machine.

*Protective equipment

In order to ensure the safety of workers, protective gear should be used. If you are doing welding works, you should use goggles to protect your eyes. If you are working in a warehouse, you should wear hard hats and your eyes should be protected. Usage of helmet, leather coat, apron, gloves and other equipment is necessary depending on the working conditions. The helmet should be provided with a focusing light if you are working in low light or no light conditions. If you are working in a paint shop, the eyes should be protected. It is the responsibility of the safety manager that even visitors will be provided with safety gear.

**Industrial safety covers a number of issues and topics affecting safety of personnel and the integrity of equipment in a particular industry.

The following topics are generally discussed:

General Safety – General aspects of safety which are common to all industries

Occupational Safety and Health – Particularly associated with the occupation

Process and Production Safety

Material Safety

Workplace Safety – Safety issues directly related to the workplace setting

Fire Safety

Electrical Safety – Arising from the equipment used

Building and Structural Safety – Including installations as per existing building code

Environmental Safety – Concerns the direct and indirect environmental impact of the industry

Second lecture

Personal protective equipment

Personal protective equipment:_ is defined as equipment, tools and preventive measures used to protect the worker from injuries and risks that may surprise him during the period of work in his facility or workshop.

Personal protective equipment is the last line of defense to protect workers from the harm factors that they may be exposed to due to the work conditions they do, but sometimes protective equipment is the first line of defense to protect workers from risks as is the case in wearing protective glasses for workers in welding And the operation of minerals or when handling chemicals … etc.

Personal protective equipment is used when there are cases that represent the possibility of injury, absorption, inhalation, or direct contact and that result from various risks such as (process risks – environmental hazards – chemical hazards – radiological hazards – mechanical hazards.

Conditions to be met by personal protective equipment:

1- Personal protective equipment must be chosen so that it conforms to international specifications in order to reduce the dangers to the minimum possible, it must be effective in preventing the risks which the worker is exposed.

2- It must be appropriate for the body, comfortable for the worker, and easy to use, meaning that the worker can perform the necessary movements to perform the work and accomplish the tasks without difficulty and so that their use is not neglected by the worker.

3- Its size must be appropriate and acceptable shape, and it must bear the working conditions so that it is not easily damaged.

Worker's duties towards personal protective equipment:

1_The worker must be trained in the correct use of personal protective equipment to provide familiarity between them so that are part of his daily work program.

2- The facility's safety regulations and must be applied to compel workers to use personal protective equipment and organize awareness programs for them to prove their benefits in avoiding injuries ,

as well as maintenance and cleanliness of this equipment.

Types of personal protective equipment

There are several types of personal protective equipment that cover almost all members of the body, and each type of this equipment depends on the nature of the risks present in the work environment and the purpose for which this equipment is used.

1 – **Protective clothing**: To avoid exposing workers in the workplace to various dangers and may be fatal at times, such as heat –acidic fluids , therefore, protective clothing such as (bibs, vests, and protective belts must be used. Etc.) that contribute to protecting the worker's body from various damages in the work environment that ordinary clothing does not provide, which may itself be a cause of injuries.

2_**Head protection equipment**: These equipment must be hard to protect the head from solid objects that may fall over or collide with materials and devices. Helmets are used, many types depend on the materials involved in their manufacture and the types of the risks likely to occur as well as their suitability to the size of the head, resist heat and materials Chemicals such as acids, alkalis, solvents, oils.

One of the most important conditions that must be met in the head protection equipment is that it is able to absorb shocks, and in some cases it must be resistant to electric shock and be in accordance with standard specifications.

3 – **Hearing protection equipment**: Hearing protection equipment (earplugs) is used to prevent harmful effects of noise on the audio system and on the body in general, as this equipment works to reduce the noise level to the extent that it is considered safe .

4_ **Respiratory Protection Equipment**: Respiratory protection methods vary according to the type of pollutants (dust – gases – vapors) that workers deal with it in different work environments, causing problems in breathing system .

Equipment must be in the form of masks placed on the face so that it covers the mouth, nose, or the entire face, including what completely covers the head. The mask or muzzle may be part of work suit or Separate

5_**Hand protection equipment**: In most working environments, hands and arms are exposed to various dangers, including burns, cuts, electric shocks, and chemical substances.

The types of gloves used vary depending on the type of exposure to pollutants

6- **Foot protection equipment**: This equipment is used to protect the feet from the danger of materials falling on them or collision risk or heat. When using protective shoes, it is required that be made with special specifications appropriate to the nature of the risks found in different workplaces.

The following are the types of protective shoes:

1_ Footwear made of natural or artificial leather reinforced with a steel toe.

2_ Shoes with a long leg or a leather protective covering the leg.

3_ Anti-skid shoes.

4_ Shoes made of synthetic or natural rubber or corrosion-resistant plastic.

5_ Insulated shoes.

7_**Face and eye protection equipment**: It is a plastic or metal masks or glass glasses used to protect the face and eyes from volatile parts and rays and from the splash of hot and incendiary materials.

And it is required that the following specifications be met:

_ To be comfortable enough.

_ To be a court.

_It can be cleaned and disinfected.

_To be in good condition.

8- Safety belts: These belts are used to protect workers from the dangers of falling from high places such as construction workers and others whose nature of their work requires them to climb to high places.

9 - Prevention of low temperatures: There are types of protective clothing manufactured by scientific way to resist temperatures under zero, and these clothes are used in very cold places, the clothes manufactured by nylon with totally insulated polyester

Industrial hazards

Hazard is a term associated with a substance that is likelihood to cause an injury in a given environment or situation. Industrial hazard may be defined as any condition produced by industries that may cause injury or death to workers or loss of product . Safety in simple terms means freedom from the occurrence of risk or injury or loss.

What are industrial hazards ?

- Physical : noise ,vibration , heat , cold , pressure , radiation
- Chemical : flammable / explosive materials , toxics
- Biological : dust , pathogens
- Psychological : work place practices and system , payment systems

- General hazards in industries

- Fire hazards
- Mechanical hazards
- Electrical hazards
- Chemical hazards
- Pharmaceutical hazards
- Radiation hazards
- Dust explosion

Fire hazards

- Fire is an chemical reaction between oxygen and fuel.

Sources of fire hazards

- Hot surfaces
- Combustible and flammable liquids
- Heat utilization equipment’s (over heating)
- Chemical process equipment’s
- Gas cylinders
- Ovens and furnaces
- Reactor
- Welding and cutting
- Sparks
- Carelessness

Mechanical hazards

- are created as a result of either powered or manual (human) use of tools, equipment or machinery in plant.
- Occurs due to :
- *large number of equipment’s
- *crowded work place conditions
- *frequent interaction between worker and equipment
- *insecurely fixed machines
- *worn and teared parts
- *negligence
- *improper maintenance of equipment

- Factors responsible of mechanical hazards
- - Physical : physical capability of worker may be not meet the job requirement
- - Physiological factors :
- A – age B – sex C – time D – experience

- Safety measures for mechanical hazards
- • All safety machinery must be fenced or mechanical interlocking or photocell
- • Machine should be fitted with emergency shutdown system
- • Control system override should be monitored
- • Operator must have a safe distance from the machine
- • Stop and lock button for machines

Electrical hazards

- Electricity is the flow of electrons through a substance which allows transfer of electrical energy from position to another.
- The most frequent causes of electrical injury /death are :
- 1_ Contact with power lines
- 2_ path to ground missing or discontinuous.
- 3_ Equipment not used in manner prescribed.
- 4_Improper use extension .
- 5_Electric shocks and burn due to poor indication facilities
- 6_Wiring faults and improperly wired equipments

- Safety measures for electrical hazards
- 1. Design of a safer system .
- 2. Implement a safe electrical work program.
- 3. Observe work practice.
- 4. Use protective equipment's.
- 5. Use warning labels.
- 6. Recheck the equipment's every day.
- 7. Overhead electrical wire should have extra care .
- 8. Recheck the lines every day.
- 9. Proper training to workers.

chemical hazards

- chemical hazard is a type of occupational hazard caused by exposure to chemicals in the workplace. Exposure to chemicals in the workplace can cause acute or long-term harmful health effects.
- Chemical hazards types of material:
- _Toxic _Corrosive _Irritant _Carcinogenic _Flammable
- Chemical reactions may get out of control due to:
- _ Wrong raw materials
- _ Raw materials with impurities
- _ Changed operating conditions
- _ Time delay
- _equipment failure

- Effects of chemicals on exposure
- 1. Skin burn
- 2. Ache
- 3. Ulcer in hand ,nose etc
- 4. Cancer
- 5. Irritation on Bronchus

- *Many chemicals can cause severe burns, if comes in contact with living tissues.
- Living tissues may be destroyed by following chemical reactions:
- _ Dehydration by strong dehydrating agents
- _ Digestion by strong acids and bases.
- _ Oxidation by strong oxidizing agents.

Pharmaceutical hazards

- Some general health hazards in manufacture of pharmaceutical include
- * Dust exposure
- * Exposure to UV radiation
- * exposure to formaldehyde : Formaldehyde may cause lung cancer , prostate cancer ,Acute exposure may cause pulmonary edema and pneumonia leading to death. Also causes allergic dermatitis
- Hazards from handling crude drugs and it is extracts
- Solvents: eg benzene
- Alkaloids: eg scopolamine
- Toxic intermediate
- local anesthetic
- varies hazards
- -Radiant energy
- -Bacteria and viruses

Dust explosion

- The term dust is used if the maximum particles size of the solids in the air mixture.
- Dust explosion is a rapid combustion of dust cloud.
- Drying , milling and blending operations generate atmospheric and fugitive dust emissions.
- During wet granulation , compounding and tablet coating ,hazardous air pollutants may be released to the atmosphere or the workplace as process or fugitive emissions.

Fourth lecture

industrial accidents

has been defined as “an occurrence in an industrial establishment causing bodily injury to a person which makes him unfit to resume his duties in the next time .

The accident may be the result of the wrong behavior of one of the workers during work or as a result of external conditions in the work that cannot be controlled and avoided.

work injuries

It is every accident that occurs during work and leads to its disruption for some time, and effects of one worker in the establishment or more of workers , which leads to suspension from work until he is fully recovered from the injury and returns to his work again.

Causes of industrial accidents

- Violation of the rules of operation of machines,
- tools, facilities and safety engineering;
- Defects in construction of installations and installation of technical equipment; Violation of repair works regulations;

- Improper organization of the production process;
- natural disasters

Technological accidents

* Where technological accidents occur for the following reasons:
- Degree of deterioration of technical equipment
- vehicles
- Insufficient level of control of the harmful factors associated with this version of the risk detectors, and the low level of collective and individual protection for workers;
- Lack of energy reliability, transportation and technology security systems;
- Lack of staff competence in potentially dangerous projects
- Expanded use of radioactive, chemical, biological, flammable and explosive materials and technologies;
- Defects of measures to prevent accidents
- The location of potentially dangerous production facilities near populated areas
- Reduced production of personal and group employee protection equipment
- Lack of local alarm systems regarding the emergency situation in dangerous installations.

Factors must be determine to reduce accidents

- Defects of technological processes and tools; design flows
- Defects of fences.
- Low quality safety devices and alarms.
- Low degree of material strength
- Insecure properties of substances and reactions formed during production

The consequences of industrial accidents are explosions, fires, destruction of residential and industrial installations, and the collapse of machinery and equipment. Often, as a result of industrial accidents, extensive air pollution occurs, the release of corrosive liquids and petroleum products

Types of accidents

*__Traffic accidents__ - that occur in production facilities that are not directly related to the movement of vehicles, and that occur during the process of their movement. Fires and explosions - the most common type of accident in the modern industrial world. Explosive Objects - The first in the number of industrial enterprises that use flammable materials, including pipeline and railway transport and used to transport flammable goods.

*__Accidents threatening to release chemicals__ - These are industrial accidents that occur due to leakage of harmful substances in their manufacturing, processing, storage and transportation. In some cases, the chemical compounds produced during an accident are toxic and deadly.

*__Accidents that threaten the release of biologically active substances__ are accidents with a relatively rare possibility due to the need to preserve the confidentiality of information, in addition to providing timely measures to prevent such contingencies.

*__Electrical power and utility systems accidents__ - lead to complications in the vital activity of the population, disruption of industrial activity and agriculture

*__Accidents at industrial wastewater treatment plants__ - not only has negative consequences for employees, but also lead to massive emissions of harmful substances into the surrounding space

Various personnel characteristics can be associated with events causing accidents in the following ways:

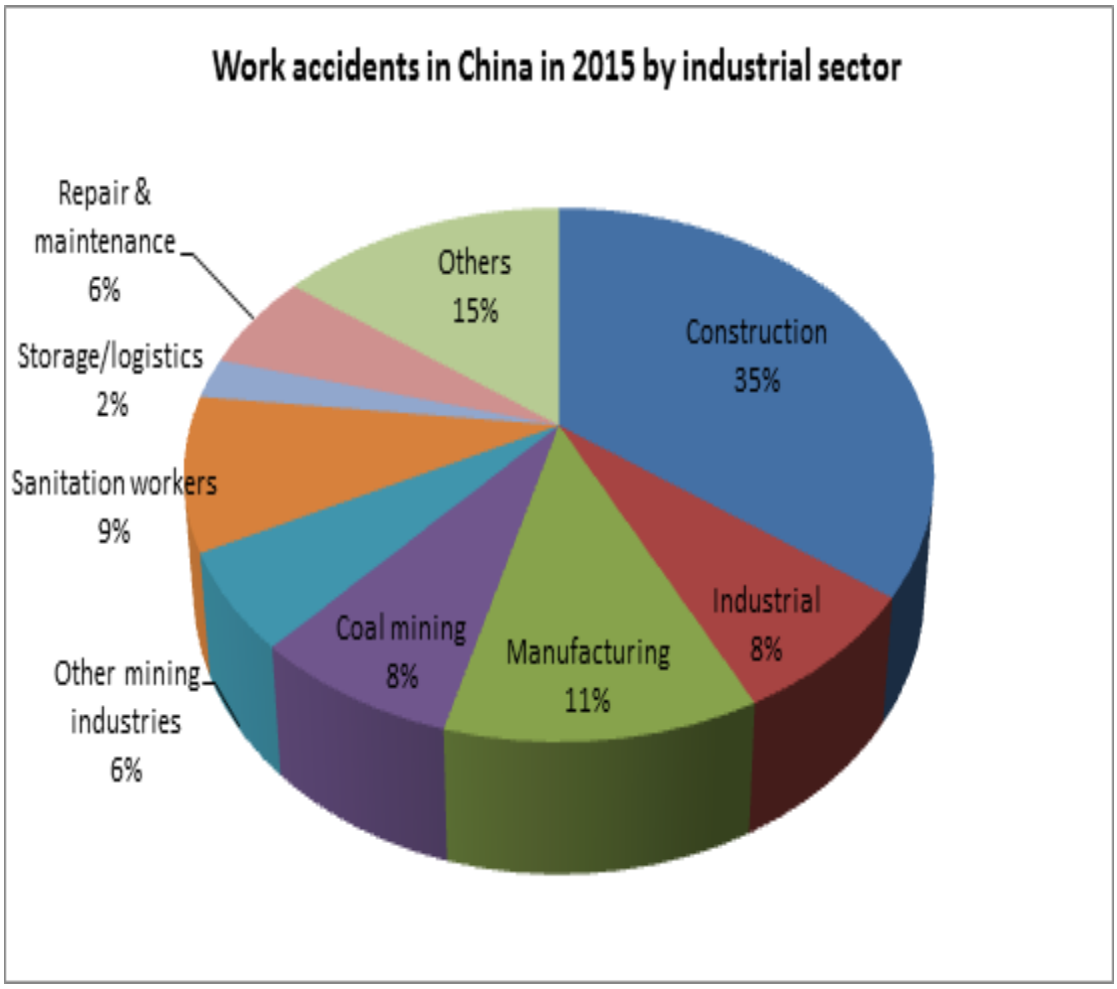
1. Untrained and unskilled persons are more prone to accidents than trained and skilled ones.

2. Persons who take unusual risk are more prone to, accidents than those who take moderate risk.

3. Alcoholic and drug addict persons are more prone to accidents than those who are away from such vices.

4. Persons who work under stress caused by their personal factors are more prone to accidents than those who do not.

5. Male workers are more prone to accidents than female workers because the latter adopt safety measures with more precaution



An example of accident rates in a Chinese laboratory

Fifth lecture

Fires

Fire is a chemical _physical process occurs as a result of mixing a flammable substances with oxygen under the influence of a certain temperature .

Elements of combustion

1 – **Fuel** : there are in solid form such as wood ,paper , cloth , etc and the liquid phase and semi liquid such as oil ,gasoline ,alcohol and the gas phase such as acetylene , methane etc .

2 – **Heat** : the temperature reaching to the necessary degree for flashing and the source of spark , flames , friction , sun light , chemical reaction ..etc .

Flash point : is defined as the lowest temperature at which it can form an ignitable mixture in air. Fire point, which is a slightly higher temperature, is the temperature at which vapors of the flammable liquid continue to burn after being ignited even after the source of ignition is removed.

3 – **Oxygen** : oxygen is available in the air (19 – 21) % .

Dangers of fires

1 – **personal dangers** : the risks that exposed the lives of human for injuries which requires a provision of measures for protecting from dangers in case of fire .

2 – **Destructive dangers** : it is the destruction of buildings and constructions as a result of a fire and the severity of the destruction vary depending on amount of flammable materials .

3 – **Expansion dangers** : danger to the neighborhood , the risks to nearby locations to place the fire called external dangers .

Causes Of Fire

1 - Humans cause:

- Ignorance

- Negligence

- Accident

- Firers from the wars.

- Strange storage and risk of flammable materials or explosion.

2 - **natural causes**

- earthquakes

- high heat

How the fire transmission

Heat moves by the following ways :

1 – **Touching** : heat transfer by conduction is direct touching or through the connector and the materials are vary in the degree of their ability to contact , some materials are a good conductor of heat and some other non-conductive heat .

2 – **convection** currents : heat moves in liquids and gases due to the density , heat transfer by convection currents are moving from bottom to top .

3 – **Radiation** : thermal radiation is absorbed by some objects and reflected by others , black or dark objects absorb greater than the shiny objects.

Fire extinguishing ways

Extinguish fires way depends on break the connecting between the fire elements (fuel , heat ,and oxygen)

First : cooling the fire

Is defined reduce the temperature of the burning material by using water , this method depends primarily on ability of the water to absorb heat substance flaming fire .

Second : covering the fire

Cover fire by barrier to prevents the arrivals of oxygen to the air for the following means :

1 – close the ports for the fire place to reduce the percentage of oxygen in the air

2 – cover the substances flaming chemical foam

3 – replacement of oxygen by water vapor or carbon dioxide

Third : to starve the fire

The fire is starved by reducing the amount of flammable material.

Causes of factory fires

1-raw materials entering in factory production (plastic -wood-

fuel or high-risk materials)

2-non-maintenance and continuous care of machinery used.

3-load on and machinery above the capacity.

4 - Incorrect storage of materials or lack of storage

Heat sources in factories

1- electric in the wires and electrical connections in

the factory.

2. .Engines in machines

3. Hot parts with factory equipment

4. The excess heat

5 - Non-care and neglecting ,smoking inside workshops

Preventive measures when a fire occurs in the factory

1 - Stop the workplace immediately.

2. Cut the power supply on the fire site.

3. Take out all workers and keep them distance away from the

effect of smoke and gases from the place of fire.

4 - Request for assistance from civil defense.

Fire Protection

The fight against fires is not limited by fire extinguishing , but preventing his occurrence from the beginning by installing fire alarms in all the rooms of the building; to warn workers when the fire starting , for trying control.

Training individuals on how to handle fire, use of simple fire extinguishing

tools, such as: carbon dioxide cylinders, may prevent great disaster

fire extinguishing tools must putting in clear and easy Place

Classification of fires

European states agreed upon the modern classification is divided into four types of fires are :

Class (A)

That arise in solid which often are of the nature of the organic (carbon compounds) such a paper ,wood , and because most of these material are porous can be considered the water most suitable to extinguish this type of fire .

Class (B)

It is the fire that occur with flammable liquid . the way to extinguish these type of fire by (sprays of water or foam or vapors halogens or carbon dioxide or dry chemical powder).

Class (C)

Are the fires of flammable gases , including liquefied petroleum gases propane and butane are used chemical foam and dry powder to face the fires of gases

Class (D)

A fire occurring minerals and inefficient use water to face the fire . usually used graphite powder or dry sand and other types of dry chemical powder to extinguish this type of fire.

Sixth lecture

Fire alarm system

A fire alarm is a device that sounds an alarm (noise) when a fire occurs This is to evacuate the area where the fire broke out in preparation for extinguishing the fire. And the fire detection system is operated either manually, or automatically.

fire alarm system has a number of devices working together to detect and warn people through visual and audio appliances when smoke, fire, carbon monoxide or other emergencies are present. These alarms may be activated automatically from smoke detectors, and heat detectors or may also be activated via manual fire alarm activation devices such as manual call points or pull stations. Alarms can be either motorized bells or wall mountable sounders or horns. They can also be speaker strobes which sound an alarm, followed by a voice evacuation message which warns people inside the building not to use the elevators. Fire alarm sounders can be set to certain frequencies and different tones including low, medium and high, depending on the country and manufacturer of the device. Most fire alarm systems in Europe sound like a siren with alternating frequencies. Fire alarm electronic devices are known as horns in the United States and Canada, and can be either continuous or set to different codes. Fire alarm warning devices can also be set to different volume levels.

Fire alarm systems guarantee reducing the severity of fires and the resulting damage as they allow it to be controlled quickly by alerting all those in the presence of the fire. Therefore, detectors and alarms of various types and shapes are designed according to the nature of sites and places that need a fire alarm panel, fire alarm detectors and alarm sirens and Wires and cables resistant to high temperatures.

the purpose of fire alarm system

The main purpose of these systems: is to quickly respond to the fire

and then convert this early response into an audio and visual

signal to alert an individual or group of individuals in the building,

place, or relief or extinguishing center that there is a fire in its

early stages.

The stages of the fire are divided into:

The first stage "primary": the fire is smoke-free or odorless, as it began to form and is small in size and is not noticed

The second stage: It is where the smoke begins and the fire begins to appear

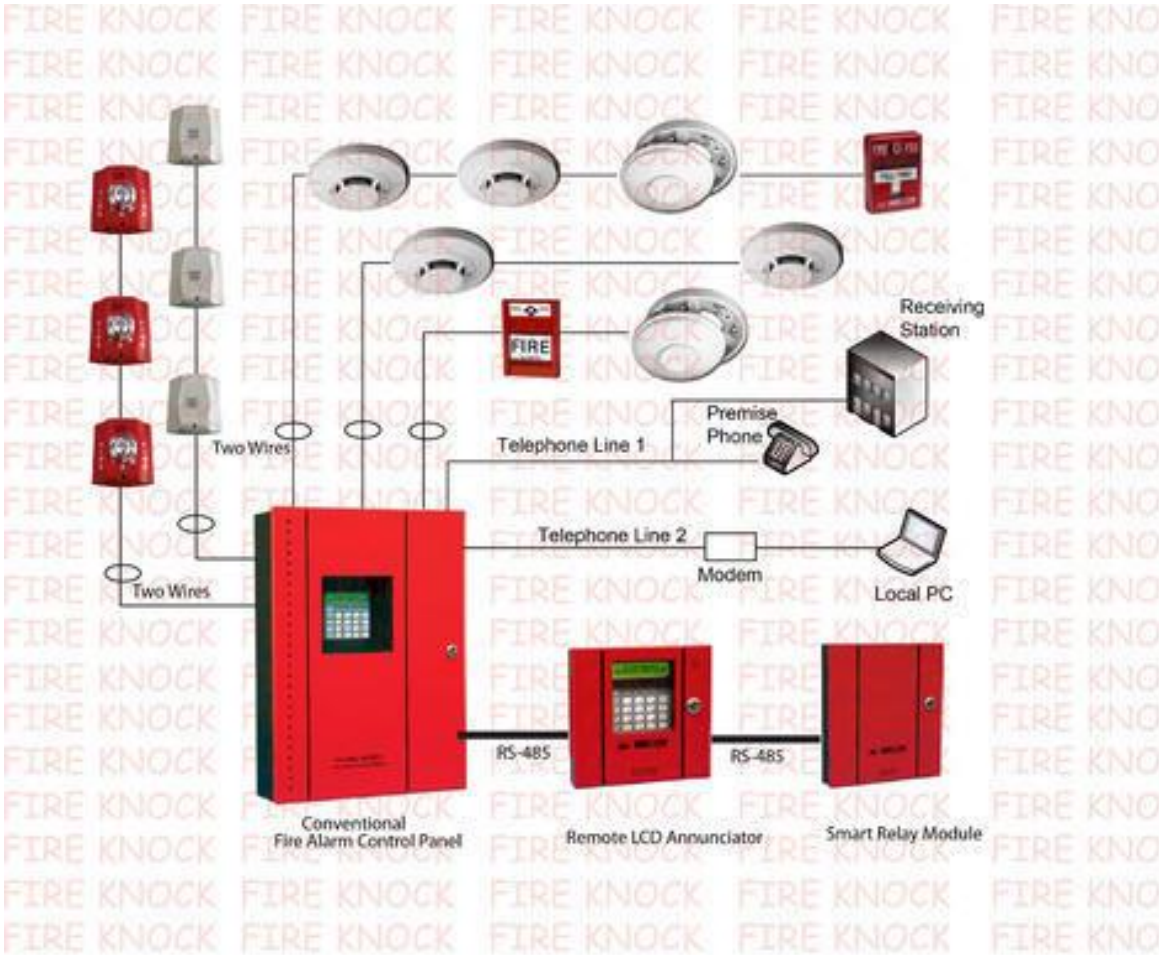
The third stage: the flames begin to appear and the smoke rises, which is the stage that the fire alarm feels

The fourth stage: the fire develops to its maximum degree and its spread is rapid and must be eliminated before it continues during this stage .

Types of Fire Alarm Systems

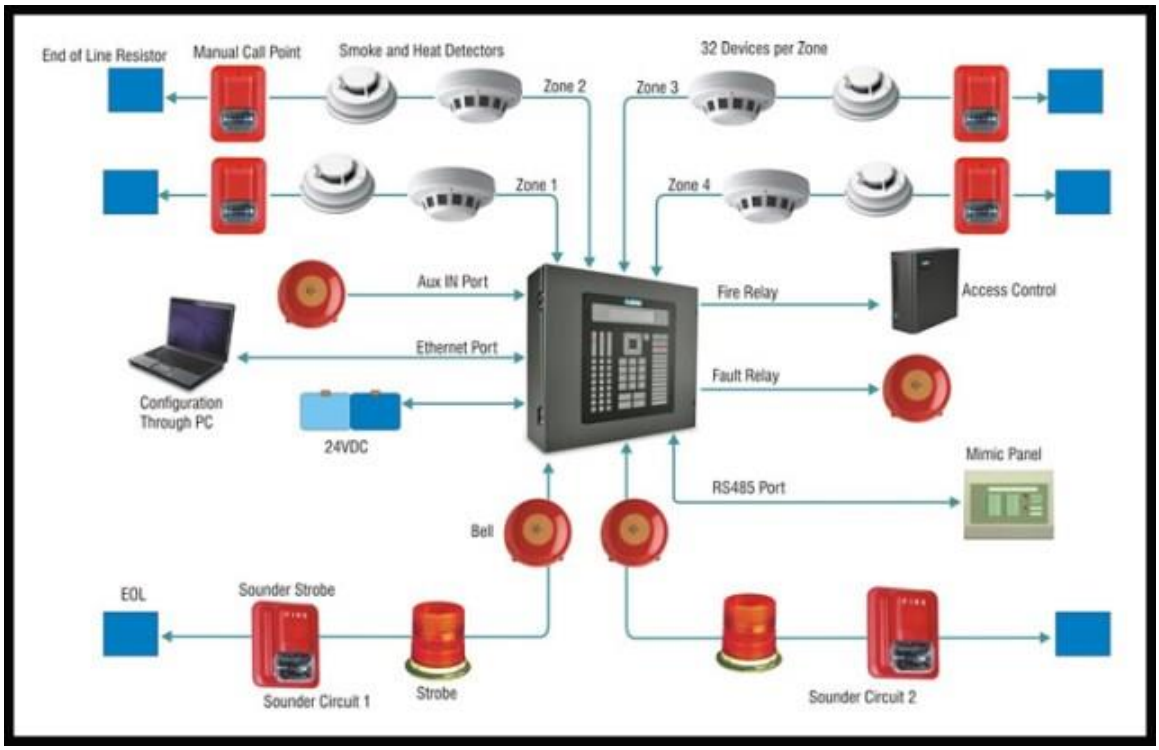
Type 1: Conventional Fire Alarm

Conventional fire alarm systems and its components are all wired to the same cable that connects them to a fire alarm control panel. The control panel displays a signal when these components activate. These types of systems are inexpensive and work well in small facilities. The main problem with conventional fire alarm systems is that when a fire alarm component produces a signal and it appears on the control panel there is no way to know which component it is in the building. If you foresee this to be a problem you may want to consider an addressable fire alarm system.



Type 2: Addressable Fire Alarm

Addressable fire alarm systems are the most modern type of system and its components have individual unique identifiers. When one of the system's components initiates, it indicates the component's address on the fire alarm panel. Large facilities utilize these systems because they can quickly pinpoint where the trouble signal originated. This saves a lot of time because it eliminates the need to search for the component that produced the signal.



Fire alarm system compounds

•**Fire alarm control panel** – the system hub monitors inputs and system integrity, controls outputs and relays information.

•**Primary power supply** – primary power for your fire alarm system is usually supplied in the form of 124V or 240V AC from the power company.

•**Secondary (backup) power supply** – backup power supplies usually consist of lead-acid batteries used to power the system in case the primary power source fails.

•**Initiating devices** – these are your activation stations, and can be manual (pull stations) or automatic (smoke detectors).

•**Notification appliances** – notification appliances are things like flashing lights, horns, speakers, etc. that actually let people know of the danger in your building.

•**Building safety interfaces** – these are things like exit lighting, ventilation systems, etc. that make it easier for people to get out of the building once a fire has started.

Seventh lecture

Industrial safety in chemical laboratory

Working in laboratories requires a full awareness of the importance and seriousness of the materials and devices used, as many substances are toxic, or irritating to the membranes and flammable and other forms of risk, so before starting work in the laboratory must be aware of the importance and seriousness of the materials used .
Take caution and follow the recommended safety instructions for each laboratory.

General safety measures by level:
Public health protection and maintaining is a first-class ethical process, requiring the state to establish laws and enact appropriate legislation to work on them in different laboratories , safety procedures in laboratories vary with the level in effect

the basic specifications of chemical laboratories

The basic specifications when establishing laboratories should include the following:

The basic specifications when establishing laboratories should include the following:

1. The space available for movement will be sufficient.
2. Leave a work area of at least one meter around each equipment or workbench
3. Sub-corridors with a suitable width
4. Storage cabinets are not above eye level.
5. The bench is made of a chemical resistant material, such as epoxy.
6 . The laboratory shall be equipped with two emergency exits that open to the outside .
7. Fire extinguishers and blankets are suspended near the exits, at a height of one meter from the ground.
8. The laboratories shall be provided with good ventilation system .
9. Laboratory floors are non-slip, chemical resistant.
10. The upper half of the laboratory is shatter-proof glass to monitor what happens inside the laboratory.
11. Each laboratory has major switches for water, electricity, and gas so that the supply can be cut off if there is a breakdown in one of the laboratory tubes or wires
12 . Drainage pipes shall be made of a chemical resistant material.
13 . Preparation room.

Personal protective equipment in chemical laboratory

1. protective glasses that protect against splash of chemicals and glass shards
(note: contact lenses do not protect the eye because they absorb the vapors of certain chemicals and are difficult to remove in the event of splashing chemicals).
2. In the case of using medical glasses, wear protective glasses on top of medical glasses.
3. Protective shoes.
4. Chemical resistant protective rubber gloves
5. Protective face, neck and ears mask used when dealing with explosive and splashing chemicals under high pressure or dealing with chemical reactions.
6. Filter respirator masks

Personal behavior of employees

1- The use of laboratory devices within the intended purpose only.
2- Taking the work in the laboratory on a large degree of responsibility and lack of recklessness when conduct of experiments.
3- Children are not admitted to laboratories because they contain hazardous materials, chemicals and emissions.
4- In the event students are entered for the purpose of educational benefit, they should be kept under the supervision of trained person.
5- Put warning boards. When dealing with chemicals, the highest levels of caution should be taken; To reduce the exposure of the skin, eyes and hands to gases emitted from various experiments.

Types of hazards in chemical laboratories

1. fires.
2. Explosions
3. Gas leakage,
4 chemical fluid leaks and solid
5.chemical spread.
6. Contact with electric current
7. contact with harmful chemicals
8.Contact with hot objects and fall
9. collision.
10. Sliding
11. glass tools explosion under pressure

The factors which effect on chemicals influence

1- Concentration of the chemical.
2- Physical state of the chemical (solid , liquid , gas) .
3. Physical processes involved in using the chemical (cutting , heating , cooling , etc.) .
4. Chemical processes involved in using the chemical (mixing with other chemicals , purification , distillation , etc.) .
5- other processes (improper storage , addition of moisture , storage in sunlight , etc.).

Safety precautions after completing work in the laboratory

1. Close the gas sources.
2.Dispose of the broken glass in this wastebasket.
3. Dispose of chemical waste.
4. Return the tools, devices and chemicals to their original locations.
5. Explain the type of waste that is placed on the trash.
6. If there are damaged devices, they must be clarified.
7. Turn off the electrical appliances and electrical source for each bench.
8. Leave personal protective equipment in the laboratory
9. Wash hands with soap.
10. Close the water taps.
11. Close or lock the door.

Safety precautions against chemical hazards

1- Know the properties of the chemical through the labeling on the package.
2- Not touching the chemicals directly by hand and not tasting or inhaling them.
3- Wearing gloves while working.
4- Not to use the mouth to fill the pipette. Rather, the air compressor should be used.
5- The chemicals are not stored inside the laboratory, but they must be placed in special storage places.
6- Disposal of chemical residues in the appropriate way for each material according to the lab technician’s instructions.
7- Conducting experiments from which gases or odors rise in the gas chamber.
8- Caution when directing the test tube to the face or body during heating.
9- Close the chemical bottles when finished and not open several bottles at one time

CHEMICAL HAZARD SYMBOLS

Chemical hazard symbols are found on some home products, as well as bottles of chemical reagents in the lab. Here, we take a look at European hazard symbols and the various dangers that they warn of.

ENVIRONMENTAL HAZARD

Indicates substances that are toxic to aquatic organisms, or may cause long lasting environmental effects. They should be disposed of responsibly.

ACUTELY TOXIC

Indicates life-threatening effects, in some cases even after limited exposure. Any form of ingestion and skin contact should be avoided.

GAS UNDER PRESSURE

Container contains pressurised gas. This may be cold when released, and explosive when heated. Containers should not be heated.

CORROSIVE

May cause burns to skin and damage to eyes. May also corrode metals. Avoid skin & eye contact, and do not breathe vapours.

EXPLOSIVE

May explode as a consequence of fire, heat, shock or friction. Chemicals with this label should be kept away from potential ignition sources.

FLAMMABLE

Flammable when exposed to heat, fire or sparks, or give off flammable gases when reacting with water. Ignition sources should be avoided.

MODERATE HAZARD

May irritate the skin, or exhibit minor toxicity. The chemical should be kept away from the skin and the eyes as a precaution.

OXIDISING

Burns even in the absence of air, and can intensify fires in combustible materials. Should be kept away from ignition sources.

HEALTH HAZARD

Short or long term exposure could cause serious long term health effects. Skin contact and ingestion of this chemical should be avoided.

Eighth lecture

Industrial safety in chemical storage

Chemical storage is the storage of controlled chemicals or hazardous materials in chemical stores, chemical storage cabinets, or similar devices. Improper chemical storage can result in the creation of workplace safety hazards including the presence of heat, fire, explosion and leakage of toxic gas. Chemical storage cabinets are typically used to safely store small amounts of chemical substances within a workplace or laboratory for regular use. These cabinets are typically made from materials that are resistant to the chemicals stored in them and sometimes contain a bonded tray to capture spillage. Chemical stores are warehouses commonly used by chemical or pharmaceutical companies to store bulk chemicals.

the storage and handling of potentially hazardous materials must be disclosed to occupants under laws managed by the Occupational Safety and Health Administration (OSHA). Chemical storage devices are usually present where a workplace requires the use of non - hazardous and / or hazardous chemicals. Proper storage is imperative for the safety of, and access by, laboratory workers.

Requirements to build up the chemical storage

1 – choose proper place

A – far from populated areas and important establishments

B – one floor building

2 – providing emergency equipment’s

3 – Construction of the building

4 – Wiring and electrical installation

5 – Ventilation

6 – Discharge leakages

7 – lighting

8 – Exits and corridors

9 – Personal protective equipment

10 – Fire alarm system

11 – Detector leakage of hazardous material

Personal protective equipment’s in chemical storage

Providing the storage area with protective equipment and equipment to protect workers during the handling and storage of materials It includes manual gloves, rubber boots, breathable masks, and essential safety equipment Depending on the quality and nature of the materials stored.

Main storage condition

1. The materials are not stored based on the alphabet, but according to severity and category.

2. Maintain a copy of the MSDS (Material safety data sheet) of safety instructions for each material.

3. Avoid exposing the stored materials to sunlight or heat.

4.Stored in appropriate way according the nature of its risk.

5. Ensure that the chemical containers are closed well.

6. Reducing the quantities stored as possible.

7 . Characterize materials stored clear signs (warning signs).

8 . Storage homogeneous material : the separation of substances that can cause dangerous when it mix .

9 . Leave a space between the stacks stored material.

10 . The drag of material stored oldest storage industry

11 . Be stored dry and free of moisture .

12. The cylinders shall be stored vertically and closed.

13 . Monitor containers on an ongoing basis to avoid leaks.

14 . Cylinders (containers) can only be repainted by the supervisor of storage.

15 . Allocate an area inside the store for empty cylinders.

16 . Ensure that the information on the cylinder body matches its contents.

classification of dangerous substances categories

1 - Explosive

2 - Gases

A / flammable gases

B / compressed gases

3 - Solvents (flammable liquids)

4 - Solid flammable materials

5 - Oxidizing substances and organic peroxides

6 - Toxic chemicals

7 - Radioactive materials

8 - Corrosive material

material safety data sheet (MSDS)

A safety data sheet (SDS), material safety data sheet (MSDS), or product safety data sheet (PSDS) are documents that list information relating to occupational safety and health for the use of various substances and products. SDSs are a widely used system for cataloging information on chemicals, chemical compounds, and chemical mixtures. SDS information may include instructions for the safe use and potential hazards associated with a particular material or product, along with spill-handling procedures. The older MSDS formats could vary from source to source within a country depending on national requirements; however, the newer SDS format is internationally standardized.

the required conditions in material safety data sheet (MSDS)

1 - Written in local languages

2 - It is easy to find in the places of using and storing chemicals

3 - Other copy is available

4 - It should be continuously updated

Chemical identification label

Each chemical-containing package contains labels that give quick and easy-to-understand information, as follows

1- The commercial and scientific chemical name

2 – Chemical compounds

3 – Dangerous signs for the material

4 - Safety precautions

5 - First aid on exposure

5 Steps to HAZCHEM SAFETY

1 Know where material safety data sheet are kept

2 Store chemical in an appropriate storage facility

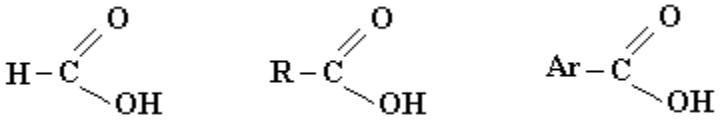
3 Put chemicals away when not in use

4 Keep chemicals in their original containers

5 Dispose of chemicals in an appropriate manner (environmental friendly)

Carboxylic acids

Carboxylic acids are organic compounds that show appreciable acidity. These compounds contain carboxyl group.



The carboxyl group can be attached to hydrogen (HCOOH), or an alkyl group (RCOOH).

HCOOH

Methanoic acid
(Formic acid)

CH_3COOH

Ethanoic acid
(Acetic acid)

CH_3-CH-COOH
|
Br

2-Bromopropanoic acid
(α-Bromopropionic acid)

Naming of Carboxylic acids

Aliphatic carboxylic acids have been known for along time, and as a result have common names that refer to their sources rather than to their chemical structures.

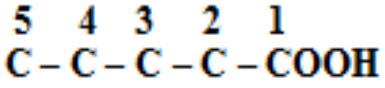
Formic acid, for example, adds the sting to the bite of an ant (Latin: formica, ant); butyric acid gives rancid butter its typical smell (Latin: butyrum, butter); and caproic, caprylic, and capric acids are all found in goat fat.

Table of Carboxylic Acids

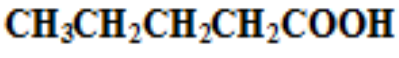
Name	Formula	Origin of name
(Formaic acid) Methanoic	$HCOOH$	L.formica, ant
(Acetic acid) Ethanoic	CH_3COOH	L. acetum, vinger
(Propionic acid) Propanoic	CH_3CH_2COOH	Gr. Proto, first pion, fat
(Butyric acid) Butanoic	$CH_3(CH_2)_2COOH$	L. butyrum, butter
(Valeric acid) Pentanoic	$CH_3(CH_2)_3COOH$	L. valere, to be strong (valerian)
(Caproic acid) Hexanoic	$CH_3(CH_2)_4COOH$	L. caper, goat
(Caprylic acid) Heptanoic	$CH_3(CH_2)_5COOH$	L. caper, goat
(Capric acid) Decanoic	$CH_3(CH_2)_8COOH$	L. caper, goat
(Lauric acid) Dodecanoic	$CH_3(CH_2)_{10}COOH$	Laurel
(Myristic acid) Tetradecanoic	$CH_3(CH_2)_{12}COOH$	Myristica, nutmeg
(Palmitic acid) Hexadecanoic	$CH_3(CH_2)_{14}COOH$	Palm oil
(Stearic acid) Octadecanoic	$CH_3(CH_2)_{16}COOH$	Gr. Stear, tallow

The IUPAC names follow the usual pattern. The longest chain carrying the carboxyl group is considered the parent structure, and is named by replacing the –e of the corresponding alkane with –oic acid.

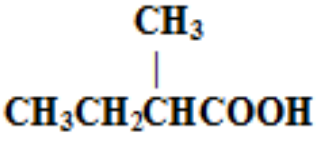
The position of the substituent is indicated by a number.



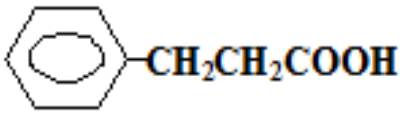
Used in IUPAC names



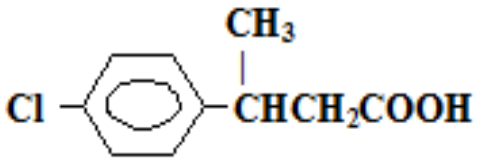
Pentanoic acid



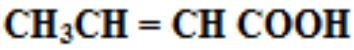
2-Methylbutanoic acid



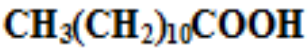
3-Phenylpropanoic acid



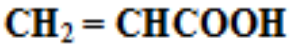
3-(*p*-Chlorophenyl)butanoic acid



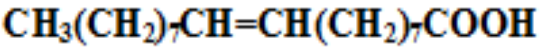
2-Butenoic acid



Dodecanoic acid
(Lauric acid)

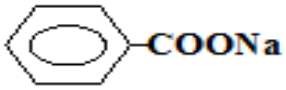


Propenoic acid
(Acrylic acid)

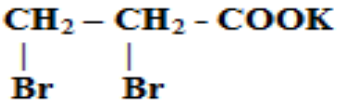


cis-9-Octadecenoic acid
(Oleic acid)

The name of a salt of a carboxylic acid consists of the name of the cation (sodium, potassium, ammonium, etc.) followed by the name of the acid with the ending –ic acid changed to –ate.



Sodium benzoate



Potassium 2,3-dibromopropionate
(Potassium α,β-dibromopropionate)

$(CH_3COO)_2Ca$

Calcium acetate

$HCOONH_4$

Ammonium formate

Physical Properties of Carboxylic Acids

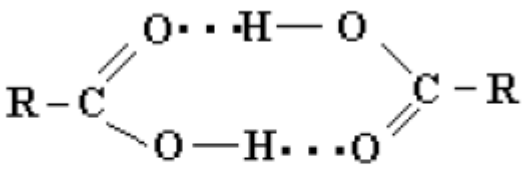
Both parts of a carboxyl group, the carbonyl and the hydroxyl, are polar groups, and can form hydrogen bonds with each other and with other kind of molecules.

The aliphatic acids therefore show very much the same solubility behavior as the alcohols.

Water solubility undoubtedly arises from hydrogen bonding between the carboxylic acid and water.

Carboxylic acids have higher boiling points than alcohols of comparable molecular weight.

These high boiling points are due to the fact that a pair of carboxylic acid molecules is held together not by one but by two hydrogen bonds.

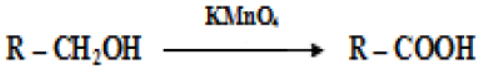


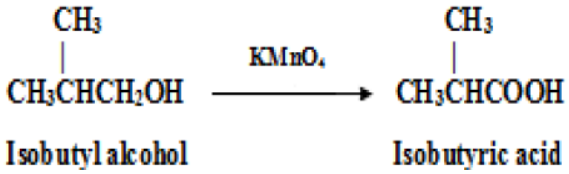
Intermolecular hydrogen bonding

Preparation of Carboxylic Acids

1- Oxidation of primary alcohols

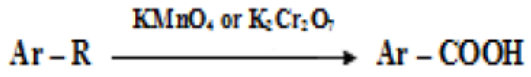
The oxidation of an alcohol involves the loss of one or more hydrogens (α-hydrogen) from the carbon bearing –OH group. If the alcohol is primary and loses both hydrogen atoms, the product is a carboxylic acid.

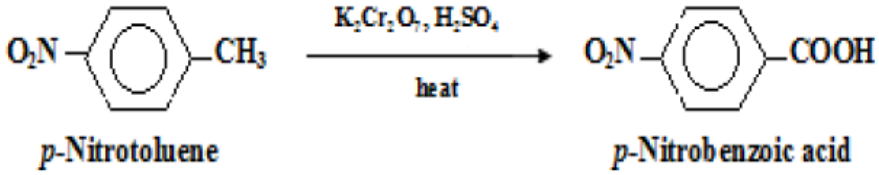


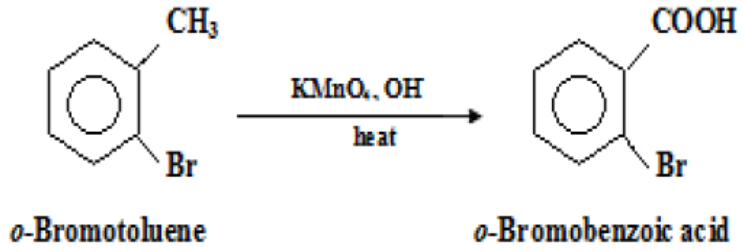


2- Oxidation of alkylbenzenes

One of the most useful methods of preparing an aromatic carboxylic acid involves oxidation of the proper alkylbenzene.

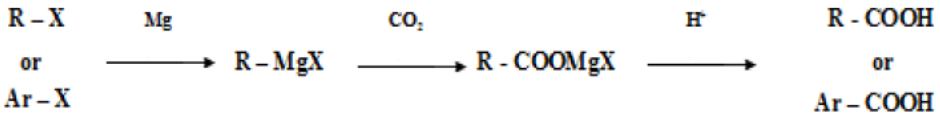


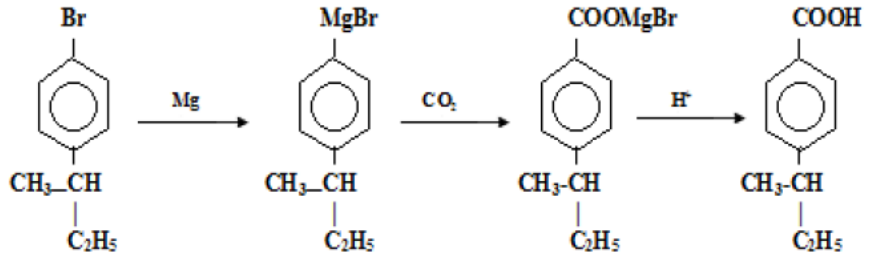




3- Carbonation of Grignard reagents

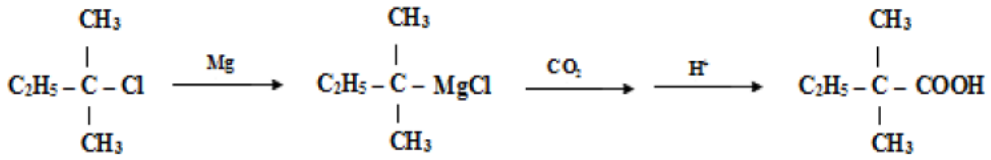
The Grignard synthesis of a carboxylic acid is carried out by bubbling gaseous CO_2 into the ether solution of the Grignard reagent, or by pouring the Grignard reagent on crushed dry ice (solid CO_2).





p-Bromo-*sec*-butylbenzene

p-*sec*-Butylbenzoic acid



tert-Pentyl chloride

2,2-Dimethylbutanoic acid
(Ethyldimethylacetic acid)

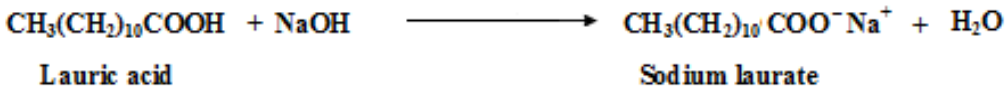
Reactions of Carboxylic Acids

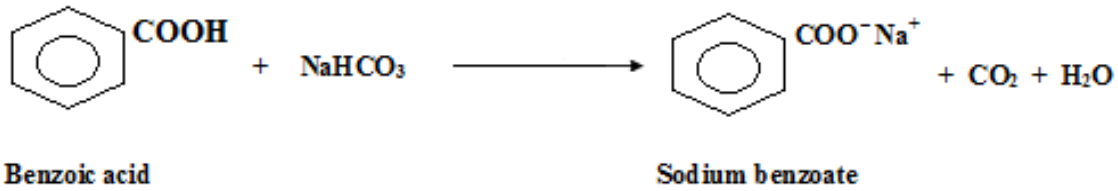
Although the carboxyl group apparently contains a carbonyl group linked to a hydroxyl group, carboxylic acids rarely display properties of either ketones or alcohols. Carboxylic acids are weak acids, but they can react smoothly and quickly at room temperature with strong bases like NaOH.

1- Acidity. Salt formation

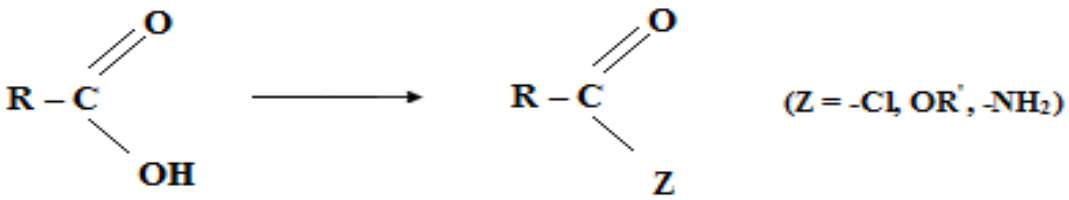
Although carboxylic acids are weak acids by comparison with mineral acids, the soluble carboxylic acids form distinctly acidic solution in water, unlike alcohols.

Carboxylic acids react quickly with NaOH, KOH, and other strong bases to form water-soluble salts and water.



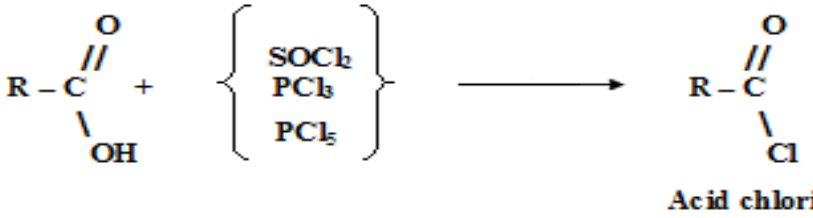


2- Conversion into functional derivatives

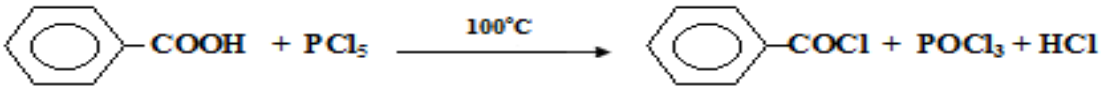


(a) Conversion into acid chlorides

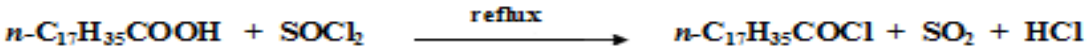
Treatment of a carboxylic acid, usually dissolved in a dry solvent to moderate the reaction, with phosphorus pentachloride, phosphorus trichloride or sulphur dichloride oxide (thionyl chloride), yields an acid chloride.



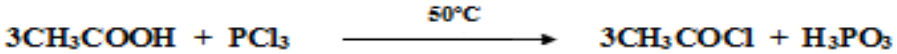
Acid chloride



Benzoic acid — Benzoyl chloride



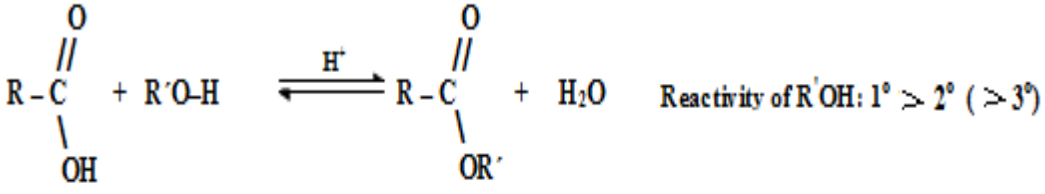
Stearic acid — Thionyl chloride — Stearoyl chloride



Acetic acid — Acetyl chloride

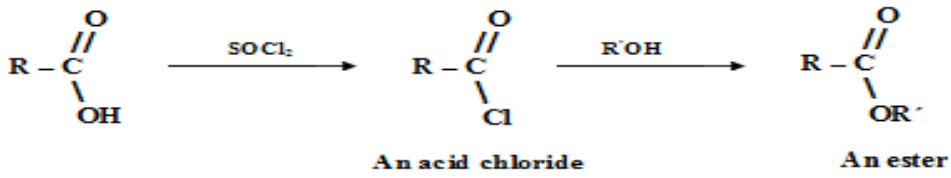
(b) Conversion into esters

Carboxylic acids react with alcohols to form neutral compounds called esters.



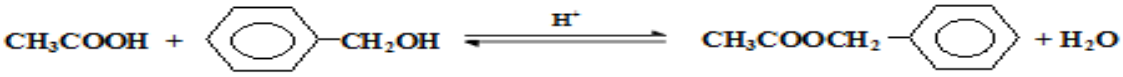
An ester

Reactivity of R′OH: 1° > 2° (> 3°)

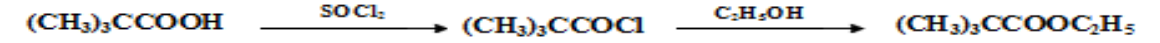


An acid chloride

An ester



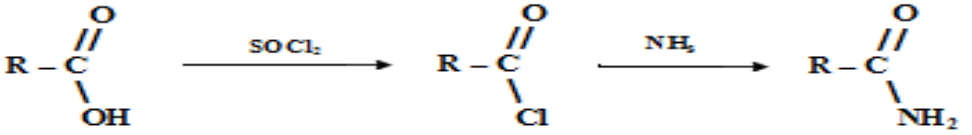
Acetic acid Benzyl alcohol Benzyl acetate



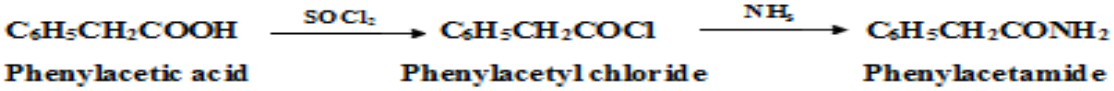
Trimethylacetic acid Ethyl trimethylacetate

(c) Conversion into amides

Carboxylic acids can be converted to amides by reaction with thionyl chloride then ammonia.



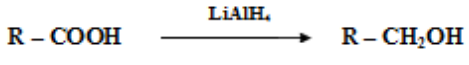
An acid chloride An amide



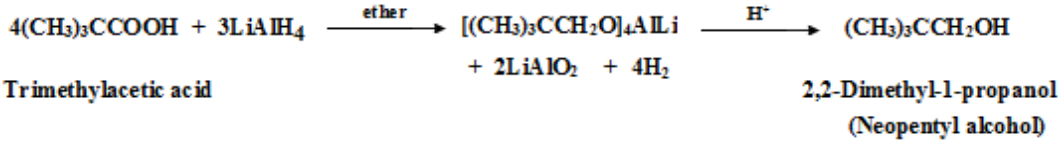
Phenylacetic acid Phenylacetyl chloride Phenylacetamide

3- Reduction

Carboxylic acids are readily reduced by lithium tetrahydridoaluminate LiAlH4 to primary alcohols.

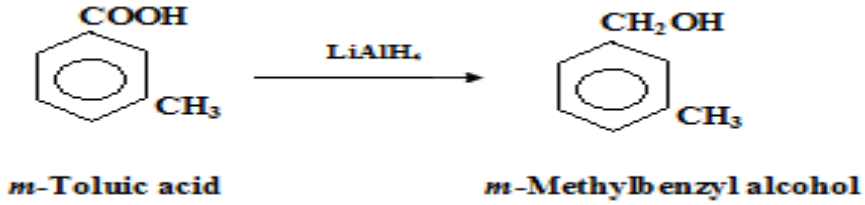


1° Alcohol



Trimethylacetic acid

2,2-Dimethyl-1-propanol (Neopentyl alcohol)



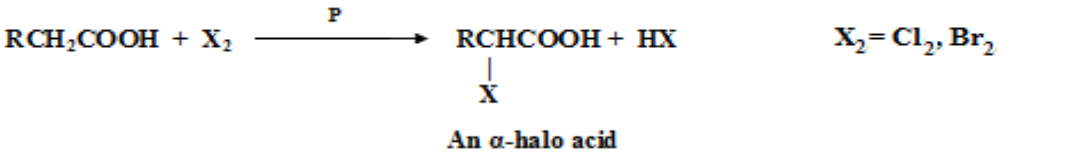
m-Toluic acid *m*-Methylbenzyl alcohol

4- Substitution in alkyl or aryl group

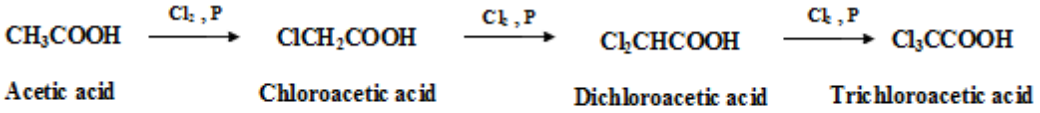
(a) Alpha-halogenation of aliphatic acids. Hell-Volhard-Zelinsky reaction

In the presence of a small amount of phosphorus, hydrogen atom bonded to the carbon atom adjacent to a carboxyl group can be substituted by chlorine or bromine.

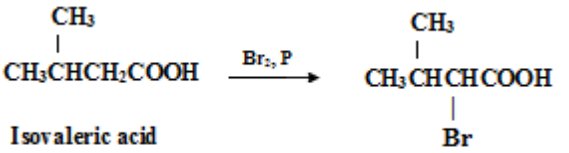
The reaction yield compound in which α-hydrogen has been replaced by halogen.



An α-halo acid



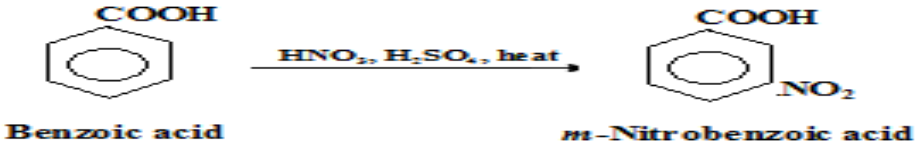
Acetic acid Chloroacetic acid Dichloroacetic acid Trichloroacetic acid



Isovaleric acid α-Bromoisovaleric acid

(b) Ring substitution in aromatic acid

Groups like NO2, can be substituted on the ring of the aromatic acids. It is meta electrophilic substitution.



Benzoic acid *m*-Nitrobenzoic acid

Tenth lecture

Radiation safety

Radiations are found in every part of our life. Radiation may occur naturally in the Earth and may reach us from radiation from the space surrounding us. Also, radiation can occur naturally in the water we drink or in the soil and in building materials (radon from the earth and radioactive elements present in the ground).

Radiation may occur as a result of being manufactured by humans, such as X-Rays. Atomic power plants are also found in lionization Smoke Detectors.

Radiation is defined as the process that results in the release of energy in the form of particles or waves. Scientific authorities estimate In the United States of America that the average person receives radiation doses of 60 millimeters per year and the exposure to natural radiation is consider 80% and 20% second of industrial radiation.

How radiations originate

●The element's atom consists of a central nucleus (Nucleus) containing

Positively charged protons and neutral neutrons orbiting this nucleus

Number of electrons

The number of protons in the nucleus is called the atomic number

Number) while the sum of the number of protons is called + sum

Neutrons (Weight Atomic)

● In most nuclei of chemical elements the number of protons is inside

The nucleus is equal to the number of neutrons and in some nuclei of some elements The number of neutrons is greater than the number of protons, and they are called Isotope elements.

The number of neutrons is greater than the number of protons, and they are called Isotope elements.

These areotopes, some of them stable, whose peak structure does not change over time.

It usually has a low atomic number □

●Some of these isotopes are unstable and often atomic numbers

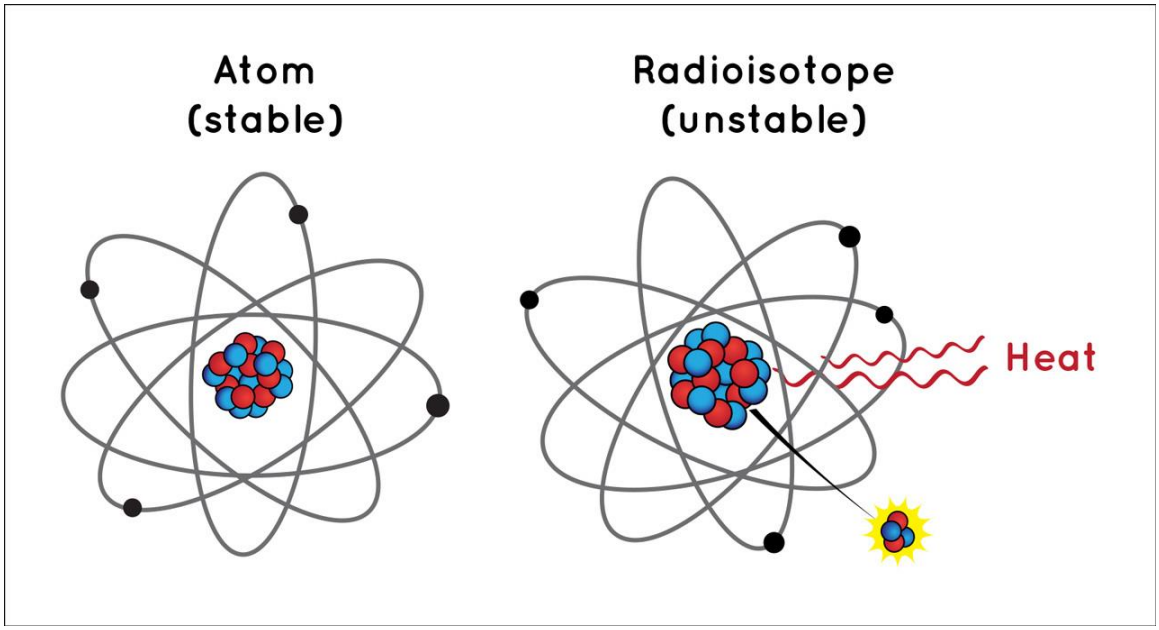
High and called radioisotopes, and these isotopes will pronounce their nuclei

Nuclear minutes (that is, they will emit nuclear radiation) are called rays

Alpha, beta, and gamma rays over time transform these elements

To other elements less weight and differ in their chemical properties

And physical properties of the original element.



There are two main types of radiation

1_ Radiation Ionizing, such as x-rays and x-rays Gamma, cosmic rays, beta and alpha particles.

2_ Radiation Ionizing-non

Electromagnetic radiation, including radio and television waves Radar and heat waves , infrared, and ultraviolet

Violet and normal light .

Ionizing Radiation

There are three main types of ionizing radiation that may be found in the radiation they manufacture Ionizing radiation has several dependent health damages . On the level of radiation a person is exposed to, and radiation effects on Body cells increase the possibility of cancer and genetic changes Others that may be transmitted to children, and in what case a person is exposed to me A large amount of radiation may result in death.

1-**Particles Alpha**

The alpha ray trajectory can be stopped by a piece of paper or by the human body

2-**Beta Rays**

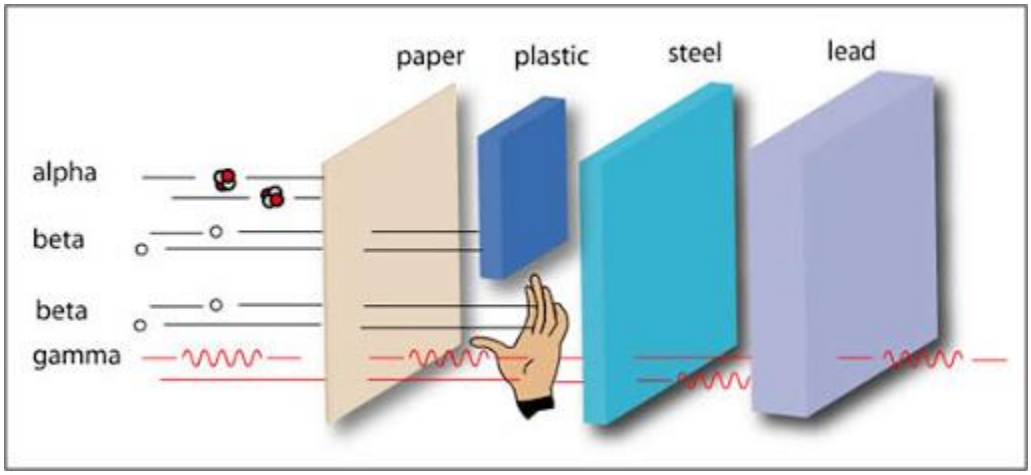
Beta minutes cannot be stopped by a piece of paper and these rays cannot stop With a piece of wood, it may cause serious harm if it penetrates the body.

3-**Gamma Rays**

One of the most dangerous types of radiation has a very high penetration force, much greater than alpha radiation And beta rays .

Its flow can be stopped by a concrete barrier. X-rays are located

They include gamma rays, but are less porous than gamma rays.



The health effects of that radiations

1_ Alpha particles

The penetration force of the alpha particles is very weak as it loses its energy once It exits the radioactive element. It can cause harm and health damage to the tissues during the simple pathway, and these rays are absorbed into the outer part of the human skin, so alpha particles are considered Extracorporeal damage, but can cause significant damage if done Inhaled or swallowed.

2_Beta particles

The penetration force and penetration of beta minutes is greater than the penetration force of alpha rays. Some minutes of beta can penetrate the skin and da Including beta radiation. mage it Highly dangerous if inhaled fumes or swallows Its emission can be stopped with simple aluminum or wood chips.

3_Ray Gamma

It has very high penetration force and can easily penetrate an object Human or absorbed by tissues and therefore a danger It can be highly radioactive on human Concrete or lead

4/ X_Ray

Its properties are similar to those of gamma rays, but they differ in the source Where X-rays are emitted from processes outside the atomic nucleus while they are Emitted Gamma rays from inside the nucleus of the atom.

The penetration force and permeability of X-rays are lower than that of gamma rays X-rays are one of the most common sources of human exposure to radiation Its use in many industrial - medical processes.

Its penetration ability can be stopped by a slice of lead Its thickness is a few millimeters.

●Ionizing radiation (inserting energy into the cells of the body) can cause changes in the chemical balance of the body cells, some of which are The changes may lead to an imbalance in the human atomic fluid (DNA) and thus It leads to dangerous genetic mutations that may also be passed on to children Their mother.

Exposure to large amounts of radiation may lead to diseases during

Hours or days and may result in death within 60 days of exposure (and in cases of exposure to very large quantities Death can happen within a few hours And symptoms of ionizing radiation may occur over a long period

Basic Principles of Radiation Protection

There is a set of agreed principles for radiation protection, including:

_Keeping solid radioactive materials inside a safe deposit of lead.

_The radioactive quantities of materials used in manufacturing, to which workers are exposed

according to governmental regulations, are determined by three factors:

1- Time: Reducing exposure time reduces the dose taken, and the rate of decrease is directly proportional to time.

2- The distance: the greater the person's distance from the radiation source, the less the quantity sought. According to it, the quantity taken decreases inversely with the distance from the source.

3- Barrier: blocks are used to block radiation and absorb it, and use it to the extent appropriate to reduce the amount of radiation left over. Among the most important materials used to block rays are lead, iron and concrete.

How to prevent radiation

There are practical methods used to prevent radiation, including the following:

1_Wear radiation-protective clothing, shoes and gloves when handling it.

2_As far as possible, move away from the radioactive source

3_Place the necessary precautions near radioactive sources, including the following:

*Radiological scanning devices.

*A convenient warehouse on the far side of the radiation to keep personal clothing in.

* Warning panel warning caution from radioactive sources,

* Place the ionizing radiation mark on all radioactive materials and on the laboratories where the radioactive materials are located.