

① Causes of Industrial Accidents!

→ Industrial accident refers to an undesired or unplanned event which results to an injury or death or damage to property or environment.

i) Environmental Causes!

- Poor lighting: Poor lighting ~~causes~~ results in low visibility which causes slips, trips & falls.
- Ambient temp^{rt}: If a workplace is too hot then overheating can occur, If the workplace is too cold then hypothermia can occur.
- Air pollution: Air pollution causes breathing issues, which can develop if a workplace has poor ventilation.
- sound pollution: The sound in a workplace can cause injury to a worker's hearing.

ii) Mechanical Causes!

- Broken & damaged m/c: These type of m/cs can cause injury to operating workers, due to their vulnerability.
- Power failure: Total or partial power failure can cause serious injury.
- Fire or explosion: cooling failure & a small spark can lead to a mechanical fire or explosion.
- Wear & tear: m/c parts with more wear & tear, poses higher risk of mechanical accidents.

iii) Human causes

- Poor house keeping: A cluttered workplace can lead to slips, trips & falls.
- Fatigue: when a body is tired, injury & accidents are more likely to occur.
- Over exertion: over exertion is a common cause of workplace injury, & accidents.
- Stress: workers who are stressed, often more distracted and can cause accidents & injuries in workplace.
- Dehydration: with out proper hydration, injury & accidents are more likely to occur.
- Improper lifting - It cause, lower back strains & shoulder injuries.

① Types of Industrial Accidents:

i) Slips, Trips & Falls:

⇒ These are common accidents that result from, slippery surfaces, uneven flooring & falling objects from heights, shelves & moving equipments.

ii) Mechanical Accidents:

⇒ These are the accidents that result from malfunctions or improper handling of m/c's, tools & equipments.

iii) Electrical Accidents:

⇒ These are the accidents that result from, electrical shocks, electrocution, fires from faulty wiring, inadequate grounding or improper handling of electrical equipments.

iv) Chemical Accidents:

⇒ These are the accidents that result from exposure to hazardous chemicals leading to burns, respiratory issues or poisoning due to leaks, spills & improper handling of chemicals.

v) Fires & Explosion:

⇒ These are the accidents that result from, combustible materials, electrical faults, improper handling of ~~flammable~~ ~~inflammable~~ substances, pressure vessels & chemical reactions.

vi) Transportation Accidents:

⇒ These are the accidents that result from collision between vehicles within industrial premises during transportation of goods.

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Control & Prevention of Industrial Accidents

- i) Proper safety measures:
 - ⇒ Proper safety measures should be adopted & the Govt. should provide guidelines to prevent & reduce accidents.
- ii) Proper selection of manpower:
 - ⇒ Any wrong selection of workers & supervisors can create problems thus proper selection should be done.
- iii) Providing safety awareness:
 - ⇒ Employees should be made aware of industrial safety measures through safety awareness programs & slogans.
- iv) Enforcing strict actions:
 - ⇒ Disciplinary action should be taken against those who break or fault safety measures.
- v) Giving Incentives:
 - ⇒ Employees should be given various incentives for maintaining safety measures.
- vi) Building Safety Committees:
 - ⇒ Safety committees should be created consisting of representative of workers & employees to conduct safety programs & enforcing safety guidelines.

Mechanical Hazards

① ⇒ mechanical hazards are the hazards that are mainly caused by malfunction or improper handling of m/c, tools & equipments.

i) Moving & Rotating parts:

⇒ moving & rotating machinery like, gears, belts, shafts & pulleys can cause entanglement or crushing injuries if not handled properly.

ii) High speed machinery:

⇒ machines which are operating at very high speeds can pose risks of projectiles or flying debris which can cause impact injuries to operating workers.

iii) Falling objects:

⇒ tools & equipments that are falling from a height, shelves or moving equipments can cause serious injury to the person below.

iv) Sharp objects:

⇒ sharp objects like tools, blades or cutting edges can cause slashing, tearing & ripping if not handled properly or if they are exposed during operation.

v) Fire & Explosion:

⇒ Inflammable substances & high pressure systems can cause fire & explosion causing serious injuries if not handled properly.

Energy sources!

⇒ Exposure to energy sources like, electrical thermal & other energy sources can cause injuries like ~~burns~~ ^{shocks} burns & other serious injuries if not handled properly.

⇒ Electrical hazards are the hazards that are mainly caused by electrical shocks, Electrostatic, fires from faulty wiring inadequate grounding & improper handling of electrical equipments.

1) Electrical-shocks:

⇒ Direct contact with live electrical parts on faulty equipments can cause electric shock leading to injuries like burns on fatalities.

⇒ Even low currents can be dangerous.

ii) Arc Flash:

⇒ Sudden rise of voltage & release of energy due to electric arc can cause explosions, intense heat & severe burns.

⇒ It occurs when there is a short circuit or equipment failure.

iii) Electrocution:

⇒ Electrocution can happen through direct or indirect contact where a body completes the circuit between a source & the ground.

⇒ It can cause injuries & fatalities due to improper grounding, damaged cords.

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iv) Pine & Explosion!

Fire & explosions are caused due to electrical malfunctioning & short circuits which can ignite any inflammable material & can cause severe injuries like, burn & fatalities.

v) Equipment malfunction!

=> Aging & poorly maintained electrical systems & equipment can cause ^{unexpected} power outages, electrical fires, & short circuits which can cause significant injuries to workers.

Effect of dif. ~~dosage~~ ^{=x=} dosage of current on human body!

=> Low currents might cause tingling sensations on muscle contractions, while higher currents can ^{cause} severe burns, tissue damage & even cardiac arrest or death in extreme cases.

5) Safety measures as per Factories Act, 1948!

i) Workplace safety!

⇒ It ensures a safe working environment with proper ventilation, lighting, cleanliness & sufficient space for workers.

ii) Machinery safety!

⇒ It ensures proper installation, maintenance & operation of machinery to prevent accidents.

iii) Handling of Hazardous substances!

⇒ It ensures safe storage, handling & disposal of dangerous chemical substances used in industry to prevent accidents.

iv) Welfare of workers!

⇒ It ensures provision of facilities like clean drinking water, first aid, rest room & canteen facilities for workers.

v) Young workers & Child Labor:

⇒ It provides restrictions & regulations regarding employment of young workers & child labors for their safety & welfare.

vi) Working Hours & Conditions!

⇒ It provides restrictions & regulations regarding working hours, over-time & working condition to prevent fatigue related accidents.

vii) Safety Officers!

⇒ It ensures the appointment of qualified safety officers to oversee & enforce safety measures in the workplace.

viii) Safety Committees!

⇒ It ensures the establishment of safety committees to address safety concerns & promote safety awareness among workers.

⑥ Safety color codes

⇒ safety color codes are crucial for indicating potential hazards, equipment locations & safety precautions in industrial settings.

i) Red!

⇒ used for fire protection equipment, emergency switches & emergency stop buttons.

ii) Yellow!

⇒ used for signal caution, indicating potential hazards, or areas requiring attention.

iii) Green!

⇒ used for indicating safety, escape routes, & first aid equipment location.

iv) Blue!

⇒ used for information purposes, such as indicating safety information location, or signage.

v) Orange!

⇒ used for indicating warning, dangerous parts of machinery & equipments.

vi) Black & white!

⇒ used for traffic markings, & house keepings.

vii) Purple!

⇒ Radiation hazards

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Classification of pressure vessels

i) Based on design!

a) Thin-walled PV: have a ratio of diameter to wall thickness greater than 10. $\left[\frac{d}{t} > 10 \right]$

b) Thick-walled PV: have a ratio of dia. to wall thickness less than 10. $\left[\frac{d}{t} < 10 \right]$

ii) Based on construction!

a) metallic PV: made of various metals like steel, aluminum, etc.

b) non-metallic PV: made of materials like composites, plastic or fiber glass.

iii) Based on contents!

a) Gas PV: contains gases under pressure such as compressed air tanks, & oxygen tanks etc.

b) Liquid PV: contains liquid under pressure such as, Petroleum products & chemicals.

iv) Based on pressure!

a) High PV: operates at a pressure higher than ambient pressure such as heavy industrial purposes.

b) Low PV: operates at a pressure close to or slightly above ambient pressure & used in various purposes.

v) Based on shape!

a) spherical PV

b) cylindrical PV.

vi) Based on Regulations!

a) ASME PV: Follow regulations set by American Society of Mechanical Engineers for design, construction & inspection.

b) European Press. Equipment Directive (PED) PV:

→ Follows regulations set by European standard for design, construction & inspection.

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Fire - Fighting Equipments

i) water fire ^{fighting} systems:

→ sprinklers.

→ fire hose cabinets

→ water fire extinguisher

ii) fire alarm systems:

→ Alarm bell

→ Heat detector

→ smoke detector

→ Horn

→ manual call point

iii) Gas fire ^{fighting} systems:

→ NOVEC gas system

→ FM-200 " "

→ Aerosol system

iv) Foam fire fighting system:

→ used foam to cut off oxygen supply.

v) conventional systems:

→ sand

→ mud & clay

→ water

→ dust

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Maintenance Engineering

→ maintenance engineering is a specialist area that involves systematic ~~and~~ planning, designing & implementation of maintenance related activities to ensure ^{the} efficient functioning of equipment, machinery & infrastructure within an industrial setting.

Objectives or aim!

- i) To ensure machinery & equipments function optimally to minimize down time.
- ii) To maximize operational efficiency & ~~reduce~~ ^{minimize} maintenance cost.
- iii) To create & maintain a safe working environment for workers.
- iv) To ensure final products & services meet defined standards through equipment performance.
- v) To prolong the life span of assets through proactive maintenance strategies.
- vi) To train personnel in specific maintenance skills.
- vii) To ensure compliance with environmental regulations.