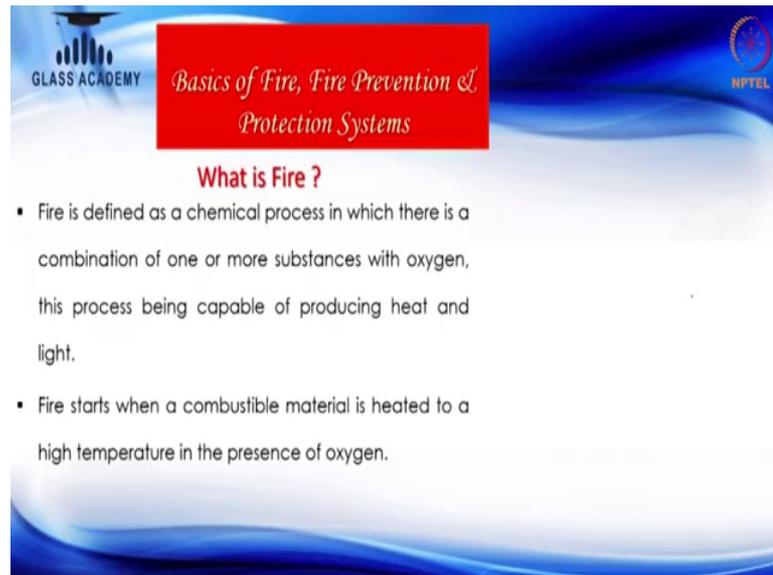


Glass Processing Technology
Prof. Roy Thomas
Department of Civil Engineering
Indian Institute of Technology, Madras

Lecture – 09
Safety in Industries

(Refer Slide Time: 00:15)



The slide features a blue and white wavy background. In the top left corner, there is a logo for 'GLASS ACADEMY' with a graduation cap icon. In the top right corner, there is a logo for 'NPTEL'. A red rectangular box in the upper center contains the title 'Basics of Fire, Fire Prevention & Protection Systems' in white text. Below this box, the sub-heading 'What is Fire ?' is written in red. Two bullet points follow, defining fire as a chemical process involving oxygen and heat/light production, and stating that fire starts when a combustible material is heated to a high temperature in the presence of oxygen.

GLASS ACADEMY

Basics of Fire, Fire Prevention & Protection Systems

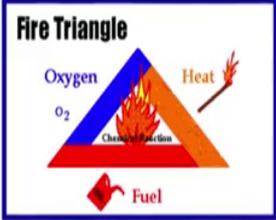
NPTEL

What is Fire ?

- Fire is defined as a chemical process in which there is a combination of one or more substances with oxygen, this process being capable of producing heat and light.
- Fire starts when a combustible material is heated to a high temperature in the presence of oxygen.

Now, I will talk about some basics of fire and fire prevention protection system. So, everyone knows that you know fire is very hazardous to properties. And it is a chemical process in which there is a combination of one or more substance with oxygen and this process being capable of producing heat and light and the fire starts or any combustible material is heated to a higher temperature in the presence of oxygen.

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The diagram shows a triangle with three sides. The left side is blue and labeled 'Oxygen' with the chemical formula O_2 below it. The right side is orange and labeled 'Heat' with a small flame icon. The bottom side is red and labeled 'Fuel' with a small flame icon. In the center of the triangle is a larger flame icon with the text 'Chemical Reaction' written below it. The entire diagram is enclosed in a blue border.

Oxygen, heat, and fuel are frequently referred to as the "fire triangle."without the presence of all the three fire cannot take place.
Add in the fourth element, the chemical reaction, and you actually have a fire "tetrahedron."

Fire triangle which we already explained. And any one of this whether it when it is not available, so there will not be any fire happen. That is why it is important to understand this fire triangle.

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The slide has a blue background with white wavy lines. At the top left is the 'GLASS ACADEMY' logo and at the top right is the 'NPTEL' logo. The title 'Fuel for FIRE' is centered in red. Below the title is a paragraph: 'Materials that burn. The higher the temperature the easier and quicker they burn.' This is followed by a bulleted list of fire classes. At the bottom, a red line of text states: 'Fires are also similarly classified in to Four types'.

Fuel for FIRE

Materials that burn. The higher the temperature the easier and quicker they burn.

- **Class A** - Wood, paper, cloth, trash, plastics
Solid combustible materials that are not metals.
- **Class B** - Flammable liquids: gasoline, oil, grease, acetone
Any non-metal in a liquid state, on fire.
- **Class C** - Electrical: energized electrical equipment
As long as it's "plugged in," it would be considered a class C fire.
- **Class D** - Metals: potassium, sodium, aluminium, magnesium
Aluminium paste used in IPB would fall under this classification

Fires are also similarly classified in to Four types

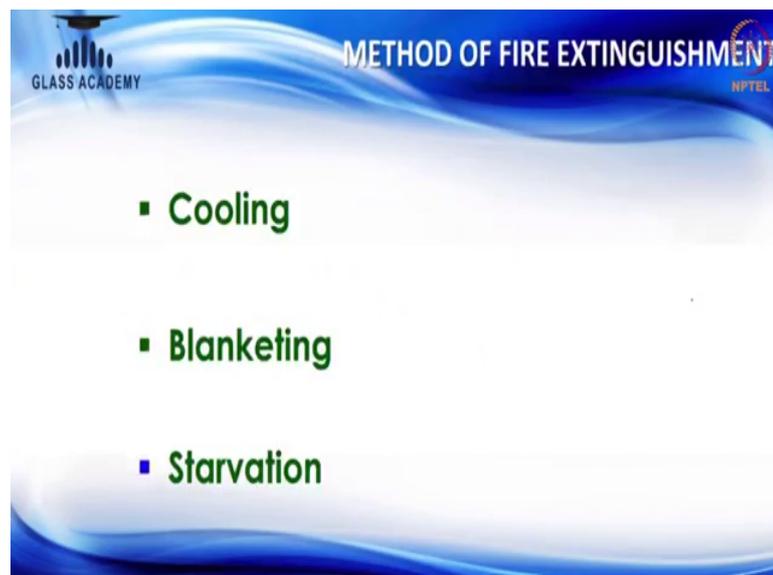
Fuel for fire, it is classified into class A, B, C and D. Class A is basically wood and paper cloth, trash, plastics which we generally see in the places. Class B is flammable liquids like oil, acetone like that. Class C is electrical fire, in class D is metal fire basically from potassium, sodium, aluminium, magnesium like that.

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So, heat if the sources of ignitions are like you know claims when welding and cutting, mechanical sparks, chemical energy, vehicles self-heating or spontaneous ignition, static electricity electrical equipment and radiation. So, we need to have a careful look or inspection about is there any sources of ignition present in the shop floor which can give rise to fire.

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Now, when it comes to fire fighting and extinguishment, there are three methodology with which fire extinguishing is happening. One, it is cooling and then, second one is

blanketing and the third one is starvation. Cooling is actually you reduce the impact of the heat source and blanketing is actually cut the oxygen levels and starvation is like cut the fuel source.

So, you know the fire will start with the fuel and then, get extinguished.

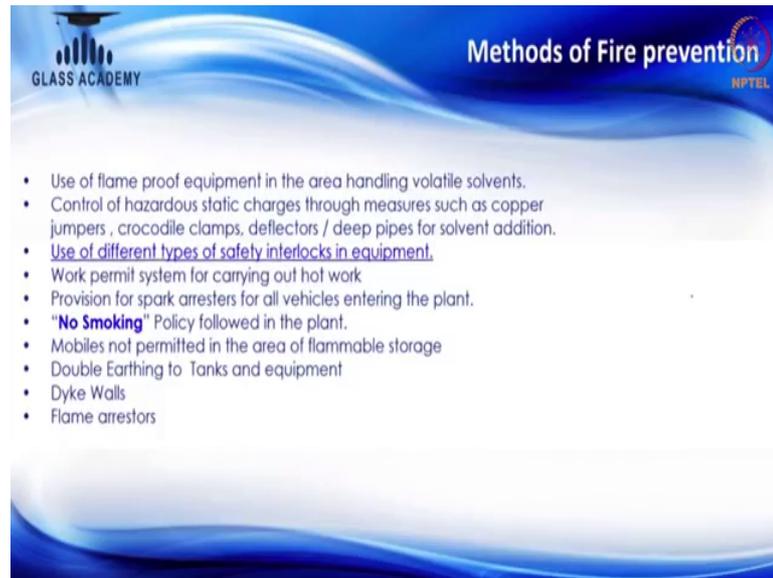
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Type of Fire Extinguisher	Type of Effect	A Class Wood, Paper, Cloth and Plastics	B Class Petrol, Diesel, Kerosene, Paints etc.	C Class LPG, Acetylene, etc.	D Class Magnesium, Sodium, Potassium etc.	Electrical
Water	Cooling & Striking	✓	✗	✗	✗	✗
Foam	Blanketing	✗	✓	✗	✗	✗
Dry Chemical Powder	Blanketing	✗	✓ ✓	✓ ✗	Special Dry Powder	✓
Carbon dioxide	Blanketing	✗	✓ ✓	✗	✓	
Halon	Blanketing	✗				

So, different types of fire extinguishers like media like water foam, dry chemical, carbon dioxide halon and the type of effector. For example, water is having a cooling effect and then form will have a blanketing effect. Dry chemical powder is we will again have a blanketing effect. Carbon dioxide will have a blanketing effect. So, these fires are you know like water is effective only for A class phase where as dry chemical powder is effective for B class as well as C classifiers.

So, that is why this matrix will try and identify help out the how to help in extinguishing the fire.

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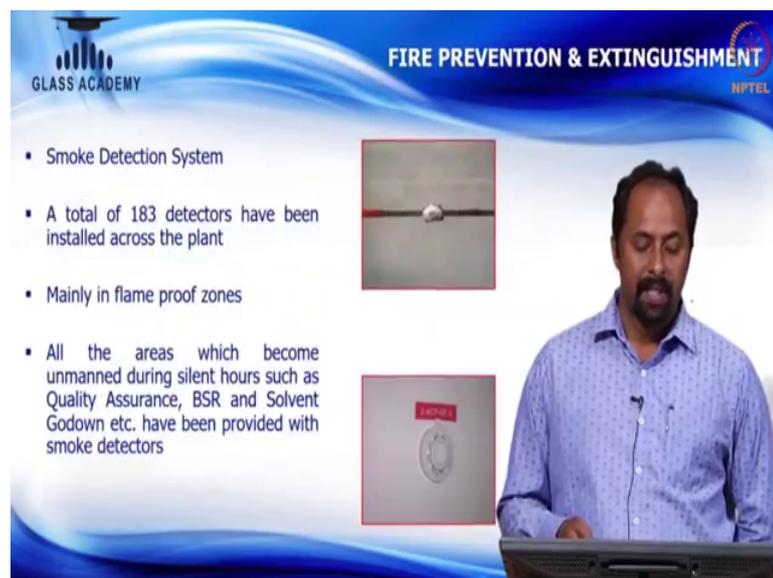


Methods of Fire prevention

- Use of flame proof equipment in the area handling volatile solvents.
- Control of hazardous static charges through measures such as copper jumpers, crocodile clamps, deflectors / deep pipes for solvent addition.
- Use of different types of safety interlocks in equipment.
- Work permit system for carrying out hot work
- Provision for spark arresters for all vehicles entering the plant.
- **"No Smoking"** Policy followed in the plant.
- Mobiles not permitted in the area of flammable storage
- Double Earthing to Tanks and equipment
- Dyke Walls
- Flame arrestors

Main methods of fire prevention, the time we need to use flame proof equipment in the area, then control hazards static charges, then use different types of safety interlocks in the equipment. Work permit system is something which is an administrative control that helps us to have a check on the hot work. And thereby resulting into fire and no smoking policy which is to be adapted in the plant. In hazardous area, mobiles are not to be permitted in the area of flammable storage. Double earthing, dyke walls, flame arrestors, all these methods all these tools will help us to mitigate the risk of fire.

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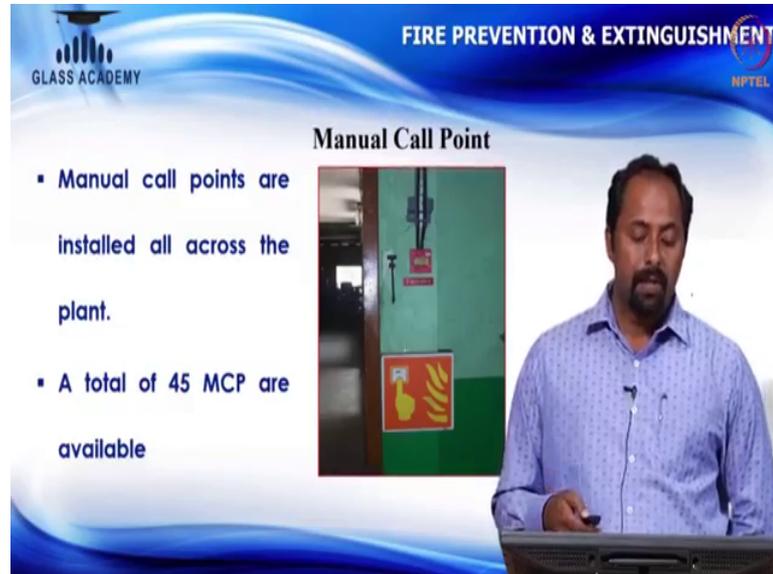


FIRE PREVENTION & EXTINGUISHMENT

- Smoke Detection System
- A total of 183 detectors have been installed across the plant
- Mainly in flame proof zones
- All the areas which become unmanned during silent hours such as Quality Assurance, BSR and Solvent Godown etc. have been provided with smoke detectors

Now, when it comes to prevention, we should have smoke detection system in various places which can help us to early detection of fire.

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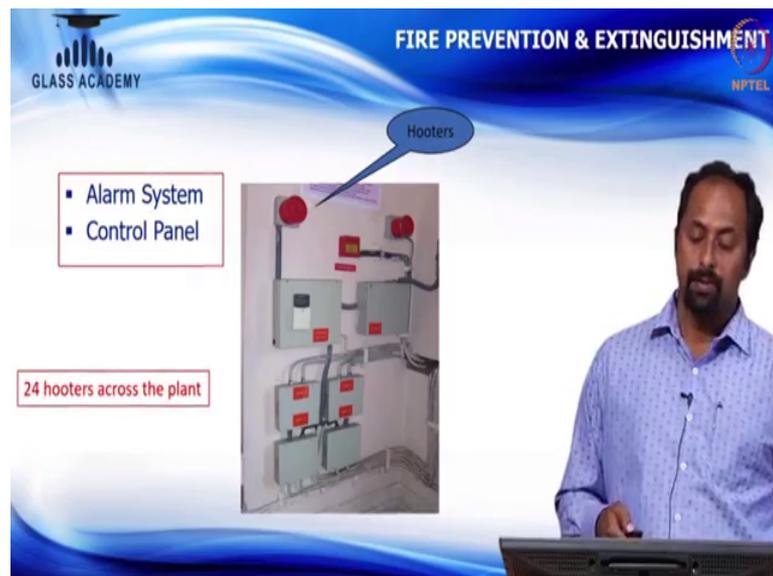


The slide is titled "Manual Call Point" and features a presenter on the right and a photograph of a call point on the left. The background is blue with white wavy lines. Logos for "GLASS ACADEMY" and "NPTEL" are visible in the top corners.

- Manual call points are installed all across the plant.
- A total of 45 MCP are available

Then, manual call point when employ or any person who actually watches the fire; he can immediately alert using this manual call point which will give rise to alarms with the help of hooters.

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The slide is titled "Alarm System" and features a presenter on the right and a photograph of an alarm control panel on the left. The background is blue with white wavy lines. Logos for "GLASS ACADEMY" and "NPTEL" are visible in the top corners.

- Alarm System
- Control Panel

24 hooters across the plant

Hooters

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The slide features a blue header with 'GLASS ACADEMY' on the left and 'FIRE PREVENTION & EXTINGUISHMENT NPTEL' on the right. The main title is 'Emergency Communication System'. Below the title, there are two bullet points: 'Speakers at various places in the plant.' and 'At a time the entire plant can be evacuated by a single announcement'. To the right of the text are two small images: the top one shows a speaker mounted on a wall, and the bottom one shows a control panel with a microphone. A presenter in a blue patterned shirt is visible on the right side of the slide, standing behind a podium.

The emergency communication system is very important, because speakers at various places, single announcement will alert all the people about the fire.

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The slide features a blue header with 'GLASS ACADEMY' on the left and 'FIRE PREVENTION & EXTINGUISHMENT NPTEL' on the right. The main title is 'Main Hydrant pump'. To the left of the image is a text box containing the title. The central image shows the entrance to a 'FIRE HYDRANT PUMP HOUSE' with a sign above the door and a fire hydrant visible inside. A presenter in a blue patterned shirt is visible on the right side of the slide, standing behind a podium.

The hydrant system is necessary for firefighting.

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The slide features a blue background with a white wave pattern. At the top left is the 'GLASS ACADEMY' logo, and at the top right is the 'FIRE PREVENTION & EXTINGUISHMENT' title with the 'NPTEL' logo. A presenter in a blue patterned shirt is visible on the right side. The main content is titled 'The hydrant System' in a red-bordered box. Below this, there are two images: the top one is labeled 'Single hydrant' and shows a red fire hydrant with a single connection point; the bottom one is labeled 'Double hydrant' and shows a red fire hydrant with two connection points.

There are different types of paraphernalia available for fire hydrant. It is a single hydrant system than double hydrant system.

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The slide features a blue background with a white wave pattern. At the top left is the 'GLASS ACADEMY' logo, and at the top right is the 'FIRE PREVENTION & EXTINGUISHMENT' title with the 'NPTEL' logo. A presenter in a blue patterned shirt is visible on the right side. The main content is a list of nozzle types: '63 mm brass type ordinary nozzles' (with a sub-point 'Only jet can be achieved'), 'Multi purpose nozzles', 'Jet as well spray can be achieved', and 'Water flow can be shut off from the nozzles'. Below the list are two images: the top one is labeled 'Ordinary Nozzle' and shows a brass nozzle; the bottom one is labeled 'Multipurpose Nozzle' and shows a more complex nozzle.

Then, fire prevention extinguishment, we have nozzles which are used in fire fighting and there are ordinary nozzles, multipurpose nozzles.

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The slide features a blue header with the text 'GLASS ACADEMY' on the left and 'FIRE PREVENTION & EXTINGUISHMENT' on the right, with an NPTEL logo. A presenter in a blue patterned shirt stands on the right side. On the left, there are two text boxes: the top one contains a bulleted list: '▪ Portable foam trolley' and '▪ Cap – 100 liters'; the bottom one contains the text '500 ltrs Multi purpose foam trolley'. Two images are shown: the top one is a yellow portable foam trolley, and the bottom one is a larger yellow multi-purpose foam trolley on a cart.

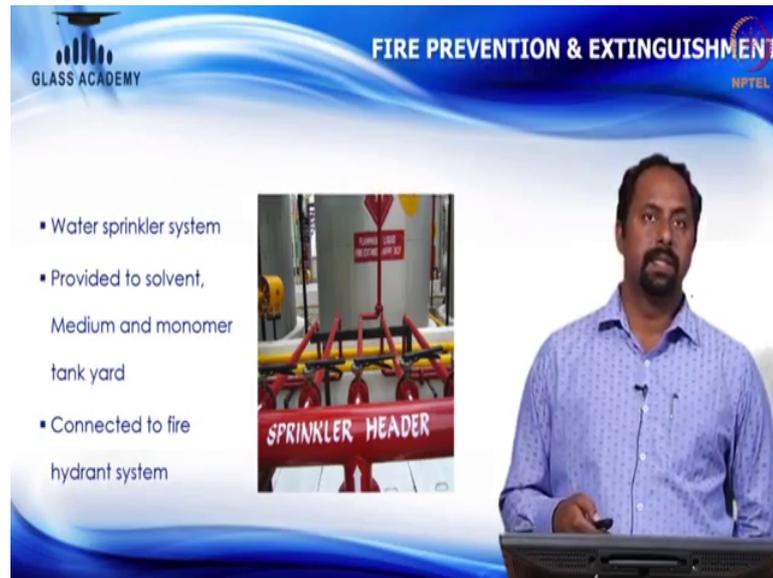
Then, a portable form trolley, these are all different ways and means of firefighting prevention and extinguishment is being carried out.

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The slide features a blue header with the text 'GLASS ACADEMY' on the left and 'FIRE PREVENTION & EXTINGUISHMENT' on the right, with an NPTEL logo. A presenter in a blue patterned shirt stands on the right side. On the left, there is a bulleted list: '▪ Foam Purer System', '▪ Medium Tank Yard', '▪ Connected to fire hydrant System', and '▪ Foam trolley having capacity – 1500 Litres'. Two images are shown: the top one is a yellow foam purer system, and the bottom one is a red foam tank with a capacity of 1500 liters.

The form power system is their medium tank yard which is connected, which can be connected to fire hydrant system. Foam trolley which is about some 1,500 meters will be enough for a plant to.

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GLASS ACADEMY

FIRE PREVENTION & EXTINGUISHMENT

NPTTEL

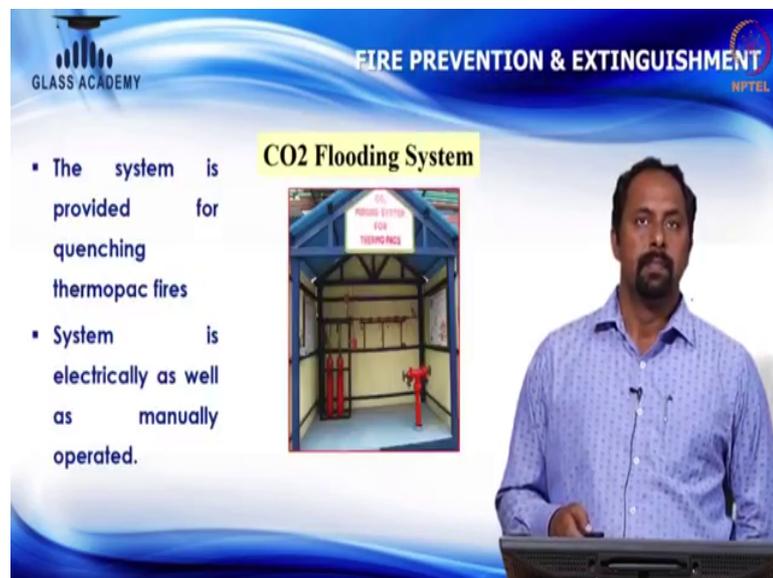
- Water sprinkler system
- Provided to solvent, Medium and monomer tank yard
- Connected to fire hydrant system

SPRINKLER HEADER

The slide features a blue background with a white wave pattern. On the left, there is a list of bullet points. In the center, there is a photograph of a red metal structure labeled 'SPRINKLER HEADER' with several red valves. On the right, a man in a blue patterned shirt is standing behind a podium, presenting the slide.

Water sprinkler system is another important thing and then, basically solvent areas monomer tanks. All those things can be connected with a sprinkler system and hydrogen system.

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GLASS ACADEMY

FIRE PREVENTION & EXTINGUISHMENT

NPTTEL

CO2 Flooding System

- The system is provided for quenching thermopac fires
- System is electrically as well as manually operated.

The slide features a blue background with a white wave pattern. On the left, there is a list of bullet points. In the center, there is a photograph of a CO2 flooding system, which is a metal structure with a red valve and a sign that reads 'CO2 FLOODING SYSTEM FOR THERMOPLASTIC'. On the right, a man in a blue patterned shirt is standing behind a podium, presenting the slide.

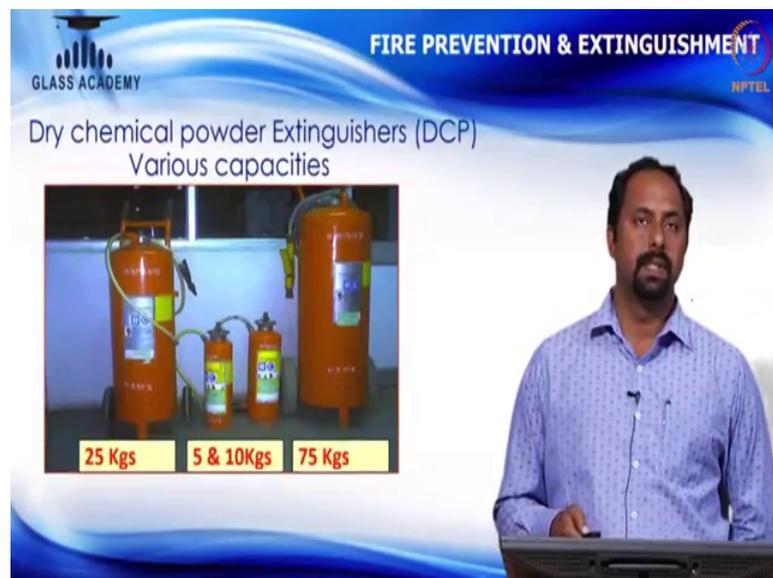
The CO2 flooding is another auto extinguishing system available in the market which would be helpful without a personal intervention that itself identifies, it will extinguish the fire.

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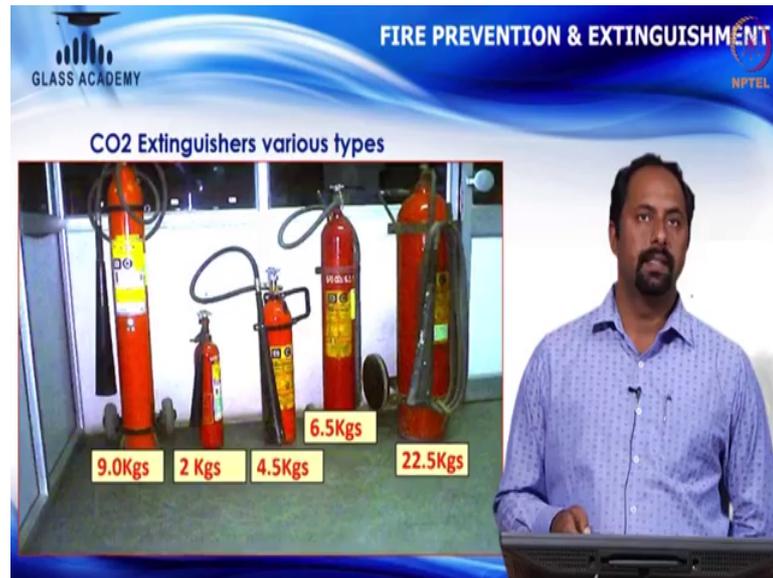
These are all general firefighting equipments.

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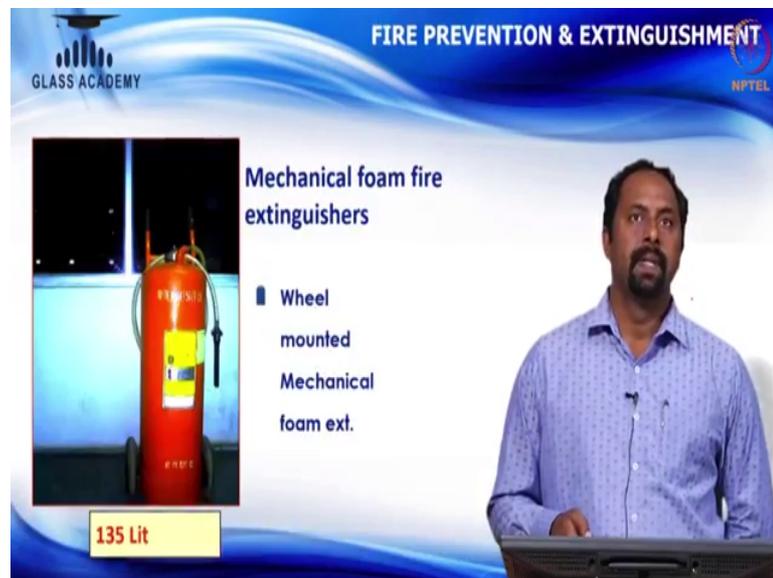
Then, dry chemical powders in various quantities are available.

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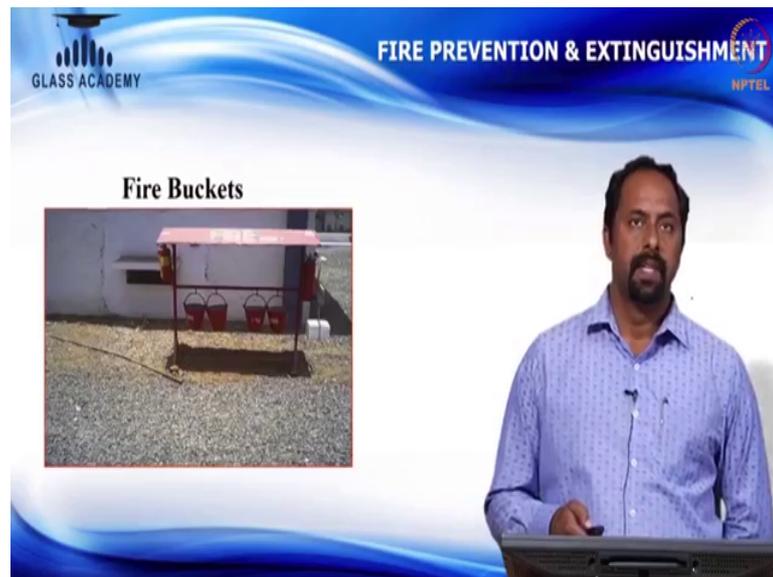
Then, CO2 extinguisher is especially very helpful in electrical control rooms and all for fighting the fire.

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Mechanical form fire extinguisher is another important thing when it comes to flammable fires.

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Then, fire buckets are mandatory thing which is to be kept in the areas.

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Then, when we tried to fight the fire breathing apparatus, because in that area it will be abundant in CO₂ so less amount of oxygen; so self contained breathing apparatus is very necessary for firefighters when they go and do the firefighting.

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The slide features a blue header with 'GLASS ACADEMY' on the left and 'FIRE PREVENTION & EXTINGUISHMENT' with an 'NPTEL' logo on the right. The main content area has a white background with a blue wave pattern at the bottom. On the left, there is a bulleted list. In the center, there is a small image of a person in a silver fire proximity suit. On the right, a man in a blue patterned shirt is speaking at a podium.

- Fire Proximity Suit
- Useful for 2 minutes at the time of fire

FIRE PROXIMITY SUIT

Then, fire proximity suit to mitigate the risk of burn injuries when somebody is going to fight the fire.

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The slide features a blue header with 'GLASS ACADEMY' on the left and 'MSDS' with an 'NPTEL' logo on the right. The main content area has a white background with a blue wave pattern at the bottom. On the left, there is a bulleted list. On the right, a man in a blue patterned shirt is speaking at a podium.

- **Material Safety Data Sheet**

It is a comprehensive data sheet universally accepted spelling out all details about the material.

- To provide information on
- Material details
- Safe handling, Storage and Transportation
- Preventive Measures

Now, we talk about material safety data sheet. When it comes to chemical safety, it is very important to have a material safety data sheet. Basically it is a comprehensive data sheet universally accepted spelling out all details about the material. It will provide information on material detail, safe handling in storage and transformation and preventive measures in case in case of exposures.

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GLASS ACADEMY

MSDS
NPTEL

- Chemical identity & Formula
- Physical / Chemical data
- Fire / Explosion hazard data
- Reactivity data
- Health hazard
- Preventive measures (PPEs)
- Preventive Measures (Fire Fighting)
- First Aid measures

What does it contain?

It throws extensive details on chemical identity and formula physical and chemical data, fire and explosion hazard data, then reactivity data health hazard preventive measures, preventive measures in firefighting, first aid measures, all those things are contained in MSDS.

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GLASS ACADEMY

Basic First Aid
NPTEL

- First aid is the emergency care and treatment of a sick or injured person before professional medical services are obtained.
- **FIRST AID MEASURES ARE NOT MEANT TO REPLACE PROPER MEDICAL DIAGNOSIS AND TREATMENT**, but will only consist of providing temporary support until professional medical assistance is available.

Now, we will talk about basic first aid. Basically, first aid is an emergency care and treatment of a sick or injured person before is shifting to a professional medical service.

And, first aid measures are not meant to replace proper medical diagnosis and treatment. So, it stands as a first aid.

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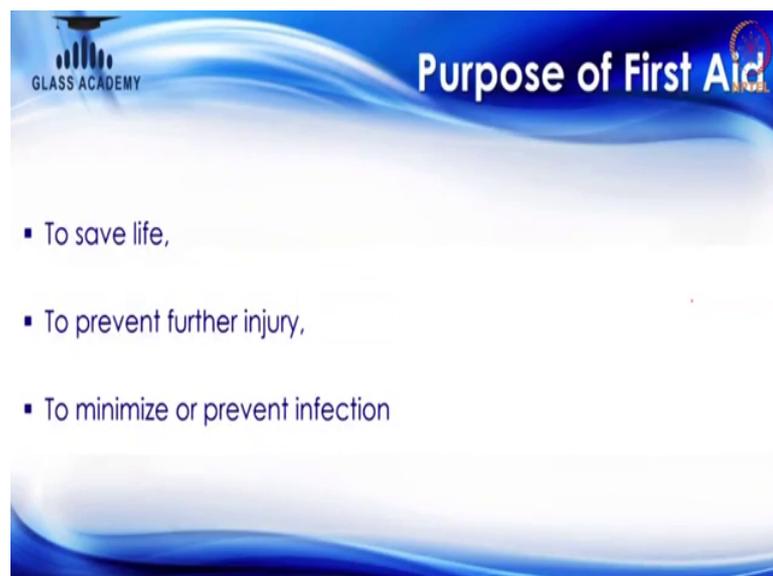


The slide features a blue background with white wavy lines. In the top left corner, there is a logo for 'GLASS ACADEMY' and a small icon of a graduation cap. In the top right corner, the title 'First Aid Vs Medical Aid' is displayed in white, with 'NPTEL' written below it. On the left side, there is an icon of a first aid kit with a red cross on a white background, set against an orange square. To the right of the icon, there is a bulleted list:

- **First Aid**
- Initial care of the sick or injured
- **Medical Aid**
- Treatment by a doctor, registered nurse or ambulance officer

It is initial care and there is a difference between medical aid. Medical aid is treatment by a doctor and registered nurse or ambulance officer, but first aid is a initial care which can be done by any trained first aider.

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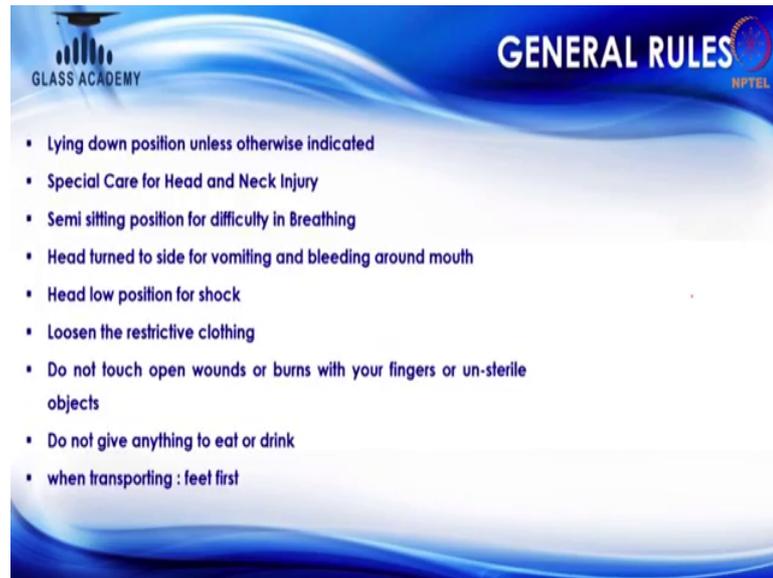


The slide features a blue background with white wavy lines. In the top left corner, there is a logo for 'GLASS ACADEMY' and a small icon of a graduation cap. In the top right corner, the title 'Purpose of First Aid' is displayed in white, with 'NPTEL' written below it. The main content is a bulleted list:

- To save life,
- To prevent further injury,
- To minimize or prevent infection

So, the purpose is to save life, prevent further injury and to minimize or prevent infection.

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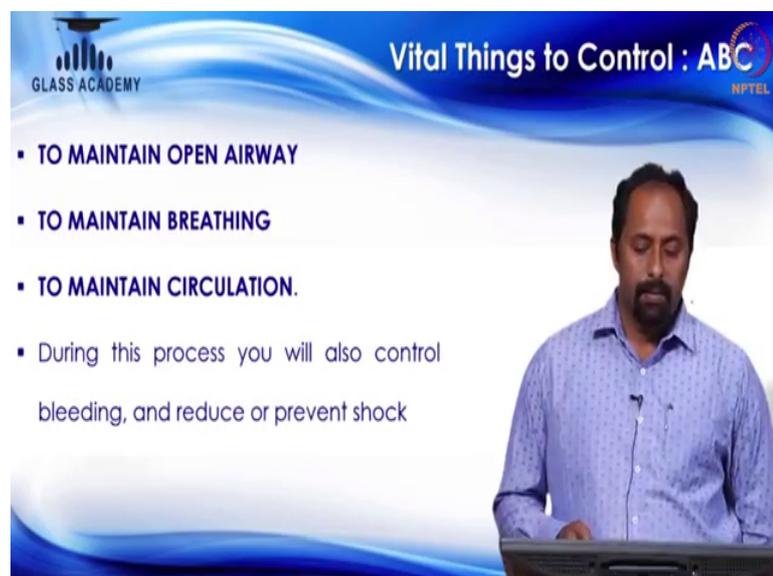


GENERAL RULES

- Lying down position unless otherwise indicated
- Special Care for Head and Neck Injury
- Semi sitting position for difficulty in Breathing
- Head turned to side for vomiting and bleeding around mouth
- Head low position for shock
- Loosen the restrictive clothing
- Do not touch open wounds or burns with your fingers or un-sterile objects
- Do not give anything to eat or drink
- when transporting : feel first

So, general rules are you know while giving first aid, the lying down position unless another way is indicated and special care for head and neck injury and semi-sitting position for difficulty. If you have breathing difficulties, semi-setting position will be good, and head turned to side for vomiting and bleeding around, and around the mouth, and head in low position in for shock, and loosen the restrictive clothing, and do not touch, and open wounds or burns with your fingers or unsterile objects. Do not give anything to eat or drink at the time of first aid, when transporting feet should be first at the time of you know shifting the patient.

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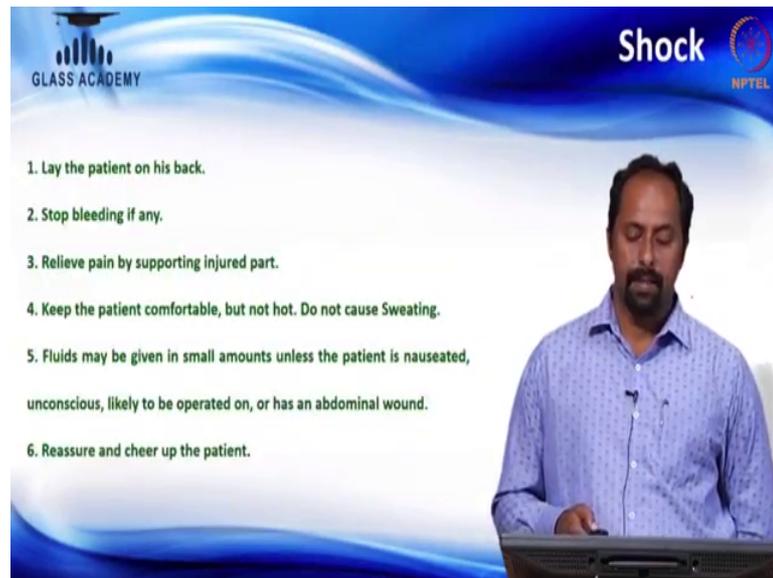


Vital Things to Control : ABC

- **TO MAINTAIN OPEN AIRWAY**
- **TO MAINTAIN BREATHING**
- **TO MAINTAIN CIRCULATION.**
- During this process you will also control bleeding, and reduce or prevent shock

Now, there is something called as ABC which is very vital for first aid means airway to a patient. When we are trying to give the first aid, airway is very important and then, to maintain and check a breathing and then, maintain the circulation. So, this is what it is known as ABC role of a first aid.

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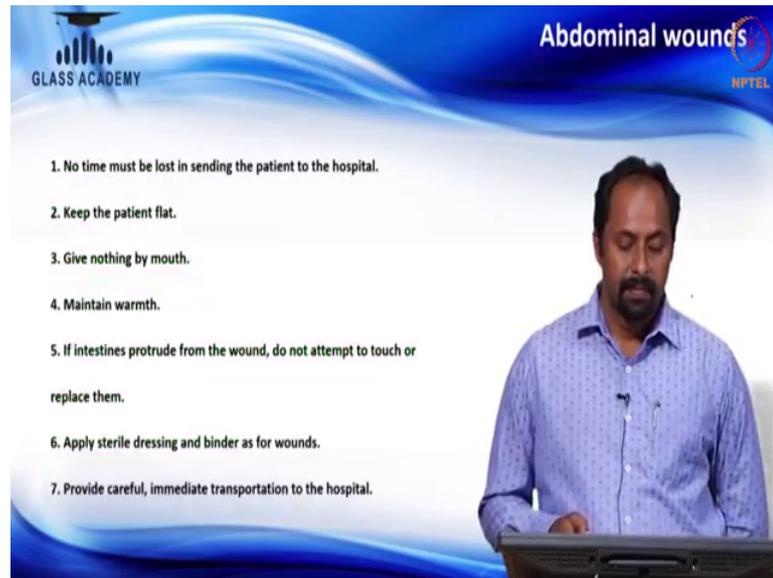
The slide features a blue and white wavy background. In the top left corner, there is a logo for 'GLASS ACADEMY' with a graduation cap icon. In the top right corner, the word 'Shock' is written in a large, bold, white font, with the NPTEL logo below it. A man in a blue patterned shirt is visible on the right side of the slide, looking down at a laptop. The main content of the slide is a numbered list of six steps for first aid for shock.

1. Lay the patient on his back.
2. Stop bleeding if any.
3. Relieve pain by supporting injured part.
4. Keep the patient comfortable, but not hot. Do not cause Sweating.
5. Fluids may be given in small amounts unless the patient is nauseated, unconscious, likely to be operated on, or has an abdominal wound.
6. Reassure and cheer up the patient.

When it comes to shock, lay the patient on his back, then stop bleeding if any and relieve the pain by supporting injured part. Keep the patient comfortable, but not hot. Do not cost any kind of sweating. Fluids may be given in small amounts unless the patient is nauseated unconscious likely to be operated on and reassure and cheer up the patient.

So, when it comes to shock, this is the first aid that is prescribed.

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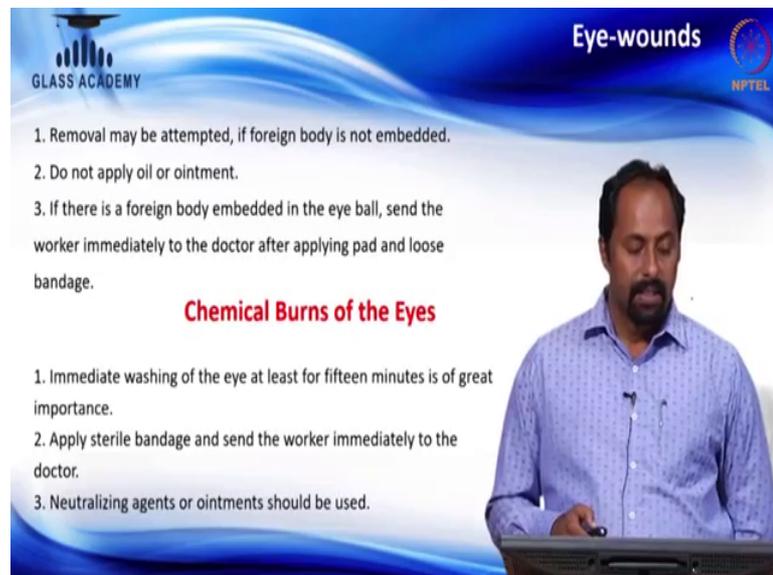


The slide is titled "Abdominal wounds" and features the "GLASS ACADEMY" logo on the left and the "NPTEL" logo on the right. A presenter in a blue patterned shirt is visible on the right side of the slide, standing behind a podium. The slide contains the following list of instructions:

1. No time must be lost in sending the patient to the hospital.
2. Keep the patient flat.
3. Give nothing by mouth.
4. Maintain warmth.
5. If intestines protrude from the wound, do not attempt to touch or replace them.
6. Apply sterile dressing and binder as for wounds.
7. Provide careful, immediate transportation to the hospital.

When it comes to abdominal wounds, no time should be lost. Keep the patient flat, do not give anything by mouth, maintain the warmth; then I always apply sterile dressing and bind the rest for wounds, provide careful and immediate transportation to the hospital.

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The slide is titled "Eye-wounds" and features the "GLASS ACADEMY" logo on the left and the "NPTEL" logo on the right. A presenter in a blue patterned shirt is visible on the right side of the slide, standing behind a podium. The slide contains the following list of instructions:

1. Removal may be attempted, if foreign body is not embedded.
2. Do not apply oil or ointment.
3. If there is a foreign body embedded in the eye ball, send the worker immediately to the doctor after applying pad and loose bandage.

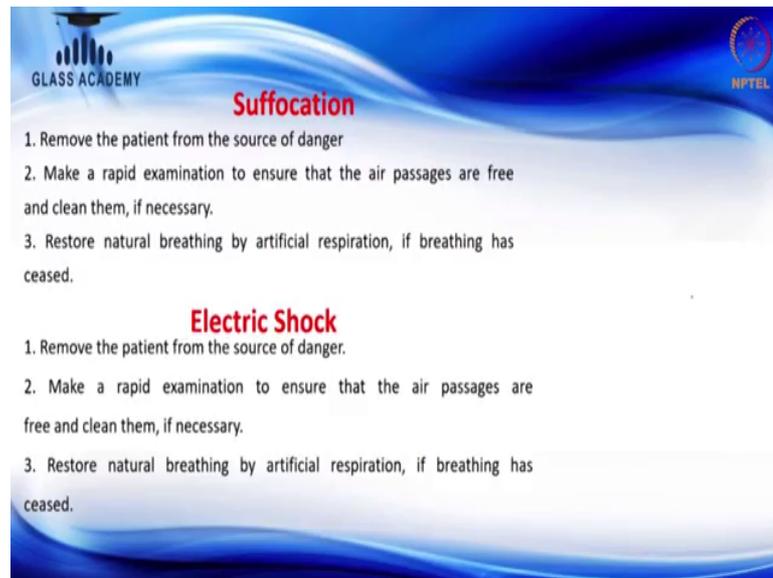
Chemical Burns of the Eyes

1. Immediate washing of the eye at least for fifteen minutes is of great importance.
2. Apply sterile bandage and send the worker immediately to the doctor.
3. Neutralizing agents or ointments should be used.

When it comes to eye wounds, removal may be attempted if foreign bodies not embedded. Do not apply oil or any kind of anointment if there is a foreign body embedded in the eyeball. Send the worker immediately to the doctor after applying pad

and loose bandage; chemical burns of the eye, immediate washing of the eye at least for 15 minutes. This is very important in chemical burns which is quite common in factories and apply sterile bandage and send the work immediately to the doctor neutralizing agents or almonds should be used.

(Refer Slide Time: 10:14)



The slide features a blue and white wavy background. In the top left corner, there is a logo for 'GLASS ACADEMY' with a stylized building icon. In the top right corner, there is a circular logo for 'NPTEL'. The slide is divided into two sections. The first section is titled 'Suffocation' in red text. Below the title, there is a numbered list of three steps: 1. Remove the patient from the source of danger; 2. Make a rapid examination to ensure that the air passages are free and clean them, if necessary; 3. Restore natural breathing by artificial respiration, if breathing has ceased. The second section is titled 'Electric Shock' in red text. Below the title, there is a numbered list of three steps: 1. Remove the patient from the source of danger; 2. Make a rapid examination to ensure that the air passages are free and clean them, if necessary; 3. Restore natural breathing by artificial respiration, if breathing has ceased.

Suffocation

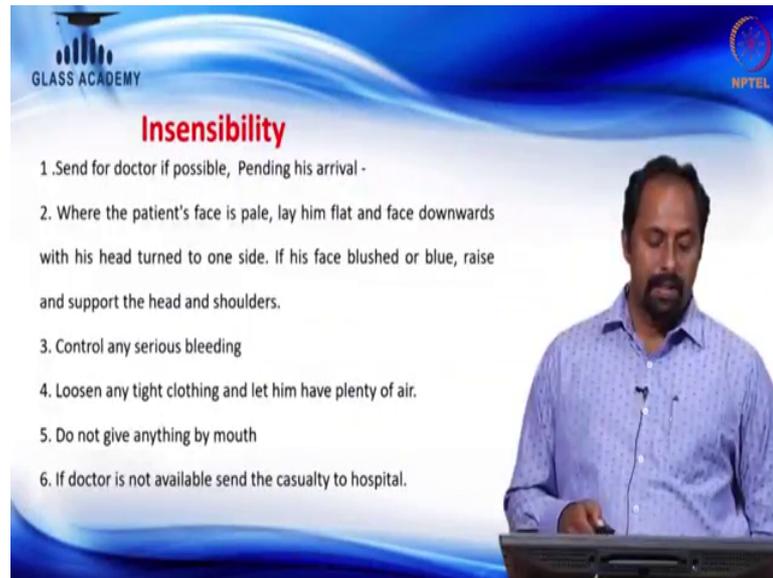
1. Remove the patient from the source of danger
2. Make a rapid examination to ensure that the air passages are free and clean them, if necessary.
3. Restore natural breathing by artificial respiration, if breathing has ceased.

Electric Shock

1. Remove the patient from the source of danger.
2. Make a rapid examination to ensure that the air passages are free and clean them, if necessary.
3. Restore natural breathing by artificial respiration, if breathing has ceased.

In terms of suffocation, remove the patient from the source of danger. We can rapid examination to ensure that their passage is free, and clean, and restore natural breathing by artificial respiration if breathing ceased. Electric shock, remove the patient from the source of danger, make a rapid examination to ensure that air passages are free, clean, clean them if necessary, restore natural breathing by artificial respiration if breathing ceased.

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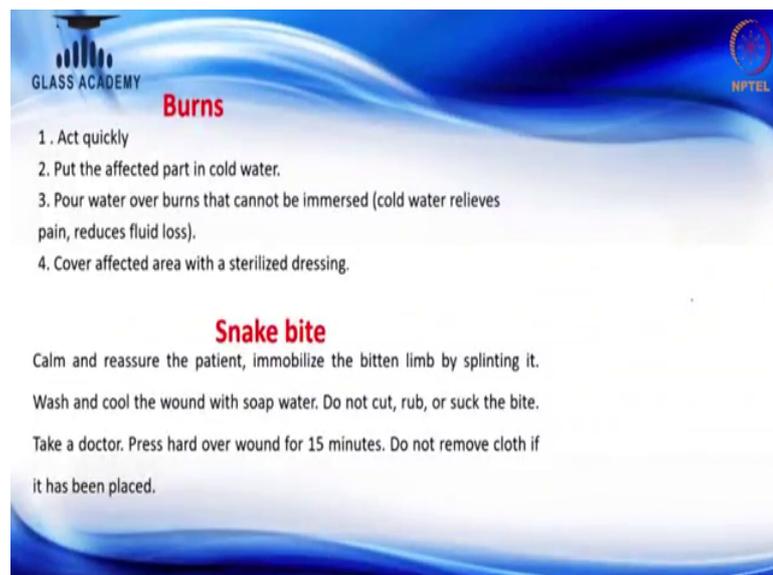
GLASS ACADEMY **NPTEL**

Insensibility

1. Send for doctor if possible, Pending his arrival -
2. Where the patient's face is pale, lay him flat and face downwards with his head turned to one side. If his face blushed or blue, raise and support the head and shoulders.
3. Control any serious bleeding
4. Loosen any tight clothing and let him have plenty of air.
5. Do not give anything by mouth
6. If doctor is not available send the casualty to hospital.

Now, kind of insensibility, immediately send for the doctor if possible where the patient face is pale, lay him flat and face downwards with this head turned to one side. If his face blushed or blue, raise and support the head and shoulders, control any serious bleeding and loosen any tight clothing and let him have plenty of air. Do not give anything by mouth. So, this is what for insensibility.

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GLASS ACADEMY **NPTEL**

Burns

1. Act quickly
2. Put the affected part in cold water.
3. Pour water over burns that cannot be immersed (cold water relieves pain, reduces fluid loss).
4. Cover affected area with a sterilized dressing.

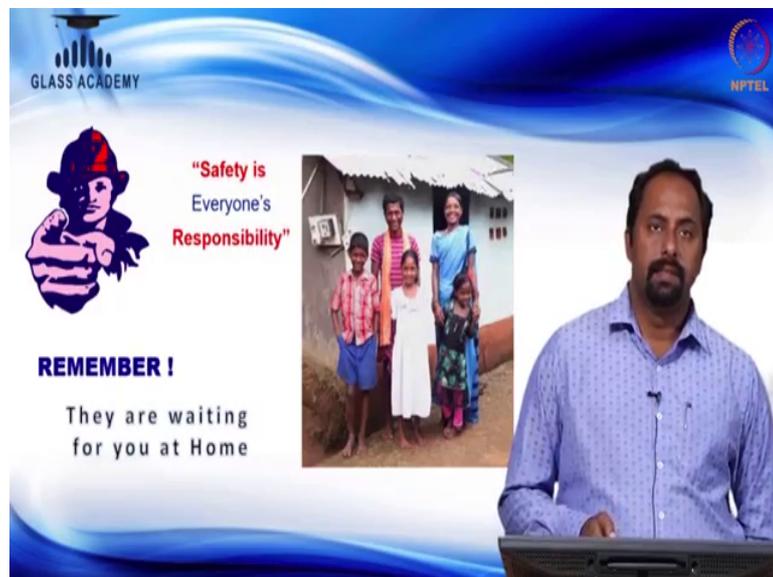
Snake bite

Calm and reassure the patient, immobilize the bitten limb by splinting it.
Wash and cool the wound with soap water. Do not cut, rub, or suck the bite.
Take a doctor. Press hard over wound for 15 minutes. Do not remove cloth if it has been placed.

For burns we have to act quickly and put the affected part in the cold water, and pour water over burns that cannot be immersed, and cover the affected area with a sterilized dressing.

In terms of snakebite, calm and reassure the patient, immobilize the bitten limb by splinting it. Wash and cool the wound with soap water. Soap water is very important. Do not cut, drop or suck the bite. Take a doctor, press hard on the wound for 15 minutes. Do not remove clothes if it has been placed.

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So, this we talked about first aid cases and when it comes to safety. Safety is basically everyone's responsibility and we need to work safe in the factory any industries. For that matter understand the hazards and identify the hazards, and understand the risk, and use the proper controls like you know elimination of the risk, substitution of the risk with less substitute less hazardous material and engineering, proper engineering controls, then administrative control, train people for the job and wearing the personal protective equipment as required. Because, remember you have family members waiting for you at your home. Be very safe and act safe at your workplace

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Summary:

By the end of this module, you have learnt about the:

- Definition of fire
- Sources of ignition
- Methods of fire extinguishment
- Methods of fire prevention
- Material Safety Data Sheet (MSDS)
- Basic first aid
- General rules of first aid

Thank you.