Chemical Process Safety
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Lecture - 58
Personal Protective Equipments

Welcome to the new module of personal protective equipment. These personal protective equipments are integral part of Chemical Process Safety. And usually they act as a barrier between the contaminants and the human being. So, without these personal protective equipments, we cannot have the complete process safety aspect in any kind of process. So, and moreover as far as the different guidelines and statutory requirements are concerned, they are being mandatory by the various government organisations and various government or state government either state government or central government.

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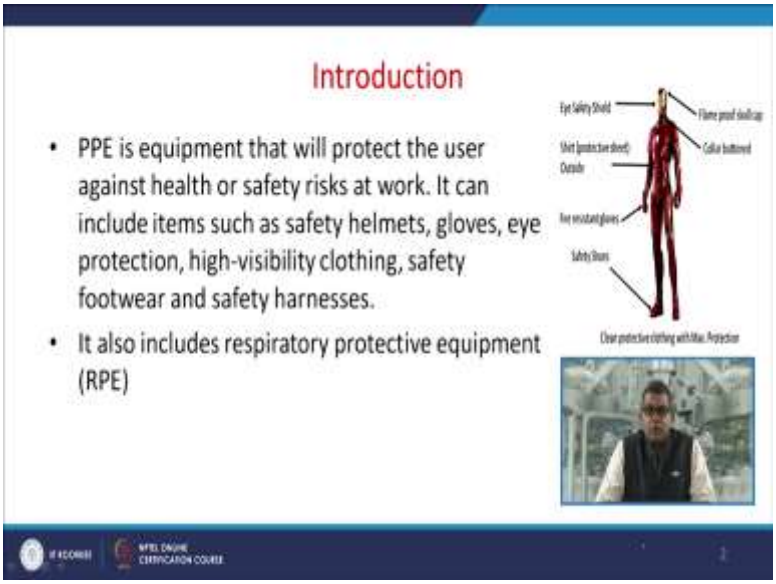

So, let us have a look about those personal protective gears which in due course of time we may use during any kind of hazardous process or any kind of operations which may involve the life-threatening or involve the occupational injury or less to the human being. So in this, the right-hand side of this particular photograph, this gives a brief idea that how many type of personal protective equipment we can use in any kind of chemical process. Like eye safety shields, you may have skullcaps, the collar buttoned shirts, fire resistant gloves of tissues, so this gives a brief idea about the different kind of personal protective gears being used in process industries.

So, let us have a look about the personal protective equipment, usually they are the equipment, they protect the user against any kind of health or safety risks whatever it may involve during the course of any process or any work. Now it may include several items like safety helmet, gloves, eye protectors like goggles, high visibility clothings, sometimes safety footwear, safety harnesses, etc. And it also includes respiratory protective equipments, now these type of, some of these equipments wave already discussed in industrial hygiene chapter.

Now, even where engine and controls and safe system of work have been applied, some hazards might remain. Because there are 2 aspects, one is that several processes, they have inherent safety issue aspects, safety barriers, etc. Now, if because of any process compulsion and because of certain process parameter aspects, some of the contaminants may escape from those processes or equipment, etc. So, they may harm the human beings, those who are involved in and around processes. So, these processes, personal protective equipments, they act as a barrier.

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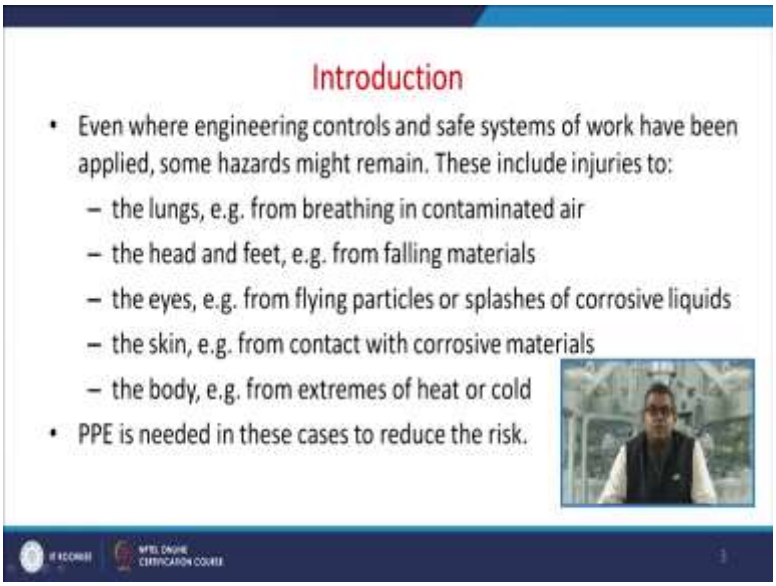

So, these type of things, they include injury, the problems which are also there in that particular process, they may include the injuries to lungs, maybe from the breathing contaminated air, sometimes this contaminated air may have toxic components. The head and feet, like from falling any kind of materials, so that is why the head gears are being used. The eyes, from flying particles or splashes of any kind of corrosive liquids.

Sometimes the skin, that is from the contact with any kind of corrosive materials through the skin, the contaminants may get absorbed to the body system through the skin and it may

become part and parcel of the blood vessels. So, it may create a future problem of health. The body, that is from extreme heat or cold sometimes, because of the process requirement, the temperature may go up to 50 degrees Celsius, 55 degrees Celsius. Or sometimes it may be subzero level. So, you may require a personal protective gears to overcome such kind of scenario.

So, in a nutshell the personal protective equipment is needed in all the cases which we have discussed right now to reduce the risk.

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Now, let us have a look, a brief look about where safety equipments are required. Like in case of fire safety, although the system may have inherent sprinkler system, system may have inherent ventilation system. But to protect human beings, you may require some fire suits, splash suits, sometimes breathing equipments, etc. Similarly as far as road safety they are concerned, you may require certain gears like helmet, kneecaps, etc or gloves etc.

When you are involving yourself in acidic environment or you are doing something with toxic substances, so you may require the hand gloves for hand safety. Similarly there are so many aspects associated with the laboratory safety like fume hoods, safety goggles, hand gloves, etc. Apart from this when you are involved yourself in the toxic environment, then you may require the respiratory safety. Some of these respiratory safety aspects or equipments we have already discussed in different modules.

Similarly if the path is rough and there may be certain inhibitors for the smooth way, then you may have, you may require the safety boots or shoes. So there are a large number of

these personal protective equipments are available. Only thing is that you, when to use these safety equipments, and that is a big question. Now, when the process safety is in question, there are certain regulatory guidelines being laid down by either OSHA or respective national agencies. And they fix the responsibility of employer as well as the employee.

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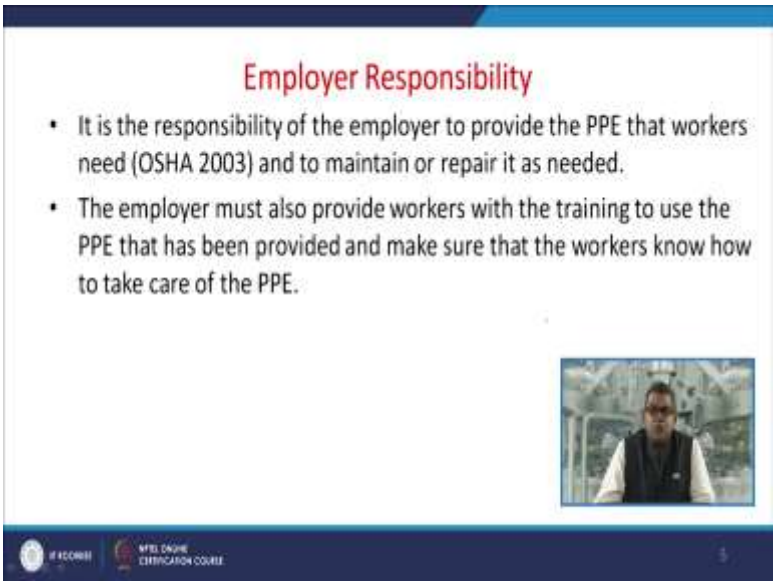

So, let us have a look about the employer's responsibility. So, usually in global context views to follow the OSHA guidelines and they were prepared in 2003. So, this suggests that it is the responsibility of the employer to provide the personal protective equipment that worker needs and to maintain or repair it whenever it is required. So, the employer must also provide the workers with the training to use the personal protective gears that has been provided and make sure that the worker know how to take care of this personal protective equipment.

So, this may be the part, integral part of the training because if you are having any safety gears and you do not have any clue about the uses of that particular safety gear, then it may become the liability. So, to overcome this problem, this part is being covered by the guidelines and moreover because it is sometimes a life-saving guard. So, the workers must know how to take care of those personal protective equipments because without those equipments or without those gears, the life may be at the stake.

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So, let us have a look about the basic part these regulations and standards. We have already listed the different numbers of these OSHA guidelines and you can have a look of those further readings through the OSHA website. Now these regulations and standards are subdivided into different categories like general guidelines or general regulations, the regulations related to clothing, although in clothing the National Fire protection Association, there provided there guidelines.

Then OSHA has suggested different eye and face protection guidelines under the head of different regulations.

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Then there are certain regulations attributed to head protections, then foot protections, and similarly one guideline is attributed to the electrical protective devices because sometimes electrical shocks, electrical threats may be at the workplace. To prevent this type of thing, they have suggested guideline for electrical protection.

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Then there are certain hand protection guidelines being laid down by the OSHA. Then hearing guidelines, sometimes hearing plugs, etc. Then respiratory guidelines, the respiratory guidelines because sometimes the toxic substances or any kind of flammable vapours, they may occur at the workplace. So, respiratory problems may occur in due course of time. So, to overcome this type of things, the regulations being provided by the OSHA.

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Now let us have a look about all these guidelines in a bit detail. So, let us have a look about the clothing aspects. Now the effectiveness of clothing with regard to safety and health is affected by different factors. So, we have enlisted 3 factors, one is related to the insulation. The high insulation is generally desired in the cold weather and not wanted when the temperature are high because your body temperature is around 37 degrees Celsius.

So, if the temperature at outside his extremely cold, then we may suffer health hazard, may be reflected in terms of occupational illness, sometimes occupational injury and even fatality. So, to overcome the broad-spectrum related to the insulation and these insulations are not at all desirable when the temperature are high. The reason is that it may hamper your efficiency or you are working capability.

Now, next is the permeability, this is the measure of resistance to what vapour movement throughout the clothing. So, this is again also an integral part of your personal protective equipments because it gives proper wetness to the skin, so that the efficiency may not be on the negative side.

Then the ventilation, the ability of ambient air to move throughout the fabric itself or through the garment opening. So, this ventilation aspect is again very crucial because it prevents the suffocation or uneasiness of the worker at the workplace. Others are like flame resistant clothing. These flame resistant materials, they are self-extinguished on removal of the ignition sources. So, this clothing made of flame resistant material is known as flame resistant clothing or sometimes referred as FRC.

This will not continue to burn in such situations nor will melt like some synthetic fabrics etc. So, the most widely used fire resistant material is sold under the trade name of Nomex, it is a very common fire resistant material. Pyrolon is another commercially available fire resistant clothing.

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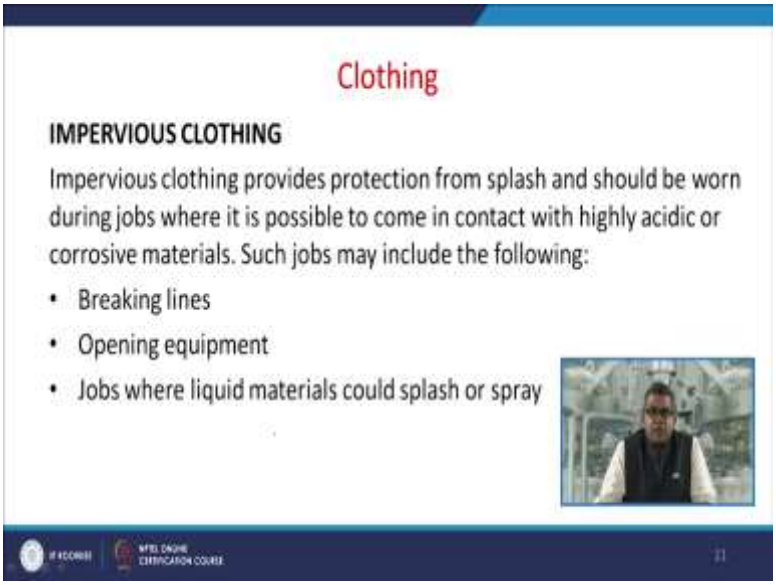

There are certain impervious clothing, these impervious clothing provide the protection from Splash and should be worn during the jobs where it is possible to come in contact with highly acidic or highly corrosive materials. So, such job may include like breaking lines, sometimes breaking lines may create the corrosive materials, etc. Sometimes the opening of any equipment may create a problem that requires the wearing of impervious clothing.

Another is a job where liquid material could splash or spare. So, these are some of the examples where you have to be with the impervious clothing.

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There are certain hazards related to the eye and face protection and because sometimes splashing, sometimes the dust particles, sometimes any kind of gas or vapour or corrosive material or acidic fumes, etc may create a problem for eyes.

And through face, because the skin to the face is very sensitive and sometimes the material may get absorbed to the blood vessels and may create further problems, sometimes itching problems, etc. So, to overcome such kind of scenario, there is an utmost need of eye and face protection. Now let us have a look at various hazards associated with this kind of problem. This may attributed to the chemical or sometimes metal splash, sometimes dusty particles may get deposited to the face or sometimes may go to eyes, then projectiles, gas and vapours, radiation, etc.

So, to prevent this there are certain options available to you and it is clearly visible in these pictures. You may use the safety spectacles, goggles, you may have to face screens like this, face shields, sometimes visors, etc.

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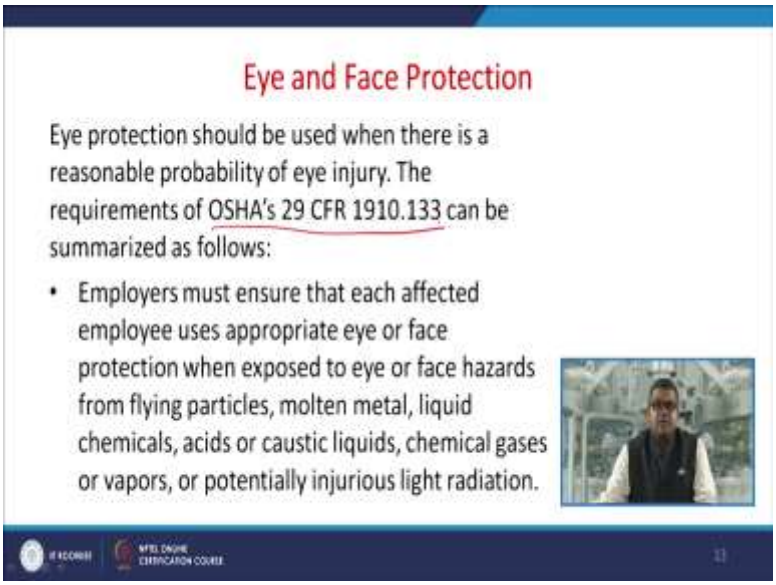

Now, OSHA has fixed a guideline for these eyes and face protection because whenever your eye is in trouble, then definitely you will not be able to do much and it may be covered under the occupational injury. And sometimes it may be desired that once you are safe, then you need to go ahead with the safety of other people, those who are working in that arena.

So, giving the major impetus to this, the OSHA has suggested the guideline and they suggested that eye protection should be used when there is a reasonable probability of eye injury. So, this requirement is enlisted in this particular guideline and which can be

summarised below. Remember whenever you are using this type of protectors, then there may be a slight chances that you are compromising with the efficiency of workmanship.

So, the guidelines summarised that employers must ensure that each affected employee use appropriate eye or face protection when exposed to eye or face hazard from flying particles, may be attributed to molten metals, liquid chemicals, acid or caustic liquid chemical gases or vapours, those may have some toxicity also or a potential injuries light radiation. Sometimes UV light or infrared light or x-rays, they might occur at the workplace. So, these eye and face protection devices are used to protect and they create the barrier between those radiations and yourself.

So, let us have a look about this guideline, that employer must assure that each affected employee uses eye protection, that provides the sight protection. When there is a hazard from flying objects also, sometimes flying objects may create a problem, so these eye protectors, they are very helpful. Now, detachable sight protectors like clip on, side-on-side shields, etc., they are admitting the pertinent requirements of this section, there also acceptable under this head.

Another aspect is that the employers must assure that each affected employee who was the prescription lenses while engaged in the operation, that involves the eye hazard wears eye protection, usually that incorporates the prescription in its particular design or wears Eye protectors that can be worn over the prescription lenses without disturbing the proper position of the prescription lenses or protective lenses.

Now, this type of scenario may occur when there are certain special cases when the lenses or sometimes the goggles, they are very special type, like the plastic lenses, etc. So, if those plastic lenses you are using and if you are subjected to a very high temperature, then there may be some deterioration to those lenses. So, these barriers will not act up to that level for which they are designed. So, that is why this guideline comes into the picture. Another aspect that employers must ensure that each affected employee, uses equipments with filtered lenses that have a (())(19:07) number appropriate for the work being performed for the protection from injuries like radiation.

Now, sometimes it may happen if anybody is having some sort of defect in the eye, so they may have to use the proper goggles, they may have to use the proper shield or proper filters to avoid any kind of occupational injury.

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Apart from this, we are having certain head protectors helmets, the common name is helmet. Because sometimes if anybody is moving here and there from the plant and sometimes anything may be because of some malfunctioning, maybe because of some negligence may fall down to his or her head. Now, head is a very sensitive part and you can say the Control Panel of your entire body. So, if anything took place, then definitely it may lead to the injury, occupational injury, even the fertility. And sometimes it may create further problem like paralysis, etc.

So, keeping in view of the gravity of this aspect, there are certain guidelines associated with the head protections. So, let us have a look about the gravity of those hazards associated with the head. The impact from falling or flying objects, risk of head bumping, hair getting tangled sometimes in different machineries, sometimes there may be a chance of chemical drip or splash. Sometimes climatic or temperature changes may take place, so that will impact to the entire body. So, there are several options available for the protection of head, like industrial safety helmets, bump caps, hair nets, firefighter helmets, etc. So, these are the options available.

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Now, the hardhats are being commonly used in the industrial facilities. Suppose if you visit any big establishment, then it is mandatory that you have to wear the hardhats prior to enter into the main arena and this is being made mandatory by all the government regulatory bodies. So, these hardhats are made of a rigid plastic as a pack with millines, reinforcement ridge. And different styles are available, those made in the form of a traditional cowboy hat. Although these traditional cowboy hats are not permissible in the process facilities because they do not solve the basic purpose to prevent the workers for occupational injuries. And these hardhats are more common in various construction sites.

So, inside, what is inside the helmet? Inside the helmet there is a suspension that spreads the helmet's weight over the top of head and that also provides space of approximately 30 millimetre between the helmet's shell and the wearer's head. So that if an object strikes the shell, the impact is less likely to be transmitted directly to the skull. So, you can say in other words that it acts like a cushioning aspect, so that the effect to the skull can be minimised. Now, this suspension generally has an adjustment knob or strap, so that the hat can be used for different head sizes. And apart from this, the distance between the head skull and the helmet's inner shield, it creates a slight ventilation to the hair so that itching or other negativeness may not occur in due course of use.

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Now, the American National Standards for industrial safety, they suggested their own guidelines for these head protection. And they provided that how to select the appropriate type of helmets for different types of services. Now, it classifies type I for top protection and Type II for lateral impact protection. Because whenever you are using these type of barriers, again they are compromising and they challenge the efficiency of worker.

So, this ANSI, they also have 3 classes to do with the electrical insulation rating, like class G, that is applicable for the general aspect helmet and they are tested for 2200 volts. Class E, that is for the electrical one, they are tested to withstand for 20,000 volts and class C, this is related to the conductive aspect, they provide no electrical protection. So, they have again further classified all these things for the better protection.

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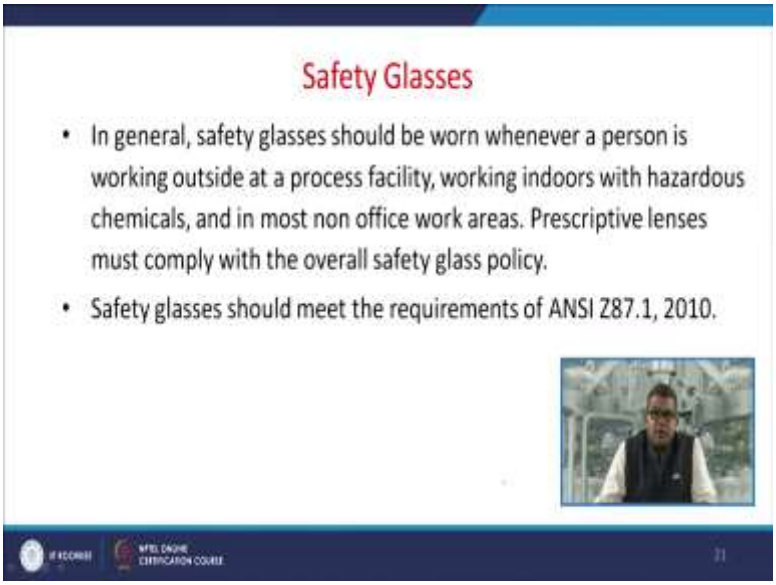

Now, let us have a look about the safety glasses. So, in general the safety glasses should be worn whenever a person is working outside at a process facility. Working in doors with any kind of hazardous chemicals and in most non-office work areas, because office work areas, they are well protected and there is no need to wear all these safety glasses. Now the prescriptive lenses must comply with the overall safety class policy.

So, the ANSI, they have suggested there the guidelines for the use of these safety glasses. So, as far as the regulatory guidelines are concerned, these safety glasses should meet the requirement of the guidelines given by ANSI.

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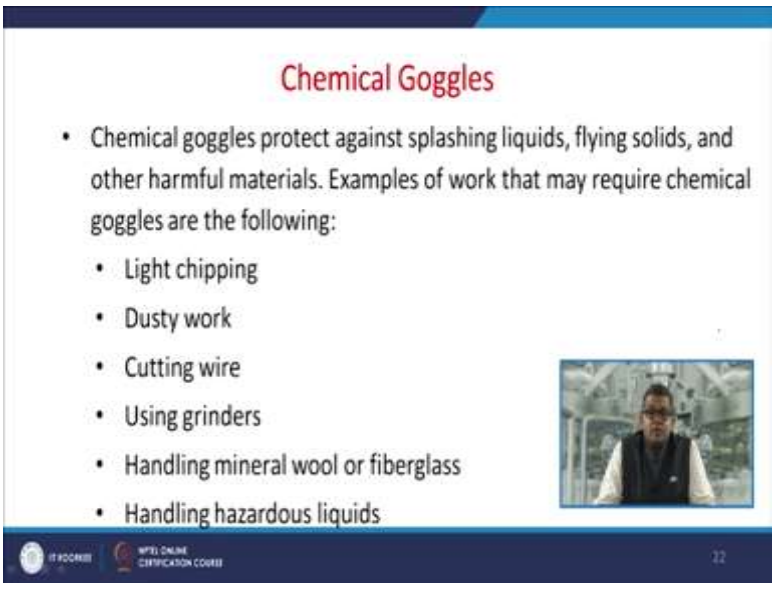

Apart from this, there are chemical goggles. Now the chemical goggles, they are used to protect against any kind of splashing liquids, flying solids and other harmful materials. Example of work that may require the chemical goggles, they are like light chipping, dusty work, sometimes you are involved yourself in the cutting of wires, using of grinders, sometimes if the blades are not well tight, then some material may splash to your face or it may harm your eyes, etc.

Sometimes handling mineral wools or fibre glasses, that may create these fine particles may entrap in the eyelashes and a create further problem, that is why chemical goggles are used. Sometimes handling of hazardous liquids/vapours. So, these may create a problem, so to overcome such type of scenario, the chemical goggles are being used. Sometimes you may encounter in heavy noise which encompasses the limits being prescribed by the various regulatory bodies, like moving machinery, sometimes the belts, sometimes the chains, etc.

So it creates a lot of hazards and sometimes it may create hearing problem, if you are in the prolonged use of those environment. So, to overcome this type of problem, there are certain ear protectors.

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So, ear protection, nowadays it has become the integral part of chemical process safety. Now, let us have a look about the hazard associated with this ear protection. Noise, this is a combination of a sound level and duration of exposure. We have discussed this thing in the industrial hygiene chapter. And this, a very high level of sound, which is beyond the

prescribed limit, they are always hazardous even for a short duration. So, sometimes it may create the hearing losses also.

So, there are several options available to overcome this type of problem and if you visit any industries, you may find that if there is any noise hazard, you may find these types of earplugs or headphones, etc. They have become the part and parcel of the industrial facilities. So, these are earplugs, earmuffs, semi-insert or canal caps, they are being used by the various industrial establishments to overcome this noise problem.

Now, each type of hearing protection device has its advantages and disadvantages. The advantage of foam and PVC earplug they are small and very lightweight because the one thing must be mentioned before you go ahead, that whenever we are using the barrier, it should not be so heavy, there are certain requirements and it should not much compromise with the worker's or person's efficiency. So the advantage of foam and PVC earplug we were talking about, they are small and lightweight and they are very comfortable in various hot environment.

And you can easily use with other safety devices, like the full mask helmet if you are using, then we can easily use these ear protectors. Now, there are several disadvantages also associate it with these earplugs. Like they may work lose and require the occasional refitting sometimes because if they are not sturdy and if they are not closely enough, then they may lose. And you have to pay attention during the working paraphernalia. Now, they require the specific fitting instructions and sometimes they frequently sweat. So, these are the problems with the earplugs.

Now, earmuffs, they are again another type of hearing protectors. And there are certain advantages of earmuffs, those who are not present in the earplugs, like they are easy for the employer to supervise the wearing of device. Now generally they are having the flexibility to fit all the head size. So, you may say that one size fits all and it fits better for a longer period of time. But simultaneously they are having certain disadvantages. So, the disadvantages of earmuffs are, they may fit tight on the head. Sometimes they are uncomfortable in the warm environment because they cover the larger area compared to the earplugs.

Now, problems occur when used with other protective equipments like if you are having a fullface shield or if you are having the helmets with you, then there may be a problem to fit

those earmuffs within the helmets or within the full mask helmets, etc. So, they may create a problem.

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Apart from this, we are having certain regulatory requirements for the hand protection, because sometimes these hand protection, sometimes you cannot overcome or sometimes you cannot avoid the scenario when you may need to use the highly dangerous materials through your hands. So, or sometimes there may be a chance that the toxic material or any kind of solvent, they may become, may get deposited at your hand surface and it may get absorbed into the body structure.

So, to overcome this type of problem, there are certain hand protectors in the form of gloves being used. So, let us have a look about the hazards of these hand protection. Sometimes abrasion, sometimes you may feel that temperature extremes like if you are working in a hot environment, then that may create a problem. And sometimes you are involved in any kind of hazardous operations where the cuts and punctures to your body may take place, especially hands. So, to overcome this problem you may require to use the hand gloves.

There may be a chance that you may have impact of various chemicals, those who may be corrosive, those who may be toxic in nature. So, you may have to look into the preventive measures of your hands. Sometimes electrical shocks may take place and that is why the rubber sleeves are being used to protect your hands, etc.

Then the radiation, sometimes vibration and sometimes the more critical one is the biological agents like pathogens, etc. Then definitely you must use the barrier between the hand and

those agents. And sometimes you are involved yourself in the prolonged immersion in water, then definitely the adverse effect may take place in your hands. So, these are the various hazard listed for the hand protection.

Now, there are various options available with those who are illiterate or those you can see in this particular picture. Like gloves, sometimes gloves with cuffs, sometimes sleevings that covers the part or all the arms. And these are made of different materials to cater the need of the process. Like chemicals, biological agents, electrical shocks, the requirement may be different with each other. So, based on the requirement they may have made of different materials like a natural rubber, polyvenyl alcohol, nitrile, neoprene, PVC, etc. Then cotton, wiremesh, Kevlar, welding, leather, so, based on the requirement these gloves are made of different materials.

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So, let us have an example that like leather palm gloves, they are often worn when carrying out heavy-duty work. Now the resist heat, spark, sharp and sometimes they resist the rough objects and provides some cushioning agent below. But they provide the minimal protection from hydrocarbon liquid. So, all these gloves are case-sensitive. You cannot say that you can use these gloves for each and every operation.

Similarly impervious gloves, they are made of materials such as neoprene, PVC or nitrile. They are used when handling hydrocarbons or corrosive chemicals such as acid and caustic, etc. The gauntlet type of gloves which extend above the cough and protects the wrist and forearm should be worn when there is a possibility of any kind of splashing. The cotton

gloves, they protect against dirt and abrasion, but are not heavy enough for the use of rough or sharp materials because the stability or strength of the material is not up to the mark, to end such kind of things.

Similarly latex gloves provides the maximum dexterity but provide a limited protection. So, they are used in light service such as laboratory work and to keep oil, grease and liquid off the skin. So, again they are having very we can say broad spectrum of uses. The welder gloves, they are made from the treated leather and that provides the protection against heat because it is a high temperature, welding sparks, splutter and hot slack.

The insulated gloves, they used in the laboratory for handling distillation pots and other hot objects. Electrician gloves protect against any kind of electrical shocks, sometimes high-voltage lines, sometimes other lines. So, they acts like a barrier to prevent these electrical shocks.

The metal mesh gloves, they resist the sharp edge and they prevent cuts. The leather gloves shield hands from the rough surfaces, the venyl and neoprene gloves, they protect hands against the toxic chemicals because these toxic chemicals may get absorbed in the body system, so again sometimes blistering may take place, sometimes cuts, sometimes it may create the wounds, etc. So, the Venyl and neoprene gloves, they protect hands.

And one more think must be noticed, that these gloves should not be reactive with those chemicals for which you using them. Rubber gloves, they protects when working around any kind of electricity works, the padded cloth gloves provide protects from sharp edge, slivers, dirt, any kind of vibration that may take place during the process arena.

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There are certain hit resistant gloves, they protect the heat flames, latex disposable gloves, they protect from any kind of germ and bacteria, there are certain lead lined gloves, they protect hands from any kind of radiation sources while we are working with say x-rays or with UV lights, then they protect the body structure.

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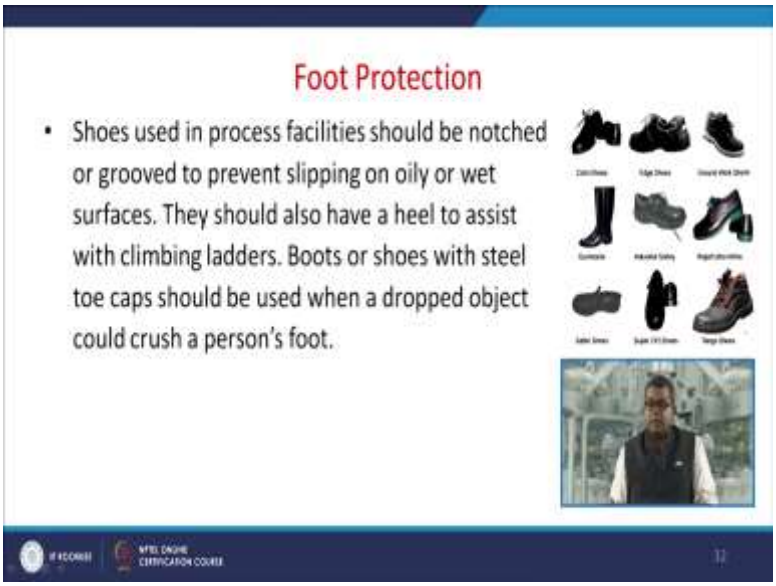

Now, we can have a look about the foot protection. So, shoes, there are very common, so the shoes used in the process facilities, they should be notched or grooved to prevent slipping on oily wet surfaces. Now they should have a heel to assist to the climbing ladders, but sometimes it is not desired when you using on a flat surface. Boots or shoes with the steel toe caps should be used when dropped object could crush a person's foot.

So, these are very common things, industrial shoes, they are very common like you can see that there are Colin shoes, air shoes, ground work shoes, gumboots, industrial safety shoes, sometimes rapid Ultra nitrile shoes, Safari shoes, so these are the shoes being used for a very specific use. So, for different type of operations, for different type of requirements can you can use the variety of shoes.

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So, let us have a look about the hazards associated with these foot production aspects. Now, wet, hot and cold conditions, sometimes in a static buildup like you are working and if your shoe or if your body is having the charge particles, then you may create the problem of electric static buildup. Then slipping, cuts and punctures, falling objects, heavy loads, metal, and chemical splash, vehicles, etc they may create a problem in the industrial facility.

So, to overcome or to protect this problem, there are options available, like safety boots and shoes with protective toecaps and penetration resistant aspect with midsole Wellington boots, specific footwear like foundry boots, chainsaw boots, etc. So, these are the various options available to protect your feet from damage. Because once it is injured, then definitely it may become the case of occupational injuries.

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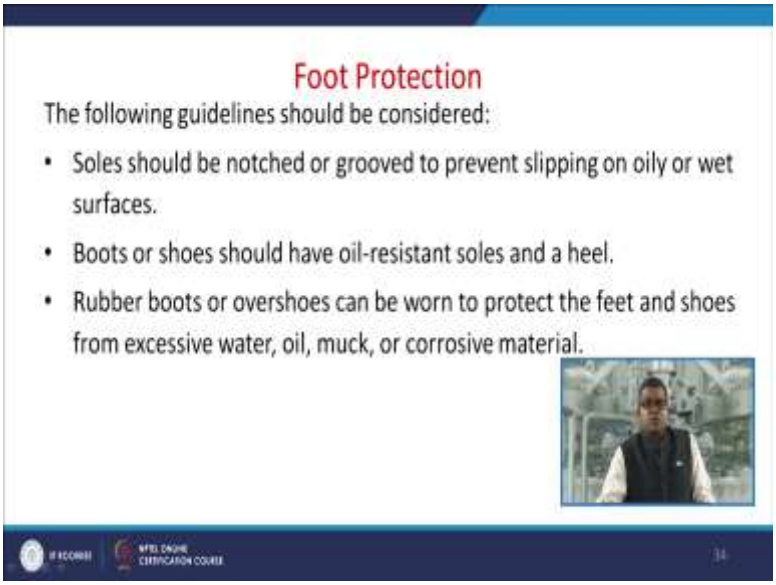

So, there are certain guidelines being prescribed for the use of these foot protection. Now, the soul should be notched or grooved to prevent slipping on oily or wet surface. And you can easily observe that normal domestic shoes, they are also being notched and grooved to protect, to prevent any kind of slipping on the surface. Now, the boots and shoes should have all resistant sole and heel. Rubber boots or over shoes can be worn to protect the feet and shoes from excessive water, oil, muck or corrosive material.

Now the Footwear of the different types should not be worn, like tennis and deck style, D plug and hiking style shoes, the crepe shoes, smooth leather soles, sometimes the Western style or narrow throat boots, lace up and zipper style boots higher than 8 inches, sometimes slip on boots higher than 12 inches. So you cannot generalise the soles or shoes for every aspect.

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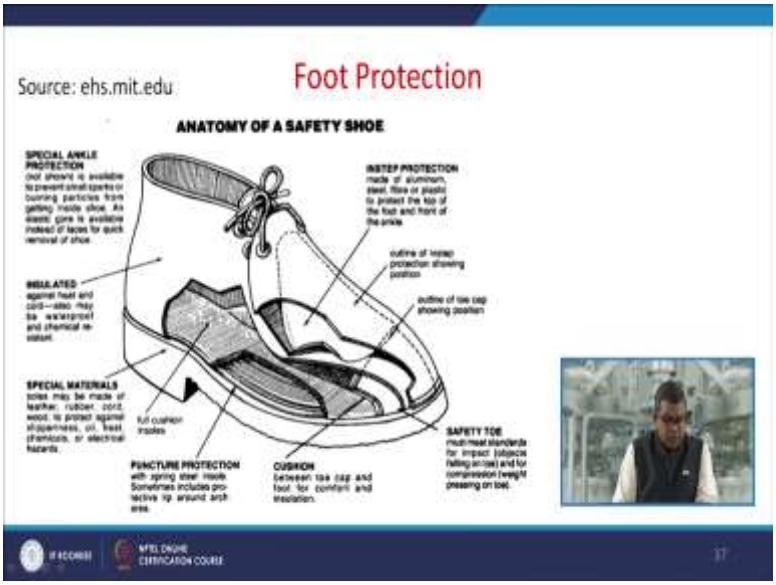

Now you can have a look about the different or you can say the anatomy of the safety shoes. They may have special ankle protection, they are insulated, well insulated, so that any kind of heat impact, that might not occur in the body system. They are made of special materials, that may be made of leather, rubber, card, wood, to protect against the slipperiness, oil, heat, chemicals, electrical hazards.

Sometimes you may have a full cushion in sole, so that it provide the easiness for those who wear these shoes. There are certain protectors for the Puncture and sometimes spring steel insoles, sometimes include the protective lip around this area. They are having the cushions between the toecap and the foot for the comfort and insulation and that too is applicable for cushioning of this aspect also. This is the safety toe, this must be the standard for impact objects falling on toe and for the compression weight pressing on toes, etc.

There are outlined for the toecaps for showing the position, there may be certain outlines, for instep protection, there are certain instep protection at this juncture also, this is made of aluminium, steel, maybe fibre or plastic to protect the top of the foot and front of the ankle.

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Now, steel toe shoes, they protect from falling objects, from impact because in this particular figure we have discussed different types of toes. And the metatarsal shoes, they have special guard that run from the ankle to the toes of the shoe and protects the entire foot. The reinforced sole shoes have metal reinforcement that protects the foot from punctures and the latex or rubber shoes, they resist chemicals and provide extra traction on slippery surfaces.

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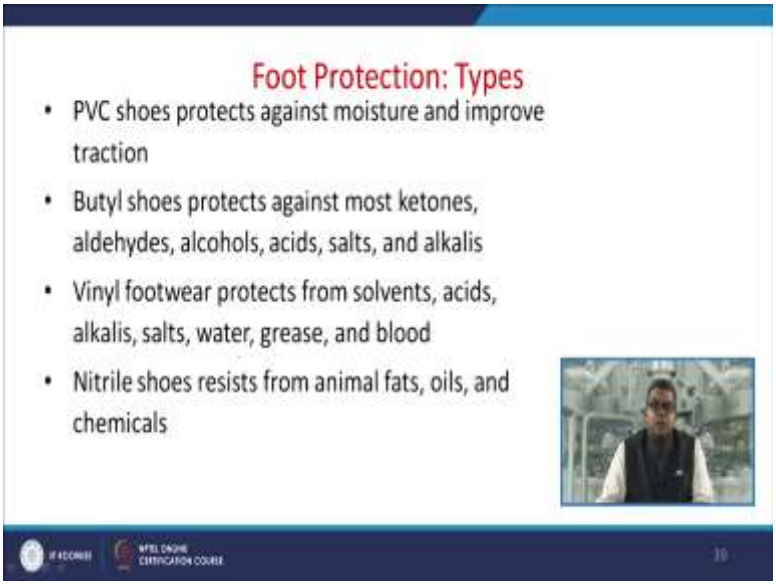

The PVC shoes, they protects against the moisture and improve traction. The butyl shoes protect against the most of the ketones, aldehydes, alcohols, acids, salt and alkalis. So, sometimes you may encounter this type of chemicals at your workplace. So, to protect your feet, the butyl shoes are being used. Venyl Footwears, they protect from the solvents, acid,

alkali, salt, water, greases, sometimes blood, etc. The nitrile shoes, they resist from the animal fats, oils and chemicals. So, you can see there are a variety of shoes.

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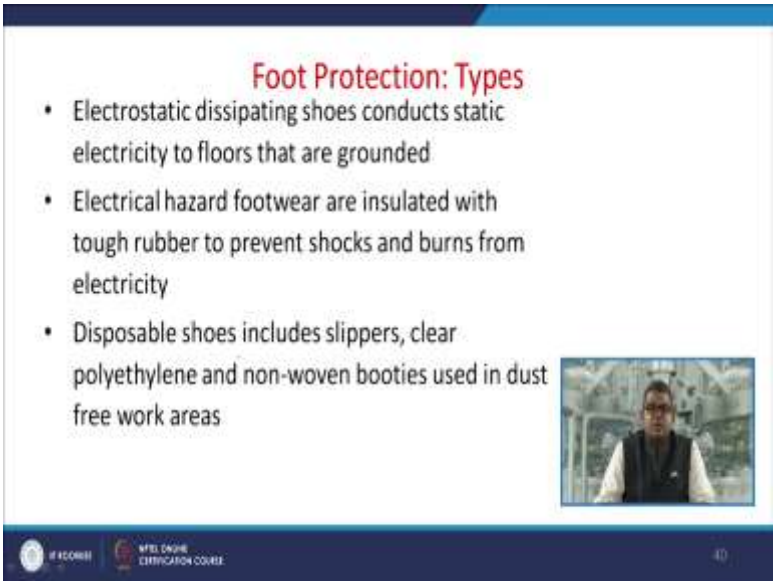

Then electrostatic dissipating shoes, they conduct static electricity to flow that are usually grounded. The electrical hazard footwear, they are insulated with the tough rubber to prevent shocks and burns from the electricity. There are certain disposable shoes including slippers, clear polyethylene or nonwoven booties used in the dust free work areas. So, these are again the variety of the shoes being used for various facilities.

Now, let us have a look about the respiratory protections. Although we have already discussed couple of things in the industrial hygiene module. So every attempt should be made to make sure that workers are never exposed to toxic or harmful vapour. There will be times when some form of respiratory protections are needed and if only the precautions are there. Now this particular aspect discusses the various types of protections that are available and how we can use those protections. Like one is we are having the fixed breathing air system, these respiratory protective equipments, they should be used in the areas that do not have a save breathing environment. Or where there is a possibility of an unexpected release of toxic gas or particulates.

Second aspect in this the fixed breathing system is that when respirators are used in the atmosphere, where the concentration of toxic gases could approach for immediate damaging to life IDLH, they standby personal carrying the SCBA, the self-containing breathing apparatus, they should be present along with the suitable rescue equipments such as harness

and hose, etc. See, again whenever you using this, either SEBA or IDLH protectors, then again you are compromising with the efficiency.

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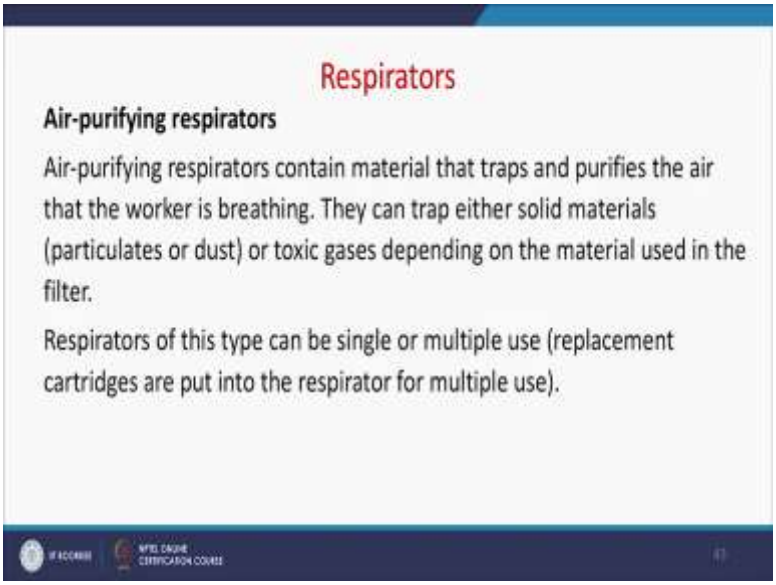

Now, there are air purifying respirator. So, these respirators contain material that traps and purifies the air that the worker is breathing. Now they can trap either solid materials, particulars or dusts, or toxic gas depending on the material used in the filter. Now, respirator of this type can be a single or a multiple, that is replacement cartridge, you can put into the respirator for the multiple use. So, when this cartridge exhausts, then you can remove it and reinsert the newer one or regenerated one.

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So, in general these respirators in the category that they do not provide high level of protection and should not be used when the concentration of toxic gas is close to IDL H. And moreover some sort of preventive measures need to be taken to overcome the problem of the excessive release of these toxic gases at workplace.

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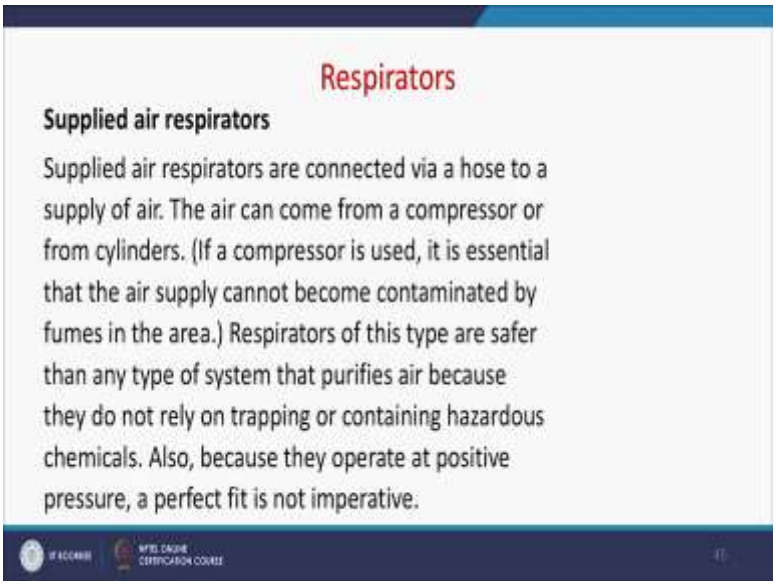

Another one is supplied air respirators. So, these supplied air respirators, they are connected via hose to a supply of air. Now the air can come from a compressor or from a cylinder, if a compressor is used, it is essential that the air supply cannot become the contaminated by the fumes in that area. Because sometimes the compressors may take air from the atmosphere and that atmospheric air may get contaminated with the period of time because of the release of the toxic material.

So, the respirator of these type are safer than any type of system that purifies air, because they do not rely on trapping or containing hazardous chemicals. Also because they operate at a positive pressure, a perfect fit is not imperative.

The self-containing breathing apparatus SCBA, they are similar to the supplied air respirators, except the air is supplied from a cylinder usually carried by the worker. So, they used for a very short duration task, emergency rescue, escape and process control procedures. The air supply is generally rated for 30 minutes, but this time is reduced if the work being performed is extraneous. Now, this SCBA's should be inspected before each use, emergency unit should be inspected at least monthly so that the oxygen pressure is maintained up to the mark.

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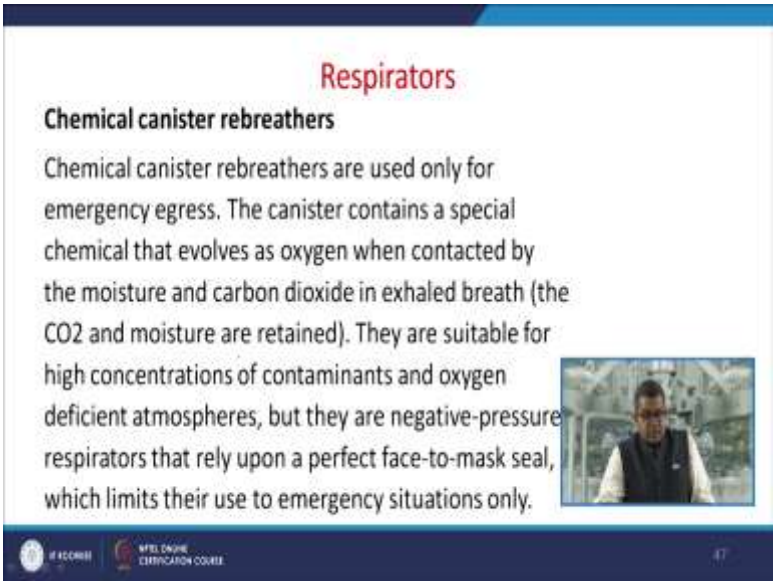

There are certain chemical canisters rebreathers. The chemical canisters rebreathers, they are used only for emergency egress. The canisters contain special chemicals that evolves oxygen when contacted by the moisture and carbon dioxide in exhaled breathe. The CO2 and moisture, they are retained. Now they are suitable for high concentration of contaminants and oxygen deficient atmosphere. But they are negative pressure respirators that rely upon a perfect face to mask seal, which limits their use to emergency situations only.

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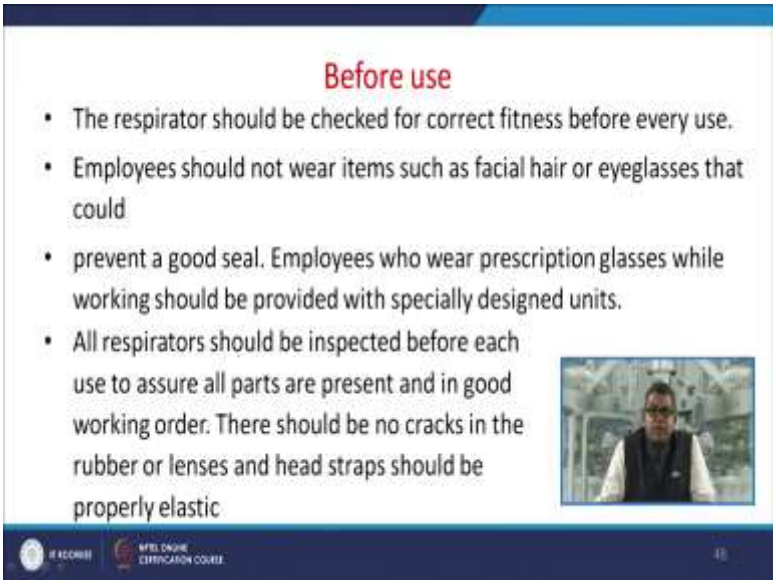

Now before use, the respirator should be checked for the correct fitness before every use and employee should not wear the items such as facial hair or eyeglasses that could prevent a good seal. Employee who wears the prescription glasses while working should be provided

with the specially designed units. And all respirators should be inspected before each use to assure all parts are present and in good working order. And there should be no cracks in the rubber or lenses and head straps should be properly elastic. These are the general advisories.

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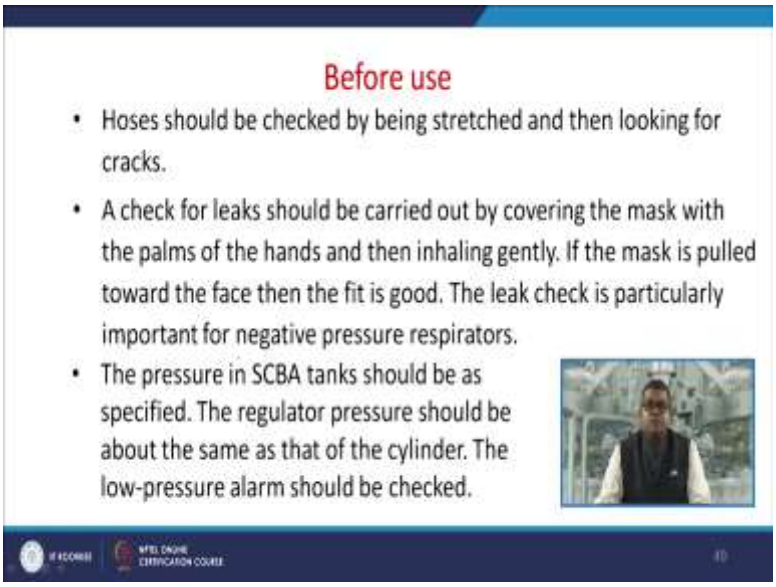

The hoses should be checked by being stretched and then looking for cracks. A check of lakes should be carried out by covering the mask with the palm of the hands and then inhaling gently. If the mask is pulled towards the face, then the fit is good. And league check is particularly important for the negative pressure respirator. Now, the pressure SCBA tank should be specified and the regulator pressure should be about the same as of the cylinder and the low-pressure alarm should be checked. Now, if the pressure is on the higher side, then again it may create a problem to the person those who are using it.

So, in this particular module we have discussed several personal protective equipments, how to use them, there are various guidelines are associated with these personal protective gears and not limited, but the use, one thing should be remembered while we use these equipments, that we must avoid the generation of such unsafe scenario. Because whenever you are using these kind of barriers, you are always compromising the efficiency.

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So, as far as the further readings are concerned, we have enlisted a couple of references for your convenience. Thank you very much.