Metal Casting

Dr. D. B. Karunakar
Department of Mechanical and Industrial Engineering
Indian Institute of Technology, Roorkee

Module – 06
Finishing, Design and Environment
Lecture – 04
Environment, Health and Safety Aspects

Good morning friends, we have come to the end of this course metal casting. In the last lectures we have been learning about the principle of metal casting its classifications and different types of what say cast alloys and so on.

If we quickly review; what we have learnt initially we have seen the introduction and the overview of the metal casting process, then we have seen the classification, then we have focused on the green sand casting process we have learnt the sand design. Next we have seen the what; say mould sand testing, gating system design, and finally we have seen the casting defects. Then we have learnt about the melting furnaces practices, then we have learnt the principle of the solidification, then we have seen the different types of the cast alloys, ferrous alloys and nonferrous cast alloys we have seen, then we have learnt about the permanent moulding process, then we have learnt about the special casting process.

So, under that we have learnt about the investment casting process, centrifugal casting process, evaporative pattern casting process and so on. And in the last lecture we have learnt about the design considerations in the metal casting process. Now we have come to the end of this course and this is the last lecture in this course and today I am going to talk about Environment, Health and Safety Aspects.

So, metal casting can cause lot of pollution and also there are several cases where the what; say workers working in casting industries were met with accidents. So, we have to take enough care to protect our environment while we are running the casting industries not only that when we are running the casting industries, we have to give enough protection to our what say workers who are working in the foundries.

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So, let us see the Environment, and Health and Safety Aspects in this lecture.

Now first let us see the Environment.

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Why should we care for the environment? That is the first question. Why because proper

handling and disposal waste protective and the environment you live in. There are so many unwanted wastes from the foundry industry right unless these are what say disposed properly our environment will be spoiled. So, that is why we have to care for our environment.

So, we have to handle these; what say wastes properly and we have to dispose them properly. Next reason unregulated past practices have already caused a lot of contamination maybe in the past people have not followed any rules they have disposed the wastes as they wished finally, there was so much of contamination in the atmosphere or maybe in the water contamination or the what; say air contamination. So, that is why we have to care for the environment. Next one your company's future success depends upon complete compliance with all regulations.

Nowadays in every country for what say the regulations are become more and more stringent. If a foundry industry is not complying the rules and regulations set by a particular government that foundry may not continue, their government will ask them too close that industry that is why if we want to survive with our industry we have to care for the environment, we have to what say comply with all the rules and regulations set by the local government. So, that is why we should care for the environment and we have to what say take necessary measures so that there won't be any pollution.

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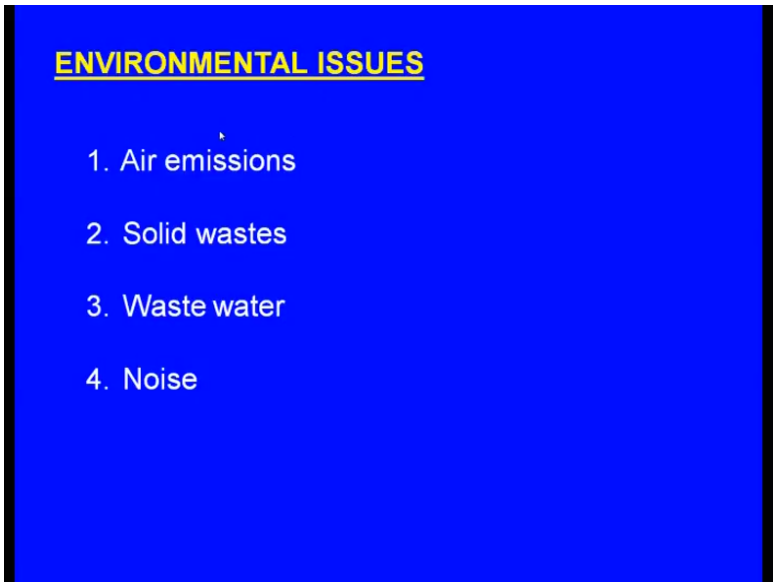

Now, what are the environmental issues: One is the air emission, second one is the solid wastes, third one is the wastewater, fourth one is the noise means when we are running a foundry industry there will be air emissions will be there like a maybe there may be a furnace like cupola finance. So, lot of what say smoke will be coming out of the cupola furnace.

Now what are the solid wastes? Solid waste means waste sand will be there and so many solid waste will be there. So, this will contaminate the atmosphere or the what; say our surroundings. Next one wastewater will be there, wastewater will be coming out of the industry. So, this could pollute what say the water the precious water which we need. Next one the foundry industry also causes noise so all these could affect the human race. So, these are the environmental issues. First let us learn about the Air emissions now you see.

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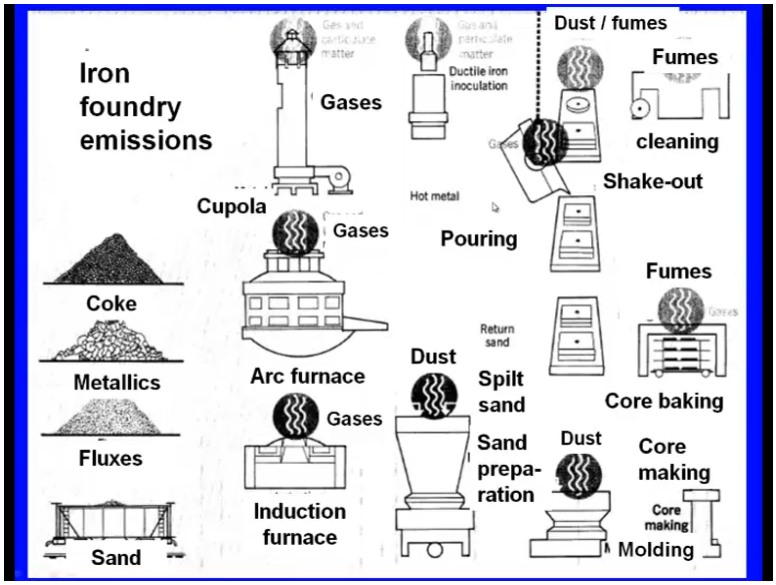

If this is the what; say different stages in a foundry industry and here we can see here the coke is handled, we need coke for melting the metal now here because while we are handling the coke somewhat say dust will be raising from the coke. So, this could cause some emission and contamination and see here these are the fluxes. So, when we are handling with the fluxes again there will be some emission will be there, some dust will be there.

So, this could what say contaminate the atmosphere or the environment and again see here this is the and again when we are handling the sand there will be pollution will be there, emission will be there and this will contaminate the environment and here we can see this is the induction furnace, induction furnace is better than cupola furnace still it what say some gases use to come right. Again these gases will be contaminating the environment again you see this is the arc furnace even from the arc furnaces gases are coming so these will be contaminating the what; say environment. Next on here you see this is the cupola furnace and from the cupola furnace so much of what say smoke and fumes will be coming out and this will be what say affecting the environment so much.

Now and here you can see this is the ductile iron inoculation, even from the inoculation process some fumes will be coming out and this will be contaminating the environment. Now here you can see this is the sand preparation, from the sand preparation place also there will be some emission will be there, Some kind of unwanted dust will be coming out which will be contaminating the environment. Now here you can see this is the molding and core making from these places also some dust will be coming, so this will be contaminating the environment.

Now you see here this is the core baking after we make the core so we use to bake them for inducing the additional strength that time also some fumes will be coming out of the baking oven, so these will be contaminating the what; say environment. Next one you see this is the shakeout means after the solidification is over we break the sand into pieces take the casting outside that time also somewhat say unwanted dust will be coming out so which will be a what say contaminating the environment.

Now again we see here so this is the cleaning stage. At the cleaning stage also unwanted dust will be coming out and we use the water for cleaning and water will be polluted or we use the pressurized air, air also will be contaminated. So, at different stages of the foundry what say process there will be pollution there will be emission. So, this pollution and emissions should be handled co carefully so that there will be minimum what say pollution will be there in the environment.

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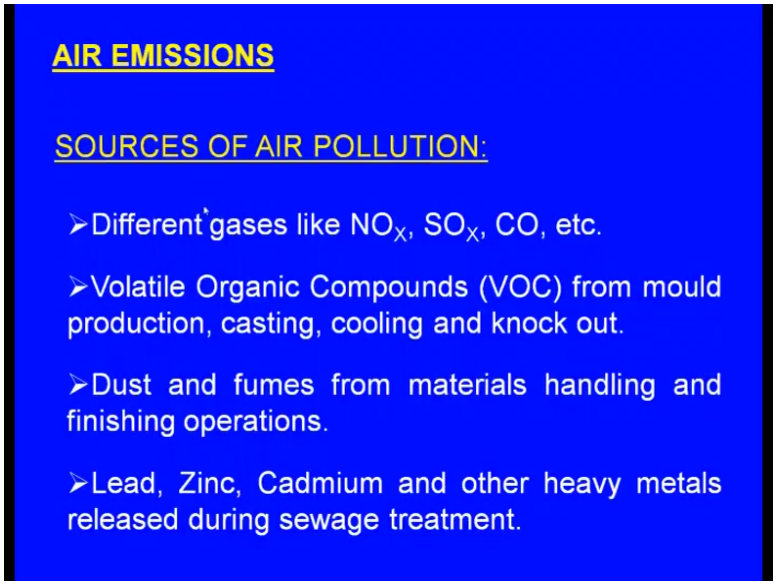

Now, what are these air emotions sources of air pollution different gases like nitrogen oxides, sulfur oxides, carbon monoxide and etcetera. Now volatile organic compounds it is known as the VOC from mould production, casting, cooling and knocking out so this also could cause the air pollution.

Next one dust and fumes from the materials handling and finishing operations, next one lead, zinc, cadmium and other heavy metals released during sewage treatment. During sewage treatment lead and zinc, cadmium will be released so this will be causing contamination.

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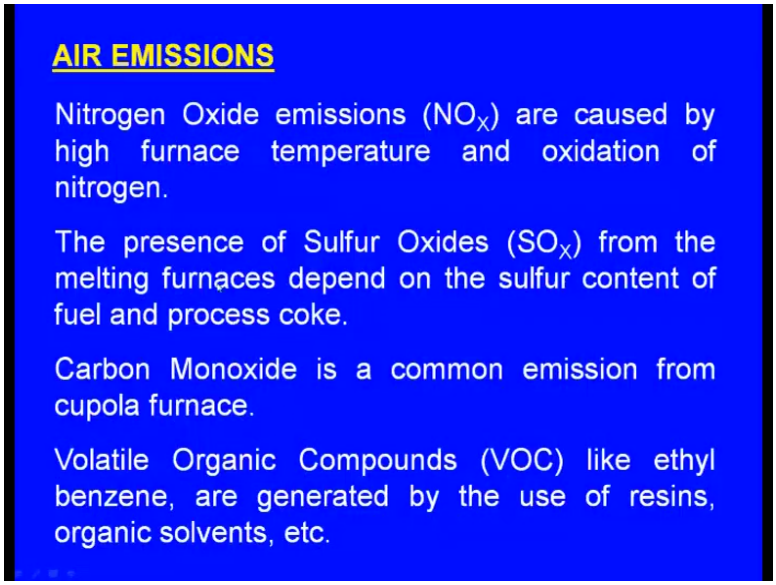

Now, again what are the sources of air emission? Nitrogen oxide emissions these are indicated as NO x are caused by high furnace temperature and oxidation of nitrogen.

Next one the presence of sulfur oxides from the melting furnaces depend on the sulphur content of fuel and process coke carbon monoxide is a common emission from the cupola furnace. So, when the what; say coke is not fully burnt then what will happen instead of carbon dioxide, carbon monoxide will be coming out of the cupola furnace so this carbon monoxide is more harmful to the environment. Next one volatile organic compounds VOC like ethyl benzene, are generated by the use of resins, organic solvents and so on.

Now Prevention and Control of Air Emissions:

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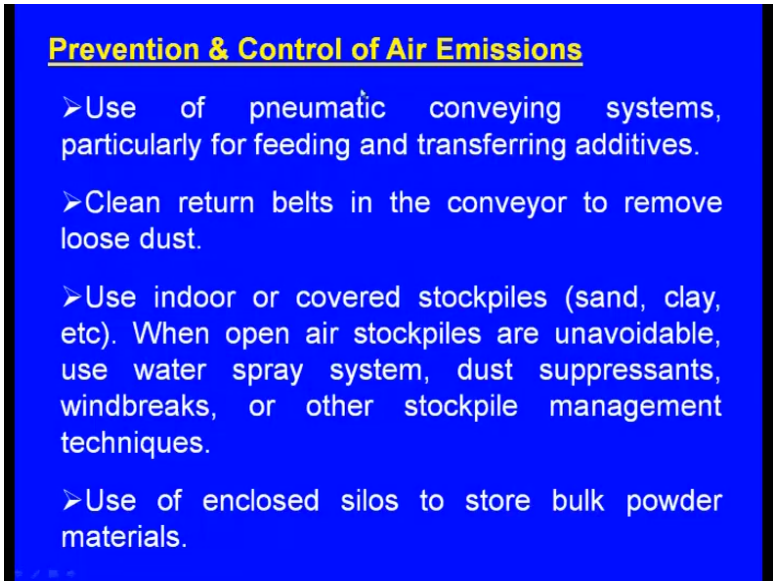

How to prevent the air emissions or how to control the air emissions? Use of pneumatic conveying systems particularly for feeding and transferring additives, now we use the what; say additives in the sand preparation. So, most of the times these are carried manually while carrying this manually what will happen they will be rising into the environment and cause the what; say environmental pollution.

So, use of pneumatic conveying systems particularly for feeding and transferring the additives will be minimizing the environmental pollution. Next one clean return belts in the conveyor to remove the loose dust, so sometimes this will be going on the conveyor while returning some loose what say material will be there like additives or fluxes. So, this will be flying into the air, so before these conveyors are returned they must be cleaned.

Next one use indoor or covered stockpiles sand clay and so on right. So, these sometimes we keep them as a what say dump so that time they should be closed or they should be kept in closed rooms. So, when open air stockpiles are unavoidable, then what happen use water spray system, dust suppressants, windbreaks or other stockpile management techniques. So, when we have to keep these what say stock materials, like what say additives or the fluxes in the open air that time we have to use the water spraying system, dust suppressants, windbreaks or other stockpile management techniques. Next one, use of enclosed silos to store bulk powder materials. Silos means big what say containers

sealed containers so we have to use them instead of keeping outside. Now what is this pneumatic conveying system, let us learn a little on this pneumatic conveying system yes it looks like this.

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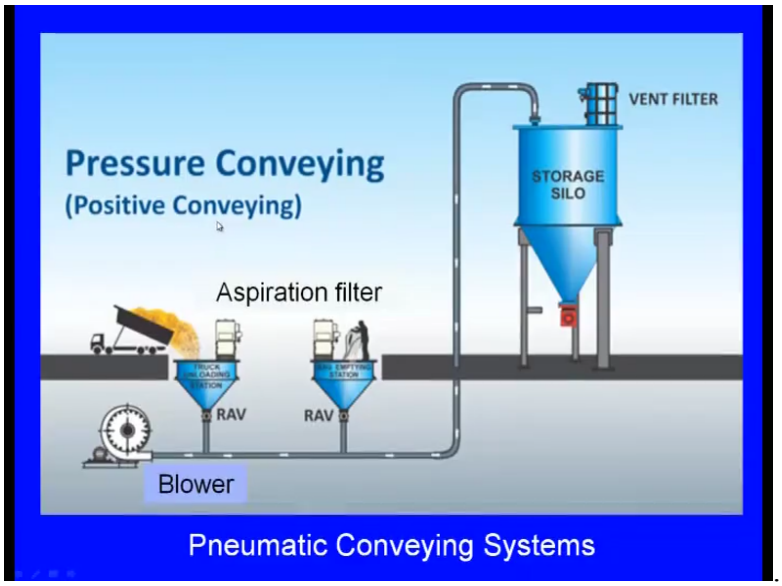

So, here we are conveying the what; say additive, this is the additive which is mixed in the sand preparation. Now here is the what; say storage silo it is here. So instead of carrying it manually, so it is what say transferred through a conveying system that too a pneumatic conveying system. And here you can see here is a blower and there is a pipe is there, this pipe will be connected to the storage silo.

Now here is the a what say additive, additive is falling into this hopper, now as it is falling there will be a blower will be there. So, this blower will be blowing pressurized air then what will happen this additive powder will be carried through this pipe and it comes like this and it comes like this finally it falls into the storage silo. So, this is the pressure conveying what say and that too pneumatic conveying system for the let say powders like fluxes or the additives. So, this also known as the positive conveying what says system.

Now then what are the meaning of the negative convey. So, negative conveying means here we have kept the blower. So, in the negative conveying system this blower won't be

there, but instead somewhere here a vacuum pump will be there. So, just like the blower is blowing, so instead of blower pressurizing the air no this pneumatic what say vacuum pump will be drawing or it will be sucking the powder and it will be coming and it will be falling into the storage silo because of the vacuum pump. So, that is the negative conveying system.

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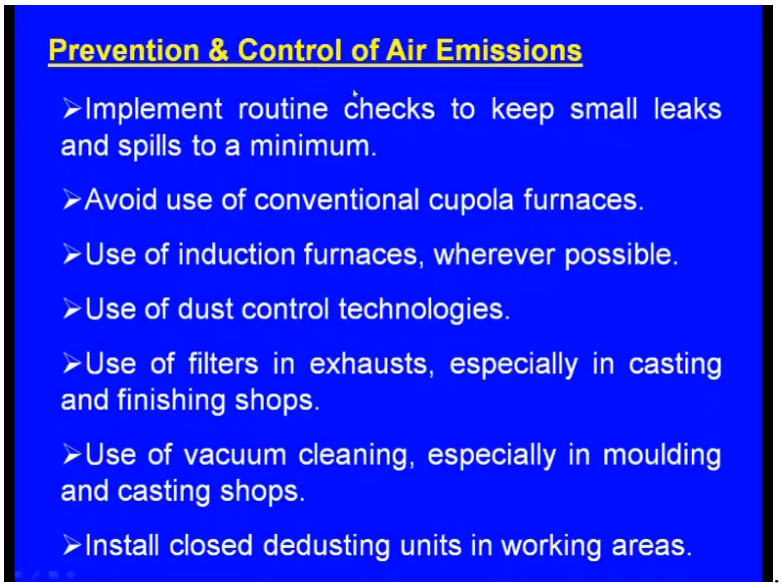

Now, prevention and control of air emissions what to do implement routine checks to keep small leaks and spills to a minimum.

So, a routine check must be done to prevent the small leaks and spills, avoid use of conventional cupola furnaces, now cupola furnace is the oldest furnace. In fact, it is that technology is very simple, but the problem is if the coke is not properly burnt it will be releasing lot of carbon monoxide which causes the environmental pollution so better to minimize the use of the conventional cupola furnace. Instead use of induction furnace wherever possible would be what say helping us to prevent the or to minimize the environmental pollution.

Next one use of dust control technologies. So, we have to use the dust control technologies like this; what say vacuum pump you see here we have seen the pressure

conveying using the blower or the using the vacuum and so on.

Next one use of filters in exhaust especially in casting and finishing sop shops then what will happen; so there will be shops will be there, so exhaust fans will be there. Now through this exhaust fans the polluted way air will be going out. So, it will be polluting the whole what say environment.

So, before the air is sent outside so we have to use the filters. So, if any what say dust is there within the factory this dust will be trapped in these filters only the fresh air will be going outside the what; say shop. Next one use of vacuum cleaning especially in moulding and casting shops, install closed dedusting units in working areas. So, these are the some measures to prevent and to control the air emissions so we have seen the air emissions.

Next we will see the solid wastes the solid wastes which will be contaminating the environment.

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Sources of Solid Wastes: One is the sand waste, second one is the slags from the furnaces, next one refractory wastes and the sludges and so on.

First let us see the sand wastes right.

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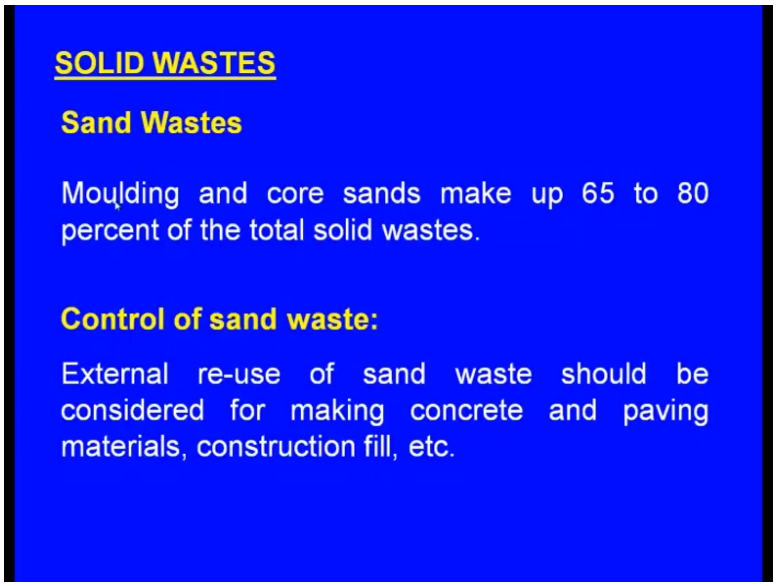

Moulding and core sands make up to 65 to 80 percent of the total solid wastes. You see the molding sand and the core sand are contributing 65 to 80 percent of the total solid wastes.

Now external reuse of the sand waste would be considered for making concrete and paving materials construction fill and so on. Now say the sand can be re used in the foundry, but not infinitely only for a certain times the sand can be reused after that that sand will be the moulding sand or the core sand will be useless then what to do they will be they used to discard that sand.

Now instead of simply discarding that sand outside the town or outside the city which causes pollution. So it can be what say used for making concrete or for paving materials construction fill and so on so they can be utilized in this way and you see here:

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The foundry wastes sand is dumped on the road side and it is looking very awkward and it is causing pollution to the atmosphere and also to the environment and also it doesn't look good in for the city appearance. So, this what say waste sand can be used for the construction purposes.

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Now, under this solid waste let us see the slags from the furnaces: First one is the what; say foundry sands so they contribute to the maximum percent of the solid wastes from the foundry. The next solid waste is the slags from the furnaces; slags constitute about 25 percent of the total sand wastes.

Slags can be handled in the following ways: Lower the melting temperature, then what will happen minimum slag will be created. Next one optimization of fluxes and refractory lining, we use the fluxes most of the times we use what say too much of flux because of that reason means which is not required so much of slag will be generated. So, the use of flux must be optimized. The best use found is its blending in the portland cement and roadway buildings. So, these slags can be used in the portland cement also for the construction of the roads and buildings so that way these slags, these wastes can be utilized so, that they wont to do any harm to the environment.

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Here you can see this is a dump of foundry slag. What they do? Simply after these slags are what say generated maybe a big stock will be there they use to dump it in a truck and they take it outside the city there you they used to dump and this causes pollution to the environment. So, this can be utilized for the construction purpose or for making the roads. Next one refractory wastes under the solid wastes.

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Sludge from the wastewater treatment may contain heavy metals like lead, zinc, chromium, oil and grease. Next one let us learn about the wastewater, how to handle the wastewater?

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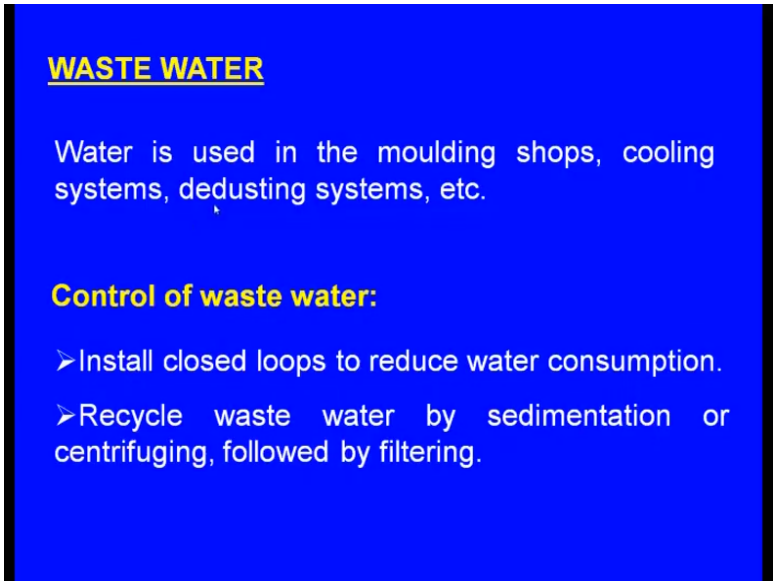

Water is used in the moulding shops, cooling systems, dedusting systems and so on. In the molding shops we use the water and in the cooling systems we use the water, dedusting system we use the water, at every stage water is polluted. Now control of wastewater install closed loops to reduce water consumption. Next one recycle waste water by sedimentation or centrifuging, followed by filtering.

First we have to do the sedimentation means this waste water which is mixed up with the impurities will be kept idle in a tank then what will happen all the what; say dust will be settled down so that is the sedimentation so the what; say water without any impurities will be taken out. Next one centrifuging, centrifuging means what so because of the centrifugal force all the what; say impurities they will be collected at the centre. So, they will be removed and finally we have to do the filtering.

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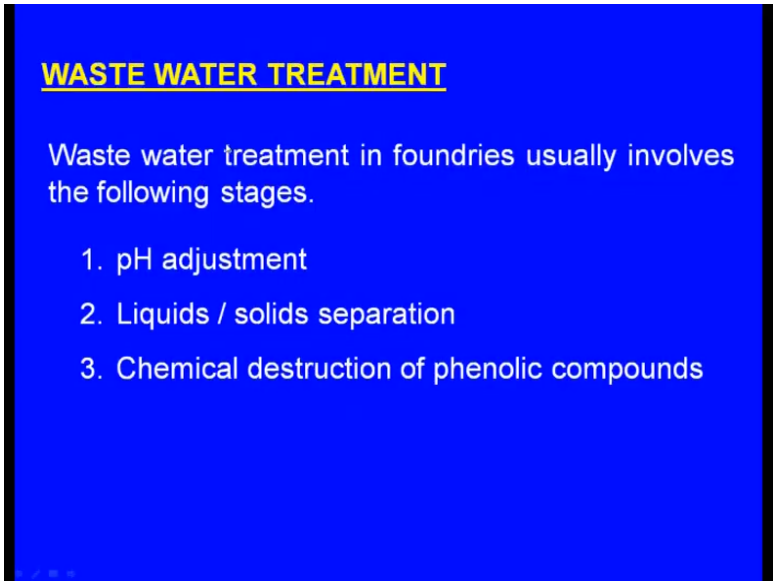

Now let us see the waste water treatment. This is very important wastewater treatment in foundries usually involves the following stages one is the pH adjustment liquids, solids separation and finally chemical destruction of phenolic compounds.

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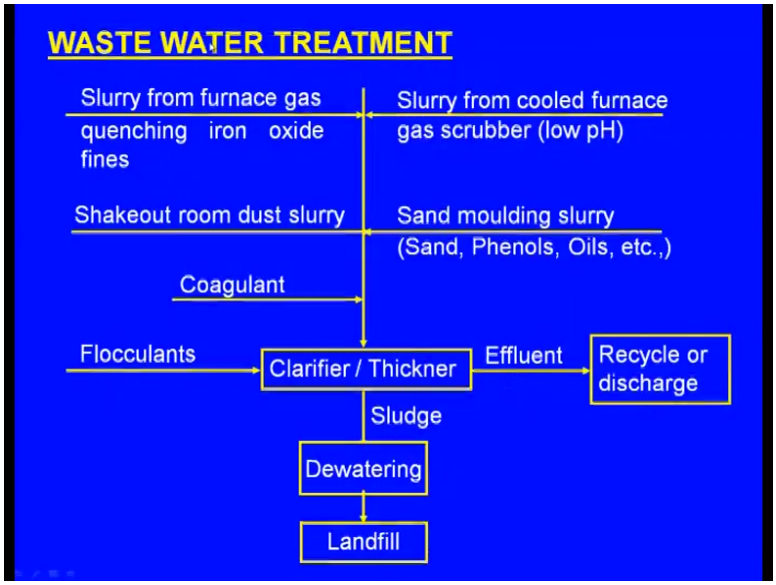

Now so this is the what; say wastewater treatment what say sequence and here we can see

slurry from furnace gas and it is coming like this quenching iron oxide fines, next one slurry cooled furnace so they will be coming like this. Next one shakeout room dust slurry from there also water will be coming out, next one sand moulding slurry that slurry we which includes water will be coming here. Now this is the coagulant which breaks them, next one flocculants and here we can see clarifier, thickner and here we can see effluent recycle or discharge.

Next one it is a sludge finally we can see this is a dewatering and landfill so this is the way that waste water has to be treated. So, far we have seen under the environmental issues: Air emissions we have seen, Solid wastes we have seen, Wastewater treatment we have seen. Next one the last factor which contributes to the environmental pollution is the Noise pollution.

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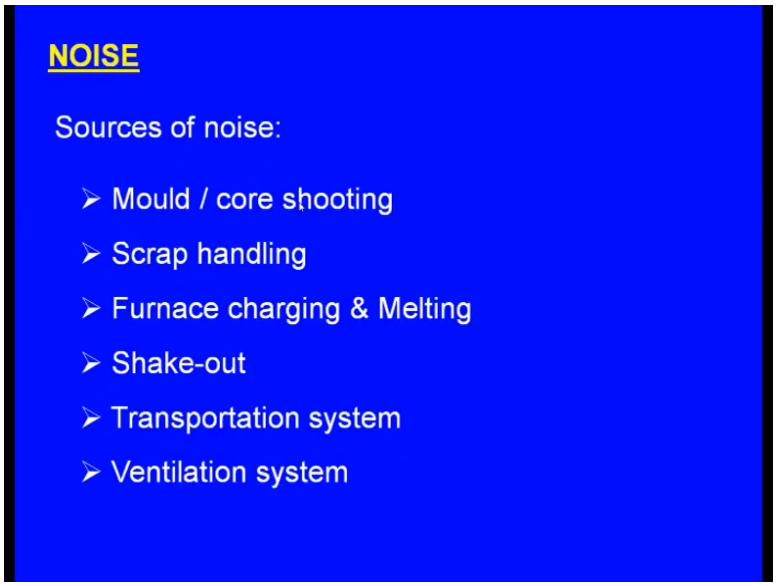

Sources of noise: What are the sources of noise? Mould core shooting, scrap handling, furnace charging and melting, shake-out, transportation system, ventilation system.

In the mould and core shooting we use the sand mullars right and we use the core boxes so lot of noise is generated. Next one scrap handling, so scrap will be received from somewhere else and it will be transferred and it will be handled so that time lot of noise is

generated. Furnace charging means we take the metallic pieces and dump inside the furnace that time lot of noise is generated. While it is melted that time also noise will be generated because of the operation of the furnace.

Next one shake out what is this after this solidification is over we break the mould and take the casting outside that time there will be noise and the castings will be what say shipped that time means transportation system that time also there will be noise will be there. Next one ventilation system there will be ventilators will be there and these will be operating and because of that there will be noise so all these factors. In fact, these are the important factors there will be many more factors which will be contributing to the noise pollution.

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Noise management techniques: First one is enclose the process buildings, cover and enclose scrap storage and handling areas. Also shake out and fettling areas. Implement management controls, including limitation of scrap handling and transport during night time.

Enclose the process buildings means the process buildings should be enclosed so that less noise will be coming out. Cover the enclosed scrap storage and handling areas lot of noise

is generated from the scrap storage and the handling areas so this must be enclosed and this must be covered and also the shakeout and fettling areas.

Now implement management controls including the limitation of scrap handling and transport during night time, so this scrap handling and transport should be avoided during night time because if it is done during night time it what say causes lot of what say disturbance to the people who are around the foundry industry so this must be minimized. So, far we have seen say the environmental issues and the factors contributing to the environmental pollutions.

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Now, let us see the health and safety aspects, the health and safety aspect in a foundry is very important the health of a what say worker working in foundry is very important. At the same time health is important safety is also very important unfortunately the foundry in the inside the foundry industry especially a what say sand casting industry health may not be very good all the time there will be pollution will be there and there is a risk of accidents will be there inside a casting industry. Now let us concentrate on health and safety aspects.

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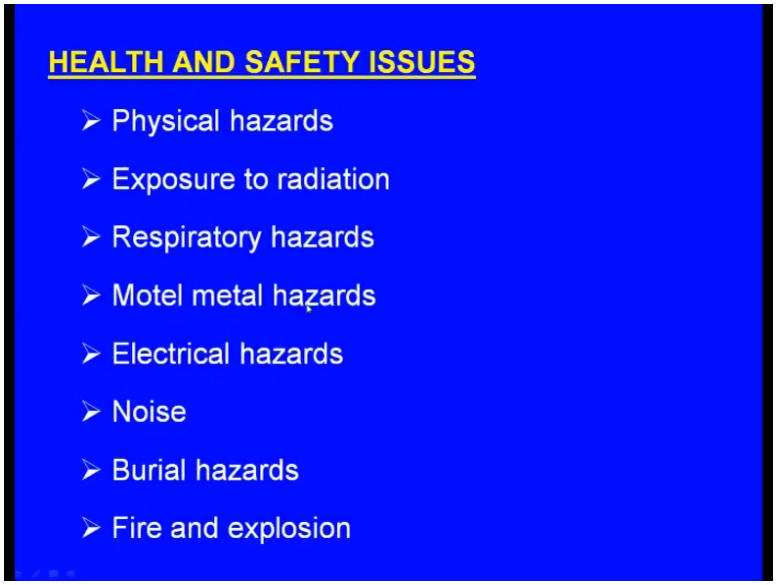

Now, what are the factors contributing to the health and safety issues: One is the physical hazards, second one is the exposure to radiation, third one is the respiratory hazards, fourth one molten metal hazards, next one electrical hazards, next one noise, next one burial hazards and finally we have the fire and explosion. Now we will see all these one by one how they could takes place and how to control them.

Physical hazards:

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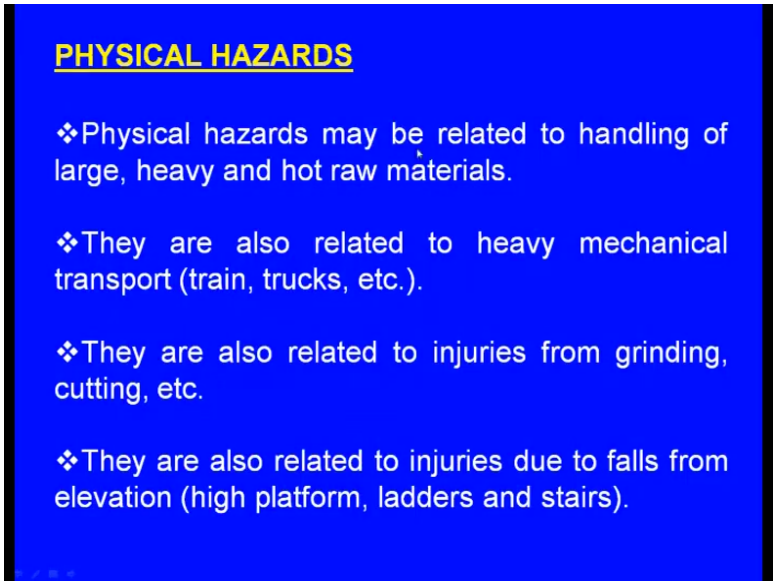

Physical hazards maybe related to handling of large heavy and hot raw materials. They are also related to heavy mechanical transport train trucks and so on. They are also related to injuries from grinding cutting and so on. They are also related to injuries due to falls from elevation, sometimes it is possible that a worker will be working at an elevated place and suddenly without his knowledge accidentally he may fall down. So, all these contribute to physical hazards.

Next one exposure to radiation:

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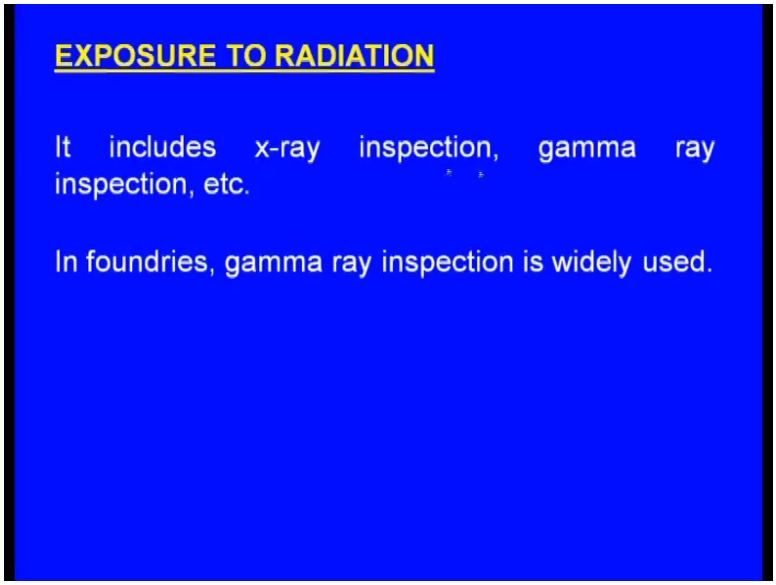

It includes x-ray inspection, gamma ray, inspection and so on. So, we have to test the castings this so these are the non destructive testing methods. So, in these non destructive testing methods we have the x ray inspection and also the gamma ray inspection. So, these are very harmful for the operator.

See if these x-ray what says are what say not controlled properly. So, this could cause lot of harm to the operator same mistake is with the gamma rays if this gamma rays are not what say controlled properly and if enough what say security measures are not taken they could cause lot of what say harm to the operators and also to the workers working surrounding the that system. So in foundries, gamma ray inspection is widely used rather than x ray inspection.

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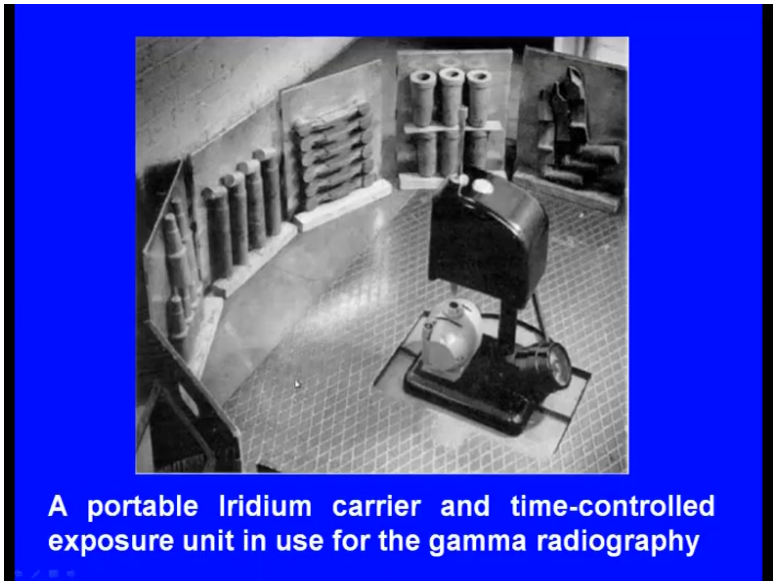

Now, here we can see a portable iridium carrier and time control the exposure unit in use for gamma ray radiography and here we can see this is the gamma ray what say set up through which gamma rays will be coming out radially in all directions and here these are the different castings you see. So, these are all the different castings they are kept around the set up because radiation will be coming out in all the directions. Now behind this castings there will be x-ray film will be there so this is the somewhere here the x ray film will be kept. So, if there is any defects inside the castings so that will be revealed in the what; say x-ray film in the what; say radio graphic film. Now the what; is the risk? Risk is if this what say area is not what say enclosed properly if it is not covered properly. So, this can cause lot of risk to the people who are working surrounding this area and also if the intensity of the gamma rays is not controlled properly that time also it could cause what say harm to the operators.

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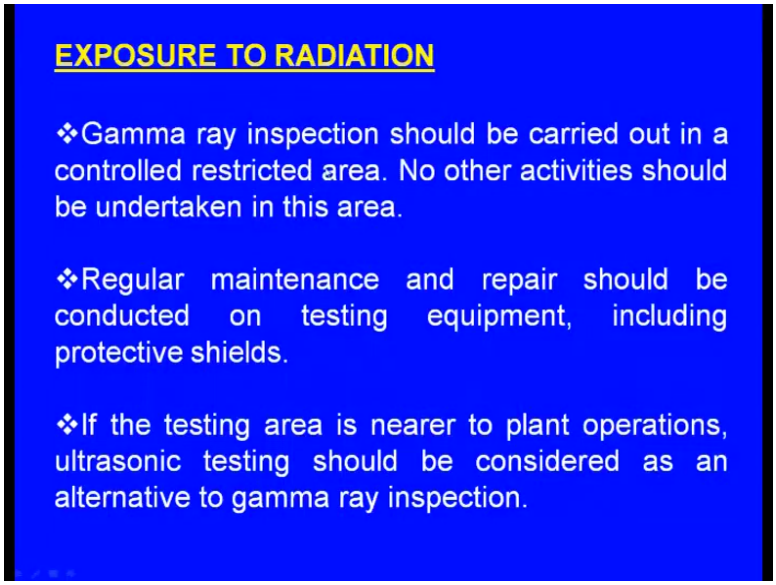

Gamma ray inspection should be carried out in a controlled restricted area this is most important it should be never carried out in a open area never and never. No other activities should be undertaken in this area.

Next one regular maintenance and repair should be conducted on testing the equipments including protective shields. If the testing area is nearer to plant operations, ultrasonic testing should be considered as an alternative to gamma ray inspection. So, this gamma ray inspection what say set up and that area should be isolated from the other sections of the industry and if it happens to be what say close to the sections. So, we should not use it instead of using the gamma ray inspection we can go for the ultra so what say ultrasonic testing. So, this is another what say good alternative for the gamma ray inspection.

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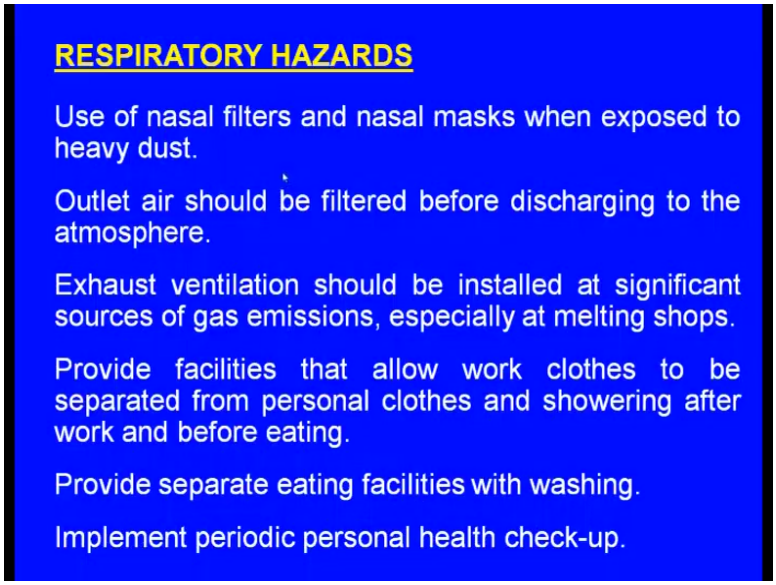

Next one respiratory hazards use of nasal filters and nasal masks when exposed to heavy dust especially when we are preparing the moulding sand we prepare the what; say mix the what; say additives coal dust and so on. So, this could cause a lot of what say respiratory hazards so that time the operator has to use nasal filters or the nasal masks. Outlet air should be filtered before discharging to the atmosphere. So, the first one gives protection to the operator, the second one gives protection to the people who are leaving around the industry. So, outlet air should be filtered before discharging to the atmosphere.

Exhaust ventilation should be installed at significant sources of gas emissions especially at melting shops. Provide facilities that allow work clothes to be separated from personal clothes and showering after work and before eating now so this is regarding the personal hygiene of the workers.

So when the workers come so they should be given what say separate what say dresses uniform for the workers while they are working in the industries. So, that is the they should be there what say official clothes should be separated from the personal clothes. So, means there should be someplace where they can exchange a what say their clothes.

So before entering into the duty so they have to change their duties and what say they

have to change their cloths, they have to leave their personal clothes and what say put them inside maybe an Almirah right or maybe a locker then they have to wear the official clothes and after completing the what; say official duty they have to wear their personal clothes and before wearing their personal clothes there should be a provision for showering to take a bath not only that in between if the what; say there is a lunch break. So, there should be what say provision so that they can watch themselves there should be a showering facility after the work and also before they eat.

So, these are related to the personal hygiene of the worker. So, this will minimize the respiratory hazard to a great extent. Next one provide separate eating facilities with washing in most of the industries this we can't see so while the work is going on one side they will be standing and they will be eating so this is not good. So, there should be a separate place for eating and there should be washing facilities must be there so that they will be cleaning their hands thoroughly. Next one implement periodic personal health checkup so this is very important how is their health do they have any respiratory problems or not so this must be checked periodically.

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So, these are the Nasal filters you see so these filters can be inserted inside the nostrils.

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And this is the nasal mask, so using this we have to cover our nose. Next one molten metal hazards.

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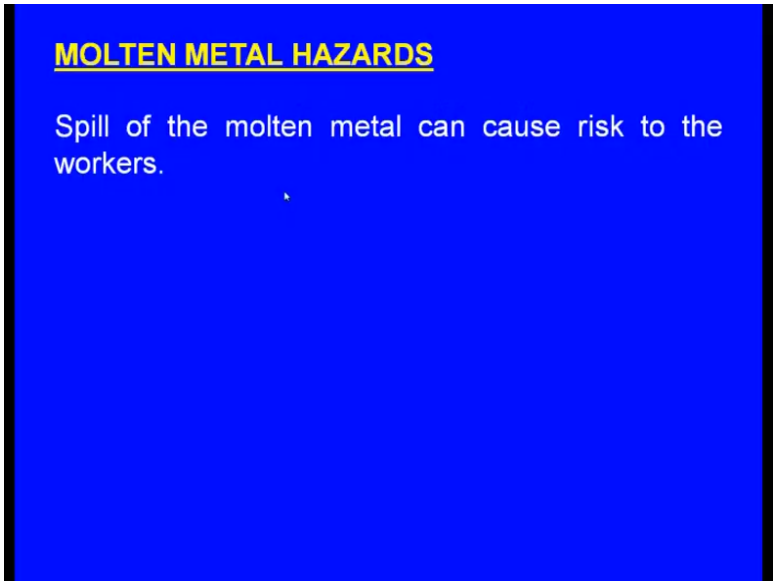

Spill of the molten metal can cause risk to the workers.

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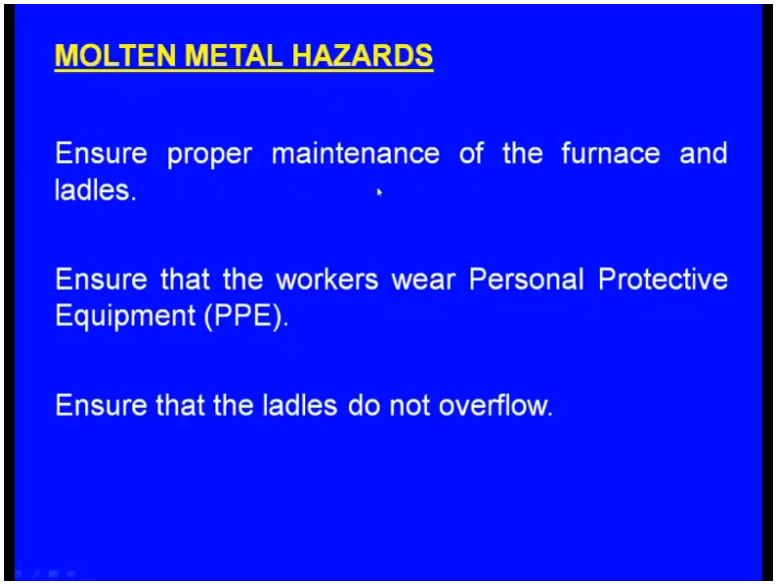

Ensure proper maintenance of the furnace and ladles sometimes if the furnaces are maintained not maintained properly suddenly there will be a leak and molten metal will be spelling. So, that is why ensure proper maintenance of the furnace and ladles. Ensure that the workers wear personal protective equipment PPE. So, this will give you a protection against the molten metal spills, even if the molten metal spills on their bodies or on their cloths so this personal protective equipment would protect them. Ensure that the laddle does not overflow. Ladle should not overflow always there should be some gap should be there.

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Now you see here you can see the ladle is overflowing that should not happen.

Next one electrical hazard:

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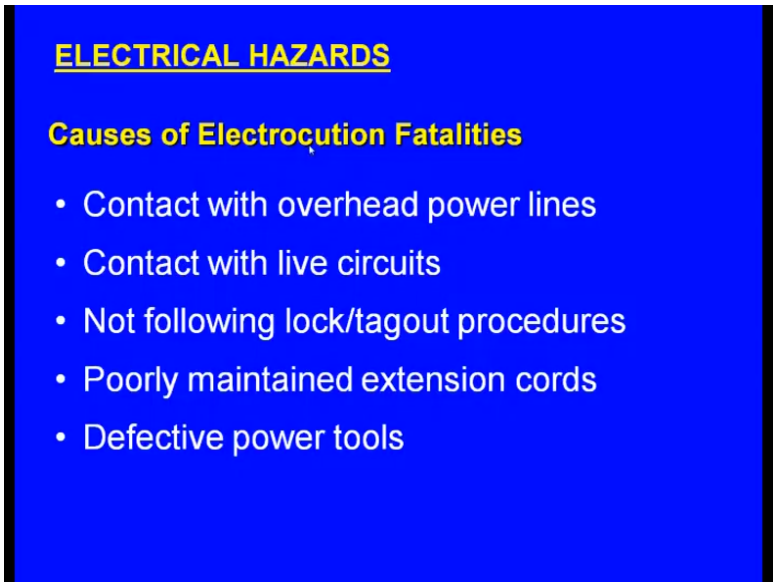

Causes of electrocution fatalities, contact with overhead power lines so this is the first

cause. Contact with live circuits not following lock tagout procedures poorly maintained extension cords defective power tools contact with the overhead power lines next one contact with the live circuits most of the workers they used to work without what say switching off the main so which may not be good. Not following the lock tagout procedures and poorly maintained extension cords. Sometimes they used to use the what; say extension cords for some application. So, this what say extension cords may have leakages.

So, these cords must be checked thoroughly before using them.

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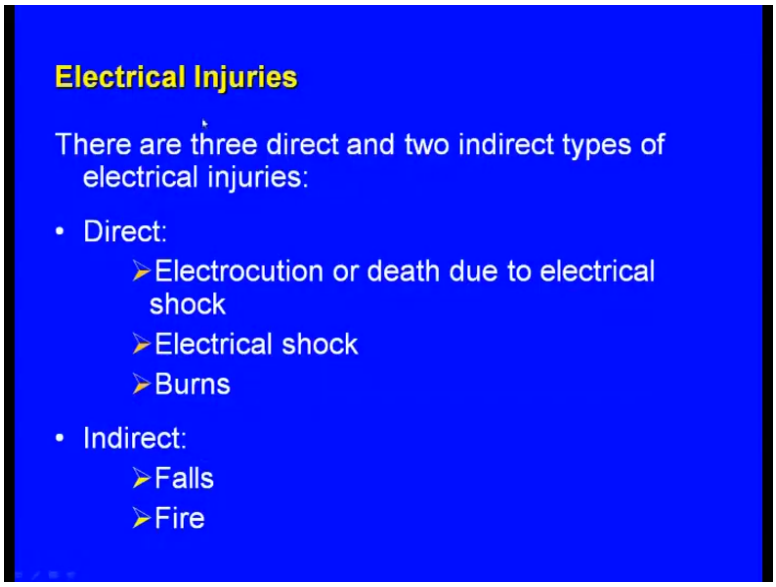

Now, these are the electrical injuries, injuries there are three direct and two indirect types of electrical injuries: Under the direct one electrocution or death due to electrical shock. Next one electrical shock means without death next one is the burns indirect is falls the what; say person may fall down another one is the there may be a fire accident. So, these are the electrical injuries, injuries direct or indirect.

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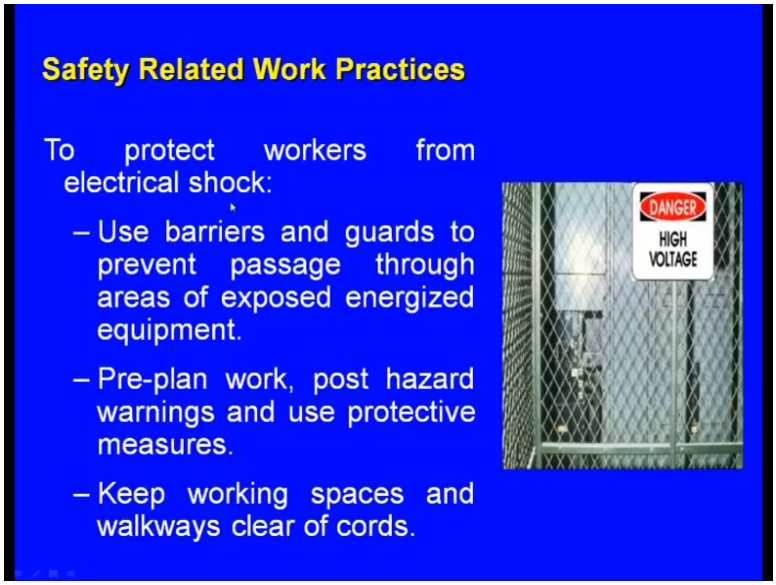

Next one safety related work practices to protect workers from electrical shock what are the measures we need to take use barriers and guards to prevent passage through area of areas of exposed energized equipments so there should be some barriers so that people won't go and touch the harmful electrical what say equipments. Pre-plan work post hazard warning and use of protective measures, next one keep working spaces and walkways clear of the cords if there is a what say heavy current is flowing through some cables there should be enough what say working space must be there people should not go close to that that is very important.

Now here we can see.

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A damaged cord you see and here we can there is a leakage is there you see here we can see the core wire. So, these kind of cords could cause what say electrical accidents and injuries.

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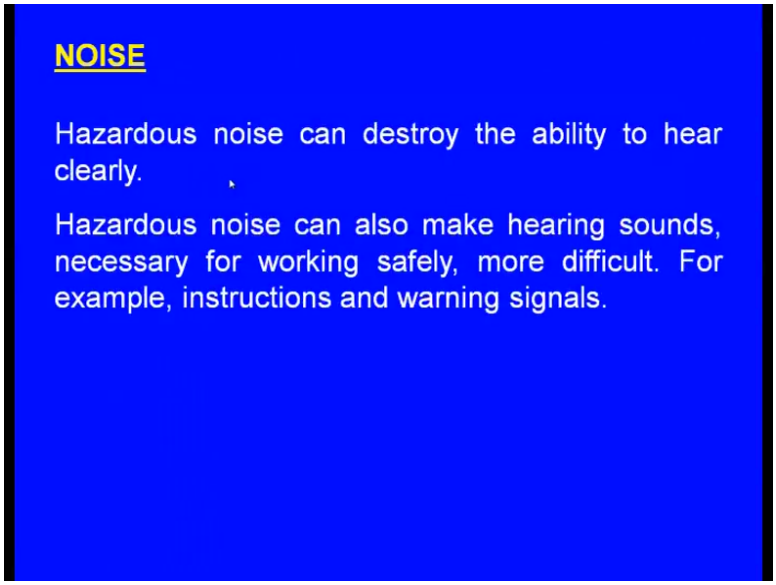

Next one noise hazardous noise can destroy the ability to hear clearly hazardous noise can

also make hearing sounds necessary for working safely more difficult for example, instructions and warning signals what will happen if there is too much of noise what say pollution the it may what say destroy the hearing ability of the operator that is one thing. If there is so much of noise will be there sometimes the higher official will be telling something to the worker the worker is not in a position to listen what the official is telling why this is happening because there is too much of noise pollution is there. So, that is why the noise is very harmful what say for the personal wise and also as for as the work is concerned.

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Now, noise level produced at various shops of the foundry and here we can see hand ramming we can see 92 to 97 DB. Moulding machines 90 to 115, sand slingers 90 to 95, shakeout 105 to 115, shot blast booths 100 to 110, chipping and grinding lines 95 to 115, hopper vibrations 95 to 115, man cooler fans 90 to 95 DB.

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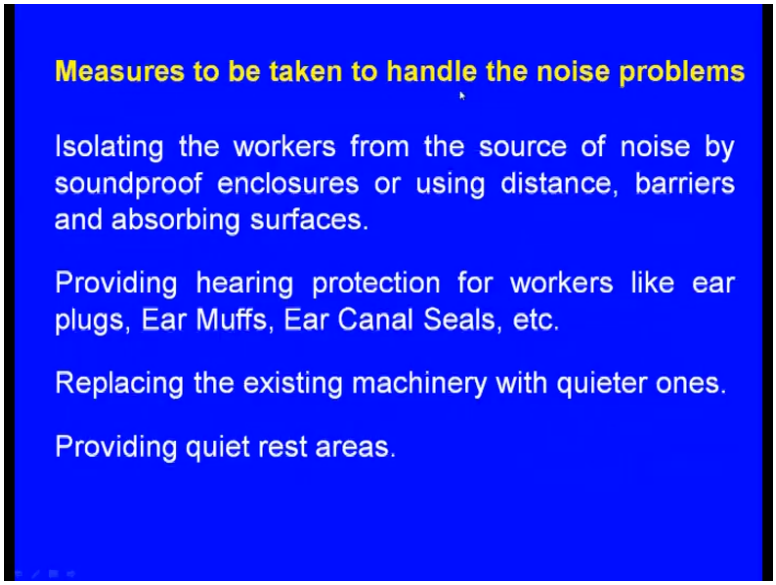

Measures to be taken to handle noise problems: Isolating the workers from the sources of noise by sound proof enclosures or using distance, barriers and absorbing surfaces. Providing hearing protection for workers like ear plugs, ear muffs, ear canal seals and so on. Replacing the existing machinery with quieter ones providing quiet rest areas so these are the measures to be taken to handle the noise problems.

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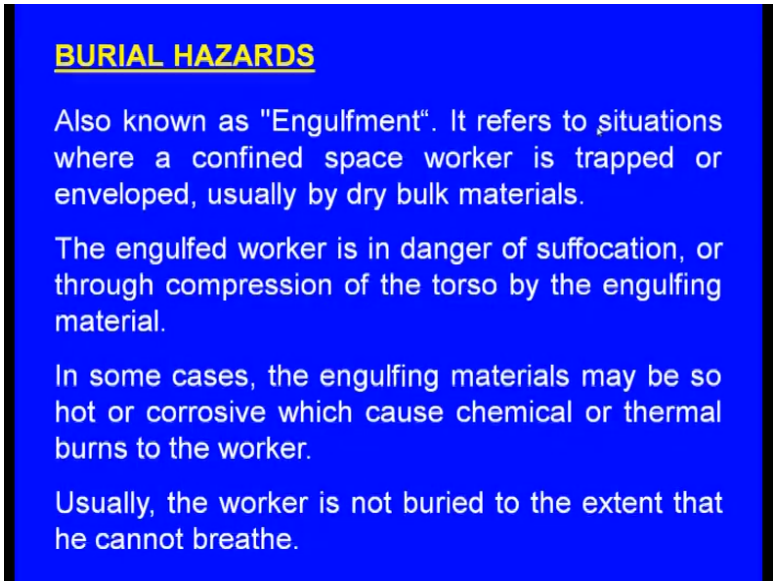

Next one is the burial hazards what is this also known as “Engulfment”. It refers to situations where a confined space worker is trapped or enveloped usually by dry bulk material maybe he is working somewhere, maybe there may be a sand lamp is there sand lump is there suddenly it falls on him.

So, he will be what say surrounded by the sand, most of the times he may not die but he will be buried up to the neck to that extent he will be buried so this is the burrial hazard. The engulfed worker is in a danger of suffocation or through compression of the torso by the engulfing material. So, this engulfing material will be surprising him compressing him in some cases the engulfing materials maybe so hot or corrosive which cause chemical or thermal burns to the workers or sometimes if the what; say if the material is cool they what say compress his body. Sometimes the material is maybe hot sand then what will happen it causes what say injurious to the worker. Sometimes these material maybe corrosive in nature then further it causes further damage harm to the worker. Usually the worker is not buried to the extent that he cannot breathe. So, this is the burial hazard.

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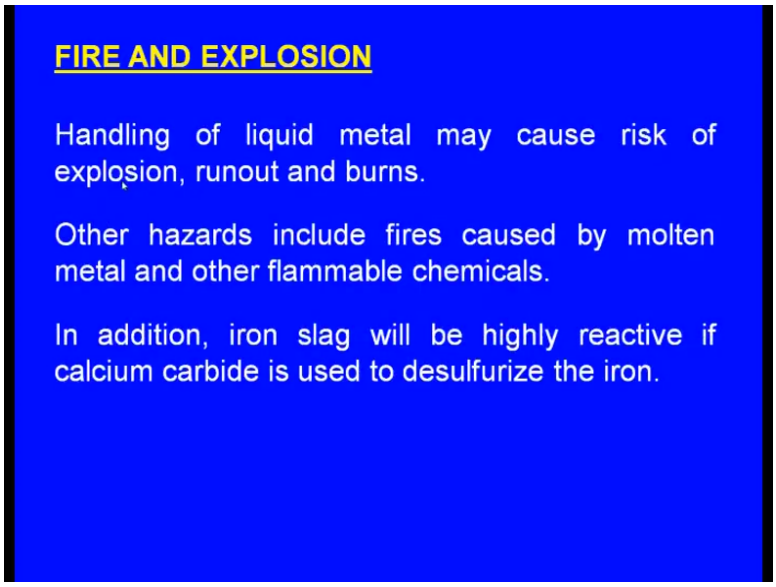

Next one fire and explosion so this is another what say difficult situation handling of liquid metal may cause risk of explosion, run out and burns. Other hazards includes fires caused by molten metal and other flammable chemicals. In addition, iron slag will be highly reactive if calcium carbide is used to desulphurise the iron. So, fire and explosion is also a

what say risk in the foundry so this should be handled very carefully.

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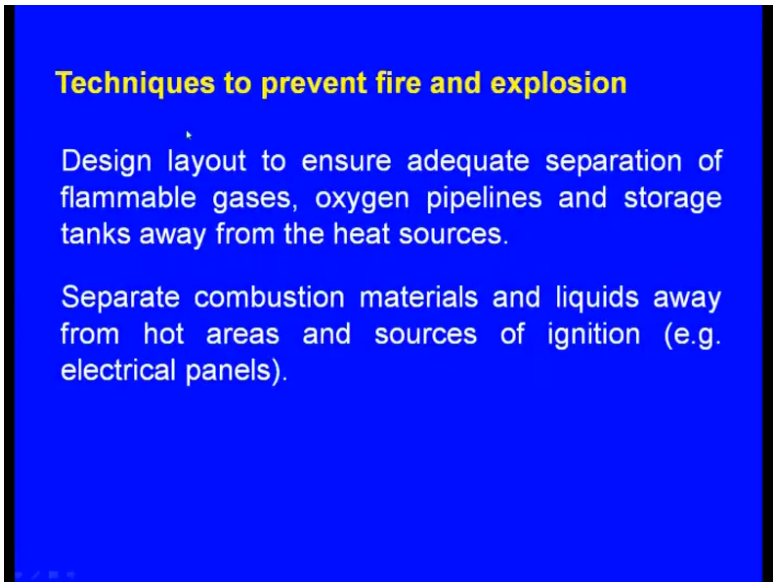

Techniques to prevent the fire and explosion: Design layout to ensure adequate separation of flammable gases, oxygen pipe lines and storage tanks away from the heat sources, next one separate combustion materials and liquids away from hot areas and sources of ignition example electrical panels. So, these are the few techniques to prevent fire and explosion.

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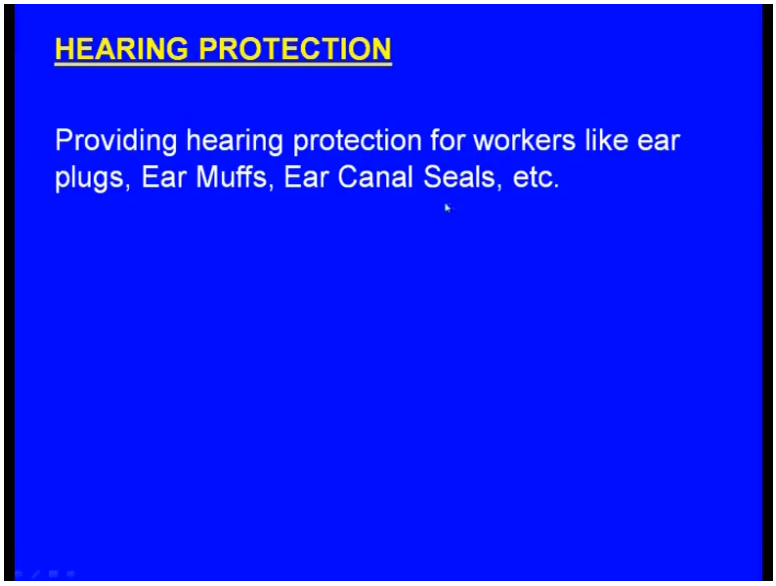
Now, finally we will see the protective measures to be taken in a foundry: One is the hearing, protection second one is the head protection, third one is the eye and face protection, fourth one is the hand protection, fifth one is the foot protection and finally the protective clothing. (Refer Slide Time: 41:18)



Now hearing protection you see providing hearing protection for workers like ear plugs, ear muffs, ear canal seals and so on. So, this kind of what say equipments will give what say hearing protection to the workers.

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And these are the ear plugs, the ear plug looks like this. Now these are the ear muffs so this give what say protection from the what; say noise.

Head protection:

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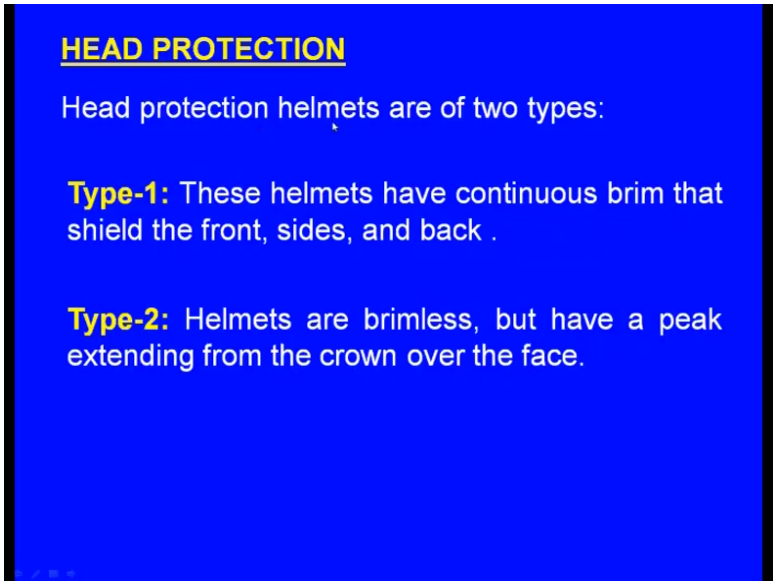

Head protection helmets are of two types: you see type 1 and type 2. In the type one these helmets have continuous brim that shield the front sides and back. In the type two helmets are brimless but have a peak extending from the crown over the face.

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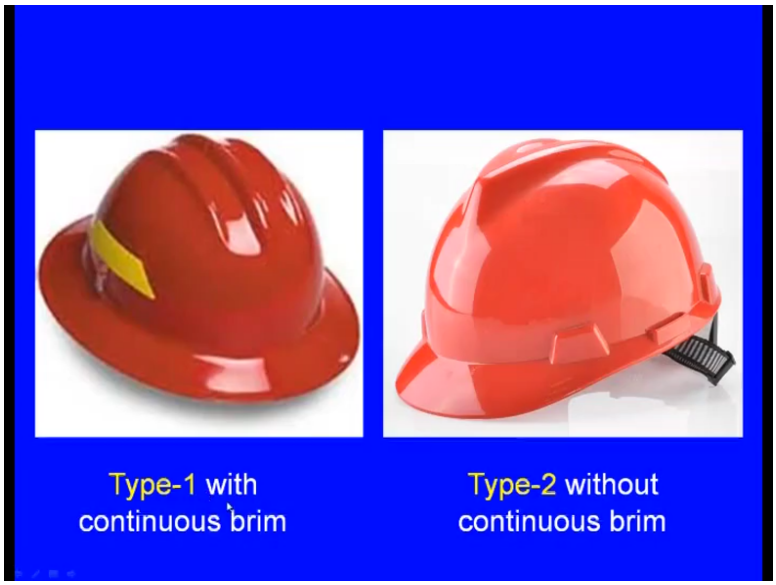

So, you see these are the type 1 helmets with continuous brim this is the type-1. So, this is the type-2 helmets without continuous brims, but they are only extending from the top up to the face like this eye and face protection.

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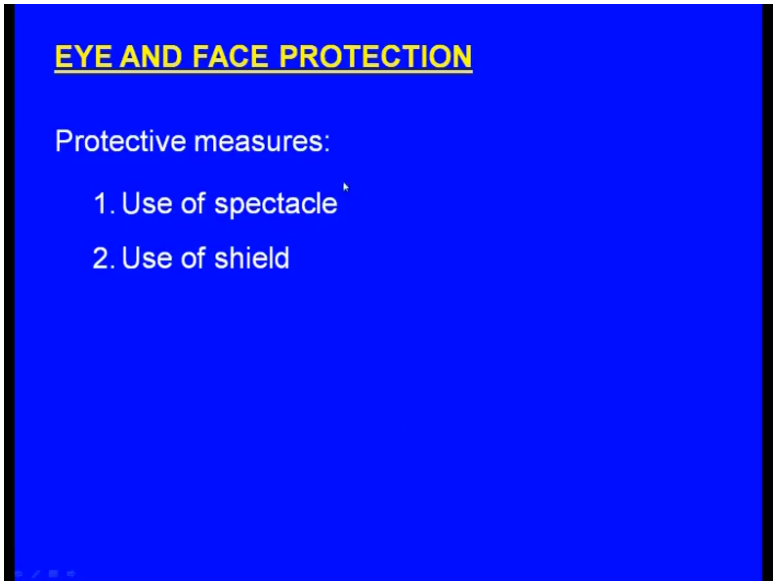

Protective measures: One is use of spectacles and use of shields. So, these two what say measures will give protection to the eye and face, one is the spectacle, use of spectacle it gives protection to the eyes and shield use of shield it gives protection not only to the eyes but also to the entire face.

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Now, you see these are the hand protection, for hand protection one has to use the gloves. So, use of gloves will give protection to the hand of the worker.

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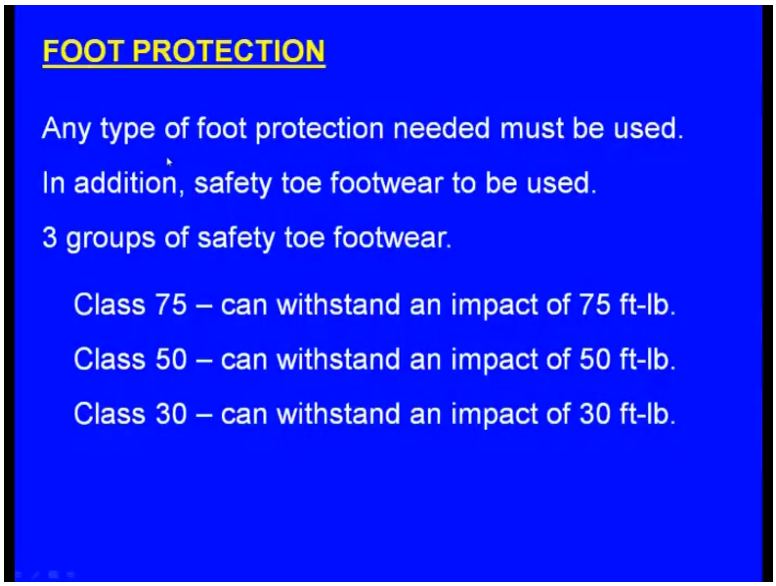

Foot protection: how to protect the feet of the workers. Any type of foot protection needed must be used. In addition, safety toe footwear to be used. 3 groups of safety toe footwear are one is the class 75, class 50 and class 30. Class 75 can withstand an impact of you see 75 feet lb and class 50 can with stand an impact of 50 feet lb and class 30 can with stand an impact of 30 feet lb.

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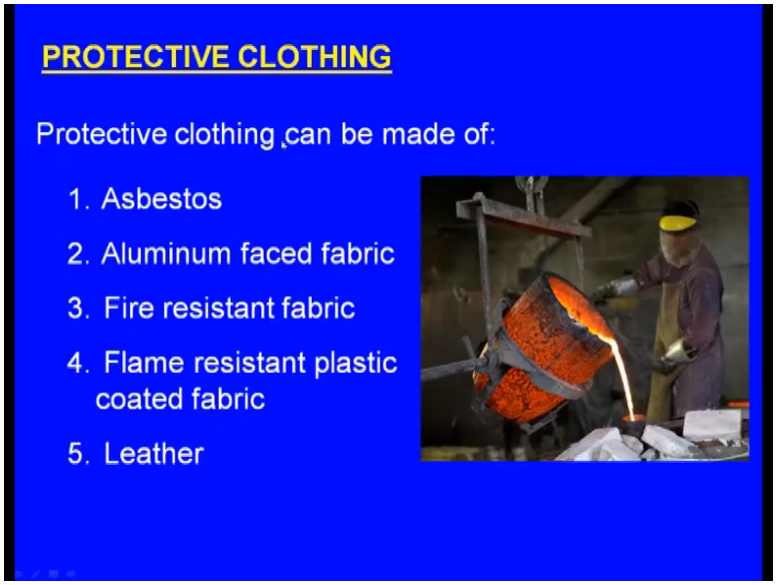

Next one: Protective clothing this is very important especially at the melting place. Protective clothing can be made of one is asbestos, aluminium faced fabric, fire resistant fabric, flame resistant plastic coated fabric and leather. You see here the worker is using protective clothing. So, he is handling with the molten metal and he is tapping the molten metal from the ladle so he is safe. So, this way the worker can be given protection from the molten metal hazards now in this lecture.

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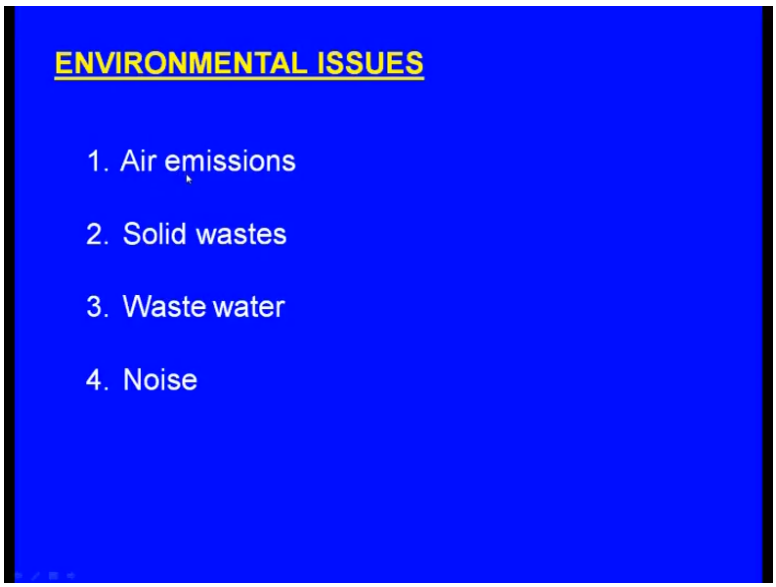

We have learnt about the environmental issues. We have seen the air emissions, we have seen the solid wastes, water waste and noise pollution and we have seen the factors contributing to what say whether it is air emission, solid waste or the what; a waste and so on and also we have seen how to minimize them and how to control them.

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Then we have seen the health and safety issues, physical hazards, exposure to radiation, respiratory hazards, molten metal hazards, electrical hazards, noise, burial hazards, fire and explosion. And how to what say take care of with these what say issues we have seen.

So, with this friends we are completing this lecture the environment and health issues not only that we are completing this whole course the metal casting. So, with this we are completing this lecture. So I am available at this address, I am working with the Mechanical and Industrial engineering department my name is Dr. D. Benny Karunakar. So, I am in the Indian Institute of Technology, Roorkee. So, this is my email address bennyfmeatiit or dot er net dot in. So, if you have any doubts in any of these lectures that I have delivered you can always contact with me. So, I shall reply you with my answers. So, thanks for listening to my lectures.

Thank you.