Bulk Material Transport and Handling System
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Lecture - 10
Safety and Troubleshooting

Welcome back to our discussion. Now, in the last few classes, we have introduced the bulk material handling system and then belt conveyor. Now before going to the design and calculation of belt conveyor let us discuss some safety and troubleshooting aspects of this belt.

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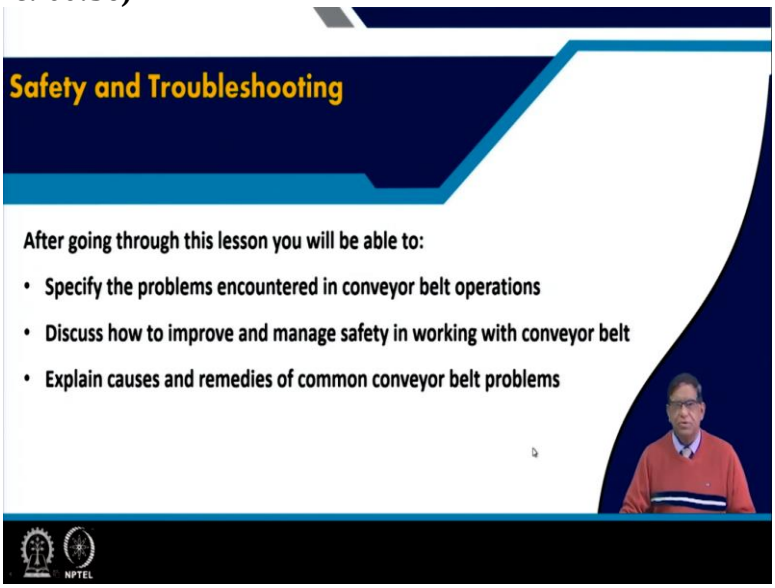

Now, after going through this lecture, you will be able to specify the problems encountered in conveyor belt operations, because, while designing a new installation, we will always need to see that it runs trouble free so, what type of problems may come if we do not design it properly should be understood well now discuss how to improve and manage safety in working with conveyor belt.

Whenever you were working in bulk material handling system, exactly a huge quantity of materials is being handled. So, you will need to be very careful about the safety aspects of the people working on the equipment which are deployed there. So, their well being is also very important. So, you should be able to explain the causes and remedies of common conveyor belt problems. So, that after this class, if you are going to see any installations you will be able to feel what exactly needed and so, you will be thereby getting carrier ready for such type of operations.

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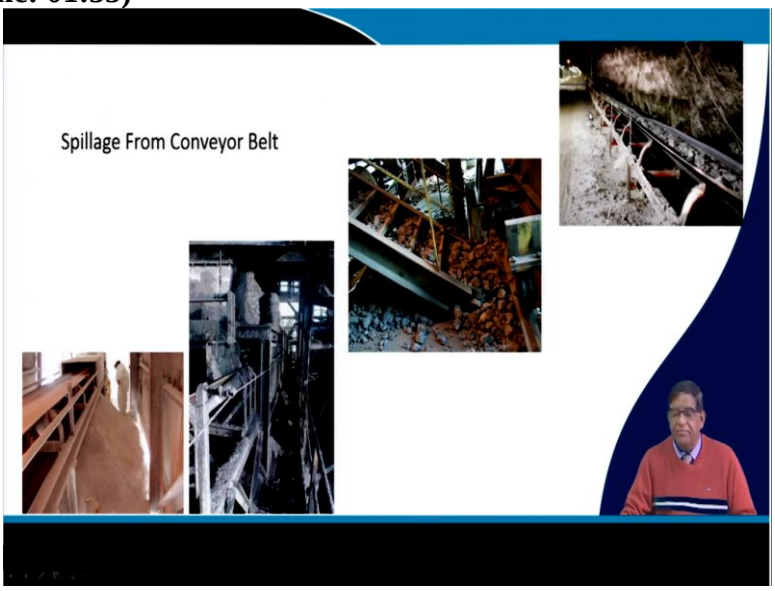

Now, one thing is that if you have not seen any conveyor installation yet, these pictures will say you something here you can see in the first figure that is, there are a lot of spillage material you can see at the side of it similar type of figure that is in the second figure you can see the accumulated mass it is not like that let us say for months it is not cleaned like that such type of things happen within a single day of operation.

If your systems are not properly maintained or the design is not proper, sometimes from the conveyor belt material may come and fall now, at the time of this falling if any person is working on this staircase, you can easily think what may happen. So, all along the conveyor belt sometimes even in underground or even in opencast mines or anywhere you will find that this lot of spill has come on to this. So, that means the belt was swinging over here and then the material have fallen all along this line.

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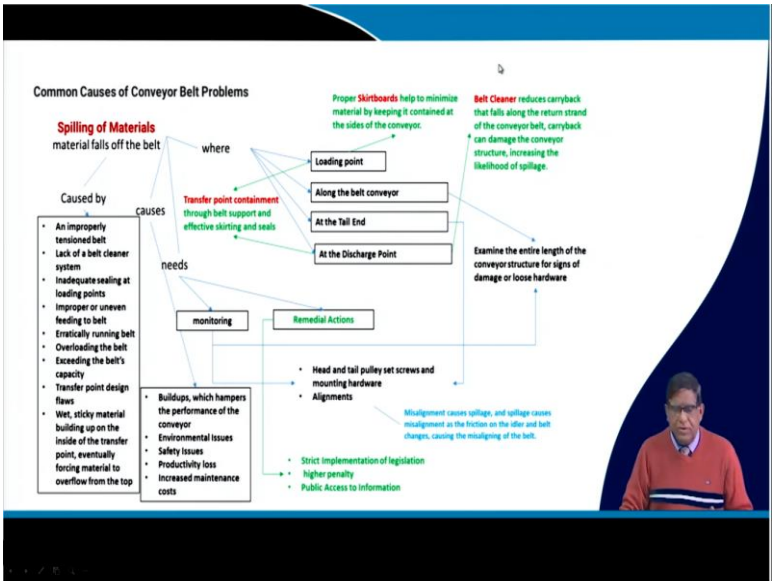

So, such type of problem that is a spillage is one of the very big problems in this conveyor belt. Now, let us see some of the common causes of conveyor belt problems, we will be discussing few things over here with this approach say we are taking any problem to consider say for here we are taking the spillage problem. Now, this spillage problem that is materials are falling out of the belt.

That is a where you want to discharge instead of getting a discharge there some part of it is getting discharged anywhere that is the spillage. Now, for that we need to know it is a what has caused such type of problem and then what it causes that is what is the impact of such type of problem and where such problem may come? If you see that in the figure you have seen that spillage it may come in the loading point it may be there at the your along the conveyor belt it can be at the end or that is your tail end.

And the opposite side or it can be at the discharge point where you are discharging material at different locations. Now, when such things happen, their remedial actions at different locations will have to be different, but you need to know what has caused such type of problem. Now if the belt tension is not proper and improperly then some belt can lead to a spillage because it will be somewhere loose and then it may be that your traffic idler it may jump and then there could be material will fall down.

Now, there is a belt cleaning system you have seen in the constructions that when the discharge belt is there and that discharge point outside a belt cleaner is there which is exactly rubbing off whatever the material is sticking to the conveyor belt carrying sight. Now, if that

is not separated, when this return belt is moving, it is interacting this in the return side, the carrying side of the belt is touching the idlers.

Now there, whatever the sticking material is there, it we will get to exactly rubbing those idlers and all along your conveyor belt return side the material will be falling down then there is a at the loading point you have seen in that skirtboard, there is a chute and that is skirtboards. Now, this thing is not properly covered. And as a result what may happen while you are discharging onto the conveyor belt at that time material may go sideways.

So, you have seen that how in this skirtboard you have got the skirtboard rubber itself adjustable and you maintain a seal between the skirtboard and the conveyor belt. So, if that is not properly working, you will be getting spillage at the discharge point. So, exactly by knowing where the spillage is taking place, you should be able to find out that where from the problem is coming.

Similarly, there could be the belt is running very erratically. That means if it is sways maybe your whole along the belt supporting structure that supporting structures may not be properly aligned. So it will be running with a lot of sway or there could be you have given more load onto the conveyor belt, you always will see that whenever it troughing belt is there, that the material should not be up to the brim there should be at the end some and clearances are there.

So that the cross section of the material which is under belt should be at the optimal level if you are making it more than that you may be carrying more material, but most of that thing will be getting spillage and other belt problem also will come similarly at the transfer point how have you exactly taking the material from one to the another you may be having chute or sometimes that speed at which it is coming that trajectory which is exactly supposed to give a pulley over there.

So, if your speed is exactly getting a belt is getting over speeding compared to the that particular material, the trajectory of the material will be going and falling and getting the spillage so there even sometimes the problem comes with the weight and sticky material, which is exactly get onto the carrying side and then they may be and so, now you know that what are the common causes of your belt material spillage.

Now if the material is getting that is falling out of the conveyor belt, what it will cause? This is exactly a built-up of those dusty materials. Now, those dusts they will be exactly getting airborne and then when there is an airborne then it will be giving it to the problem of SPM that is Solid Particular Matter in the air will be more and which will be leading to a violation of the environmental rules and regulations.

So that is why you need to be very careful that it does not create an environmental problem, but your another environmental problem is even if it is not getting airborne sticky and other materials are falling and getting dumb, you will find that the aesthetic of the whole area is wet as you have seen in the previous photographs, exactly you will not feel like walking over there. So that is why you it causes an uncomfortable work site conditions and that type of condition is unsafe.

Because if there is a sticky material or that a weight material is falling onto the stair that is your walkways and staircases then what will happen? The person walking over there may slip and fall and then when this getting spilling from a top over that top layer level conveyor belt it may hit the builder may hit a person. So there could be risk of getting injury is increased. And then what will happen you will have to manually clean those things or you will have to give somebody a contract ultimately it will be contributing to your costs.

So as a result what that is your whatever your productivity was there your productivity is reduced by getting that your spilled material which are supposed to be exactly transferred to your destination that is lost and also your cost of production is increased because of the more maintenance work and also sometimes you need to stop the conveyor belt because of clearing this spillages so, at that time your total production loss during that time it is there.

So, that is why the spillage needs to be very carefully considered. Now, for that what is required, you need if there is a spillage of material, your design of the system you need some monitoring and that monitoring can be done by different way that is your you can examine the entire length of the conveyor belt structure for signs of damage and loose that is your structural problem you may have to see and also you will have to see the head and tail end.

So, that means wherever this spillage position is there that will have to be monitored. Now, there comes exactly how will, you do that, that is when you monitor you will be finding that whether this is by a misalignment or that you say the if your misalignment is causing some frictions and then idler damage is taking place. So, these issues can be taken into the monitoring.

Now, how will you do that monitor by deploying a person or you will be going a proper sensors and data acquisition system in this places can be automated. So, that monitoring part it will be very interesting. Now, then what type of remedial actions you will have to do? As a remedial action at different locations you will have to take different type of actions like at the discharge point.

You will have to see that the belt cleaner are properly selected so that the type of material, type of weight of the belt, type of load coming on the belt, the operation hours considering all these things, what type of cleaner will be working so that that whatever sticky material is there on the caring side will be just cleaned over there at the return side itself if required, maybe after discharging the belt may be making is another small distance run.

So that there; all the spillage material can be accumulated. Similarly, at the transfer point you will have to do a very good containment so that exactly dust also cannot go out or maybe that you may have to have a separate dust collecting system over there or your this skirtboard will have to be properly designed so that the spillage do not take place and then other remedial action is you will have to introduce a new system over there.

So all along the conveyor belt you may have say for example, there will have to be sensors and then if more spillage is coming a robot can work over there, collect the material and then put it onto the conveyor belt. So, such type of systems will be there in developed but this can be managed by inducing inducting some penalty if the environmental quality is reduced, then there should be a penalty and in a fear of penalty.

Sometimes that management will do work otherwise, sometimes it is felt that giving such type of additional activities is just costing money, but exactly they are not realising that by proper maintenance a more that in the future you may get better benefit. So that your whatever the regulations and whatever the company directives are there that will have to be

properly followed and that can be ensured if the information get are given access is given to the people so that all the workers or everybody knows that what is the condition.

So that is how spillage problem can be handled. Have you know understood that what is a problem with spillage and how it gets.

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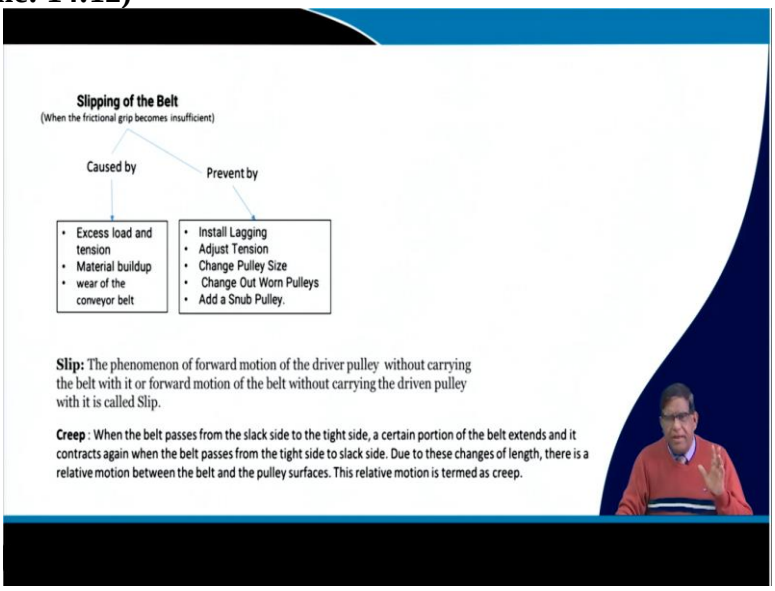

Another thing is that slip of the belt now, what is exactly slip is when you are a conveyor belt slip means the belt is going and taking a turn over your end pulley. Now, exactly that when the belt is moving at that time, whatever that is your linear velocity of at the circumference of the pulley and the velocity of your conveyor belt should be same. But sometimes what happens there is a; that is your driver pulley when it is carrying the belt in a forward motion, the belt without carrying and driven pulley there is a difference of the speed.

If while the belt is coming over to the pulley at that time, belt speed is more than the pulley or quality is going over there at that time if the belt speed is less than the pulleys that your circumferential velocity which is coming over there. Then that is called your slip or we can say sometimes that when the grip is not proper or the proper friction is not there with the conveyor belt and the pulley at that time this slipping is taking place or we can say over there.

That there is a relative motion between the belt surface and your pulley surface that also will be giving a slipping. Now, this is caused by excess load. If you are having a more load onto the conveyor belt and then if there is a material is built up between the belt in the pulley at that time also the conveyor will be slipping or there is wear of the conveyor belt and then you

know that in the pulley there is always a that is a steel pulley at the top of it, there is a lagging called a cover is given.

So, that the friction with the pulley and belt; can be increased for a better power transmissions and to get a better effective tension. And that for that purpose, if that lagging is damaged at the time also there will be this belt will slip. So, you will have to properly maintain the tension in the belt and for that tension is maintained by your take up device that whether it is a gravity take up whether it is a loop take up or whether it is a combination of that. So, these take up systems should be proper then only we are you can prevent such type of slips.

And then your size of the pulley also should be properly matched with the size of the belt and the type of the belt and then if sometimes the pulley is getting lot of it worn out and it is damaged, then also the slip may occur. So you should prevent it over there. And sometimes by providing the snub pulley that is you have seen in the constructions that for the angle of wrap is increased by that also this your slip can be prevented.

So, this another phenomena you should know that is your the belt creep exactly when the belt passes from the slack side to the tight side from the lower side to the opposite when it is going like that, then a certain portion of the belt get extended, because there is a more that it is getting a little bit more tensile strength and it contracts when it is coming from the tight side to going to the slack side it will be getting a little the tensile strength tensile force coming into the belt will be reduced because of this phenomena. There is a relative motion between the belt and the pulley and this phenomena it is called creep.

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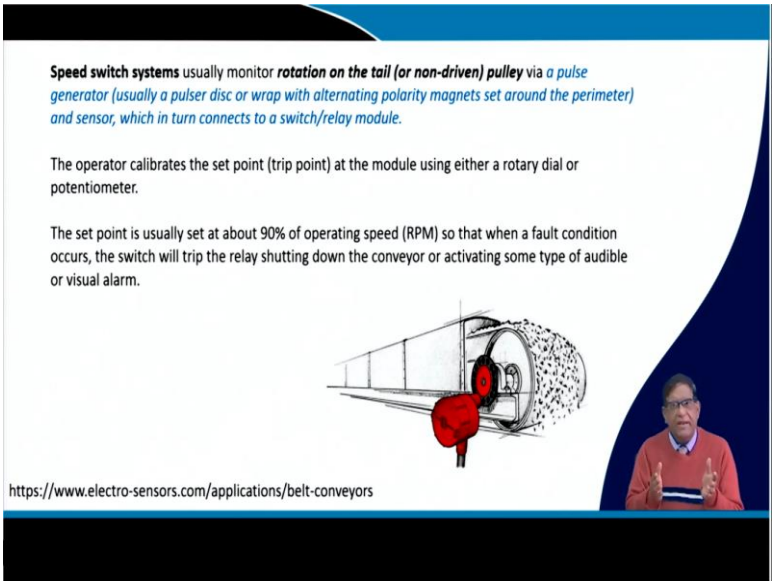

So exactly a proper running or proper maintenance of a belt, we should not have more creep or slip then what is there exactly they say we can monitor this creep or slip by knowing exactly what is the relative motion between the belt and the drum. And then for that, we need to get this pitch switches. What they do, if your both the you are driven pulley and driving pulley, if they are running at the same RPM, then we assure that there is no slip of the belt.

So, for that purpose, what is done, we just sense the speed of that measuring the RPM and if there is a difference is increasing beyond a given capacity and we have given value then that will trip the motor you will check and take care of that slip is the cause of that the region because of which this slip is taking place you rectify that and then you ran it. So such types of devices are there.

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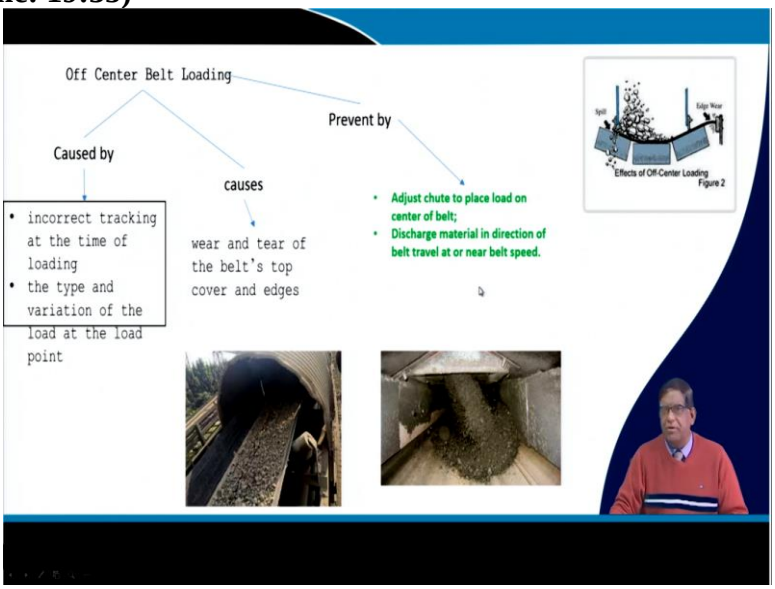

Then, another problem you can see in this figure, that is your material while you are loading at that time it should be loaded at the centre portion from the skirtboard, you can see that the material is coming to the one side and it is also giving to your problem of slipping and then more load is coming means on your edge, there could be a wear over here. So, now this off centre belt loading is often a big problem.

And this is exactly what is called a belt tracking that means belt should be properly aligned earlier also you have said that exactly you should make a perpendicularity of the centreline of the belt and the centreline of the supporting frame should be there. Now, if such type of problem is there that is your material is going into a one side it can cause a lot of wear and tear of the belt.

Because there will be differently loading, differential loading will be coming and for that your job is always to see that the loading point is properly made. That means your chute and that is skirtboard that should be properly observed and you can have a monitoring system because there you cannot go all the time you cannot see over here. So, on the side of this skirtboard, you can keep sensor which can exactly inform you whether the load is getting properly or not these are the area where you can also work.

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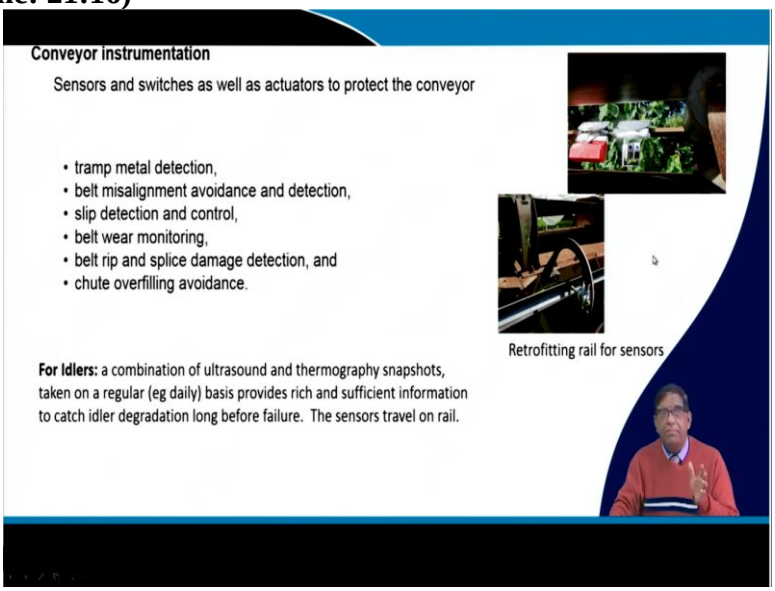

Now, today, there is a lot of that people are trying to do start up for developing new instruments and then so that the operations of the conveyor belt can be improved. Nowadays the different types of sensors and switches are there the tramp metal detections, this is another

sensor they use on the conveyor belt, if you are alone with the material some iron crafts and other things from the mines short away from the material is going over there.

If they go and feed into the processing system, where you are giving the material then the process equipment and others they get damaged. So, it is necessary that any metal that which are going along with your material when you are transporting coal, then to a burner at that time that coals should not have any add on things leaning with that. So, if you keep an electromagnet over there on the conveyor belt, when it is moving.

Then this all the magnetic material will be attracted and kept it and then you can separate it out. So, such type of automatic metal removal system can be available then how the misalignment that detection if the conveyor belt is not running truly at wherever it is going away from the centre then it should be detected and informed. Then the slip detection as I have said that if the belt is wearing out at some places.

Then it should be detected if there is any cut at any point it should be detected. Then as earlier also we have said that for the belt to rip and splice damages, if anything happens by keeping sensors embedded it can be done. So for the idlers, because if it is a 1 kilometre, 2 kilometres long conveyor belt and whether the idlers are properly working or not earlier there is a person shall be going on walking and then coming over there to see whether all the idlers are intact that is a tedious.

And many a times it is not a very failsafe monitoring people sometimes fail to detect a particular idlers bearing is not rotating, but because it has the fail to rotate that the conveyor belt all along will get cut and the conveyor belt which is coming about say 20,000 to 25,000 rupees per metre and that 1 kilometre get damaged then you will to replace that belt it is a very big problem.

So, to solve that, there is a new approaches have come you can see you can retrofit a rail along the conveyor line it will just retrofitting a rail and on that rail a sensors say robotic sensors can move. So, what you can do that means this will be going on and sensing if you see the noise if the bearings of the rollers are not properly rotating, then there will be a signature of its acoustic signals that will be coming. The sound generated by a faulty bearing will be different from the sounds generated by proper bearing that of the rollers.

So, by knowing that and then if sometimes what you can do you can take a picture and measure this noise and then they can be put and send it to back.

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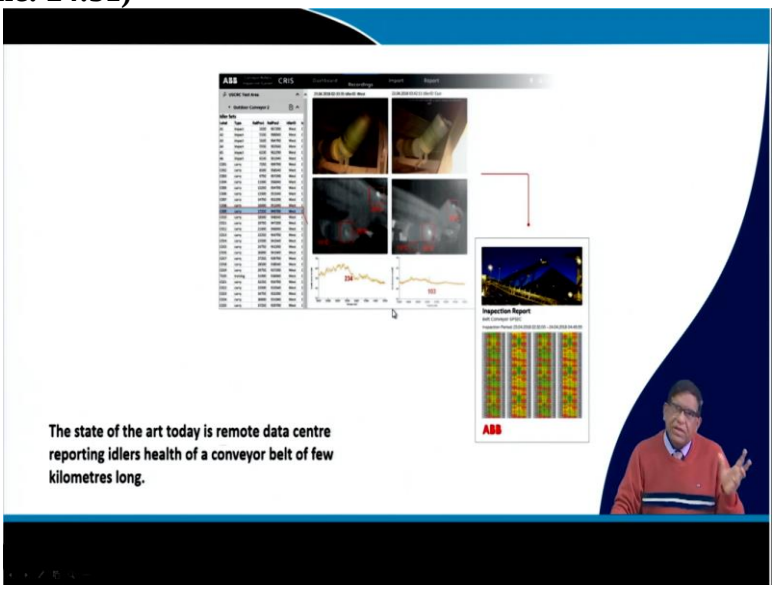

But one thing is there such type of systems when it is working on a conveyor belt which is going along say for example, there is a from Meghalaya to Bangladesh that Lafrazee has constructed that limestone is going from India to Bangladesh in Meghalaya, which is more than about 30 kilometres long conveyor belt. Similarly, in Karnataka, you have got very long conveyor belt over running for taking the material from the mines to the dispatch sections.

So, such a large area when it is to be monitored it will have to be done remotely and then it will have to be done a proper spatial system. So, if we use this type of sensors, which are automatically giving instead of persons going over there, they send the data and an inspection report is generated that depending on main what are the main problems coming is a strip reader it will be reading and you can sit in your office and look into it. So, such types of devices are coming and in future there will be more devices coming to have this type of things.

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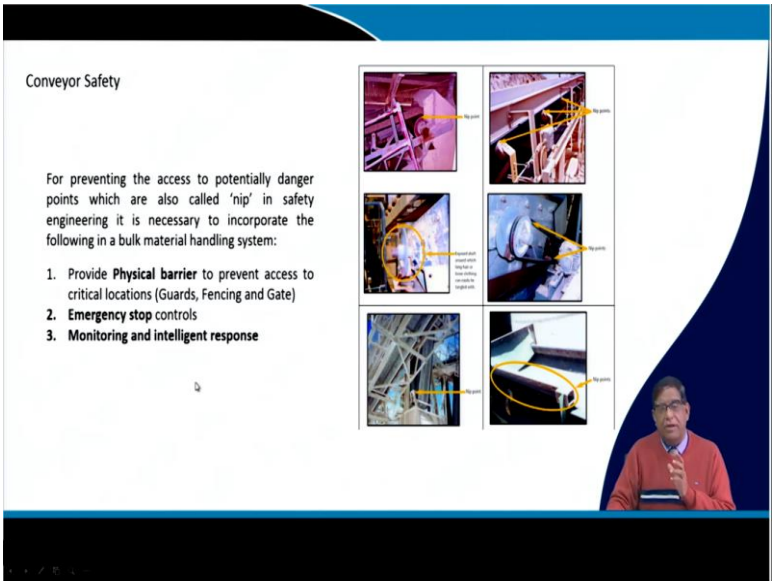

So, now, coming to this some of the problems you have said then safety is exactly the preventing the potential dangers, the potential dangers are called nip points. Now, there are different nip points wherever there is a motion there is a nip point there is a moving things if you are walking nearby whatever your lose garment if a lady operator go with a saree then what will happen the saree edge can get stuck over here and it is there.

So, that is why when you are working over there, you will have to prevent it by why you require a proper uniform and proper dress because all these nip points they may be obstructions, if you are wearing something and that it gets stuck over there, you will get trapped. So, if there is another nip point you can see if this sharp edge is there, if by walking if you hit your hand it will get cut.

So, that type of points should be covered. So, those nip points for the safety purposes you can give a physical barrier or if you find that there is something wrong happening you must give an emergency stop and then you will have to give a monitoring and intelligent response. These are the 3 ways how you can improve the safety.

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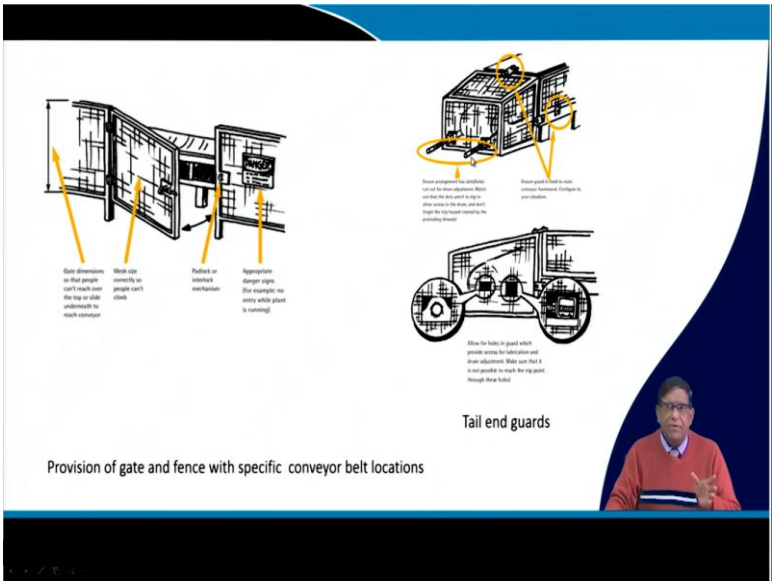

There are a lot of literatures exactly generated by the Australians, Australian safety wing, you can read some of their and these figures are from the Australian regulations, they maintain that they are all the conveyor belt installations should have the proper type of guard. Now, what type of guards should be there, whether the guard will be opening in the forward directions opening in the reverse directions.

Where it will be the gate will be opening downward or opening upward because at different locations different type of guard and doors will be there. And then some of the operations that when the belt is running at that time, you are this door should not be open that is called an interlocking system. So unless and until your conveyor belt is stopped, you cannot open this gate to see that what is happening near to the drive motor. So these types of interlocking systems are there to improve the safety.

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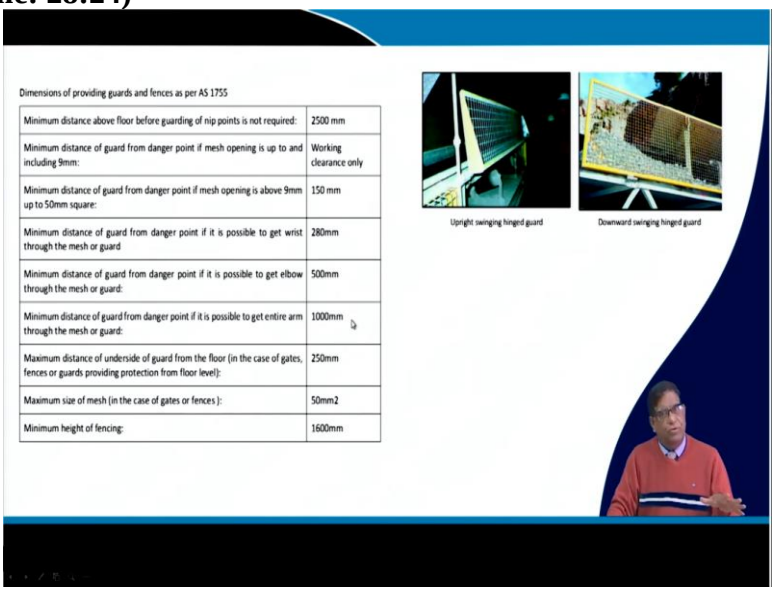

So, you can see here that there are different types of guards and then there are different locations this type of tabular form guidelines are coming from the safety and forcing authorities. Our DCMS also prescribed some of this, the techniques that will have to be followed. So, the mining operator a belt operator, they will have to follow those standards of the safety regulator so that it can be maintained the safety is maintained. So, this part you will have to look into the safety manuals and the safety regulations and then the mandatorily you will have to do it over there.

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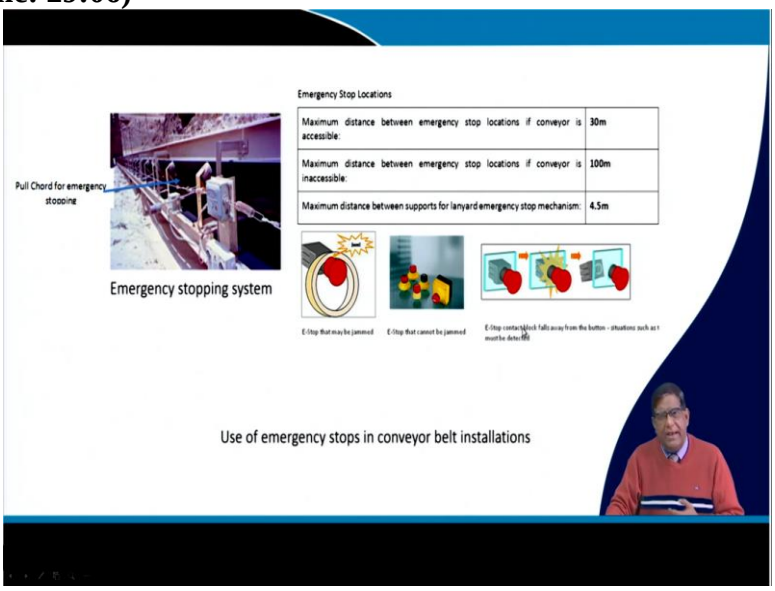

Now there is a pull chord switch which is exactly all along the conveyor a chord is there and there is a switch now this switch is through relay and contacts connected to the main drive motor circuit this pull chord circuit is connected through relay and contacts. Now if you press there and these are this pull type of button if you just pull it anywhere. Then it will trip the motor power supply to the drive motor will be obstructed.

Sometimes this instead of this pull chord at different locations this your, some push button type of switches are there. And that is those are emergency switches. You can push it and then that conveyor belt will be running that is it will become you can stop it.

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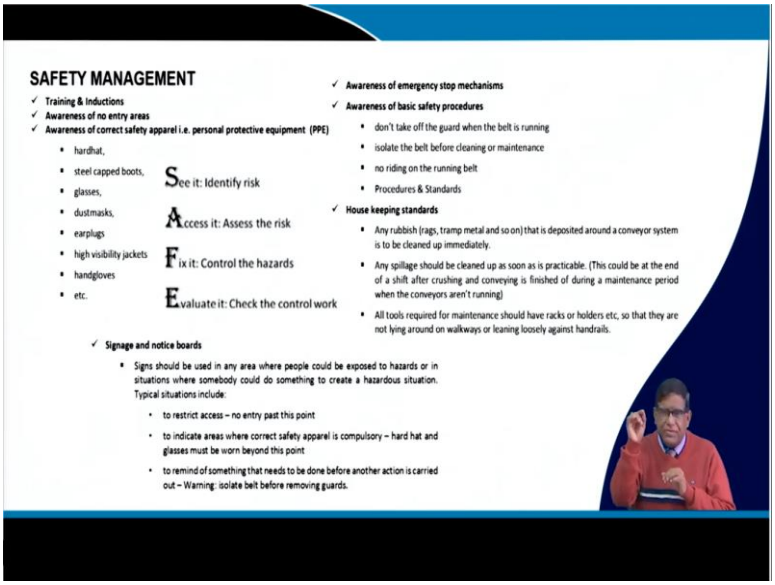

So, what is necessary for maintaining this safety? You will have to do the sensors for material management and for the management of safety, you will have to have a data driven management. So, you will have to have sensors and the data will be going over there at the same time on the spot where the workers are working their safety also will have to be looked. And that is why you need to get this safety management through training through awareness drive through a lot of your signage will have to be given over there.

And then you will have to make the personal protective equipment while they are working, they will have to have the hardhat they will have to have the proper steel boot they will have to wear proper glass so, that the product the dusts and all they should have a dust mask. And they will have to have earplugs because near the conveyor belt a lot of noise will be there, then there should be high visibility jacket in the nights on the light that should be seen that some persons are there.

Then there should be hand gloves will have to be used these are the some of things, but in our mining conditions in our many material handling plants, you will find our Indian workers they are not ease to put on gloves. They are not easy to work with we are having an earplug. So, that is somehow culturally we need to slowly improve those things. So that we get more that is accustomed to do that thing then your awareness of the emergency stop end mechanisms.

You will have to make a proper display and proper warning systems everywhere then the basic safety procedures everybody must follow. And through the VTC or the training of the

that worker this will have to come out and most important is the housekeeping many times we do not do our proper housekeeping that is a proper cleanliness proper things we do not maintain whether it is in the workshop, where it is in our chamber, whether it is in our kitchen.

In many places something traditionally we are not very tidy you can verify it by making an inspection of any randomly at any 10 houses in India. So now for that we will have to make special arrangements that to train yourself that engineers that the workplace is made more tidier and that is one more important thing then signage that is to make it tidier will have to make their people educated.

And for that the basic rule for save is see it that is you will have to identify where from it is coming that is why the problems and we have shown that how you will have to see that caused by and that causes these 2 things need to be seen. And then you access it whereas assess the risk that means how much damage it can be there because if your risk is not very high, you should not be spending a lot of money on it, because any management will be requiring some money.

So, you will have to be judicious by assessing the risk and then you will have to fix it fixes your control the hazard so, what is the remedial actions? So, in that very first diagram, when I have shown you the spillage is you make is that type of concept map or a brain mapping by asking a questions find out the things that what are the things to be controlled, you identify and then evaluate it that is whatever measure you have taken is it working or not that need to be measured. So, this is the way how safety in a conveyor belt is managed.

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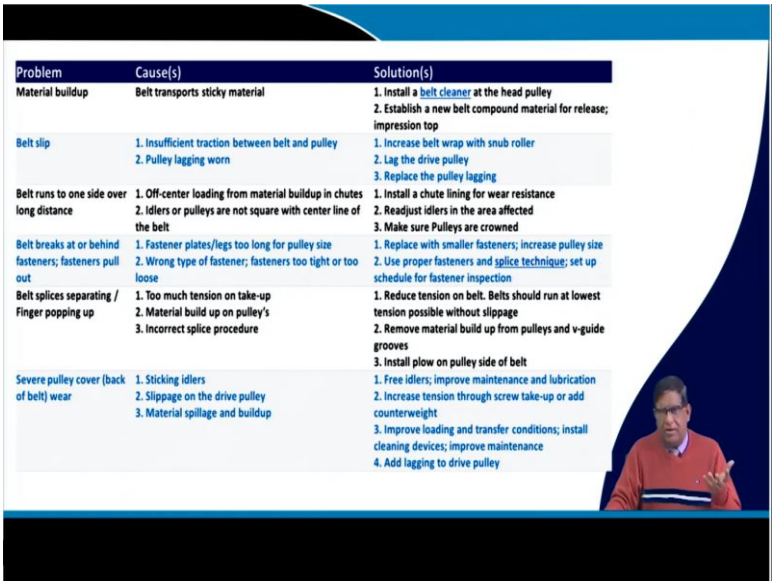

And before that it troubleshooting chart will have to be maintained by you find out the problems as you have seen that it may be a belt slip it may be belt brakes or bands that may be a severe pulley cover brake so down each of them that has got a the causes, you identify the causes, and then you fix it find out the solutions. So, there are a wide range of such type of troubleshooting charts will be available, please as an assignment, you make now that what are the common problems in a conveyor belt?

What are their causes, and what should be the solutions? And while reading the solution, try to find out that where new sensors and instrumentations and data driven decisions can be taken. So that this can be modernised and where our housekeeping will be improving this our troubleshooting that also you can highlight.

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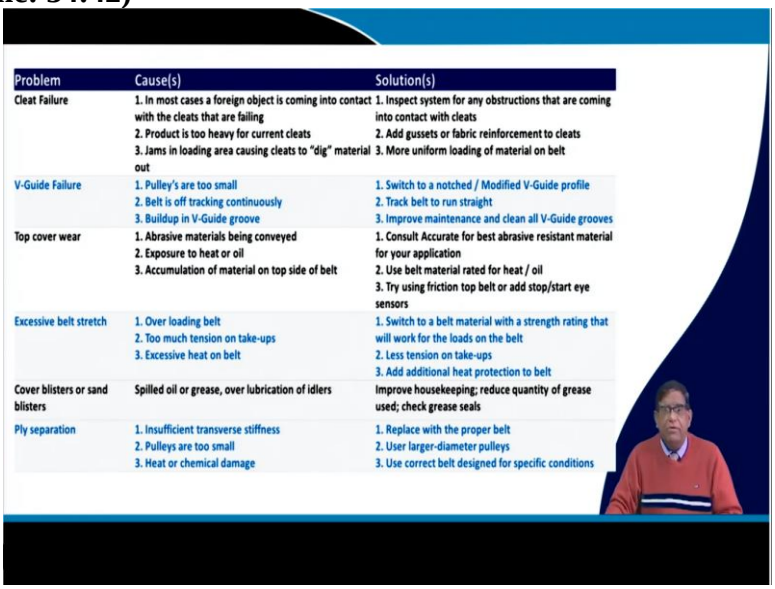

So for example, if your top cover is wearing out in that case, our abrasive material is being conveyed or not you can see it is not because of the abrasive material problem is different. Whether it is getting exposure to heat or oil or is it the accumulation of material on the top side something is happening you can find out and then you will have to consult accurate for best practice best abrasive resistant material if your material is abrasive then your cover you have selected which is exactly getting worn out.

That means, you will have to think of replacing your conveyor belt by a proper top cover so this type of initiation this type of a little bit of on the spot R and D you need to carry out so, that the next step when you will do it will be correct.

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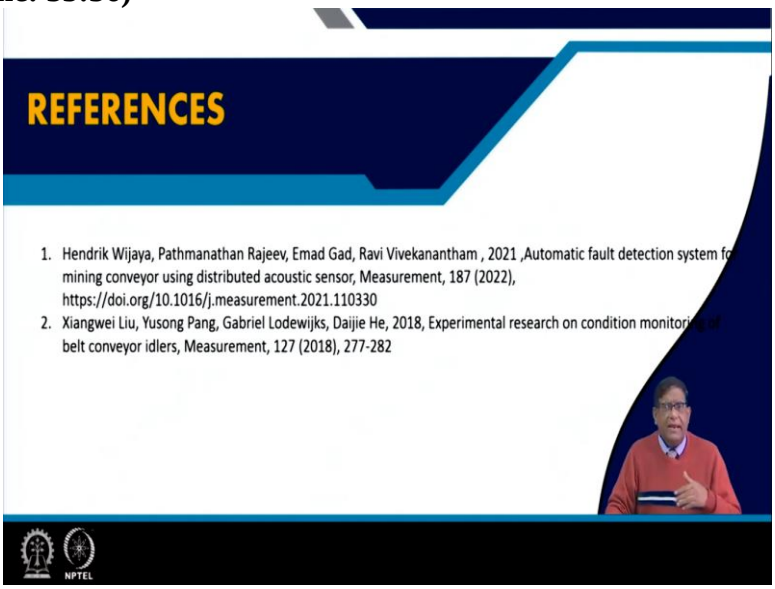

So, there are a number of literatures available. And then particularly, I have said that this automatic fall detection system, which is a new research which is coming up that is I think will be published soon, it is now available in the internet so this type of work, whatever is going on and up to date, you should be able to find it out similarly, some experimental research on condition monitoring in Chinese have done a lot of work for developing their system.

But other than that for common problems and all as you can read the Spibakovsky book of the Russian 2 books that conveying machines 1 and conveying machines 2 and also that our mining handbooks that material handbook and that SEMA handbook that conveyor engineer manufactures associations that SEMA handbook on conveyor belt design, please find out that there are a lot of troubleshooting charts are given.

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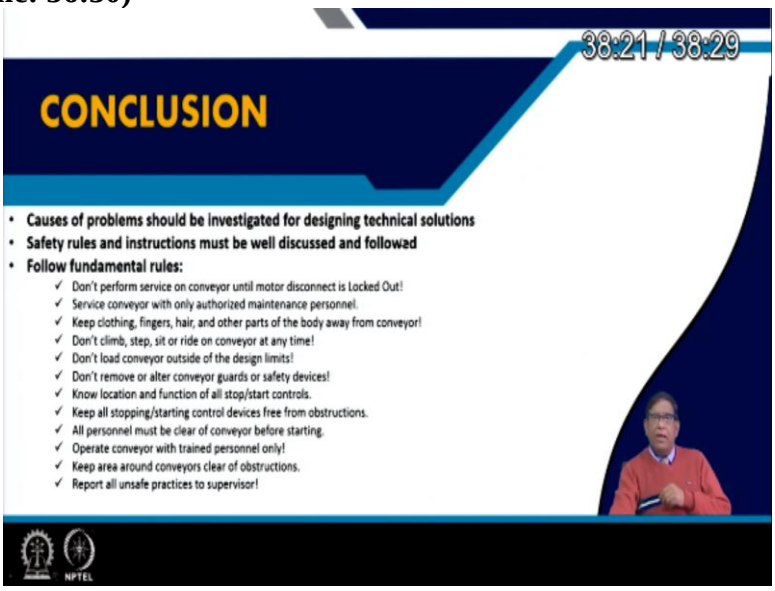

So to conclude, that your causes of problems should be investigated. For designing technical solutions, safety rules and instruction must be well discussed and followed and then follow the fundamental rules that is how you do not perform services on the conveyor until motor is disconnected or locked out that whatever the problem may lead to a problem should not be done, that is the basic principles.

Service conveyors only when authorised maintenance personnel do not let anybody to do a work if he is not a competent person do not let him touch. Similarly, your clothing, fingers, hair and all these things the proper should do not get entangled into a nip point. Do not climb step, sit or ride on a conveyor belt anytime do not go on crossing the conveyor belt or the just keeping a leg on it but if suddenly someone starts then you will be getting carried away and getting accident.

So then do not remove the conveyor guards then note the location and the function of where the stop switches and all these are there. They if you are going to work with a conveyor belt system, first find out what are the emergency provisions where are they located and all that thing, then you test them the different switches they are working or not then there should be exactly proper knowledge.

Proper discussions, proper way of record keeping should be there so the work whatever has been done is recorded and other can know. So there are a number of reports may be generated but the report not for the reporting sake make a habit that the reports generated by previous

user you go through it find out and then go it by that way you can get better your conveyor belt system. Thank you.