Mining Machinery
Prof. Khanindra Pathak
Department of Mining Engineering
Indian Institute of Technology, Kharagpur

Module - 09
Lecture - 49
Belt Conveyor Maintenance

Welcome, in our last class, we discussed about the driving of a conveyor belt, what will be the motor power required, where the motor will be placed, and then as a general components of the conveyor belt, and by now we know that how conveyor belts are used in the mining industry.

So, today we will be telling about some general discussions on what are this the main objectives of today's class is to introduce the maintenance of conveyor belt.

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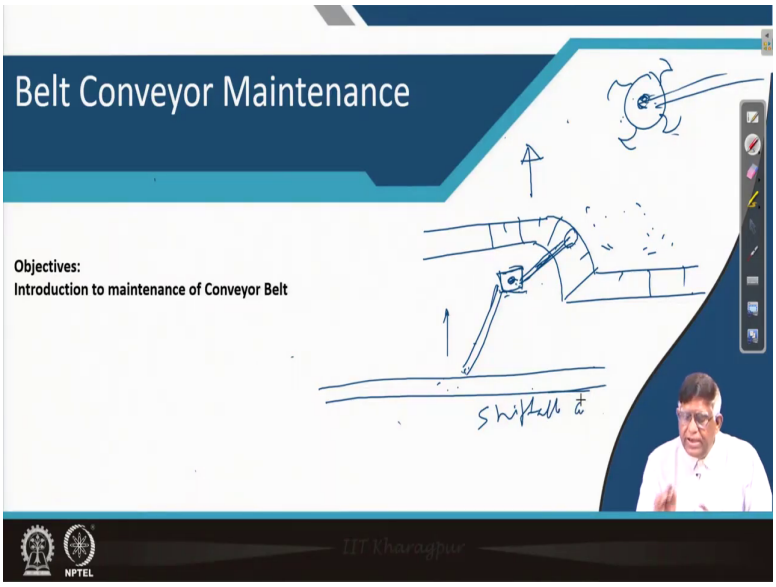

So, here we will be discussing some of the general bulk material handling uses of conveyor belt. You know that is the conveyor belt is used in a surface mines which differ particularly with continuous surface mining operations. Say for example, if you are having a mining phase here.

This is you are having a bucket wheel excavator is working on a bench like this. You are having a conveyor, you are having a surface mining bench here this area is blasted off. And then we are having a bucket wheel excavator which is sitting over here, and then the bucket wheel excavator will be this is a wheel with where the buckets are connected like this.

And then these buckets will be collecting the material, and then it will be giving on to it say it has got the boom on which we are having the conveyor belt. This conveyor will be bringing

the material over here. And then there will be a ditchers boom that ditchers boom conveyor it will be loading on a conveyor belt which is there.

It is a on the, this is your the main conveyor belt which is called the shiftable conveyor belt. As the mines will be going in this directions your this conveyor belt will be moving towards this. So it will be shifted that is why we say it is a shiftable conveyor belt. So, in a mine wherever you are using if you are not using a bucket wheel excavator here.

What you will be having? You may be having one say a in pit crush that is your in pit crusher is there the crusher hopper, and then this crusher will be giving a you are having a conveyor belt from here it is coming, and then its ditcher belt is loading over here.

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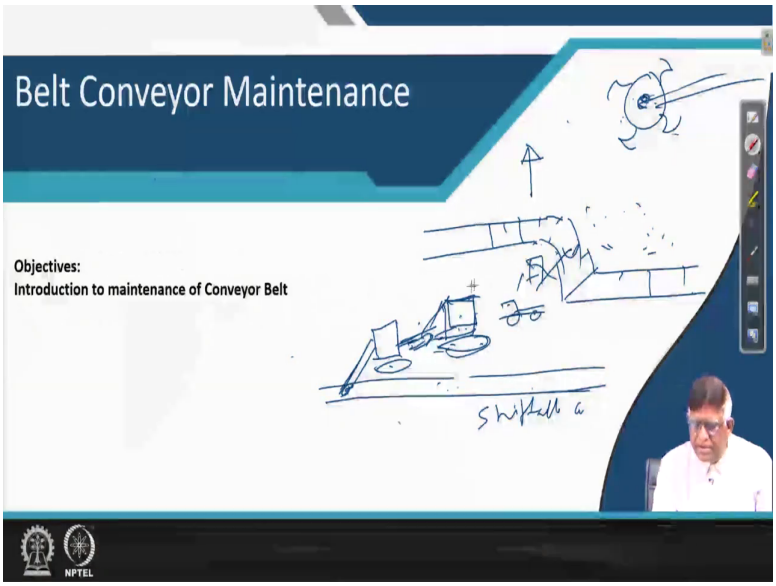

So, this crushing plant which is here which will be a mounted on a crawler, and now this will be having a receiving hopper. Now, this phase can be developed by a shovel, and then it will be loading onto a dumper. And now this dumper will be bringing the material over here and then it will be giving over here.

So, in real life what is more important to know is that this conveyor belt which are being operated they are operated in a mining conditions where we have to shift the belt several time, and also the material which is being loaded. So, you are having the conveyor belt mounted on a that is your these idlers are there. And then your the conveyor on the conveyor belt, you are having this material loaded over here.

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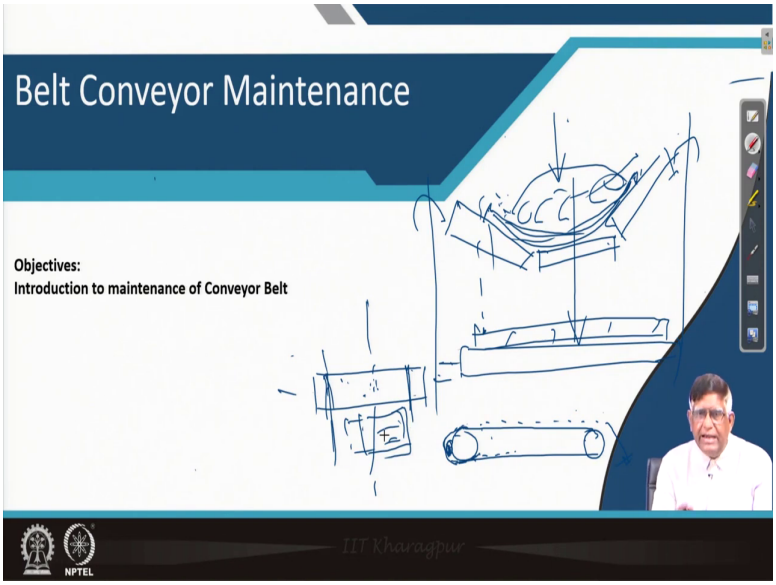

So, normally what is there? This conveyor belt when it is say running between these idlers. Now, this whatever the material is going in a true running condition, your conveyor belt when

it is running properly that material which is coming over there and it is getting discharged and everything is trouble free.

But if while loading over here that is some material come and fall on this, then what will happen this material will be carrying there, and then it will create a locations here and then what will happen this on the conveyor belt which is supposed to be this is suppose the conveyor belt is.

And then the center line of the conveyor belt and center line of your the I that is your n pulley they should be always coinciding. But because of this loading a little bit this way or that way if this material do not come centrally, if the material goes like that, then the conveyor belt will be moving to another site, and that is called exactly a conveyor belt is running off center.

And when a conveyor belt runs off center, then what happens because this conveyor belts in a shiftable or in a mining conveyor belt.

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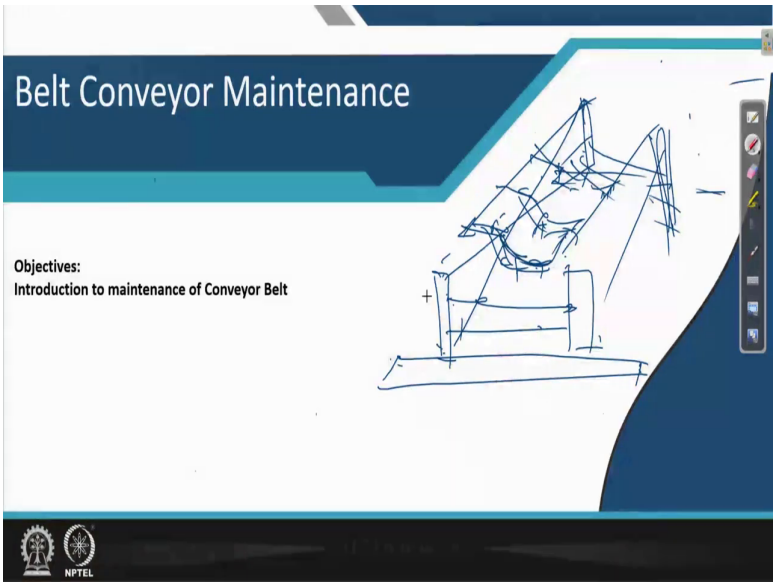

It is placed on some that is we are having a supporting frame on which suppose this is a supporting frame, where we may have this four members which are supported on a which are supported on say skid. We may have a on a skid mounted distance which would have a just you are having these two connected like that.

And then they are connected like this. And here we are having the idlers which are which the idlers are supported over here. And then these idlers could be supported here, and then another set of idlers two return idlers are supported here.

Now, what happens, this if the belt goes off center, the belt will be it is normally the belt supposed to be here in between that if the belt go and hit the supporting frame the side will be

breaking down. So, under that conditions, there will be a lot of that is a belt will be getting damaged.

So, that means, in a operations there will be number of situations where the conveyor belt will be getting damaged. So, the maintenance means your operations will have to be done in such a way that no problem occurs. So, first thing in your maintenance, you need to know what are the different type of problems may come on a conveyor belt and how it is to be there.

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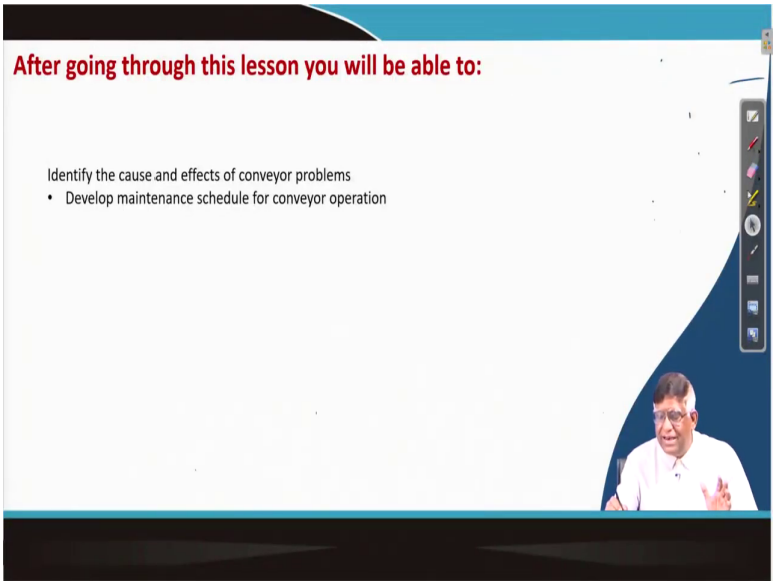

So, we will be discussing few points on this today that is your our is after this discussions. You should be able to identify the cause and effects of the conveyor problems and develop a maintenance schedule for the conveyor operations. So, it will require a lot of course, studies afterwards. Today, you will be just getting an introductions of the things here.

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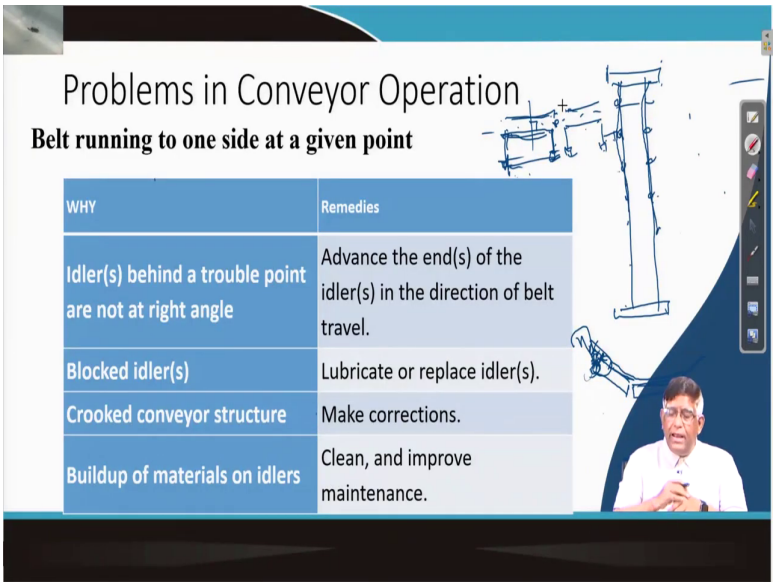

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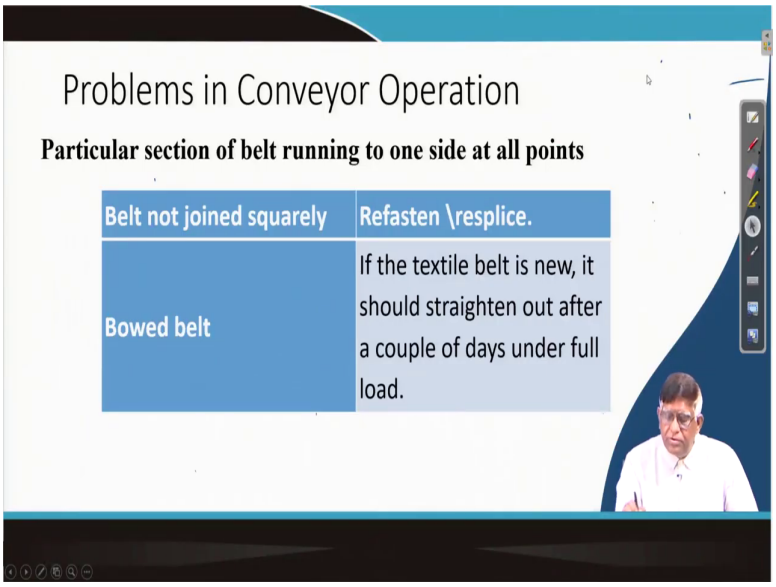

So, one thing is that what are the problems in conveyor belt operations. Sometimes belt running to one side at a given point. Say for example, you are having this is a, sorry, this is you are going to have suppose, this is a you are having a conveyor belt running like this say here we are having a roller, here is another roller. And it is supported on different this you can see that these are the idlers you can see.

Now, you can find that conveyor is running one side at a given point. At this point, it is coming that is your, it is the belt is going like this; at one point it is going like this. And what may happen there because on that point whatever the idlers is here this idler, so that means, the belt which is normally it supposed to run like this, now it is going over here, it is coming up to here, or sometimes going over here.

Now, this having a supporting structures it is come and then the belt go and hit over here, then the edge of the belt will get damaged. So, now, why such type of things can happen? Now, there could be that is exactly this frames which are as we said that is your supporting conveyor frames are there, and these are having their own support like this, now this another frame is here.

So, this number of frames are put together, and then their central line should be properly aligned. If one of them this alignment is not proper, then it may give the problem, so that is your that if this is not perpendicular properly – that this axis and this axis are not perpendicular the problem may come. Then what may happen, you are having this set of idlers now one idler their bearing has run, it is not rotating.

When it not rotates, then it will be giving additional force to the conveyor belt and it will be shifting to the other directions. Now, this is sometimes, what may happen, the conveyor belt structures that where you are supporting the these may get a bend, because these are all many a time with a mild steel construction component. Now, you have been shifting it number of times by pushing by dozer.

Maybe sometimes it when you are pushing by these things by dozer, it was other side it was getting obstruct. So, when you push, it has got little bit crooked. So, if the frame itself is not properly straight, then it will leads to a problem. Similarly, there will be on the idler because this conveyor belt when it is running there will be say and as you know the basic principle of conveyor belt that carrying side become the return say.

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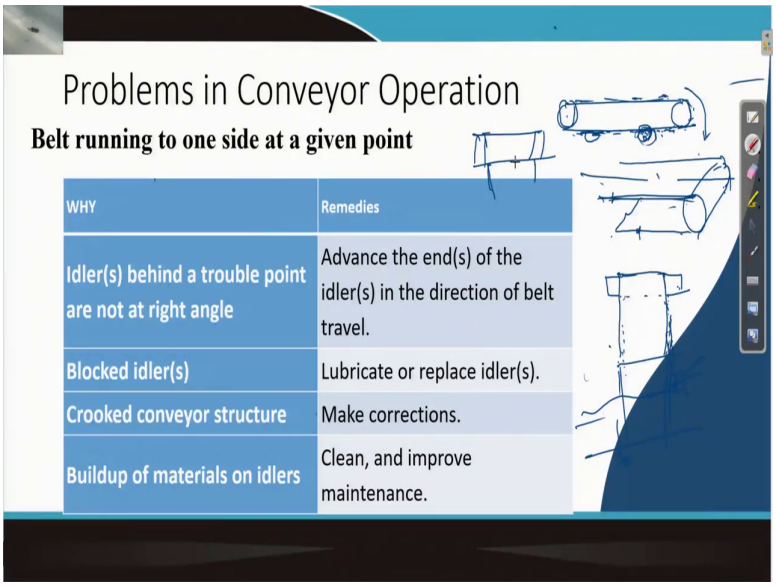

If your conveyor belt is running like this, here, here this is your carrying side. And then after returning, this is your exactly the carrying side is going and this is supporting on the return roller. Now, what happens, now this material which were sticky over here they come and gets stick here. So, then what will happen, this material will be that is your it will be going on making a layer on the idlers.

Now, these idlers then will be giving a pushing action to the conveyor belt. So, that is why normally what is there you should see that is your if you are having a conveyor belt suppose say this is a conveyor belt. This is your n pulley, and it is just going you can see like that it should be.

Now, if you see here this center line, this edge and this edge when you see on a top view, then your this is your drum, this is your drum over here now it should be perfectly like this. Now,

it may so happen that when you are doing you can find that exactly after some time this is coming over here, and you can see the edge of the return here.

So that means, this has got the return idlers that belt has got shifted because this sticky material that has got stuck in between. Now, what will happen if this is shifted at one idler, now depending on this is a whole length after going when it will be coming over here on this pulley, your this pulley also you are supposed to have like this.

But here you will find that your that carrying side will be carrying side maybe here, and the return side may be here. So that means, there is a gap that is the belt is coming like this. So, that type of problem comes if you are not properly cleaning the belt. So, what we will have to do you will have to see your how the belt cleaner is operating. So, there are many issues like that which may come in while running a conveyor belt.

Now, say particular section of the belt running to one side at all points. So, this could be a bowed belt that is the belt it cannot it has exactly the manufacturing problem in the belt. That is your if it is a new belt then should be straightened and after a couple of days under full load it may come that is your it has got some bend, it has got that bowed, at that time this problem may come.

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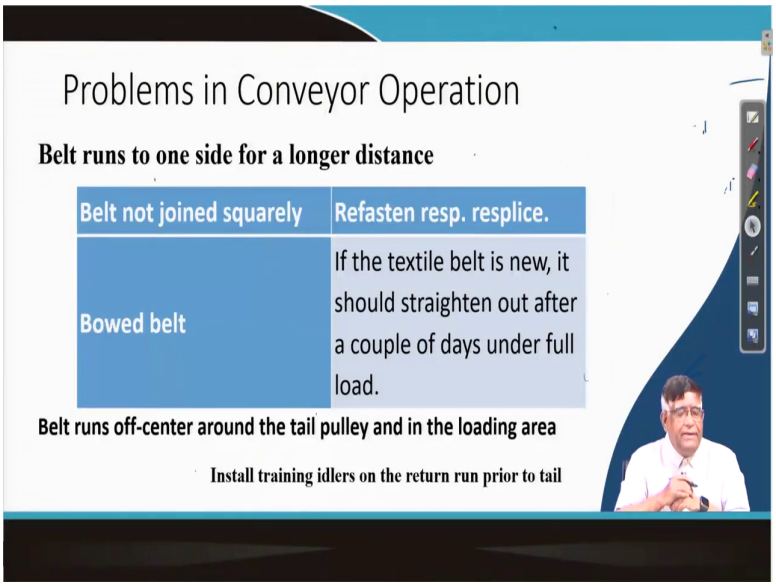

Similarly, belt runs to one side for a longer distance, and then belt runs to of center around that tail pulley. It is going and the tail pulley, it is going over there. So, it happens that is your what happens your training idlers.

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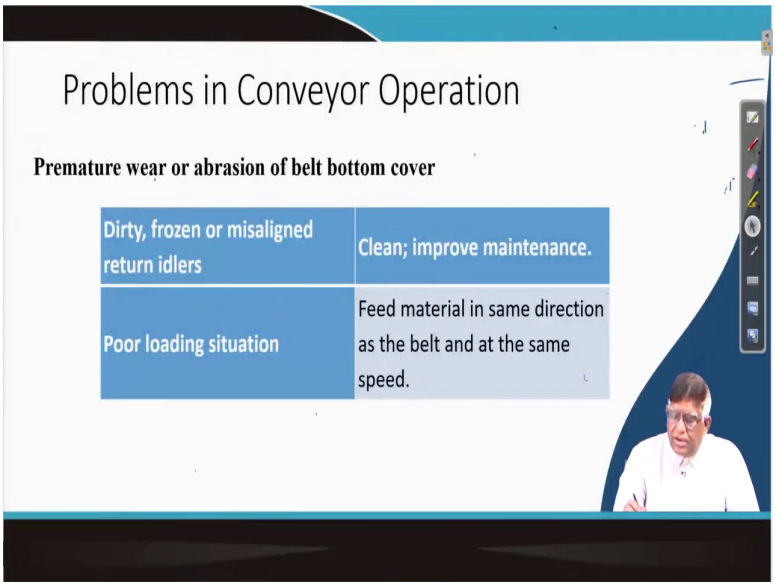

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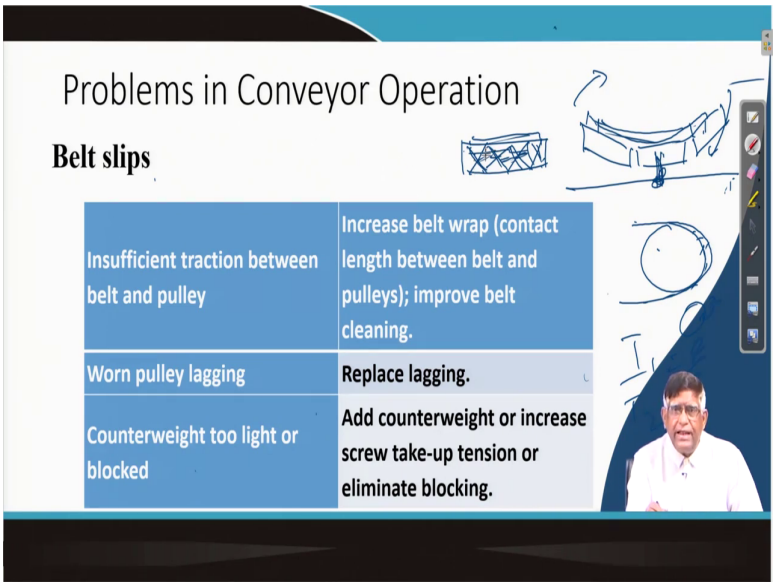

Now, what is the meaning of this training? So, that your as we say here the training idlers, sorry, I will tell you when your in any trough belt conveyor that is your in case of the belt. You need to have, you need to have a suppose these idlers which are placed over here.

Now, these idlers they need to be that if that conveyor belt goes to another direction if it becomes like that, this one should give a screw, so that it will be pushed over here. So, that is why this idler will be on a pivot point. So, that if this is going to another directions, it will automatically give a torque over here, and that under the torque it will get aligned that is called yourself-aligning idler.

So, that is where exactly when we put the things in a conveyor belt that self-aligning idler will make it trim. Similarly, sometimes the belt slips; that means, the at that when you are giving a

driving, your drive pulley, and the other side your tail and pulley if we find that both are not running at the same speed.

That means, what is happening that is your there is a slip in the belt. That means, the that that rpm of your driven pulley and rpm of your the drive pulley they are different, that means, your tail and pulley and drive and pulley they should move at the same rpm. If it is not there, that means, there is a slip.

Now, why it happens? Because on the that your this drum when your conveyor belt is going there should be a proper friction if the friction is not there you cannot that is a T 1 by T 2 e to the power mu theta, there mu is the coefficient of friction. To increase that mu, what is done on the pulley you give some lagging.

Lagging means you get a rubber tire type of things, and you are giving some groups type of things over here, and that conveyor belt when it is running they gives a more friction. So, if after some time of use this lagging it may wear off. If they worn out, then exactly there will be a situation of slip, because theta will get down and then your the proper ratio of T 1 and T 2 will not be maintained.

So, these are the things need to be looked into. So, sometimes what happens you know in a conveyor belt you have got the belt is running over here to keep the tensions properly; you are always having a bend pulley and then give it over here. Now, this is given a weight.

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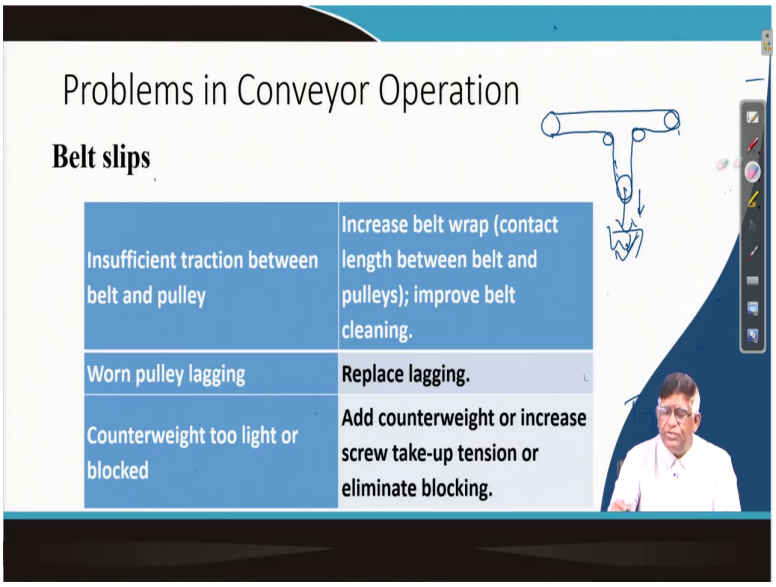

Now, if there is a any elongation of the conveyor, this weight will be taking place. But if this weight is less that is your then what will happen that belt will be having that proper grip will not be there on the n pulleys, and that may result in your slip. So, that is why you will have to increase or the keep monitoring of this.

So, here you can think of that is a how you can use a new sensors, and the sensor based exactly or hydraulically you can control the weight and things like that. There are the where you can do some innovative activities on this.

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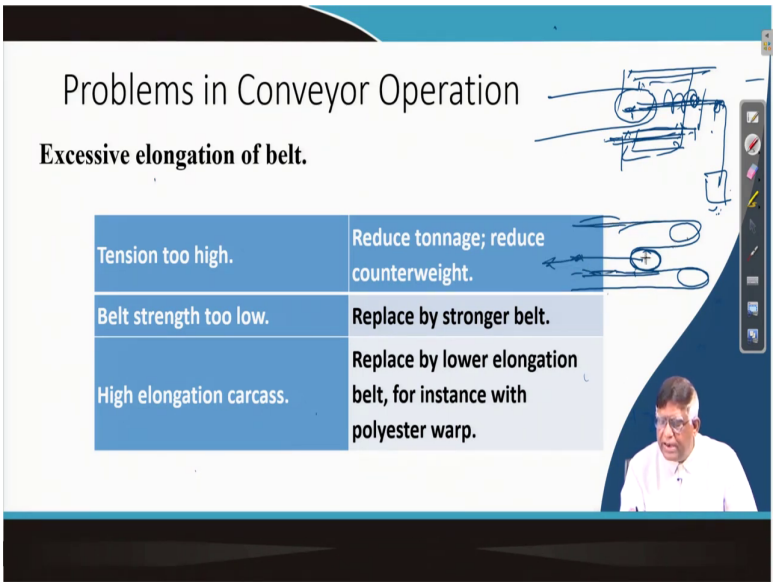

Similarly, your say next another problem we can discussed here, excessive elongation of the belt, that means, the your take-up can take only a particular amount, we have not discussed the detailed design of the take-up. You can read it that take-up or the tensioning at any elongation of the belt is taken care of by take-up that. As I drew that that is a gravity take-up, or other one we say that the screw take-up.

That means, in a screw take-up what it is done you are having this your suppose this is your the n pulley this one is exactly connected with a rope, and then there will be a platform on which exactly a wheel is there, so that means, this whole structure it will go in this direction. So, we can have that pulley to it weight, and then give a with a rope and weight is given. So, by that way you are adjusting it.

Now, this drum that is your n drum or tail and drum, it can move within this distance that this is a it is a trolley mounted type of things. But or sometimes what it is done you are having a big screw and then you can just push pull it out or push it up just like in you in your bicycle when you adjust your chain.

If chain is elongated what do you do? Your rear that rear wheel there is a small screw by tightening it you just push the your wheel towards the outer side that is what is exactly the screw take-up. Your chain, it is elongation of the chain is you taken care of by the making a screw take-up at the rear wheel of your bicycle, the same arrangements can be done there.

Now, if the elongation is more that you cannot take-up by the take-up, then the problems comes. So, it is it could be a problem of the conveyor belt that is the carcass is not properly made. So, then your or the there could be a different way of arranging with the take-up. So, you can have a loop take-up sometimes what happens you are having this you can make that conveyor belt to move like that.

And this one you can make on a move on a on a rail, so that it can take-up the things if this is getting elongated. So, this loop will be taking up the take-up. So, this type of arrangements are done in the field which you will have to if you get an opportunity to take your practical training in a mines take and look take care of the problems, and then you will be able to learn.

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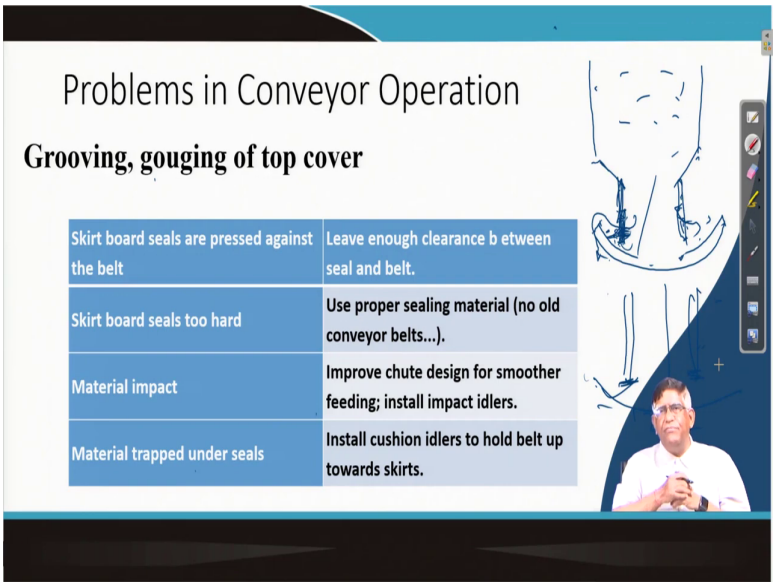

Now, there is a on the top cover of the conveyor belt, there could be a gouging, there could be cut, there could be grooves, all these things may be falling. And this is exactly the problem with this cardboard. Sometimes what may happen you know that the loading of the conveyor belt is given by this cardboard.

This cardboard is having a upper type of arrangements here, and then this is your conveyor belt, and the conveyor belt is here. And then your material which is coming over here it is guided with this cardboard. Normally, what is done at this cardboard here you are having a by nut and bolt you keep a conveyor belt or a rubber piece here, so that this boulders whichever is coming it is coming and falling over here.

Now, of course, I have given this is not this much distance it will be less, so that it will be loading like that to this much area. Now, what is here if a rock gets stuck up over here, then

this rock will be cutting this conveyor belt. So, that is why while your conveyor belt inspections, you should see that nothing is getting stuck up in this cardboard.

That means, in this cardboard your that this rubber which is here it should be flexible enough that if any boulder comes it will go like that and then they accommodate it, so that the boulder can move on the conveyor belt. But sometimes what happens they use this old conveyor belt over here.

And then these get worn out these get worn out and then it may sometimes give a problem that your this material come and fall out like this. So, in that case, that will be giving you another problem. But for the cutting problem is also related with here. Sometimes, whatever may happen your, this is your mild steel, on that only you are giving this liner of the rubber.

If it is not there, your this rubber and then your conveyor belt is over here. When at that impact load it is jumping under an impact vibrations. If that conveyor belt was loose when the weight will be falling, it will get a jump. At that time, it is moving and jumping.

If it touch this steel hard surface, it will give a indent or a cut or a groove would be formed. So, there could be a number of different region when while you are working with that system, at that time you will get it. So, that is what you need to do how to keep them observed. So, once you know the problem, you can find out how they will have to be resolved.

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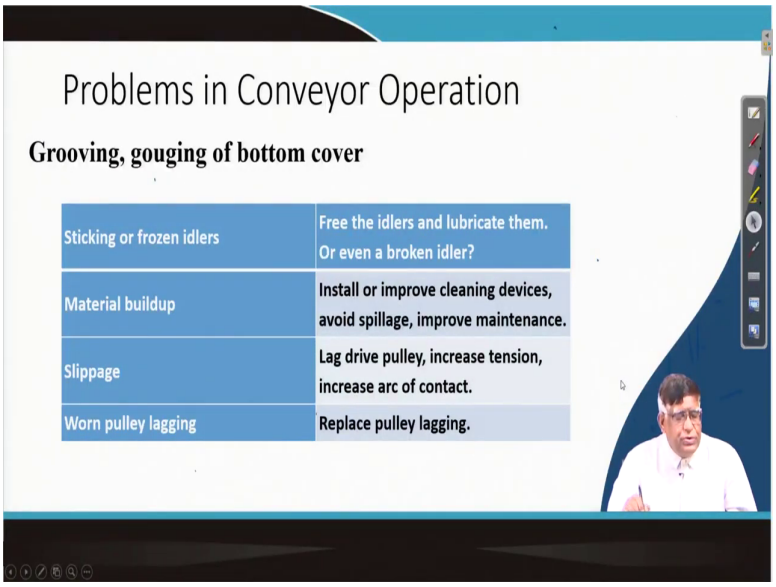

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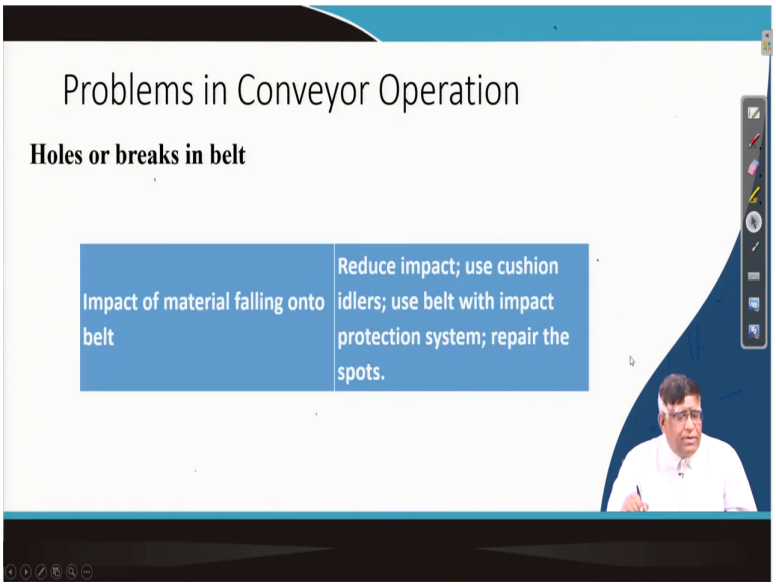

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So, there is another problem. Exactly there could be a hole that is your conveyor belt damage may be there by impact, sometimes that cushion idlers are not there. So, these different problems of a conveyor belt come. And then as you know the problem you will have to analyze it, find out the solutions, do it over there. And so that no problems come for that you will have to keep monitoring and other the systems ready, so that it does not affect.

So, for example, you will have to keep a belt cleaner, this is one of the very good that maintenance of the conveyor belt will be there if you can keep it clean. That means, if you keep the belt carrying surface clean. It will not give the problem of accumulation of material between the belt and the drive drum which is called the crowning effect that is what I was telling you that is if on a on a conveyor belt, if the material is coming on the return belt, then it can be giving and it can be crowning.

Now, this material many a times, the crowning can take place here and then when this material are getting stick over here when they go at the return drum if this stick material it will go, and then it will exactly get over here. That means, this stick material will be making a crowning over the your return idler, and then that conveyor belt will be pushed to run off center.

When they run off center that exactly because of this dart coming over here this dart is getting over the return idler, and because of this is having a rear as a crowning on the return idler the conveyor belt will run off center. That means, on the on the drive pulley, you will be having your the top side it is like that, and the return side this is and your return, return belt will be coming like this.

So, that means, what is there this gap is there, and then the more material will fall over here. As a result your whole belt will be running off center and then it may hit away the even sometimes the frame. Then if it is hitting the frame, the edge of the conveyor belt also will get damaged everything is there.

So, where is the source? Source is the that sticky materials are not cleaning, that is why the belt cleaner their job is will be at that at that where you are discharging, at that time you are keeping a scrubber by which this belt is clean and the that material is removed. And for doing that, there are different type of designs have people have made. You can see over there these are kept.

So that this that your material is constantly it is kept clean. Sometimes, in a sticky material you can have a heat blower that is your you are giving a some blowing out a heat hot air to that. So, that the sticky material which is which becomes sticky because of the moisture, they can get scale formations and will be removed.

So, that can be that is why sometimes you need a pre-cleaner whether you will be heating it little before or you are having a first you do because if you do a very hard cleaning at that time if you give a more pressure, then it may lead to it may lead to just cutting the belt. So,

that is why you will have to see it is not giving at one stage, you can give it a two stage, so that is what your primary, tertiary type of cleaning can be given over here.

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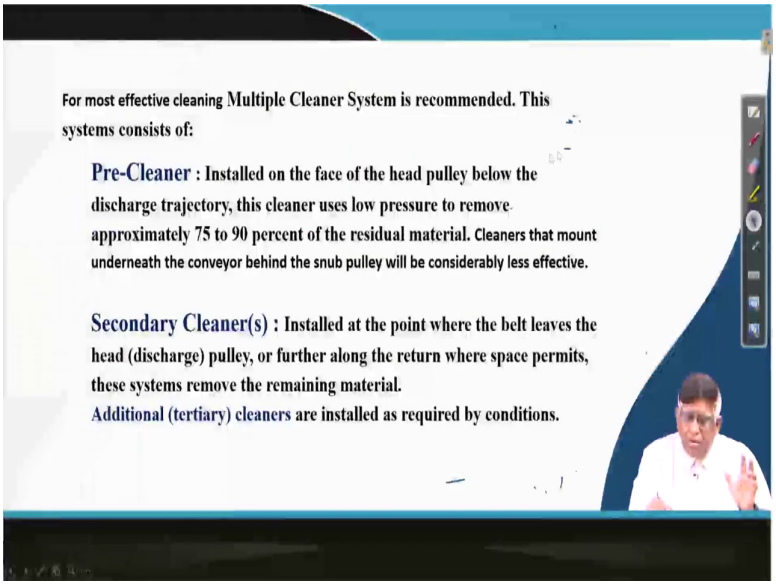

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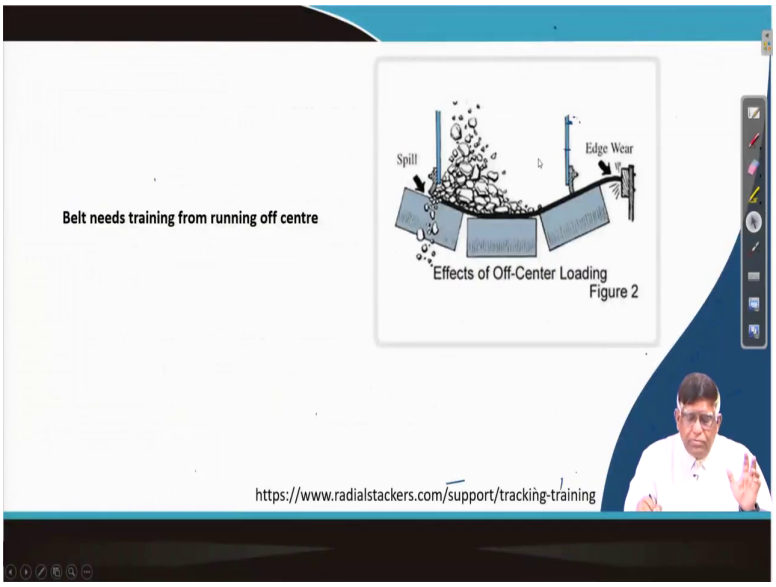

So, other than this, you can find another thing over here that is your pre-cleaner and secondary, secondary cleaner, tertiary cleaner will help. Now, this that what I have said about the belt training in maintenance is this type of situation should not have. You gets cardboard as this is a cardboard in between over here. So, the material all is going over here, and then it is going to fall over the return belt, and you get the off center.

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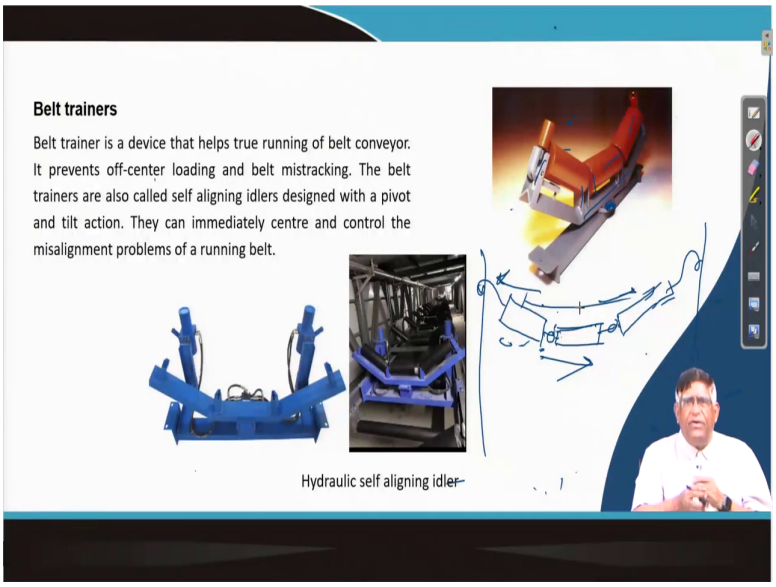

So, this type of situations, then how will you if the belt is running off center you will have to again bring into center, that is the center line of the top cover and the center line of the bottom cover they should be all aligned. And that is what is called a true running of the belt.

And if they are going not running, there is a difference of the that is your central lines of the two conveyor belts up to carrying the side and the return side, then it is running like this, it is a off center running. Or if there is a, the belt is showing to the another side that is another off center running.

So, the belt will have to be trained means it will have to run properly. And for that the trainer is in a troughed idlers, you use a what is called self-aligning idler. This is a set of self-aligning

idler you can see. There is a pinion point on which a frame is there. And on this frame, there are this separate brackets are there for each of them. This is one type of idlers.

Normally, for wherever a bracket mounted idlers are there, you require a such type of self-aligning idler. Now, that you can see sometimes this modern new development has come, this self-aligning idlers are hydraulically operated there are hydraulic idlers are there.

If there is any they will be having a sensors will be sensing the if that is running off center, accordingly they can push and then push the conveyor belt to run again onto the idler. So, this is the arrangements are there. So, but sometimes the new development is if these idlers you are having a coupler between them, and then what happens this idlers you are having as a garland.

Now, if you are hanging it over here on this, now the if the conveyor belt is going in this directions that this will be going over here and the pushing force will be coming to this directions, and the belt will be coming over here. So, a garland type of idlers they have got that self-aligning is inbuilt.

But if it is not a garland type idler separate mount, then we will have to use this where it is placed it is placed just in front of the loading point. So, this is what is important.

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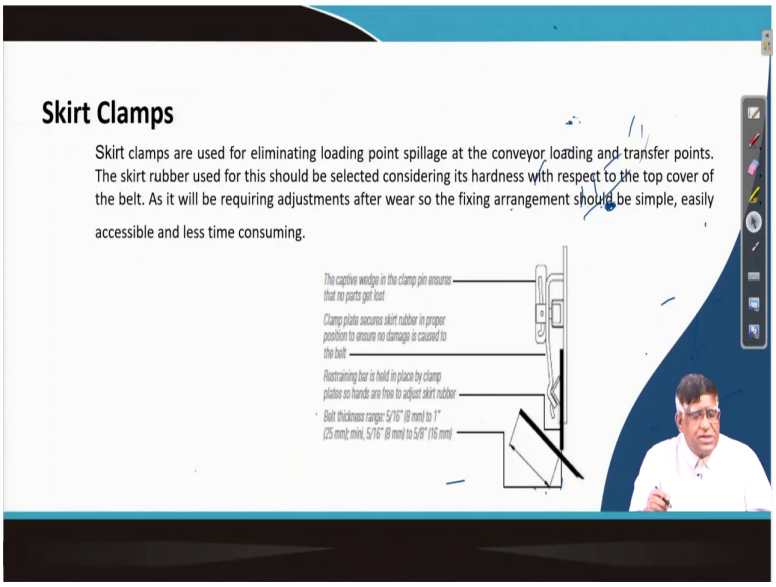

Then sometimes we are using a skirt clamps that skirt clamps are this is what exactly in the your cardboard. As I said this is clamp and a rubber is kept, so that the material do not go and do not fall into the return rate that is a skirt clamp.

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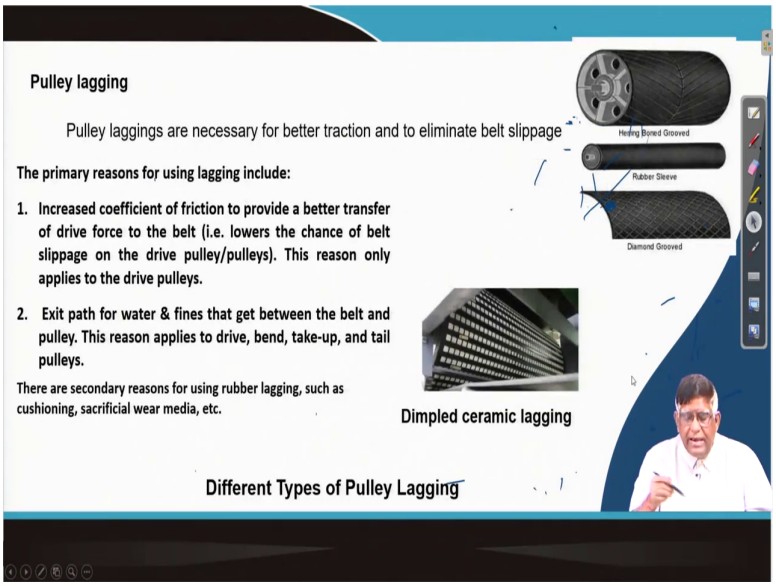

Then the pulley lagging I said so that the your slip does not occur for that on the drum you will have to put this type of lagging, and sometime dump ceramic laggings are also put over there. So, that the frictions that e to the power mu that that mu part is kept more.

So, that your the transmissions that T 1 by T 2 that is effective tension can be always better, because if your friction is better higher you can get this effective tension better. So, this is how exactly the pulley lagging will be doing.

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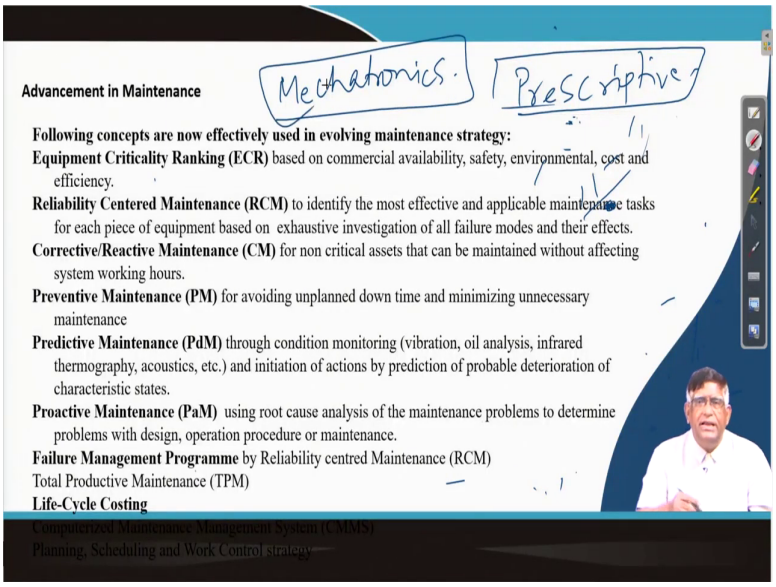

Then there is a nowadays advanced maintenance system has come we can have this is a equipment criticality ranking which is done your reliability centered maintenance, corrective reactive maintenance, your preventive maintenance, predictive maintenance, pro proactive maintenance. And today with IoT and artificial intelligence what is coming is your prescriptive maintenance.

Now, for a prescriptive maintenance, we need to do a continuous monitoring. And there your application of mechatronics in conveyor belt maintenance and operation is your recent phenomena. And there exactly lot of works are yet to be done in our country. In our country, most of the conveyor belt installations are being operated and maintained in a very traditional manner which has not changed much over the last 10-15 years.

Of course, there is certain things is that your because of the designs in the idlers and all have come. And nowadays exactly for running the conveyor belt you do not go by grease guns to put the all idlers. It was in the 70s and 80s for any conveyor installations in the maintenance persons, they used to take the grease guns and grease each and every idlers.

And that those things have now because of the proper idlers have been manufactured which do not require any this that your lubrications. So, one thing is very, very important those idlers their self maintenance type of things that for a lifelong lubricant which is they are putting in an impregnated in the design of the idler itself.

Those type of things are very very important to determine what will be the life cycle costing of your this conveyor belt system.

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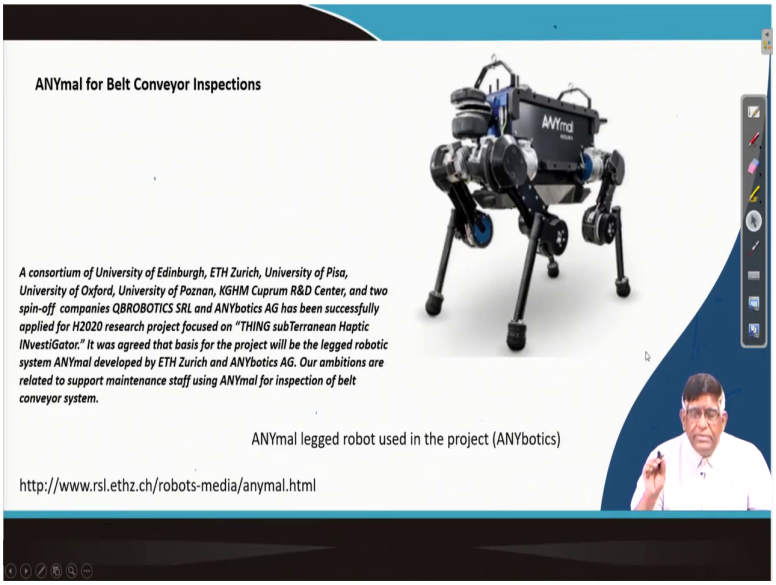

So, there is a, I would likes to before ending, I just like to tell you that that development today is of advanced technology. This ANYmal which is a for the maintenance of the conveyor belt a robot is used exactly a consortium of the University of Edinburgh that is in a Zurich, University of at Pisa, and University of Oxford, University of Poznan.

They took a very big project then their in their consortium and they developed a this is that was a Anybotics AG this under that company's name. They have developed this ANYmal which they are exactly used for conveyor belt maintenance. I request you to go through this and then find out that what will be coming in your near futures this type of things.

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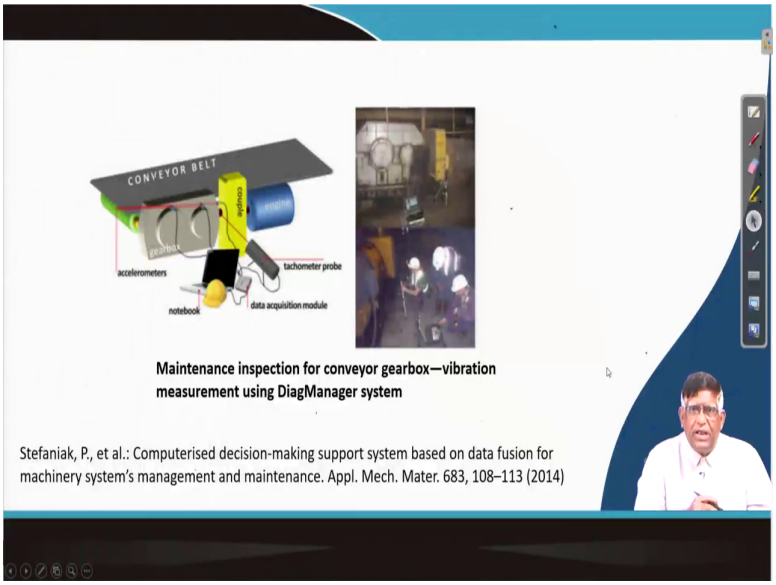

But at the same time that maintenance inspector of the conveyor gearbox and others are also nowadays by giving a high level instrumentations because conveyor belt technology is a

worldwide used in a and it has got a multipurpose applications in different industries, and including food.

And then to our material handling, a huge a multimillion dollar business in conveyor belt exist. As a result there is a development of new instruments and new technologies are required.

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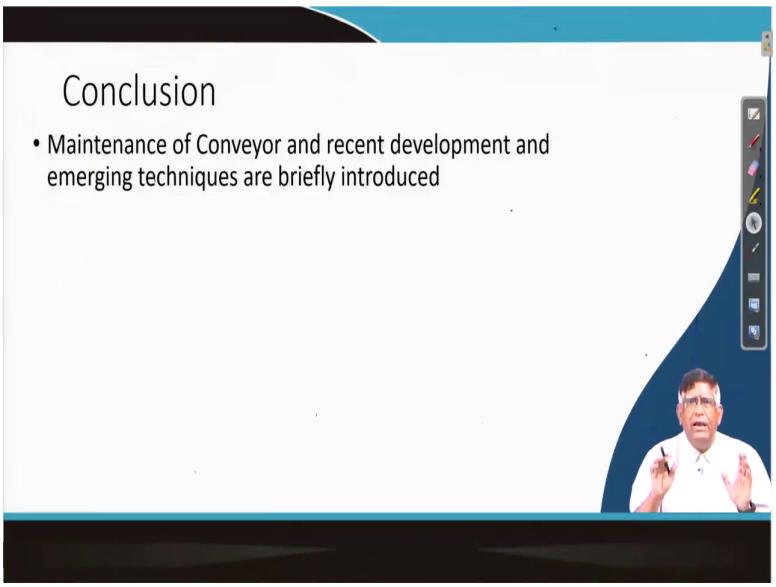

So, what our discussion is the only a basic maintenance of a conveyor belt we have talked about. But this is a technology where as a mining engineer you may venture into a new business and they getting a new way of doing your mining operations which ultimately will be contributing to the productivity.

Because transportation takes about 75 percent of the total cost in mining industry. So, bulk material handling and continuous transportations by conveyor belt is very, very, very, very important.

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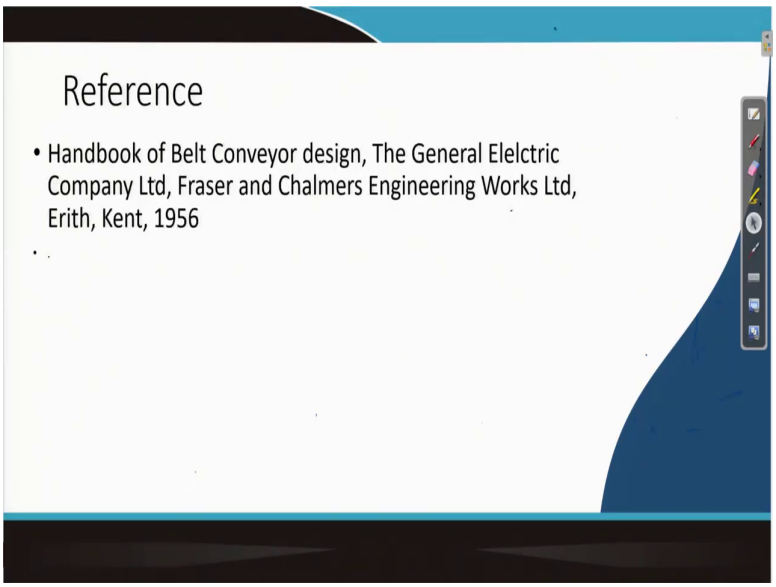

So, I tell you that already I have given you the references of Simon handbook, and there are many other articles are available. But this General Electrical Company, their handbook is also very good. They are the worldwide leader in giving this different control, and of course, the for the motors and for the control that Simon they makes they have developed lot of drive aids and all.

Conveyor technology discussions can take a long time. We can discuss a lot of things about that how the drive edge will be there, how the shifty people conveyor will be working, how

high angle conveyor will be working. There are so many different types of applications are there.

But in a undergraduate course, you please know how to calculate the power, how to get these resistances, what are the instrumentations can be done on this conveyor belt, and then prepare yourself to do more research and more activities with conveyor belt.

Thank you very much.