

**Bulk Material Transport and Handling System**  
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**Lecture – 57**  
**Safety Aspects in Bulk Solid Handling and Transportation**

Today we will be discussing about this maintenance aspects of bulk solid handling and transportation. You know you have got this operations of bulk solid handling and transportations in the those operation you deploy a large number of machinery of different type there are mechanical systems there are electrical systems there are electronic systems and there are digital system.

And this are having some capital investment and you have been spending money for operating it but if they are not maintained well that your results that whatever the productivity whatever the output you want to get from there will not be available. So, that is why the maintenance aspects of bulk solid handling and transportation I will be briefly introducing to you however you should understand that this maintenance engineering and the maintenance of this machines itself it is own area own subject.

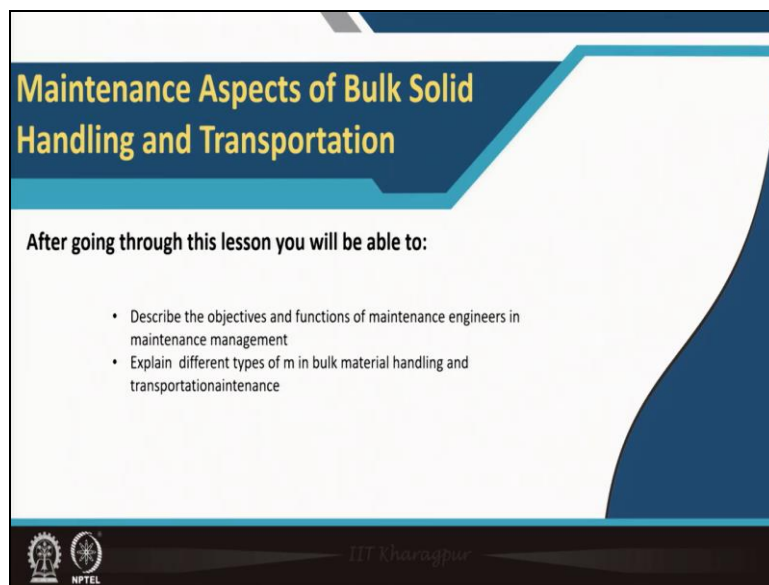
But in your bulk material handling how this maintenance works are carried out for that we need to know basically that what are the objectives and what are the functions exactly are to be done in maintenance management and you should be able to explain the different types of maintenance systems which are incorporated. And when you will be investigating further you can take up a specific one issue on which you can academically you can do a research you can find out some of the terminology which you may learn like that it is called tribology.

Tribology is a subject that is which is called the science of friction wear and lubrication because any machine it deteriorates because of the friction. There are wherever there is a relative motion there frictions will take place and the wear will take place and other than that sometimes the parts will be getting corrosion there could be also the after repeated use there could be fatigue.

So, when you go for a maintenance of this machinery we need to know whether the how the machine is deteriorating. Just like your health you will have to take care of the health of the

machine that one of the most important thing is the lubrication you have heard even in your bicycle you may find if you do not put the well it will be just your chain will get damaged you will be finding that you are putting more force sometimes you find that your bearing is broken and it is the cycle is you do not require any bill to be put because it will be giving you a lot of noise.

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**Maintenance Aspects of Bulk Solid Handling and Transportation**

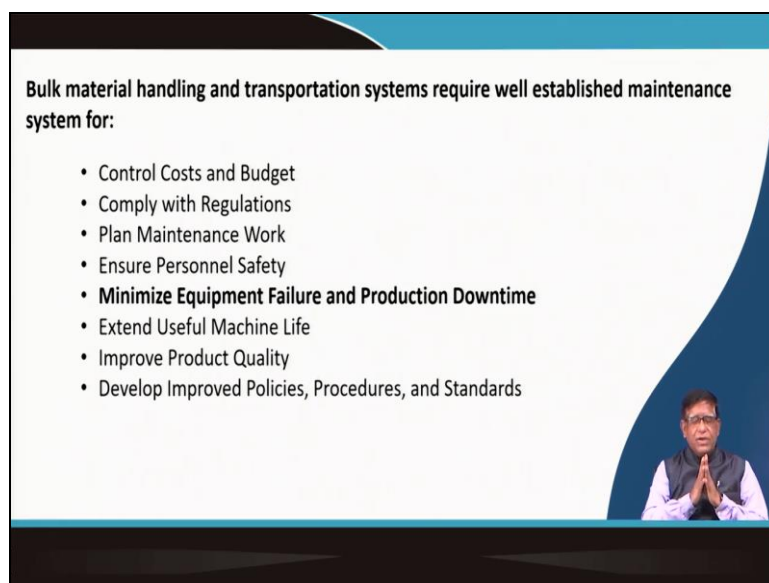
After going through this lesson you will be able to:

- Describe the objectives and functions of maintenance engineers in maintenance management
- Explain different types of m in bulk material handling and transportationaintenance

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So, similarly when you will be using a machine you will have to use that maintain it properly and here you the objectives and the functions of maintenance engineers in maintenance management that we will do it here. And explain different types of bulk material handling and transportation maintenance.

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**Bulk material handling and transportation systems require well established maintenance system for:**

- Control Costs and Budget
- Comply with Regulations
- Plan Maintenance Work
- Ensure Personnel Safety
- **Minimize Equipment Failure and Production Downtime**
- Extend Useful Machine Life
- Improve Product Quality
- Develop Improved Policies, Procedures, and Standards

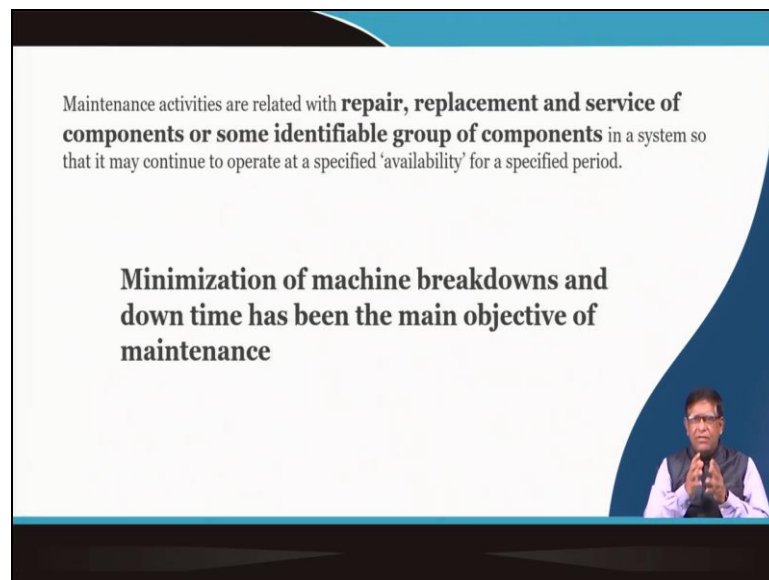
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So, these are the main things we will be doing here the bulk material handling and transportation system will require a proper maintenance system. Now, why that maintenance system is necessary because it control costs and budgets it comply with the regulations because that how you will be using a machines that it is also regulated. Then you will have to plan the maintenance work and ensure personal safety.

That safety will get jeopardised if your machines are not properly maintained because unmaintained machines will be liable to or it has got the risk of sudden failure. And it minimize the equipment failure and production downtime that is one of the things that why we go for a regular proper maintenance. And that is your if you do the maintenance it will extend the useful life of the machine and improve the product quality.

That is the by using that machines whatever work you are doing say if a if a crusher if it is that that crusher the liner you have not taken care of properly the gate may get increased that the what is the crust particle size you wanted you may not get. There could be more undersize may coming or more oversized becoming that means you are not getting the proper quality of the product. So, develop improved policies procedures and standards for operation there also you need to have.

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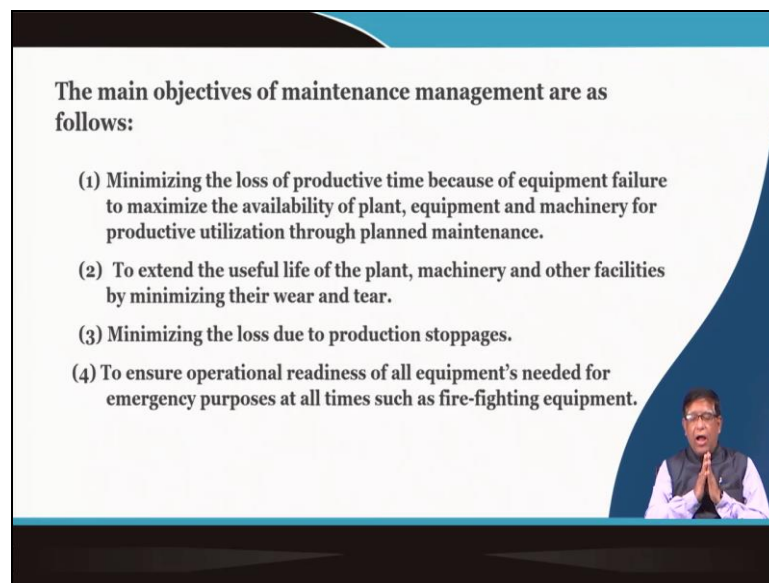


So, maintenance is a very important operations while getting the proper benefit of a machine or a system. The maintenance activities are related to it repair replacement service of the components or some identifiable group of components in a system. So, that it may continue to operate at a specified availability for a specific period. That means if you are depending on

how your work schedule your there are two things that the machine should be available and it should be utilizable.

That is it should be usable only by keeping your machine is available means you have maintained and all that thing but when your car if you see you start at the time it is not starting that means you cannot use though the machine is available but it is not available for the services. So, the minimization of a machine breakdown and downtime has been the main objective of maintenance.

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The main objectives of maintenance management are as follows:

- (1) Minimizing the loss of productive time because of equipment failure to maximize the availability of plant, equipment and machinery for productive utilization through planned maintenance.
- (2) To extend the useful life of the plant, machinery and other facilities by minimizing their wear and tear.
- (3) Minimizing the loss due to production stoppages.
- (4) To ensure operational readiness of all equipment's needed for emergency purposes at all times such as fire-fighting equipment.

So, this to be fulfilled that how along with this the objective is minimizing the loss of your productive time because of the equipment failure the if you do not maintain then it can lead to a failure. And it will have to maximize the availability of the plant equipment machinery or productive utilization through plant maintenance. So, the effective working hours of the machines should be maximum.

That means if in a shift you may take say the machine may be off because of you want to do the some repair and maintenance and then there is a some scheduled main break schedule stoppage you may be there. But other time if the operator comes and put it over there he can start working that is the how a machine should be available in your site. The extend the useful life of a plant machinery and other facilities by minimizing their wear and tear.

That is why you need to know how that wear and tear takes place wear and tear takes place by friction that is a surface damage may take place. So, whether the material if it is a two type

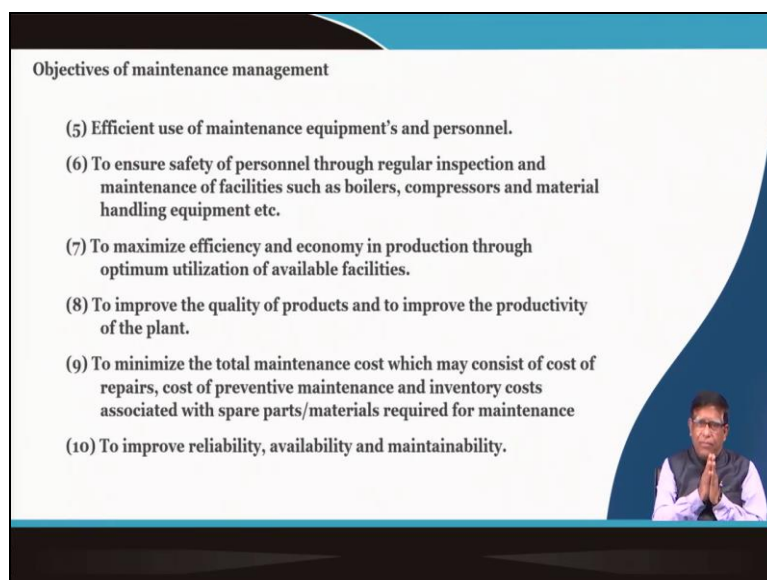
of two parts are rubbing together then at that time what type of surface finish should be there that need to be seen. And that is why the friction of that signs of friction would be to be seen.

And then for the type of material surface what type of lubricant will be there all the lubricants also there are different type of lubricants and the in certain things you may put it grease but in some places you will have to put some oil and then those oil also if you do not use the right specification oil to the right machine then you may damage your system. So, that is why you will have to when you are working with that machine you need to find out what the manufacturer has suggested.

What type of oil that oil characteristics that is what is its viscosity what is his flash point how it deteriorates those things are to be there. So, that is the in a maintenance when you will be working you will have to minimize the loss due to the production stoppages. So, for that you will have to monitor that whether at what time your machine is going getting damaged. So, maybe you will be monitoring the temperature of it if the heat is coming up.


That means the how the heat is taking away that is not working if the lubricating oil it is its purpose is also to keep the that is your rubbing parts cooled. But if you find that the quality of that lubricant has got deteriorated over time because of the friction some particles have come into that oil and that oil viscosity has changed its property has changed. So, that is why it is not being able to dissipate the heat and the machine is rubbing surface to surface and more wear is taking place.

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Objectives of maintenance management

- (5) Efficient use of maintenance equipment's and personnel.
- (6) To ensure safety of personnel through regular inspection and maintenance of facilities such as boilers, compressors and material handling equipment etc.
- (7) To maximize efficiency and economy in production through optimum utilization of available facilities.
- (8) To improve the quality of products and to improve the productivity of the plant.
- (9) To minimize the total maintenance cost which may consist of cost of repairs, cost of preventive maintenance and inventory costs associated with spare parts/materials required for maintenance
- (10) To improve reliability, availability and maintainability.



So, that is why by knowing the condition of the oil you can do a more maintenance. So, that is why you will have to find out that your objective is maintenance to get the proper monitoring of the things so, that you can take actions on it. So, efficient use of maintenance equipment and personnel if your maintenance should be such that your persons and then material whichever is for the maintenance the resources should be effectively used.

And ensure safety personnel through regular inspection and maintenance of facilities such as boilers compressors material handling equipment all these things you will have to during this maintenance operations their safety will have to be also managed. Because many of the accidents takes place for the maintenance crew because they will be working under different conditions.

So, you will have to ensure that while you are planning the maintenance then maximize efficiency and economy in the production through optimum utilization some available facilities. So, maintenance job is also to arrange for the facilities. So, improve the quality of the products and improve the productivity of the plant to minimize the total maintenance that means the maintenance required should be minimized.

So, if you do one thing then the next maintenance should not be there. So, these are again measured the by that is the time between two repairs. That is you are repairing today and that same problem should not come then if it again comes that is a time required between two maintenance should be longer and then time to repair that is your that that mean time between two fillers should be more but the time to repair should be less.

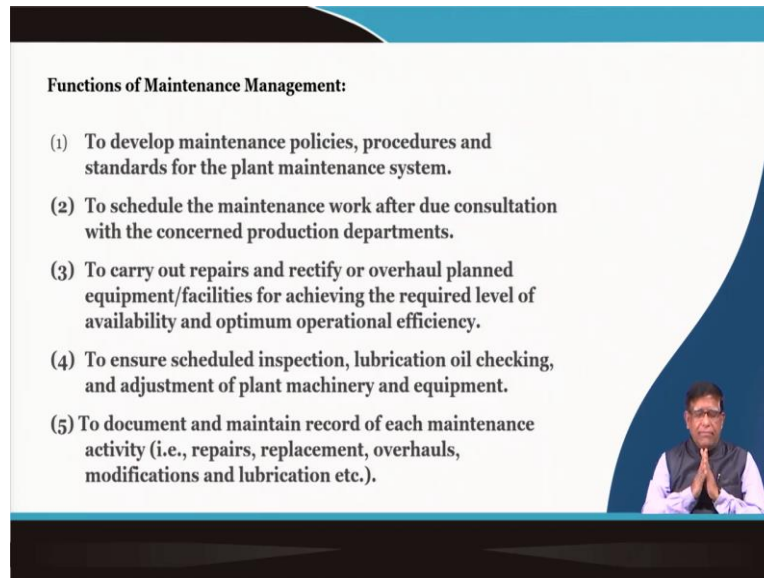
So, while doing the maintenance you will have to minimize the total maintenance that is within a short time you can do the maintenance and then you can prolong the time. So, that the machine will not stop or will not break down after certain maintenance have take place. So, that means that is the maintenance quality you will have to manage. And then afterwards you will have to have the reliability availability and maintainability of the machine.

Maintainability of course is designed when you have selected the equipment for your material handling at that time you will be finding out that the what type of the manufacturers are how they have made that maintainability of a machine may go down if you find that to check a

gearbox if that you have to go down below and then very difficult conditions to open that and then remove the gearbox.

So, that means the maintainability is less if it is there easily accessible you can open or even that your you can see a enunciation panel for the seeing the conditions that means that machines maintainability is more.

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**Functions of Maintenance Management:**

- (1) To develop maintenance policies, procedures and standards for the plant maintenance system.
- (2) To schedule the maintenance work after due consultation with the concerned production departments.
- (3) To carry out repairs and rectify or overhaul planned equipment/facilities for achieving the required level of availability and optimum operational efficiency.
- (4) To ensure scheduled inspection, lubrication oil checking, and adjustment of plant machinery and equipment.
- (5) To document and maintain record of each maintenance activity (i.e., repairs, replacement, overhauls, modifications and lubrication etc.).

So, the functions of maintenance management is therefore to develop maintenance policy procedures standards and plant maintenance system. So, you will have to find out that what is the maintenance policy or what are the maintenance functions being exactly how it is being managed at your work site. The scheduled maintenance work after they do consultation with the constant production department.

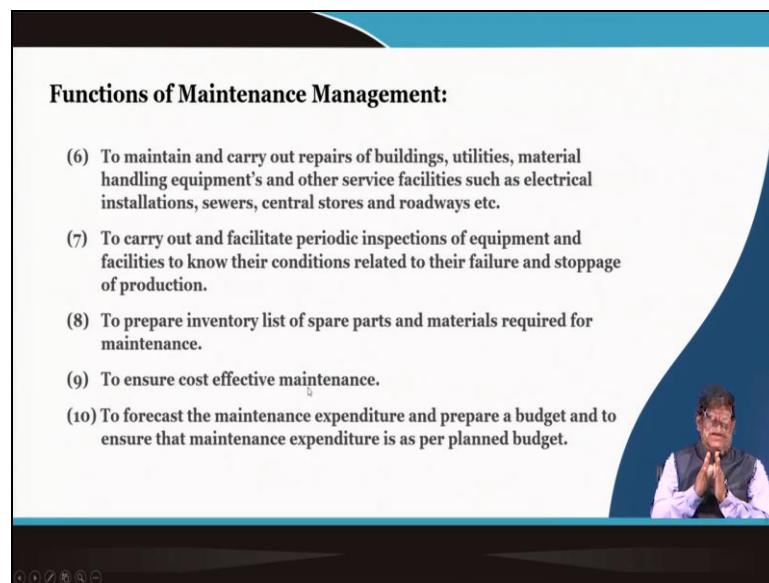
How exactly whenever a problem comes in you will need to plan that is your which activity will be done what material will have to be collected which are the persons to be deployed and this planning with a proper schedule then only that. Now, is I have taken the breakdown as quickly as possible I will do the maintenance and give it to the production system so, that they can operate it.

Now, to carry out the repair and risk rectify the or overhaul planned equipment facilities for achieving the required level. Many a time, you need to do these words that you are repairing but sometimes you do a overhauling that overhauling how it is to be done that is also to be

seen. Then to ensure scheduled inspection lubrication and checking that is a you will have to prepare a checklist.

And according to the checklist you depend determine a frequency whether you will be do is checking it daily some of the items you will be checking it weekly some of the items you will be checking in 15 days some after say 500 hour some after 5000 hours. So, make a schedule and get it reminder that which need to be done and that is called your checklist maintenance by doing that you will be exactly practicing what is called preventive maintenance.

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**Functions of Maintenance Management:**

- (6) To maintain and carry out repairs of buildings, utilities, material handling equipment's and other service facilities such as electrical installations, sewers, central stores and roadways etc.
- (7) To carry out and facilitate periodic inspections of equipment and facilities to know their conditions related to their failure and stoppage of production.
- (8) To prepare inventory list of spare parts and materials required for maintenance.
- (9) To ensure cost effective maintenance.
- (10) To forecast the maintenance expenditure and prepare a budget and to ensure that maintenance expenditure is as per planned budget.

That your document maintained and record the documentation is very very important because if you do not document then your next persons will not be knowing that what work has been done. And then this will have to be done for all your all buildings utilities material handling equipment everything will have to be brought under this maintenance system and you will have to carry out and facilities periodic inspection.

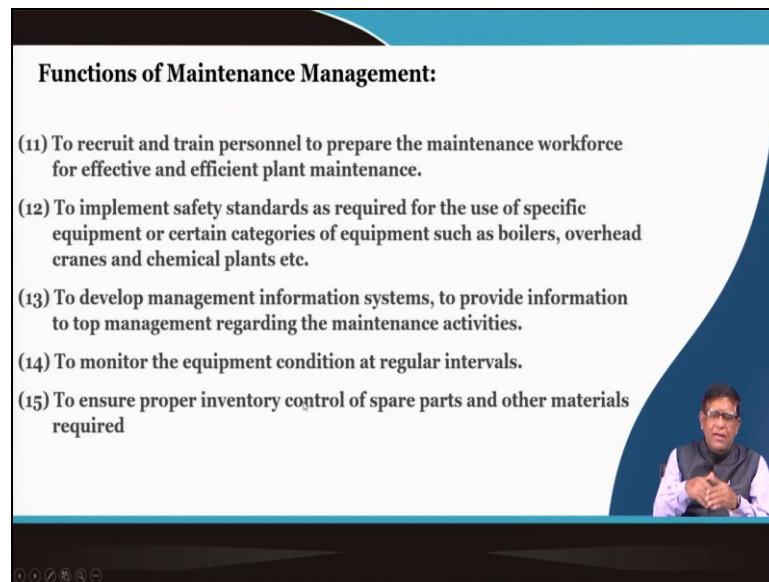
As I have said that without inspection you cannot find out that what is the periodicity of inspecting which item in what way and that inspection could be a visual inspection where instrumented you can bring a instrument and testis and sometimes you may install an instrument and by that continuously you will be getting online the what is the condition those are depending on these things you have got a different type of maintenance.

And your you will have to find out that how much your maintenance is cost effective you depending on that if your failure sometimes if it is very you need not maintain you just



replace it because it is a small low cost item and then there should you should not keep it that some items will be there you just take it out and put another one new let the system run and take this old item and then repair and maintain and keep it in your stock. If that one fails again you put it over there.

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**Functions of Maintenance Management:**

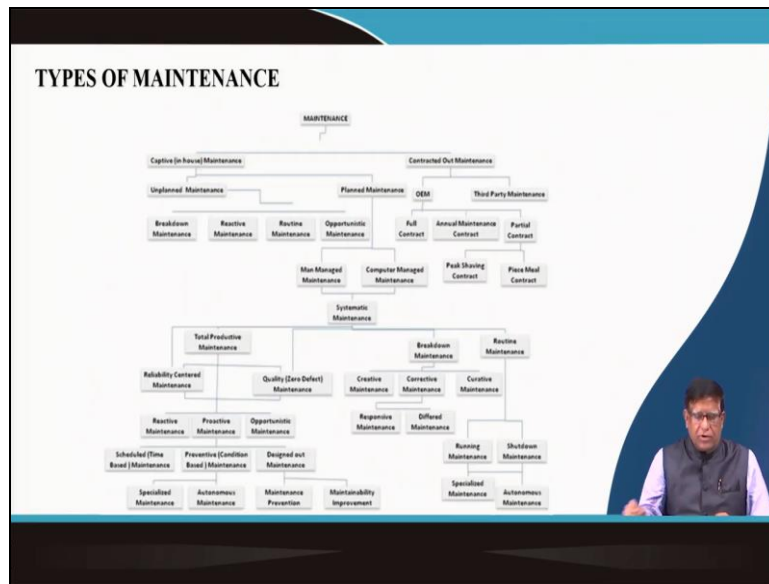
- (11) To recruit and train personnel to prepare the maintenance workforce for effective and efficient plant maintenance.
- (12) To implement safety standards as required for the use of specific equipment or certain categories of equipment such as boilers, overhead cranes and chemical plants etc.
- (13) To develop management information systems, to provide information to top management regarding the maintenance activities.
- (14) To monitor the equipment condition at regular intervals.
- (15) To ensure proper inventory control of spare parts and other materials required

So, there are different things are there but the management is so, that your failed system can be very easily returned to a operating system that means for that what you will be requiring as a maintenance management you will have to also have a maintenance crew and for that you will have to recruit and train personnel. That is why everywhere wherever you will be having a vocational training.

There the workers will have to be given proper training and that is why what will happen there all the machinery or instruments which you have got their detailed specifications and their detail functionalities then their characteristics all should be available in the engineers desk. Now, the implement safety standards required for the use of specific equipment or certain categories of equipment they will have to be properly in some equipment you need not worry about that is a very easily and easily available parts also.

But some parts may be some machine may be there the parts are not available they will have to be very careful to monitor their conditions and all. So, at the end you will have to develop an information system the total maintenance management information system is a very important one and nowadays with the digital monitoring systems you have got a lot.

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Now, all these things that your maintenance can be of different types of maintenance of course this chart looks like a very big but I will just tell you that the maintenance can be your the captive maintenance. That means within your company you are doing it yourself or it could be a contracted maintenance. You can give it that your you are employing you have given outsource the job the some contractor will come whenever the problem is there they will be doing.

Now, this contracted maintenance it can be through the original equipment manufacturer that is your original equipment manufacturer that OEM they can take the contract as you will find in many of the houses and all the lifts, lift are the different manufacturer there they keep the control of the things by they will be having a maintenance contract that every year some amount of money they will took that is called your annual maintenance contract AMC.

Then there could be a third party your original manufacturer are not coming they have given to the third party for whatever the spare parts and all required for maintaining the third party will get it from the this original equipment manufacturer. And sometimes the OEM they take a full contract or they can take annual maintenance contract or a partial contract. Then the partial contract it can be is a peak saving contract or a piecemeal contract the different type of contract of maintenance could be there.

But if you are not doing a outsourced you are you are not giving to a contractor you are doing by yourself keeping your own engineers then there could be two type of maintenance. One is unplanned maintenance unplanned maintenance job because problem with I at that time you

will do it that means you will be doing a maintenance on the basis of whatever comes that problem solving type of things.

Another is your planned maintenance this unplanned maintenance is called your breakdown maintenance you are doing nothing unless and until it is breaking once it is breaking down you will be finding you will be calling different people come and then solve it try to solve it as early as possible. And sometimes you will be doing a reactive maintenance when you find out there are something happening you will be mobilizing your resources to do it.

But in unplanned maintenance you can do certain routine maintenance also. That is your though it is unplanned but as a routine work you will be going on doing it over there and sometimes you will be doing opportunistic maintenance. Whenever you find an expert is there you taking away please just go and check it over there. So, you will be doing this opportunistic maintenance but the planned maintenance there are different type of one is your man manage that is your manually you will be doing the maintenance.

And the planned maintenance could be a computerized maintenance computer you are using digital you are using data analysis you will be using and that your machine learning you will be using nowadays artificial intelligence and machine learning are used for maintaining and then optimizing that your maintenance cost. And here when whatever whether manually or computerized you will do a systematic maintenance.

In that systematic maintenance there are a total productive maintenance this is a concept which came from Japan and then there is a breakdown maintenance in a planned breakdown maintenance they have got they either a creative maintenance, corrective maintenance or curative maintenance. Most common is your corrective maintenance where they will be doing a responsive maintenance or deferred maintenance.

They will be relying and then depending on the type of resources you will be doing. In case of routine maintenance you will be doing either running maintenance or shutdown maintenance that is every shift or every first shift in the daytime you will be taking two hours and there all that everything is shut down each and everything will be checked up according to a checklist and they will be doing the routine maintenance over here.

And there you can do a specialized maintenance some of the very specific and important job where a specialist is required or you can do a autonomous maintenance that automatically certain things will be you allow it to run for maintenance. Similarly when other type of maintenance which developed over the year is called your reliability centered maintenance. In the reliability centered maintenance they determine that as a what is the reactive maintenance proactive maintenance and opportunities maintenance .

There they determine what is the reliability of the equipment whenever you are working after that you have done the repair. You try to find out that how will you ensure that it will be working and to do that this they do a pro proactive maintenance and along with that the new term is we are getting a prognostic maintenance. Before this prognostic maintenance there when they do this proactive maintenance they do the preventive maintenance on the basis of condition.

Earlier in the preventive maintenance what they used to do in the preventive maintenance they were just doing a checklist and going on checking and over there. But for that your the system need to be shut down and putting it there even if it is no problem but you are you will be going on checking. But in a condition based preventive maintenance you have put some instrument sensors over there and whenever they have indicated whichever has in the given some indications that part only you will be opening and checking and doing it.

Because otherwise what happens sometimes if just on a checklist maintenance you are to check the gearbox you will be opening the gearbox and at that time when you are again closing it if you do not do properly some dust may go inside and then the your gear will be damaged after the preventive maintenance. So, to avoid such type of things they put that say either you can put a boroscope or you can put a that is your gear ticket monitoring system.

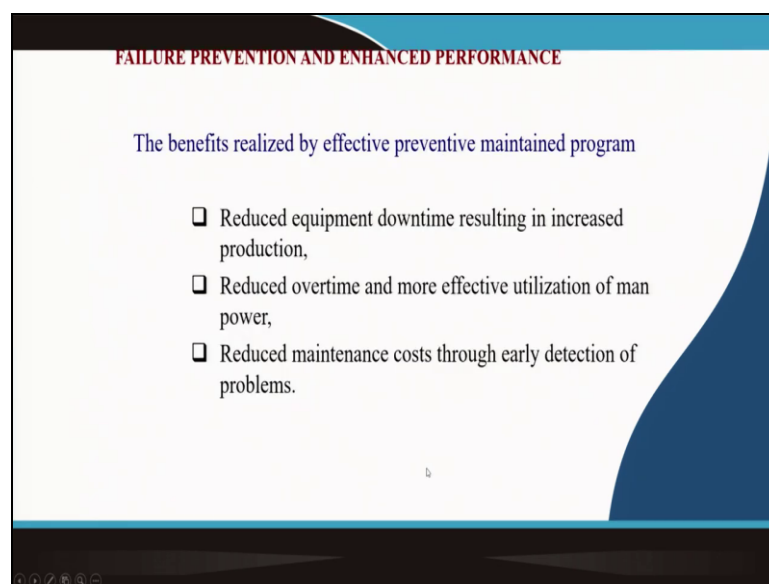
You will be putting a oil condition monitoring system by that you will be knowing what is the condition of the gear kit or you can have a your optical fiber inserted into that and you can take an image of the things that if everything is ok then you will not touch the gearbox do not open it. So, that type of things call your condition based maintenance and there also you can bring your specialized or autonomous type of things.

And the designed out maintenance is you find out when you are inspecting it with your instrument and sensors you find that some parts are exactly going faulty and they will be creating a problem and your machine may failure. So, they will change the design and they will make it as a maintenance prevention that is by doing a design work they will and then sometimes what they do in the design in the construction itself they will put something and they will call it as a maintainability improvement.

So, now, you can see over here that this type of maintenance it has developed over the time in the in your last century in the 20th century up to 50s and 60s it was only a preventive maintenance checklist maintenance. Then came this condition base maintenance came in 70s and 80s that of the last century the condition based maintenance came and then it started coming with the reliability based maintenance.

When the reliability based maintenance came after that this computerized maintenance management system came in the 1990s it started working over there. Then it came today is the prognostic maintenance in which that you are having the sensors and then they are intelligent enough to monitor and give the decisions what to be done and then the automations come some of the things the automatically by itself get repaired that type of systems have also now, coming.

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The slide features a blue header with the title "FAILURE PREVENTION AND ENHANCED PERFORMANCE" in red. Below the title, the text "The benefits realized by effective preventive maintained program" is displayed in blue. A list of three bullet points, each preceded by a square checkbox, details the benefits. A large blue curved shape is on the right side of the slide, and a small cursor is visible near the bottom center. A navigation bar with icons is at the bottom.

**FAILURE PREVENTION AND ENHANCED PERFORMANCE**

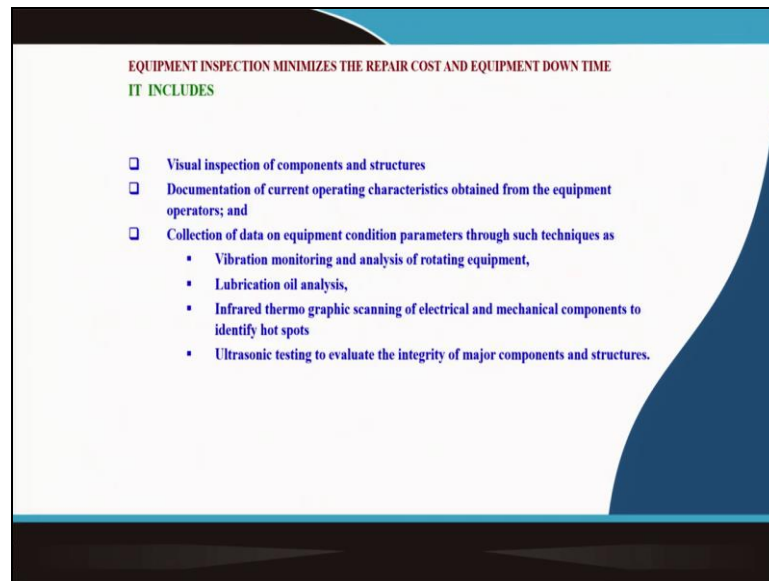
The benefits realized by effective preventive maintained program

- Reduced equipment downtime resulting in increased production,
- Reduced overtime and more effective utilization of man power,
- Reduced maintenance costs through early detection of problems.

And this is how exactly different type of maintenance they will be giving the failure prevention and enhanced performance once you do it the benefits will be the effective preventive maintenance program that will reduce equipment downtime resulting in increased

production. Now, reduced overtime and more effective utilization of manpower can take place and reduced maintenance cost.

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If you are doing the things in proper manner this will be giving that your the benefit of the maintenance systems. Now, equipment inspection will minimize the repair cost and equipment downtime because it includes the what type of exactly maintenance inspection you will be carrying out. There will be visual inspection of components and structures documentation of the current operating characteristics obtained from the equipment operators.

And collection of data on equipment condition parameters through such techniques that what are those techniques that will be used for your maintenance improvement the vibration monitoring and analysis of rotating equipment this is one of the very important things some of you can study this aspects of this the vibration monitoring. And then because every component every bearing every shaft every foundations where you are put when after and commissioning it will be giving a signature.

It will be having a what type of vibration it is coming now if you continuously monitor it then if there is any change have taken place say for example the your the gearbox and your motor there two subs are connected by a coupling. Now, this coupling if there is a little bit of unbalance that is the alignment is not proper when it will be rotating every time there will be a different type of sound by knowing that vibration level it is changing you can find out.

Now, maybe because of the your mounting nut and bolt somewhere it has got loose because of the disalignment has got a problem. So, by monitoring those vibrations you can start action on that you can remove that. Otherwise what will happen if that shaft or the motor or the whole system may go wrong and then you will be losing your productivity. Then another thing is lubrication analysis.

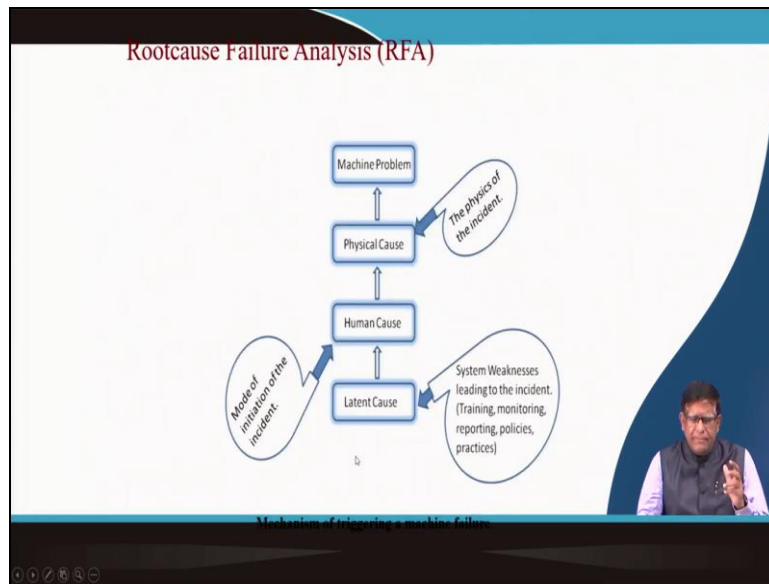
As I already said the oil contamination and that that monitoring and things it could be helping then infrared thermographic scanning and electrical and mechanical components to identify hot spots. This infrared camera that is exactly when you sense that is with the help of when your normally when you see the reflected waves are coming only 0.4 to 0.7 micron wave for our bibs your range.

But if your camera can detect that means if you can detect that whatever that your radiations is reflected back from the surface in a say for example your up to 0.14 micron that is giving your the thermal radiation infrared radiations you are detecting. Now, by doing that you can exactly make there is a subject which is called your tomography. In a tomographic manner you can find out if there is a different portion is getting hot you may not see it but thing is that that will reveal.

And by that exactly you can find out if there is any stress is developing normally the equipment any mechanical component they before failing they develop certain stress they develop some emphatic at that time their internal structure started changing and those things can be monitored by these methods. Similarly ultrasonic testing to evaluate the integrity measure components if some cracks is coming that time also by ultrasonic you can find out that a crack will be giving a different signature.

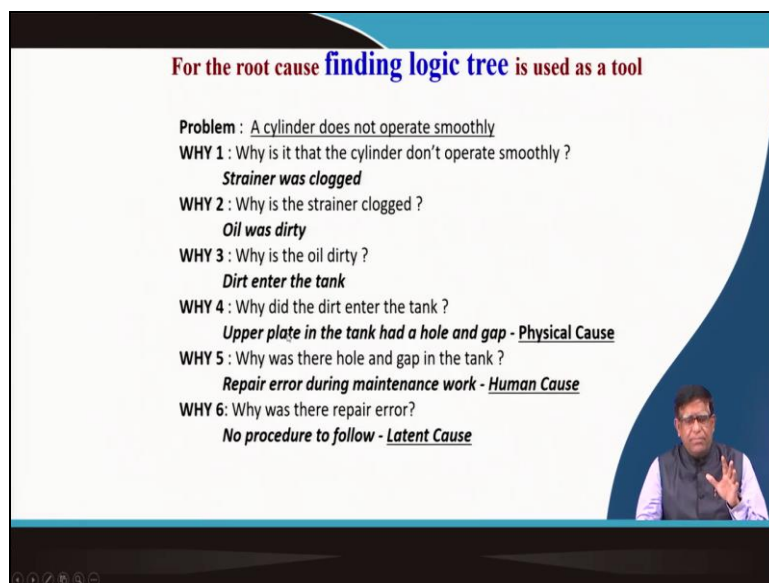
Other than that you may have die penetration methods there are lot of things that you can have along the inspections sometimes if a failed surf failed surface that is also tested and looked into that what has happened. There are lot of issues here that non-destructive testing entity is another way of finding out how the particle is behaving.

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And then you can do the root cause failure analysis is another area when a machine problem comes your physical cause that the physics of that incident then you can find out the human cause. That how exactly that incident has happened and the latent cause that is your system weakness leading to the incident what exactly training monitoring reporting policies required.

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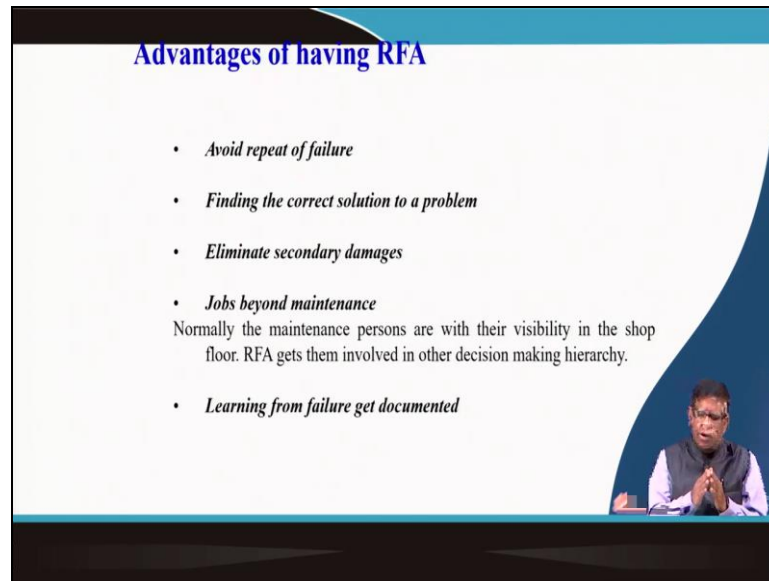


That is a root failure analysis can be done by certain questions for example a cylinder does not operate smoothly you are in a hydraulic cylinder you are working for a say in any material handling machines. Then you will be asking why is that cylinder do not operate smoothly they can say strainer was not clogged most probably then why the strainer is clogged that the oil was dirty why the oil was dirty dirt entered through the tank.



Why the dirt entered to the tank upper plate of the tank had a hole and gap. So, that is a physical cause you can find out. Why was there a hole in the gap in the tank that is repair error during maintenance work that means human cause at the time of repairing they did the problem why was the repair error no procedure to follow latent cause because you have not maintained a the whole thing is coming there is no proper instructions it sop for the work personal. So, that means there is no system.

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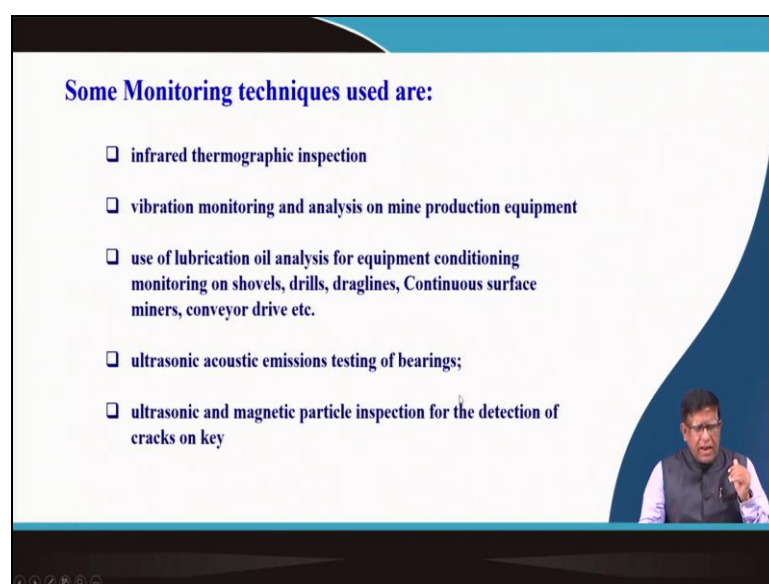


**Advantages of having RFA**

- *Avoid repeat of failure*
- *Finding the correct solution to a problem*
- *Eliminate secondary damages*
- *Jobs beyond maintenance*  
Normally the maintenance persons are with their visibility in the shop floor. RFA gets them involved in other decision making hierarchy.
- *Learning from failure get documented*

So, like that by analysing the root failure analysis you can avoid the repeat of failure finding the correct solution of a problem eliminate secondary damages jobs beyond maintenance also can be improving.

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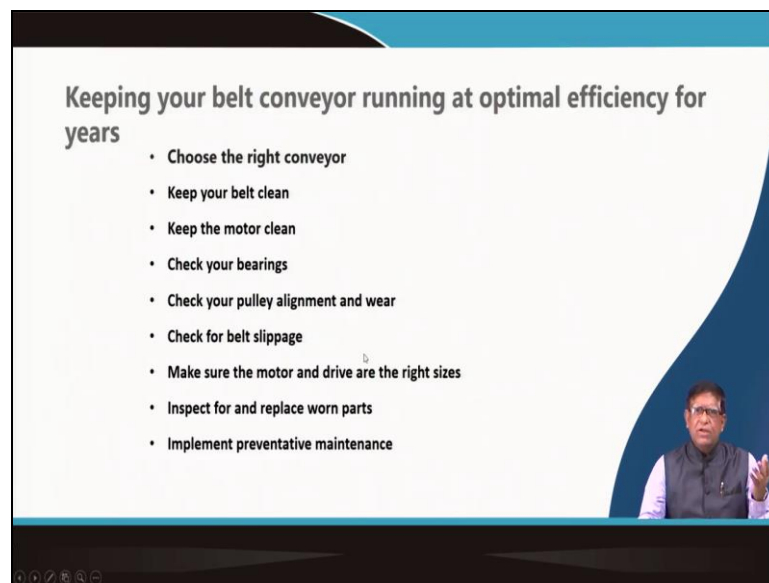
**Some Monitoring techniques used are:**

- infrared thermographic inspection
- vibration monitoring and analysis on mine production equipment
- use of lubrication oil analysis for equipment conditioning monitoring on shovels, drills, draglines, Continuous surface miners, conveyor drive etc.
- ultrasonic acoustic emissions testing of bearings;
- ultrasonic and magnetic particle inspection for the detection of cracks on key

And learning from the failure should be documented in this way you can use moreover you will have to find out if you are interested that what are the infrared thermographic inspection what is the vibration monitoring how the oil analysis can help how ultrasonic acoustic emissions can help or this magnetic particle inspections for crack and all to detect then you can take magnetic powder and then with a magnetic field.

When it is created and you give some iron fillings over there you see that in which way they get attracted.

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So, that by using simple physical methods you can find out the; how to find out that there is a problem in the machines. Keeping your belt conveyor running in optimal efficiency what you have to do you will have to select the right conveyor keep your belt clean keep your motor clean check your bearing check your fully realignment and wear check for bell spillage make sure of the motor and drives are in the right sizes.

Inspect for the replace one part these are some of the instructions you will find out when you go to the field.

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**Ways to optimize conveyor belt operations and boost productivity**

- 1.maintenance is the key to maximizing ROI
- 2.find fixes to common problems
- 3.calculate the load
- 4.check your conveyor belt's performance
- 5.choose the right horizontal and vertical conveyors
- 6.train for conveyor belt safety
- 7.design workstations ergonomically
- 8.choose the right belting

I am just trying to give you a feeling that in industry how this maintenance are going on and you have studied about the conveyor belt you have studied about the truck. But your this return on investment of the systems you will be maximizing only when your maintenance is proper and then you will have to problems if there is anything then your maintenance will fix it. And then what type of load it should be there that also maintenance people will be able to calculate it out.

So, you can overall performance and overall that is benefit of the systems can be found when you apply the maintenance engineering concepts.

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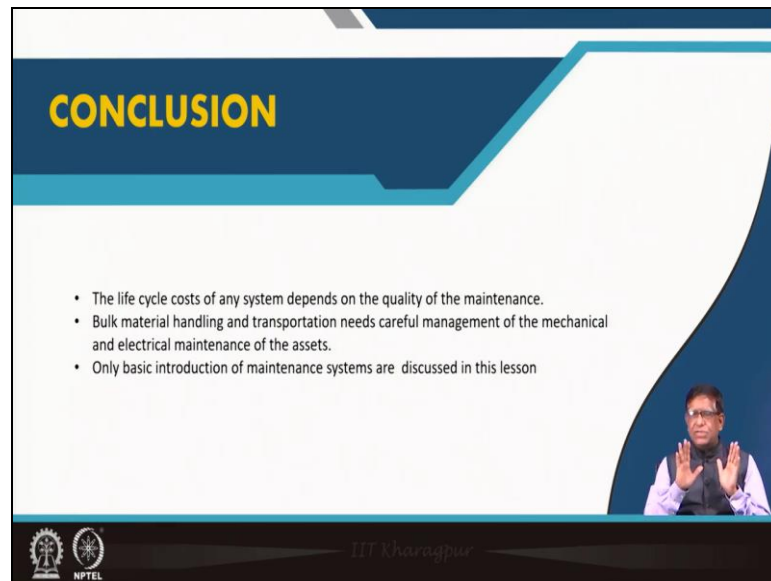
**REFERENCES**

1. [Maintenance Management: Importance, Objectives and Functions \(yourarticlelibrary.com\)](http://yourarticlelibrary.com)
2. <https://ftiinc.org/10-ways-keep-belt-conveyor-good-shape/>

You can see this also there is a book by the R.C. Misra and myself as R. C. Misra that rudiment of maintenance engineering you can read that book and there you will be finding

that exactly how maintenance management and the maintenance engineering is done. A lot of books are available it is just some articles also you can read from the net.

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The slide features a dark blue header with the word "CONCLUSION" in yellow. Below the header, there are three bullet points. In the bottom right corner, there is a small video inset showing a man in a white shirt and glasses speaking with his hands raised. At the bottom left, there are logos for IIT Kharagpur and NPTEL. The name "Dr. Khurshid" is written in the bottom center.

**CONCLUSION**

- The life cycle costs of any system depends on the quality of the maintenance.
- Bulk material handling and transportation needs careful management of the mechanical and electrical maintenance of the assets.
- Only basic introduction of maintenance systems are discussed in this lesson

Dr. Khurshid

But the life cycle cost of any system depends on the quality of maintenance it should be clear in your mind. Bulk material handling and transportation needs careful management of the mechanical and electrical maintenance of the assets. All assets that what are the electrical maintenance what is mechanical maintenance need to be separated out. While you are studying one of those machines the conveyor belt or the crusher or the screen or the bins or the bunker.

Take one of them and in that try to find out what are the maintenance what will be the checklist what will be their say weekly maintenance what is their monthly maintenance what will be after 5000 hours what should be done. Those are aspects given and here today I have just discussed the basic introductory concept of maintenance engineering. I hope you study little further.

Once you know that what is happening in the bulk material handling and transportation sector with the different machines selected there you can plan your maintenance and then you can start more analytic work on this, thank you very much.