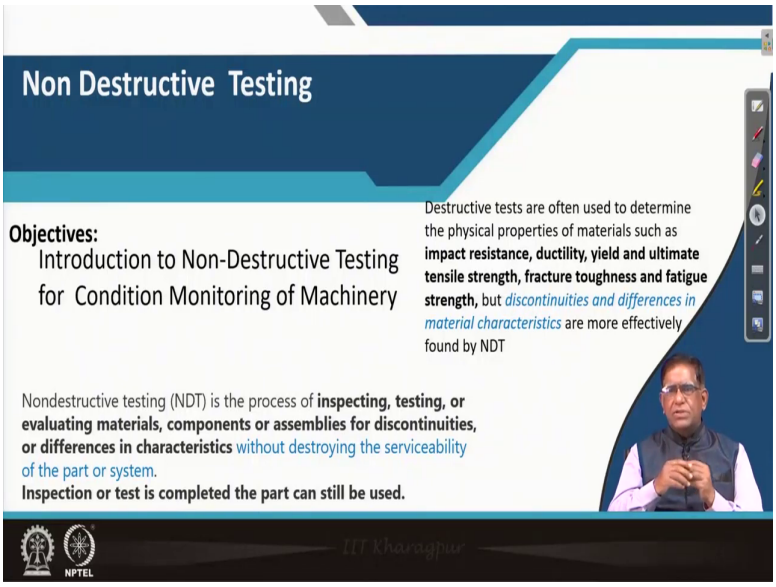
Mining Machinery
Prof. Khanindra Pathak
Department of Mining Engineering
Indian Institute of Technology, Kharagpur

Module - 11
Lecture - 60
Non Destructive Testing

Welcome boys. Today, it is our last class of this course on Mining Machinery which we designed for different machines as well as through certain extent introduction of the maintenance and today, this concluding class I will be talking about some advanced technique which are being used in maintenance of machinery.

So, you know that is a Non Destructive Testing this is an area which is, which has got lot of scopes in enhancing the safety and productivity of our machines. So, this today this slides I will be showing here are all taken from this National Science Foundation of Iowa state, where they have got a this nondestructive testing the educations forum they have produced a lot of materials which are of use, you can also see they are available in the public domain.

(Refer Slide Time: 01:44)



Now, this objectives of today is to introduce this nondestructive testing and so that you can think of how such type of systems, such type of testing can be incorporated in our condition monitoring of machinery and then how the maintenance can be improved so that the overall capacity utilization and performance of the machines are improved.

Now, as we know that this machinery problems come because of the failure of certain components. So, those components there what is the their internal of this structure how their exactly the capacity of that is how their breaking strength or compressive strength whether those are remaining same or not.

It cannot be normally done by nondestructive testing. Normally, what is done? A lot of destructive testings are taken. This destructive testing which is for impact on the resistance their ductility yield their ultimate tensile strength, fracture, toughness, fatigue strength these

are very very important property. So, then while these parts are used at that time you cannot test it you might have studied in the strength of materials or in mechanics of solids.

If there were some practical classes in your second year level normally you have done how you do this either tests and different test of specimen there was defined specimens are there, they are under impact and all their crust and then once it is tested, the test specimen is no longer it is used because that is a destructive tests.

But, while doing this test, how exactly there is any discontinuity within the structure or how exactly internal things are there in that particular material or member that cannot be done. That is why this nondestructive testing it came and which is a process by which you can inspect tests or evaluate the materials and their components and particular assemblies if there is any discontinuity or there is a change in the characteristics of the material which may lead to a premature failure which may cause to an accident.

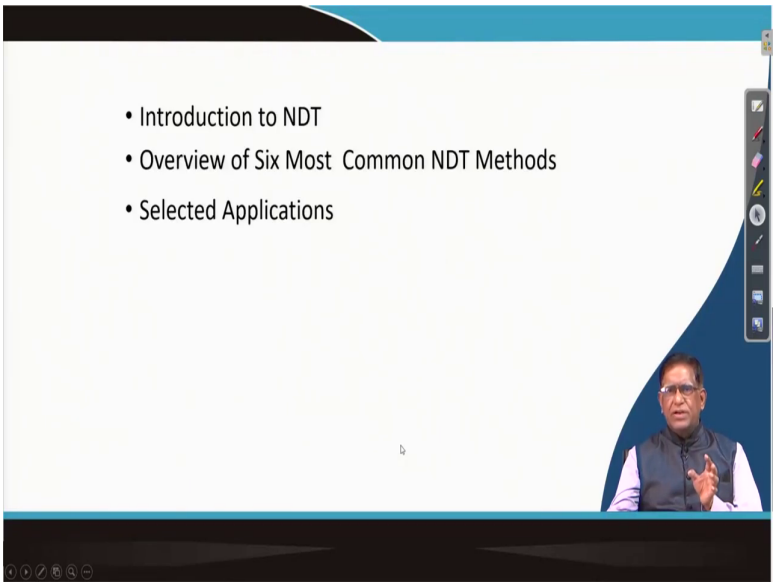
So, that is why this then what is there? When you are doing the tests while the item is in use that is the principle or philosophy behind this non-destructive testing or it is sometimes it is called also nondestructive evaluation.

(Refer Slide Time: 04:35)

So, today we will be just giving a brief that is a bird's eye view on this subject and we will be describing few applications under advantages in the mining industry how we can take it up, but you should note it down that there are many organizations in the world where they are creating a standards and code of practice how those things will have to be done. So, those standards are basically from the American Petroleum Institute, American Society of Mechanical Engineers, then American Society for Nondestructive Testing.

This society they have exactly standardized many of the this nondestructive techniques. So, in France also is there, then Canada also there I think Indian Bureau of Standards they have also certain standards certain testings have been standardized.

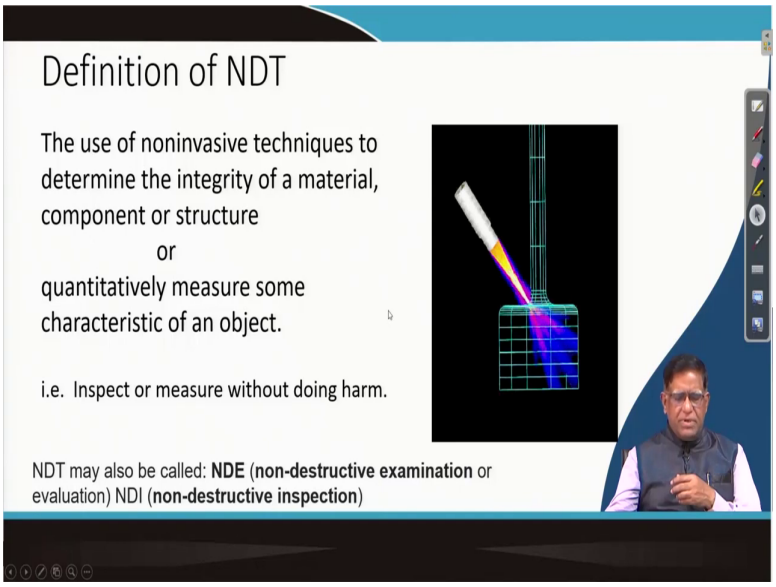
(Refer Slide Time: 05:42)



So, one thing if you are when you will be going to field as an engineer you will have to be aware of these standards so that in the industry you can do a very that is your in a better way the work can be carried out. So, now, we have got this introductions that in nondestructive testing NDT is nothing, but having the internal characteristics of the materials are known while the member is in service or you are not destroying it, it is still in use.

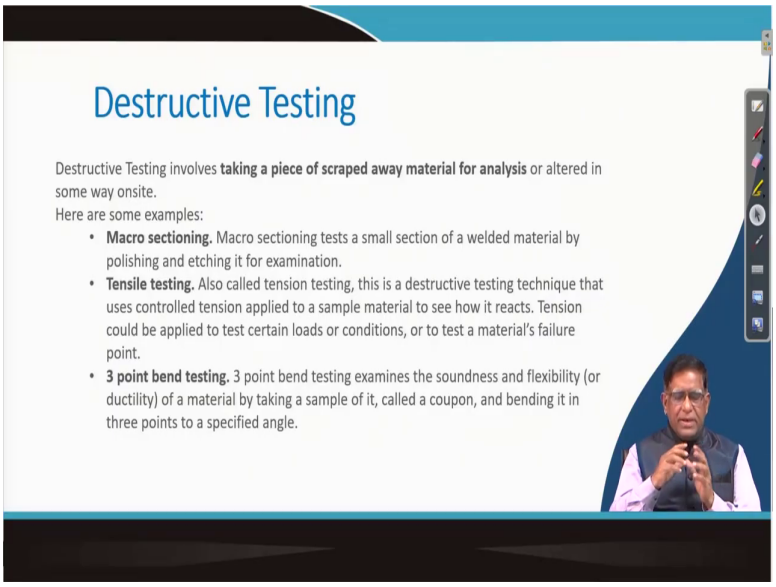
So, there are many methods. Some 6 or 8 methods we may be talking today. There are many new methods and there are many new things will be coming up. It is basically the physics and the chemistry and material science – metallurgy, from those sections these knowledge are being developed a new creative innovative ideas are coming and those things are to be used. As a mining engineer, as a mine manager you need to get those development and innovations of different fields to be used over here.

(Refer Slide Time: 06:37)



So, it is clear to you now that the nondestructive testing is nothing, but use of non-invasive techniques which do not destroy the material, but it can you can reveal what is there and it is also called nondestructive evaluation or nondestructive inspection.

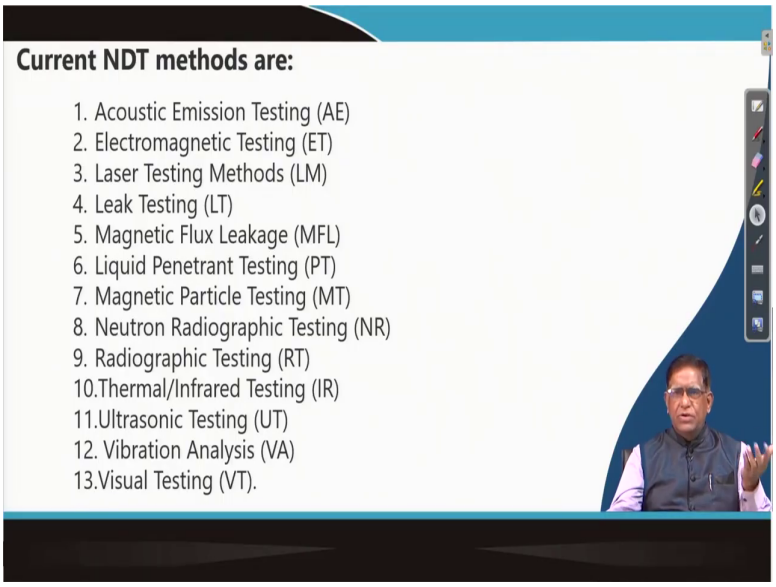
(Refer Slide Time: 06:59)



Now, in the destructive testing you may be knowing that what need to be done. If suppose you have done a welding, after that welding things are correct or not you need to do a micro sectioning test. A small section or portions are cut and taken it out and then they will be doing over there some testings are done.

Tensile testing you know that is a tensile test is there that is a particular specimen is created and then it is broken in a particular test rig. And, then there are also for bend 3 point bend testings these are standardized tests by which that is your the whether the material is really working or not how it will be behaving in bend, those things are done by bending the material properly.

(Refer Slide Time: 07:48)



So, those things are done, but in nondestructive testings you do not bend or you do not destroy the sample or the piece of material they are done differently using the advance scientific knowledge. In this, that what are the some of the techniques like acoustic emission technique that is your exactly very high frequency, this your sound wave they are used for doing this testing. Electromagnetic testing is another way, then laser testing, leak testing, magnetic flux testing.

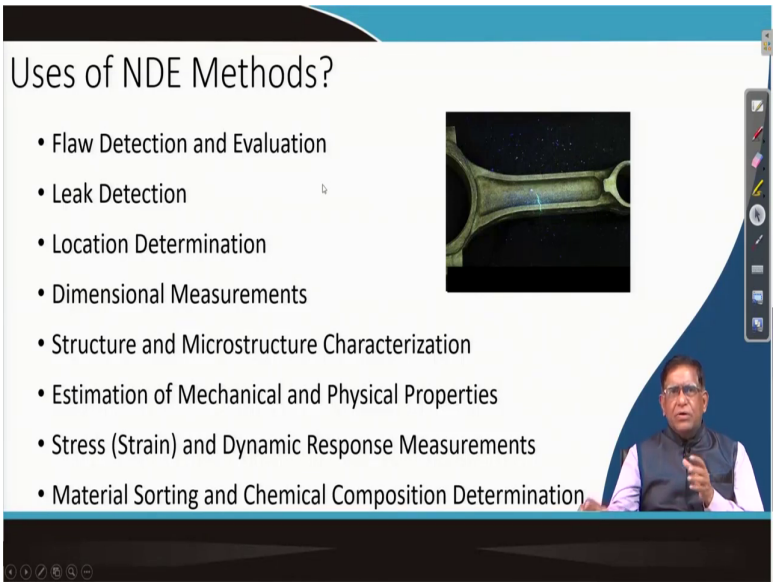
That is magnetic flux leakage for our winder wire rope also it is used, then your liquid penetrant testing which can be used for our winder drum gear whether the gear teeths are proper or not there we can test it, even sometimes on a boom or in a pipe if there is any crack coming up that can be done by this liquid penetrant testing or magnetic particle testing can be

used for that. Then neutron radiographic testing – this radio graphic testing is also if there is any flaws inside the particular piece of item can be find out.

This radiographic testing, thermal infrared testing, ultrasonic testing, this vibration analysis, visual testing like that infrared testings means you are taking a infrared photography that is another methods which are very much used called tomography. Those are the terminology which are coming up these days need to be at least you should be aware of this how it is done and then the instruments which are being manufactured and then this testing feature done by others you need to understand.

And then find out in mining industry where you can use these tests.

(Refer Slide Time: 09:29)

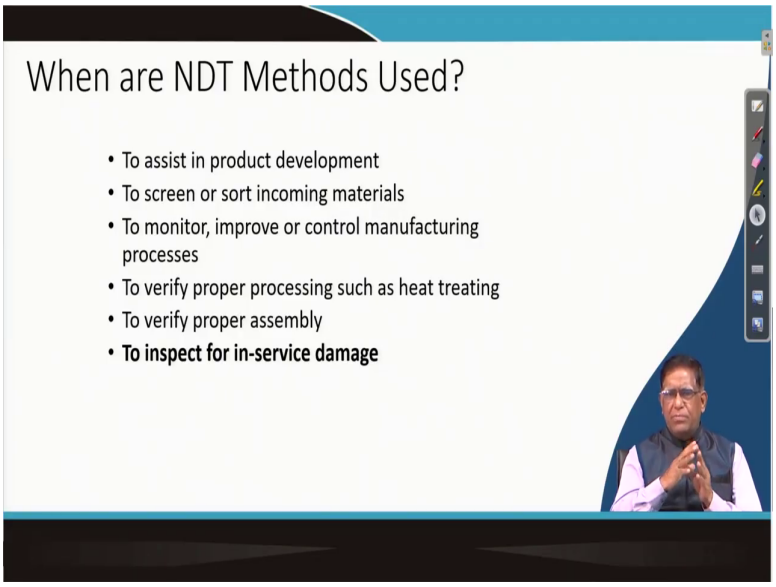


So, for example, this is our nondestructive evaluations it is done for flaw detections. If any piece of member anything there is inside a crack or things like that how will you do it? So, these flaw detections your the particularly this nondestructive testing will be used for leak detections if any pipe or anywhere from that there is a leak is coming.

Where is the location determination where from that exactly problem is coming. Say for example, sometimes you get some vibrations from a particular this say bearings or gearing gear box then where exactly that is located can also be done by some of the nondestructive testing; then structure and micro structure characterizations can be done.

Then particularly that particular member after use as the aging is done that how the aging effect is coming if any creep developed is any weakening of the material or weakening of the particular member is taking place, that thing also can be evaluated by estimating the physical property or the behavior how it will be doing in pressure. So, basically the stress and dynamic response measurements can be done by doing this and this non-destructive testing.

(Refer Slide Time: 10:46)

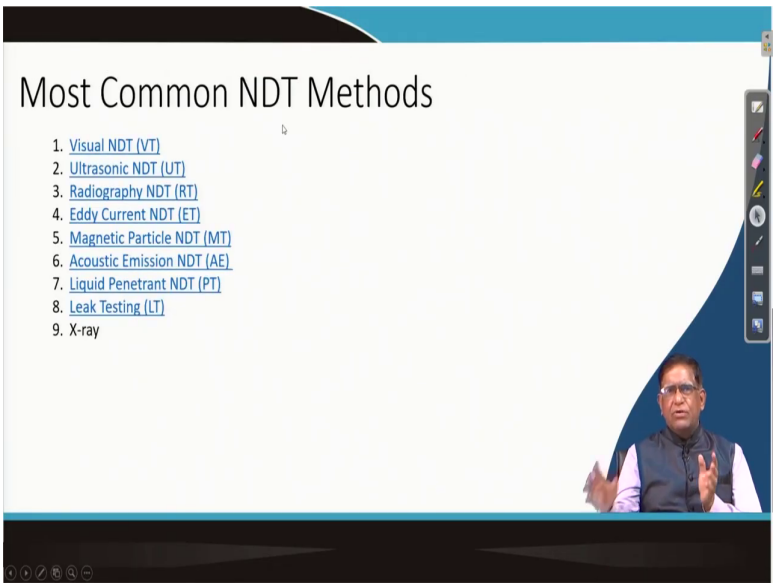


Now, where and why you will use in the mining industry? It is to assist the product development if exactly you can when a particular item is being purchased at that time you can demand that you send the nondestructive testing report while you are manufacturing a part so that you can be sure that it will be serving your purpose.

To screen shot of the some incoming materials. To monitor, improve and control manufacturing process that is if you are using you are having a good workshop where you are of say the making some critical parts which will be used for say for your some of these roof bolts and all that is exactly when you are making those bolts whether they are coming with the proper property or not after this you can test it and then you can let it go.

Similarly, you can verify proper procession such as the heat treatment you do in many parts, whether the heat treatment is done properly or not can be tested. So, but basically it is whether there will be any in service damage have taken place that also can be tested.

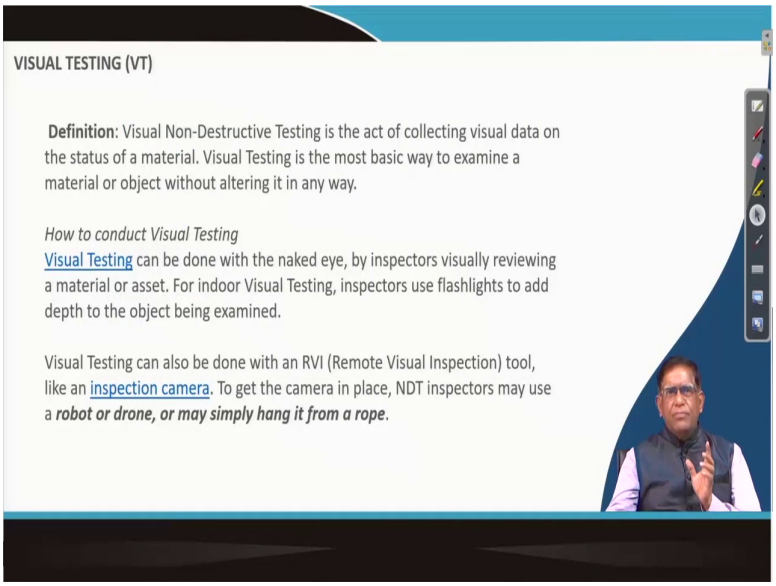
(Refer Slide Time: 12:00)



So, these are the most commonly used methods. These methods you can make a your own drossier about what is the latest devices available, who are the manufacturer, whether such type of manufacture are there in Indian or not, if not that is exactly what it makes to manufacture such type of things, whether this the principle can be adopted and can we locally manufacture some of this that in that system or instruments, then in manufacturing those things then how that what type of market will be there.

So, that type of study you should do those particularly who are looking for our entrepreneurship and some Make in India movement if you want to join.

(Refer Slide Time: 12:51)



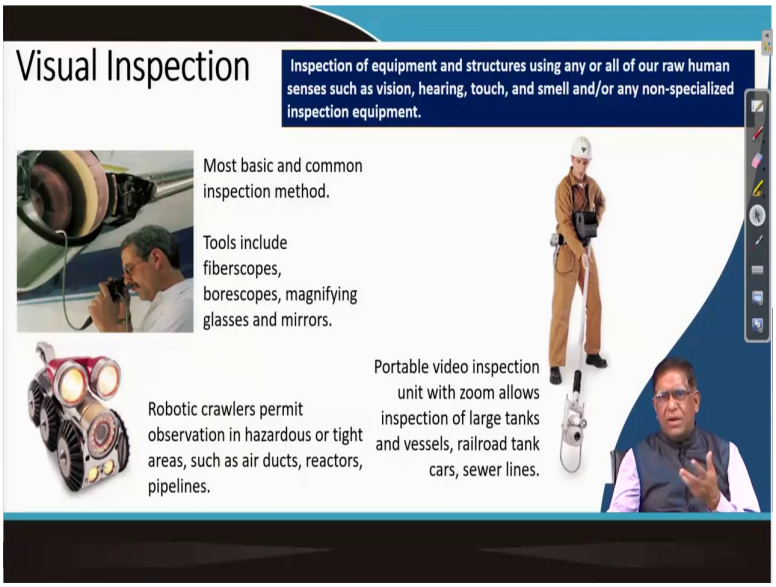
So, now let us see this what is this visual testing. Exactly in any maintenance job you do and see the things and find out whether they are we use that seeing means by without any instruments, by we can hear, we can see, we can this like that when you go to see over there then you find out whether there is a cracks and all.

But, by looking it you may not see the crack then you will have to take it for other devices. And, some equipment say for example, you are going to see the shaft in a mine shaft there are the liners there, there are the guide ropes are there, now, these guide rails are there.

Now, if those things are for a long time you are using under a corrosive environment if the corrosion has taken place whether they are exactly in any places there is a corrosion or some this rusting is there or not, to see that you will have to you cannot go in between. So, you can think of easily if you take a drone and then you have some good light emitting and then a photography taking arrangements in the drone, it can go down the shaft and take the things and it can do the inspection.

So, that type of inspection comes under visual inspection.

(Refer Slide Time: 14:31)



So, for example, while just at the time of your blasting, then this lot of fumes and other things are coming at that time you cannot go there. It is dangerous, even in underground blasting you

cannot go up to that much because there may be noxious gases coming up. At that time also you can keep certain things that it will visually take up.

What happened exactly at that moment of blasting and it can be brought in and you can take decisions. Like that this is not only with the machinery with the other operations also this visual inspections help. Now, it is a for looking into there are different devices say for example, in a gear box. How the gearbox inside the teeths are there, there are instrument like your borescopes and all just like your stethoscope hear sound like that our with a microscope you can see a piece.

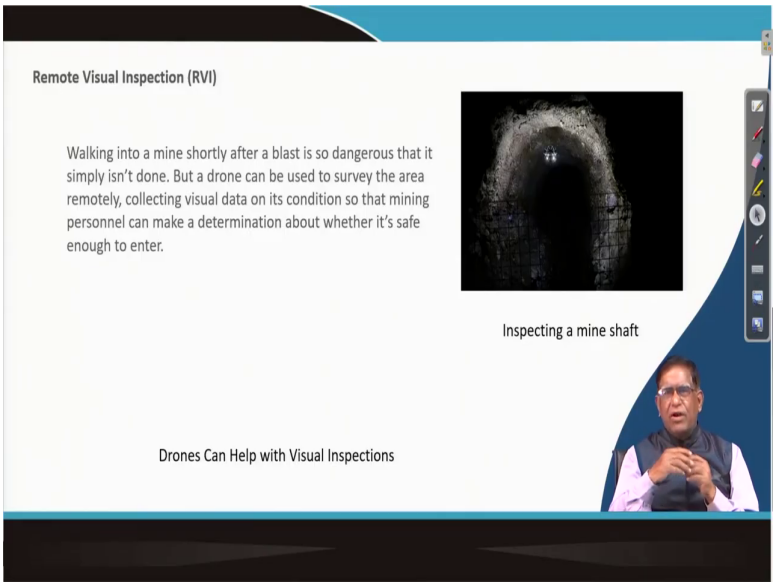
Now, there is a borescope in which there will be a microscope inside a tube and that tube can be inserted into the gearbox and you can take a image and that you can visually see what is happening there inside. So, that type of visual inspections can be carried out. Similarly, that is your inspections you can do it by making those camera or other sensors mounted into the other device and then you can put it over there and do it. For example, in your crushing plant in that your crusher in iron ore mines.

If you go there this is a run of material is going to a jaw crusher first. In the jaw crusher when the jaw are that exactly making at that time there will be the say the liners whether they are varying or not, you cannot go there to see because when it is coming when the things are in operations you cannot do.

But, there you can have a visual inspections through camera can be installed over there and you can see the exactly that how the they are interacting with the rock and what is happening there. So, that type of things are there. By using robotic crawler that type of things are also it can go and climb different ducts or reactors pipelines there it can go.

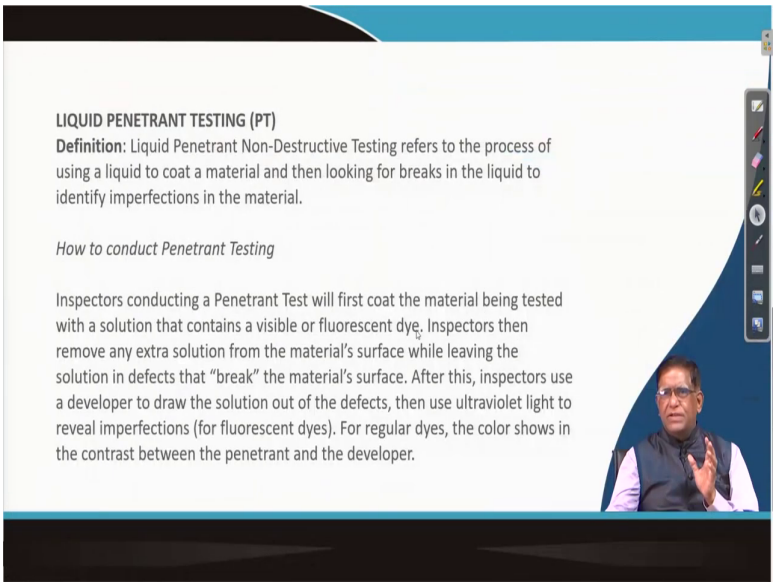
Similarly, such type of camera can go even in your underwater. Say in a mine sump and in the sump exactly below there could be a lot of this mud and pit and there if something your machine say you are having a pump installed if that is going wrong you cannot do it. Then you can send a underwater robot with a camera and then it can see.

(Refer Slide Time: 16:32)



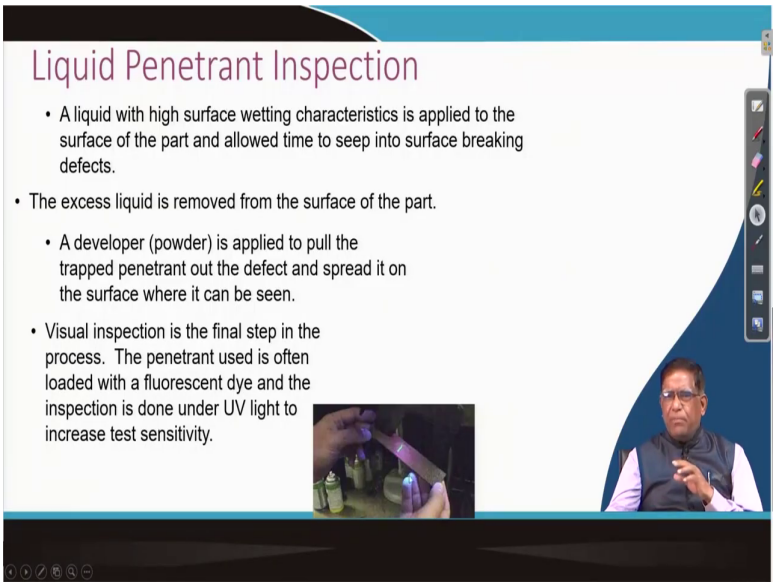
So, that is your you can how here you can see how inspecting a mine shaft by a that drone it is going over there. This type of inspection which is called remote visual inspections that is also possible. So, there could be a lot of features are there of this technology in our.

(Refer Slide Time: 16:49)



Then, similarly there is another device called liquid penetrant or sometimes called it is a dye penetrant. If there is a surface which the which has got some crack, in that case what it will be done that particular liquid which will be placed over there it will go and then this has got a colour you wipe it out. After that you take a put a high light this wherever some liquid has penetrated that person will give you a illuminations differently and you know that there is a crack. So, that type of your liquid penetrant can give this.

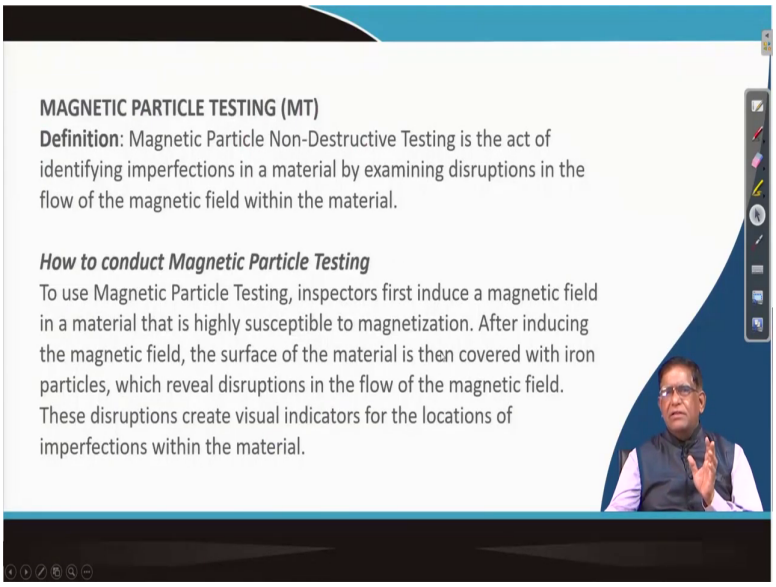
(Refer Slide Time: 17:24)



Liquid penetrant inspections is used for exactly that liquid with high surface wetting characteristics. Exactly when the liquid is applied it should be having it should wet the whole surface properly and then you can see that the whatever that excess liquid is there you wipe it out and then you put a developer; that means, whatever has remained over there, with the developer it will react and it can give a coloration that colorations can be seen.

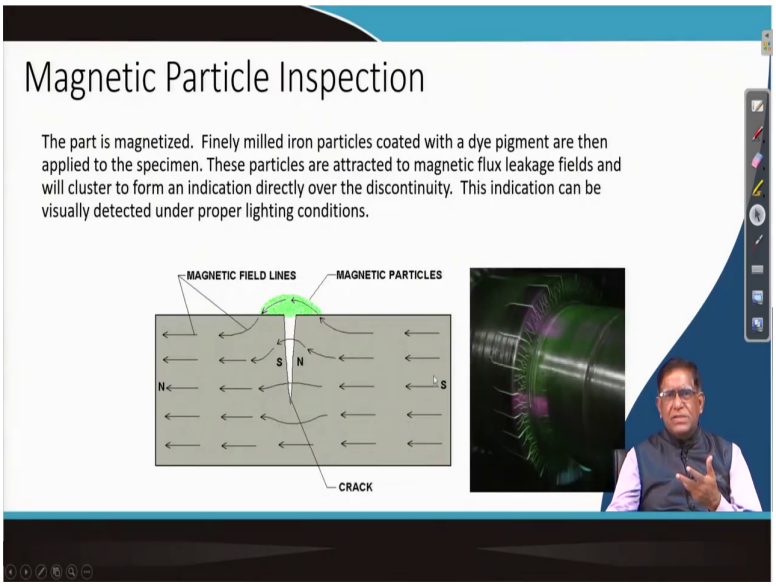
So, like that exactly you can visually the in inspect over here. Suppose this plate there they first they put that liquid then they has put the that is wiped it out after that they put a developer and then they use a laser light with that illuminations they have seen and they can see that inside there is a crack. So, that type of inspections that you have that plate is intact, but you know that there is a the it has weakened.

(Refer Slide Time: 18:17)



So, similarly the magnetic particle the testing this is another device in which the magnetic particle is it exactly the particle is spread over there on a if you magnetize the item, then that your iron particles iron fillings they will get attached with that depending on how the magnetization has taken place.

(Refer Slide Time: 18:43)

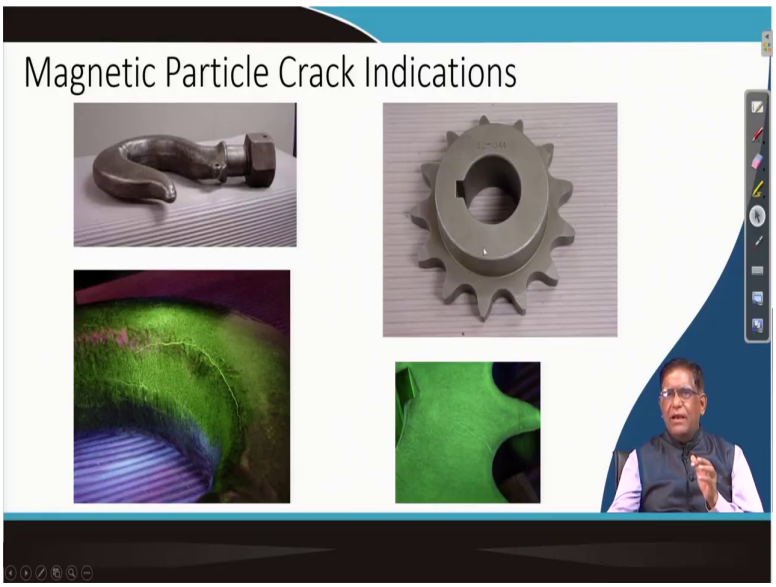


So, that means, in a magnetic particle inspection what happens, if there is a crack is there those magnetic particles they will be getting accumulated over here because in this case there will be a magnetic field will be generated, if because of this crack when this plate is being magnetized. So, this principle that can help you to find out if there is any crack.

So, just you magnetize the that is the area where you will have to do and then you just sprinkle the iron particles iron fillings and then you will see that they will go and accumulate in one place. So, you can identify that is there and then you do the next phase of inspections for.

And then what could be how it can be rectified. And, such type of things can help sometimes in a parts when a crack develops it may lead to propagation of the crack and then the collapse of it, the many beam and all they may have got this type of testings necessary.

(Refer Slide Time: 19:42)



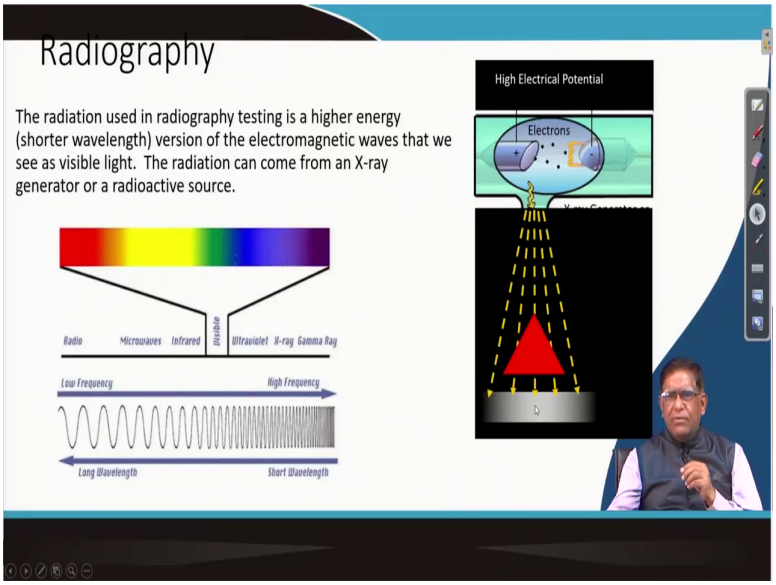
So, these are some of the things exactly by the this type of hooks and all if they got a crack inside you cannot see anything by your that by naked eyes, but if you do periodically that this type of hook you are using say in a crane and then or you are using in a pipe layer for conveyor belt laying.

And all at that time when the heavy load comes if already a crack is there it can lead to a big accidents. So, that should be under a condition should be monitored of this type of components so that if there is any problem it can be eliminated. So, you can see that it in this particular member there is a crack inside. So, this member it looks ok, but it could be there

for certain load. But, if you are using in a crane with a heavy load carrying at that time it is breaking strength may not be sufficient may lead to (Refer Time: 20:37).

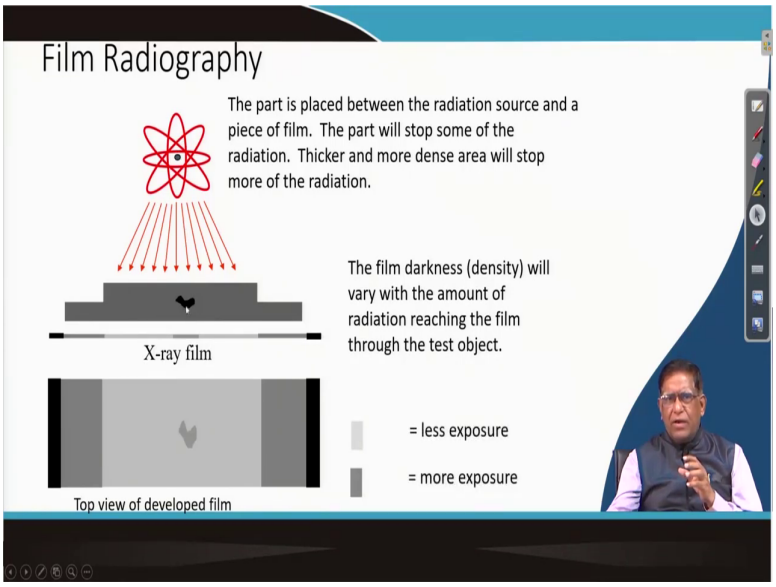
See similarly, in some of the that your sprockets teeth that will also that may give a problem where it is a in this there is a problem with near the key there is a crack here, but in a normal here you cannot see anything, but with the magnetic particle detector this is possible.

(Refer Slide Time: 20:57)



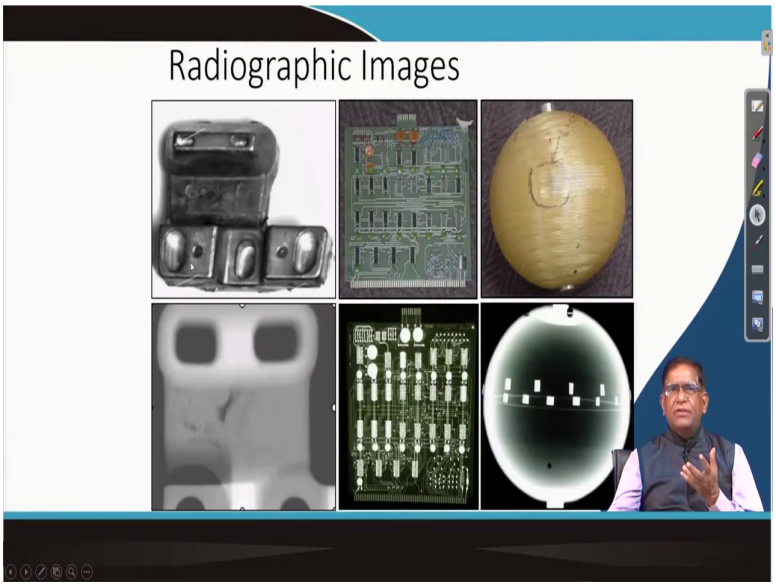
Then this radiography is another device that is exactly normally in our X-ray range where high frequency wave length is there. If your high frequency that wave length it is allowed and then they will go through. And, then they will find out that exactly it will what is there and from there it will be reflecting.

(Refer Slide Time: 21:18)



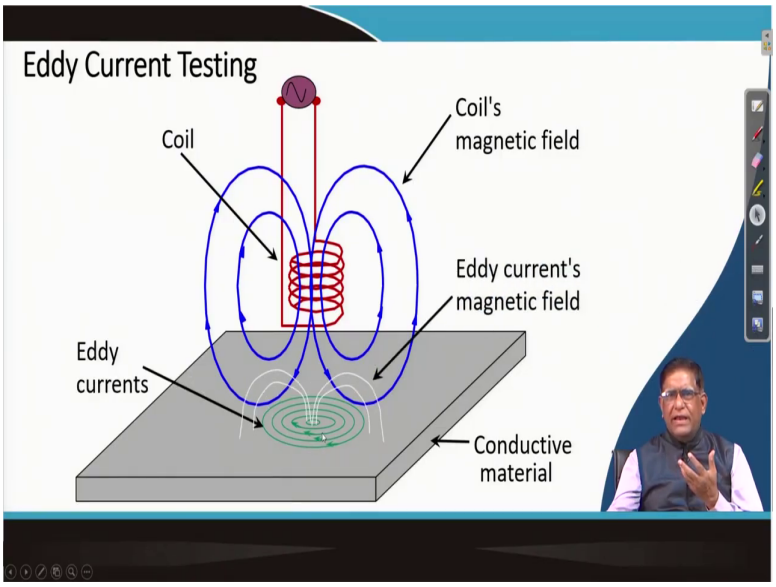
From that you can find out that you can take the X-ray of the film. If that your that X-ray is going through there is a crack or there is a gap something is there fault in the this member. Now, you are keeping one X-ray film below this your this when that your radio graphic rays are coming over there, it is coming on this X-ray film this wherever there is a this is this will not get exposure. So, from here you can find that there is a defect. So, this is the way how X-ray is used for nondestructive testing of some parts.

(Refer Slide Time: 21:59)



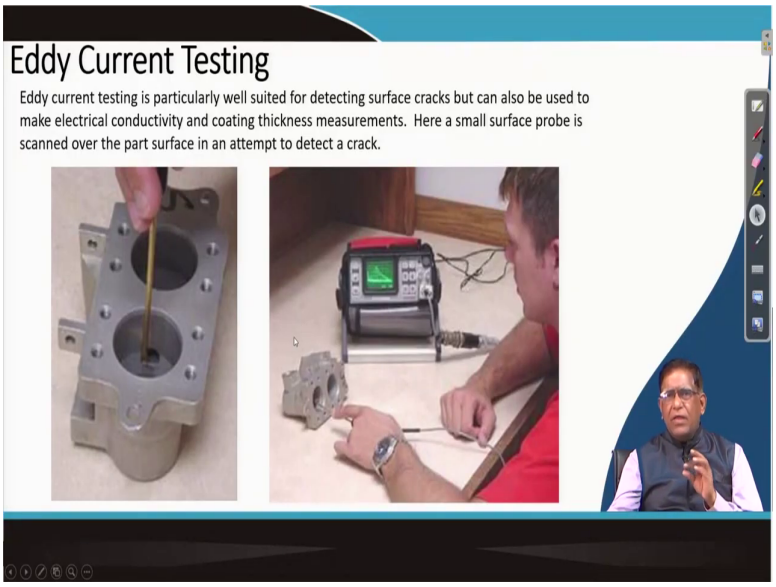
So, there is this is a you take radio graphic images of different parts, how they are taking these are used for exactly when you do a systematic different components, their internal flaw if it is to be identified you will have to use this better otherwise you cannot depend on our only judgment without anything.

(Refer Slide Time: 22:17)



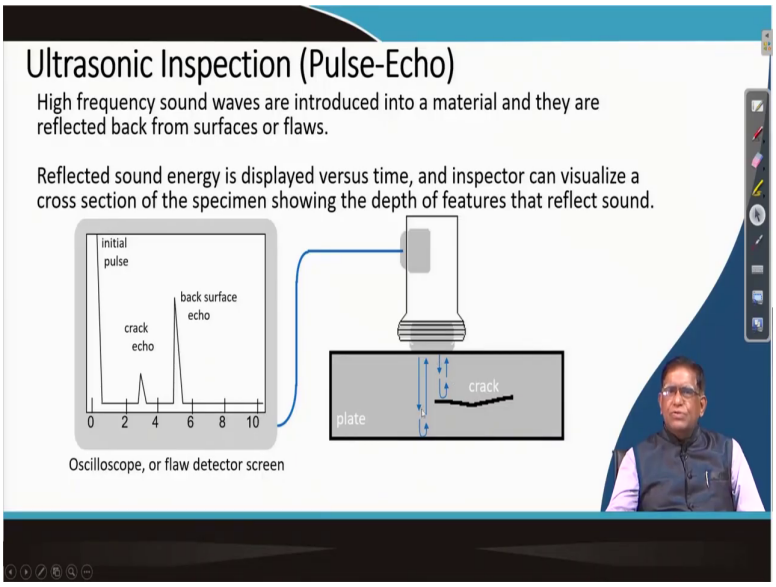
Similarly, there is another system of called your this eddy current which is formed now. If there is a magnetic conducting material and there if a this eddy current when it is formed by giving this you are giving a 2 coil magnetic field, now based on this conductive material if there is any fault over here that fault could be detected.

(Refer Slide Time: 22:41)



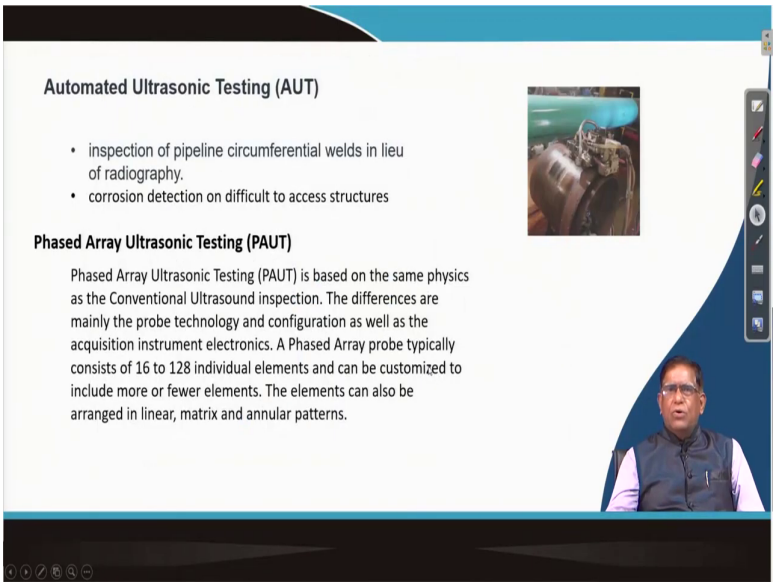
So, this eddy current testing of different components that is done by seeing the way the eddy current is formed, where it is formed, how it is formed on that basis they can identify the detection or the cracks which is there.

(Refer Slide Time: 22:58)



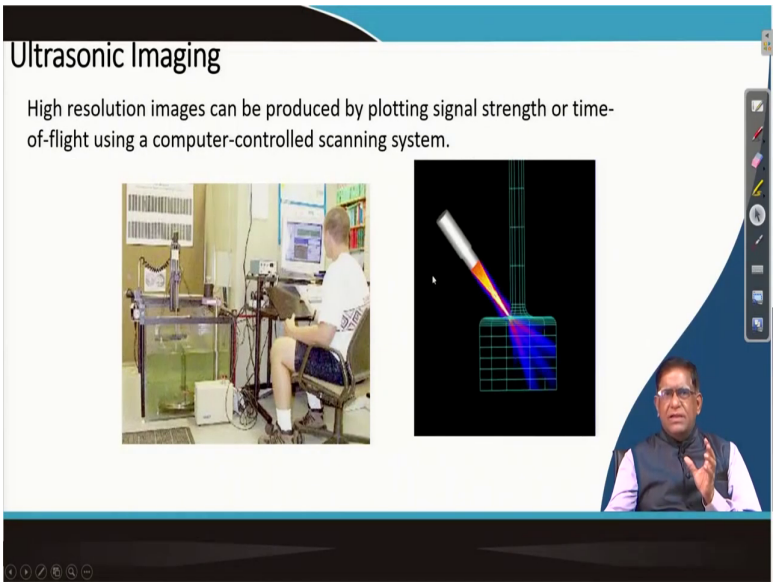
Similarly, the other one is with your ultrasonic that is you vary high frequency sound wave acoustic waves are sent and then wherever there is a cracks are there it will be rating return. Now, when there is a from that crack; that means, the time to receive it will be here will be less. This principle can be used to find out if there is any fault in any member. So, this is your pulse eco technique of them.

(Refer Slide Time: 23:25)



And, there is automated ultrasonic testings these are, there are many methods out of that this is a phased array ultrasonic technique. They take a number of 16 to 128 individual elements can be customized to take this. It is a just a scanning you are doing with an acoustic scanning of the whole member and by that you can detect a corrosion, it can inspect the pipeline and that type of things can be done by this ultrasonic methods.

(Refer Slide Time: 23:55)



Say this is how exactly the testing is done by with the help of these high resolution images and then we get that signal, and then from there you determine where is that. Now, you see the investment in such type of devices it is exactly sometimes it is a very judicious because if you do not identify the problem then it will be creating a problem.

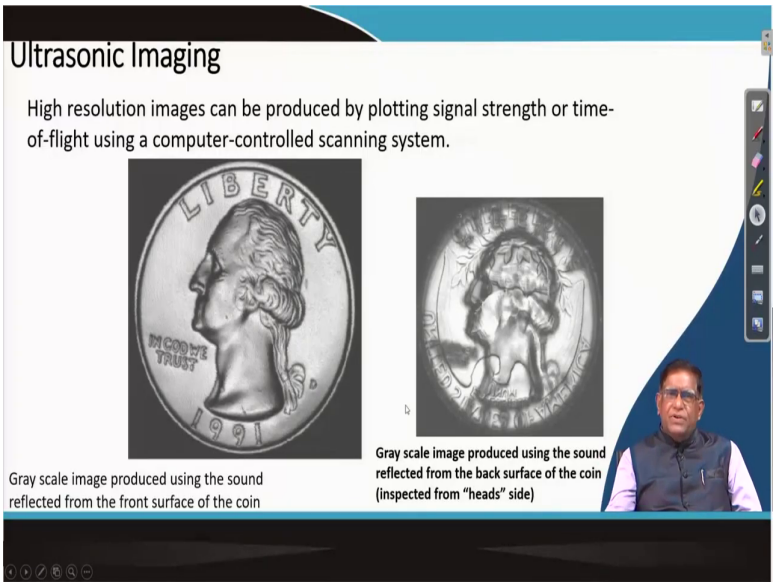
It is something like your whether you are having a fire extinguisher in your house or not that normally the fire will not take place, but if it takes place it will destroy everything. So, similarly if you are that a part or member is working there, but you do not know whether the internally it has become weak or not.

Then if you do not detect at one day you may get totally lost all your things. So, that is why which are the critical item which that by your that knowing the machines that knowing the machine elements machine components you will have to identify from the that is your failure

behavior from your normal observations of the maintenance pattern need to identify which are the critical where this type of things will be there, because to bring each and every component it is not necessary.

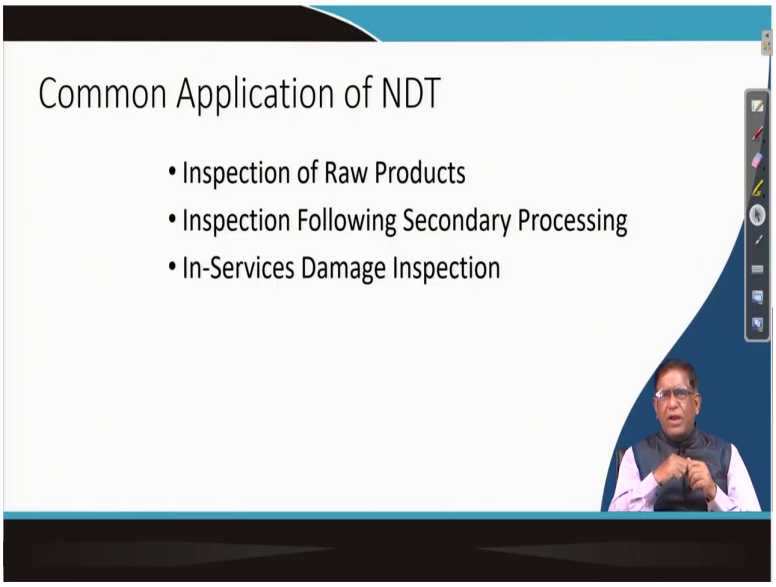
Because this ultimately doing testings and all is a costly affair.

(Refer Slide Time: 25:18)



So, high resolution image can be produced by plotting signal strength of time of light using computer control scanning system. That they scan the things over here and then if this you are getting a grayscale image that is by from sound wave and then you can find out that there is a some the back surface of this coin; that means, there is a some corrosions and erosions taking place.

(Refer Slide Time: 25:44)

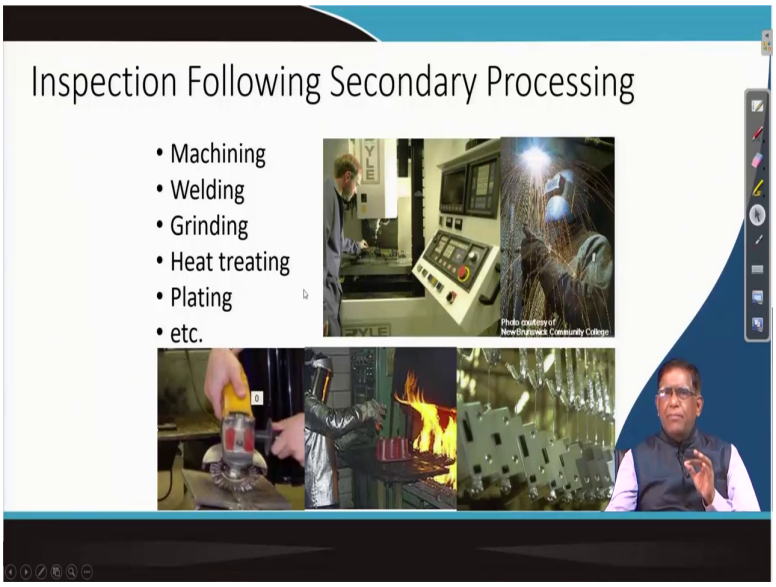


So, like this you have got number of methods, but these NDT methods can be put into the raw product for the inspection of secondary processing, in-service damage inspections all these things can be done.

(Refer Slide Time: 26:00)

Now, this is a you can see that how different it is applied at different places. Few slides I have collected from this I was nondestructive testing. From that you can see that the in the forging, in the casting, in extrusions. In the metallurgical plant and in manufacturing industry these are very much used.

(Refer Slide Time: 26:26)



So, in that machining, welding, grinding, heat treatment, platting these are also in your manufacturing process when you are making these machines and the components at that time at the time of after developing the component before putting it to assembly line, it should be tested that there is no flaw in it.

That is why in the manufacturing industry manufacturing sector this is very very important. In your mining, in your application sector they will be required only for dump specific then it will be added with the condition monitoring, condition based maintainace system within that we will have to bring.

So, as such all the techniques and all the things how they are used is not very important for us, but for condition monitoring of our very costly equipment where that the that parts which are not manufactured in our country and then which needs to be exactly if we want to venture

for manufacturing we need to know their exact behavior. There, some of these tests need to be carried out.

(Refer Slide Time: 27:33)

So, that in service for in the mining industry also you will find that is a crack detections for your corrosion detections for your erosion and wear detections, heat damage those things need to be find out. You can see here that these are the your damage due to the erosion, corrosions.

Then wear has taken place may be that sometimes in your pump impeller where lot of cavitational pitting is there. So, those things exactly the you may not open up whole pump and all, but there you can use some nondestructive visual inspections by inserting probe or by other, by your acoustic applications. There are may be a different type of new principles can

be applied and you can identify if that is your critical component what type of nondestructive testings can be done.

(Refer Slide Time: 28:28)

And, because if the things are not yet known, then exactly the problem is that you are maintaining unnecessary maintenance. One most important thing in using this condition monitoring or bringing nondestructive testing into our normal maintenance system is to avoid unnecessary replacement or unnecessary maintenance.

Many a times if you are sure you are 100 percent sure that there is no problem why should you open it up, why should you go for a maintenances work. So, one area which is of course, you can see here aerial rope way; we have discussed aerial rope way also how it is used for our sand transport for sand stain purposes.

Now, this wire rope is a device or is a is very widely used in mining industry tell whether it is in winding purposes, whether it is in your rock haulage or it is in drag line or in rope shovel then many places in mining you find this wire ropes. And, this wire ropes inspection there a nondestructive testings can be very easily designed.

Here is a winding rope this winder drum you can see where this rope is going there they have kept one that is your magnetic flaw detectors type of things. What they do? That is where they wherever there is any crack any break or anything of the wire around that a magnetic flux is created. So, this flux will be detected and from there you can know that in that particular point there is a wire. So, this type of electromagnetic devices and the visual inspections are used to find broken wires and other damages.

Because if you are creating if you are creating any magnetic flux, suppose you are having a you can create a keep a magnetic flux over here now if a wire is there in this wire if there is something is coming out, so, what will happen? It will create a current type of things and that flux generated will get.

And you can detect these things and then you can put it to that find out that yes, there is a problem. Same type of things can be used in your nondestructive testing without stopping the conveyor belt you can test if it is a steel cord belt. If the in a steel cord conveyor belt, if the upper surface is getting worn out and then the steel cord is getting exposed you need to do the maintenance of the belt, you need to do vulcanizing and things like that.

So, by getting the magnetic signal from that wire rope which is exposed from the conveyor belt you can find out and then you can plan the maintenance for the conveyor belt in a steel cord conveyor belt. So, this the that by the that this type of condition monitoring or that is your nondestructive testing can help you in other maintenance.

(Refer Slide Time: 31:33)

Similarly, you are in a storage tank. There also if you can go for nondestructive testing because you cannot take these things out of service, you can go on testing like this. Similarly, your that whenever you are using in a area which are very critical any failure may give raise to a major problem should be brought under nondestructive testings.

(Refer Slide Time: 32:00)

Many people do in that your they say, aircrafts this these things were exactly this nondestructive testings and all it were much of these development scheme in the aviation industry where they where very much safety conscious.

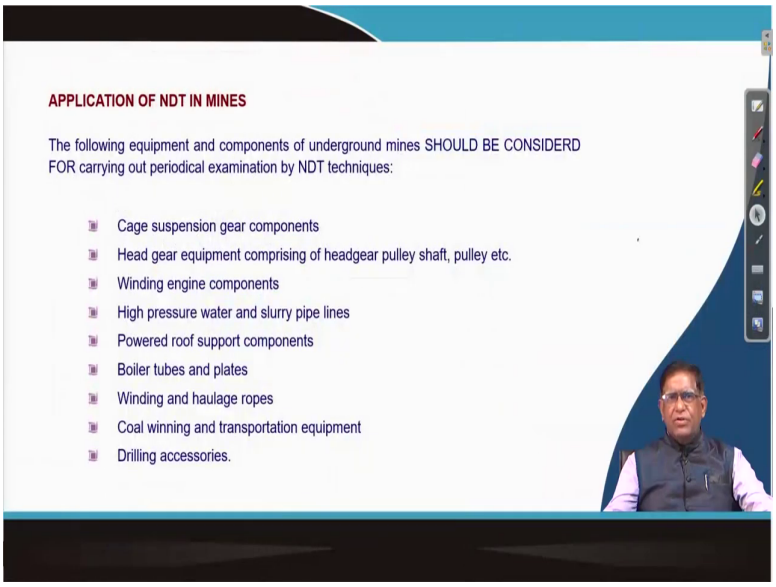
(Refer Slide Time: 32:17)

So, then in the railway system also we can have some of these railway they say crack and other monitoring railway rail monitoring system which is also very much developed.

(Refer Slide Time: 32:27)

Then this pipe inspection – this pipeline which are used for in many mining industry we are having slurry pipeline, in we are having also different type of pipeline is used in the mining industry their monitoring is also possible.

(Refer Slide Time: 32:42)



So, ultimately now you have got a general idea about what is nondestructive testing, what are the different type of nondestructive technique tools are there and then now, you can identify if you wish you can take up your own learning project in your BTech project or any other where you want to get a business in future.

May be the cage suspension gear components, how those things can be tested non destructively and we can see be sure that because in our mines in our industry there are many winder installations which are now more than 40 – 50 years old. So, those how to find out the remaining life.

For that you will have to do them and make some systematic testing. So, in that there is a possibility that some company in India will be doing that assessment of the remaining life of

those installations and to assess the remaining life you will have to do a lot of nondestructive testing.

Now, head gear equipment that is your comprising of the head gear pulley shaft that in a winder you have seen that structure as well as there is a pulley; pulley is mounted on a shaft, shaft is mounted on a bearing their conditions can be tested. Even that your winding engines, they have got their component gearbox, their breaks that all that can be tested then powered roof support. In the underground mine that roof supports are also that is a very very important things.

If they fail that whole gallery can collapse and exactly sometimes that to identify that how much load with the load how it is behaving. It is periodically should be tested because in India also it happened a long wall whole gallery it collapsed because the power supports which were that lakes were designed for the type of load exactly that in situ load was much more. So, that definitely before it finally collapse there were definitely an indications that they are internally becoming that is stressed.

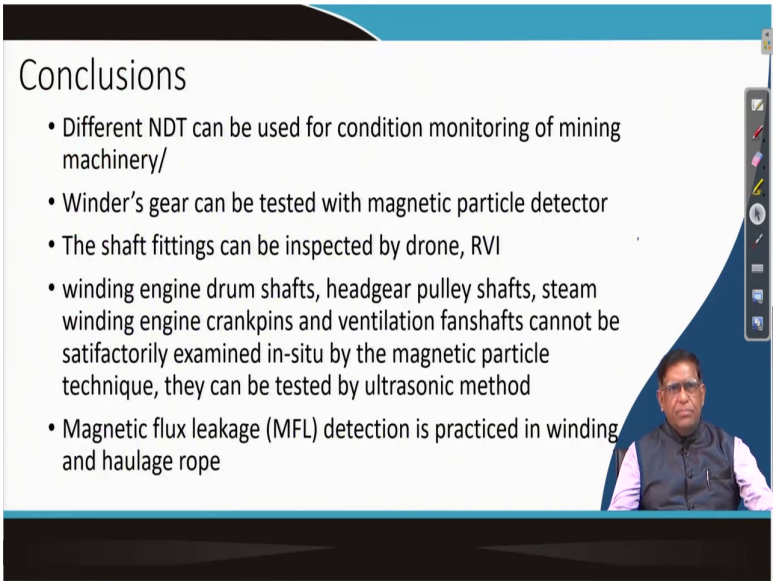
So, those type of testings were not there now exactly it should be brought under some testing like that. Similarly, the that is your boiler tubes and plates wherever we are having any steam powered boilers in the boiler testing also it can be done. But, nowadays in the mines very few boilers are still there, but that is all almost everywhere we are not using boiler here, they are early in the thermal power stations. Then winding and haulage ropes these are very much used; then the coal winning.

And transportation equipment like I told you conveyor belt, rope haulage, then this your in the machines like your the shovel, drag line the everywhere bucket wheel excavator all these machines also has got this wire rope. Then in the drilling also sometimes this you are having a exploratory drilling.

Many times you use this rope for the drill strings and there is also in the wire line rope in a drilling also in the drilling assembly number of components how they are exist sub they say

or their testing is very very essential. So, in that way that some the nondestructive testing also could be done in some of the cutting tools that in the bucket teeths and others.

(Refer Slide Time: 36:11)

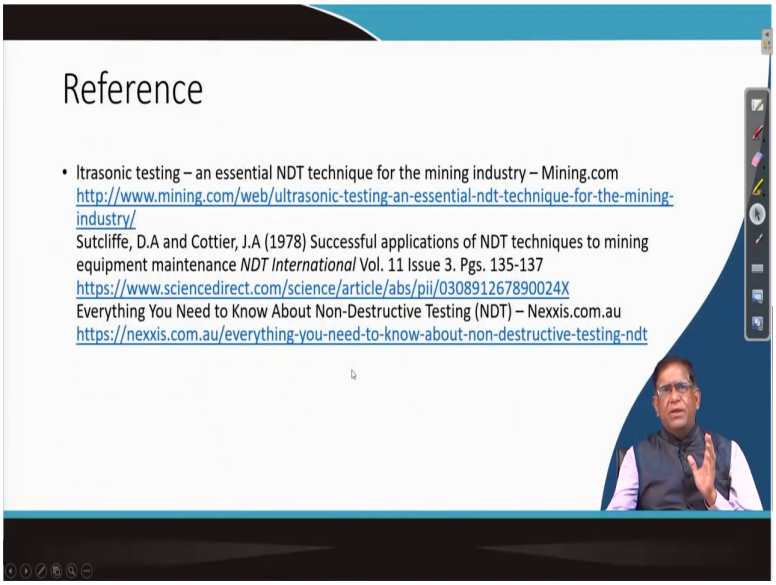


So, to coming a conclusions that different NDT can be used for condition monitoring of mining machinery. So, that is where we need to exactly focus, then winder gear can be tested with magnetic particle detector, the shaft fittings can be inspected by drone, remote visual inspection.

Then winding engine drum shafts, head gear, pulley shaft that stream winding engine crankpins, ventilation fan shaft this cannot be satisfactorily examined in-situ by magnetic particle technique and they should be done by ultrasonic method. So, those type of devices need to be found out. If one method is not usable other method can be done that magnetic

flux leakage this can be done for the winding and haulage ropes we can test it. So, there are different way it could be used.

(Refer Slide Time: 37:07)



So, please go through various these literatures. Particularly, we will find interesting that when it first developed during the 80s and early 90s lot of innovations were made in this field and today, there is a majority in this industry of nondestructive testing. And, they simultaneously a lot of condition monitoring has been improved.

We have not touched upon the condition monitoring and in maintenance how vibration signature that is the equipment component signature is analyzed and then on that basis how you can predict failure those things are there. So, my dear friends you have learned about mining machinery.

And it is from the very basic mechanical engineering to the maintenance level. The everything is put in a very this is too much to learn in one semester. However, I hope now you have got a general interest that is necessary to become a professional in the mining industry.

So, I hope you have got a general outlook about this subject. This if you are interested to carry out any further studies on this, you are welcome to contact and also as I said earlier I will be having a module that free sites where you can yourself also get in contact with me from wherever you are.

And, then if any further study you want to carry out, you want to develop some entrepreneurship, if you want to do any new innovative exercise on it all these matters can be discussed with different your pear group through that module site. If you are there if for any further informations you can contact me.

So, I thank you very much for undertaking this course and I wish you all the best in your next endeavor and I hope that you will be serving the mining industry with a proper objectives that we need to get the benefit out of our deployed machinery and whenever necessary we should be able to prescribe that what new machines are needed in the mining industry, whatever is there it may not be sufficient for tomorrow. So, that innovations, that creativity we expect from you.

Thank you very much.