Technical Textiles
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Lecture - 12
Textile Reinforced Composites (Contd.,)

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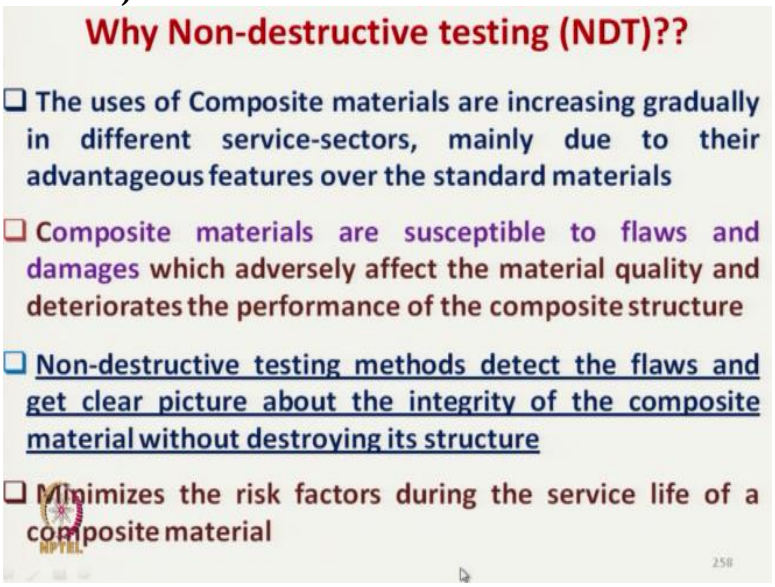

Hello everyone, so, we will now discuss the non-destructive testing of composites. So, first we must understand why do need to test composite in non destructive manner. So, the uses of composite materials are increasing gradually in different service sectors. So, mainly due to their obvious advantages, but the composite materials are susceptible to flaws and damages which adversely affect the material quality and deteriorates the performance of composite structure.

Non destructive testing methods detect the flaws and get clear picture about the integrity of the composite materials without destroying it is structure. So, it is very important, we cannot destroy the structure once it has been erected, it is very important to know the characteristics of composite without removing the component. So, it minimizes the risk factors during the service life of composite material.

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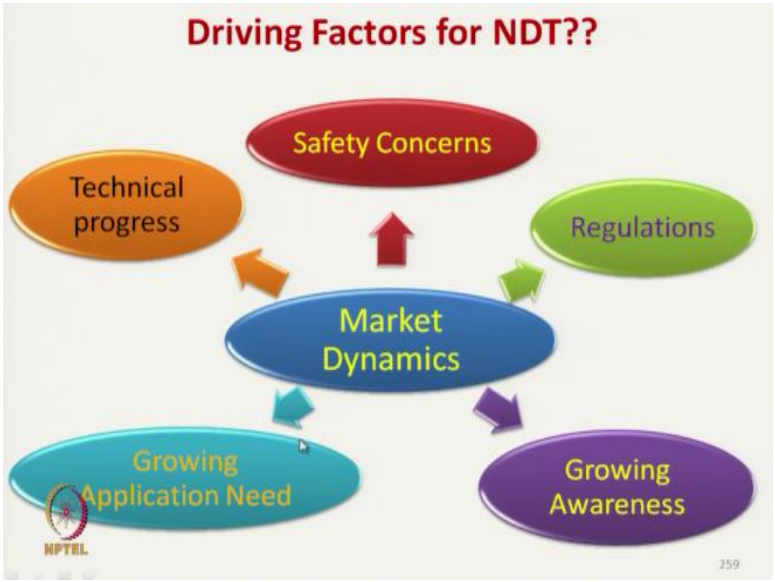

The driving factors for non destructive tests are the market dynamics, safety concern, regulations, safety concerns means we have to test intermittently the condition of the composite materials, so we cannot take out or we cannot destroy that component. So, we have to test the composite insitu, so regulation, growing awareness, growing application need, technical progress these are the market dynamics which actually driving the interest towards the non destructive testing.

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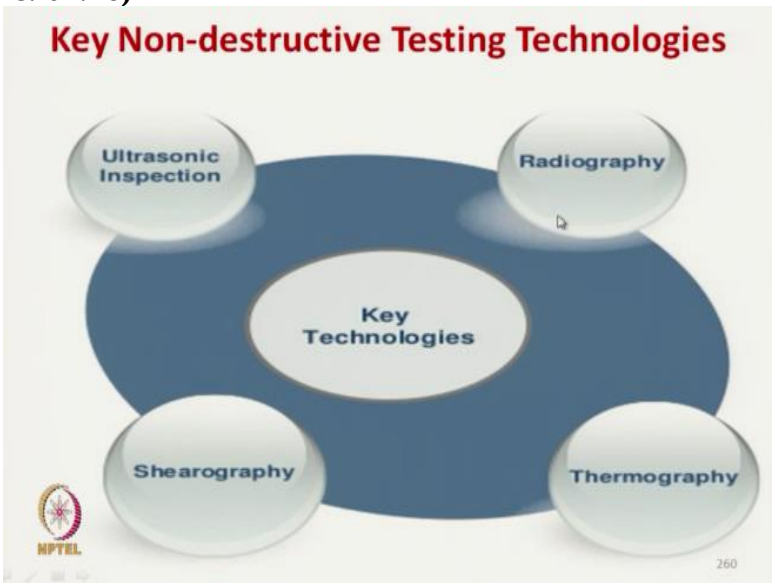

The technology which is used for non destructive testing of composites are radiography, thermography, shearography and ultrasonic inspection. Shearography here we will not discuss here that this is another technique. So, we will discuss mainly radiography, thermography, ultrasonic inspection.

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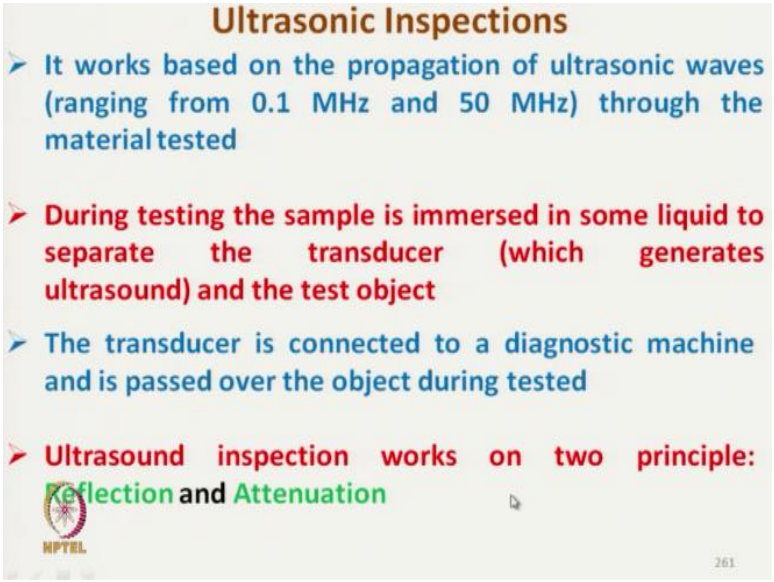

So, ultrasonic inspection here it works based on propagation of ultrasonic waves. So, ultrasonic wave is being propagated through the composite material. So during testing, the sample is immersed in some liquid to separate the transducer and the test object, the transducer is connected to the diagnostic machine and passed over the object during test. So, that transducer is moved through the objects. Ultrasound inspection works on 2 principles, one is reflection principle another is attenuation principles.

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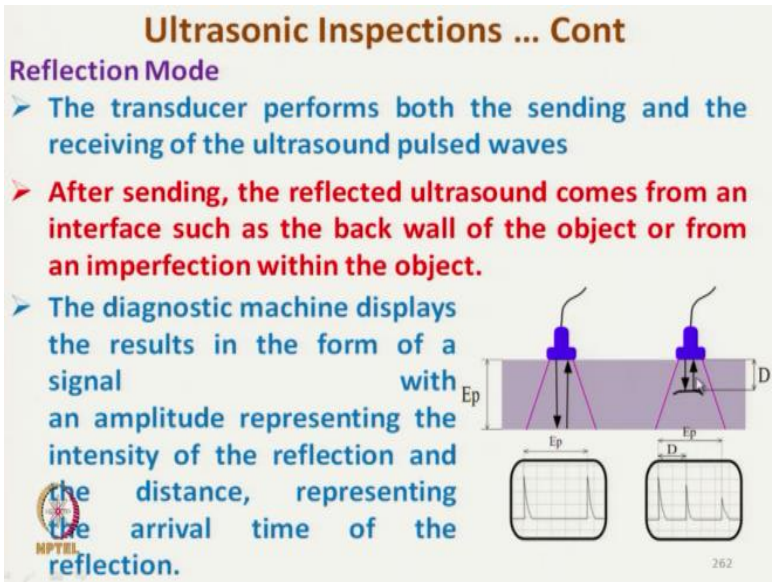

In reflection mode, if we see here, this is a composite material, this portion is without any damage, here damage is present. Now, if you see this is the ultra sound generator and this wave is transmitted through the uniform composite and from other surface it is getting reflected. So, we get the peaks at a certain distance. After every receipt of this reflected ray, we get P.

But once the there is a damage inside the composite, the ultra sound, this wave will get reflected earlier than this previous one and we will get different peaks depending on the shape and size of the damage and we will get idea about the damage present inside the structure. So, the transducer here performs both the sending and receiving of the ultrasound pulse wave.

So, it sends ultrasound pulse and receives, after sending the reflected ultrasound comes from an interface such as back wall from back wall here of the object or from an imperfection within the object, imperfection any damage. So, this can come out reflected from back wall or from this imperfection and then we get a plot and looking at the distance between these peaks, we can get an idea about the presence and even location of the damage. Suppose the location is close to the surface, one surface, then we will get the distance will be smaller. If it is a farther from this generator then we will get at the higher distance.

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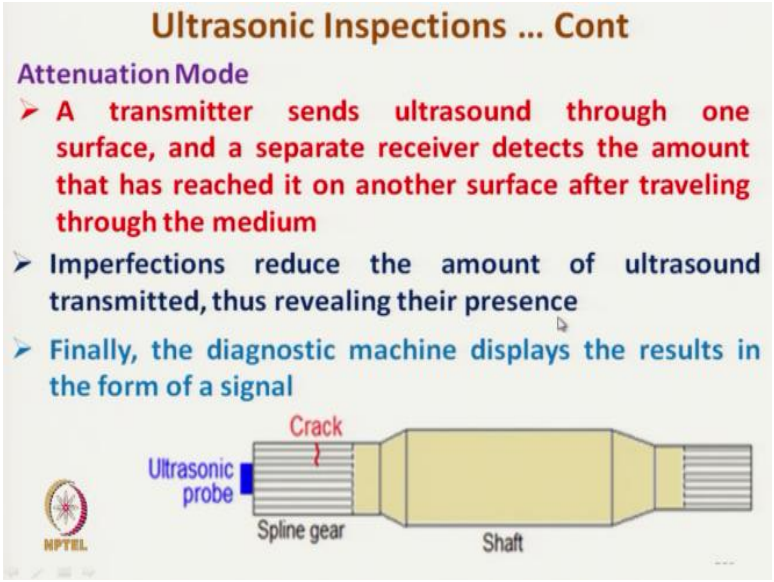

In attenuation mode, we will get that we have got 2 probes. One is this is the generator here and this is generator, this is the probe which receives, the transmitter sends ultrasound through one surface and a separate receiver. This is the receiver detects the amount that has reached it on another surface, so here we know the amount of wave, amount of energy it is transmitting and here it is receiving.

If there are cracks or any other imperfections, that means amount from that portion, the ultrasound will get reflected. So the amount of energy it is coming here will be less. The imperfection reduced the amount of ultrasound transmitted, thus revealing their presence.

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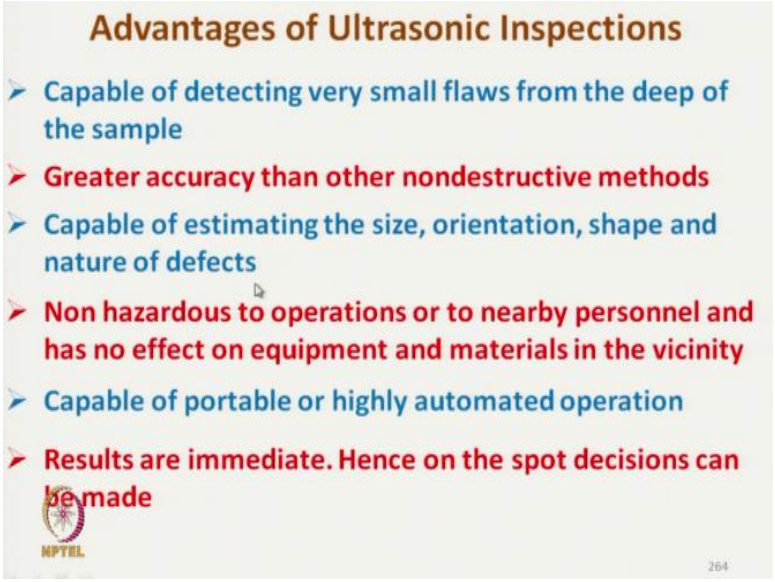

The advantage, there are many advantages. So capable of detecting various small flaws from deep of the sample, generate accuracy, it is a greater accuracy than other non destructive techniques capable of establishing the size, orientations, shape and nature of defect. It is non hazardous, capable of portability. So we can move that take that instrument to the actual site and we get the result immediately.

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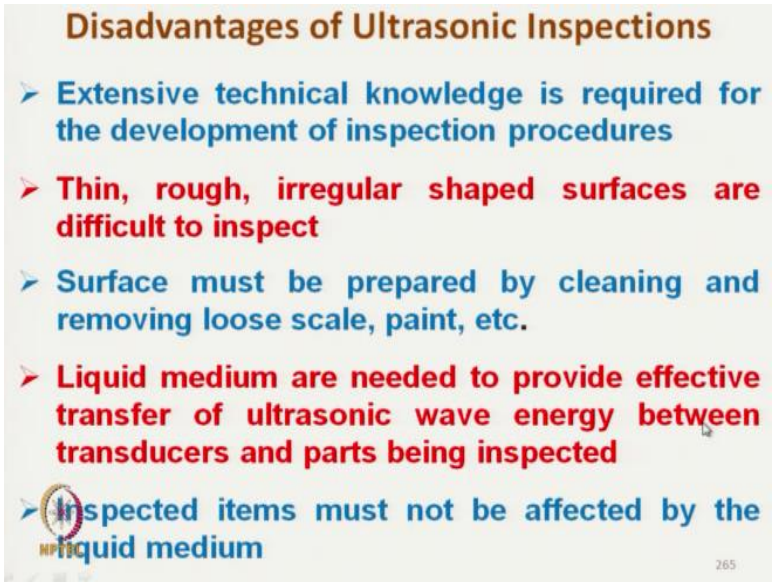

So, it is actually technical extensive technical knowledge is required that those are the disadvantages. Thin, rough surface, it is difficult to measure. It should be clean surface, liquid medium is required and the liquid medium should not react to it the composite surface.

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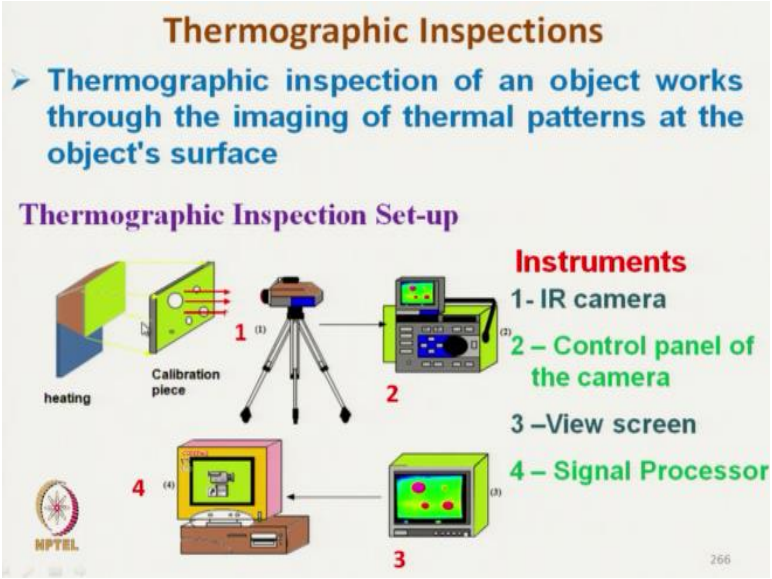

Thermographic inspection, where this is the heater and from other surface we get the image through thermal imaging camera. Depending, this is the IR camera and then here it is a viewing screen, signal processing. So, that we are getting signal processed here viewing the screen is here, so control panel. So, depending on the type of defect we get the image on other side.

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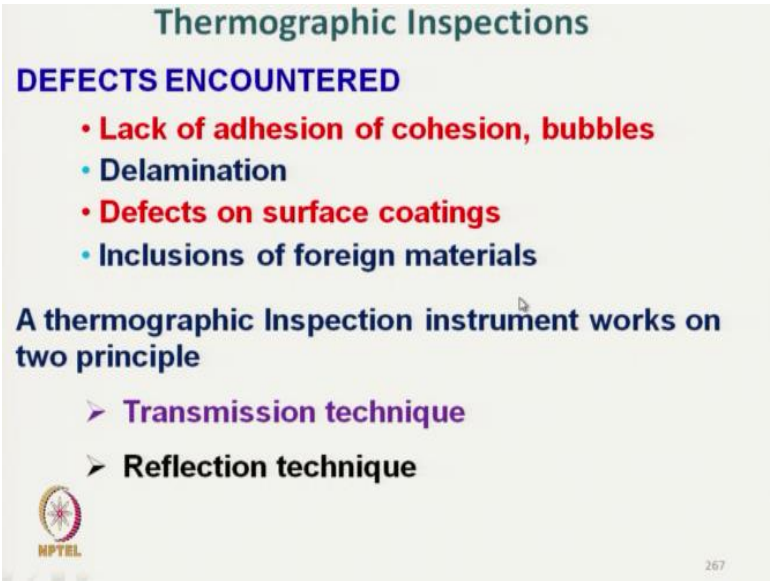

So, there are different types of defects we can get delamination, defects on surface coating, so, different types of defects, inclusion of foreign particles. So, this also works on transmission and reflection mode.

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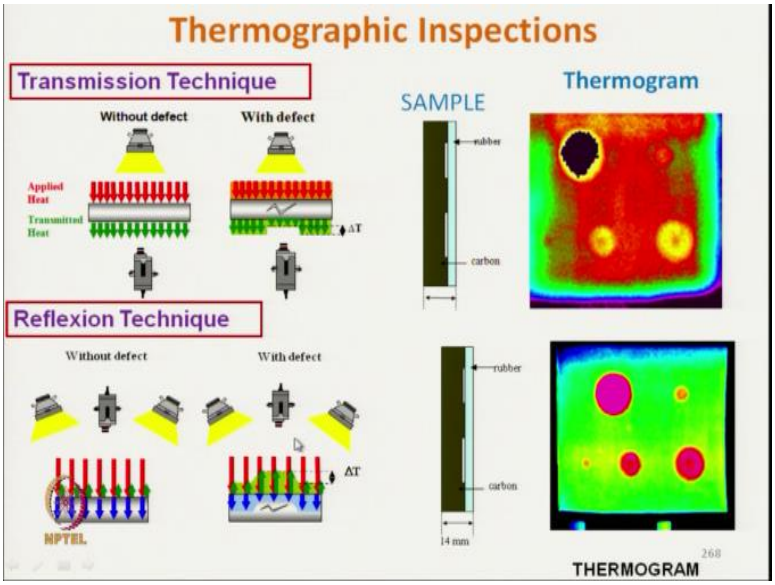

So, this is the transmission mode here, we can see that the heat this is the heater, without defect that heat is applied here if there is no defect, the heat will be uniformly transmitted. So, we can get image, but in case of any defects like void content, any other defect, the heat will not get transmitted evenly on the other side and we get image here. So, these are the image from there we can get idea about the defects present inside the structure, specimen. And in reflexion mode also we get so, this is the reflexion mode this is heater here and camera we get the reflexion mode.

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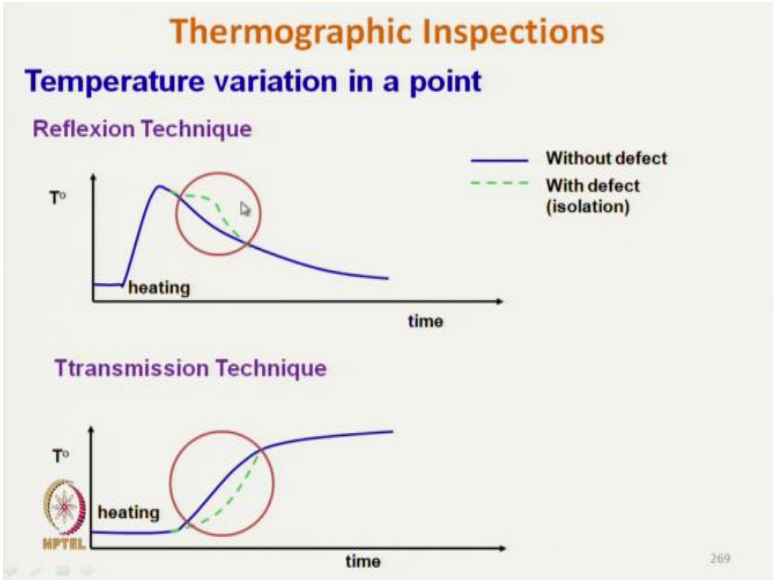

So, here we can see in reflexion mode from the defective area we get more heat, because extra heat is being reflected here. But on the other hand in transmission mode, the heat is being blocked in that heat transmission is being blocked at the defective zone. So, the effective heating temperature we are getting it is less. From there these are the 2, the difference between reflexion and transmission, but for same type of defect we get these 2 different curves. So, we must know whether it is working in transmission mode or reflexion mode.

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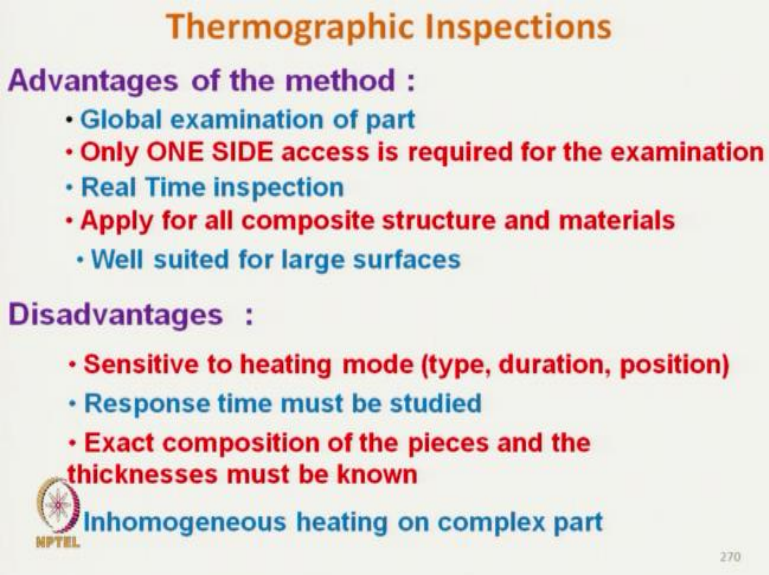

So, the advantage is global examination is possible for different parts. But only one side here is required for examination, real time inspection, apply for all composites structures. And main disadvantage is that it is sensitive to heating mode. So, if the duration or type of heating changes, its result may get changed, inhomogeneous heating is there in complex type of part, it is actually it can be used easily for very uniform or straight part, but for complex type of composite, this method it gives wrong results.

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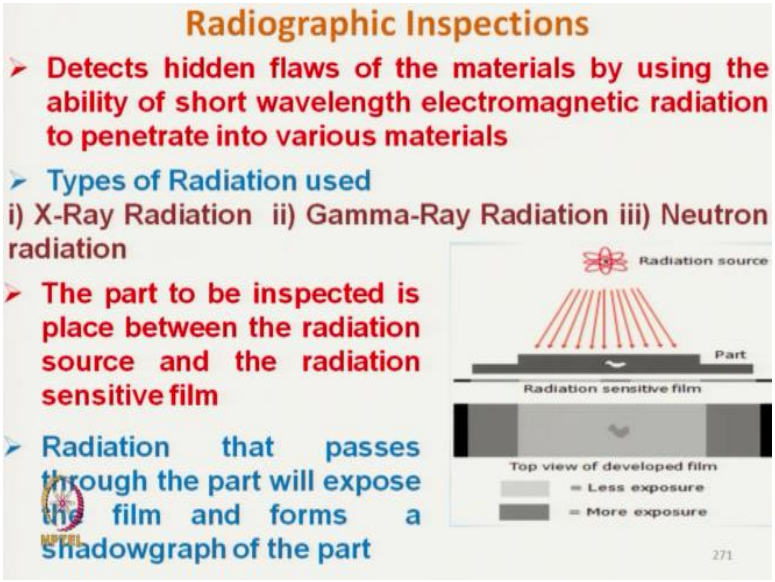

Radiographic inspection where different types of radioactive electromagnetic waves are passed through the composite like X ray, gamma ray, neutron radiation. In case of other side there is a, there will be plate, photographic plate will be there, in case of any defect present or any void content present. So that there will be more and more rays will pass through that and that will show up by darker, more exposed portion and that will give us idea about any presence of any defect there.

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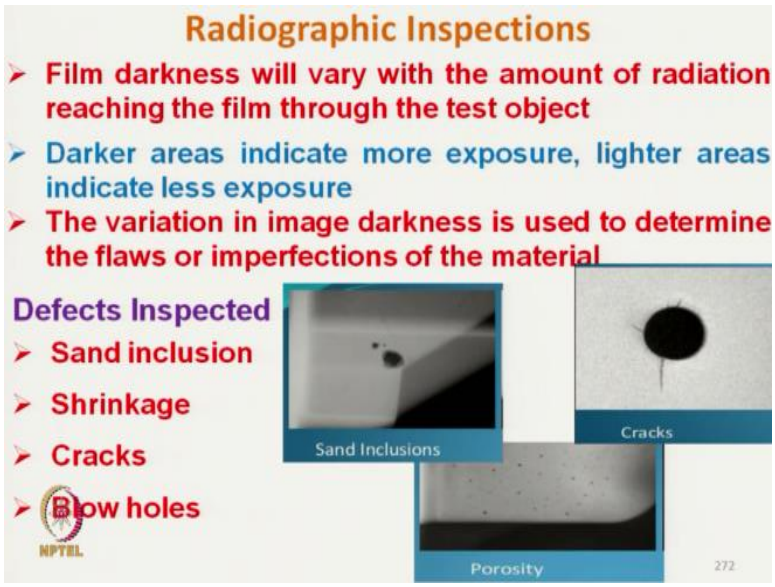

So, these are the defects inspection. So, here if there is any crack or sand particles, so these are the different or porosity, we can get an idea about internal defect present in the composite through radiographic inspection.

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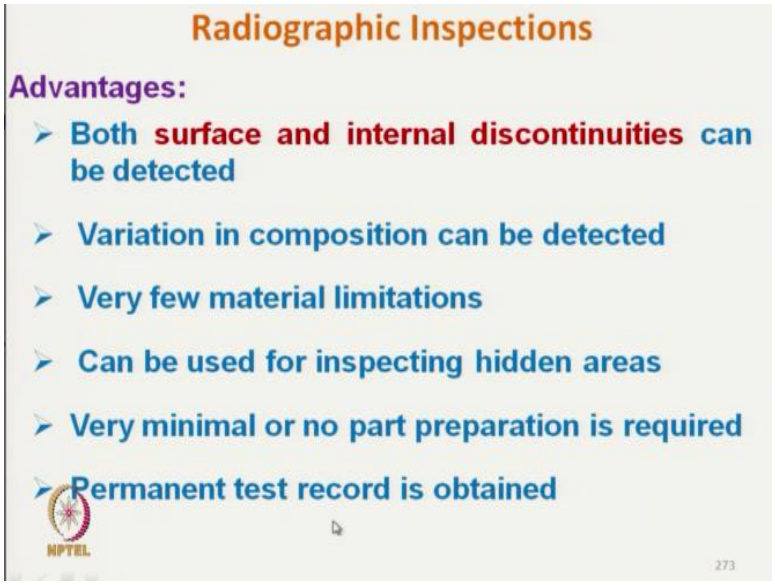

So, main advantages here is both surface and internal discontinuities can be detected, variation in composition can be detected, very few material limitations, so, we can use for different types of material, can be used for inspecting hidden area, very minimal to no part preparation is required, we can use directly permanent test record is can be maintained.

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Main drawback, these drawbacks are its hazardous. So, all this X ray, gamma ray these are for human health hazard risk are there, skill of the person who will be testing is required high skilled person, expensive testing and it needs 2 side access to the component. So we need to have 2 side access so it is not reflective does not work on reflective mode only in transmission mode. So we need to have access in both surfaces. So this is all about composite. So, next class will start with new topic. Till then thank you.