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**Theory and Practice of**
**Non Destructive Testing**

**Dr. Ranjit Bauri**
**Dept. of Metallurgical & Materials Engineering**
**IIT Madras, Chennai 600 036**

**Radiography - 4**

Yeah so in the last class we were talking about the characteristics of the film.

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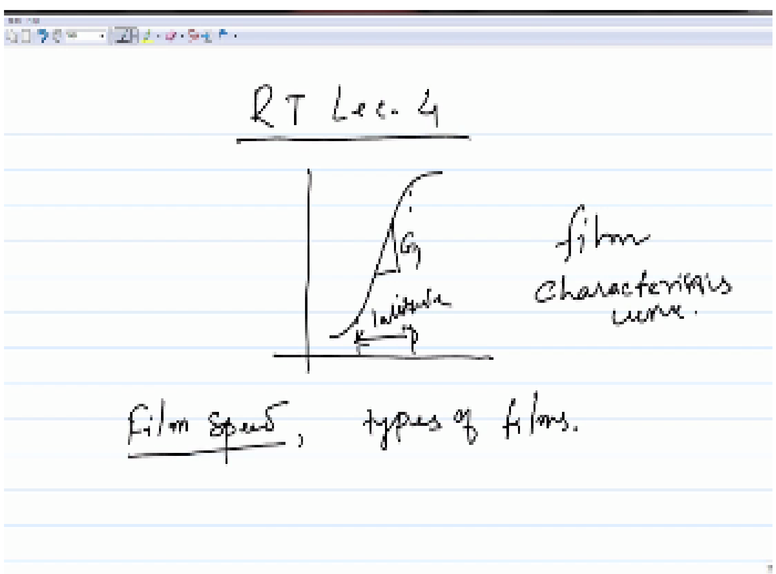


And we saw this curve which is known as the film characteristics curve and then we saw that we can derive some properties from this curve like the film gradient and the theme latitude and in today is class we are going to see how this film properties will control the quality of the image but before that let us talk about one more property of the film which is about the speed of the film okay and while discussing about this we will also learn about the types of films as I said before different films would have their different characteristics curve which is provided by the manufacturer so these curves sometime we look like S shape.

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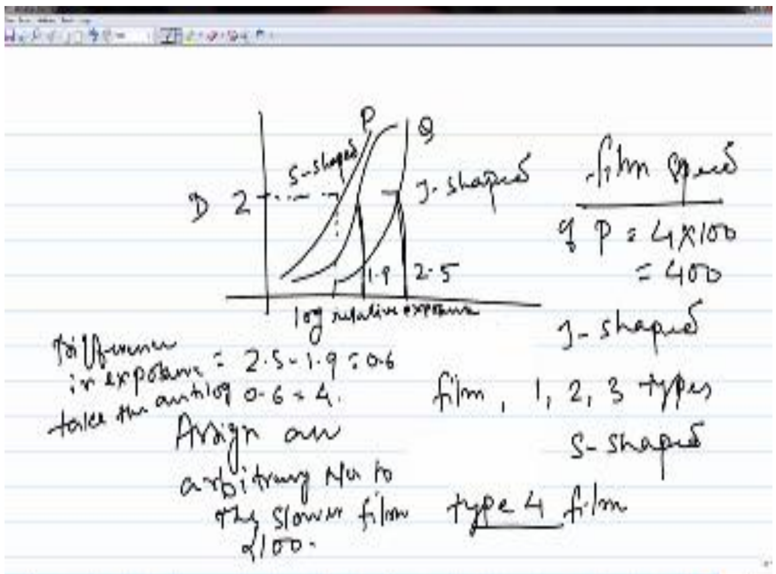


And sometime they might also look like a j-shaped curve okay so this one we have seen which is S shaped but you may also have curves which will look like this which is like J shaped okay and in this J type curve you have three varieties one two and three types depending on the different properties of the films and the s shaped curve you have type for film okay, so this axis is exposure which is the combination of intensity and the exposure time okay.

So since time is involved here you would also be able to derive the speed of the film okay for example if I have two films like this p and q okay so here you could see for a particular density d the exposure time which is needed for Q is higher compared to that needed for p okay, so this itself tells you that film p is faster compared to film q okay so that means the film street for film p is higher than the speed for film q okay so like this on a comparative basis you would be able to get a number which will provide you the speed of a film for a particular film.

But it has to be on a comparative basis okay let us say and that for a particular density let us provide a number for that let us say we want a density 2 and for that the exposure needed for the slower film which is Q let us say that is 2.5 and for the faster film it is 1.9 okay so in order to get a number for the speed of the film what is done first you assign an arbitrary number to the slower film okay so that the number for example can be let us say like 100 which can be easily remembered and which can be easily used to calculate the film speed comparatively for the other fields okay.

So first you assign an arbitrary number to the slower film for its speed and let us say it is hundred okay then you calculate the difference in this exposure so in this case the difference is 0.6 and take the antilog of that since it is on a logarithmic scale so anti log of 0.6 is 4 okay so this tells you that film p is four times a faster compared to film q and since we have already provided a speed of 102 film q to the slower film the speed of the faster film will be 400 okay so this is how the film speed is assigned to a particular film on a comparative basis.

Okay similarly you might have another film over here and for that also you can see what is the exposure and take the difference between that exposure and the exposure for the slowest film take the antilog of that and then you can calculate the speed for that particular film also okay so this is how the film is feed is decided and this also tells you that you know for a given kind of film whether you need higher exposure or lower exposure time.

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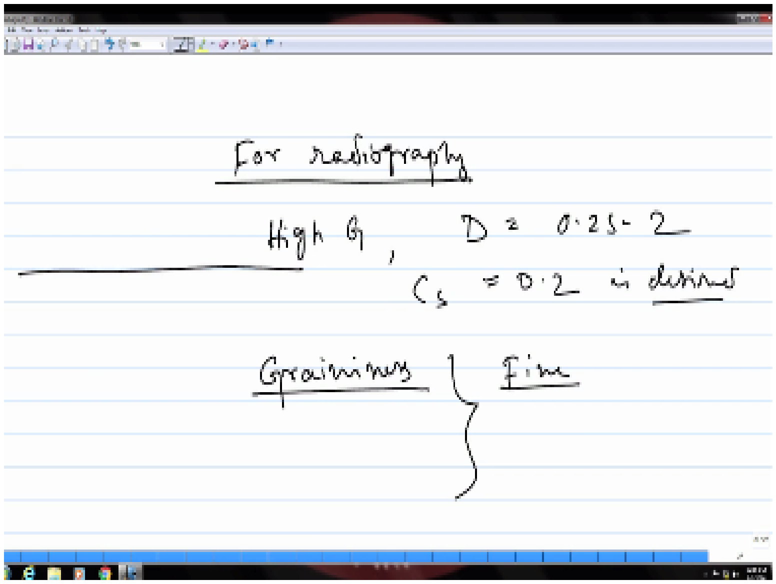


So for radiography you need a high gradient so in a good quality radiograph you need a high gradient a high G value D should be in the range of 0 point 252 to a higher DS again good for a good quality image a minimum contrast of 0.2 is needed although human eye can identify a contrast below point2 but for a good quality image which can be easily seen a contrast of point2 is desirable.

And there is one more property one more feature that you see in the film which controls or which you know influences the quality of the image is what is known as graininess so as I told you this radiographic film is basically made of silver halide particles these particles are very small that you cannot see them by naked eye if I if you want to see them you have to see them in an electron microscope but sometimes these particles tend to cluster together so several particles will form a clump a cluster and when they do so.

They will appear as some kind of white patches here and there which will affect the contrast of the image or which will affect the quality of the image adversely okay, so a high graininess in an image is not good for the quality of the quality of the image so for a good quality image you should have a fine graininess that means you will not see much of this big clusters on the image so if on the other hand if you have a course kind of adenines that tells you the quality of the image is not so good because this graininess will tend to blur the image so a table is given by ASTM for different types of film and looking at this table you would be able to see what kind of film will give you what film characteristics with regard to the quality of the image. So this is a table of film type.

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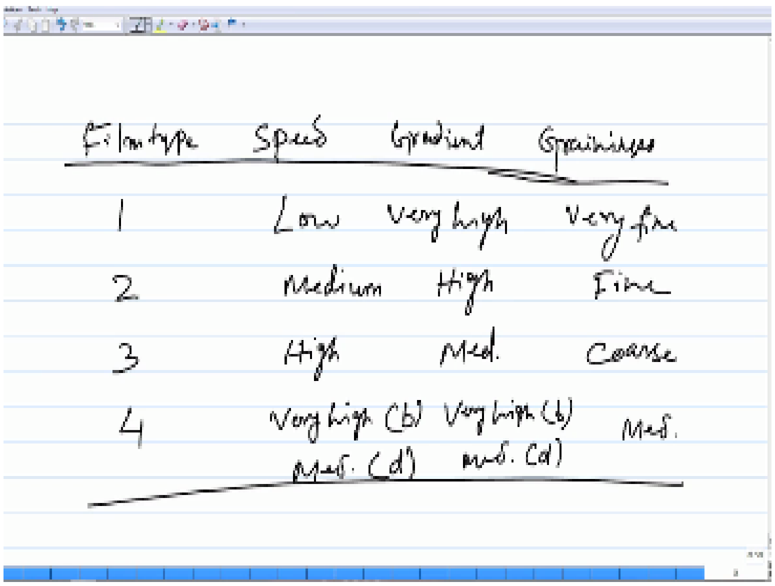

| Film type | Speed | Gradient | Graininess |
|---|---|---|---|
| 1 | Low | Very high | Very fine |
| 2 | Medium | High | Fine |
| 3 | High | Med. | Coarse |
| 4 | Very high (b)<br>Med. (d) | Very high (b)<br>Med. (d) | Med. |

Film speed gradient and graininess so for type 1 film the speed is low gradient is very high and the graininess is very fine okay so although the speed is low that gradient is very high the drainage is also very fine so that tells you that for a film which is type on the quality of the image will be good for film type to the speed is medium gradient is high and the graininess is fine for type 3 the speed is high gradient is medium and graininess is course for type four we have two types one is a very high speed.

Which is indicated as B type small be in this case and medium speed which is indicated as d within the tie for itself so for this B type within tie for the gradient is very high and for the medium the gradient is also medium and the gradient is for both of them is medium okay so you can see there is a trade-off between the speed of the film and the quality of the contrast you get okay.

So it depends on you know what exactly you want whether you want whether you can afford to have longer exposure time or you can compromise a bit up on the quality but you want to have a lower exposure time okay so depending on that you could select this film types so this particular table will guide you selecting a particular type of film for the particular quality of image which is needed next we are going to talk about the intensifying screens.

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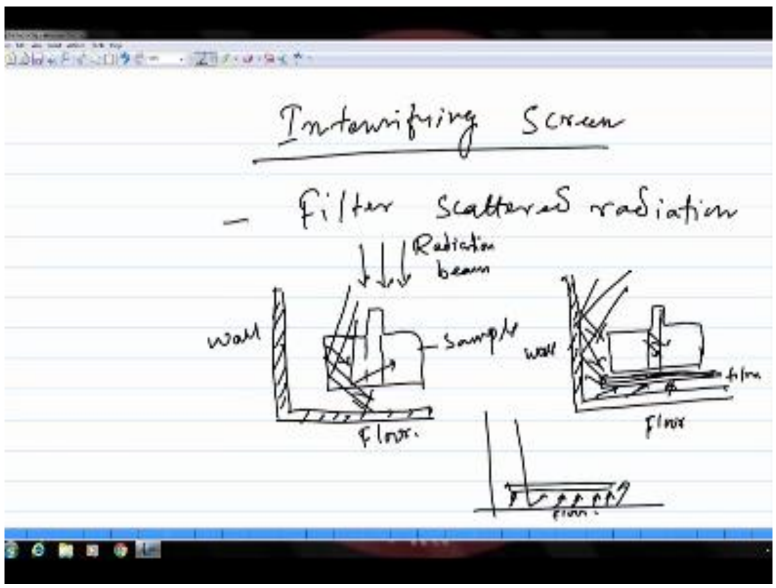


If you remember I told you before that the efficiency of the image formation or the quality of the image can be improved by using this intensifying screens so the objective of using and intensifying screen is to first filter out scatter the radiation because within the sample and within the sample holder and the exposure chamber there will be lot of scattering happening and this scattered radiation intensity is much lower compared to the main radiation and that is why if scattered intensity is present in the beam which is passing through the sample and falling on the film it will attain to haze the image and effect the image quality adversely okay.

So that is why if you want to improve the quality of the image this as scattered radiation has to be filtered out and there are different sources for this scattered radiation some of them come from within the sample and some can come from around the sample okay for example you know if you have a sample like this let us say some geometry like this so this backscattering can happen from within the sample from different regions of the sample like this so the main radiation is coming like this.

This is the sample and you can have this exposed chambers so you have this side wall or this floor over here so the first source of scattered radiation is from within the sample itself which will come from different portions of the sample and some of these radiations some of these back scattered radiation come can come from the surrounding of the sample like for example this wall or from this floor so these radiations can go to these walls and get scattered from the floor also they can get scattered.

And if there is some hole or something inside the sample from there also they can get scattered okay and in the third case you can get scattering from this floor also which is opposite to the sample like this okay so there are different sources of this back scattered radiations and as I told these scattered radiations are not good for the quality of the image and you need to filter them out okay so you need to use something over this film before the film is exposed to the radiation you need to use something over the film which can absorb all these low intensity radiations okay.

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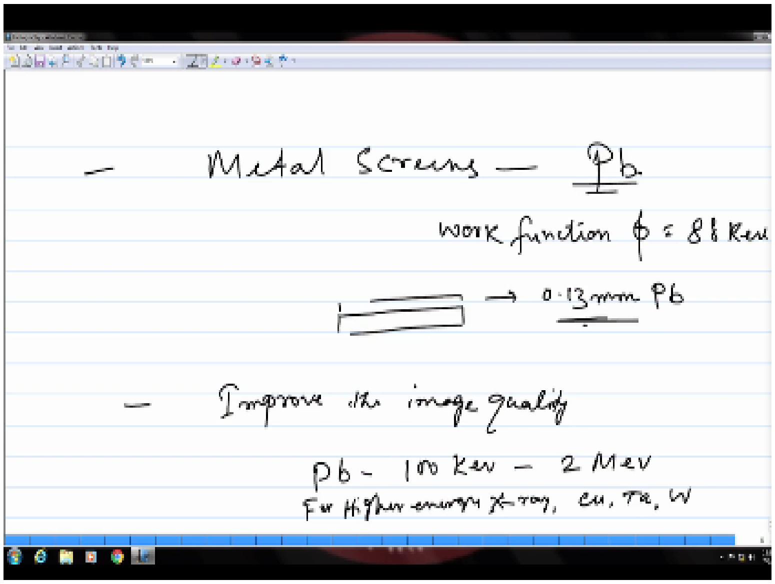


So ladies a material which is generally used because lead can easily interact with x-rays and absorb them particularly the low intensity ones so this kind of screens are the metal screens and most commonly used metal is led okay so this low intensity radiations when they enter this layer of lead they will knock out electrons from the atoms of lead and that is how they get absorbed okay so that is how they will get filtered and let can easily absorb the scattered radiation because the work function or the energy needed for knocking out an electron from lead is only88 kilo electron volt.

On the top of the film there has to be a very thin layer of this intensifying screen so if lead is used a very thin layer which is around point 13 mm is enough to filter out all these scattered radiations which are not desirable and the second objective of using an intensifying screen is to improve the image quality and as I told this main radiation when it enters the lead screen it will knockout electrons and these electrons will now go and fall on the film and they will additionally expose the film by providing this electrons.

So these electrons will go and interact with the silver bromide particles which are therein the film and that is how they will enhance the quality of the image okay so this is the second objective so if you use an intensifying screen you can not only improve the image quality because you are providing some extra source which can interact with the silver ions and at the same time you can also filter out the scattered radiation which is not desirable for forming the image.

So ladies used very commonly and if you have high intensity x-rays so late can be used from anything between this energy range 100 kilo electron volt 22mega electron volt extra energy and for higher energy x-rays other metals can also be used like copper tantalum tungsten all these metals can also be used for higher energy x-rays so this is about metal screens.

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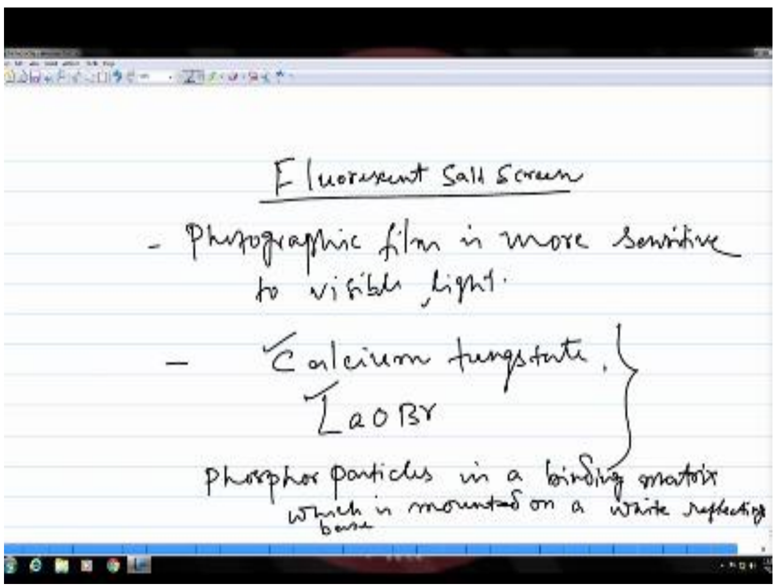


But there are other types of screens also which can be used for example these fluorescent salt screens which are generally used in medical x-ray radiography so these screens will essentially have this fluorescent material or this phosphor kind of material which emits light when they interact with x-rays and since these x-ray films are more sensitive to visible light the compared to excel radiation this photons or visible lights can improve the quality of the image okay so that is the objective here to convert the x-ray photons into visible light photons.

Since the film itself is more sensitive to visible light photons okay so photographic film is more sensitive to visible light so if you can convert the incoming radiation into visible light photons see then it will improve the quality of the image okay so that is exactly what is done when you use these fluorescents all screen so they are made of a material which can absorb x-rays and emit light so materials like calcium thug state.

And this rare earth halides for example lanthanum oxide bromide these kind of materials so this fluorescent property that when you expose them to x-ray radiation they will emit visible light okay so they are again made into a thin screen kind of thing a thin sheet of screen which can be kept on top of the film so in order to make that film what is done is this is coated on some kind of binding film so this phosphor particles are phosphoric else which is made of this kind of materials.

They are in a binding matrix which is mounted on a white reflecting base so that is how the screen is made you code this materials in a binding matrix and that matrix itself is mounted on a white reflecting base so that you can easily reflect this light onto the film and other materials.

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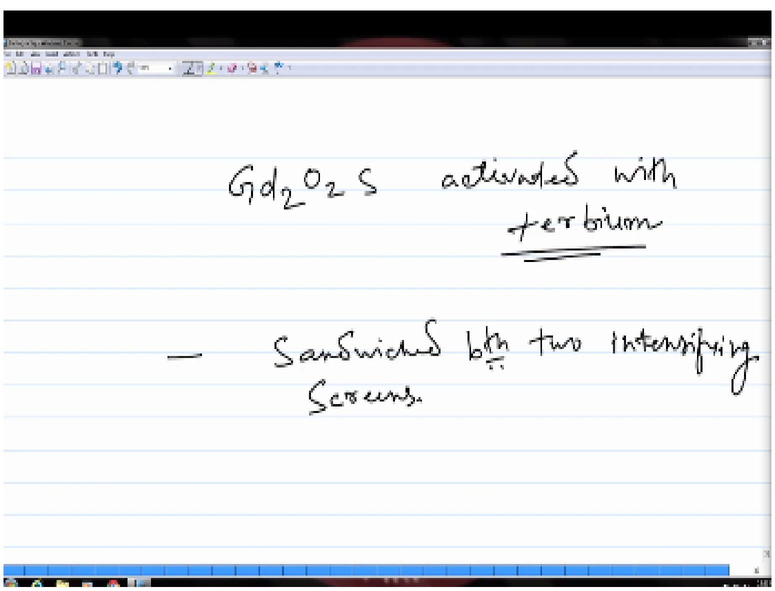

Like this gadolinium oxy sulfide which is activated by and rare earth like terbium so the film is coated on either side so that the backscattered electrons which are coming from bottom can also be filtered out so the film is sandwiched between the intensifying screen and this kind of phosphor material is the origin of digital radiography okay so with this we come to the end of this particular lecture the rest of the things that we have lined up for this particular technique will take it up in next few lectures so pleased to our tune in for those and I will see you back again thank you.


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