Evaluation of Textile Materials
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Lecture-30
Evaluation of Moisture in Textiles (contd…)

Hello everyone, so we will continue with the moisture measurement moisture in textile topic. So we are now discussing the moisture and fibre properties.

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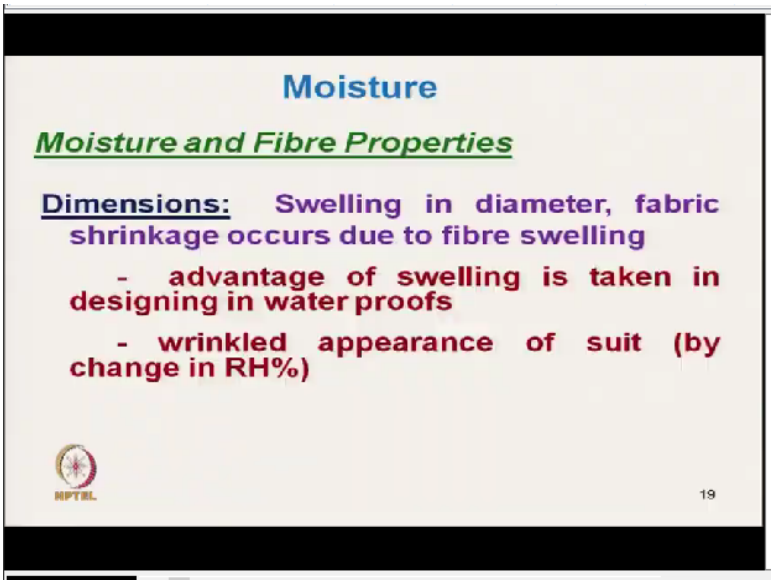

In last class we discuss that the absorption of moisture by textile material, it results swelling in diameter and also that it turns result the shrinkage of textile material.

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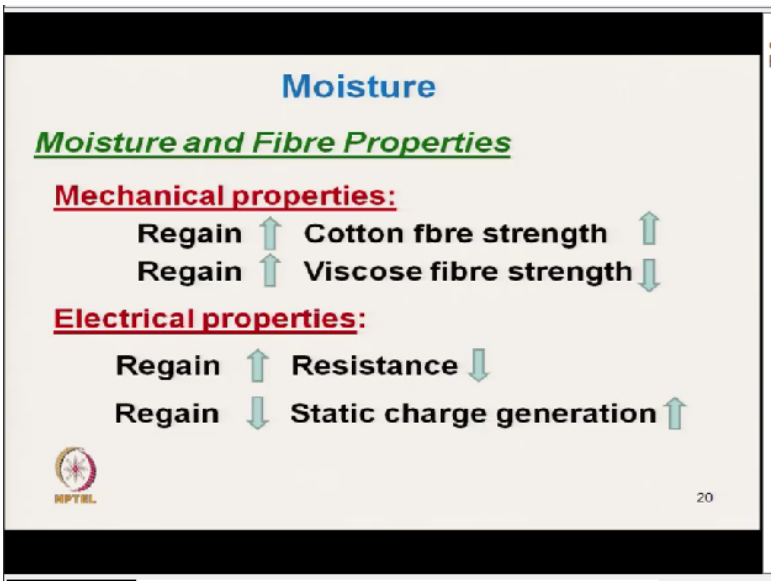

Now as for as mechanical properties are concern most cotton is an example where with the moisture regain the strength of the fibre increases. But in rest most of the fibre the mechanical properties are strength reduces with increase in moisture regain ok content of moisture inside the fibre. And electrical properties electrical resistance reduces with the increase in moisture content in presence of moisture in fibre.

Because water is good conductor of electricity, where as textile material most of the polymeric material are not so good conductor of electricity. And also the static electricity generation this problem it is more when the air is dry. In dry condition the textile material the content of moisture in textile material is low that is why it generates static electricity and that creates lots of problem during processing or even during use.

So, we must have seen that the textile material particular synthetic material it is sometime it is stick to our body ok that when layers of cloth stick. So, this is actually due to the static electricity generation ok.

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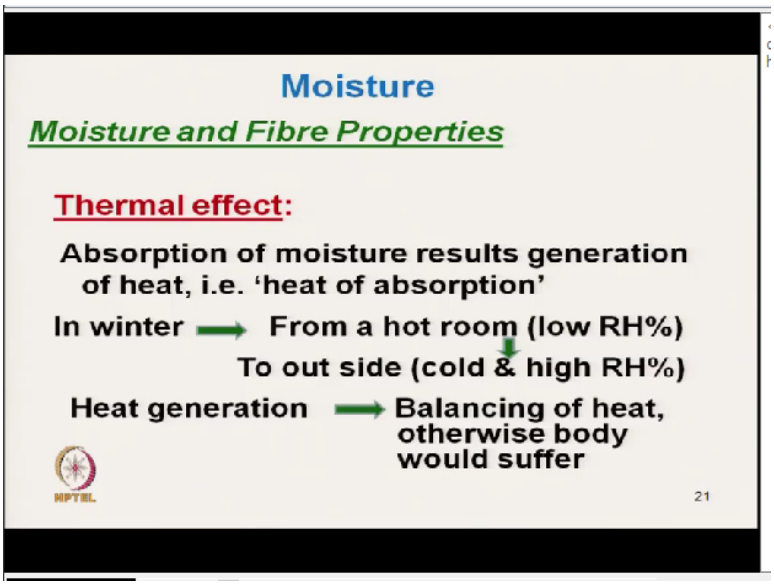

So, another important effect is it is a thermal effect and that directly affect the comfort sensation of during wearing cloth ok. So, absorption of moisture it actually it releases heat, it is a called heat of absorption. Now that it is a very common example suppose in winter in cold countries, in winter the room become hot and humid hot and dry. So, dry at low temperature at a low humidity from a person from a hot room with the low humidity when he is going out in cold condition.

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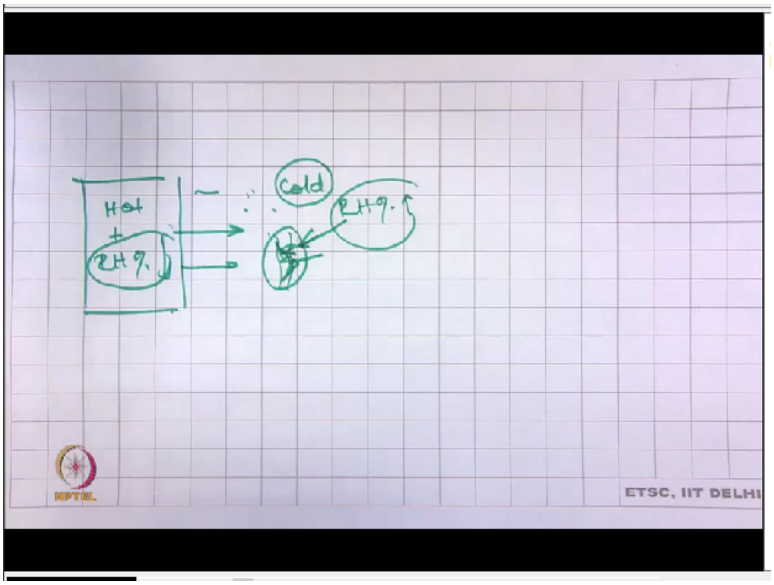

So in that case what will happen?, suppose this is room which is hot and relative humidity percent is low, low relative humidity. Now when someone is going out in cold environment and with high humidity suppose it is snowing at high very cold outside ok. In that case when he is

going out the textile material will absorb moisture ok and release heat of absorption heat absorption he will release that will keep the person is wearing the cloth keep the person warm.

So that heat generation heat will get generate the heat of absorption will get generated and balancing of heat. Otherwise body would support sudden cold shock you will suffer. So, that is actually that buffering action is done by the textile material.

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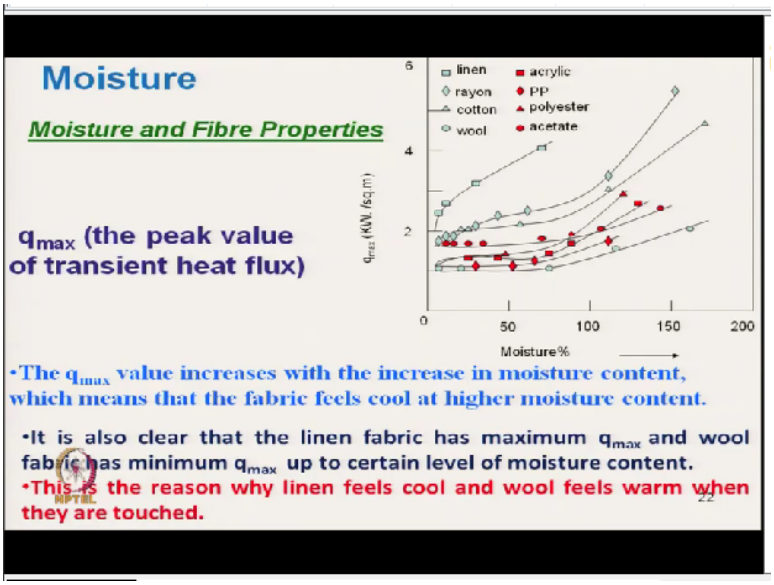

And another property is that is called the warm cool touch ok which is actually expressed in terms of qmax that means the transient heat, transient heat actually it takes away from our body. So, it increases with the increase in moisture present, so moisture present in the material if it increases. So the if the qmax value the qmax value increase with the increase in moisture content which means that the fabric feels cooler at higher moisture content.

So for all the fabrics all the different types of fibres the qmax value increases. So higher qmax value means the fabric actually feels cooler. So it is also clear that the linen fabric as maximum qmax value, so it is maximum qmax value that means the linen fabric is cooler in turns ok.

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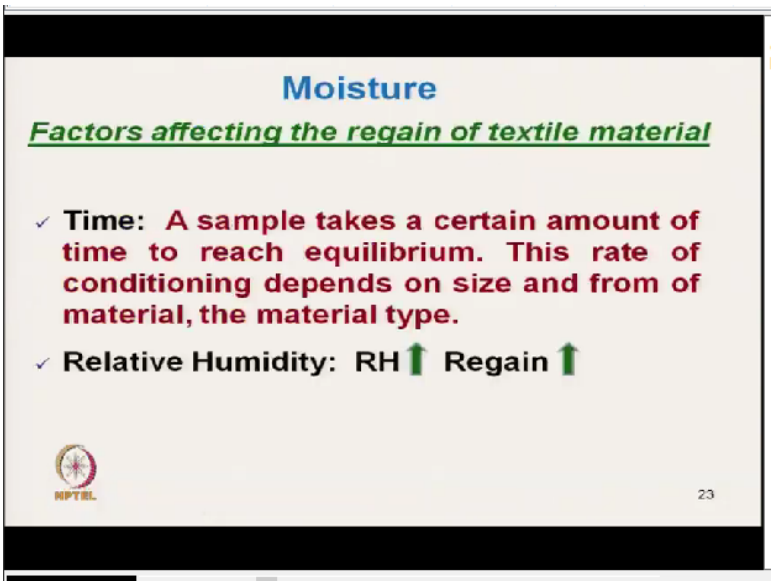

So, this means that and wool has got it is a least qmax value. So, for certain for any moisture or any relative humidity if we touch linen fabric it will be cool in touch and we will be warm. So, another effect is that it is a effect of time as we have discussed during due to the moisture hysteresis characteristics a sample takes a certain amount of time to reach the equilibrium. This rate of conditioning depends on the size and form of material and the type of material like cotton let us take an example of cotton and polyester.

So, polyester material will reach equilibrium quickly because the cotton the re-shift the cotton absorb moisture and form certain bond ok. Because of the presence of (()) (07:18) material, so that means it is release it is a drying behavior it is very slow ok that is why depending on the type of material and also the shape of material like if we talk about the yarn in lose hang form or fibre lose form.

Those will absorb or dissolve moisture exchange moisture quickly than the fibre in bell form or yarn in package form. So form of material also affect the moisture exchange capability and as relative humidity increases the regain increases that is we have already seen.

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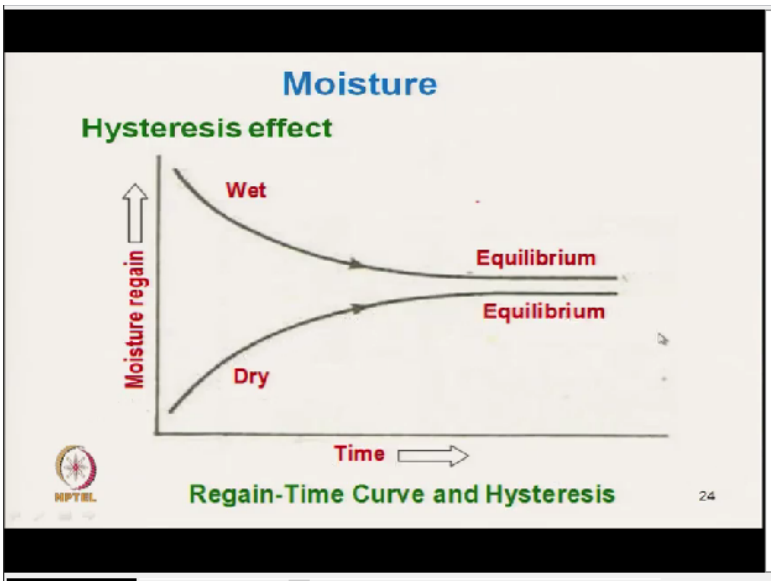

So, this is the hysteresis curve depending on the time the moisture value changes.

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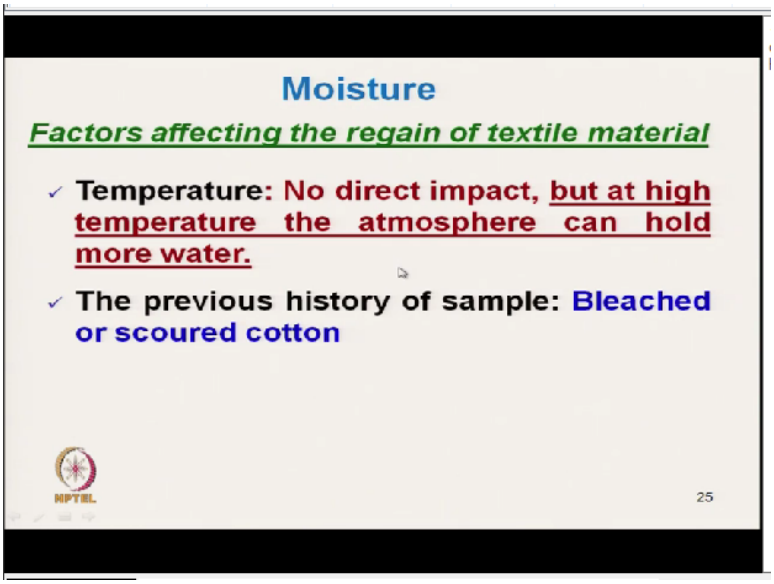

Another effect is the temperature although there is no direct impact of temperature at least for lower temperature, lower temperature it has but definitely at higher temperature they have fabrics the textile material will get affected there will be damage. But as far as moisture is concern if we increase the temperature to some extent the moisture content will increase although there is no direct impact. Because at high temperature the atmosphere can hold more and more moisture.

So, that will allow the textile material to absorb higher moisture content moisture from the atmosphere. Because the moisture availability at high temperature is more another factor is that

the previous history of the sample that moisture regains or moisture content will change. If the material the cotton is bleached or scoured, so raw cotton if we try to if we keep it will absorb certain quantity of moisture like say 8.5% if we keep it in the normal standard atmosphere.

But because it has got some wax material some other impurities, but if we bleach the cotton or if we scour it. Then the amount of moisture the moisture regain or moisture content will change. Because removal of this wax material ok, so the moisture changes with the previous history of the material.

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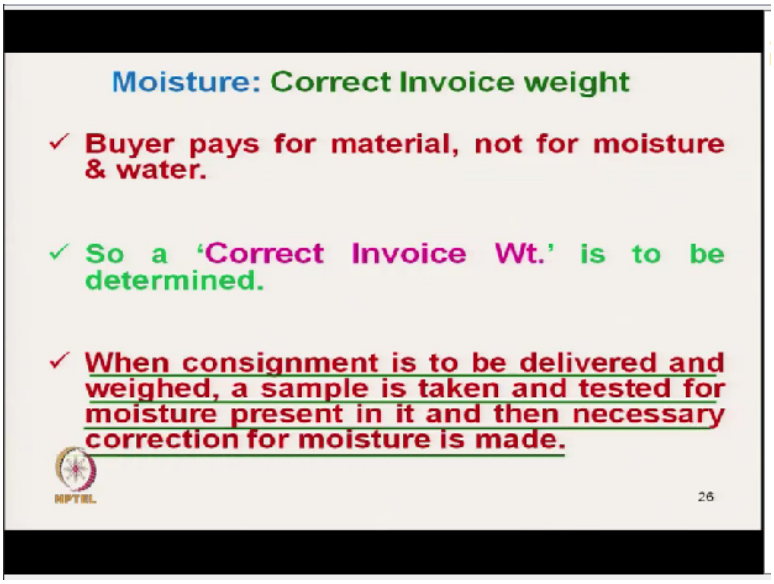

Now coming to one of the most important part which is correct invoice weight. So, the buyer pays for material not for moisture or water ok suppose we are supplying a material with higher moisture content. Why should buyer pay for the water excess water?. And also at the same time it is not possible to sell material without any water because it is a nature of the textile material. So, that means there must be standard acceptable moisture regain ok that is the standard regain is available.

And accordingly it is also not possible that suppose what I am trying to sell it is not it is the moisture content in that material is different from the standard ok that is ok. But I have to make some correction, I have to bring the total weight of the consignment as for the standard moisture

allowable. And if I do that means I am correcting the invoice wet and that the total trade will be based on correct invoice wet.

Now, so correct invoice weight has to be determined, now let us see how to calculate when consignment is to be delivered and weighed a sample is taken. So first before delivery we must take a sample from the consignment and then we have to test for the actual moisture present in that material that test sample. And that sample we have to take as for the sampling procedure that we have seen we have discussed earlier. And as for that we have to make sample and we take the sample and measure the actual moisture content in that material in the sample ok.

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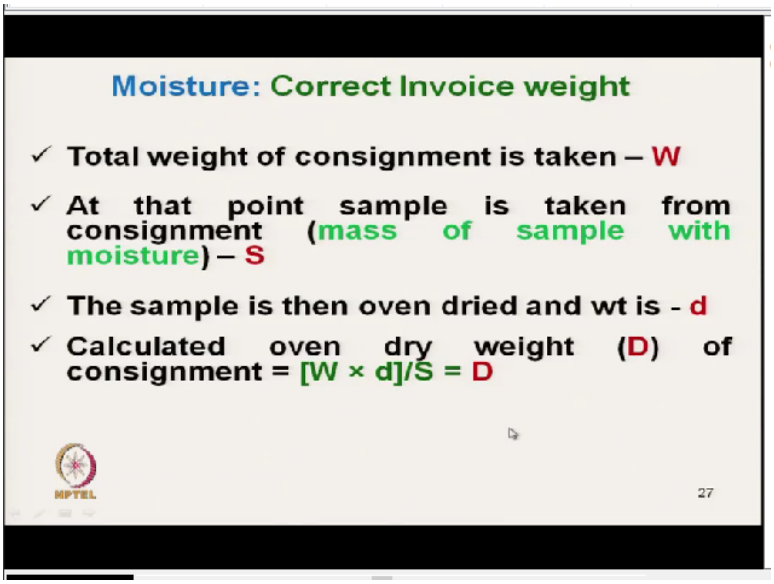

And say total weight of consignment is W capital W is the total wet of consignment, at that point the sample is taken from the consignment a small mass is taken that is consignment is a large total consignment and small sample is mass is taken ok. The sample is then oven dried and the wet is d, d is the dry wet of the sample S, that means S-d is the actual water content. Then we have to calculate the oven dry wet d ok of the consignment.

And this d that sample dried, so d and from that we can calculate oven dry wet of the total consignment W*d small d/sample. So this is the thus D oven dry wet of the consignment and from there we can calculate the correct invoice weight.

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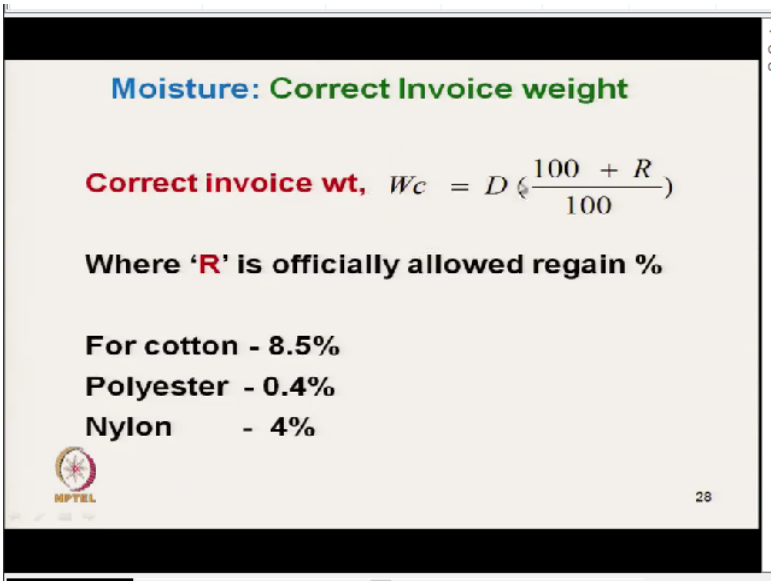

D is the oven dry weight calculated oven dry weight and R is the allowable official regain of the material. So, D*100+R/100 this is the correct invoice weight of the consignment. Now the total trading will be based on this correct invoice weight ok. Now these are the standard values of regain or some of the materials there are list of the materials are the official regains are available. So we have to correct accordingly.

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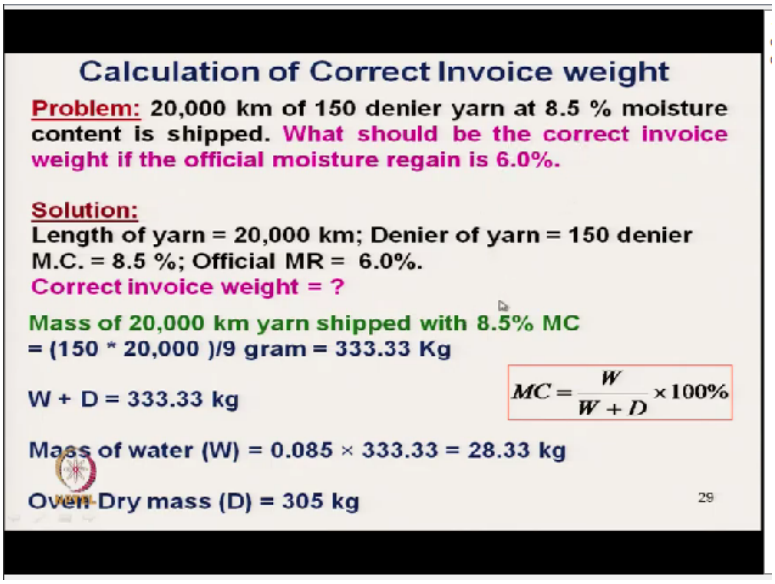

Now let us do some numerical here the problem is that 20,000 kilometer of 150 denier yarn at 8.5% moisture content is shipped, so 8.5% moisture content. We have actually we are shipping we are actually sell, now what should be the correct invoice weight. If the moisture content

moisture regain of that material is 6% we do not know the material but here moisture regain official moisture regain is given it is 6%.

And what we are selling it is at 8.5% moisture content we are selling it. So, that accordingly we have to **ca** calculate the correct invoice weight, so first thing is we have to calculate the total mass of the material 20,000 kilometer of 1.5% denier filament ok. So, length of yarn is 20,000 kilometer, denier is 150 denier and moisture content is 8.5% and official moisture regain is given 6% this all this data given.

Now let us calculate the moisture correct invoice weight. Now mass of 20,000 kilometer of yarn ok of 8.5% moisture content, so the mass at 8.5% moisture content is 333.33 kg which is coming from 150 denier. And it is a 20,000 kilometer and we are dividing by 9 because 9000 meter we are converting into meter and 9009, so that it is becoming 9. So, it is coming out to be 333.33 kg that is the actual mass of the consignment we are shipping ok at 8.5% moisture content.

Now next thing is that we have to calculate the dry weight, this is the equation for moisture content that is the weight of water and total weight by 100. So, this is the total weight when means W+D is 333.33 kg and mass of water we can calculate, so 85% means 0.085*333.33 it is a 28.33 kg is the mass of water. So dry mass will be dry, oven dry weight will be 333.33-28.33 it is 305 kg.

So, the dry mass of the material this 20,000 kilometer material it is a 305 kg. So, that is the now we cannot sell we cannot actually arise invoice on 305 kg. Because the 6% moisture content is allowed anywhere, so then we have to again add 6% moisture content moisture regain we have to add.

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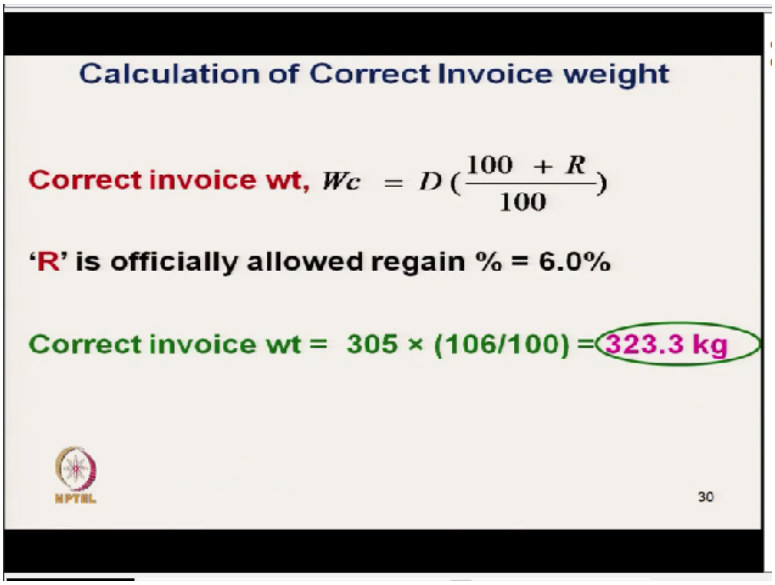

So, the what is happening? So, correct invoice weight becomes dry weight, so official regain 6%. So, dry weight*100+6 106/100, so 323 kg. So, our total invoicing will be on the basis of 323 kg not on 333 kg, so this is the correct invoice weight. Now let us try to see how to calculate the correct invoice weight of the blended material.

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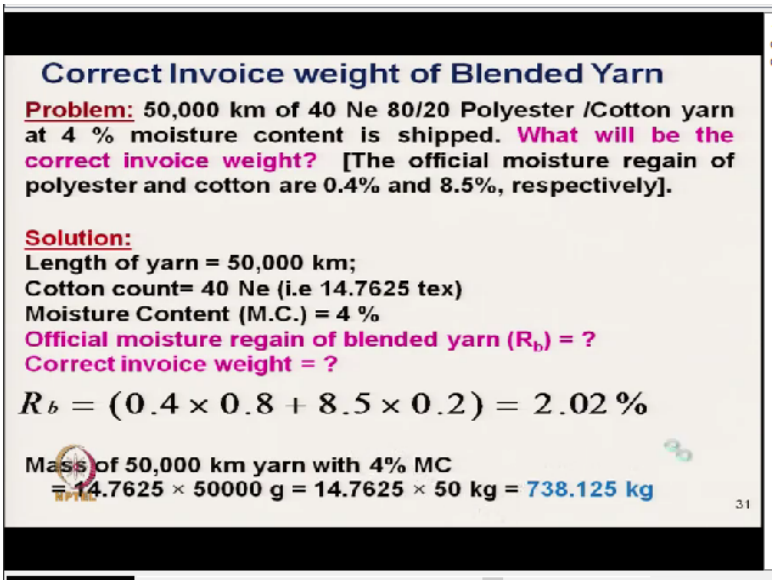

So, this is high 50,000 kilometer of 40 Ne 80/20 polyester cotton yarn. So, we have polyester cotton blended yarn at 4% moisture content is shipped. So, we know the moisture content of the what will be the correct invoice weight? And official moisture regain of polyester or cotton are given as 0.4% and 8.5% respectively then the problem is exactly is same as earlier problem only difference is that here it is a blended material.

So length of material is known and cotton count, so we are converting into direct count the because it is nothing but it is a it will be simpler, so 14 tex 40 Ne 14.76 tex. And moisture content is given official moisture regain of blended yarn. So, that we have to calculate and we will calculate using earlier equation. So this is the earlier equation, so 0.4 ok the moisture content and 0.8 80% ok.

And then 8.5% and 0.2, 8.5% is the percent regain ok percent regain of polyester, polyester 0.4% percent regain of cotton 8.5% 80% and 20%. Then it is coming out to be 2.2% of this is the moisture regain of the blended material and then moisture content is 4%. And we will calculate the total weight mass of the material will be 738.125 kg and this mass is having with it is with 4% moisture content.

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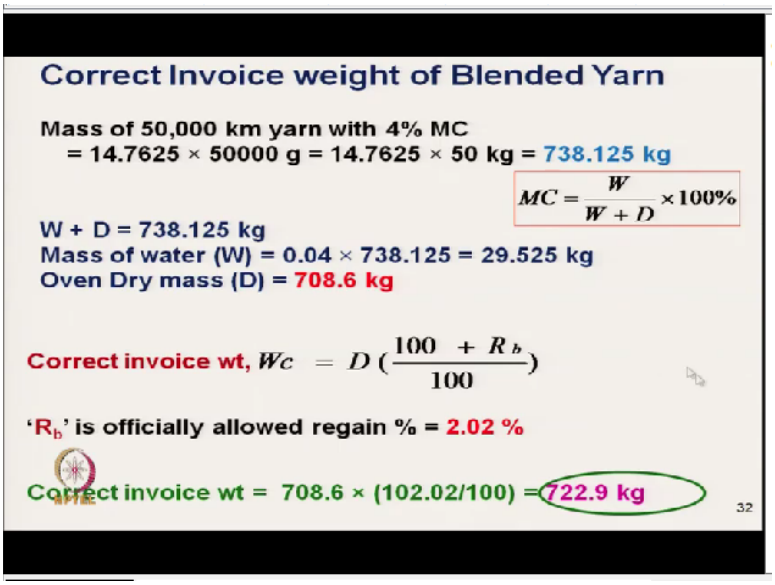

Then we will calculate the oven dry weight, so this is the W+D is 738 kg and the mass of water present is this ok. This is the mass of water present 29.525 kg and will get the oven dry weight it is a 708.6. So 738.125-29.525, so 708.6 kg is the oven dry mass. And then we can calculate the correct invoice weight, so this is the dry mass 738 and official regain we have already calculated 2.02% and correct invoice weight is 708.6*100 2.02.

Because 2.02%, so 100 2.02/100, so 722.9 kg is the correct invoice weight. So, we actually will not raise invoice on 738 kg but we will raise invoice on 722 kg 22.9 kg ok.

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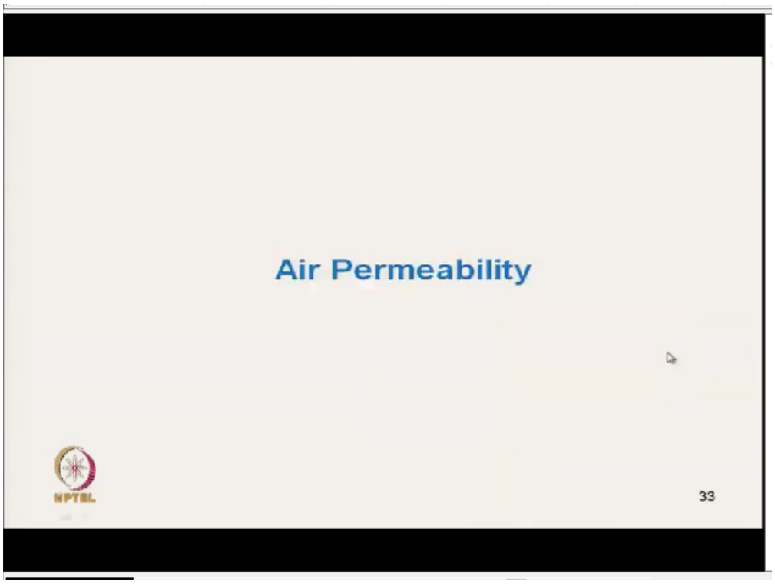

Now we will discuss another important characteristics of any textile material it is basically in the fabric form that is the air permeability. What is air permeability?.

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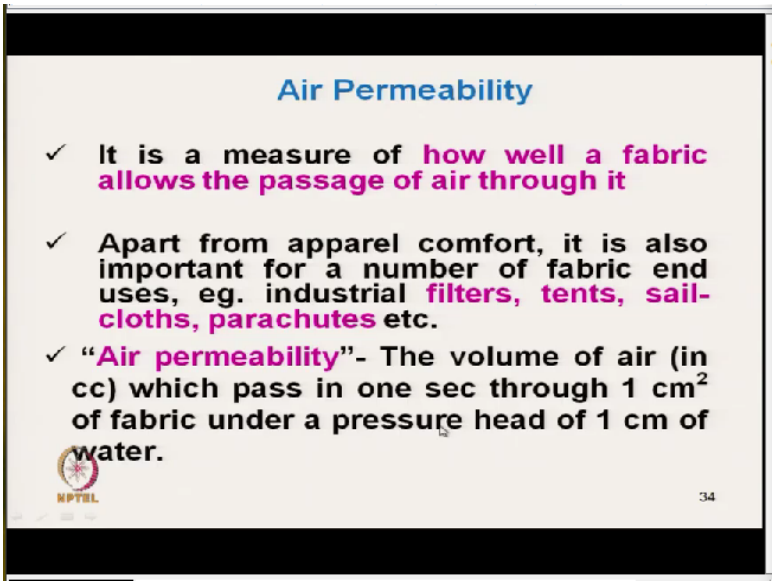

It is basically it is a measure of the flow of air, so how well of fabric allows to pass the air through it. And it is extremely important not only for apparel, for apparel it is important because of comfort ok, so if we it allows whether it is allowing air to pass through or not accordingly we can actually come to know that whether it is it will allow moisture vapor permeability or not. But

in technical textiles in especially for filter, tent, sail-cloth, parachute cloth the air permeability is extremely important.

Because in filter if the air permeability is less then it will not allow the air to flow through it, that means the filtration performance will be very poor. So, it will create high pressure drop similarly for tent or sail-cloth, sail-cloth if we it is air permeability is very high then it will be a problem if it is blocked that will be problem. So there should be some controlled air permeability similarly for parachute cloth ok, there must be some air permeability.

So, that it controls the rate of descent ok. The air permeability it is the volume of air which pass through one second through 1 centimeter square under a pressure of 1 centimeter of 1 water**.** So, it is the actually rate of air flow through fabric per unit area per unit pressure that is the definition of air permeability.

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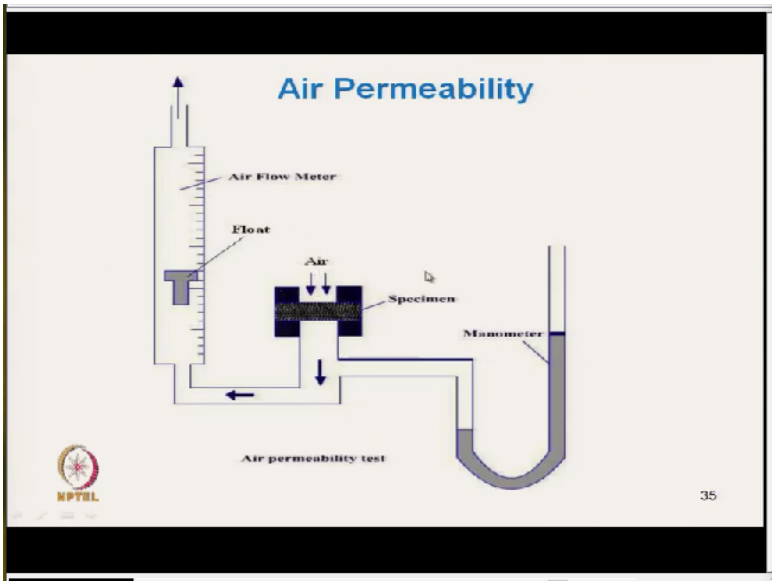

The measurement principle is exactly same as that we have used in air flow method of the micron air value. The cotton fibre micron air value that is the linear density measurement the similar method is used here that is the in this air that is the air pump is there, air suction is there. And in that the fabric is placed here specimen is placed here and air it will suck air, air will flow and it will measure the flow rate ok.

The flow by liter or cubic centimeter per second like that it will it is gauged and the rate of suction is adjusted. So that the unit pressure difference is there ok. So, that is the air flow rate that is the measurement technique.

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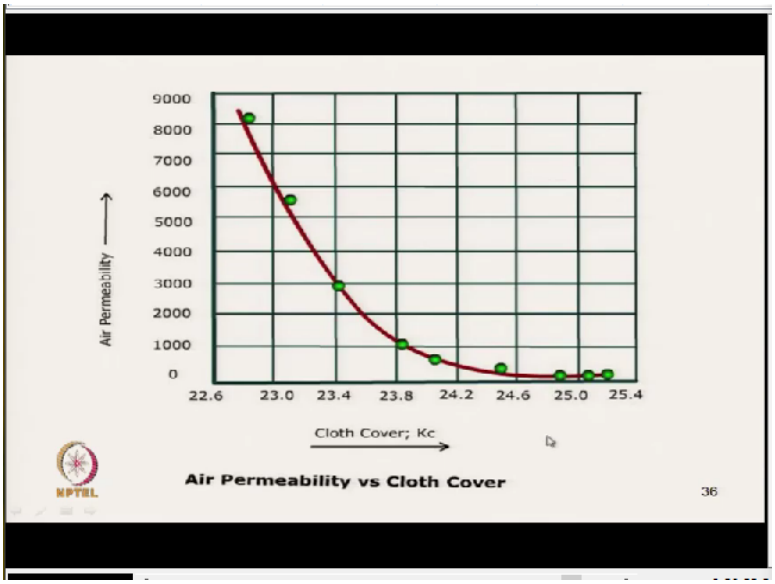

And air permeability changes with different parameter like if the cloth cover factor increases it is the cloth becomes compact air permeability will reduce. And this will help us in designing the cloth for parachute fabric or filter for many application we must know the relationship between cloth cover factor and air permeability, typically this relationship it is a logarithm relationship. So if we take the logarithmic value of air permeability verses the cloth cover factor.

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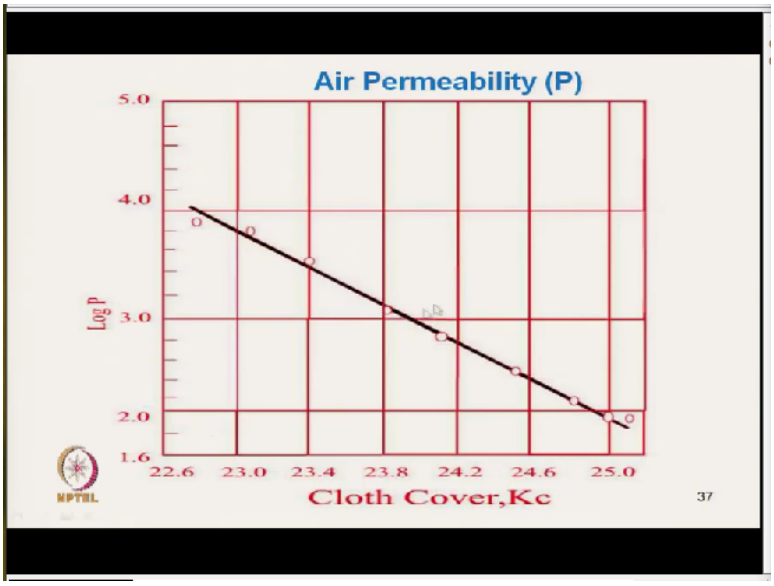

Then the **cover** will be straight line straight length ok this is the almost straight line curve. So, that it varies with the logarithmic value of air permeability.

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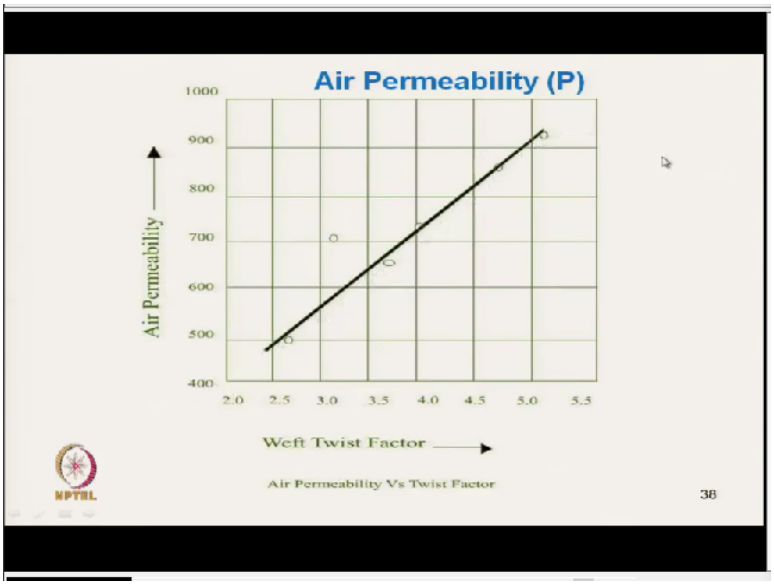

Another factor is that if we change here we can see if we change the twist factor of yarn. So this plot is the against in x-axis the twist factor of weft yarn verses air permeability. So keeping all other parameters constant if we change the twist factor that means the diameter of weft yarn is reduced. So effective cover factor is increased cover factor is reduced as diameter is reduce, so a fabric cover is reduced. So it will allow more and more air to pass through.

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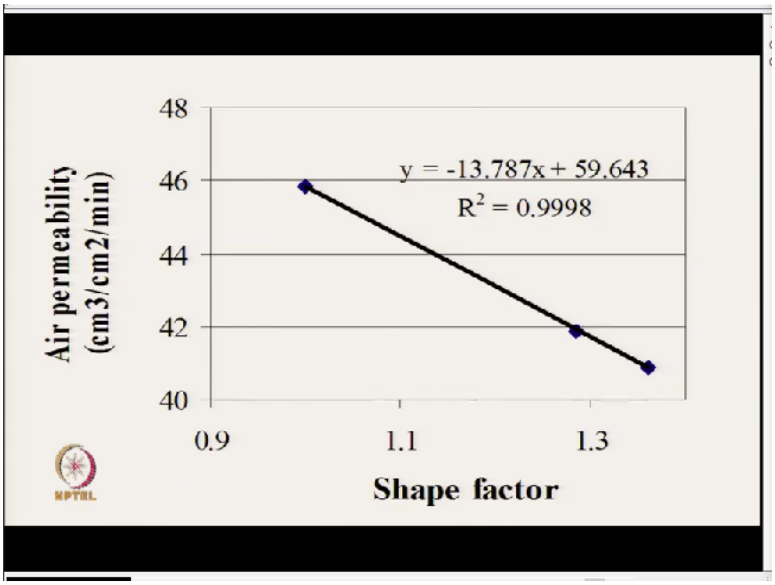

Next is the shape factor of filament ok, as the filament shape factor increases keeping all other parameters constant suppose we have prepared different fabric made of polyester filament of different shape ok. If we change so this is the say circular polyester, this one is a certain shape another is this one is with different shape. So it is a shape factor increases as the shape factor increases keeping inch per inch peaks per inch diameter of the linear density of fibre everything constant.

It has been absorbed that the air permeability of fabric reduces linearly, this is because of that the higher shape factor will present more surface area. And it will actually restrict the air flow rate and will stop here we have finished the air permeability, thank you.