Science of Clothing Comfort
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Lecture - 33
Moisture Transmission & Clothing Comfort (contd..)

Hello everyone.

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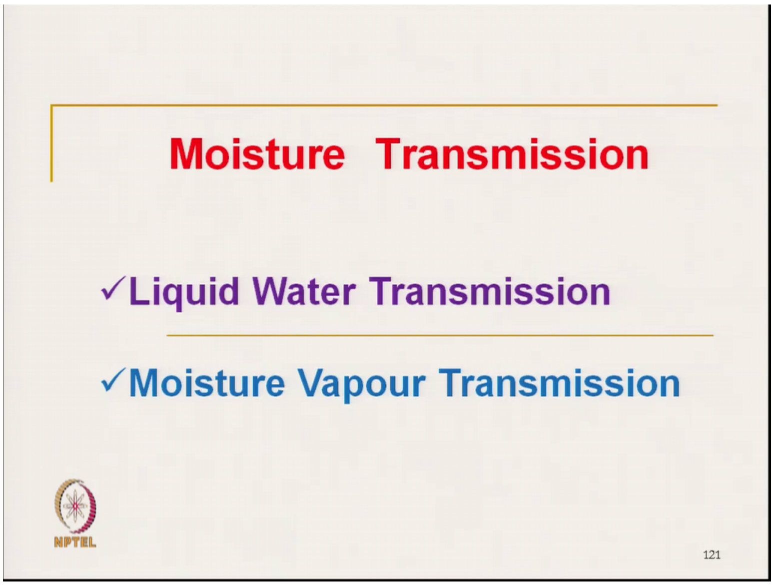

We are discussing Moisture Transmission related aspects of Clothing Comfort. So, we know that moisture transmission through textile material takes place in two form; one is liquid water form liquid water transmission and the moisture in vapour form. So, liquid water transmission we have discussed in detail in last segment. So, in this segment we will discuss the moisture transmission in vapour form.

So, if we see the if we compare the moisture transmission in liquid form and moisture transmission in vapour form; the a principle of transmission, the theories of transmission are entirely different. And the moisture gets transmitted through the textile material textile media at two different form at two different activity levels.

So, for normal activity level most of the moisture gets transmitted in vapour form and in high activity level; it gets transmitted in sweat form. Now, we will a discuss the moisture transmission in vapour form.

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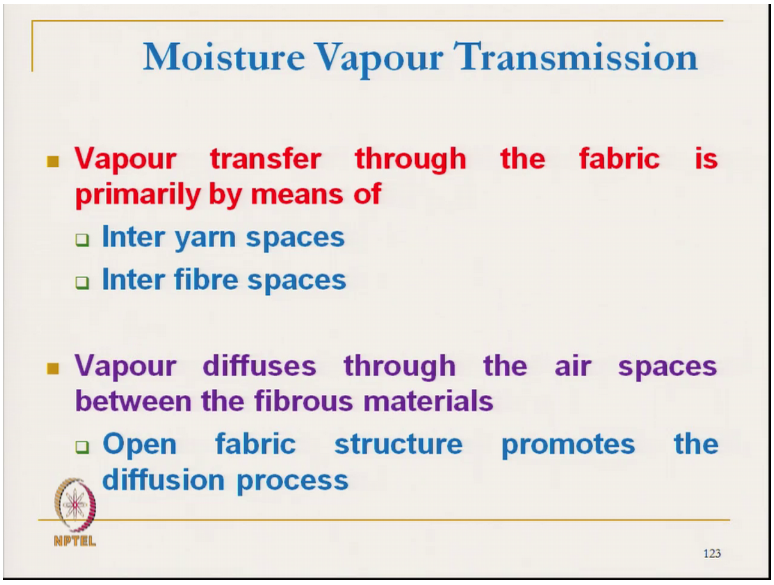

So, moisture transmission in vapour form it moisture vapour transmits through the fabric primarily in through the inter yarn space and through inter fibre space. So, in this two zone through this two zone moisture in vapour form gets transmitted. And moisture vapour diffuses through the air space between the fibrous material. So, open fabric structure promotes the diffusion; so, if there is some open space, so moisture gets diffused through this. Now, try to see that: what are the different layers through which the moisture gets transmitted.

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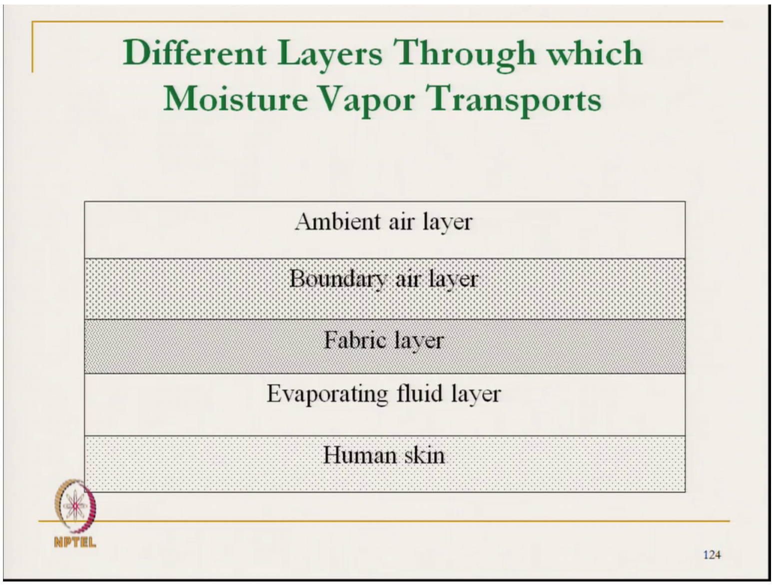

So, moisture vapour from our human skin from our skin gets transmitted to the evaporating fluid layer. So, just above the skin just below the fabric layer; there is a layer which is called evaporating fluid layer, then it comes inside the fabric layer. So, through fabric layer moisture gets transmitted and the transmission through the fabric layer takes place by different principles; we will discuss. And our main focus of discussion will be this part where moisture gets transmitted through the fabric layer from one layer to another layer.

And above the fabric layer it is a boundary air layer and this layer is a very important; if the moisture concentration vapour concentration at this layer is high; then that will affect the moisture transmission of the fabric layer. And this boundary layer is connected with the effect this is actually influenced by ambient air layer. So, if the ambient air layers at the moisture level it is; if it is saturated then boundary air layer will definitely will be affected and so the fabric air layer will get affected. So, all the layers will get affected; so, this the total balance has to be there.

Then proper transmission of moisture vapour from humans our skin to the ambient layer will take place. Any of the layers if there is some problem then that moisture transmission will get affected and most important which we can control is our fabric layer. So, we will see that how the fabric structure; structure of fabric, structure of yarn even type of fibre affect the moisture transmission behaviour through this fabric. So, basically if you see the moisture transmission through the fabric layer it takes place by actually it follows four mechanism ok.

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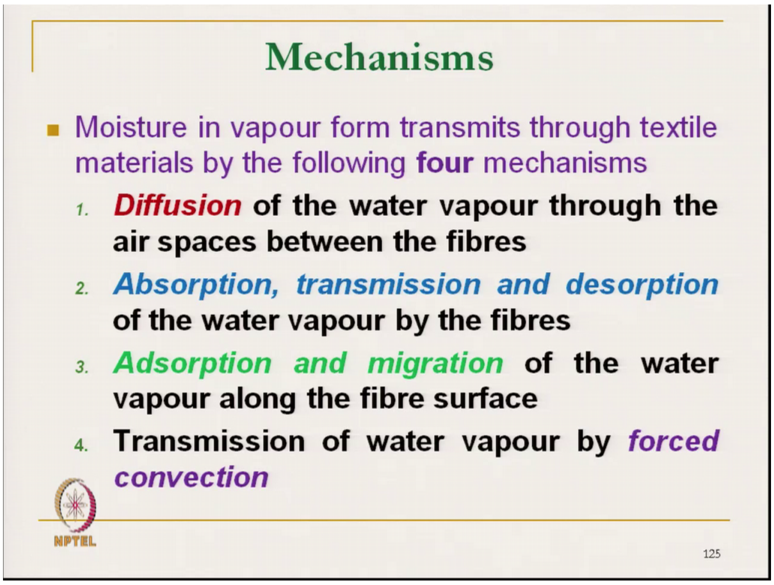

So, these mechanisms are diffusion; first is diffusion of water vapour through the air space between the fibre. So, diffusion takes place through the air pockets; if air pocket is not there, so fabric is totally compact solid material; so, there will not be any diffusion to for diffusion to take place. So, there has to be some air pocket. So, that if we can create air pocket within the fabric structure; then we will enhance the moisture vapour transmission through diffusion, which is very predominant principle of moisture transmission through textile material.

Next is the absorption, transmission and desorption; so, this only takes place for hydrophilic fibre. So, hydrophilic fibre material it get it absorbs the moisture and moisture gets transmitted through the material; through the fibre and to the other surface where the vapour pressure is relatively low and from there it get actually evaporated dissolves. So, this is the principle and if we compare the diffusion principle and second one absorption transmission desorption; the diffusion through air is very very fast it is much faster than absorption transmission desorption.

But diffusion this second principle is very important where diffusion is not there; so, that is we will discuss. And third is adsorption and migration; so fibre is not absorbing the moisture, but it gets adsorbed at the surface. And from the at certain temperature; it adsorption takes place at certain temperature below certain temperature at high temperature, it actually moisture droplet does not occur. So, that adsorption is not that does not takes place.

So, after the moisture gets adsorbed at the surface; then the moisture is transmitted along the surface ok. And last one is that it is a forced convection; so, like forced convective heat transmission we have seen, similarly here the air flow of air transmits the it enhance the moisture transmission. So, boundary air layer outside the fabric above the fabric layer as we have seen in last slide. So, if the air blows; so at air as the air blows that will take the all the moisture beyond the above the fabric surface and so forced convection will take place. Now, we will start the first principle of moisture transmission it is a diffusion.

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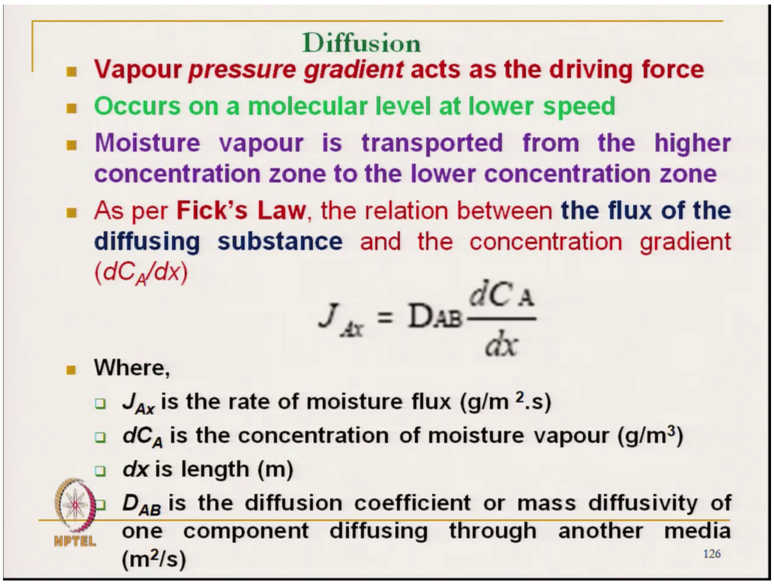

So, diffusion it is basically the vapour pressure which is the driving force. So, if the vapour pressure is created the vapour pressure gradient is created that will actually drive the moisture vapour. So, vapour pressure gradient acts as the driving force occurs on a molecular level at low speed. So, it is basically it is at lower speed it cannot take place at high speed. So, it at a lower speed; so, moisture vapour pressure gets generated due to the presence of moisture and it is; it pushes the moisture that vapour to the other surface.

So, depending on the pressure difference the moisture gets transmitted. So, moisture vapour is transported from the higher concentration zone; where the vapour pressure is high to the lower concentration zone. So, it follows the Fick's law; as per the Fick's law the relationship is between that is the moisture flux this is the moisture flux is equal to the D AB; which is the diffusion coefficient by and it is a concentration of moisture vapour and this is the distance between the distance that is the length.

So, depending on the concentration; so moisture flux at higher concentration the moisture flux will be more. So, that the difference in the concentration a moisture; the moisture the, which actually the concentration gradient, this is the concentration gradient which is the driving force. So, it is proportional to the heat flux and the diffusion coefficient or mass diffusivity is actually it is of one component diffusing through another media; so this is the D AB is the mass diffusivity. So, moisture rate of moisture transmission in terms of gram per square metre per second it is proportional to the concentration gradient d C A by d x this is the concentration gradient; vapour concentration gradient.

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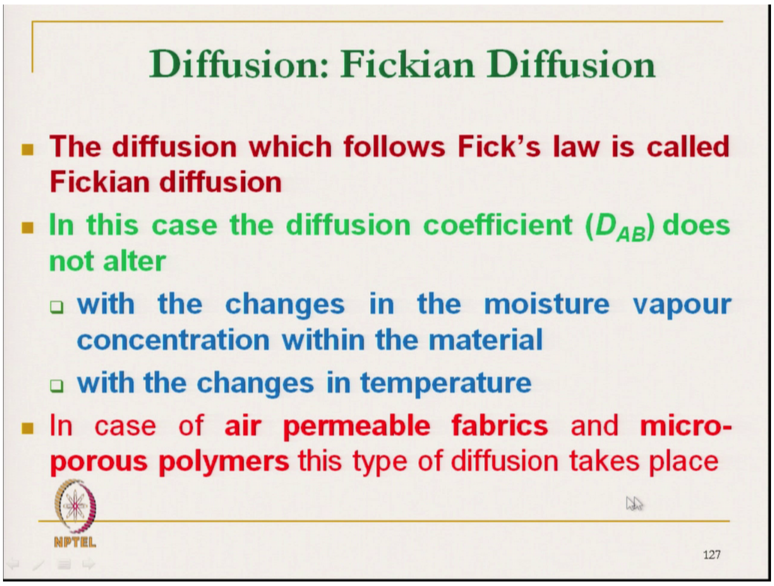

So, the diffusion which follows the Fick's law; so that is called Fickian diffusion and Fickian diffusion takes place through the air pockets. We if we can create the air pockets within the fabric structure or yarn structure then diffusion will take place.

In this case the diffusion coefficient does not alter with a change in moisture vapour concentration within the material with the change in temperature. So, this diffusion coefficient the constant it does not change with the temperature and moisture vapour concentration. In the case of air permeable fabric and micro porous polymer these type of diffusion take place. So, air why air permeable fabric? In air permeable fabric there is there are pores available so, that through the pores depending on the moisture vapour concentration gradient the moisture vapour gets transmitted.

And similarly why micro porous polymer? In micro porous polymer the moisture gets the pores are get filled with the moisture vapour and as soon as the moisture vapour pressure is more than the ambient air and other side. So, that moisture will get transmitted. So, the vapour pressure gradient has to be created as soon as the moisture vapour gradient a pressure gradient is created the moisture gets transmitted. So, in addition to the Fickian diffusion there is another diffusion which is called non Fickian diffusion.

That means the material the process which where the Fickian diffusion is not followed means, the only vapour pressure Fickian diffusion takes place through the vapour pressure gradient.

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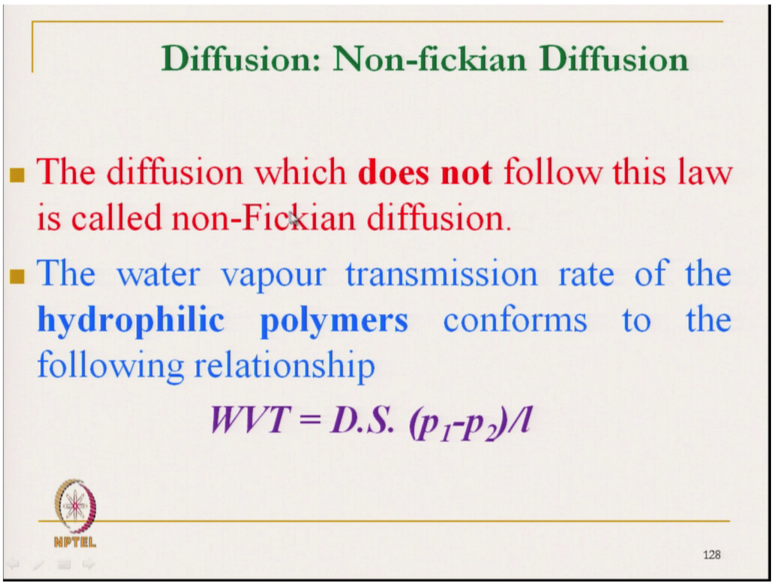

So, the diffusion which does not follow the law this actually Fickian law is called the non Fickian diffusion. The water vapour transmission rate of the hydrophilic polymer conforms the following relationship; that means, for hydrophobic polymer; normally it goes through the air pocket. The air; it moisture does not get absorbed by the polymer; so, the Fickian efficient take place.

But when we use the hydrophilic polymer then the hydrophilic polymer trans; suppose it is a solid polymer its polymer and it absorbs the moisture and then through the material it gets transmitted to the other surface.

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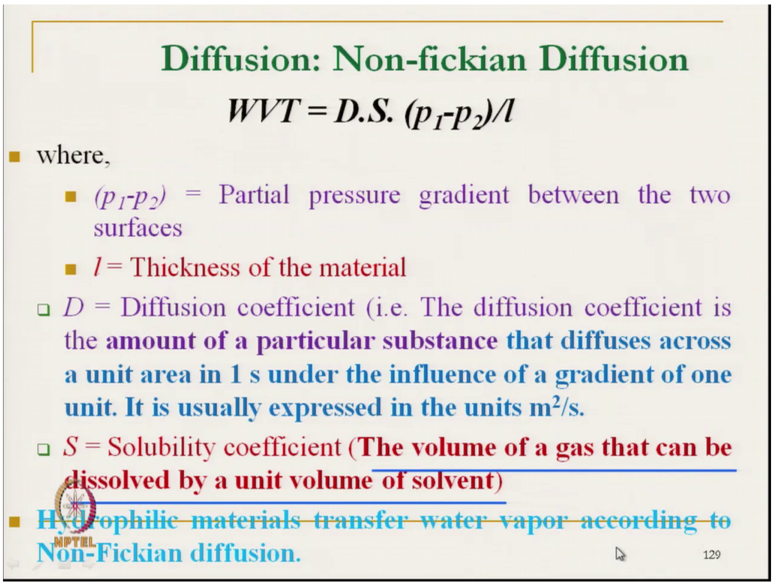

So, water vapour transmission is equal to the D, where D is the diffusivity diffusion coefficient is the amount of the; of a particular substance that diffuses across the unit area in 1 second under the influence of the gradient of 1 unit. So, this is the diffusion coefficient and p 1 minus p 2 these are the partial pressure gradient between the two surfaces.

So, there are the any polymer surface material is there in between two surfaces; there are pressure difference p 1 and p 2; p 1 is the surface of the higher pressure and p 2 is the on the other side and D is the diffusion coefficient and S is the solubility coefficient. That means, the volume of gas that can be dissolved by a unit volume of solid; now this is important for particular for a textile material; here we are talking about we are not talking about the gas here we are talking about the it is a moisture vapour.

This a non Fickian diffusion; it is basically it is for a gaseous material. So, this S is the solubility coefficient of gas here, but in our case it is a moisture regain of textile material. So, as the it is a equivalent to moisture regain of the textile material and l is the thickness of the material.

Now, if we see moisture of a hydrophilic fibre in suppose a cotton fibre fabric is made of cotton fibre and if we assume that there is no pore; pores are not available here. So, what happen? In that case the moisture vapour diffusion take place through non Fickian diffusion, it moves through the structure of the fabric; which is actually (Refer Time: 16:31); it is very close to our that absorption disabsorption principle; the hydrophilic material transfers water vapour according to non Fickian diffusion.

So, that for hydrophobic material, like polyester if you see the transmission of moisture vapour through Fickian diffusion. But, transmission through cotton fabric is basically both by Fickian and non Fickian diffusion. The Fickian diffusion take place when through the pores whatever pores are available through that the Fickian diffusion takes place and if there is no pore; so, in that case the non Fickian diffusion will take place.

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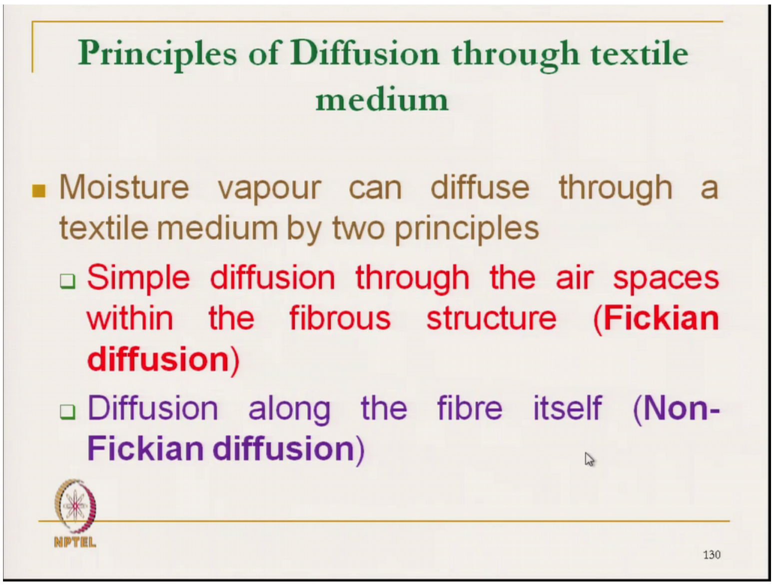

So, non Fickian diffusion is if you see it is very slow in nature. So, moisture vapour can diffuse through a textile medium by two principle; the simple diffusion through air space within the fibrous structure, it is a Fickian diffusion and diffusion along the fibre itself; it is a non Fickian diffusion.

So, if you see the fire most of the textile material they have some moisture absorption moisture regain. So, the textile material it moisture transmits through the textile material; in using both the principle Fickian diffusion and non Fickian diffusion. Depending on the moisture absorption hydrophilicity of the fibre; the Fickian and non Fickian and also depending on the air space present within the structure which principle will be predominant that actually there is a control.

So, if the air space is more; that means, a Fickian diffusion will be predominant; if the hydrophilicity of the fibre is more and air space is very less then non Fickian diffusion will take place.

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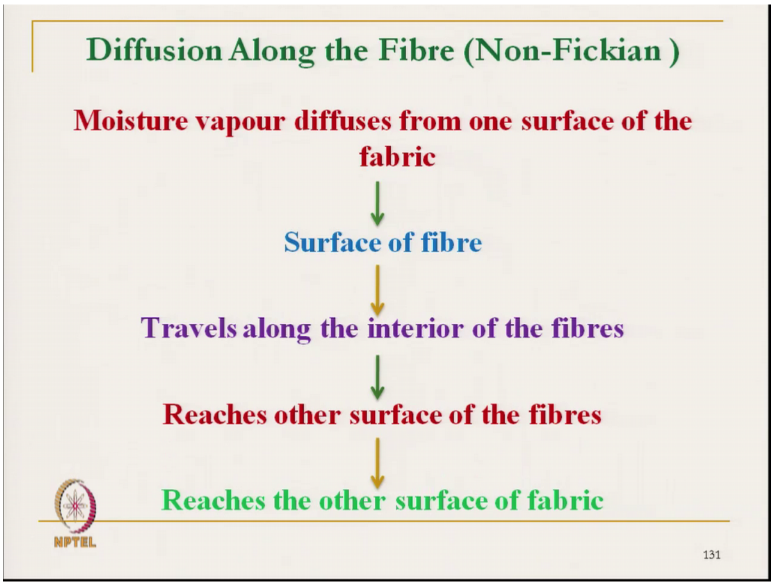

So, moisture vapour diffuses from one surface to of the fabric to the surface of the fibre; I am talking about the non Fickian diffusion to the surface of the fibre. Then travels along the interior of the fibre, reaches to the other surface of the fibre and from there it gets evaporated. So, this is the process and if we see moisture is reaching to the surface of the fibre; it gets penetrated through the structure fibre structure, it is reaching to the other surface and from there it is getting evaporated.

This is one principle of non Fickian diffusion; another principle is Fickian diffusion where pores are already present in the structure. Moisture vapour with higher pressure gets its penetrated inside the pore; gradually and vapour pressure is developed there. And that vapour as soon as the vapour pressure is more than the other surface vapour pressure of other surface that will get transmitted.

So, if you see the Fickian diffusion is very simple and straightforward. So, that is why it takes much less time than the non Fickian diffusion and non Fickian diffusion to take place non Fickian diffusion.

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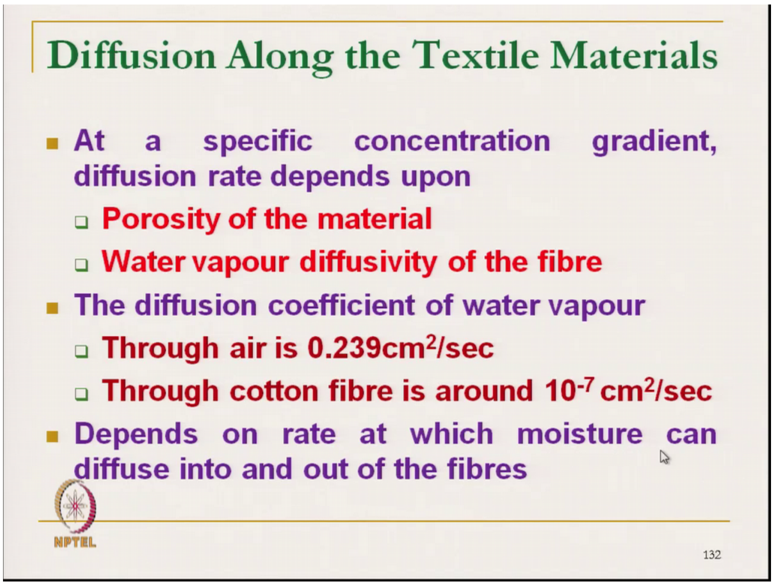

So, if you see at a specific concentration gradient. So, if you see the concentration gradient is same; so for our, from the skin and to the atmosphere if the concentration gradient is a fixed, if you see; the diffusion rate depends upon the porosity of the material. What is the porosity of the material? And water vapour diffusivity of the fibre.

So, and diffusion coefficient of water vapour if you see through air it is much higher than through cotton fibre. So, here if you considered it is a cotton fibre it diffusion through cotton fibre is 10 to the power minus 7 square centimetre per second whereas through air it is much higher 0.239 square centimetre per second.

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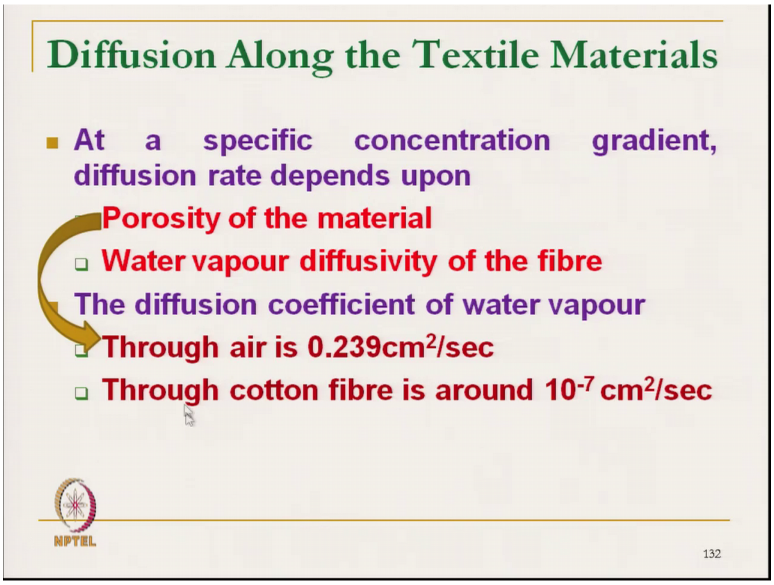

So, what is here? The porosity of the material it is controlled by the diffusion through air. So, if we can increase the porosity the diffusivity will increase and this diffusion is by Fickian diffusion. So, Fickian diffusion is very-very high; so, if we have to increase the; if our vapour pressure level is very high if we have to eliminate, if we have to remove the vapour at higher rate; we have to follow the Fickian diffusion.

And for that or we have to create the air pocket; we have to increase the porosity of the material. If we see that our vapour pressure is generated or vapour pressure gradient or generation of a vapour pressure is slow very low.

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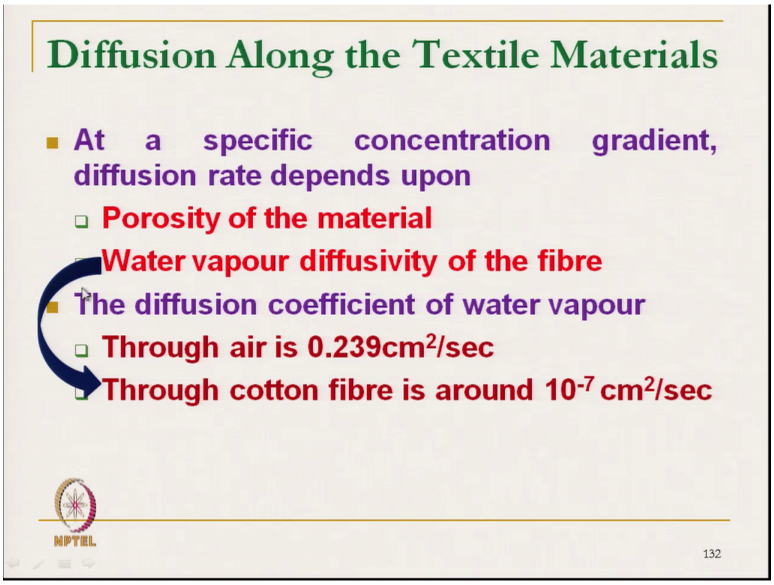

In that case we can depend on the water vapour diffusivity through the fibre. So, in that a; so the situation is that at very low activity level. If we have suppose if we wear two different fabric highly compact say with 0 porosity, polyester filament fabric another is the cotton fabric made of cotton fibre, cotton fabric very highly compact fabric two fabrics.

And we are sitting idle; so because; that means, we are generating the moisture vapour only. So, if we consider that porosity is least let us for argument we consider the porosity is 0. So, when porosity is 0 for both the fabric polyester and cotton in that case polyester will not have the non Fickian diffusion; if we consider polyester is hydrophobic fibre. So, in that case polyester is not absorbing any moisture, it is not transmitting. So, in that case even if we are sitting idle polyester will give uncomfortable sensation because, the insensible perspiration whichever we are whatever we are generating it is not getting transmitted.

But cotton although it is very slow transmission rate is very slow, but cotton will have comfort feeling because of the non Fickian diffusion through the fibre ok. So, it depends on the rate at which moisture can diffuse into the; into and out of the fabric. So, this actually at very high rate if we consider; in that case cotton will fell in that case you have to generate some pores; so, we have to create the Fickian diffusion ok.

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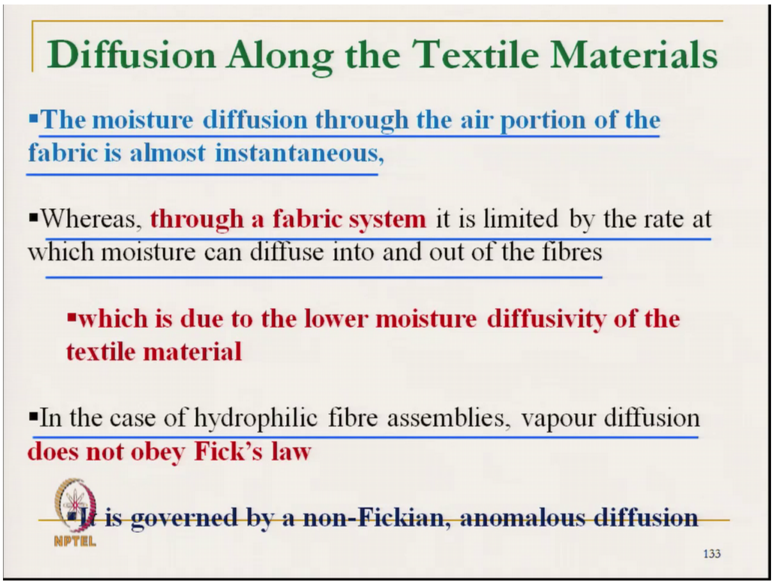

The moisture diffusion through air portion of the fabric is almost instantaneous; so, we have to create that air whereas through fabric system it is a limited. So, it is instantaneous; it is a slow through fibre which is due to lower moisture diffusivity of the textile material ok.

And in the case of hydrophilic fibre assembly; vapour diffusion does not obey the Fick's law. So, that is the way the it is a non Fickian diffusion that we have discussed, but hydrophilic fibres our advantage is that if we can create the air pocket the Fickian diffusion also take place.

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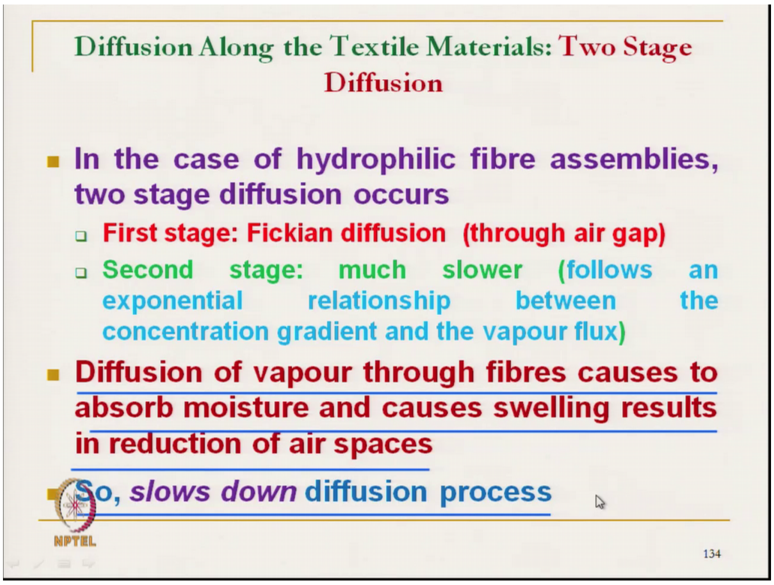

So, diffusion along the textile materials; two stage diffusion in the case of hydrophilic fibre assembly two stage diffusion take place; so, hydrophilic say cotton fibre cotton fabric ok. First stage is a Fickian diffusion through air gap as we have discussed and second stage its much slower follow an exponential relationship that is a non Fickian diffusion between the concentration gradient and vapour flux its very slow diffusion of vapour through fibre causes absorption of moisture; so, it creates another problem. So, when the hydrophilic fibre, so, when non Fickian diffusion take place; so, due to absorption of moisture the fibre get swell.

So, it sometime it slows down diffusion the slows down diffusion means it is a which diffusion it is a Fickian diffusion. So, non Fickian diffusion also affect the Fickian diffusion by slowing down the by reducing the pore volume. So, fibre which like a cotton fibre is an example where it; when it slows down when it swells down swells up; so it slows down the Fickian diffusion ok.

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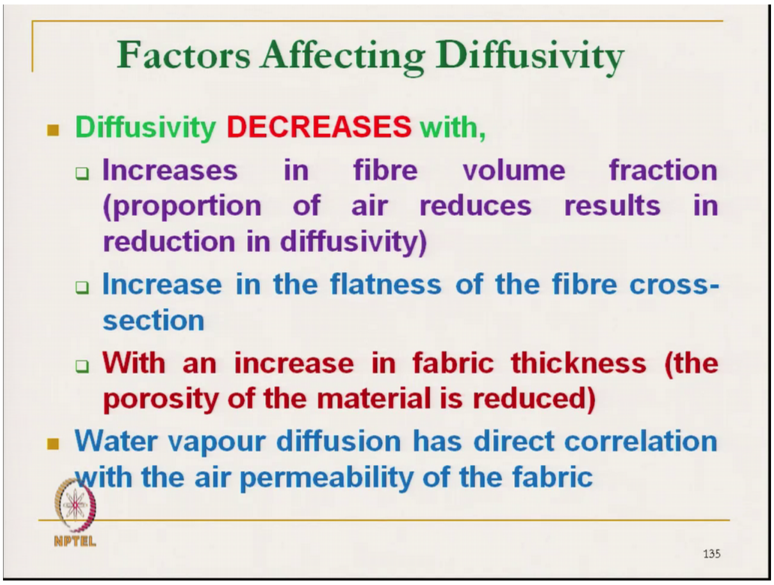

So, the now let us see the; what are the factors which actually controls the diffusivity? So, diffusivity of any material of textile fibre particularly decreases with the increase in fibre volume fraction; that means, proportion of fibre in the fabric; that means, if we; that means, air pocket volume of air pocket is reduced.

So, when the fibre volume fraction increases; the air pockets proportion of air pockets reduce; so diffusivity reduces. So, this diffusivity it is due to Fickian diffusion; increase in the flatness of fibre cross section. So, this is important what happens if the flatness increases it is like a deviation from roundness; that means, the specific surface area if it is increasing, then what happens? It will actually drag the flow it is similar to the airflow. So, airflow if the specific surface area is increased; it will drag the flow free flow of the moisture vapour and the diffusivity decreases.

And it also decreases with the increase in fabric thickness. So, as the fabric thickness increases the path flow path will be longer; so, the diffusivity of the fabric decreases also this is reducing the porosity of the fabric and water vapour diffusivity as direct correlation with the air permeability. So, all these factor if you see these are related with the air permeability. So, by measuring the air permeability of a fabric; we can actually in directly get some idea about the diffusivity at least the Fickian diffusion. So, non Fickian diffusion is something else which actually where moisture gets absorbed by the fibre.

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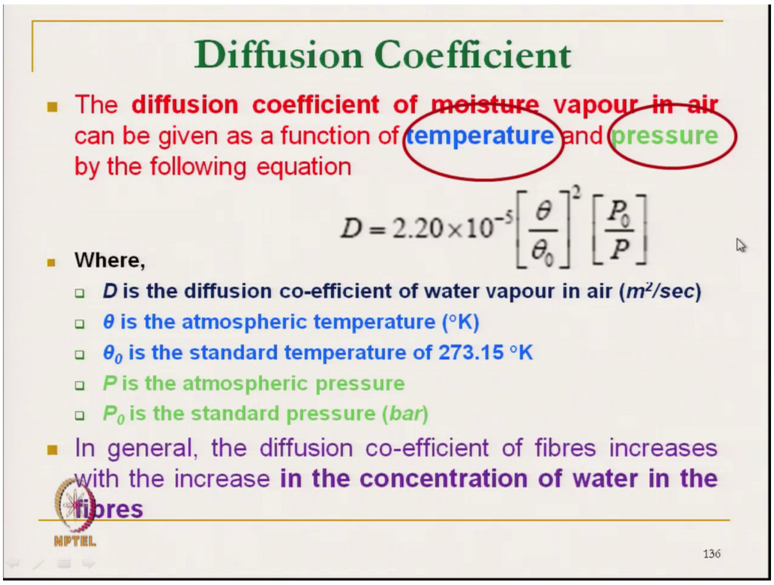

And diffusion coefficient if you see; it depends on the two factor one is the temperature of the system atmosphere and also the pressure; though at higher temperature the atmospheric temperature diffusion coefficient is high, at higher pressure diffusion coefficient will be reduce.

So, if the temperature is increased the environmental temperature is increase the diffusion coefficient will increase; that means, it will have higher diffusion. So, and if we increase the atmospheric pressure is increased; so, diffusion will be slowing down. So, in general the diffusion coefficient of fibre increases with the increase in concentration of water in the fibre; so, if the concentration if the water concentration in the inside the fibre increases, the diffusion coefficient also increases.

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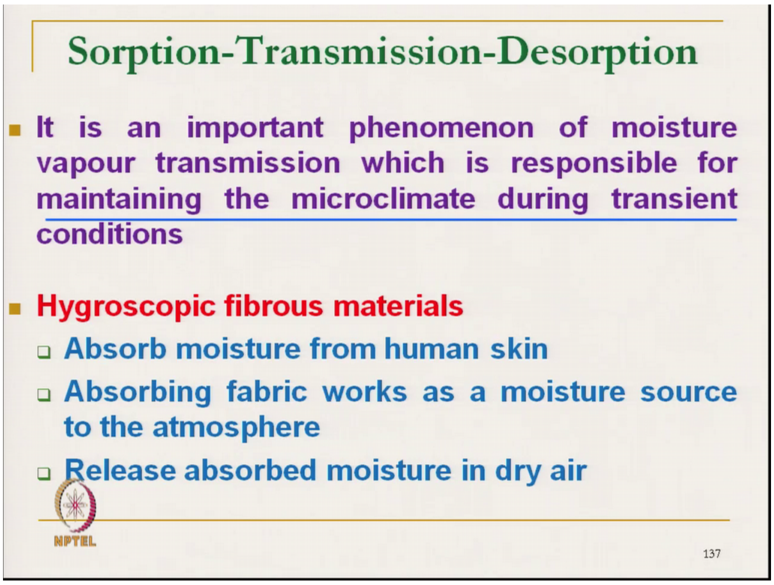

So, after diffusion next principle of water transmission is sorption transmission and desorption. It is an important phenomena of moisture vapour transmission which is responsible for maintaining microclimate during the transient condition; so, that we have already discussed the non Fickian diffusion. So, it maintains hydroscopic fibrous fibre materials absorbs moisture from human skin; absorbing fabric work as a moisture source to the atmosphere. So, it absorbs moisture and then it is actually it absorbing fibre it gets transmitted to the other surface and release of moisture.

So, the difference here with the Fickian diffusion and this absorption transmission desorption is that; the in Fickian diffusion moisture get absorbed by the fibre in vapour form. But, here it is a basically in the at high concentration of the moisture here it absorbs moisture is absorbed by the fibrous material from the human skin and it gets transmitted through the fibre structure through the fabric and in earlier case it was the through one fibre reduce.

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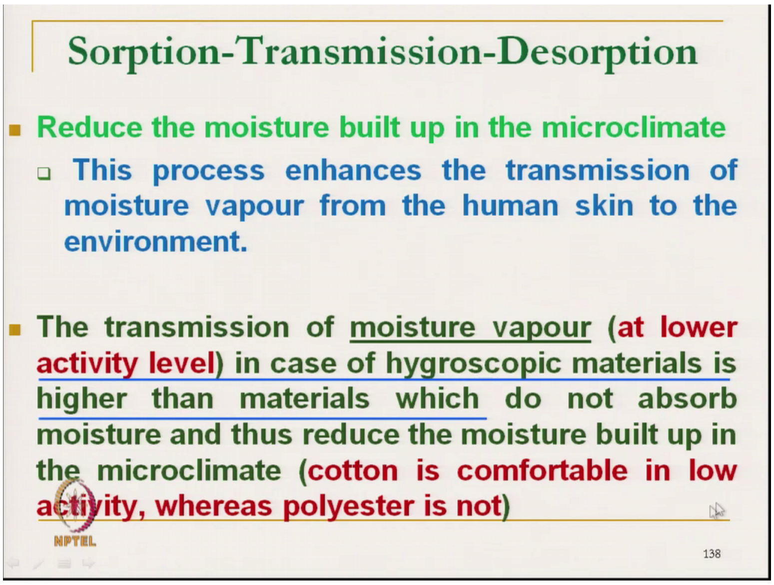

It reduce the moisture built up in the microclimate. So, as soon as it absorbs moisture from the micro climate; it reduces the moisture built up. So, our skin become dry ok; so this process enhance the transmission of moisture vapour from human skin to the environment; so, that way it absorb.

The transmission of moisture vapour at low activity; that means, in case of hygroscopic material is higher than which do not absorb. So; that means, the at high at low activity level; the hygroscopic material absorbs more moisture than the fabric fibre which does do not absorb; that is why this phenomena is for that a cotton is comfortable at low activity level, where polyester is not; that means, that it does not absorb moisture at low activity level.

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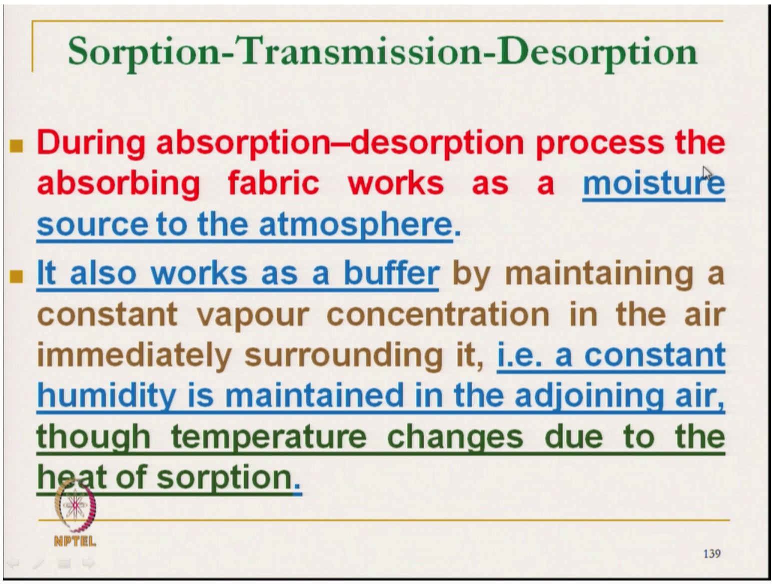

During absorption desorption process; absorbing fabric works as a moisture source of the atmosphere. So, that is why it actually always the absorbing fabric when it absorbs moisture from the human skin. It is always it acts as a moisture source to the environment, it always release moisture to the environment. And it also acts as buffer; that means, it maintains the constant vapour concentration always in the around the surface; a constant humidity is maintained in the adjoining air through though the temperature change due to the heat absorption. So, it maintains the constant moisture vapour concentration because it is a constant source of moisture. Next comes the next phenomena it is a come it is adsorption and migration.

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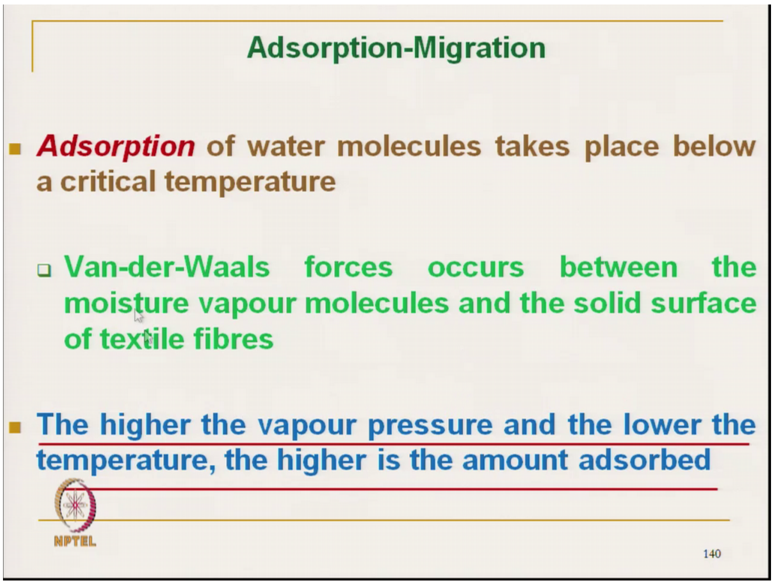

So, adsorption of water molecule takes place below critical temperature. So, adsorption normally at a high temperature it does not take place. So, at below; some critical temperature the moisture droplet falls. So, at below critical temperature Van der Waals force occurs between the moisture vapour molecule and the solid surface of textile fibre.

So, that force comes into picture the higher the vapour pressure and lower the temperature; higher is the amount of adsorption. So, at lower temperature and higher vapour pressure, that amount adsorbs and by the Van der Waals force will be high; so, adsorption will be more. So, this only adsorption take place at the lower temperature.

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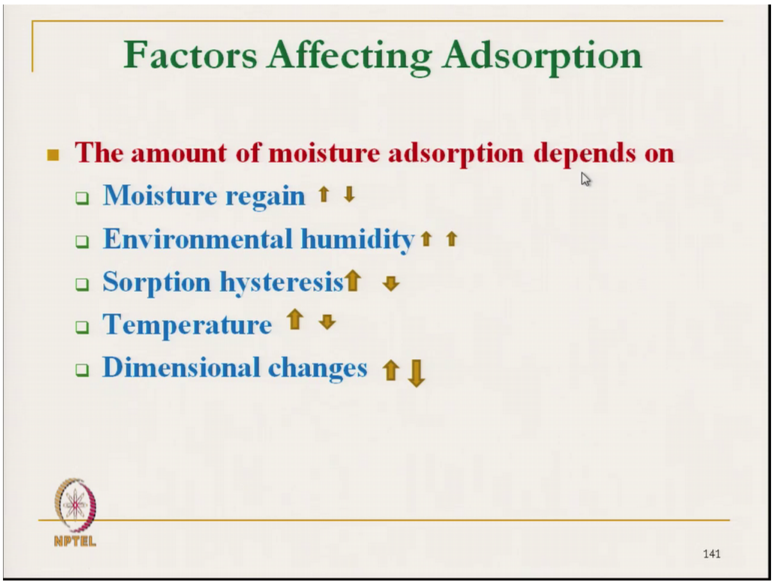

So, the factors which effects the adsorption. So, amount of moisture adsorption depend on the moisture regain of the fabric so; that means, a fibre with high moisture regain it will absorb the moisture. So, adsorption will not take place; so, for cotton fibre adsorption principle will not take place; it will be absorption desorption principle.

But for polyester for any hydrophobic fibre the, this principle when absorption desorption principle is not taking place; in that case the adsorption and transmission will take place. So, fibre with high moisture this is not the only condition, but high moisture regain will immediately absorb the moisture.

So, fabric with low moisture regain at high humidity level; if the humidity level is low then the adsorption will not. Because droplet will not form the quantity of humidity should be high; the moisture vapour should be high. So, the adsorption take place at high humidity level; at high sorption hysteresis the adsorption will be low, at high temperature adsorption will be low; that means, temperature has to be low to have more adsorption and also the dimensional change dimension change we will discuss.

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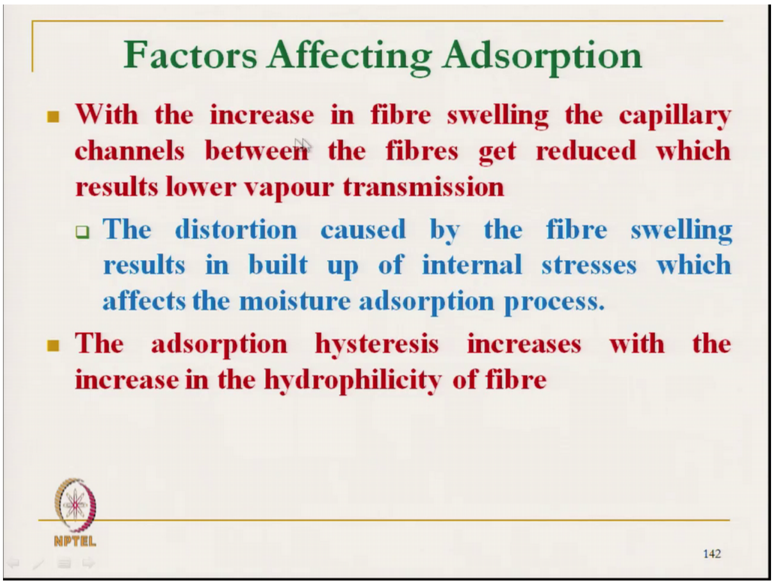

So, with this condition we can achieve the adsorption with the increase in fibre swelling. So, the dimensional change we are discussing though as the moisture gets adsorbed; so, dimensional that a fibre swelling the capillary channel between the fibre gets reduced which result lower vapour transmission. So, that; that means, the pores will get reduced; so, that will affect the moisture flow.

The distortion caused by the fibre swelling results in built up of internal stress which acts as the acts; which affect the moisture adsorption process. So, if the internal pressure is more the moisture adsorption process will be will get affected the adsorption hysteresis increases with the increase in hydrophilicity of the fibre. So, that is why we have seen the adsorption hysteresis if it increases; that means, sorption hysteresis increases the adsorption will be lower.

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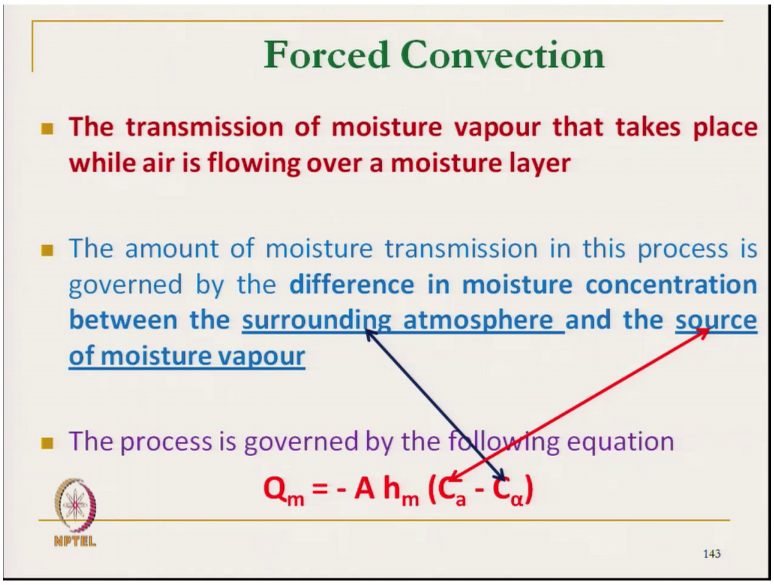

And last principle is the forced convection; the transmission through forced convection takes place when the air is flowing. The amount of moisture transmission in this principle is governed by the difference in moisture concentration between the surrounding atmosphere and the source. So, that is the governing principle and this is a same as the diffusion that moisture concentration difference has to be there.

But in diffusion the moisture gradient pressure gradient was the only source of transmission, but here in addition to that is the surrounding atmospheric moisture concentration in the surrounding atmosphere and C a is the in the source that is the in a in the clothing case; it is the skin humidity.

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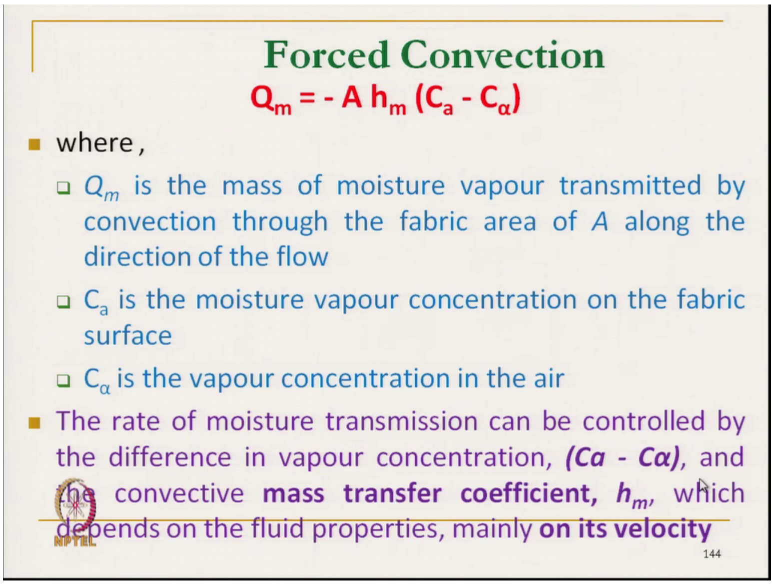

This is the equation where Q m is the mass of moisture vapour transmitted by the by convection through the fabric with an area A area of the A fabric at h and C a is the moisture concentration of the fabric surface; which is high enough higher than the atmosphere so, that moisture gradient pressure gradient is created.

And the rate of moisture transmission can be controlled by the difference in vapour concentration. So, that this is the difference in pressure concentration and the mass transmission transfer coefficient h m which is the which depends on the fluid property that is the on the viscosity of the fluid. So, this is the mass transmission coefficient here.

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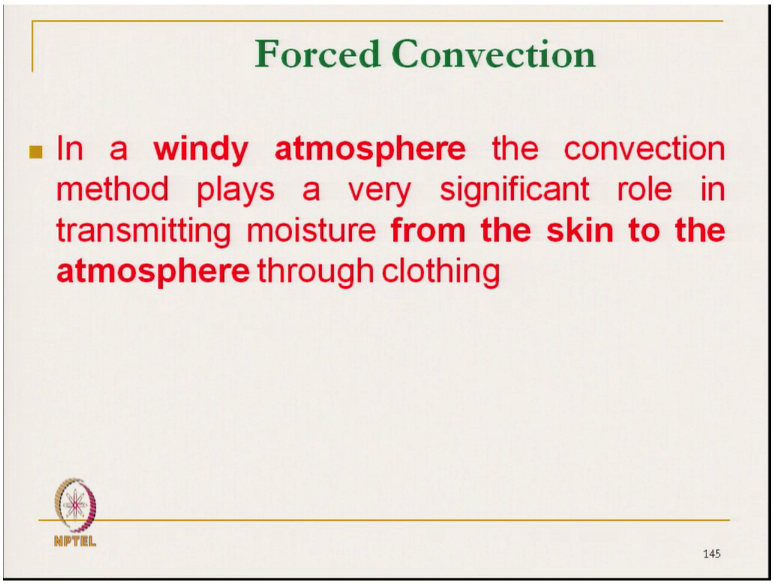

So, in windy atmosphere the convection method; this is forced convection method plays a very significant role in transmitting moisture from skin to the atmosphere through the clothing. So, we have we will see one method we have developed; in that method if we have tried to see that the effect of the wind blowing how the; a speed of flowing air affect the moisture transmission? So, now we will see the few study; research study.

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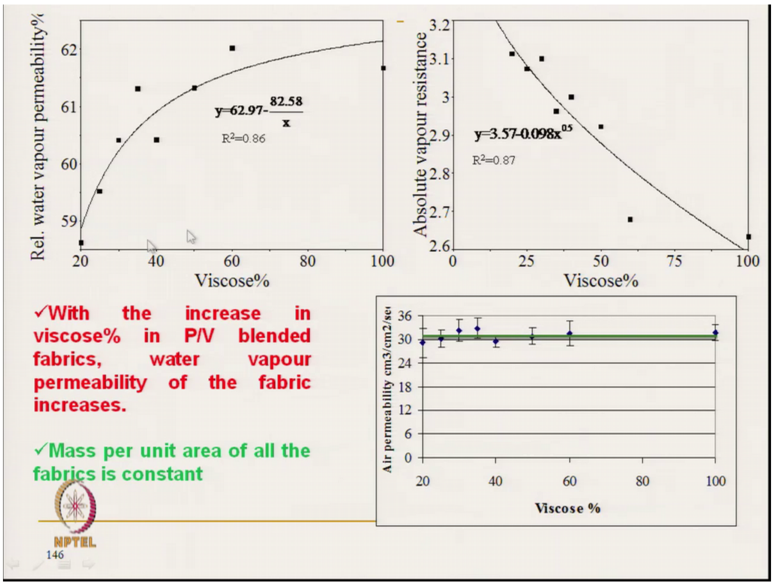

So, in this study in what we have see we have got; we have developed different fabrics of polyester viscose. The same fabrics we have discussed in last class that the liquid to water transmission wicking. In wicking what we have seen? With the increase in viscose content; so, viscous content is increased from 20 percent to 100 percent that in 20 percent means 20 percent viscose 80 percent polyester.

So, as the in earlier case; in liquid moisture transmission what we have observed? As we increase the viscose content, the wicking rate reduces and that is the we have seen that is due to the water gets actually attracted by the hydrophilic fibre. And which slows down the wicking, but in case of moisture in vapour form the; it is also in moisture, but it is in vapour form.

Here the same fabric shows the reverse trend means as we increase the viscose content; that means, here the polyester content is reduced. So, as we increase a viscose content the relative water vapour permeability increases; increases at very high rate, so from say 58 percent to 62 percent; so, relative water vapour permeability increases. So, this is basically; so, with the increase in viscose percent P V in P V fabric polyester viscose blended fabric water vapour permeability of fabric increases and mass per unit area of all fabrics are constant.

So, this fabric all the fabrics if you see the fabrics mass per unit areas are constant their porosities are constant, the pores structures are constant. That means, if we see the same fabrics with air permeability the; they have this almost same air there is no change in air permeability; which shows that air per pockets air open cover factors of the fabrics are same.

But here the fabrics; that means, pore structures are same the; for the that means, this is not directly related with the air permeability. So, moisture vapour permeability here it is increasing and that is mainly due to the non Fickian diffusion. Here viscose being the hydrophilic fibre it absorbs the moisture and it gets transmission transmission. So, moisture absorption and desorption and non Fickian diffusion comes into picture here. And if you see the absolute moisture vapour resistance it reduces with the increase in viscose content.

So, this is a very interesting trend which shows that the at lower activity level; when the moisture transmission is in the vapour form, we have to go for higher hydrophilic content. But when the moisture transmission is in liquid form at higher activity level then we have to go for the hydrophobic fibre ok.

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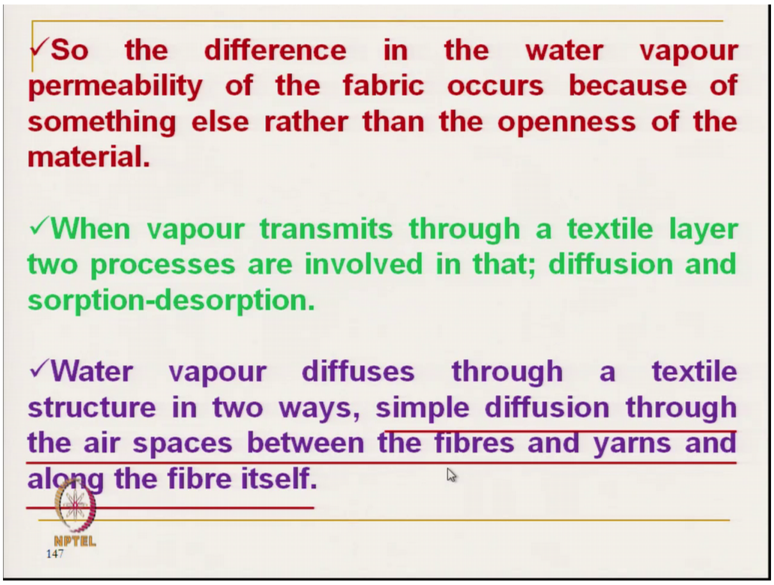

So, the difference in the water vapour permeability of the fabric occurs because, of something else rather than openness of structure. When the vapour transmits through the textile layer two processes are involved; the diffusion and sorption desorption. The water vapour diffuses through a textile structure in two ways, simple diffusion through air space and between the fibres and yarn and along the fibre itself a non Fickian diffusion; so, Fickian and nonfickian – we have discussed.

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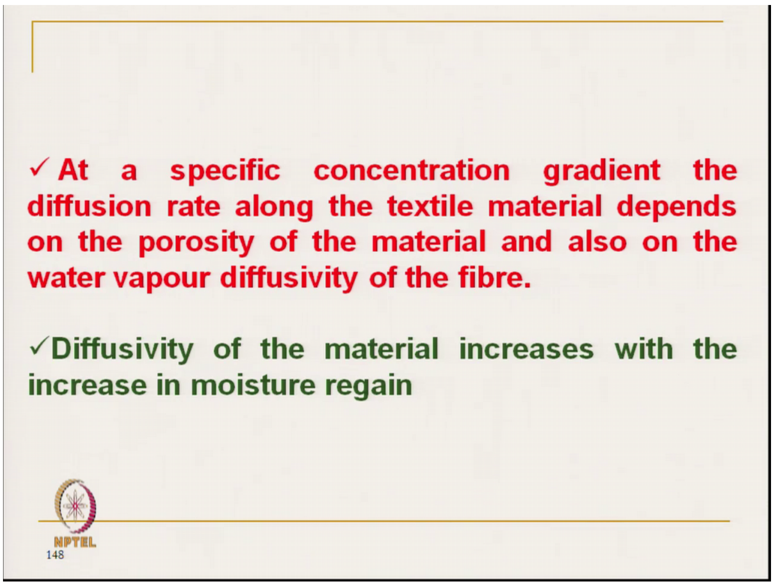

At a specific concentration gradient which we have maintained the diffusion rate along the textile material depend on the porosity of the material; that we have already discussed also to the water vapour diffusivity of the fibre. The diffusivity of the textile material increases with the increase in moisture regain that we have already seen; so, that is why the diffusivity increases here.

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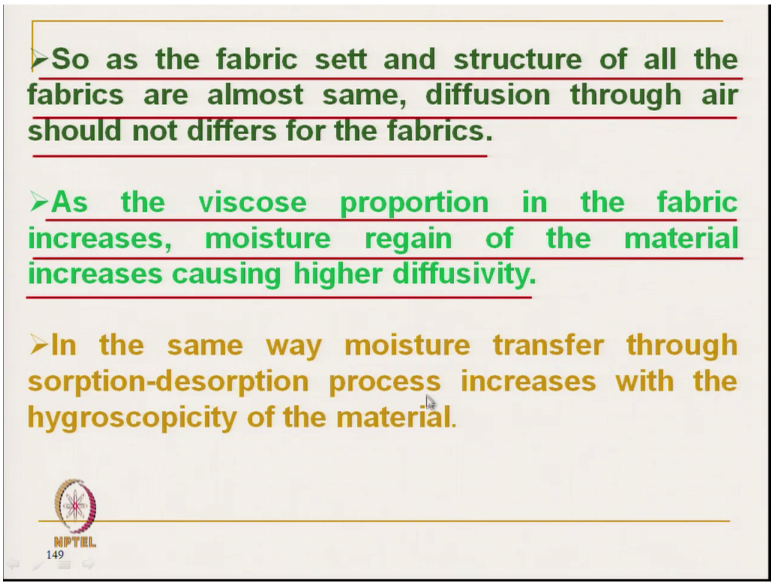

So, as the fabric sett and structure of all fabrics almost same; the diffusion through air should not differ. So, that diffusion through that Fickian diffusion should be constant. So, here it is actually in this case when the viscose content is increase it is other than the Fickian diffusion.

So, as the viscose proportion in the fabric increases; moisture regain of the material in increases causing the higher diffusivity; so, due to increase in diffusivity it is increasing. As the same way moisture transmission through sorption desorption process increases with the increase in hydrophilicity of fibre. So, here the in this particular case when the porosity of the fabrics are same; only the hydrophilisity of the fibres increases in that case the Fickian diffusion is not there, nonfickian diffusion and sorption desorption comes into picture; which is at lower level high hydrophilic fibre like cotton viscose fibre is actually suitable for that for low activity level.

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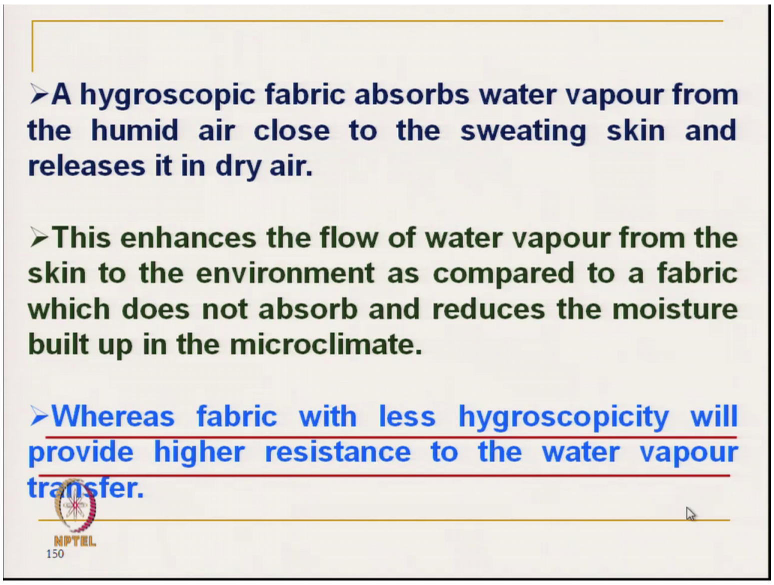

So, hygroscopic fabric absorbs water vapour from humid air; close to the sweating skin and releases at the dry this already we have discussed; fabric with less hygroscopicity provide higher resistance of air. So, this we will continue in the next session; till then good bye.

Thank you.