Natural Dyes

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Lecture No. # 30

Today we will be doing a chapter related to wool dyeing. So far we had taken a very serious look at the dyeing procedure of cotton, and then we went on to see the dyeing procedure of many synthetic fibers like polyester, nylon and poly acrylic fibers. And today we will spend some time understanding what are the requirements when we deal wool fiber or fabric, because each fabric as I told earlier also that it depends on the structure of the fabric, and the structure of the dye.

So, these two things have to be compatible if they are not compatible then dyeing will not occur. So, this should be understood very clearly that dyeing is a function of the chemical composition of the fiber as well as dye. So, we let us take a serious look at the wool dyeing process.

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Wool processing is a multi step process. So, even before it can be taken for dyeing. What are the various processes or pre treatments that the wool must go on with for getting to

the finished product. Wool processing is the multi step process of turning raw wool into finished product, and the basic steps involved are scouring, drying, carding or combing, spinning, felting and then comes the final step of dyeing. So, you see that in the case of cotton we were only looking at de sizing, scouring, bleaching, and that is it; and then of course the modern treatment, if we are using natural dyes or it could be you know other dyes where other kind of pre treatment may or may not be required. But here the steps are quite different, because here the skeins of the or the yarn of the wool need to be handled in a particular manner, and only then it will not get entangled while dyeing. So, the basic steps are scouring, drying, carding or combing, spinning, felting, and then finally dyeing.

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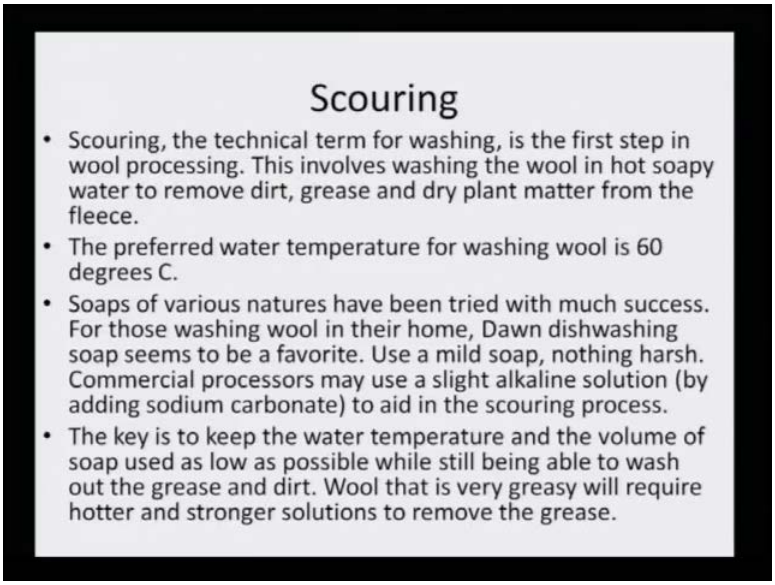

Scouring: Let us try to see how the scouring of wool can be done, we have learnt about scouring of different fabrics as we came along this up to now, and now let us spend some time in understanding, although fleetingly when I was teaching natural dyeing I had mentioned that you know by mild detergents the wool, and the silk, and the natural cotton can be scoured, but let us try to spend some more time, and in understanding the entire process of scouring.

The scouring - the technical term for washing is the first step in wool processing. This involves washing the wool in hot soapy water to remove dirt, grease, dry plant material from the fleece, etcetera. So, you see that it has much purpose; it mainly is involved in

the removal of oil and grease and waxes, and any kind of dry plant material that may be adhering to the fleece on the body of the fleece. The preferred water temperature for washing wool is 60 degree centigrade, soaps of various natures have been tried with much success. For those washing wool in their home dawn dish washing soap seems to be a favorite use a mild soap nothing harsh. Commercial processors may use a slight alkaline solution by adding sodium carbonate to aid the scouring process.

So, the best process or the best material is a slightly alkaline soapy material. So, that it can wash very well, and this scouring step is very important to remove the dirt and the grease. The key is to keep the water temperature, and the volume of soap used as low as possible while still being able to wash out the grease and the dirt. Wool that is very greasy will require hotter and stronger solution to remove the grease; obviously, if the wool is very dirty and has lot of grease it cannot be washed with mild soapy solution instead stronger solution, and higher temperature would be required. But the optimal temperature is 60 degrees and a very low concentration of the soap must be used.

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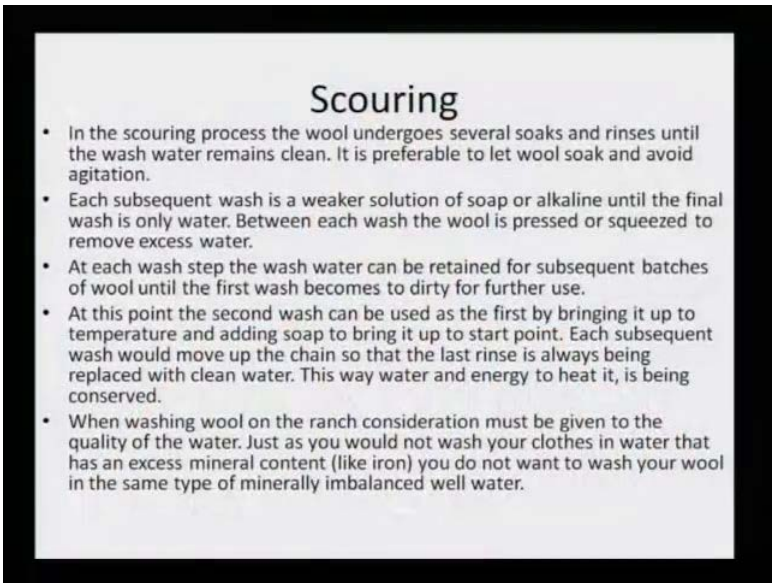

In the scouring process the wool undergoes several soaks and rinses until the wash water remains clean. It is preferable to let wool soak and avoid agitation. So, in order to avoid entanglement of the wool yarn or skin it is better to soak it for some time, so that all the grease that is adhering to the yarn or the skein may come out. And there is no point in agitating, because the movement one tries to agitate what will happen? The skeins will

get entangled, and it will be difficult to un do it. Each subsequent wash is a weaker solution of soap or alkali alkaline until the final wash is only water between each wash the wool is pressed or squeezed to remove excess water. Now, because wool is slightly hydrophobic it is possible to just simply squeeze it, and several times this process has to be done.

It is not that one time scouring can help. Shows every time a milder, and a milder and a milder soap should be used; and finally a water wash is required. So, one thing that you have understood now that scouring with the mild soap at sixty degrees, and several times this has to be done. Each wash step at each wash step the wash water can be retained for subsequent batches of wool until the first wash becomes too dirty for further use.

So you see the, it is not that you know you just take the soap solution and throw it away; the same soap solution can be used again and again. At this point the second wash can be used as the first by bringing it up to the temperature, and adding soap to bring it up to start point. Each subsequent wash would move up the chain, so that the last rinse is always being replaced with clean water. This way water and energy to heat is being conserved.

So, because there is so much of wool that needs to be washed; this washing need not be thrown. The second wash can now become the first wash in the next batch by replanting it with the little more of the soap solution, and raising the temperature to sixty degrees. So, if this is maintained then the same you know washing bath can be used again and again, till it really becomes dirty and then it is time to discard. When washing wool on the ranch consideration must be given to the quality of the water, just as you would not wash your clothes in water that has an excess mineral content or iron or sand ores, you know all kinds of things are possible in water. So, clean water should be there as one must understand that, because we are cleaning the wool. So, we cannot possibly use dirty water. So, its it is just for you are mentioning and for your understanding that clean water should be used for scouring purpose.

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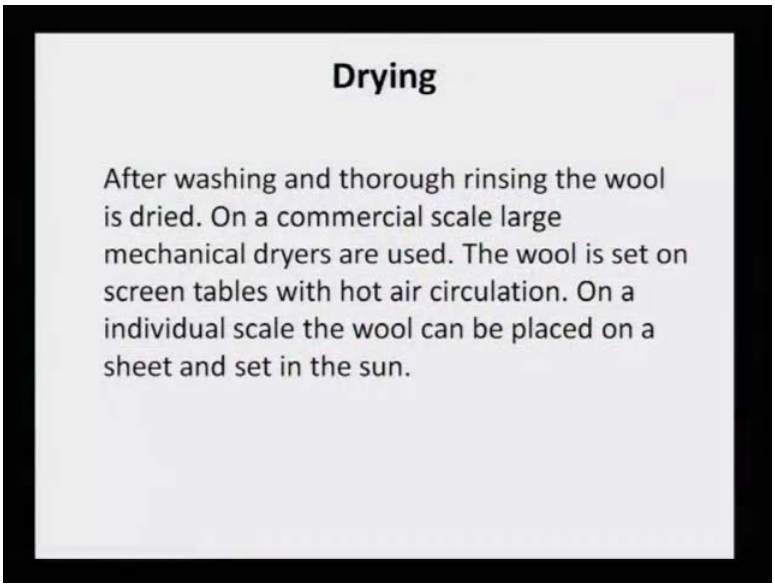

Then comes the next step the drying. After washing thoroughly rinsing the wool rinsing takes place, and then the rinsed wool is then dried. On commercial scale large mechanical dryers are used, the wool is set on screen tables with hot air circulation. On individual scale the wool can be placed on a sheet and set in the sun. So, either it can be sun dried or it can be spread on huge commercial tables, screen tables where by mechanical driers they can be dried. So, depending on the volume of the wool that needs to be handled the process can be adapted.

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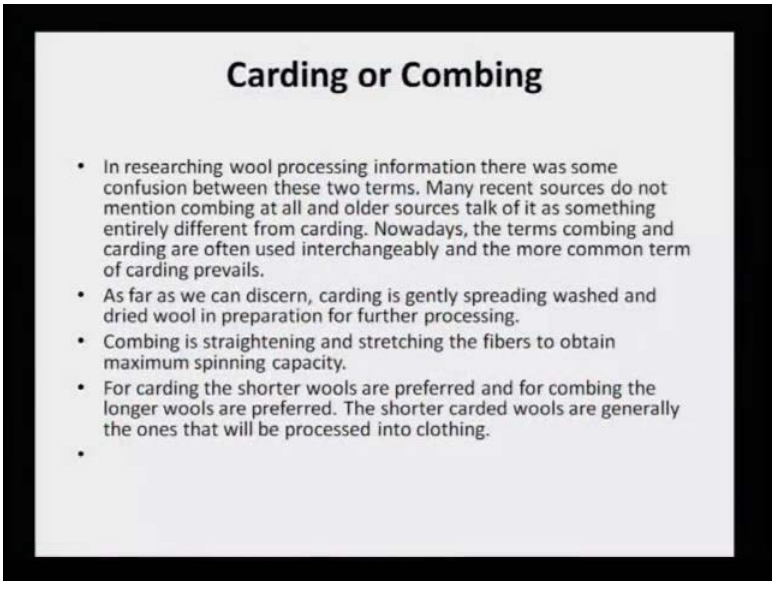

Then comes the next step which is the carding or the combing: As the name suggests; that means, you are trying to straighten out the skein or the yarn. In researching wool processing information there was some confusion between these two terms, many recent sources do not mention combing at all, and older sources talk of it as sometimes entirely different from carding; something which is completely different from carding. So, this can be a little confusing

Nowadays the term combing, and carding are often used interchangeably, and more common term of carding prevail. So, the carding word is more closely associated, but carding or combing means the same, and one need not get confused, because these nomenclatures are just procedural details, and if you know one that is enough. As far as we we discern carding is gently spreading washed, and dried wool in preparation for further processing. So, it is just like straightening out, so that there are no entanglements of between the skeins of the yarn.

Combing is a straightening and stretching the fibers to obtain maximum spinning capacity, because if we straighten it out be it any thread it will not have any kind of turns and so therefore, the spinning will be very even. If there are turns, and twists in the yarn it will cause bad spinning. For carding the shorter wools are preferred and for combing the longer wool striations are preferred, the shorter carded wool are generally the ones that will be process into clothing. So, it is for the purpose of either you know spinning it into a cloth or you know weaving it into a cloth or spinning it into a yarn depending on that whatever be the situation carding or combing. It is necessary to process the wool in the following manner – scouring, drying, and then followed by that carding, because sometimes scouring and washing creates some kind of entangle mention and it is this entanglement that needs to be straighten out.

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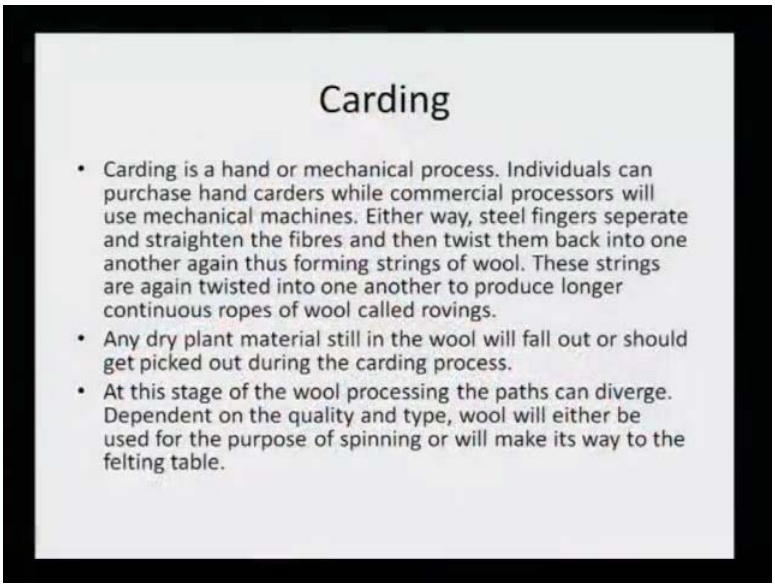

Carding: Carding is a hand or mechanical process individuals can purchase hand carders while commercial processors will use mechanical machines, either way steel fingers separates and straighten the fiber, and then twist them back into one another again thus forming strings of wool. These strings are again twisted into one another to produce longer continuous rope of wool called rovings. Any dry plant material still in the wool will fall off or should get picked out during the carding process, at this stage of the wool processing the paths or divert dependent on the quality, and type wool will either be used for the purpose of spinning or will make its way to the felting table. So, depending on what is the next step that the wool must follow this carding will be done accordingly, but whatever be either by mechanical or by manual carders; these can be separated, and they need to be straightening out.

So, once they are straightened out it is important that the they are you know made into big rovings, you must have seen that when in earlier times wool was brought from the market it was the roving, and the mothers would sit with their cross leg, and then take the rove all on the two knees and then make balls. So, that knitting was easy. I am sure all of you must have noticed this. Some talking about the roving or in Hindi we call it lachi. So, that is what is prepared, so that the wool is absolutely straighten out, and it easy to either spin or take it for felting.

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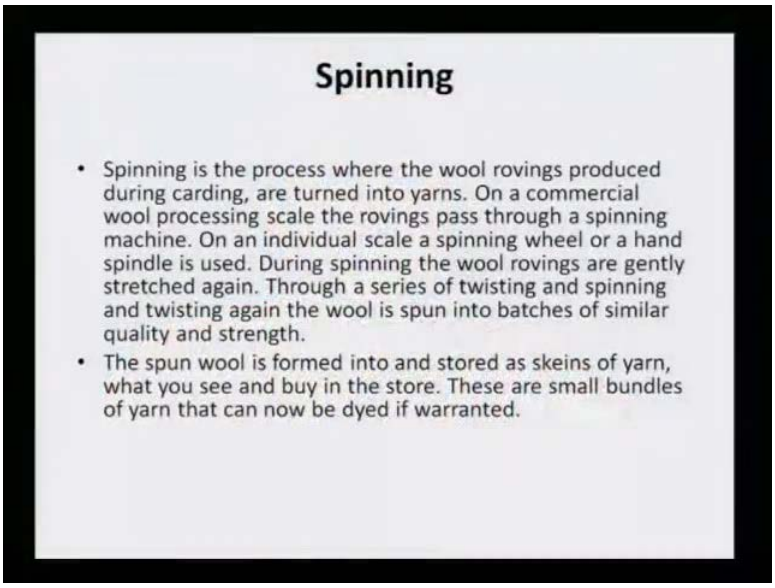

Spinning: Spinning is the process where the wool rovings produced during carding are turned into yarns. On a commercial wool processing scale the rovings pass through a spinning machine. On an individual scale a spinning wheel or a hand spindle is used.. During spinning the wool rovings are gently stretched again through a series of twisting, and spinning and twisting again, the wool is spun into batches of similar quality, and strength. So, spinning is the next step after the carding process, and it helps that these wool rovings which have been prepared can now be taken to these spindles where hand spindles, where this they can be you know spun. And it is also important, because the wool now has to be twisted, and again it has to be stressed and twisted.

So, this stretching and twisting, and stretching and twisting can only be done on a spindle machine. The spun wool is formed into and stored as skeins of yarn what we see and buy in the stores, these are small bundles of yarn that can now be dyed if warranted. So, if this is the entire process of you know preparing the wool for dyeing. So, depending on what is the next step spinning can bring about good spinning can bring about good dye obtained, because you see it is not just once striation of the wool, there is several striation which have been spun like a very minute rope. So, this is an arty work, it is not that any machine can do the spinning or we can do it by hand, because the hand will not attain such perfection, so mechanical spindles are a must.

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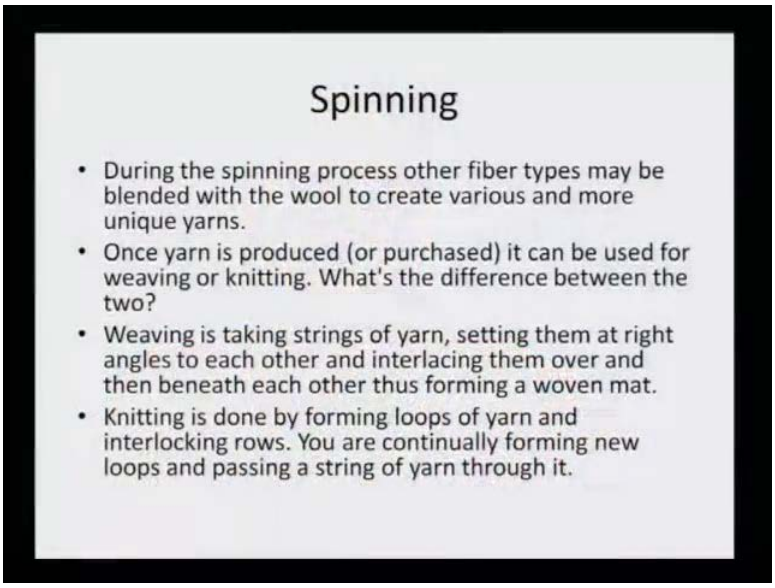

During the spinning process other fiber types may be blended with wool to increase various, and more unique yarns. Once yarn is produced it can be used for weaving or knitting, what is the difference between the two. Now, let us even try to see what is the terminology weaving is taking strings of yarn setting them at right angles to each other, and interlacing them over, and then beneath each thus forming a woven mat. So, I told you just the way in the cotton, we have Warf, and we have a weft.

So, Warf and weft - this is coming from one string of the cotton going in the x direction, and the other going in the opposite horizontal direction. So, that is the kind of weaving we are also referring here, there is a Warf and a weft. So, pane bane that is what is meant and that is how the fabric comes like a mat, like a mesh; otherwise it is not possible to interlace the yarns in a proper manner, and knitting is done by forming loops of yarn, and interlocking rows.

You are continuously forming new loops, and passing the string of yarn through it. So, that is how knitting I am sure all of you have seen how knitting takes place, but yarn when it is converted into fabric must have a Warf; that is one set of strings going in this direction and another set of strings going in this direction that is the weft.

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Then comes the next step which is felting. Felting can occur after carding and instead of spinning. So, it is possible that at the step of carding, we can either go to spinning or we can go to felting. Depending on what is the requirement, and how do we want to proceed. Felting is a feature of wool that enables it to form mats of fabric, because the fiber can interlock with each other. How much it can felt is the dependent on the fineness or coarseness of the fibers. The fine wool felt better due to finer crimps which result in more ridges and a tighter lock or joining.

In the process of felting the wool is subjected to moisture, pressure, and gentle beating action. Layers of wool are laid at right angles to one another to establish fibers that run length wise and cross wise, and then length wise again. The felting machine applies term maister, and pressor along with back and forth action to felt the wool. As the fiber string they become entangle together and form a strong durable felted mat of the material. So, because these are skeins, there will be gapping, and therefore in order to fill that gapping, felting is a special process which needs to fill up the gap between these fibers. And in order to do that the process is that some extra wool is kept, and then there is a beating action. So, that it suckles, this gentle beating moisture, pressure can compress; this gaps with these little, little wool pieces, and that is how felting is completed.

Wool can be felted to the point where it is impossible to distinguish the fibers, and the material or to pull it apart as fibers that become, so entangled and timely meshed. Felting

done to this extent is then called falling, so actually it is like falling the fabric, because all the small, small, small, small, small gaps are filled with these wool pieces which have been beaten up and with moisture and pressure they have been compressed very tightly into this mesh work. So much so that there is no hole that can be seen, if you put the fabric like this the light cannot pass through it. Whereas, if you put a fabric of cotton like this you see that light can pass, which means that there are minute holes which have not been felted or with there was no need for felting.

But in the case of wool there is a need for felting; and therefore, after the matting of the fabric the spelting process must be carried out. Then finally, we come to the main topic dyeing. So, if we just try to re take a recap, we have seen that in wool processing (( )), drawing, combing, spinning and felting; these are various steps that need to be followed before one goes in for dyeing actually dyeing the wool, whether we dye the wool with synthetic dyes or we dye the wool with natural dyes is a next subsequent issue, but for preparation of the wool these many steps must be carried out in order to have good dyeing of the wool.

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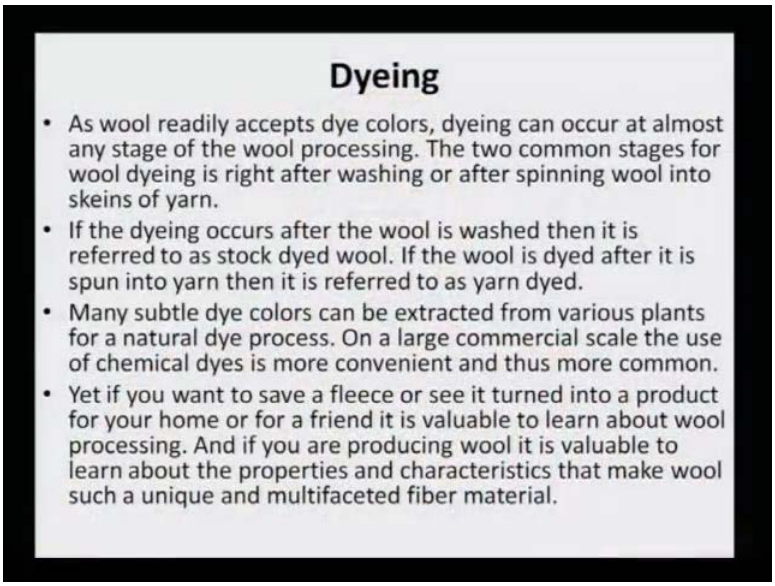

As wool ready readily accept dye colors; dyeing can occur at almost any stage of the wool processing. The two common stages for wool dyeing is right after washing or after spinning wool into skeins of yarn. So, one can die at any step it is not necessary that all these steps have to be followed meticulously, but these steps are followed for preparation

of wool one or more, and the dyeing can occur even immediately after the scouring or even after spinning.

If the dyeing occurs after the wool is washed, then it is referred as stock dyed wool. If the wool is dyed after it is spun into yarn, then it is referred as yarn dyed. So, as the name suggests: Yarn dyeing or stock dyeing are the two modes of dyeing the wool. Many stubble dye colors can be extracted from various plants for a natural dye process, on a large commercial scale the use of chemical dye is more convenient, and thus more common.

But that is not a hard and fast rule, we have seen that wool dyeing has been done on industrial scale, and shown on to be done on industrial scale by us by some of the dyes which are very abundantly, available. Of course, synthetic dyeing is definitely much easier when we do commercial dyeing, but nevertheless natural dyes have also now have a competitive market. Yet if you want to say a fleece or see it turn into a product of your home or for a friend it is valuable to learn about wool processing, and if you are producing wool it is valuable to learn about the properties, and characteristic that make wool such a unique, and multifaceted fiber material, so in order to understand the chemistry of wool dyeing. We have to first understand the chemistry of wool itself, and as what we have been talking along when we were doing the natural dyeing.

We said that cotton, silk, and wool; these were all along you know taken as examples are (( )) of these three different types of fibers or fabric were used, because we wanted to show that cellulosic fibers, and protinateous fibers; like silk and wool. They both have compatibility with synthetic dyes and natural dyes.

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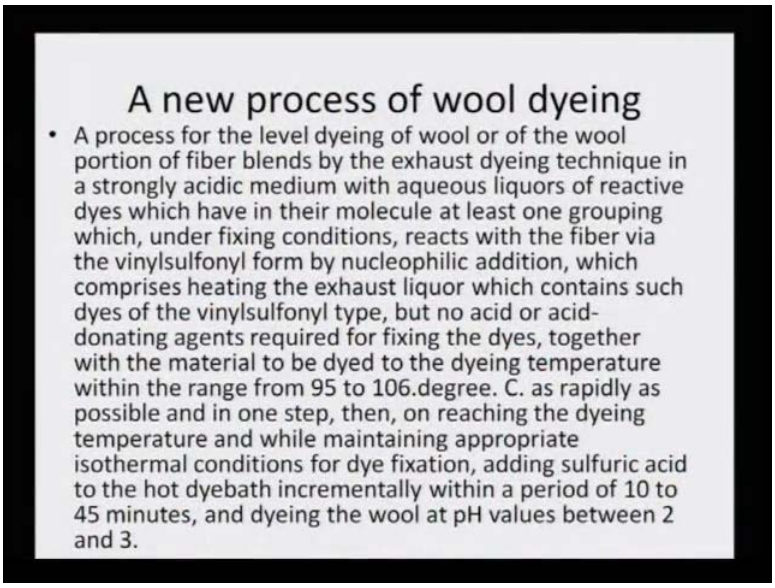

A new process of wool dyeing has been introduced, and I thought that I should talk about this to you. A process for level dyeing of wool or the wool portion of fiber blends by the exhaust dyeing technique is a strong in a strongly acidic cell medium with aqueous liquor of reactive dyes which have in their molecule at least one grouping which under fixing condition reacts with the fiber via the vinyl sulfonyl form by nucleophilic addition, which comprises heating the exhaust liquor which contain such dyes of the vinyl sulfonyl type.

But no acid or acid donating agents required for fixing the dyes, together with the material to be dyed to the dyeing temperature within the range of 95 degrees to 106 degree centigrade, as rapidly as possible and in one step. Then on reaching the dyeing temperature, and while maintaining appropriate isothermal condition for dye fixation adding sulphuric acid to the hot dye bath incrementally within a period of 10 to 40 minutes, and dyeing the wool at pH values between two and three.

So, here was the dyeing recipe giving to you for using reactive dyes under the exhaust dyeing technique, and in that the the the main requisites was that the dye molecule must have one group of vinyl sulphonic form. Only then this process or this type of reactive dye only can be chosen, and then the following step that heating it up to 9 between 95 to 106 as rapidly as possible in one step. So, the dye fixation can take place some sulphuric acid must also be added, and that too incrementally it is should be added in one go

between 10 minutes to 45 minutes the solution of sulphuric acid must be done. So that the dye bath temperature is maintained between two to three, then it is just the ideal situation for dyeing wool with synthetic dyes. Even the wool blends, you see wool can be pure natural or there could be synthetic fiber while spinning it, it can have another scheme which is not purely natural. So, those of kind of wool blends also can be dyed by this reactive dye recipe, now when we try to look at the various machines that can be used for wool dyeing.

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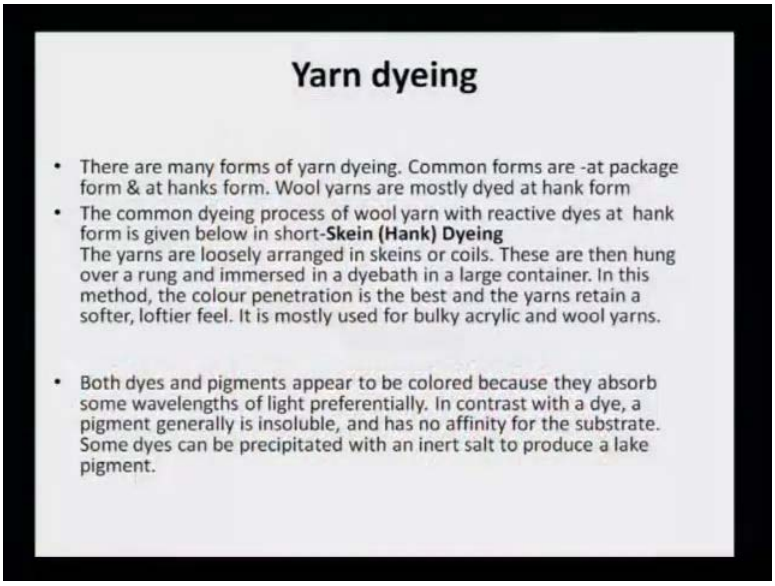

Yarn dyeing is one very important you know way of dyeing wool. There are many forms of yarn dyeing; common forms are at package form or at hanks form, wool yarns are mostly dyed at hank form. The common dyeing process of wool yarn with reactive dyes at yank at hank form is given below in the short it is called skein hank dyeing. So, because it must be made clear, that we are taking yarn or skein and the machine that is used is hank, and that is why the procedure is called skein hank dye.

The yarns are loosely arranged in skeins or coils, these are then hung over rung, and immersed in dye bath in a large container; in this method the color penetration is the best, and the yarn retain its softer, loftier feel. It is mostly used for bulky, acrylic, and wool yarns. So, you see it is such an easy process that there is rung, and over that all these skeins are just hung, and then this is simply dipped into the into the dye bath.

So, that the dye penetration is very even, and it does not you know, because there is no agitation it does not entangle the skeins, and it is one of the best ways to keep the softness of the wool intact. Both dyes and pigments appear to be colored, because they absorb same wave length of light preferentially. In contrast with the dye a pigment generally is insoluble, and has no affinity for the substrate; some dyes can be precipitated with an inert salt to produce a lake pigment.

So, depending on what we want to use whether we want to use a dye or a pigment or a lake you know these are various possibilities for dealing with the type of dye that can be used for skein hank dyeing. Now this is a kind of a machine it does not look very good, and attractive although in the picture, but I tried to show you that this is the way it is hank dyeing it is you know all the blue skeins are hanging from a rung, and they are dipped into the dye bath.

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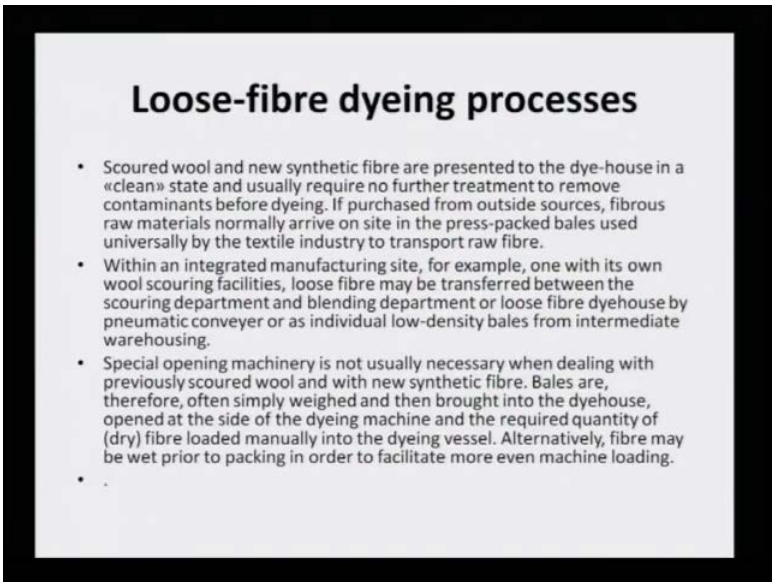

Loose fiber dyeing process: Scoured wool, and new synthetic fiber are presented to the dye house in clean state, and usually require further treatment to remove contaminants before dyeing. If purchased from outside sources, fibrous raw materials normally arrive on site in the press packed bales you used universally by the textile industry to transport raw fiber. Within in an integrated manufacturing site, for example one with its own wools covering facilities loose fibers may be transferred between the scouring departments and blending department or loose fiber dye house by pneumatic conveyor or

in individual low density bales from intermediate warehousing. Special opening machinery is not usually necessary when dealing with previously scoured wool and with new synthetic fiber.

Bales are therefore, often simply weighed, and then brought into the dye house open at the site of the dyeing machine, and the required quantity of fiber; that is the dry fiber loaded manually to the dyeing vessel. Alternatively fiber may be wet prior to packing in order to facilitate more even dyeing into the machine and it is then loaded. So, you see that you know when loose fibers have to be done; one is the rung hank hank dyeing which is done on the rung, otherwise loose fibers can be directly put into the machine. So, that is not such a big problem that dyeing cannot be done there are various methods of transporting the material from the warehouse to the dye house, and depending on what is the requirement, various you know methodologies can be adopted for loose fiber dyeing process. Directly it can be opened the bales can be opened near the dyeing machine or through a conveyor bale it can be sent to the required place where the dyeing has to be carried out.

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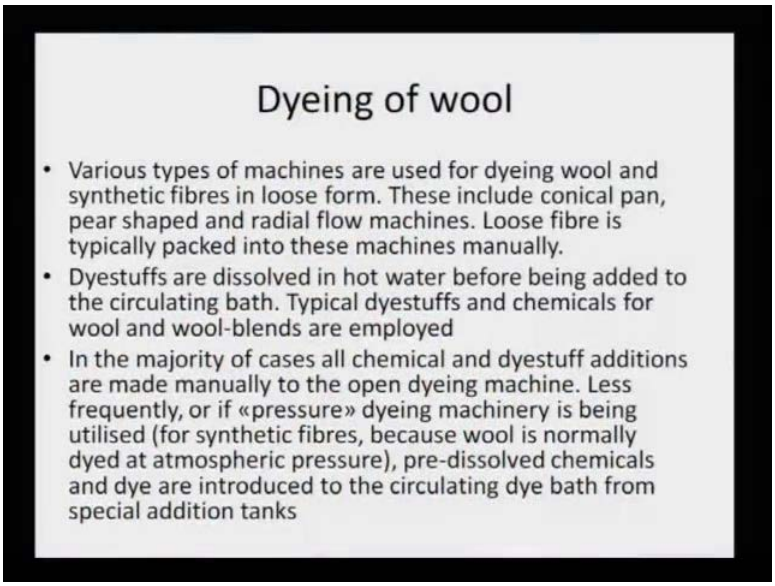

Dyeing of wool: Various types of machines are used for dyeing wool, and synthetic fibers in loose from. These include conical pan, pear shaped and radical flow machine. Loose fiber is typically packed into these machines manually, dyestuffs are dissolved in hot water before being added to the circulating bath. Typical dyestuff and chemicals for

wool, and wool blends are employed, in the majority of cases all chemicals and dyestuff additions are done manually to the open dyeing machine, and less frequently if or if pressure dyeing machinery is being utilized for synthetic fibers, because wool is normally dyed at atmospheric pressure. Pre-dissolved chemicals, and dyes are introduced to the circulating dye bath from special addition tanks. So, all this process is very well mechanized, but one thing that has to be kept in mind that the dye, and the wool have to be compatible in order to be taken up; otherwise it will not give good dyeing property on the yarn or the skein or the mat or the fabric.

So, that is very important, and another important point is that mostly when it is simple wool dyeing. Then it is done at at atmospheric pressure; therefore, it is done in open machine, but when these synthetic blends are also spun along with the pure wool, then it is called wool blends. Now, these wool blends have two different types of chemical compositional material; therefore, they have to be done in a pressure dyeing machine, and that is very crucial point that must be remembered.

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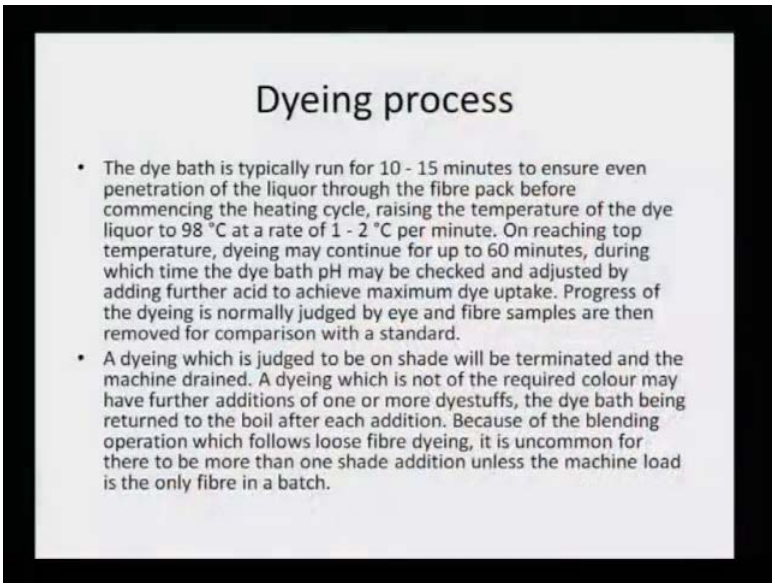

The dye bath is typically run for 10 to 15 minutes to ensure even penetration of the liquor through the fiber pack before commencing the heating cycle, raising the temperature of the dye liquor to 98 degrees at a rate of 1 to 2 degrees per minute. On reaching top temperature dyeing may continue for up to 60 minutes during which time the dye bath pH may be checked, and adjusted by adding further as it to achieve maximum dye up

take. So, three things have come up: First thing is the temperature is very important. Second thing is the PH maintenance is very important, and the third thing is that one hour is more than enough for dyeing; progress of dyeing is normally judged by eye and fiber sample and fiber samples. And then remove as for the comparison with the standard. A dyeing is just to be on shade will be terminated, and the machine drain, a dyeing, which is not of the required color may have further addition of one or more dyestuff the dye bath being turned to the boiling after each addition.

Because of the blending operation which follows loose fiber dyeing, it is uncommon for there to be more than one shade addition unless the machine load is the only fiber on the batch. So, variation in shade can be checked, but variation in color cannot be done in one go. So, that is what it means that one has to take care of these dyeing processes very carefully, and the maximum period of you know bringing the dyeing bringing it to dye slow raise in the temperature helps. Dyeing is then followed by rinsing with cold water, and this is done for 10 to 15 minutes.

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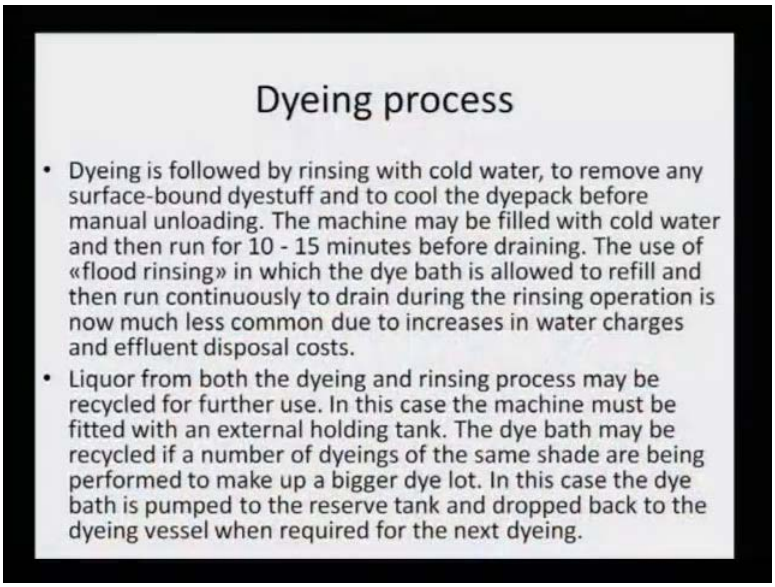

This is the common practice, because all the superfluous dye must be washed off, and rinsing is a best way to run off all the excess color. Liquor from both the dyeing, and rinsing process may be recycled for further use in this case the machine must be fitted with external holding tank. The dye bath may be recycled if a number of dyeing of the same shade are being performed to make the bigger dye lot. In this case the dye bath is

pumped into a reserve tank, and it can be reused. So, you see that it is such a you know process; and therefore, however severe the limitations may be you have seen that wool dyeing is relatively very simple, and to be able to do we these dyeing the basic criteria's must be kept in mind.