Natural Dyes

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Lecture No. # 15

Since, yesterday we have being looking at the basic principles of dying. And then further on we try to understand the role of mordant, how these mordants, metal salts particularly the aluminum, and the ferrous ions which are trivalent; coordinate with the oxygen's of the dye molecule, belonging to the hydroxyl group, and this coordination helps them to adhere to the fabric. Now, all this we have learnt. And we also learnt that for a dying cotton, which does not support or does not have to many free hydroxyl group on the surface, needs to be treated with tannic acid. So that, the surface of the cotton, then develops adhering groups. And therefore the dye, and the mordant, and the tannic acid, and the fabric they all come together to actually be a part of the dying process.

Now, let us try to see today, a typical dying process for cotton. Because, it is important for you to know, what are the basics of natural dying? What are the requirements of natural dying? Dying procedure for cotton as well as silk has little variation, but nevertheless we will go through the entire process in order to understand, what are the requirements that one must ready, when one is doing natural dying. One should be ready with the natural dye either a fresh fresh extract or a powdered you know standardize natural dye.

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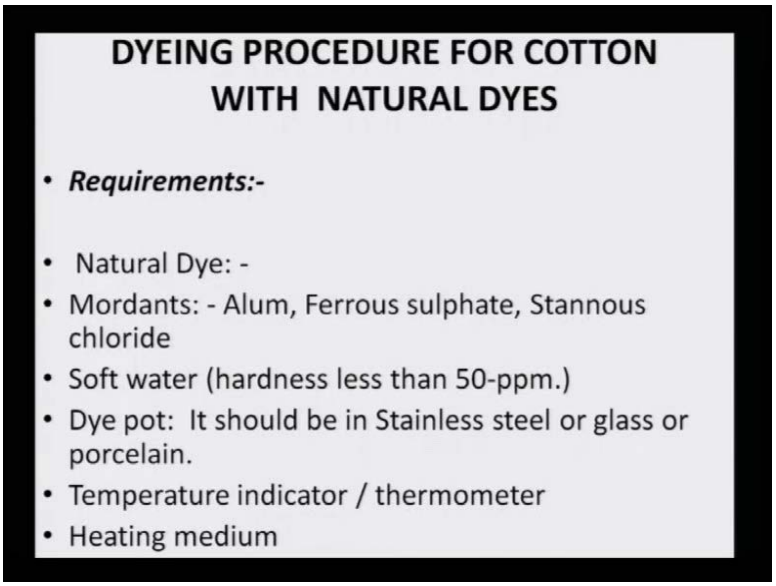

Then one must be ready with Alum or ferrous sulphate, stannous chloride whichever is the mordant, that one needs to use. One thing, I have all along told that the water should be soft water. Hardness should not be more than 300 ppm, which means that the interference is caused by the calcium, and the magnesium ions should be avoided. Dye pot: it should be made out of stain less steel or glass or porcelain; why because we saw that in the examples, where tin pot or aluminum pot or iron pots were taken.

The dye extract showed a difference in the hue color; that was, because the metal was leaching in at that pH, and the dye was not just the dye solution; it had the metal component also. So, it was like simultaneous mordanting was occuring. So, therefore, it is important to only use stainless steel or glass or porcelain. And the temperature indicator; that means, there should be a thermometer, one should keep track track of what is the temperature of the dye bath, and of course the heating medium. One can not heated too high or too low otherwise, the dye uptake will not be optimum. So, these things have to be kept in mind, while one is using natural dye. So, natural dye mordant soft water quality, dye bath should be made out of material which does not leach any metal ion, and temperature device, and heating device.

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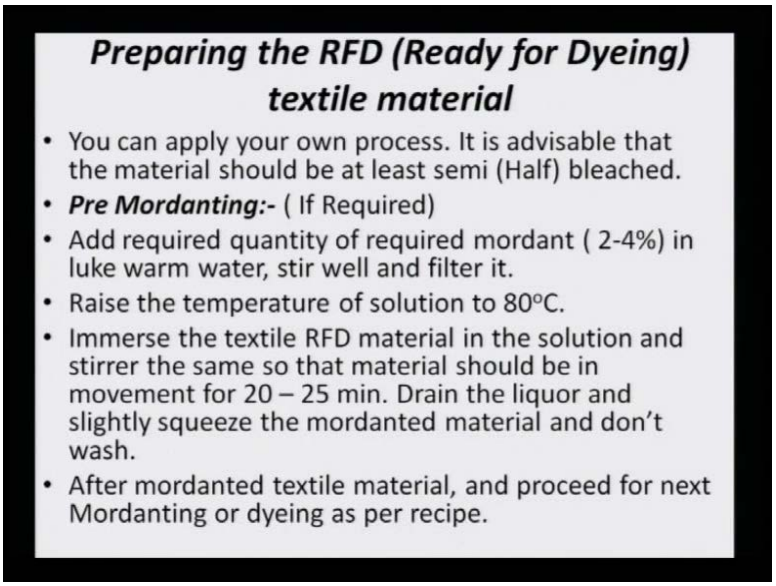

Now, how do we prepare: A ready to dye fabric or textile material. There is a particular protocol, that needs to be followed or a methodology that needs to be followed. You can apply your own process; it is advisable that the material should be at least semi half bleached. That means, it should not be a gray material, but it should be bleached material, and one can then start doing the scavering or bleaching itself will take care of the scavering process, then comes the pre mordanting. Yesterday, we learnt that there are three processes.

We can either treat the mordant in before dying or we can put the mordant after dying or the third option is that we can the mordant, and the dye together; that is called simultaneous dying, so or simultaneous mordanting. So, in the case of pre mordanting, if that is what is required - add required quantity of required mordant, mordant should not be more than 2 to 4 percent of the weight of the fabric. In lukewarm water, stir well and filter it. So that, there are no lumps of this mordant salt. Now, what happens, I will give you practical tips, because usually if it is not stirred; if it is not mixed uniformly, if it is not filtered for the lumps that up you know, still remaining un dissolved. What will happen that the fabric will have this lumps sitting on it, and eventually and those positions that dye uptake will be very abnormal.

And if the dye uptake is abnormal, it goes to prove that the dying will not be even; and it will create you know, patchiness. Rise a temperature of the tell solution to 80 degrees,

immerse the textile RFD that is ready for dying material, in the solution stirrer, the same stir the same. So that material should be in movement for 20 to 25 minutes. drain the liquor, and slightly squeeze the mordanted material and, but do not wash, because if you wash the entire mordant will run off in the water.

So, what one does, one just dips it in the mordanted bath, and takes it out slowly squeeze it, and just dry it; after mordanting textile material and proceed for the next mordanting or dying as per the recipe. Now, if this mordanting of pre treatment as in the case of cotton - in the case of cotton, one require stannic acid free treatment, then mordanting if one is using pre mordanting, and then dyeing. So, that is the sequence, but that is not this case in all the cases, in some cases like in silk. We do not need the premordant, free treatment procedure of tannic acid for silks, because silks have amino acids or proteins; and these proteinaceous materials have amino group, and carboxylic group which are good adhering group for the dye. So, therefore, the procedures are slightly different.

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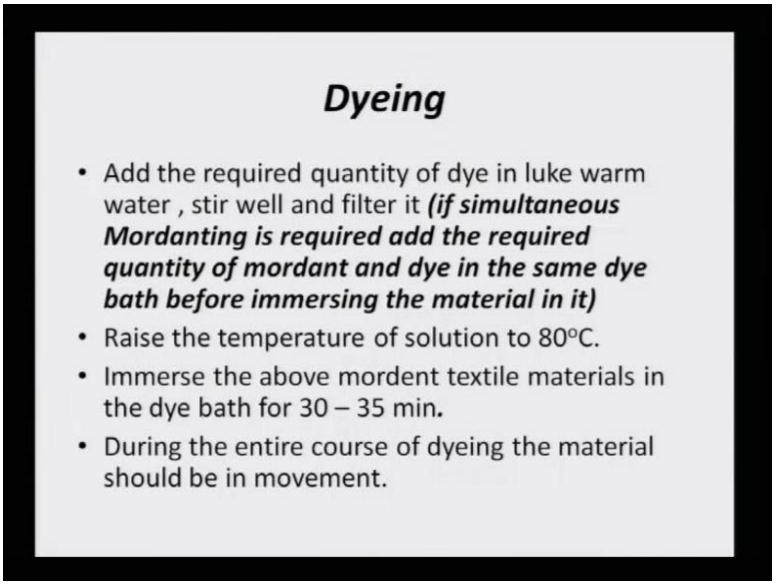

Now, add the required, when we start doing dying of cotton: Add the required quantity of dye in lukewarm water, stir well, and filter. If simultaneous mordanting is required, add the required quantity of mordant, and the dye in the same dye bath, before immersing the material in it. So, as we all know that in the case of simultaneous mordanting, after the free treatment of the tannic acid, directly we go to the dying process. And in the dye bath itself the mordant is added, but the same required amount 2 to 4 percent of the weight of

the fabric. Then slowly the temperature is raised to 80 degrees, immerse the above mordanted textile material in the dye bath for 30 to 35 minutes or even some times for 1 hour.

During the entire course of dying, the material should be in movement. So, it should be stirred. Yesterday, also we were talking, when we were looking at the basic concepts and basic principles of dying; that the dye solution and the fabric, should not be left still. Why, because what happens is that, at that particular point the dye uptake will be much higher. And therefore, it will and other place is which are not exposed to the dye solution or fabric portion, if they raise from the surface of the dye solution will remain un dyed. So, this is not a very good situation, and would cause patchiness. Another thing that one has to keep in mind, is that dying must be done in a very even manner.

Unless and until one gets an even dying, it is not considered to be a good dying process. Therefore, the movement is very important, and because even when I will be talking about the jigger, and the winch, these are very big dying machines; you will see that the fabric is constant touch with the dye solution, and is in movement. So, that at a time too much of dye solution is not in contact with the fabric; and that is what the whole idea is. Actually, the dye is taken up by the fabric, through the force of the netted fabric; and this capillary action is more facile, when the dye solution is momentarily in content with the solution. Otherwise, the processes will take place go on taking place, and there will be an dye aggregate in one place, and other will remain un dyed.

So, this will cause patchiness. So, that is why it is important to understand, what is the role of stirring the dyed material or what is the emphasis - why is it emphasize that all the time the movement should be there or stirring should be there or fabric should not be kept still in the dye bath.

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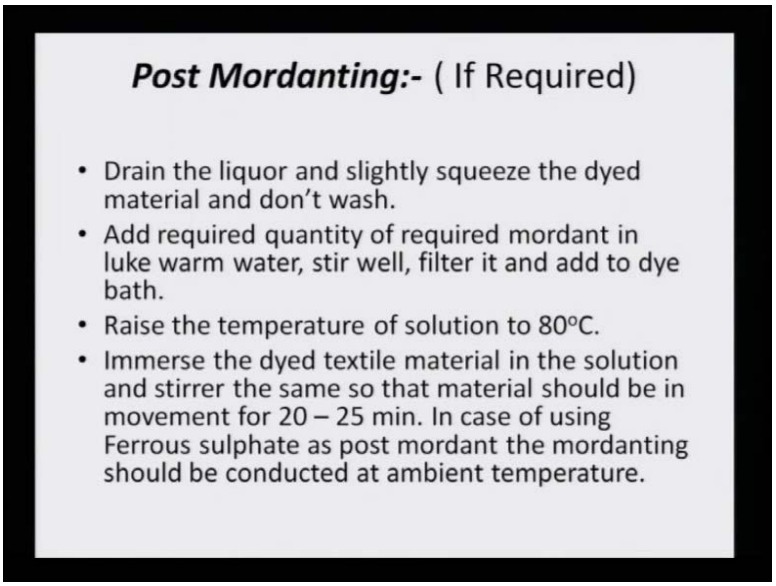

Post mordanting: As I said either the dye can, either the mordanting step can be carried out before dying which will be pre mordanting or sometimes, in order to gets some beautiful or some different shade, the practitioners - natural dye practitioners try to, do post mordanting. drain the liquor and slightly squeeze the dyed material, but do not wash. Add required quantity of required mordant in lukewarm water, stir well filter it, and add to dye bath; raise the temperature to the solution of the solution to 80 degrees, immerse the dye textile material in the solution, and stir the same so, that the material should be in movement for 20 to 25 minutes.

In case of using ferrous sulphate as post mordant. The mordanting should be conducted at ambient temperature, because as it is the ferrous salt is very you know, it brings in darker shades. And it is not necessary to heat the iron and salts so much. Therefore, it can be carried out at room temperature. But other post mordanting a mordanting processes must be carried out at 80 degrees, and that is the most ideal temperature, because it is slightly below the water boiling point, and it does not needful. But whether we do pre mordanting, whether we do post mordanting or whether we do simultaneous mordanting, the role of mordanting is very very important, specially when we are dealing with natural dyes.

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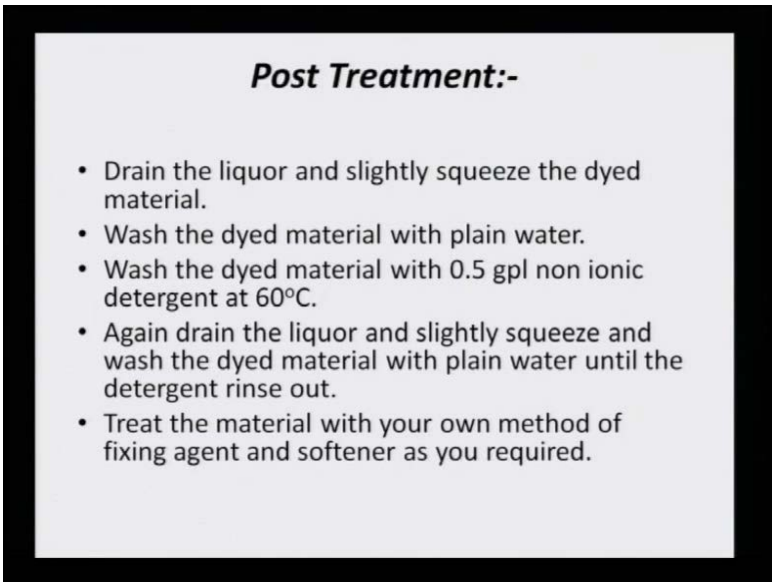

Post treatment: Sometimes, it is also necessary to do post treatment of the fabric. drain the liquor, and slightly squeeze the dyed material. Wash the dyed material with plain water. Wash the dyed material with 0.5 gpl, non ionic detergent at 60 degrees, again drain the liquor and slightly squeeze, and wash the dyed material with plain water; until that detergent rinse out, treat the material with your own method of fixing agent and softener as you required.

So, many at times dye fixers have to be used. Now what happens is that, there is some lose dye molecule on the surface that needs to be rinsed out. So, the first time it has to be rinsed out with the mild detergent, but nevertheless dye fixer always assures, that whatever has adhere to the fabric will remain on the fabric; and therefore, treatment with dye fixer is always advantages. There are commercial samples of dye fixers which are being marketed by BSF and (( )), and so on. And these are nothing but softeners, they tried to act like a coat coating, and un invisible coating on the fabric. So, that the color does not run off.

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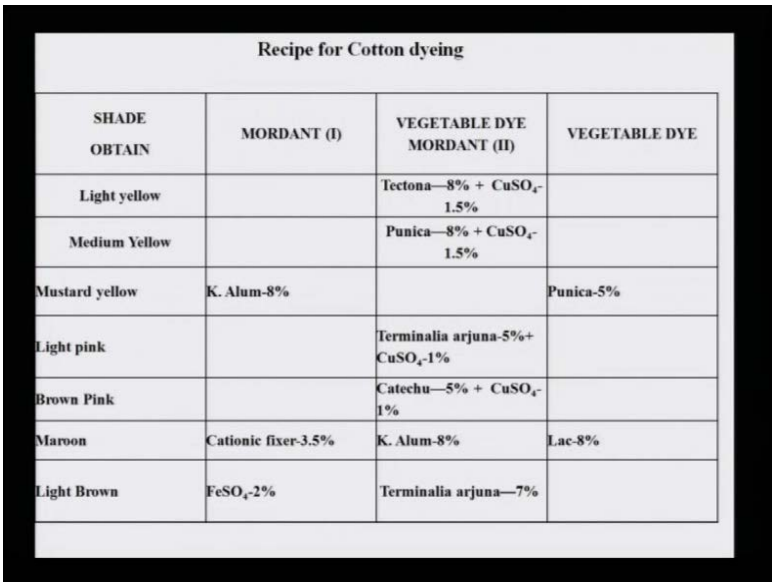

Recipe for Cotton dyeing

SHADE OBTAIN	MORDANT (I)	VEGETABLE DYE MORDANT (II)	VEGETABLE DYE
Light yellow		Tectona—8% + $CuSO_4$-1.5%	
Medium Yellow		Punica—8% + $CuSO_4$-1.5%	
Mustard yellow	K. Alum-8%		Punica-5%
Light pink		Terminalia arjuna-5%+ $CuSO_4$-1%	
Brown Pink		Catechu—5% + $CuSO_4$-1%	
Maroon	Cationic fixer-3.5%	K. Alum-8%	Lac-8%
Light Brown	$FeSO_4$-2%	Terminalia arjuna—7%	

Now, if one raise to look at a simple recipe: what would be the kind of recipe, if you one desired to have a light yellow shade; the vegetable dyed that should be used is tectona leaves 8 percent with 1.5 percent of copper sulphate as the mordant. So, you see that this Recipe; is just like our cookery recipe. That the formulations are given, how much of the weight of the fabric should the dye powder be used 8 percent, and the copper sulphate should be very little in quantity, and minimum requirement is 1.5 percent; that would yield a yellow color on the fabric - cotton fabric. If a medium yellow is to be obtained.

Another dye can be used, dye from the punica granatum or anarka chilka 8 percent with the same copper sulphate as 1.5 a mordant. If dark Mustard yellow has to be obtained; then the Alum should be (( )) used, as the pre mordant and the dye that should be used is 5 percent punica. alum and punica not as simultaneous dyeing, but as pre mordanting will yield dark mustard yellow color. If light pink has to be obtained. A simultaneous dying of terminalia arjuna bark 5 percent powder with 1 percent copper sulphate, should be used. If brown pinkish has to be obtained on the cotton fabric; the combination of dye, and mordant should be that simultaneously catechu 5 percent powder, and copper sulphate 1 percent powder.

If maroon color has to be obtained. Cationic fixer must be added, and potassium Alum 8 percent with lac dye 8 percent, should deal the maroon color out of the lac dye. Normally, lac dye would yield a color which would be ranging from red to purple. And

by the time it is fixed, and mordanted it, it sometimes has a very different kind of a shade, but if one wants to keep the reddish maroon color intact, then cationic fixers must be added. So, that it takes care of the pH. If you recall lac dye was a lactic acid. Most of them where you know, acidic material; and therefore, it is important to add Cationic fixer.

So, that the pH is maintained, and in the all the acid groups are more acedic, acedic in nature and would provide the reddish maroon color. If light Brown has to be obtained; a pre mordanting with ferrous sulphate 2 percent, and terminalia arjuna 7 percent would provide light Brown color. Now, you will see one thing that the there, the recipe shows pre mordanting, the recipe shows that simultaneous mordanting, but all along you will see that copper sulphate, wherever it has been used, has been used in their minimum quantity that is ranging from 1 to 1.5 percent only.

And the dye could be from 5 to 8 percent. So, as as a basic rule, the dye powder or extract, which ever you are using must be having 5 to 8 percent of the weight of the fabric, whereas the mordant can range from 1 to 2 percent preferably when we are using copper or chromium mordants, but in the case of ferrous or Alum, it can go as high as 4 to 8 percent. So, considering the toxicity of copper and chromium, one has to keep the mordant level low. Now, when we try to look at the dying procedure for silk, there are small amendments here as well.

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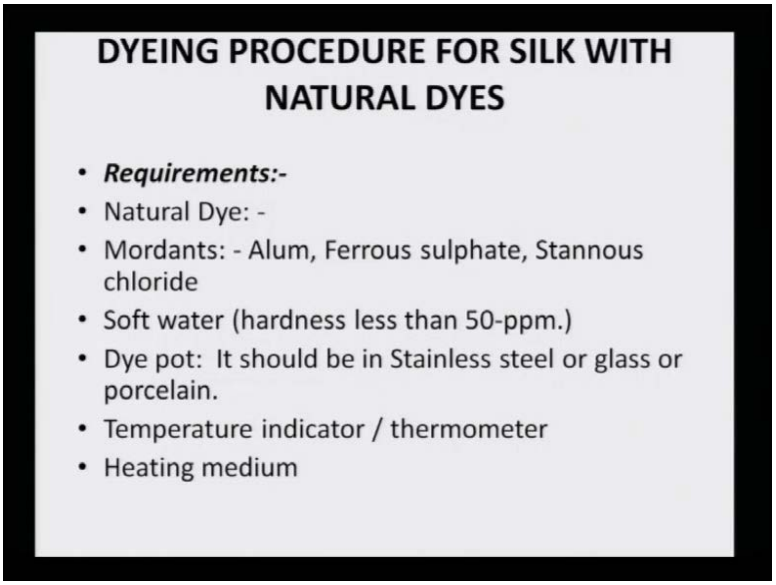

You will see that, whatever natural dye is being used, like you can take natural dye which is catechu, which is from the flower extract or from any source. Mordant the same alum, ferrous sulphate, stannous chloride. Here also the soft water should be used, hardness should be still lower; that is less than 50 ppm. And the dyed the dyed bath should be made out of stainless steel glass or porcelain; one should have a thermometer to keep a check of the temperature, and there should be a heating device or a heating medium.

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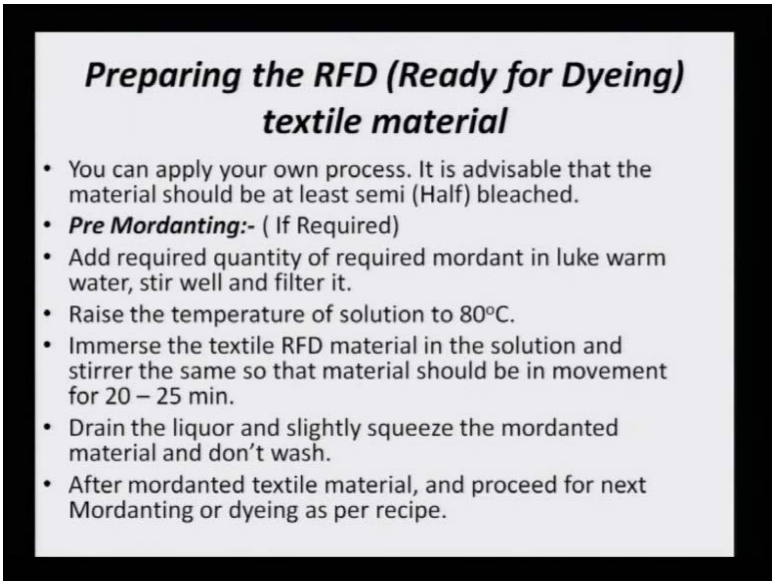

Now, how do we prepare a ready to ready for dying material, when it comes to silk. One should use a bleached or a semi bleached silk, and if pre mordanting is required; then add required quantity of the required mordant in lukewarm water, stir and filter. The same practice has to be carried out. Raise the temperature of the solution, that is the mordant solution to 80 degrees immerse the textile, which is ready for dying in the material, that is RFD is the short term, in the solution. And stir the same so that the material should be in movement, and there is even coating of the mordant. drain the liquor and slightly squeeze the mordanted material, but do not wash; I told you why washing is prohibited here, because it should not run off the mordant. After mordanted, textile material and proceed from further mordanting if required or directly to dying.

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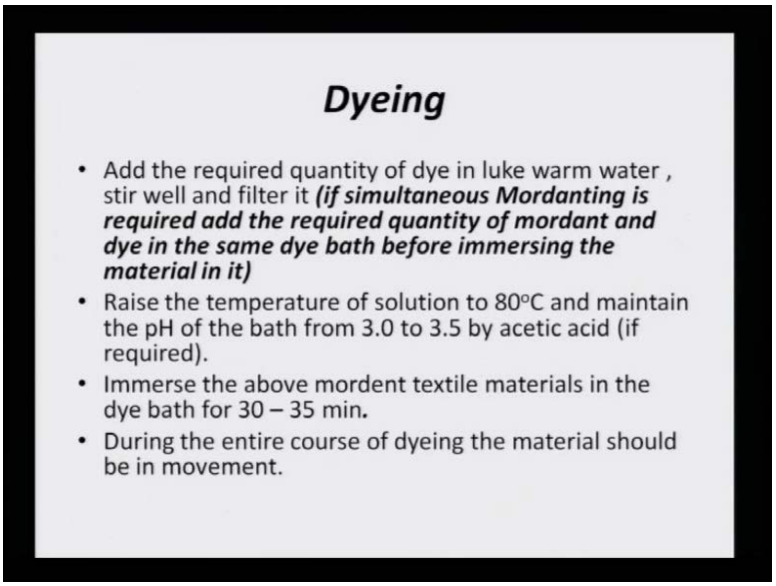

Now, when we try to do dying. There are of course, three different ways of dying: one is using a pre mordanted fabric, and then dyeing or we can have a simultaneous mordanting, and dying or we can have first dying and then mordanting. So, whichever is required or whichever is the choice at for that particular type of exercise, one can go for simultaneous mordanting if required, at the required quantity of mordant and dye in the same bath - dye bath. Before immersing it in before immersing the material into it. Rise the temperature to 80 degrees, and maintain the pH of the bath between 3 to 3.5 by acetic acid if required.

Now you see, that this particular step was not there in cotton dying. This is particularly, a typical case where we are doing silk dying. Immerse the above mordanted textile material in the dye bath for 30 to 35 minutes. During the entire course the dying material should be in movement. Here also the, you know the but in order to have evenness, in order to avoid patchiness, one needs to have a constant movement of the fabric while dyeing.

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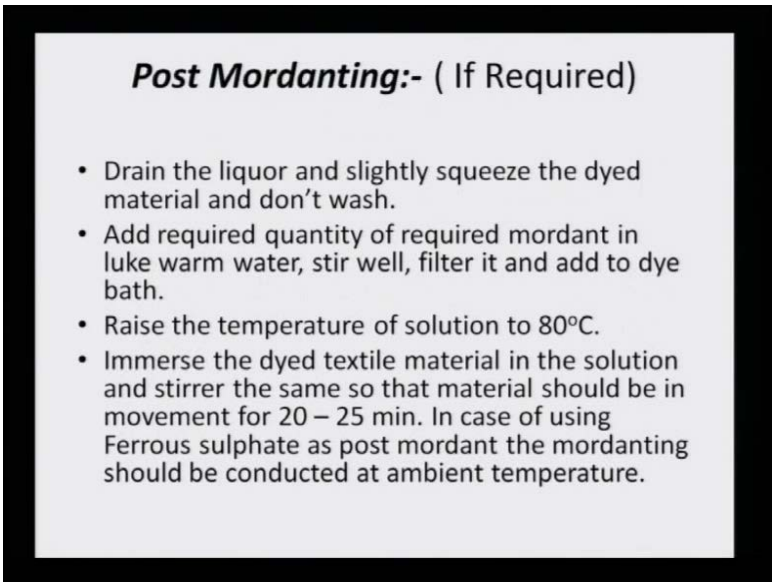

Post Mordanting: Where ever it is required, drain the liquor liquor, and slightly squeeze the dyed material, but do not wash. Add required quantity of required mordant in the luke warm water, stir well, filter it and add to the dye bath. Why I am all the time emphasizing, that even the mordanted solution should be stirred well, should be filtered, because again and again any kind of lump, un dissolved mordant salt can create patchiness on the fabric. If it adheres to the fabric; raise the temperature of the solution to 80 degrees, immerse the dyed textile material in the solution, and stir the same so that material should be in movement for 20 to 25 minutes is generally sufficient. But sometimes, if the required shade is not obtained one can, prolong the heating up to 1 hour.

In case of using ferrous sulphate has post mordant, the mordanting should be conducted at ambient temperature. This is the same, because ferrous does not require any further heating only at room temperature, this can be carried out very easily. Now, post treatment is common to both the cotton and silk.

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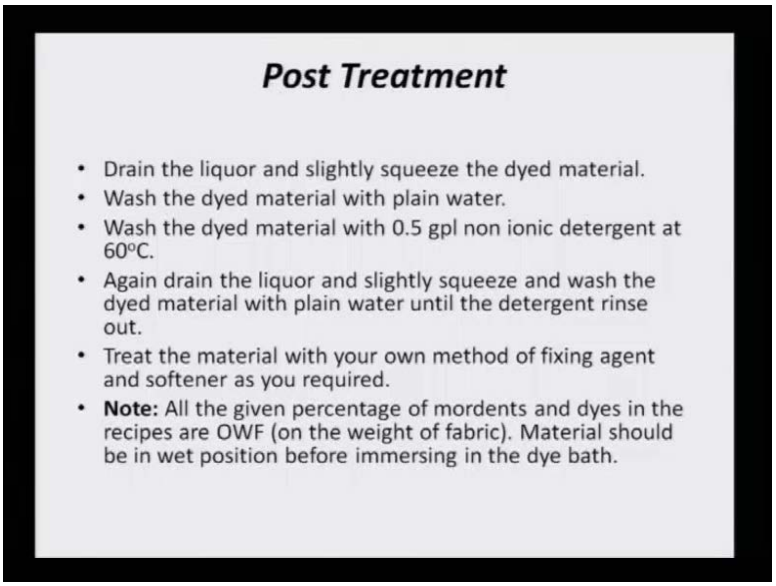

Drain the liquor, and slightly squeeze the dyed material. Wash the dyed material with plain water, then wash the material with 0.5 gpl non ionic detergent at at 60 degrees. See, these procedures are important, in order to understand that any surface adhering extra dye must be washed off, otherwise it will cause bleeding to the other fabric which are washed together. Again drain the liquor, and slightly squeeze and wash the dyed material with plain water until the detergent rinses out, treat the material with your own method of dye fixing or softener as required, now one thing that has to be kept in mind. All the given percentages of mordant, and dyes in the recipe are WOWF on the weight of the fabric. So, it depends on what is the weight of the fabric?

It is not a measurement just like that, in the volume of water; it is with respect to fabric. Because of fabric is a one, which will take up the dye. So therefore, it is always referred as OWF - that is on the weight of the fabric. Material should be in wet position before immersing the dye bath. Now, there are little little tips that needs to be you know brushing up, because you see dying is an art; and in this art if one masters over these little no answers, then one can actually do perfect natural dying. Of course, one learns to practice, but if slightly wet cloth is immersed, as compared to completely dry cloth.

What will happen that in the wetted cloth, the capillary action is enhanced, whereas in dry cloth, the capillary action is slightly retarded. Now, through the capillary action that dyes, dye molecule actually get in to the mess work of the fabric.

So, that is facilitated, if the initial dying material is slightly wetted. If it is not wetted, if one does it of course, the dying will take place, but the movement or the capillary movement of the dye molecules will be slightly retorted, will be slightly uneven. But in the case of wetted cloth, it is very even. So, now the choice is yours, that you know that this facilitates, and the other one retards. So, would not you, chose to opt for a procedure which facilitates the process, which makes it more even, which makes it more proper; rather than going for an improper process.

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Recipe for Silk dyeing

Shade Obtain	Dye + Mordants	Dye + Mrodants (IInd Step)
Yellow	K.Alum-6% + Punica-5%	
Orangeish Yellow	Rubia-5% + K. Alum-5%	
Olive green	Punica -6%+ K. Alum-5% + FeSO4 – 1%	
Pinkish red	Lac – 4% + SnCl2 – 2%	
Maroon	Lac – 6% + Oxalic acid – 6% + SnCl2 – 2%	
Light purple	Lac.-4%+K.Alum-1%+Citric acid-3%	
Purple	K.Alum-5% + Tarataric acid-2.5%+ Lac-3%	
Violet	Lac- 4% +K.Alum-2%+FeSO4-0.6%	
Light Gray	Lac+Tannic acid – 2% + FeSo4 – 2%	Space-B 6%+ CuSO4-2%
Gray	Terminalia arjuna-4%+ Ganga-2%+FeSO4-2%	
Light Brown	Terminalia arjuna-5%+ CuSO4 – 2%	
Bronze	Catechu – 3% + CuSO4 – 1.5%	
Radish Black	Lac- 4%+Ganga-2 After 15 min. FeSO4-2%	
Grayish Black	Lac-2%+Ganga-4%+After15 min. FeSO4-2% After 10min.Oxalic-6%+After10min.NaOH-2%+Soda Ash-10% After 10 min.+ FeSO4-2% For15 min.	

Now, similarly we have developed some recipes for silk dying. Now, if one wants to get yellow dye, yellow shade on the fabric; potash Alum 6 percent and punica that is anarka chilka 5 percent is just the best combination. If one wants to get orangish yellow, rubia cordifolia dye powder 5 percent, and potash Alum alum 5 percent, even simultaneous mordanting would be very helpful. Similarly, one wants to get olive green with punica, potash Alum and ferrous sulphate 1 percent; one can get 6 is to 5 is to 1 ratio of the punica, Alum and ferrous sulphate can give olive green shade.

Pinkish red, if one wants to obtain on silk. Lac 4 percent, and stannic Stannous chloride 2 percent. If if if one wants to get maroon color from lac dye, lac dye should percentage, should be increased to 6 percent, oxalic acid 6 percent, and stannic stannous chloride 2 percent. So you see that, whenever we are using alum; we are going up to 5 percent, but ferrous sulphate, stannic Stannous chloride are all between 1 to 2 percent. If light purple

color has to be obtained; lac has to be taken as 4 percent, potash Alum has 1 percent, and 3 percent citric acid. This will give light purplish shade.

Similarly, if dark purple color has to be obtained; potash Alum 5 percent, tartaric acid 2.5 percent, and lac dye 3 percent has to be used. If violet has to be obtained; lac dye 4 percent, potash Alum 2 percent, ferrous sulphate only 0.6 percent is required which will give the desired color. If light gray has to be used or if light gray color has to be obtained on the silk fabric, lack with tannic acid 2 percent and ferrous sulphate 2 percent gives a required blackish gray color. The gray color can also be obtained on silk from terminalia arjuna 4 percent, and ferrous sulphate 2 percent. light brown can be obtained with terminalia argjuna 5 percent, and copper sulphate 2 percent.

Browns color can be obtained from catechu 3 percent, and copper sulphate 1 percent 1.5 percent. Similarly that reddish black can be obtained from lac 4 percent, and ferrous sulphate 2 percent. So, you see different combinations of the dye powder or fresh extract with different concentrations of the mordant ranging from potash to ferrous to copper, can give various color combination in this on the silk fabric. But one thing that you have to remember, when to add what to get what color. And these recipes are just a directive that this is what you will achieve, if this is the kind of combination that you use; of course, you can have your own combinations system, and you can develop many many colors out of combination of dyes.

With natural dyes there is also another advantageous situation, that one can use two different dyes one by one or simultaneously, and get a completely new shade. One can use different mordants either use post mordant, either use pre mordant or post mordant or simultaneous mordant, and get different shades. So, from the same dye extract, the color variation can be immense. By changing the mordant, even then the color shade differs; it is not that, you will get the same color with all the mordants. And that is the beauty of natural dye that from the same dye extract. One can get different shades, completely different shades reddish to green from the same dye.

From anthraquinone dyes or anthocyanin dyes, this is possible just by manipulating the pH or by manipulating the mordants. And therefore, one can have whole large range of coloration on fabric be it cotton, be it wool or be it silk.

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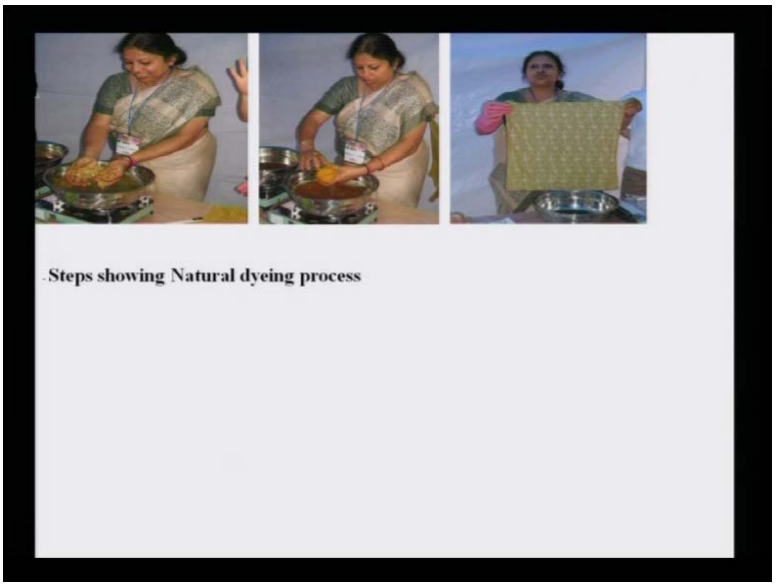

Now, this are some are some of the steps of dying which I am just shown here, just to give you an example; how this you know vessel which is an open vessel can be utilized, and dying can be carried out, very efficiently using gloves and using these kind of open troughs which which is directly kept on the gas, and beautiful tie and dye fabric can be seen which is shown in the last slide

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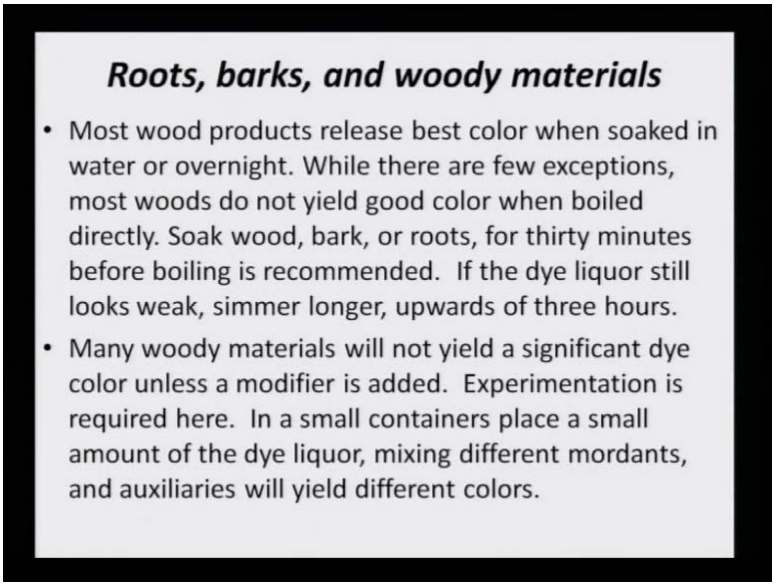

Now, one can use materials from roots, barks, and woody material. Most wood products release best color when soaked in water or over night. While, there are few exaction most

woods do not yield good color when boiled directly. Soak wood bark or roots for 30 minutes before boiling is recommended; if the dye liquor still looks weak, simmer longer up to 3 hours. So, if the wood is Soaked overnight that is the best. Many woody material will not yield a significant dye color unless a modifier is added. Experimentation is required here, in a small container place a small amount of dye liquor, mixing different modern and auxiliary, and that will yield different colors.

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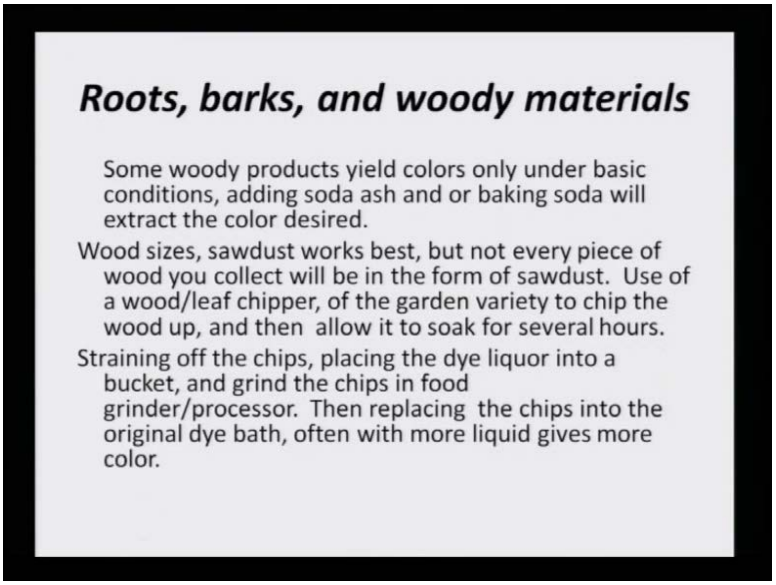

Some woody products yield colors only under basic condition; adding soda ash and or baking soda will extract the desired color. So, these are various methods of getting the dye out from the wood or bark or woody material. Wood size is sawdust works best, but not every piece of wood, you collect will be can be formed in the sawdust. Of course, the bigger the surface, the better will be the effectivity. But nevertheless you know, the smaller the piece is the better the dye extraction will be use of wood will be chipper, of the garden verity to chip the wood up. And then allow it to soak for several as is a ideal situation situation. Straining of the chips, placing that the dye liquor into bucket, and grinding the chip in food grinder or processer is also possible. Then placing the chip in to the original dye bath often or more liquid gives you more color.

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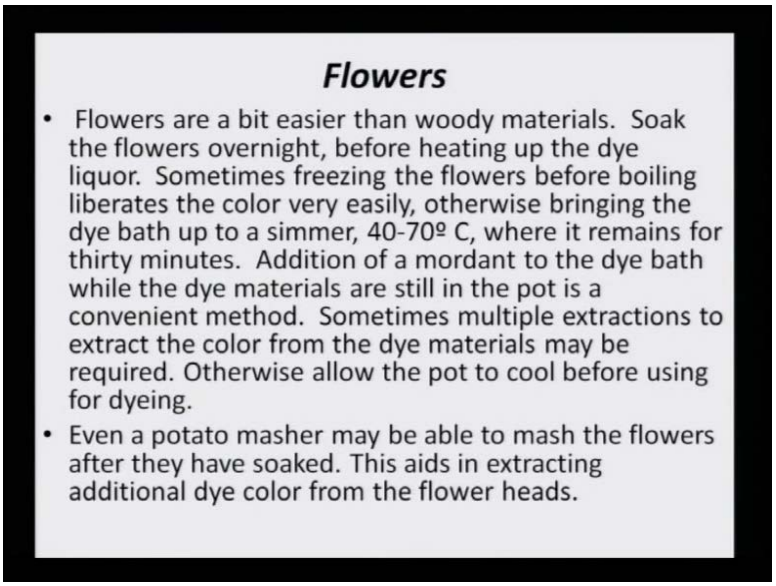

So the larger the surface the better it is. Similarly, for flowers are a bit easier then woody material. Soak the followers over night, before heating up the dye liquor; sometimes freezing the flowers before boiling, liberates the color very easily. Otherwise, bringing the dye bath up to a simmer to 40 to 70 degrees, where it remains for 30 minutes. So, there are various ways, either it can be left for overnight or it can be just you know frozen, and then put into boiling water; and that would help to actually get the dye out of the material.

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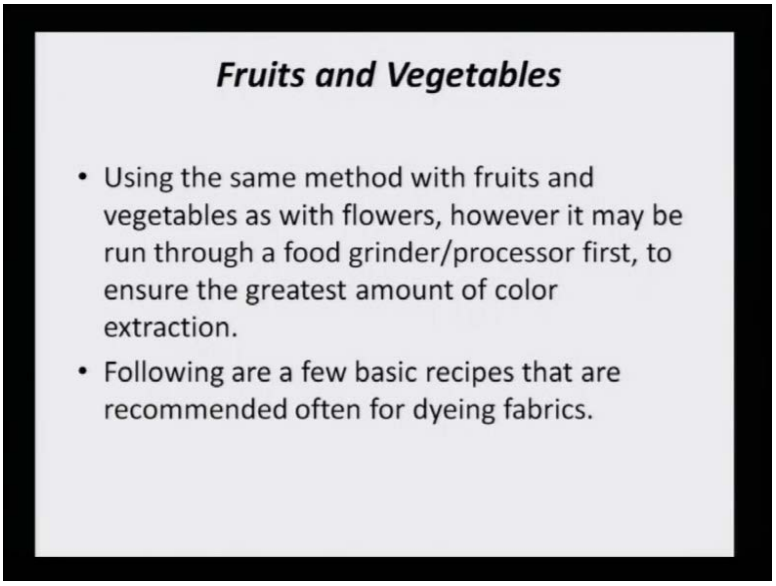

And dye from the Fruits, and vegetables using the same method with fruits and vegetables as the flowers. However, it may run through a food grinder - processor first to ensure; the greatest amount of color extraction. Following are the basic recipes that are recommended often for dye fabrics.

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So, you see for genda flower which is a very very common flower take it us. There is the plants, the flower can be simply taken and put in to a plastic bucket, in with hot and not boiling water. That itself will extract most of the color. So, from plant to plant; if suppose even if we do not have a sox let extractor, if we do not have an access to the super critical extraction process, if you do not have a sonicator in our hand; simple experiments can also help in extraction of the dye. Simply by taking of 5 liter bucket or container will work.

And marigold yields greatest color if allowed to soak for 6 to 10 hours. Just place a solution in one area or or in heated kind of room, and just place it in the warm place for overnight. Over night soaking itself, will actually bring out all the color, and then simply filter the Marigold liquor in to the dye bath, and evaporate the dye bath, whereas all the biotic material can be easily used for composting. So, there are simpler methods also for extraction, it is not that for a dye procedure, for doing natural dying, you have to have a very elaborate laboratory to do that. Things can be done even in the house, in simplified

manner and of course, things can be carried out in a very exclusively designed laboratories.