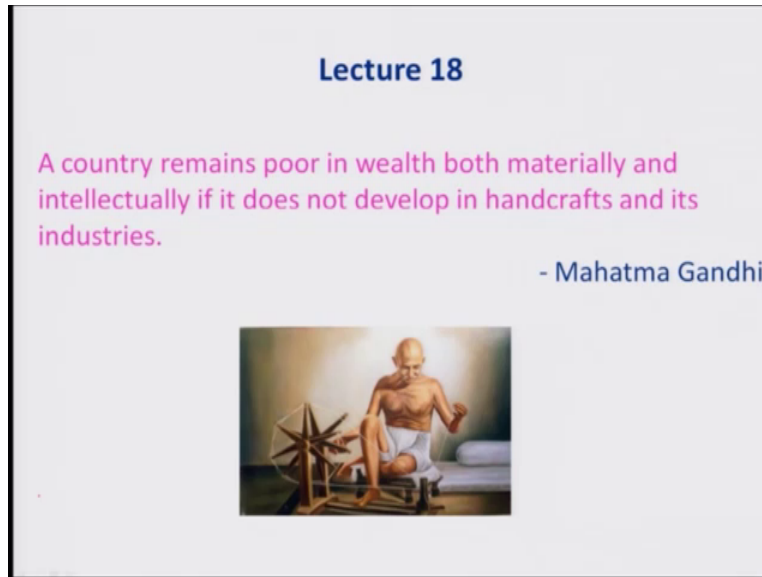


Course on Ancient Indian Technology
By Professor D.P. Mishra
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Lecture 18
Module 4

Let us start this lecture with a thought process from Mahatma Gandhi.

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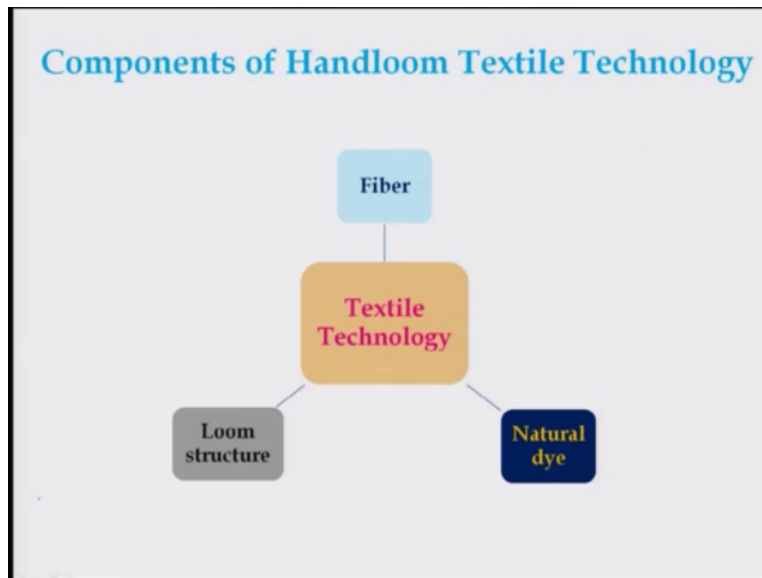
He says” A country remains poor in wealth both materially and also intellectually if it does not develop handicrafts and its industries”.

So we know that Mahatma Gandhi who was a hardened supporter of the making cloth using the hand and therefore it is having we are having a legacy of cotton making by ourselves. Let us recall what we have learnt in the last lecture. In the last lecture we looked at the question why need to have you know cotton industries particularly in handlooms which is having the historical base and then we looked at the evidences in literature starting from Ramayana and Arthasastra and other things. And also we looked at that the cloth making was there even in the during Indus valley civilization.

Later on we also looked at what are the side effects or the drawbacks of modern cloths and unnatural dyeing being used in the modern cloths and which is causing detrimental effects not only on the health but on the water and also air to some extent, so also the soil is getting contaminated. So later on we moved into the also the various aspects of the cloth making in India

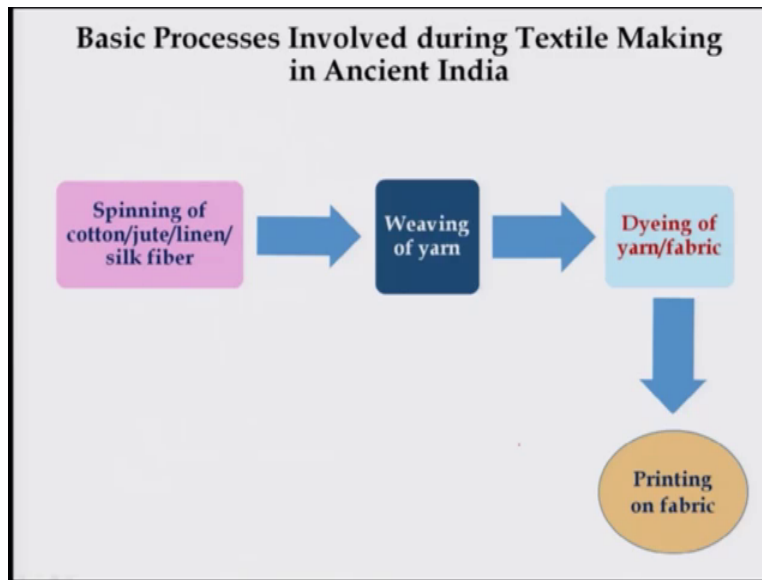
and each state is having the their own design of fabrics and also the kinds of looms they are having. Today, we will be looking at basic processes involved in cotton making or you can say textile making.

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And if you look at handloom textile technology is consisting of these things, one is making of the fiber, right? How to make the fiber from the main ingredients, for example, cotton or maybe silk or maybe linen or the jute, like how you will make the fiber then the question arise how you will weave it? Weaving you know weaving of the cloth to the fabric the loom structure and of course you will have to use the dyes to have you know better color and attraction for that. And these three component we will be discussing we will start with fiber and how to make fiber from this and let us look at the basic processes involved during textile making in ancient India.

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And even today that is true but in ancient India people were doing all the thing by hands and they were using certain simple technologies for that if you look at like spinning of the cotton, jute or linen or silk fiber or various kinds you know is the first important things and that is the basically will be coming from the raw materials.

And then of course the you can color or the dye it this fibers or you can color it after making of fabrics you know and this fibers will be converted into yarns and this yarns means thread means basically thread and weaving of this yarn will give you the fabric or the cloth. And this dyeing it can be done printing on the fabric itself and also you can as I told earlier dye the fiber also dye the yarn itself so that you can get various designs and make a various combination of colors and design kind of things.

And if you look at like the as I told earlier that in India that the design was you know like various kinds even in a single state, that means if you go to each region you will be having their own design and even like various kinds of looms they were having and as a result the creativity was intact due to the weaving and the designing of the thing.

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And if you look at various tools being used for weaving the cloth manually and some of the tools I will show you and this if you look at this is a kind of a spindle and this we call it as a drop spindle and in Hindi it is known as Taklis and there are various kinds you can get in the country.

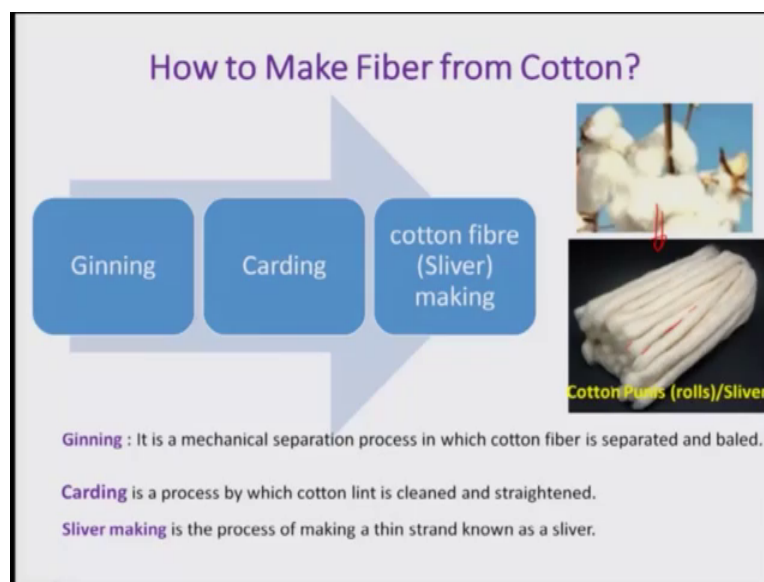
But the basic principle remain same and it will moving around and the yarn will be produced from the cotton. And there is a also a very old this kind of instrument which is known as basically some arrow kind of things which will be discussing little later on and this is a very old in this our country.

You might have seen, you might have seen in your local areas and even still It is being used and this is used for carding the cotton, right? Which it will be for cleaning and also making it the separated out and there is a hand tool which is being used which I will show you how you can use this tool the hand carding tool this one I am mentioning, right? And which can be used to make kind of a Punis of the cotton

And there is another one which is roller carding tools and which is a little recent one you can think of, but again you can use a hand to carding that. And of course you will be knowing it is a very famous and then kind of charkha we call or a wheel, spinning wheel and this is the another form of this charkha.

This is a table top spinning wheel, and this is of course a loom which is a traditional loom by hand and which will be discussing some of this design but some of the designs are not you know being used today and it is going out of our culture because of power loom. And this is known as shuttle and which will be carrying the bobbins of the threads or the yarns like threads and which will be moving or it will be part of the you know weaving process and which will be discussing later on. So what I would like to suggest that you just keep this tools in your mind so that it will be helpful as you go along to understand this about their functions and then how it is being used.

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So how to make a fiber cotton, right? If you look at we will have to the basically start with the cotton which we will get from the by cultivation from the plant and we will have to collect it and collection is very important and it will be continuing the seeds, right? This cotton seeds and this seeds has to be separated and that we call it as a Ginning. Ginning is basically mechanical separate separating process in which cotton fiber will be separated from the seeds and it will be baled, bale means stack of cotton together in a particular shape what you can think of.

And then you will have to do this Carding, Carding is a process by which the cotton lint is cleaned and straightened out, right? And that we call it as carding and of course the last process what we call is a Silver making and it is a basically a process of making a thin strand known as silver and you can call it also as a cotton Punis or the rolls, right? And this will be the same one

can use basically from this rock cotton from the plant you will be getting making this cotton Punis which will be used for making yarns.

So therefore this process has to be done and let me just tell you that the cotton seed can also be utilized for making oils and which can be used for various purposes. And it is important that you know this has to be separated and also it can be utilized so and if you know that is the reason why it is important to be separated properly and collected.

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The story of cotton to fiber



The story of cotton to fiber



So let us look at the story of cotton to fiber, basically how to convert the cotton to fiber. I will show you a video which is available in the YouTube, you can see that also but let us look at how it is being made let us see how the cotton can be converted into a fiber with the help of this video which I have taken from the YouTube, I am really grateful to this old lady who has really demonstrated this work and you can see that she is now making a Punis and this Punis she has made from the Carding using the Carding tool by the hand and this Punis is of course from India and this Punis she has made, now she is showing you that how to make the yarn from this Punis using a drops spindle.

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How does a Takli (drop spindle) work ?



How does a Takli (drop spindle) work ?



How does a Takli (drop spindle) work ?



How does a Takli (drop spindle) work ?



How does a Takli (drop spindle) work ?



And let us see that how the Takli or the drop spindle work in more detail and this video “Here is the machine gun of the nonviolence movement in India and the key to independence. It is known as Takli, a substitute for the spinning wheel for those who are moving about and are unable to devote the time required for the spinning wheel.

It costs but one cent and can be conveniently carried about so that each spare moment while talking with friends or traveling or listening to lecture can be devoted to spinning. Here is my cotton for spinning yarn. Cotton is grown clean and supplied in India by Indian labor.

Spinning is very easy and can be learned by anyone even a child in a few days. If a man works at Takli during his spare moment, spare moment about four hours per day he will be able to spin four hundred yards of yarn which is sufficient to supply his own clothing consisting of his cap, his shirt and his dhoti


He spends an extra hour a day on spinning he will be able to supply yarn for those who are unable to spin and thus eliminate the purchasing of foreign cloth”.

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Basics of Cotton Textile

What is yarn ?
Yarn is a long continuous length of interlocked fibers used for weaving/ knitting .
Standard measure for a length of cotton yarn is termed "hank" (1 hank = 767 m).
Hank yarn is used typically in handloom production as opposed to cone yarn which is used in mill production.

- The process of converting cotton fibre to yarn is complex.
- The fibres are separated and then assembled into a loose strand (sliver or tow) which is known as **carding**.
- As to Science historian Joseph Needham bow-instruments for carding known as **kaman (bow)** and **dhunaki** was invented in India (200 CE) which would loosen the texture of the fibre by a vibrating string.
- The strength and fineness of yarn is dependent on the staple length of the fibre and the skill of the spinner.
- Yarn can be produced in two ways;
Cotton fibre to yarn by hand,
Cotton to sliver by mechanical process ,
then spun by hand in various thicknesses.



So let us look at the basics of cotton textile and as I told earlier this is basically the raw cotton and we will have to make this cotton we will have to utilize this cotton to make the Punis and from Punis we will be making the yarn.

The question arises what do mean by yarn? Yarn is basically a long continuous length of interlocked fiber used for weaving and knitting or knitting. And you can in simple term you can say it is a thread, right? That we will have to make by twisting so that it will be having more strength. And the standard measure for length of cotton yarn is basically "hank" and one hank is seven six seven meter that is the unit what is being used and there are two types of yarn is used, one is Hank yarn which is basically used for handloom production and which will be looking like that this is basically the hank yarn. The other one is the cone yarn which is used for the mill productions like in a mechanized one this is basically cone yarn.

And the process of converting cotton fiber to yarn is quite complex and that is why we were using the Taklis which is a very simple one charkas is also being used and the fibers are to be separated first and then assembled in to loose strand which is basically known as Carding and carding tool is very old in this country according to the historian Joseph Needham bow instrument was used for carding which is also known as Kaman, Kaman means bow in Hindi and dhunaki.

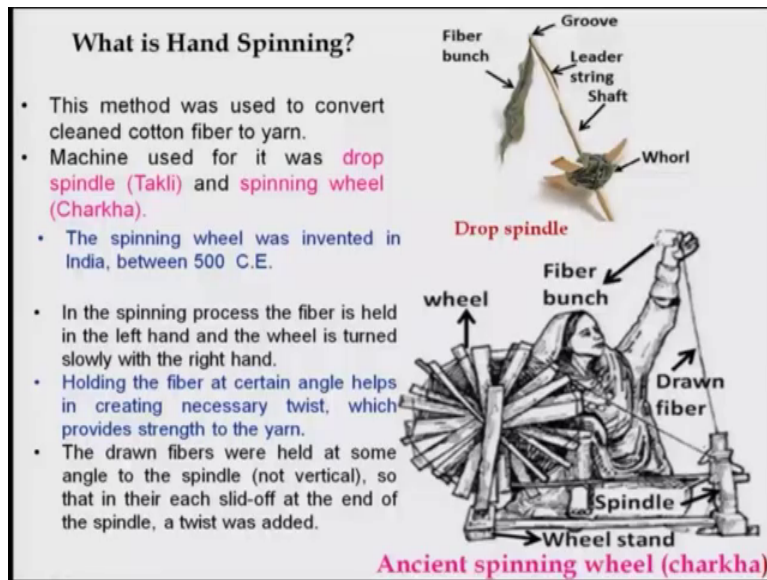
So this is been shown here the Kaman and Dhunaki which is being used for carding and this is being tied over here with the string and then you can use this for you know carding purposes you might have seen and even like I think last year I saw in my native place and for what you call cleaning the cotton old cotton whenever we make a mattress we will have to clean and then make this loosen this cotton and this is still being used and that is from where when it was 200 A.D, right? So eighteen hundred years still we are using.

That is the technology we are still having and it is a good one and which is used for loosening the texture of the fiber by vibrating the string, the string has to be vibrate this has to be vibrate here and you can make that thing easier and it will be you know hanged from the top so that you can utilize very easily. And of course the strength and fineness of yarn is generally dependent on the staple length of the fiber and skill of the spinner, so you need to be a very good hand to do that because it will be twisted so that it can take the strength you know for the thing.

As I told earlier that yarn can be produced in two ways one is you know by hand and which was being used basically in our country in those days and today also but of course nowadays machine is being used that is the mechanical process for you know converting the cotton to silver and then spun by hand in various thickness like that is also can be is being used today in our country even in handloom sectors.

And mill sector it is the machine which it will be doing and it will be consuming lot of the energy and this here in this case no energy will be you know utilized rather you will be using what you call hand and then doing a you know it is good for exercise, physical exercise.

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So what is hand spinning that is the thing which we will see that. It is basically process of converting the cotton into yarn and of course two devices are used, one of them is drop spindle which you call it Takli and the other is the spinning wheel what you call it charkha.

This drop spindle as I you know you might have seen earlier also that is this is the fiber bunch or the cotton you can call it as Puni that is going through this group and then it is having leader string and this is the shaft and this is the whorl which will be can rotate you know and this is a one typical case one can think of local people might be using made out of wood and this is the drop spindle and spinning wheel which is the improved version of this spindle, drop spindle or Takli who was invented around may be something 500 C.E.

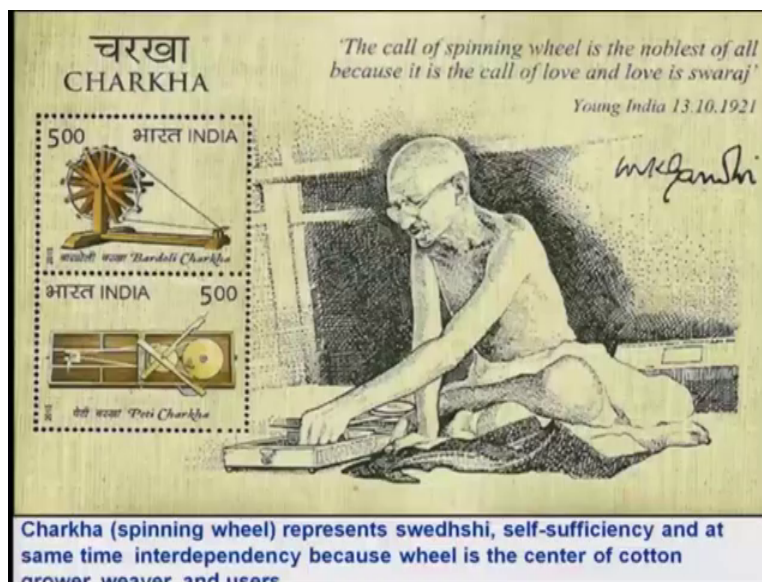
So if you look at this is the the spinning wheel and which I have shown here and this also known as the charkha and if you look at this is the wheel components having the wheel and this is there is a spindle which is not shown here and this wheel and the spindle is basically placed on this wheel stand and there is of course nowadays lot of pulleys are being used in this place also to improve its performance.

And the during this spinning process the fiber is to be held generally the left hand if you are a right hand person but if it is a left handed person it will be the other way around, right? And the wheel is turned slowly with the right hand this is bigger wheel which will be basically helpful in making this spindle to move properly so that you can twist it.

And holding this fiber by this lady in this hand whatever I have shown in this figure is very important particularly for maintaining certain angle such that it will provide the strength to the yarn, right?

It cannot be 90 degree it is having certain slanted angle and which I will show you in the next video and the drawn fibers are held at some angle to the spindle as I told not vertically and so that in their each slide off at their end of spindle a twist is added that means more twist will be added with this and then when it will when this hand will be moved towards this then that means will rotate and it will be founded on the spindle itself. That means you will be collecting the thread which will be made out of this fiber bunch or you call Punis.

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If you look at the Charkhas is very old and in 2015 that Government of India actually produced two stamp which is having the Mahatma Gandhi picture and Mahatma Gandhi wrote in Young India thirteen October 1921 “The call of the spinning wheel is the noblest of all because it is the call of love and love is Swaraj” so at that time he was trying to get you know Swaraj and also become independent country but unfortunately we have not achieved Swaraj till now.

We are depending on the other countries too much at this moment of time and we need to follow Mahatma Gandhi. According to him the charkha represents Swadeshi that means we will be doing all the things from our own country, self-sufficiency and at the same time inter dependency because today people want to be independent.

I always tell to my young friends like you that independent is not possible you will have to dependent but what is important is the inter dependency, that means you will have to appreciate others work also and why according to him wheel is the center of cotton grower weavers and users.

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So therefore it is very important, let us now look at like you know types of charkhas or the spinning wheels and there are of course I have noted down four but there might be several others also. One is the Bardoli charkha and this charkha which I have shown is a stamp again Bardoli Charkha and this is the actual model one can think of there is a if you look at this act like a you know pulley system mean this is the bigger pulley and this is a smaller pulleys. And there is also a the improved version and this is the pulleys as I told there are more number of pulleys are being placed here. This is the so that you can improve its performance and this might be they might have started from a place Bardoli this is a movement for a popularizing the charkha and other things during the pressure-independence time as a historical thing. That might be the Bardoli and there is also you can say it is on the ground you can keep and then keep that charkha.

There is a table top charkha which is called Peti, Peti means it is a box you can keep in the box also and carry with you, right it is easy to carry and this also known as table top on the table itself you can put and do that work. And beside this there is a Amber Charkha which was being

used basically in this place in this photo by the Rajendra Prasad who was the first president of independent India.

And this is the mechanized one there might be here you can have one spindle in this case one spindle here but here there are more than one it can be two it can be four. And at that time it was being you know designed and then fabricated and it is far superior than the hand one. The yield of this yarn making is much higher as compared to the traditional charkha.

And in current time of course there is a e-charkha people are talking about it and in this case this is according to me it is a improved version of the Amber Charkha, they have two spindles also, it can be four spindles it can be six spindles, even till eight people have made it

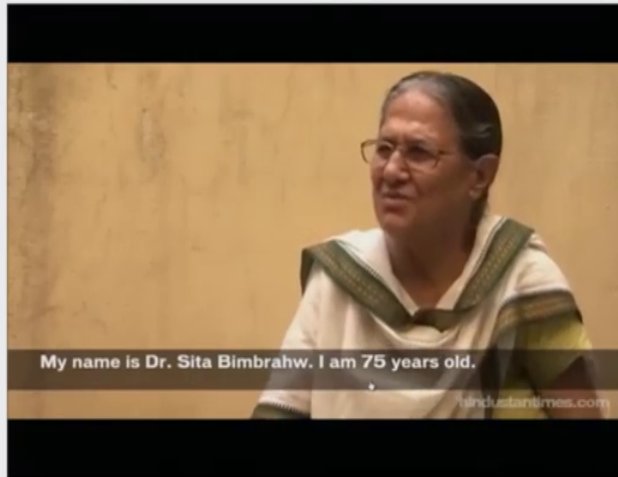
Lot of gear and arrangements are there which are not showing you. And beside this there is also another improvement in the local level occur like they will be using like this you know wheels of the cycle and then do that and this also the bamboo like you know the steel you know local people they do design the thing which you call indigenous design and the improve over the traditional one.

So therefore these are the kinds of things what you can think for there might be several other varieties which I have not really collected it and also looked at them but you may look at it and then if you come across more than this you can let me know.

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How does a charkha work ?



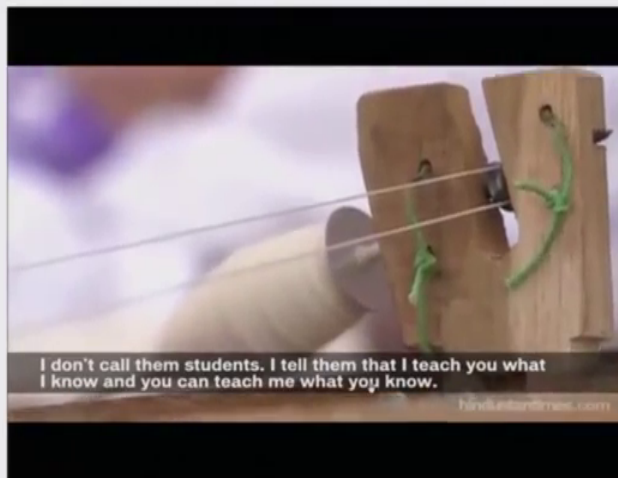
How does a charkha work ?



How does a charkha work ?



How does a charkha work ?



How does a charkha work ?



How does a charkha work ?



How does a charkha work ?



How does a charkha work ?



How does a charkha work ?



So let us now look at how does a Charkha work “Charkha in itself is one of the most beautiful and effective modes of entertainment. My name is Dr. Sita Bhimbrahw, I am seventy five years old. I was eight or nine years old when Gandhiji had such an influence that each house owned and spun charkhas and sand about charkhas “We keep spinning the charkha until we attain Swaraj”. Every Wednesday from 3 pm to 5 pm, charkha classes are held at the Gandhi Bhawan.

The numbers of students have been increasing day by day I do not call them students, I tell them that I teach you what I know and you can teach me what you know. Each child has a talent, they just need to find a way to use it. It makes me happy when I see the joy these children get when they are spinning the charkha, the most thing I learned was the peace of mind and the concentration.

While spinning charkha you have to concentrate a lot with just because of the didi over here we are also learning the peace of mind and how to keep calm. I was a person who was very short tempered before I joined the course and after joining I started with interactive sessions with didi I started being calm down and be more active. This hobby is not that spinning charkha to earn money or anything it is a mainly based on the concentration. The sense of self dependence this will give to you and most precisely the simplicity this will provide to your life which is most worthy thing in the current age.

When you are spinning the charkha you are completely immersed in it. Your mind does not wander. Our eyes and hands are on the charkha and we keep spinning it. We do not listen to

anything around us but the charkha, we are naturally not distracted by anything. There are three things that Sita mam has asked us to take ahead in our lives. Firstly, to spin the charkha dutifully and secondly to wear khadi clothes, lastly to lead a simple life. I am hoping to follow it as much as I can.”

So if you look at you can learn from this video that charkha is very important producing the yarn but at the same time it enhances the concentration level and also the peace of mind. So if you look at in modern days when digitization is going on you can think of digital India we are facing a lot of problem among the young people and also maybe the later on with the old people of concentration of the middle aged people concentration and this problem can be you know solved by using the charkha for spinning purposes and it can also be utilized for getting a peace of mind.

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Modern e-charkha

Components of e – charkha:

- Spinning unit contain one / two / eight spindle charkha.
- The lighting unit has the LED of bulb.
- The transistor radio – normal AM/FM tuner.
- Generator & Battery.

Benefits of using only 2 spindle Charkha

- ❖ Spinning of this e-charkha just for 2 hours would give yarn of length 2.4 km (2.4 hanks).
- ❖ It can provide a light output / **back up for 7.5 hours.**
- ❖ Spinning on 2 spindle e-charkha for 25 days in a month will produce **yarn sufficient for a single bed-sheet, a bath towel and a shirt.**
- ❖ **One can listen to programmes on radio.**
- ❖ It keeps your body and mind fit and energetic.



Let us start this discussion about modern e-chakra which is basically improved version of Amber charkha and as I had showed you earlier this is having a lot of gear mechanisms are there and which you know quite complex in nature for designing and developing. And this is a two spool e-charkha and various components it will be having basically spinning units which may be of single one, or two one or four one or eight spindle maximum eight spindles can be accommodated in the e-charkha.

And it is having a unit lighting unit which is made of basically LED bulb. And it is having also transistor radio normal AM FM tuner kind of things where you can really listen to the songs and

then programs. And it is also consist of a generator and battery because you need electricity for running this LED bulb and the AM or FM tuners.

So if you look at benefits of using only two spindle charkhas is that you will get enough must if you just spin it for 2 hours and you can manage to you know produce yarn of length of two point four kilometers, right? And it can provide also light output or back up of 7.5 hours of course for a single bulb maybe. And spinning of this two spindle e-charkha for 25 days less than a month will produce yarn sufficient for a single bed sheet, bath towel and a shirt. So if you look at if you just spend two hours, right? And for 25 days you can manage to get yarn enough to do meet your need.

And one can also listen to the what you call programs on radio and it will also make your body and mind fit and energetic. If you look at it can be utilized very much in the rural area where electricity is not gone but they will also use electricity to some extent. So it is a very you know good part and the improvisation and what I was trying to advocate basically to improvise our technology in the modern context not copy the old technology and use it here today which cannot be. So that our people can get and then they can keep the ethos that leaving eco-friendly.

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What is Bobbin Winding?

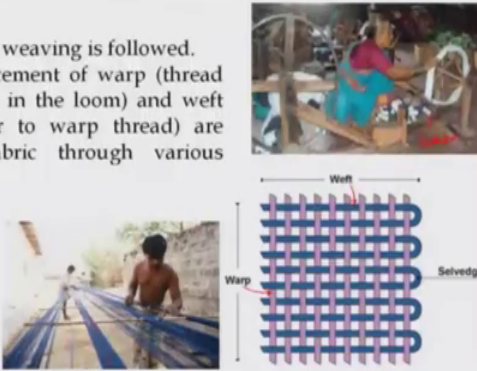
- ❖ Yarn in the hank form is wound on to bobbins in this process.
- ❖ This is the first step in transforming the yarn from the hank form to a linear form.
- ❖ Dyed hank yarn is wound onto bobbins with the help of **charkhas**.
- ❖ This process enables the laying out of yarn lengths for weaving.
- ❖ Typically 19 to 20 bobbins are required for a five saree "warp" length of 34 meters

Weaving

- After spinning process, weaving is followed.
- In this process interlacement of warp (thread running longitudinally in the loom) and weft threads (perpendicular to warp thread) are done to produce fabric through various handlooms.

Warping

The warp is a set of the base lengthwise yarn that runs along the length of fabric through which the "weft" yarns are filled in to make the fabric.



So let us look at the bobbin winding which is the every important thing for the cotton making because the yarn in the hank form is to be wound unto a bobbins in this process. Let me show you a pictures over here and this is basically the hank if you look at and this is your bobbin,

right? Which will be wound properly and this is the first step basically transforming the yarn from the hank form to the linear form which will be utilized for basically making warp kind of things.

And this of course the yarn or the hank yarn can be dyed before and also and it can be put into the bobbins with the help of charkhas which will be much easier to do that. And typically 19 to 20 bobbins are required to for a 5 saree warps of length of 34 meters. If you look at in a saree you know lot of threads are there yarns are being utilized and which has to be properly managed and with the help of you know winding over the bobbin.

So weaving is basically followed after the spinning process. The spinning has to be done first and it is basically the interlacement of warp. The warp is a thread running longitudinally in the loom and if you look at this one this is your warp. This is basically the warp you can say and this is your weft the blue color one and which is perpendicular to the warp thread and are to be you know knitted properly so that you will get a cloth.

Basically, if you look at the warp and the weft what we call tana in Hindi and weft is the bana, tana bana, right? In other languages it will be different also, but generally we use that. And this has to be done in the hand, so therefore we call it basically handloom

Warping is a process you know like the because this is the very important one that this is the length wise threads which has to be arranged properly generally on the street or a very you know open space it has to be done and it is very tedious and work which is to be done by the hand and of course nowadays there is a lot of mechanized way of doing it. But we always emphasize earlier days and today also in handlooms to be made by hand and this is the set of base length wise and that runs along the length of the fabric. This this where is the length of the fabrics kind of thing, and through which this weft has to be passing through. And that is the basic design of any fabrics. This is the simplest one and of course nowadays with the help of machine very complex fabric design has been you know developed.

So with this I will stop over here and then in the next lecture we will be looking at basically the kinds of looms and how you know what are the various parts of it and the how it functions and we will see in the next lecture. Thank you very much.