Science and Technology of Weft and Warp Knitting
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Module - 3
Lecture - 15
Analysis of a Double Jersey Fabric

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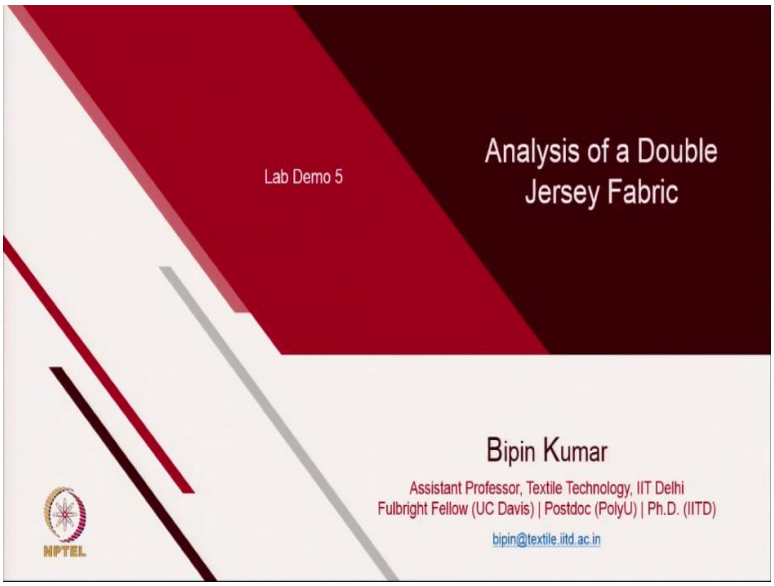

Welcome participants, to lab demo 5. In this particular week, we have already seen technologies related to double beds. Now, let's analyze a simplest fabric, which we create on double bed knitting machine. So, in this particular lecture, I am going to analyze in front of you, on a double jersey fabric structure. So, in double jersey fabric structure, there are lot of varieties are possible.

But I am going to choose just a simple fabric and how this fabric will be different from a single jersey fabric. So, that is the target you will learn in this process. Not only the analysis of fabric, but you will also learn how it is different from a single jersey fabric. So, this fabric is actually having the symbol of 0, cross, 0, cross.

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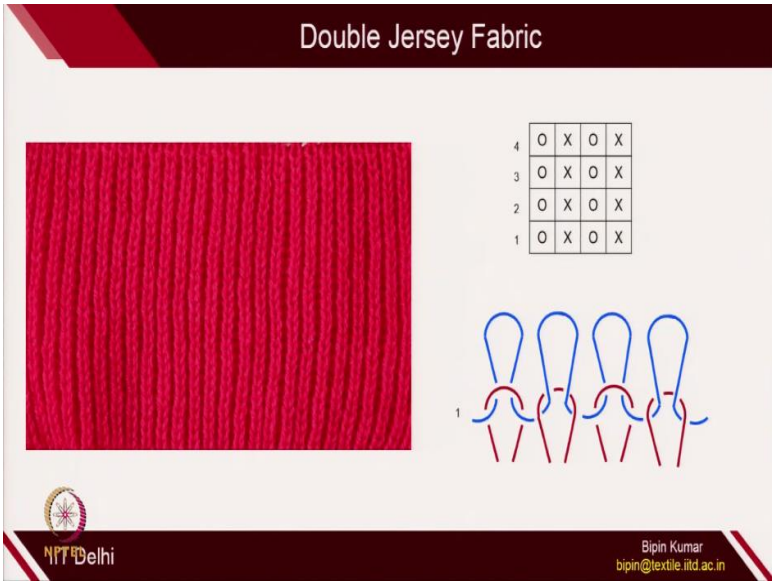

So, basically, along a course, this fabric has technical back and front loops alternatively. So, in the first column, the technical back, then next column, technical front; then back, front. So, along the course, loops are changing from technical back to front alternatively. So, in this particular lecture, we are going to analyze only this particular fabric.

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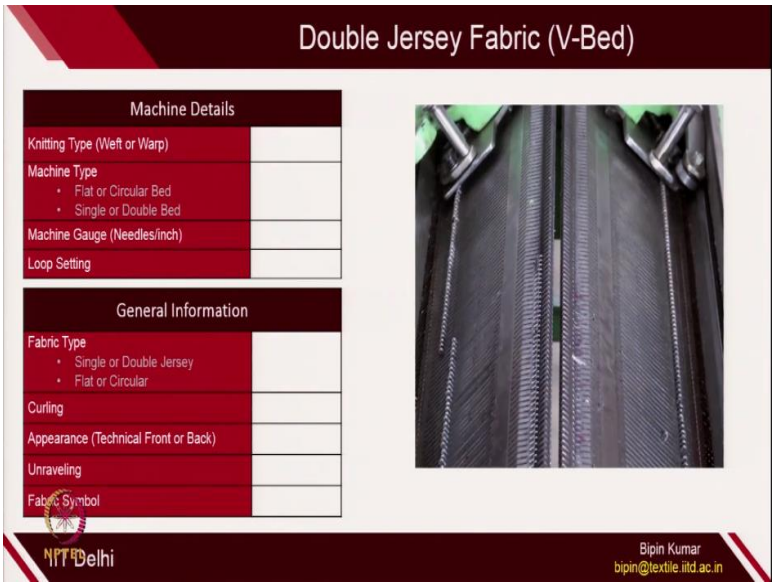

If you analyze any fabric, before you start, you must know the machine details on which this particular fabric is created; especially, what type of machine they are using; what type of knitting they are using; what is the nature of machine; whether it is flat, circular, single bed, double bed; what is the gauge of the machine; what is the setting of the machine, loop setting. So, all of these things, you must know.

Apart from that, the general behavior of the fabric; whether you call this fabric as a single jersey, double jersey; curling; appearance; unravelling; fabric symbol. All of these things, you should be doing in case of fabric analysis. So, we start from the machine details. If you see this particular machine, the fabric is being created on this machine which is nothing but the V-bed machine. So, the demo number 4 was all about the machine demonstration related to V-bed.

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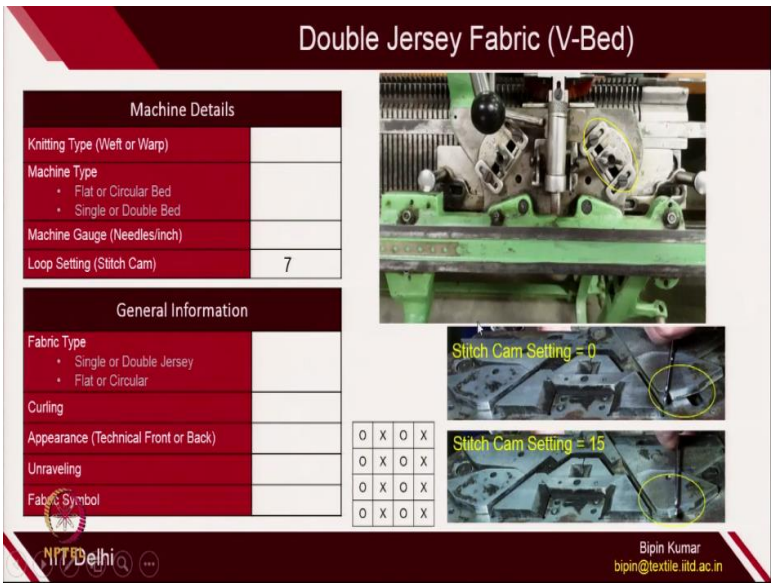

So, in V-bed machine, this is the front view of the cam jacket which was traversing on the machine from left to right and right to left. So, the loop setting is again similar to the knitting in flat bed. The stitch cam setting has to be adjusted, so that you can control the loop length. I hope you remember this. So here, the stitch cam is nothing but, denoted with the, with this circle.

So, this part is the stitch cam. So, if you rotate or if you slide this stitch cam from across this slot, you are basically changing the position of a stitch cam. So, this is the stitch cam, you can see. When this stitch cam is at 0 position, this is the 0 position; this is at the top most. So, the needle will not descend too much. So, in this case, the loop length will be too low, so the size of the loop will be minimum.

But, if you slide this stitch cam to the bottom most position, the stitch cam will reach at this location. So here, the needle butt has to descend too much and carrying the yarn, so that the loop length will increase. So, this cam setting is 15. So, on the machine, you should be

knowing, on when stitch cam setting you are operating the machine. Because, if any of these information is incomplete, you cannot produce consistent fabric.

And analysis will be different. So, my suggestion; whenever you go for doing any analysis and if you are making the fabric by yourself, you must have all these information ready in front of you. So, a stitch cam setting; for example, herein, the stitch cam setting is approximately around 7. So, between 0 to 15 the stitch cam setting is 7.

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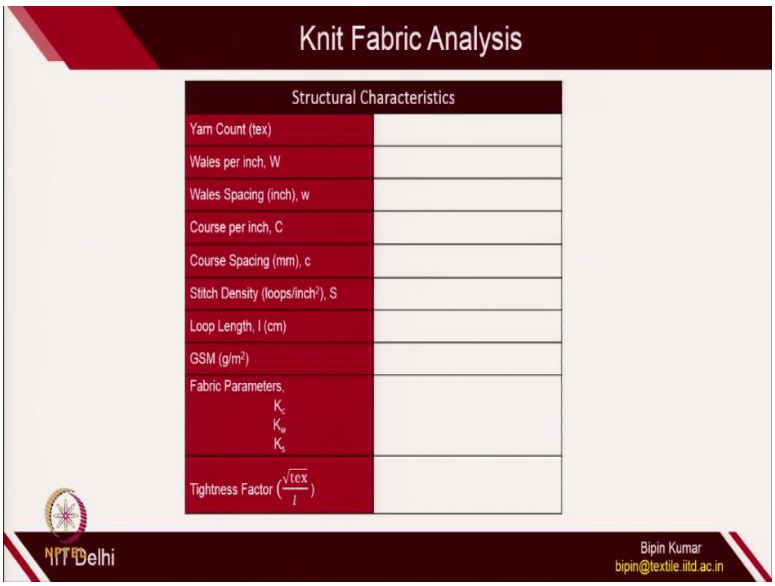

So, after that, you can go for a structural analysis which I am going to show you. And you can make some calculations. It's starting from yarn count, wales per inch, course per inch, stitch density, loop length, GSM, fabric parameters, tightness factors. So, these fabric parameter and tightness factor, I am going to cover in next few weeks. So, for the time being, these 2 parameters are also important.

And I will, going to show you how we calculate these type of parameters. So, let's switch to the fabric. So, in the demo number 1, **(Video Starts: 05:25)** I demonstrated you a single jersey fabric. So, this is the single jersey fabric and this is double jersey fabric. So, you can see, the first difference which you can observe here is, this is curling, this is much more stable from the edges.

So, and obviously I have, in this week also, I have given you sufficient information why this curling was happening; what, how the curling nature was different. So, I am keeping this fabric apart, because we have already done the analysis of this particular fabric. Now, let's

focus on double jersey fabric. So, in this double jersey fabric, you have technical front and back loops alternatively in course direction.

So, for analysis of the fabric, you basically need to have 2 things: scale, pick glass and scissor. And these are the information's which we must need to find out for the fabric. Okay. So, we start one by one. So, if you see this fabric, so the first thing is, what are the knitting type; whether it is a weft knitting or warp knitting. So naturally, we are focusing in on weft knitting technology. So, this is weft knitting. Okay.

Now, the machine type. So, this machine, I have shown you the machine which was used in this particular fabric production. So, this is a flat bed knitting machine. Okay. And, now the next thing about machine type is whether it is a single or double bed category. So, this is a V-bed machine; so, which has a double bed. So, this is made on double bed machine. And the machine was V-bed type. Okay.

So, V-bed. Now, the next thing is machine parameters like gauge; how many needles was present per inch. So, the number of needles which was present/inch was around 8. Okay. So, **8 needles/inch** was present in each of the bed. The pitch: Pitch is nothing but the distance between 2 needles on the bed. So, this will become 1/8. Okay. So, this is in inches. This is in **8 needles/inch**.

So, if you arrange this needles, so 1, 2, 3, 4, 5, 6, 7, 8. So, this is 1 inch. And in 1 inch, you will find 8 needles on the bed. And pitch is nothing but the distance between 2 needles. So, distance between 2 needles. So, if this total distance is 1 inch; so, **distance between 2 needle =1/8 inch**. Now, the loop setting. Just now I showed you; the loop setting was around 7. So, if more loop setting, more loop length; lower loop setting, lower loop length.

Now, the general information about the fabric. So, this was the fabric. If you see, the fabric was actually double jersey category; double jersey. In double jersey also, there are different type of construction: rib, purl and interlock. Which in the next week, I am going to introduce different construction in double jersey. At this moment, this particular fabric is having rib construction.

So, within the double jersey also, it is the rib constructions which we are analyzing. The fabric type: whether it is a flat fabric or circular fabric. So, obviously, the edges are free, it is not bent, it is not a circular fabric. So, naturally, this is a flat category. Curling: If you see the curling; so, the fabric is not curling from any of the edges; no. Appearance: This is most important part. So, if you see the appearance of the fabric; I am going to zoom it.

So, on one side, you can see only the leg part, okay, only the leg part. So, along this column, you can see only the leg are visible. Okay. If you reverse this fabric, if you reverse this fabric and again zoom it, again the nature are same. So, along this column, you can only see the leg part. So, this is the difference in single jersey and double jersey. Mostly, double jersey fabric appearance is same.

And since we are only able to see the leg part, which is nothing but the front side of the loop; so, this is technical front side. So, on both side, we are watching technical front. So, again if you try to see the back side, why back side is not visible. If you extend this fabric, you can see, these 2 columns are not connected, they are separated. So, if you try to extend this fabric, each of these columns along a course are not connected.

So, it means between these 2 columns, the yarn segment is inside. So, since you know the structure of this fabric, between 2 front loops, there is a technical back loops. And this is where this technical back part is there. So, if you zoom it, you would be able to see the curved part of the yarn. So, you can see here, between 2 column, this is the curved part. So, this is nothing but the head and the sinker part of the fabric is visible in between 2 columns.

So, between these 2 columns, head and sinker part is visible of the back side loop. Similarly, when you reverse this fabric; and if you try to extend, again between these 2 columns, the technical back of opposite side loop will be visible. So, these 2, if you see these 2 columns, 1 and 2, these 2 columns are formed on the front side. And between these 2 column, the other loop is formed on the back side.

So, these 2 loops are actually projected towards you. That’s why it is visible. And the back side loops is projected behind this plane. So, which is visible on the other side. So, when you are visiting that back side loops from the other side, that front part will again be visible. So,

this is the reason why the appearance is almost similar in this particular fabric. Again, if you try to see, this fabric is highly highly extensible.

So, if you try to extend, you can see how much you can extend this fabric. So, this is highly elastic fabric. Okay. So, the fabric can be extended. Compared to single jersey, if you see single jersey fabric, it is not that much extensible, because it does not shrink. When you relax this fabric, it does not shrink. But, if you, in case of this particular rib construction, you can, with a very small force, you can see, you can extend easily 100-200%.

So, this is the beauty of this particular fabric. Now, technical front side is okay. Unravelling: So, unravelling means, when you pull the yarn from the edges; so, this is the last course. So, when you are making the fabric; so, fabric will be actually being formed. So, this will be the first course on the machine which is being pulled by the dead weight. And this is the last course which is engaged by the needle.

So, once you take out that fabric, this is the last course which you knit on the machine. This is the first course which you knit on the machine. So, if you try to pull the yarn, all technical front and back loops will be easily unravelled. So, you can, entire fabric can be unravelled, from the top side, okay, from the top side. So, you can see, all these yarns are coming out. So, the loops can be easily unravelled.

But you can see, if you see the end part; so, this is the other side, the free end of the yarn; so, this is the free end of the yarn. So, if you pull it, is not coming out easily. So, from the other side, the loops are not pulling out easily. So, it means; so, the unravelling, last course: yes; first course: no. So, only one side you can unravel from the last course. Fabric symbol: So, the symbol of fabric is again, you can make boxes; cross, 0, cross, 0.

And same course is repeating. So, this is the fabric symbol. So, this is how this fabric basic informations is given. Now, again come to the basic structural part. So, yarn count: If you see this particular yarn, you can measure the distance, you can measure the weight. So, yarn count in tex. Tex is the weight of yarn per 1000 meter of length of the yarn. So, the yarn count is 192. I measured it in the lab.

Wales/inch: To measure the wales per inch, you can put the fabric, you can take out the pick glass. So, in pick glass, this is 1 inch. And you can here put, you can put it and you can count how many loops is visible in that particular length. So, for example here, if you try to count; because this camera is highly zoomed, so you can count very easily. So, 1, 2, 3, 4, 5, 6; and slightly part, because we extended this fabric little bit.

So, number of **wales/inch = 6**. And between these 2 column, if you see, if you extend; between any of these 2 column, additional column are on the back side. Okay. So, between these 2 column, additional column on the back side. So, 1, 2, 3, 4. You can count the those columns. So, all rib lines is actually representing the back side column. So, 1, 2, 3, 4 and 5. So, **6 + 5 = 11 wales/inch.** Okay.

So, between these 2 columns, the additional column is hidden inside on the opposite side. So, you can see here, between these 2, when you are extending it, you can easily see the other columns. So, wales per inch is 11. So, 6, the front loops are visible. And 5 loops are hidden between the front loops, on the opposite side. Wales spacing: Again, this is defined as distance between 2 consecutive wales.

So, **1/11 inch**. So, distance between 2 wales. **Course/inch**: You can count number of courses also. So, if you try to count it, you can count number of courses. You can put it, the fabric in a; so, this is how you put the fabric. Now, you can start counting along one column. So, 1, 2, 3, 4, 5, 6, 7, 8, 9. So, 9 courses is present in 1 inch. So, 9 courses are present in 1 inch; **9 courses/inch.**

Course spacing: Again, distance between 2 consecutive courses, which is nothing but **1/9 inch**. A **stitch density = course per inch * wales per inch**. So, this is nothing but **11*9 = 99 loops/inch^2**. This indicates how many loops are present per unit area. Loop length: To measure the loop length; it's pretty simple. So, what you can do is like, you can start unravelling the yarn from one side to other side.

So, this is the total length of the yarn which you have unravelled. You can measure its length, the entire length and then divide by total number of wales which you count on the fabric. So, if you do so; so, the loop length is actually; the length of the yarn in 1 course was 90

centimeter and total number of columns was actually 72 wales. So, it means, 1.25 centimeter. Okay. Now, GSM: So, you can, this, the fabric is with you.

This is the length, this is the width. You know the area. You measure its weight and you can find out the GSM. So, GSM is nothing but the weight per meter square. So, you know the weight, you know the area, you can find out the weight. So, the weight of the fabric was **373.6 gram/meter^2**. Okay. Some of the parameters: One is Kc. So, Kc is defined as c, l/c.

So, Kc is nothing but loop length which is **1.25 centimeter/c**, the distance between 2 loops is **1/9** inch. So, you can convert it and you can get the result of Kc. Similarly, Kw; so, 1.25 centimeter. Wale spacing is **1/11** inch. So, please note Kc and Kw is dimensionless. So, here also, the unit is length. This is also length unit. So, they will cancel it. So, Kc and Kw is a unitless parameter.

Ks is also, Ks is nothing but, if you see this, **Kc*Kw/l^2** is the stitch length density. So, Ks is nothing but **Ks = Kc*Kw**. You can simply multiply these 2 and you will get it. Tightness factor: You have the square root of tex, which is nothing but $192^{1/2}$. And loop length is nothing but 1.25. And the unit will be **tex$^{1/2}$/centimeter**. This is how tightness factor is denoted.

Now, once this is done, you can compare the experimental GSM which you found 373.6. And this is the theoretical GSM of the fabric. So, just to cross check whether you have, whether every readings are okay or not, you can basically do the theoretical calculations. So, yarn tex was 192. Loop length is 1.25 centimeters. So, you need to convert into a meter; so, 100. And stitch density in loops/meter^2.

So, stitch density is, if you see the stitch density, 99 loops/inch^2. So, **99*1/(2.54 centimeter* 2.54 centimeter).** These are in centimeter. And you can multiply by 100, just to convert it into **loops/meter^2/1000**. So, if you do this, the calculation, you will get 367.8 gram/meter^2. So, if you see this part and if you see this part, we are very much close.

So, hardly **2 - 3 %** difference. So, this is how you do the fabric analysis. So, we have done the fabric analysis of single jersey fabric as well as double jersey fabric. Okay. So, from next week, you will learn how to make different **(Video Ends: 26:24)** fabric samples. So, the

more fabric samples you make, you must have to do these type of analysis for the comparison. So, I hope you understood this particular demo. So, stay tuned. From the next week we are going to start new topic related to fabric design. Thank you.