Evaluation of Textile Materials

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Lecture – 15
Evaluation of Cotton Fibre Properties: (HVI & AFIS)

Hello everyone we will continue with testing of fibre parameters. In last few classes, we have discussed about the measurement of fibre length and the distribution of fibre length. We have discussed the measurement techniques of fibre fineness and also in last class we have discussed the maturity. Now we will continue with the measurement techniques of fibre and this technique are at present what we will discuss, the two commercial instruments, where only cotton fibres are used.

And these instruments are not for a single parameter. In this instrument we measure the large number of combined parameters, large number of parameters, ok. And this are very fast it is not slow, it is a large volume of fibres can be tested. These two equipments are it is a, combination of test methods, combination of parameters are testing. This is one is HVI, High Volume Instrument and f AFIS, Advance Fibre Information System. Both these instruments are physically used for cotton fibre testing.

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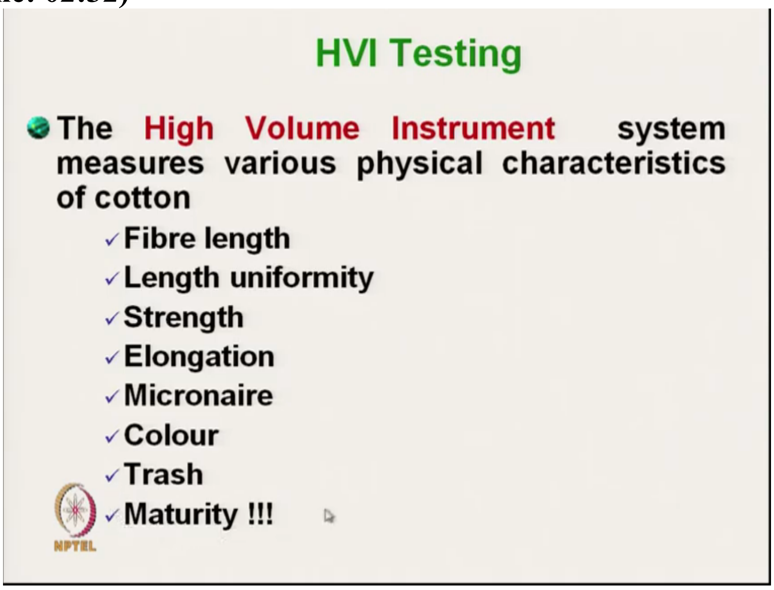

Now first we will discuss about the High Volume Instrument testing. This High Volume Instrument System measures various physical characteristics of cotton fibre. Last segment what we have discussed, like for measurement of fibre characteristics a particular technique used for a measurement of particular characteristics ok. But here in High Volume Instrument, it is a combination of instruments which keeps at overall characteristics. It is not a single instrument. It is a total system. That is why we call it as High Volume Instrument System ok.

This is a combination of systems where we take the principle of earlier method like for example in HVI, we test the fibre length exactly same as that fibrogram. Similarly the fibre fineness we measure here, exactly same as the air flow method. So, that way it is a combination. So in High Volume Instrument, we test fibre length, length uniformity, so fibre length and length uniformity we measure by fibrogram method.

Strength, it is a bundle strength we measure here. Strength and Elongation in bundle form. Micronaire we measure. Colour can be measured here and Trash percent, trash content can be measured and even maturity can be measured ok. So, all these parameters are measured here and the advantage of HVI it is a very fast method, ok. It is a quick method so that large volume of fibre can be tested.

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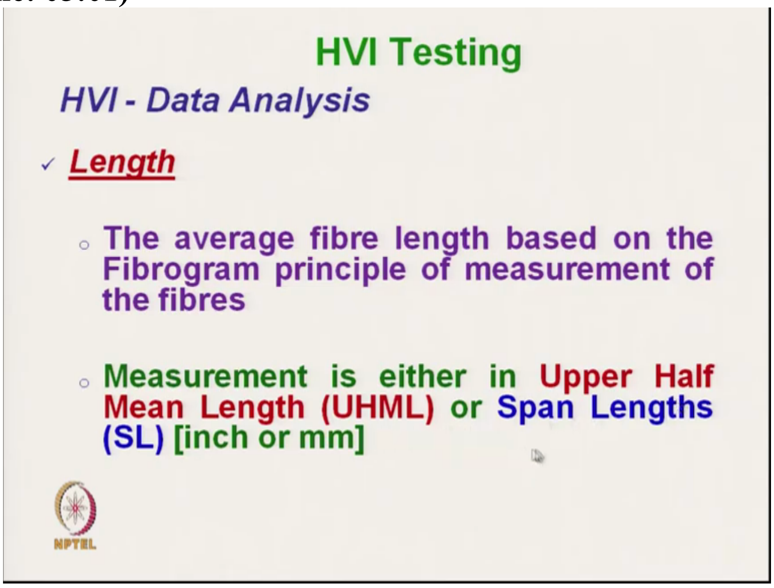

Now the length, the measurement technique we are not going to discuss here, because it is exactly same that we have discussed in fibrogram. Now length data that is the average fibre length based on the fibrogram principle of measurement of fibres ok, this is the same principle. Here also we measure the Upper Half Mean Length and Span Length.

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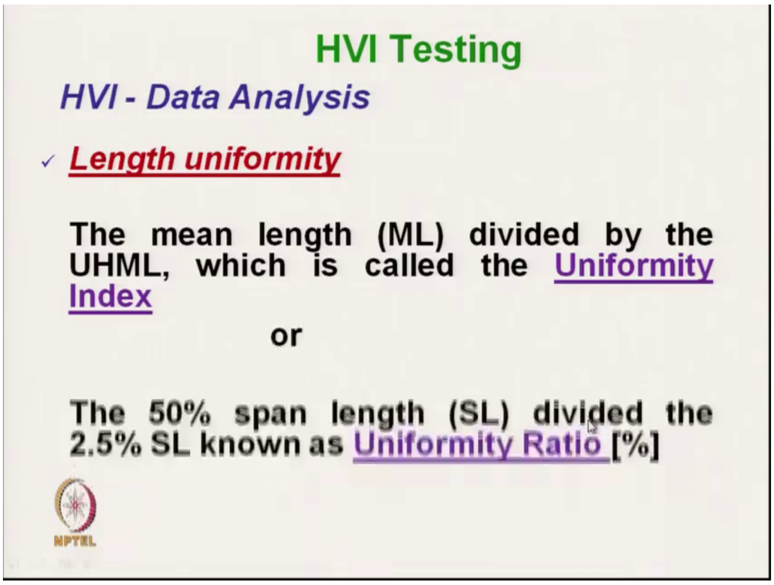

The Mean Length of fibre divided by the Upper Half Mean Length we get the Uniformity index or the Uniformity ratio we can measure this things are exactly same as the that we have discussed earlier.

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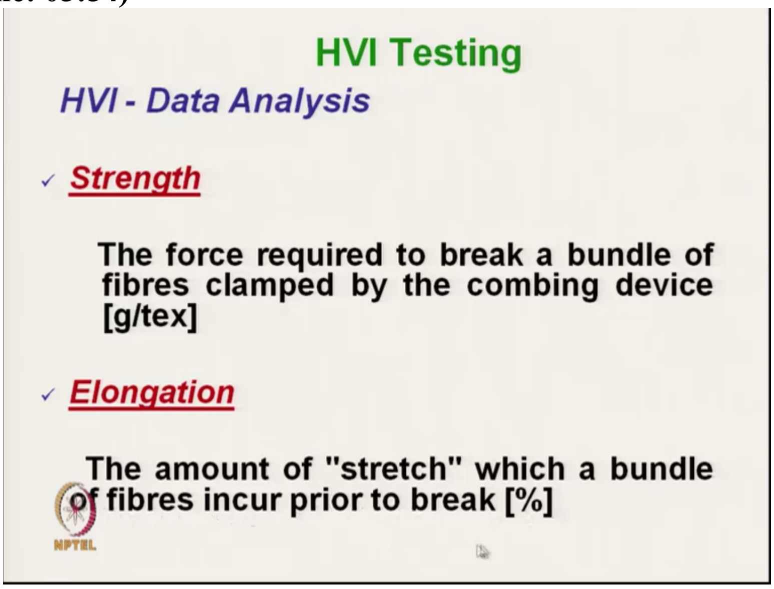

Strength is measured in the, that is a; is the force required to break the bundle of fibres clamped by the combing device. So the same plan is used which is used for fibre length designer ok the same strength here only the fibre is broken and the force required is measured, ok. We are measuring the breaking force and taking the mass of the fibre. We have to take the mass of the fibre bundle. And elongation is measured; the amount of stretch which is which a bundle of fibre incurs prior to break so before breaking the amount of stretch is measured ok.

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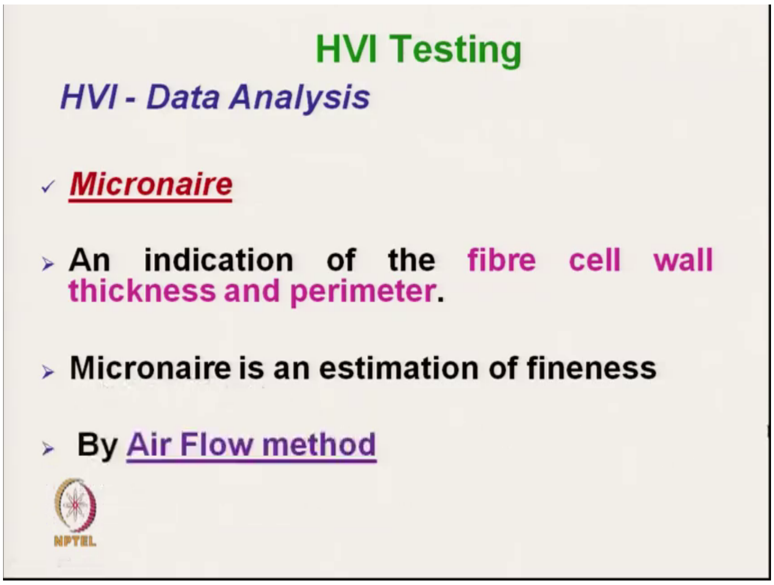

Then micronaire, an indicator of the fibre cell wall thickening and parameter ok. So, that is the micronaire value which is actually been indirectly it says that it indirectly measures the; that is maturity also. That is the why here only it measures the micronaire but it says that it indicates the maturity of fibre also. And micronaire and estimation of fibre fineness it follows the air flow method.

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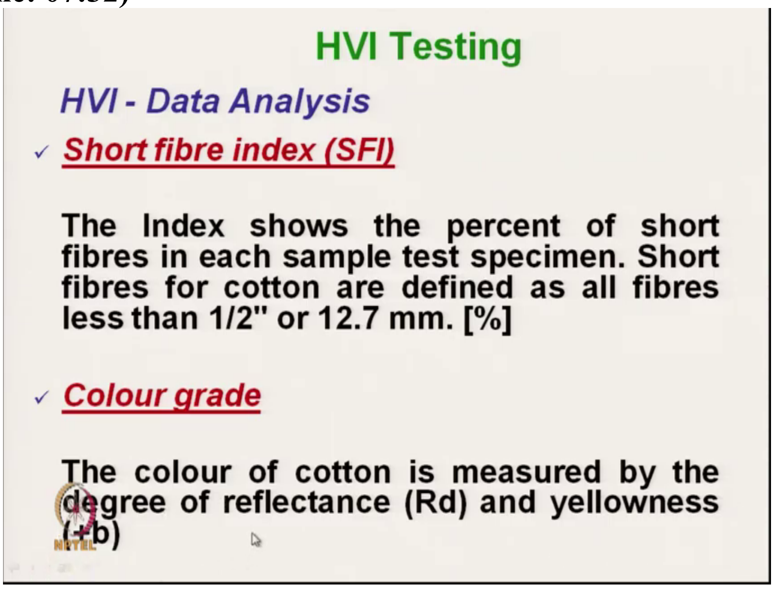

Short fibre index, and this is the index shows that the percent of short fibre in each sample tested, test specimen. Short fibres for cotton are defined as the fibres all the fibres less than 1/2 inch ok or 12.7 mm. So, after this fibre length test, one can get the short fibre percent. So that is all fibre by less than 1/2 inch that we have already discussed. And HVI can also measure the colour grading ok. Colour grading is the in terms of 2 parameter, one is the reflectance and yellowness ok.

That actually colourness, colour grading is important, because it depends on the depending on the colour grading the price also changes. It also shows the, to some extent the quality the overall characteristic of cotton. And how what will be the actually ultimate fabric characteristic fabric colour it shows.

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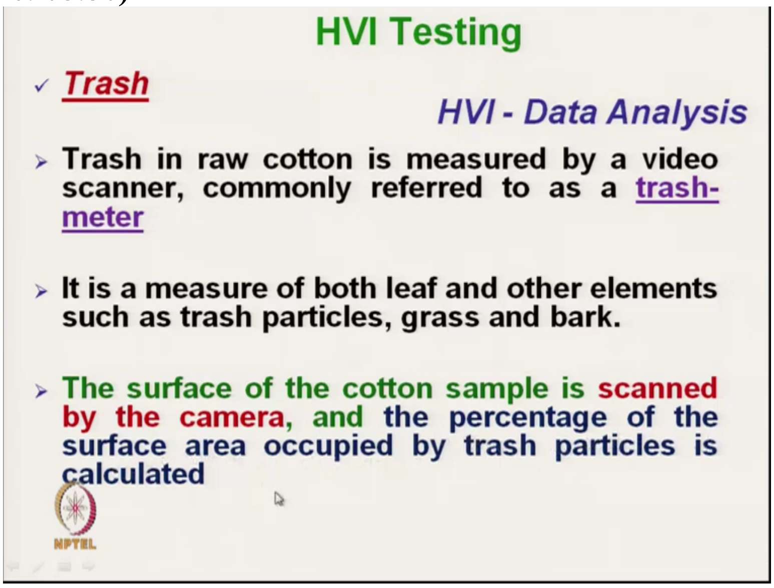

Another parameter which it measures is the trash content and here trash content is measured by video scanner, because that fibre, raw cotton fibre, the video scanner, actually it measures the, area covered by the trash. The trash in raw cotton is measured by the video scanner, commonly referred to as a trash meter. Trash meter is nothing but video scanner where it sends the presence of any foreign particle, ok.

It measures both leaf and other elements such as trash particles, grass, bark anything. Other than cotton it measures the actual area percent as compared to the total area of the fibre. The surface of cotton sample is scanned, so any material any trash present inside the fibre mass will not be actually measured here. But, here the assumption is that, the trash particles are evenly distributed ok. The surface of cotton sample is scanned by the scanner, by the camera and the percentage of the surface area occupied by the trash is calculated.

So, if we know the area, total and then you add the total area of the trash particles or foreign particles and compared with the total area and then we can calculate the trash particle. From all this data, all the trash, length, scanned data we can predict the spinning consistency index.

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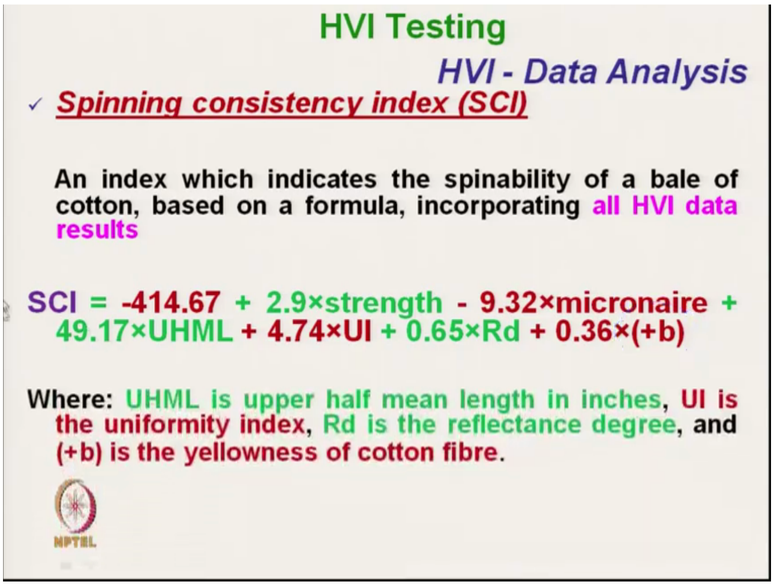

And here an index which indicate the spinability of cotton, based on the formula incorporated ok with all the HVI data, so it incorporates all the HVI data so that and this the formula this equation, empirical equation has been developed based on, the large number of data ok. Now this is the spinning consistency index, the higher value, source, the better spin ability, that means we can see the strength is in the positive side that means if strength increases the spinning consistency index may increase.

That means spinability of the particular fibre will be better for if it is stronger ok, then if the fibre is coarser, that means micronaire value is more, the spinability will be poor. So that means; that is why it is in the lower side, ok the minus, negative sign. So spinability is indirectly it is negatively affected by the micronaire value. Then Upper Half Mean Length is a positive impact so, we can see the impact of length is maximum.

As far as spinability is concerned, spinning consistency index is present. Its co efficient is point 49.1 very high co efficient. So, that from there from here we can actually get the impact ok then Uniformity Index. So it has got positive effect we need higher uniformity index then Rd value and then you measure. And this from this we can if we know all this so this instrument, measure after measuring, recording all the data. And automatically calculate the spinning consistency here and to so the spinability of the fibre.

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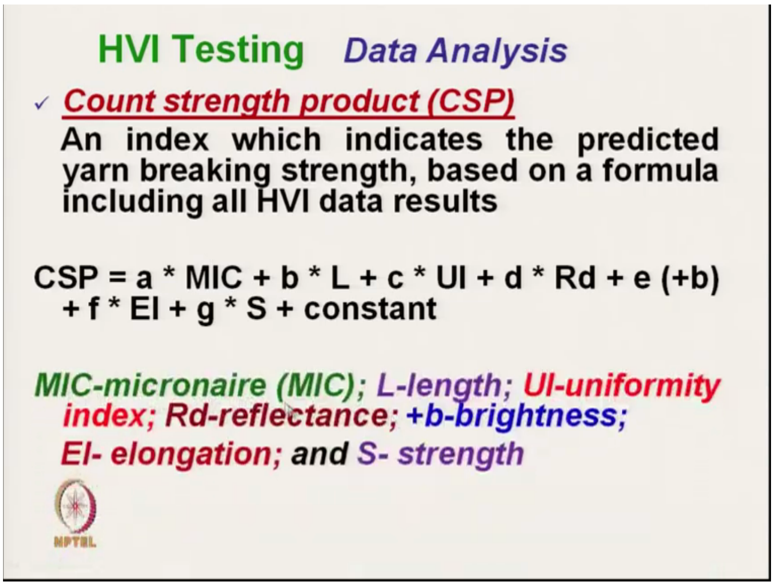

These are the values. And also it can predict the CSP from the fibre ok. The Count Strength Product can be predicted here, an index which indicates the predicted yarn breaking strength, based on the formula using the HVI values. So HVI value if we take, all the HVI value, that micronaire, this strength, every, everything if we take, we can get the CSP value, ok. So, MIC is Micronaire value, Length, Uniformity index, Reflectance, Brightness, Elongation, Strength,

If we take and if a, b, c, d, e, f, g, h, g all these things are the co efficients. So one can actually for a particular type of fibre, particular and CSP here a, b, c these co efficients are not fixed, because this CSP also depends on the on twist or different or machine type of machine, and all this. So for a particular industry, when they are using this HVI data, and they are getting the CSP they can actually develop this equation for a; for their particular machine, ok.

This, a, b this co efficient are dependent on the machine condition, the type of twist level and all that ok.

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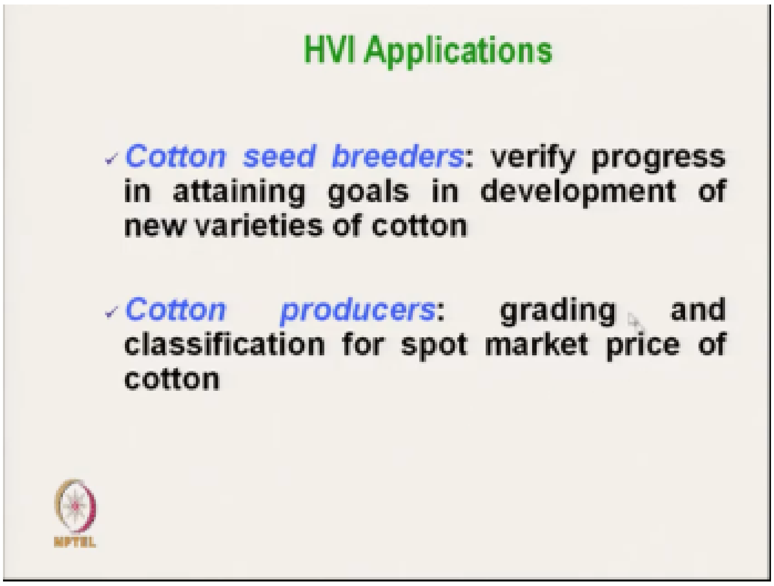

Now the application, what are the applications of HVI data, who are the people who use the, this data? The cotton seed breeder, ok. How do they use? Verify the progress in attaining the goals in developing of new variety of cotton. In the cotton research that they use, so they develop cotton and then they measure ok. Cotton producer to know the grading of cotton, what is the grading and the they can get the market price.

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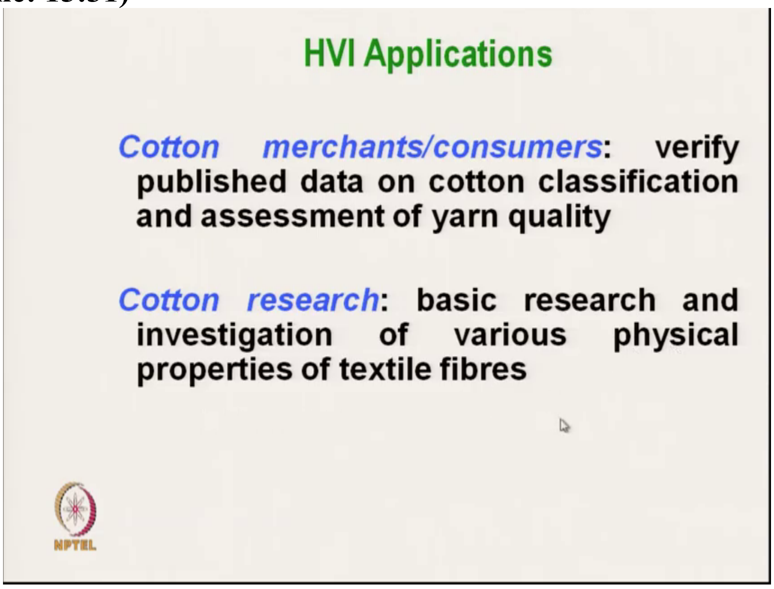

Cotton merchant and consumer obviously they would know would like to know the cotton, classification of cotton they would like to know the quality of cotton and to access the yarn quality. And cotton research, basic research and investigation of various physical properties of textile fibre and can measure, ok.

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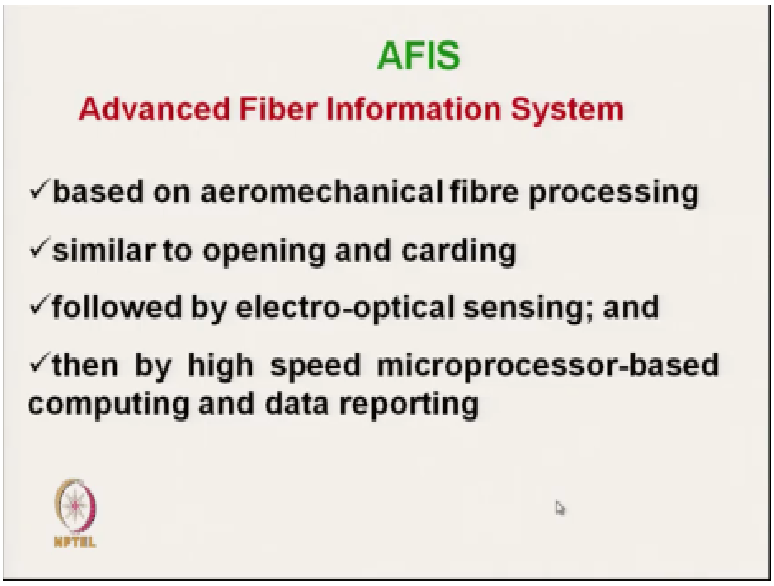

Now coming to the next, set of instrument which is AFIS, Advance Fibre Information System ok. This advance fibre information system is that, is the, it is based on aero mechanical fibre processing. What is aero mechanical fibre processing? It is just like a carding ok. We take the fibre mass and by, it is carding, it opens the fibre. It individualise the fibre. And then the individual fibre are transported trans means transported through a sensing device ok.

Similar to opening and carding, followed by electro optical sensing and then by high speed micro processor based computing and data reporting. So, after sensing all the data are that that computed and then reported.

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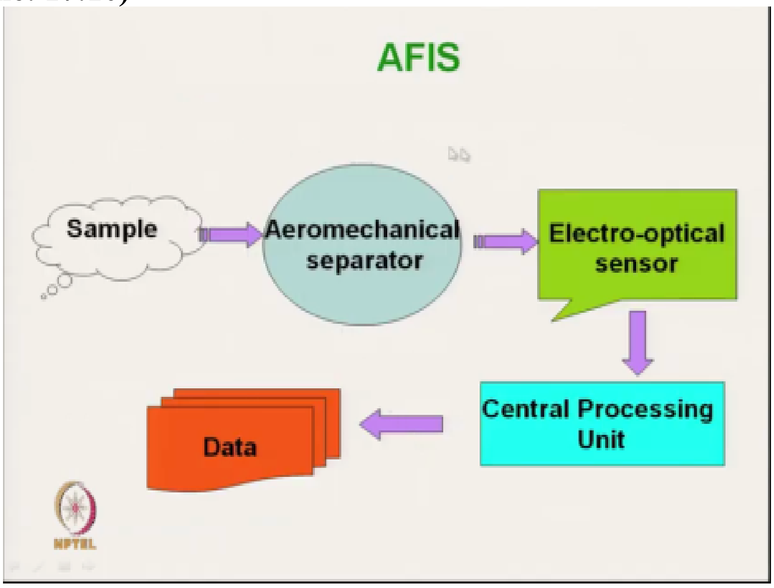

This is the schematic diagram, the sample then aero mechanical separator that is; that it; then, electro optical sensor, central processing unit then it is the data. So, this is the typical process.

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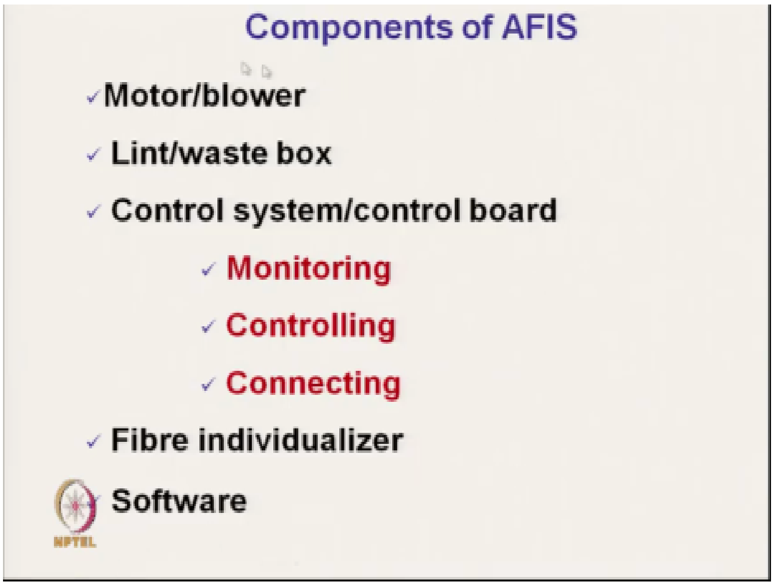

And the components are motor or blower, lint/waste box, control system/control board, it is monitor, monitoring, controlling and connecting. Then it is the Fibre individualiser. The fibre individualise the fibre. And we need software. These are the different components.

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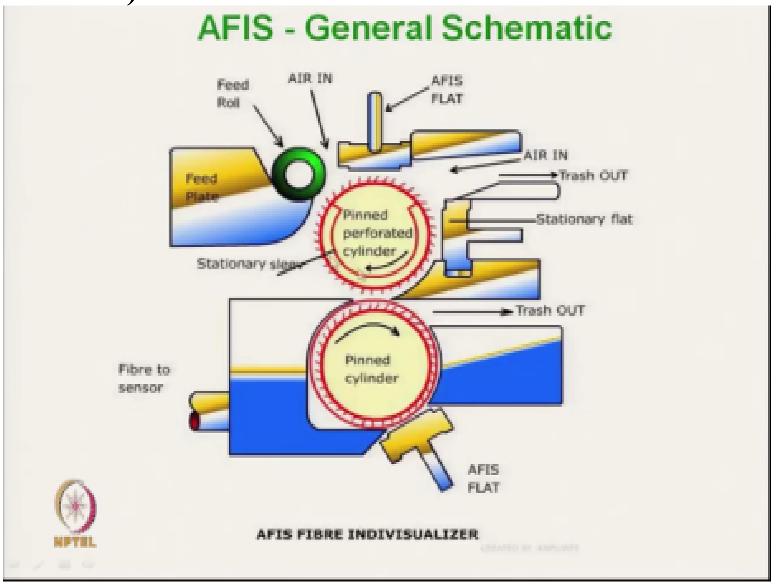

This is the basic schematic diagram, ok general schematic diagram; here the fibre is feed here ok. That is normal like carding we feed, this is the feed roller and feed plate, the fibre is feed here. And here it is the feed perforated cylinder, which actually opens the fibre, against the flat ok, AFIS flat. So, against this flat the fibre gets individualised. These are the stationery flats, ok. The individual flat, individual fibre, are carried away by the; this pinned cylinder.

And from here, it is transmitted to the; another cylinder, open fibre individual fibre. There is a stripy action is there. This is transferred to the pinned cylinder, another pinned cylinder, and from there fibre is passing to the sensor. Individual fibres are passing to the sensor and trash particles are separated this trash particles are separated, the fibres, the individual fibres are remaining. We are not talking about the large number of cluster of fibre, with high volume instrument deals with that.

High volume instrument the difference here is that, in high volume instrument we deal with the cluster of fibre at a time. Be it in fibre length, fibre micronaire, fibre whatever may be, but here it measures the individual fibre. That is why using the pinned cylinder fibres gets individualised. Then fibre one by one fibre goes to the sensor. And the trash is totally separated here ok.

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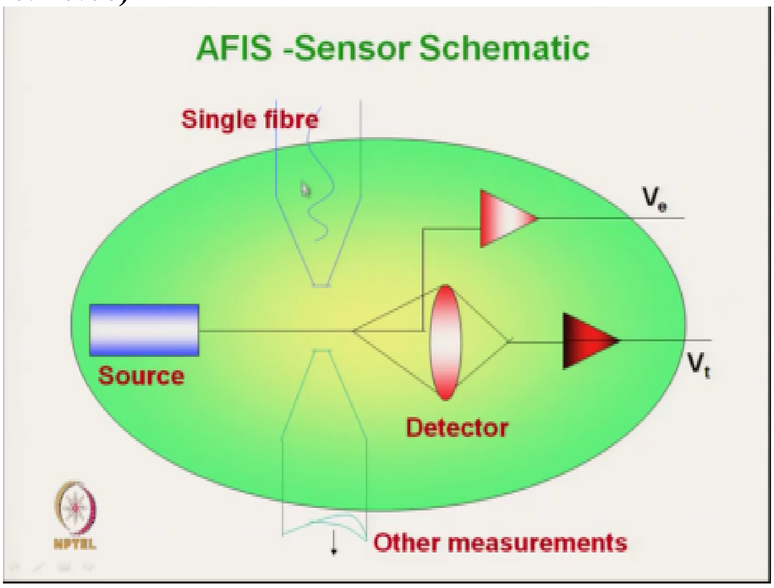

And this is the fibre sensor. From the sensor, single fibre is from that equipment, from the pinned cylinder, this single fibre is coming. Now here it is a source light. And it detects the total fibre characteristics. Fibre length, if we know the speed of flow, and time required to cross this line, then it is basically we can calculate the length. And the direction of flow in such a fashion, it, fibres will flow in a straight line.

And that is why this is the conical method, where tube which actually institute the straightening fibre. This is similar to that transport tube in a in rotorspill, ok. This is so this fibre moves in straight fashion and here the light scattering technique is used to measure, the diameter and also the shape of the fibre. And the time required and if we know the speed of the fibre, and time required to cross the line, it will give us the idea of fibre length ok considering the fibres are not the acquaint.

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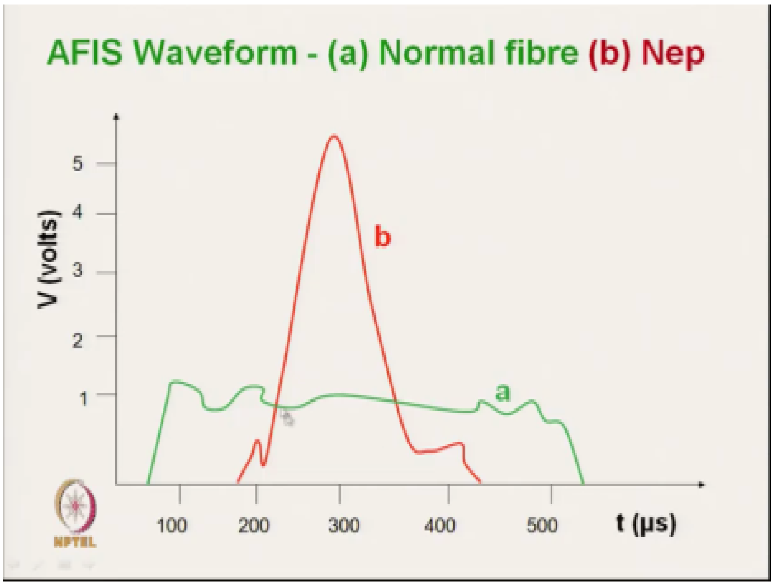

And we get the AFIS and this is the normal fibre ok this is the normal fibre that we have formed and if the fibre are in the nep form, we get this type of peak. So, we can get also in the AFIS the nep content ok, not the number of this type of peak gives the nep content ok and this is the, so we can easily separate out the normal fibre along with the nep. And also as it is the light principle here we can also calculate the diameter of nep.

So, AFIS nep data analysis is very exhaustic. From there one can get. So once it is tested, data all the data are recorded so one can easily analyse the data.

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AFIS - *Nep data analysis*

Term	Definition	Application
Neps	Fibre entanglements	Causes imperfections in yarn and fabric
Nep Count	Number of neps in one gram of material	Quality level

Now, AFIS data analysis is very important. Now we will see the individual data remittance how the data is analysed, now, the neps, what is that, definition is that, it is the fibre entanglements, so as per the AFIS, whatever entanglement is there, it will termed as nep ok irrespective of the definition of nep for other part, it will trans it will actual term the classify the fibre as the nep if it is entangled, any entangled. And it causes imperfection of yarn and fabric.

So, we will get idea about the level of imperfection in the yarn from the fibre data ok. Nep count, number of neps in one gram of material, if we test the, if we know the number, amount of material, so then we can calculate the nep count. So it measures the number of nep ok, quality level.

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AFIS - *Nep data analysis*

Term	*Definition*	*Application*
Nep size	Nep "average" diameter in microns	Determines impact on yarn and fabric
Count/ Gram CV%	Coefficient of variation between sample repetitions	Determines the number of repetitions necessary for good statistics

Nep size, so it measures the size of nep also. So nep, average diameter in microns. So it measures the size of nep and determines the impact on yarn and fabric. So if we know the size of the nep, so it can we can predict the what will be its impact on the appearance of yarn or in fabric ok. Count of variation or co efficient of variation between the samples. So that CV percent of nep we can measure.

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AFIS - *Nep data analysis*

Term	*Definition*	*Application*
Nep removal efficiency	(In-Out)/ In x 100%	Equipment evaluation and comparison

And from there we can calculate nep removal efficiency. So if we take suppose in carding or any method, before carding and after carding if we measure, so input minus output divided by input multiplied by 100, it gives the idea about the nep removal efficiency. So just we can try to see here, only if we get the nep data, we are able to get so many parameter ok and we can predict, the actual appearance of actual, quality of the final product.

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AFIS - Length and Diameter data analysis

Term	Definition	Application
L (w)	Mean length by weight	Comparable to HVI 50% Span Length
L (w) CV%	Coefficient of variation for length by weight distribution	Spinning performance and yarn quality
SFC % (w)	Short Fibre Content % by weight less than 1/2 inch	Comparable to HVI SFI

Similarly because see, the length and diameter data, nep is separately measured because of the signal, ok now length and diameter they are measured simultaneously, because when fibre is moving straight way, in that case length we can measure, length is the in terms of mass we can measure, because we know the, what is the mass we have feed in the machine, because nothing is getting well versed.

So in terms of mass, the mean length by weight, if we know the mass and if we know the individual fibre length, so it is a it is comparable with HVI 50% span length, that we can compare, that is mean length by weight. Then we have the fibre length of individual fibre, length of fibre. Then we can measure the CV percent. CV percent of fibre length but CV percent of fibre length we cannot measure in other technique, because other technique we can measure the variability in other ways, that we have seen, uniformity index, uniformity ratio.

But here, as we have got individual fibre length, we can calculate the co efficient of variation of fibre, by weight distribution ok. This is actually; we can predict the spinning performance of and the yarn quality. ok. And also as we have the number length of the individual fibre, we can also calculate the short fibre, the fibre in the on the weight basis, the length which is less than 1/2 inch. So, we can do the, this is comparable with the short fibre index of the HVI.

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AFIS - Length and Diameter data analysis

Term	Definition	Application
UQL (w)	Upper quartile length by weight; Longest 25% of the fibres	Comparable to HVI UHML, Staple and 2.5% Span Length
L (n)	Mean length by number	Monitor fibre length in spinning
L (n) CV%	Coefficient of variation for length distribution	Control of fibre variation in carding and drawing

Upper quartile length, because we have the fibre length, so we can measure the upper quartile length, it is a top 25%, mean length we can measure, we can measure the calculate the mean length and co efficient of variation also, ok and this is in the terms of number. Here important is that, in AFIS we measure the individual fibre, so that means number is there. We can calculate on the basis of number.

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AFIS - Length and Diameter data analysis

Term	Definition	Application
SFC %(n)	Short fibre content % by number less than 1/2 inch	Control fibre damage in opening, carding and combing
5%(n)	Longest 5% of the fibre lengths	Machine settings
1 %(n)	Longest 1 % of the fibre lengths	Machine settings

Short fibre content in number in terms of; and 5% in number and 1% in number also, this is important for machine settings. It is 5% longest 5% of fibre length by number and longest 1% of fibre length by number. So, this will give us the idea about the machine settings. We can get the help with the using the fibre length, So, we can use either 1% or 5% for machine settings. Then,

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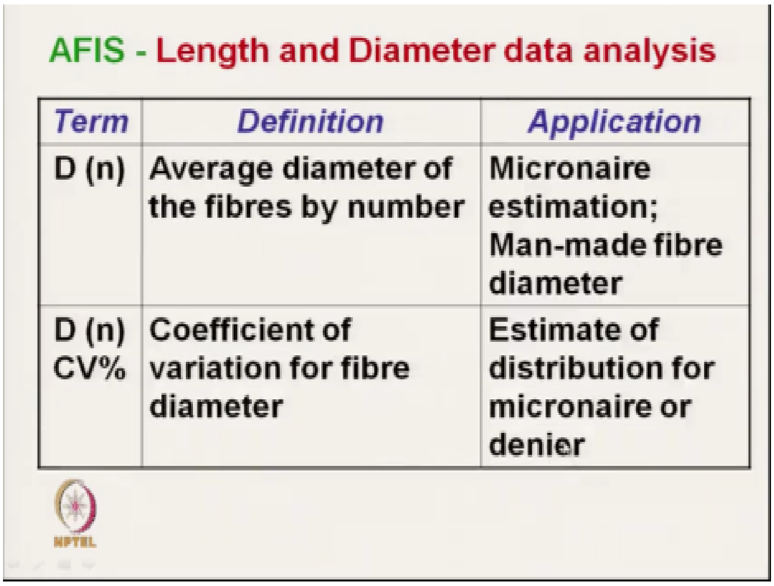

Term	Definition	Application
D (n)	Average diameter of the fibres by number	Micronaire estimation; Man-made fibre diameter
D (n) CV%	Coefficient of variation for fibre diameter	Estimate of distribution for micronaire or denier

Coming to the diameter, so as we can scan the fibre, total fibre, the length as well as diameter can also used. Diameter of individual point not the individual fibre, individual point is recorded, ok. Average diameter of the fibre by number can be measured if we know the diameter. So mean diameter can be micronaire estimation, here we do not measure micronaire. We measure directly the diameter, because it is a light scattering, light's principle. And co efficient of variation in diameter, we have the individual data, and then we can measure the co efficient of variation. It estimates distribution for micronaire or denier ok. That is all.

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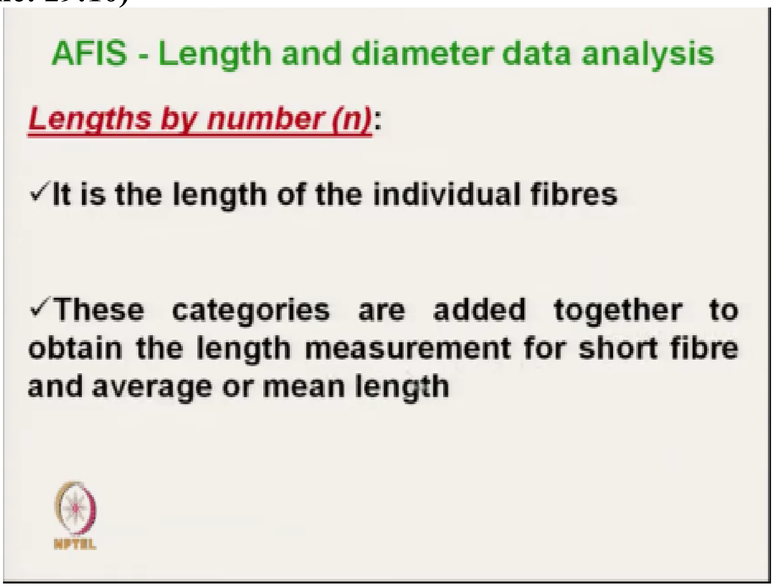

And length by number, it is the length of individual fibres. These categories are added together, ok, to obtain the length measured for short fibre and average or mean length. So, that we have the individual data,

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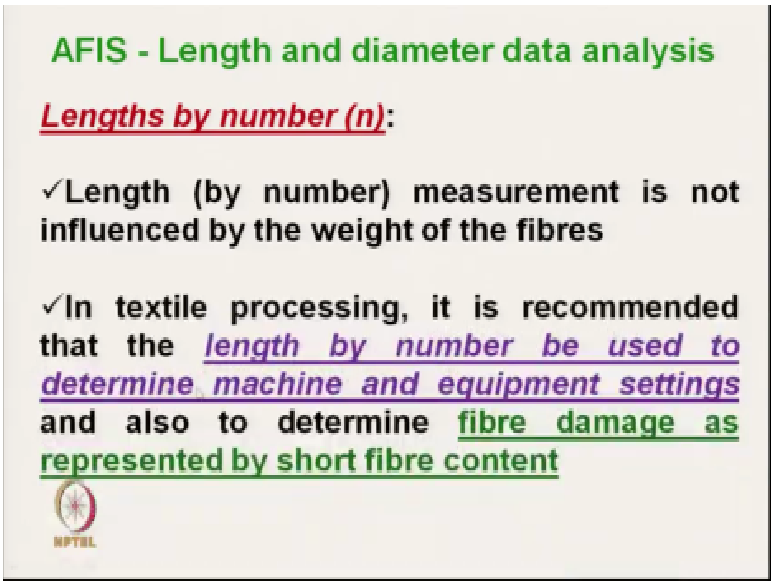

Length by number measurement is not influenced by the weight, ok. Weight, it is not influenced because it is a individual data, as individual number is there. In textile processing it is recommended that the length by number be used to determine the machine and equipment settings that are why we have actually seen here, for equipment setting it is 1% by number, 5% by number. It is not by the mass, 1% by weight, 5% by weight is not used also to determine the fibre damage, as representation of short fibre percent.

So, if you want to measure the fibre damage, it should not be by mass. It should be by number, ok. The, for 100 fibre how many fibres are have got damaged, because if the diameter changes, then the mass will get complex, ok. So that is why we must get idea about the number, because AFIS they measure in terms of actual individual fibre.

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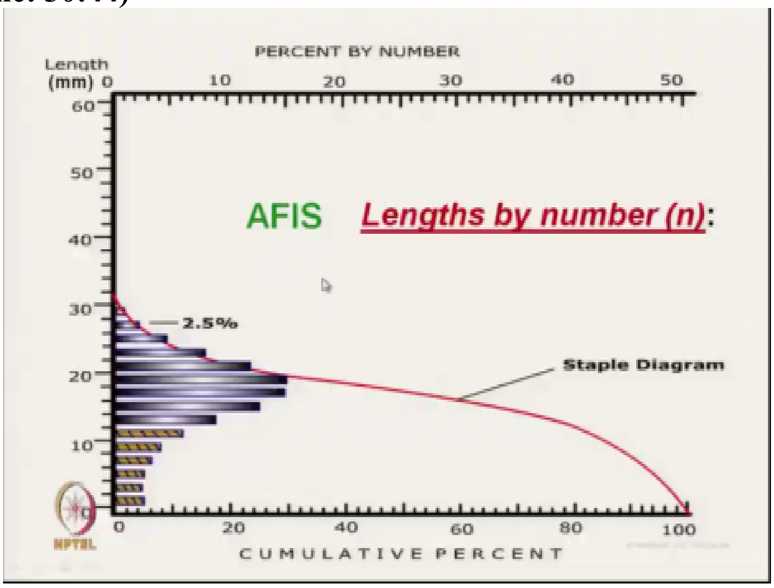

This is the length data. This is a by number, length by number. So in y axis it is a length, and X axis it is a cumulative frequency. So suppose in this picture, 30 mm length cumulative frequency is this, ok, like 28, 20 mm cumulative frequency you say this is a 25% like that. This is the cumulative frequency. Now, from this cumulative frequency, one can easily form the staple diagram. If you know the number of fibre for a particular length, then this is the what about this is the; this staple diagram.

Staple diagram is nothing but the number of fibres in a particular length, which is arranged in from the descending order. That is why. Here all the individual fibre lengths are available. That is why it keeps it can predict the staple diagram also, which is not possible in fibrogram or HVI. Because HVI and fibrogram we do not get the exact length, actual length of the fibre. Here individual length of the fibre is there, that is why we get.

And from there we can also analyse the fibrogram, diagram ok, staple diagram ok, so if it is asked which instrument about AFIS or HVI gives the idea about the staple diagram? It is the AFIS ok, because we get the individual length.

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AFIS -*Trash data analysis*

Term	*Definition*	*Application*
Total count	All particles counted	Overall trash levels by the optical sensor
Trash count	All particles larger than 500 microns	Cleaning analyses and efficiencies
Dust count	All particles less than 500 microns	Dust removal analysis

Now Trash data analysis; so here one sensor measures the fibre length, fibre characteristics and there is another sensor which actually counts the trash particles. So the trash is separated in other direction. Total count, so individual trash is counted. When trash is getting separated, number of trash, all particles are counted overall trash level by optical sensor ok. Trash count, all particles larger than 500 microns, so total count is total number of trash and trash count is actually it is all trash particles. It is a more than 500 microns.

Here the trash is divided into two distinct way, one is larger particle are known as trash and another particle which is dust ok. Trash because larger particles always have a tendency to remain in the with the material. But dust gets separated. So, dust particles are defined as the particles, all the particles less than 500 microns diameter. This is dust analysis, dust removal analysis and count ok.

And Total foreign matter, ok. Calculation of total foreign matter ok and size, average size of all particles in microns. So that, if we can measure in light principle, light, then we can photoelectric also, then we can measure the size also. So here it keeps the total idea. But in a day in HVI or other methods, those measure the trash on the surface ok. But in AFIS method, it measures the individual trash. Actual number of trash can be calculated because, fibres are totally individualised.

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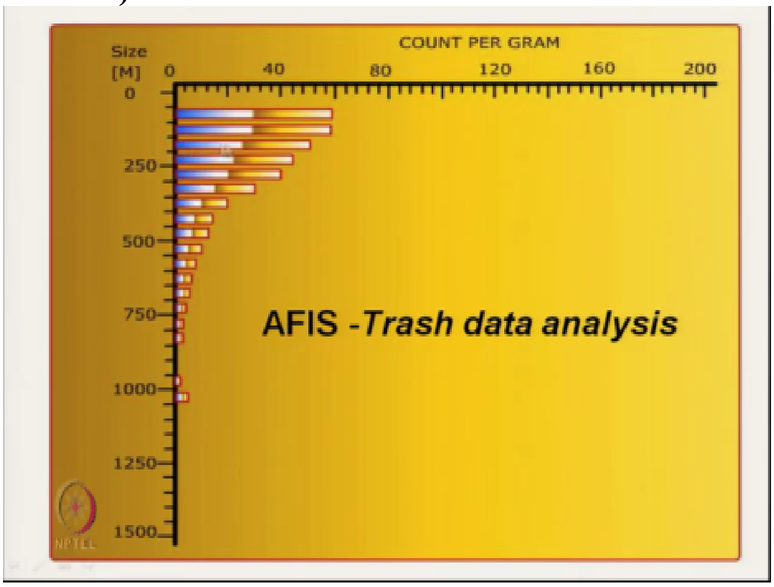

And this is the trash data analysis. Individual trash so we can get with this card, we can get idea about the distribution of trash of how different size, we can take action on that.

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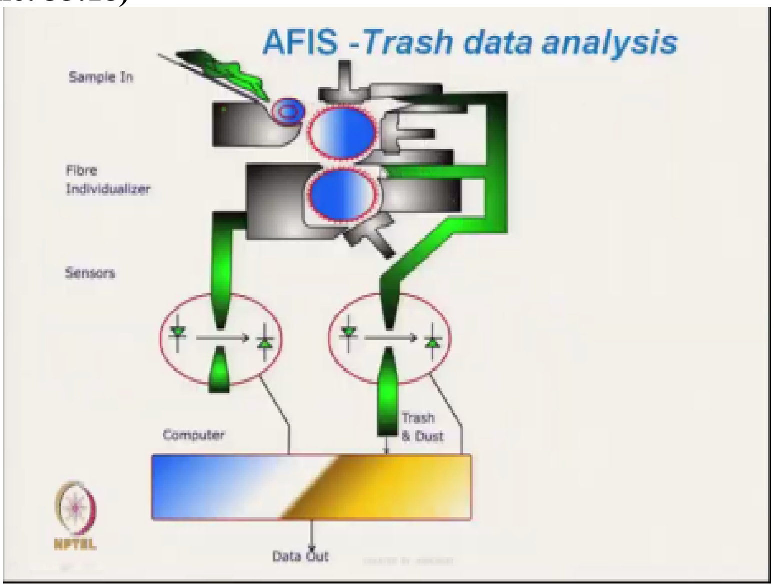

And this is the trash data analysis. So here the trash counter, trash and dust are coming. This is the; this sensor is for fibre. The two different sensors and trash is getting separated from here and from this portion. And they are transported through this pipe, and again this is the sensor, trash counter is there, ok.

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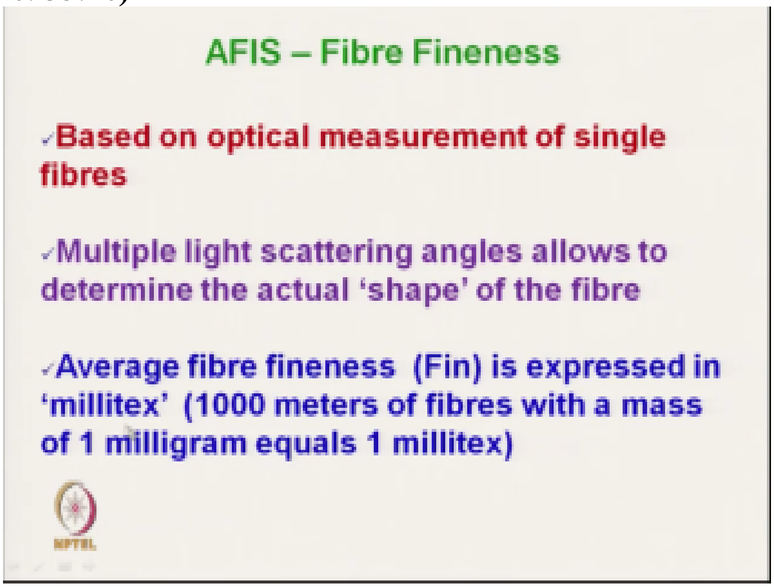

AFIS fibre fineness is again based on the optical measurement of single fibre, that is the diameter and multiple light scattering angles is allowed to determine the actual shape that we have already discussed. Actual shape can be measured and if we know the actual shape, then we can measure the degree of thickening. The average fibre fineness (Fin) is expressed in terms of millitex, it is the 1000 metres of fibres with a mass of 1 milligram that is called, one millitex ok. So, if we can measure the mass, then we can measure the fibre fineness.

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And in the textile industry, the following classifications are measured, less than 125 millitex it is very fine, like that, ok and more than 250 it is very coarse, So it measures the fibre fineness. And now we will end this session, Thank you.