Evaluation of Textile Materials
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Module No.#01
Lecture No. # 03
Sampling Methods and Sample Size

Hello everyone. So we will start the next segment of the course Evaluation of the Textile Materials which is that first segment it is a Sampling method and Sample size. In this session, we must understand that what is sampling? What is sample? And why do we want sampling?

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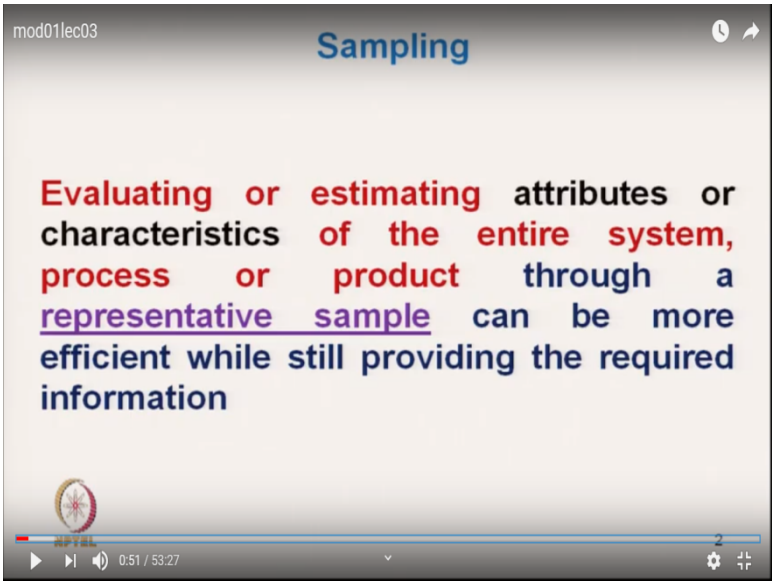

So evaluating or estimating attributes or characteristics of the entire system process or product through a representative sample the term which is important is representative sample can be more efficient while still providing the required information. Suppose we have a huge quantity of a yarn, say, yarn lakhs of bobbin 1000's of ring bobbins are there. And if we want to test all the bobbins total material for say it is count it is strength.

It is not feasible. So we have to select the representative sample to evaluate any attributes. And this if we can sample properly scientifically, this will give sufficient information and which will be actually useful.

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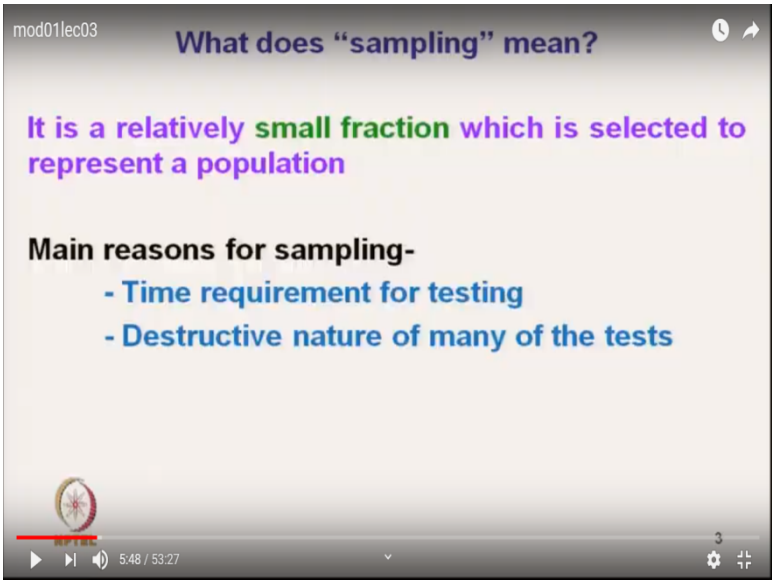

So, the question is that what does sampling mean? So it is a relatively small fraction of material, which is selected from the respective population. And the selection is not random. There are certain processes of selection so main reason of sampling, so why do we need sampling? We can go for testing of whole material if I have one product, one item. I will go for testing. Okay.

This is, I will test everything. I will try to test everything. But then why do we need sampling? Sampling is required because we do not have a small quantity of sampling. We have huge quantity of sampling, large quantity of sampling. Population is a large quantity. So if we want to test the tot entire population, then it requires time. And we do not have time. We need the result immediately.

For example if you want to know the evenness of yarn say 30's count yarn cotton yarn, which has been produced in particular factory of say 1 lakhs spindle. So per day it is producing say more than 1 lakhs bobbin this type of bobbin. And if you want to test the entire population then it will be time consuming. So we cannot get result immediately. So we want result immediately. So we cannot test the entire population.

So we have to take the small fraction of that. So time it is related with the cost. So when it requires manpower it requires everything, the instrument the number of instrument, power, everything, so it is cost is enhanced. Next reason is that most of the textile materials or testing are the destructive in nature. So if we keep on destroying the population then we will not get the material, actual material. So we have to select the sample.

So, these are the 2 basic reason for which we have to go for Sampling. And sampling is required basically for textile material. It is very important. Because textile material it is variable in nature. So if we see a particular product which is where variation is not there. Like, one industry who is producing a ball particular ball, say iron ball, by say certain method and that there is a fixed system, fixed process and it will keep on producing the ball of same diameter, same dimension; a rod.

An industry is producing a rod. Okay. Iron rod. It will be having almost same dimension so variability is not there. In that case sampling, all the sampling will be required but it is not that critical. But in textile material main problem is that most of the textile material be it a fibre, yarn, fabric, wherever it is a variable in nature. You take any characteristics. Diameter it is a variable in diameter. Strength it varies from place to place. So sampling here it is extremely important just one small quick example of sampling.

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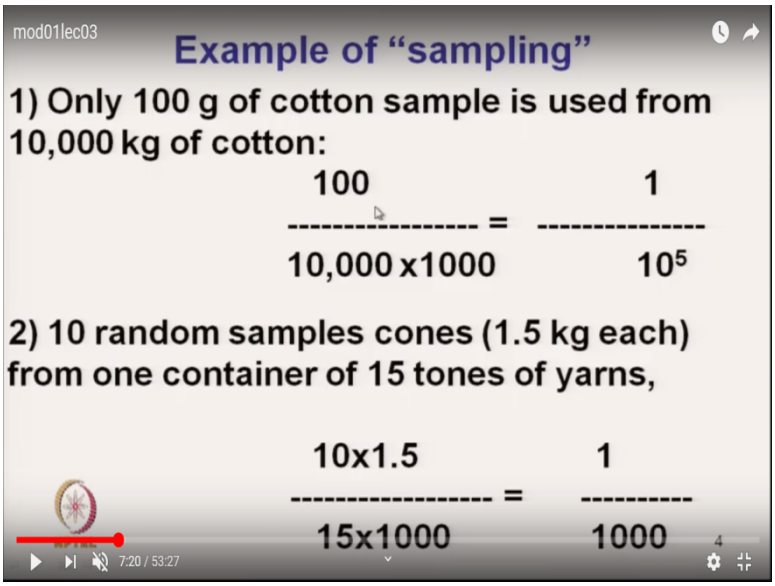

Suppose I want to a sample 100 gram of cotton from say 10 tons of cotton. So what is the fraction you are trying to see? So 1 by 10 to the power 5 that small fraction we are taking for testing. Similarly say 10 random sample of cone we are trying to take from 15 ton consignment. So we are taking a small fraction. So by doing these things we are saving time saving cost. And we are saving the material also. But the sampling has to be perfect. So that it gives confidence, that it is actually giving indicating the characteristics of the population.

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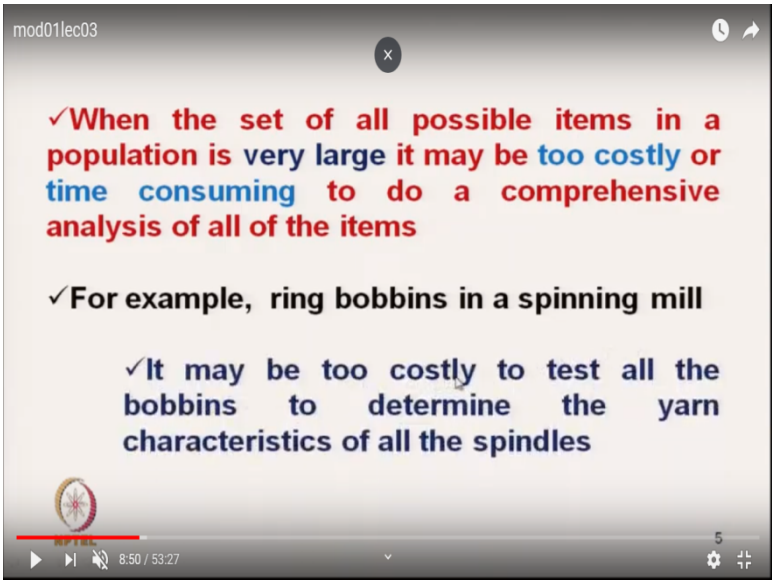

When the set of all possible items in a population is very large, it may be too costly or too time consuming to do a comprehensive analysis of all of the items. So if you take another example, for example ring bobbins in a spinning mill. It may be too expensive, to test all the bobbins to determine the yarn characteristics, test strength.

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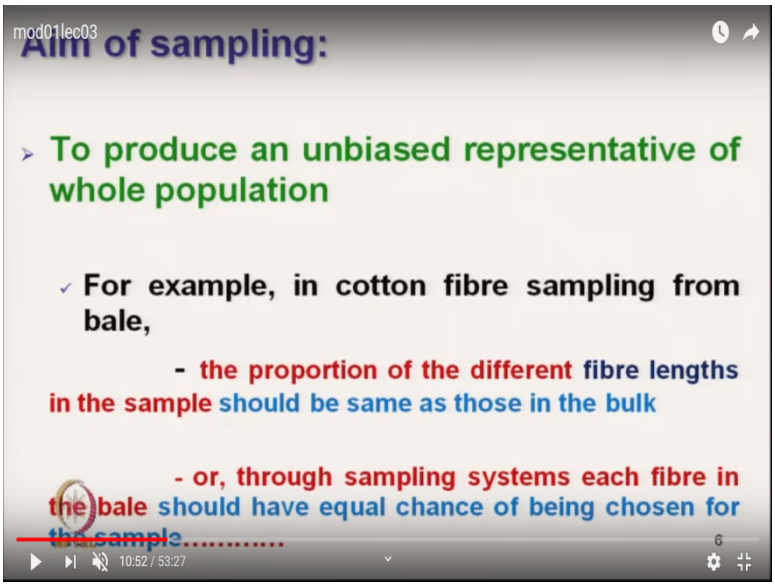

So the basic aim of sampling to produce and unbiased representative of whole population. It should be free from biasness. So the result of sample may be different from the population. But the sampling should be unbiased. There should not be any; it is only very variation should be in the chance but none other than that. For example in cotton fibre sampling from bale, the proportion of fibre length in a sample should be almost same as the proportion in the bulk.

Then only we can test the sample for length or diameter. So if we do random sampling, so unbiased sampling then we can tell with certain confidence the proportion whatever the proportion of length whatever they are in the sample is almost the proportion there in the bulk; in the bale. If we take the sample from the bale or from the bulk at random from random places then we can take.

But if we have some biasness then we will not get this same proportion. Or through sampling system each fibre in the Bale should have equal chance of being chosen for sample. So you are giving all the fibres equal chance for to get selected, means, if it is a fibre is in the bale form, if the person, testing person testing goes he is picking the sample from the surface from the outside the Bale.

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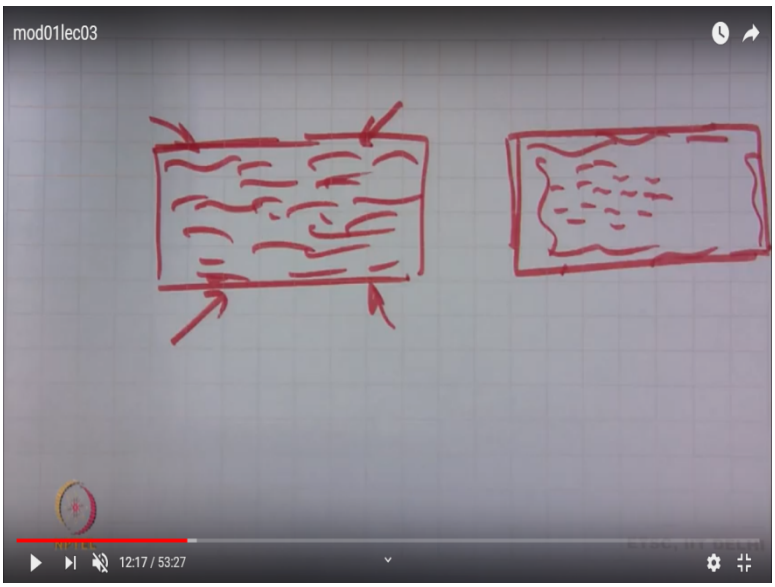

Now let us suppose this is a bale. Okay. Fibre are there different fibres are there. Now if the system says that he will only pick the fibre from the surface. Then the things will be that that if it is known, if it is the standard then what people will start doing the fibre manufacturer okay. Fibre supplier they will do they will give smaller fibre at the centre covered the; with long fibre. Then we are getting wrong sample.

So the sampling is telling that there is biasness. We have to take the sample from everywhere. The chance of sampling is there from everywhere. So the, all the fibre from the centre of the bale, from the surface of the bale, from the bottom of the bale there are fibres, they have the equal chance. Okay. And For that we have to select some sampling process.

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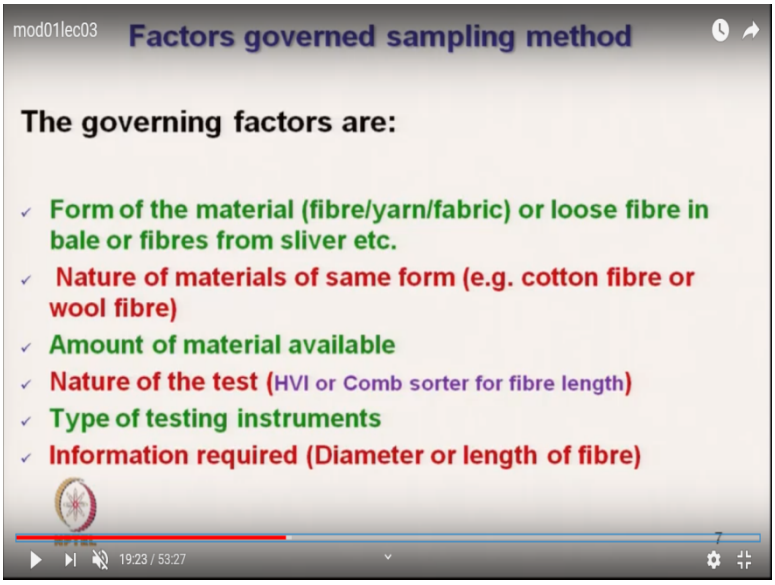

The governing factor for the sampling is that that means what type of sampling we will decide, we will adopt. It is decided by the form of the material like weather it is a fibre form, it is a yarn form or it is a fabric form. Okay. If it is fibre, weather it is a loose fibre or it is in bale form or the fibre is from the sliver so the sampling method of fibre, so we are taking the fibre, this is the fibre and here also we are taking fibre.

They are the same. It is fibre. But if the form of material if it is in the loose form, the sampling technique will be entirely different from the fibres if it is in the sliver form. Similarly if we want to test the fibre characteristics from roving which is twisted? So here the testing method will be totally different so sampling method. So sampling method is entirely governed by the form of the material. Suppose we want to test the yarn, from the bobbin.

This is the sampling technique will be different. Then if we want to test yarn from a fabric, if we want to test yarn say we want to test twist of yarn from fabric the sampling technique will be entirely different. Next is the nature of material, nature of material of same form like, as we have discussed the same form whether it is in the form of bale, in the form of sliver, in the form of yarn but if it is in the same form like bale. Bale in wool and bale in cotton, it is entirely different.

Because cotton, if we open you can take out fibre because it is just compressed. But wool in bale form it is entirely different because it contains huge quantity of grease which make it very compact. Okay, so that fibre sampling from bale of wool is different from fibre sampling

of from the bale of cotton. So, from Bale of cotton we can pick the fibre, by hand. But for wool we cannot do.

So for wool sampling, wool fibre sampling the system is different, that we will discuss. Okay, the amount of material available. Suppose I have a material of a container of say 15 ton of yarn. So 1000's of bobbins are cones are available. In that case I will adopt a particular sampling technique. But I have if I have only say, 10 bobbins are available. In that case the sampling technique will be different .Okay.

Nature of test, so based on the nature of test, we have to adopt the different sampling techniques like high volume instrument where you need sufficient quantity of material. Okay. In that case you can actually take different sampling technique. Then if we need a single fibre length measurement, in that case we have to adopt different sampling technique. Type of test instrument, so whether we are going for slow method or very fast method.

Or different types of same parameter, like again it is a HVI test or it is a comb sorter so different types of test method, test instrument we have to sample differently. Information required. For example say diameter. Do you want to measure diameter? Or we want to measure fibre length. We will see in wool testing one sampling technique is called core sampling. In core sampling technique where a coring tube is there.

Coring tube penetrate inside wool bale where which cuts that wool fibre. So which cuts and take the core, take the sample from the inside the bale. Now once it is cutting the fibre that means do you want to test, do you test length for that? We will not test. The coring technique is used for either diameter measurement or may be grease content measurement. If you want to test the length of wool fibre then it will be, sample technique will be entirely different. Okay.

So what information do we require based on that requirement we change the sampling technique? Like twist if we want to measure the twist the sampling techniques will be entirely different from the; if we want to measure the lea strength. So total different sampling technique will be there because for twist we need small, smaller length, for lea testing we need say 100, 20 yards length. Okay. So that how we have to change our sampling technique.

Degree of accuracy required. So if we think the okay, we want to only know the characteristics. Okay. Overall characteristics then our sampling our number of sample should be will be less. We can have, say, from single bobbin we can have test just to know the get the idea. But if we want to have certain confidence say 99% confidence level 95% confidence level, we can tell okay this is the range required. Okay. In that case we need a large number of samples. So sampling techniques has to be changed.

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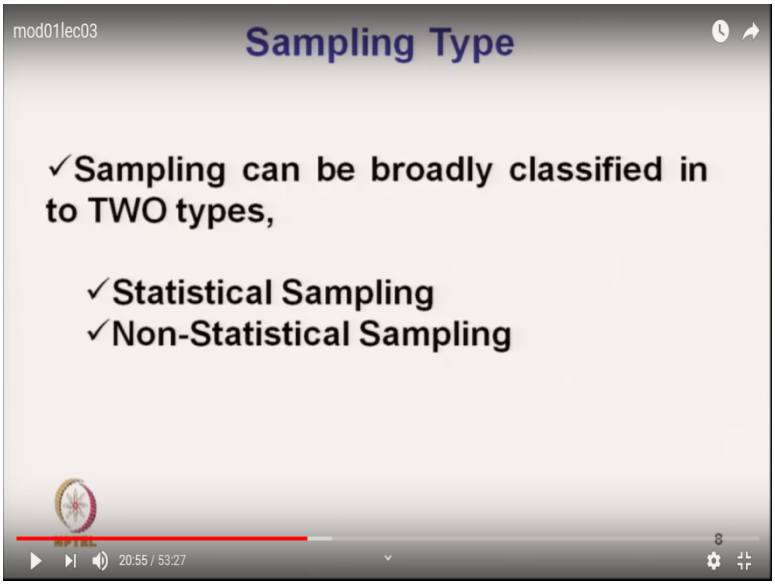

Then the sampling type, the sampling type is broadly divided into 2 categories. One is called Statistical sampling. And next is the Non statistical sampling. Statistical something means it is the process, sampling techniques these are the techniques where you use bit of statistics. Some randomness you use and Non statistical where we do not need statistical technique, okay.

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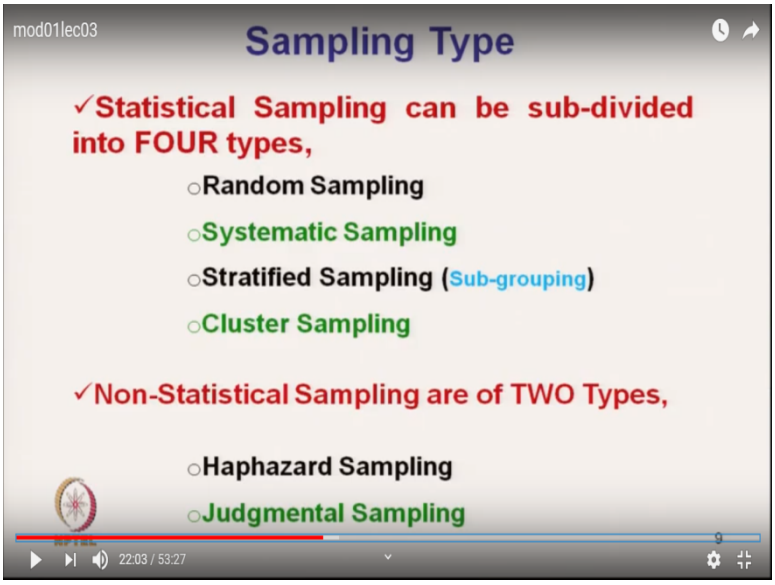

The statistical sampling again can be sub divided into 4 categories, 4 types. First is called random sampling then systematic sampling. Third is Stratified sampling which is based on the strata means sub group. We are sub grouping that. Stratified sub grouping and 4th one is the Cluster sampling. So and the non statistical sampling is subdivided into 2 categories. One is called haphazard sampling and then judgemental sampling. So these are the different types of sampling. We will start with the Statistical sampling and Statistical random sampling.

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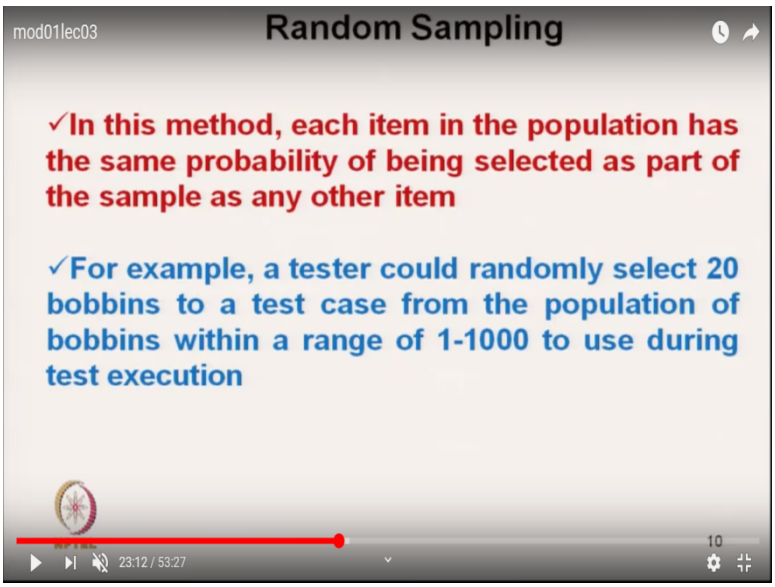

So, random sampling is based on a random number generation. In this method each item in the population has the same probability of being selected. As a part of sample has any other sample material. So they have the equal opportunity of being selected okay. Just for example a person testing person could randomly select 20 bobbins. So his idea is to select 20 bobbins. Okay, to test case of population bobbin within the range of 1 to 1000.

So, 1000 bobbins are there he has to select the only 20 bobbins, okay, to execute some testing. So, how to do that? What he will do? He will, he can use 2 techniques.

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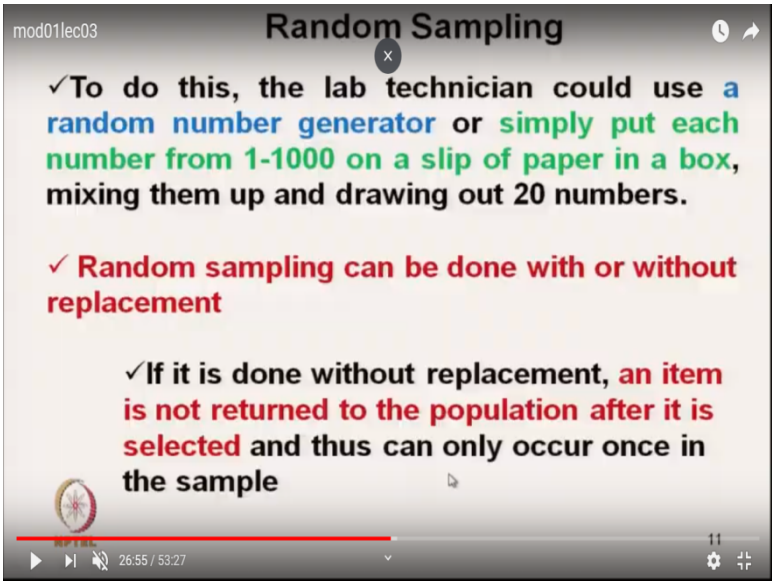

One is he can use random number. He can generate random number. So from 1 to 1000, 20 random numbers can be generated. And he picks the sample at 20 times. But here one has to be very careful that the population is numbered. It is a random. There is no biasness in numbering. So the lab technician could use a random number generator or he can simply, one is random number generation. Or he can simply put the number 1, 2, 3, 4, 5 and 1000 number he can put in small slip and randomly put take like random lottery.

And this 1 to 1000 are like 1000 spindles in ring frame. There are 1000 spindles in ring frame. And he has generated the random number 20 numbers. And he picks the bobbin from those all those spindles. And here the as it is randomly generated all the bobbins, they have the equal opportunity. So that is why how he is using some statistical technique and it is called random sampling.

And one advantage is that in random sampling he can use with or without replacement which means he has to test 5 types. And what he is doing, so with replacement means so suppose he after random generation he has taken so 51st bobbin, then 92th bobbin and then 100 something bobbin like such 20 bobbins. Now with replacement means he will again replace these bobbins to that place.

Particular their places he will replace. And again he will draw the random number. That means the same bobbin has got chance of being selected there is no issue because he is using random number. So random sampling can be done with or without replacement. And if he feels this I will not take back all, this bobbin. So that means on 20 numbers whatever he has generated, he will discard. He will make sample, he will take the replacement sample. He will take the other samples. So this is done.

So, if it is done without replacement and item is not returned to the population again, after it selected okay and thus only it can occur only once. Okay. So that is why. But he can it is up to the system he can do with or without replacement. After random sampling next is the Systemic sampling.

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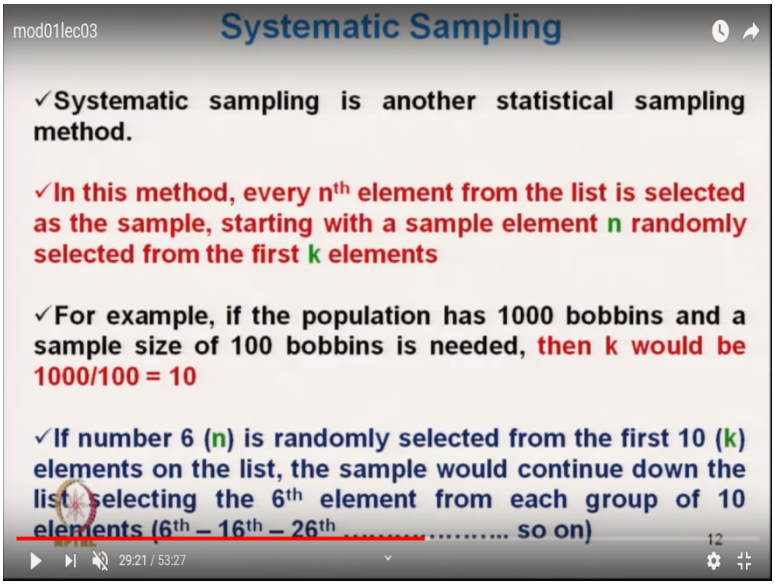

Here it is another statistical Method, the system that one has to be careful here. In this method every nth sample, nth element he will take from the list of selected. Okay. Starting with the sample element n randomly selected from the k element. So there are k elements, every k element, so he will pick nth term. I will give example. If the population has 1000 bobbin, so, here it has got 1000 bobbin and ultimately we have to sell, our idea is to select 100 bobbins. 100 bobbins are selected. That means if you divide 1000 / 100, K's value is 10.

So, everything 10th segments every 10th subgroup he has to pick 1 sample. So here K value is a 10. Among 10th suppose he decides okay and among every 10 bobbin, I will select 6th value 6th bobbin. So, if number 6 which is n is randomly selected from first 10 K value first 10 elements on the list. The sample would continue down the list selecting the every 6th

element from each group of 10th element that means what? If it is 1 to 1000 He will start taking 6th, 16th and 26th like that. So this nth term it is actually one can decide randomly. Okay.

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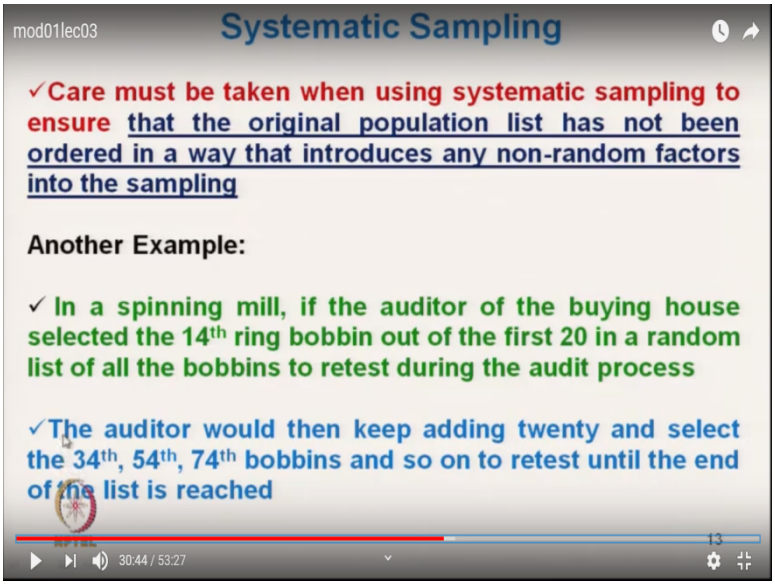

So, care must be taken when using the systematic sample to ensure that the original population list which has not been ordered. So it is a population list has to be random. Okay, order in any way which actually can introduce non random list. So the original population has to be totally random. There is no biasness similar example one can give here. It is a bobbin of 1000 spindles. So every 6th, 16th, 26th, and bobbin he can take.

Another example you can see same, in spinning mill if the auditor of the buying house sells the 14th ring bobbin out of 20th, in a random list of all the bobbins. It is randomly here so arranged here. So, 14th he is trying to take. Then what are the numbers you will take? First you will take 14th, and then you will take 34th, then 54th, 74th, in this way. So after Systematic sampling,

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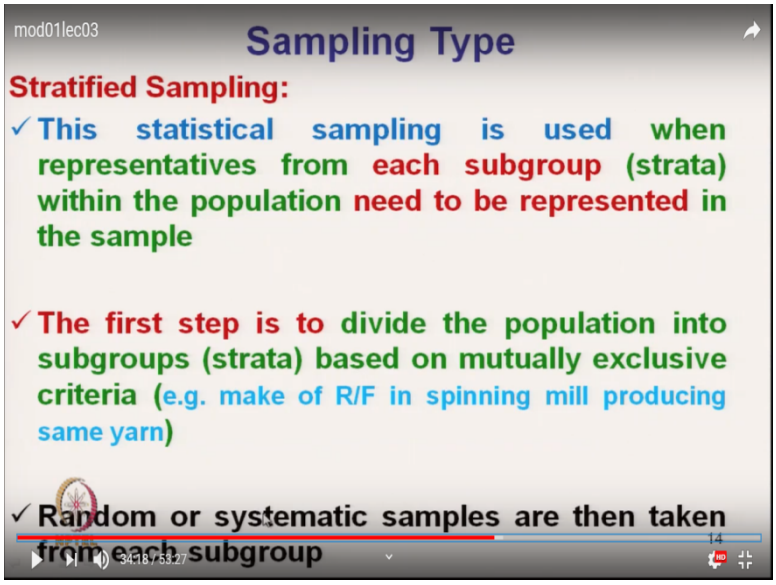

Next is that stratified sampling, which is actually this is the statistical sampling. This sampling is used, when representative from each subgroup is known as strata within the population need to be represented in the sample. It is not like a random sample. Random sampling it may or may not incorporate a particular group. Like in an industry who is producing 30s count yarn.

From same shed, ring frame shed, it has got a 100 ring frame. So it is producing 30's count. And the ring frame they are from different manufacturer, manufacturer 1, manufacturer 2, 3, 4, 5 manufacture. Now random sampling says that out of 1000 spindle you take random depending on the random number generation. Do not concentrate on the manufacturer.

Manufacturer A, B whatever, you can take if it is coming random number, if you may select the 10 bobbins from the same manufacturing. But stratified sampling says it is not. You first sub group the make. Sub group manufacturer first. So manufacturer 1, manufacturer 2, manufacturer 3, manufacturer 4 and then decide how to take the sample. And you have to take sample from each and every sub group.

Either you decide, I will select say 4 sub groups are there and we have to say take 20 bobbins. So, I will, deciding I will decide to take 5 from each manufacturer. And this 5 when you have selected, decided then you go for random number. But here in stratified sampling the advantage is that your population their samples represent the all the make all the manufacturer.

The first step is to divide the population in to subgroups. First you have to divide based on mutually exclusive criteria. So, you have to actually decide, you have to mutually understand, mutually exclusive criteria. Like the, make of ring frame in spinning mill producing a same yarn. Now suppose I am deciding okay. This will be equally that I have given example. But one can decide in other way I will give one example. And then random or systemic sample are taken from the each sub group.

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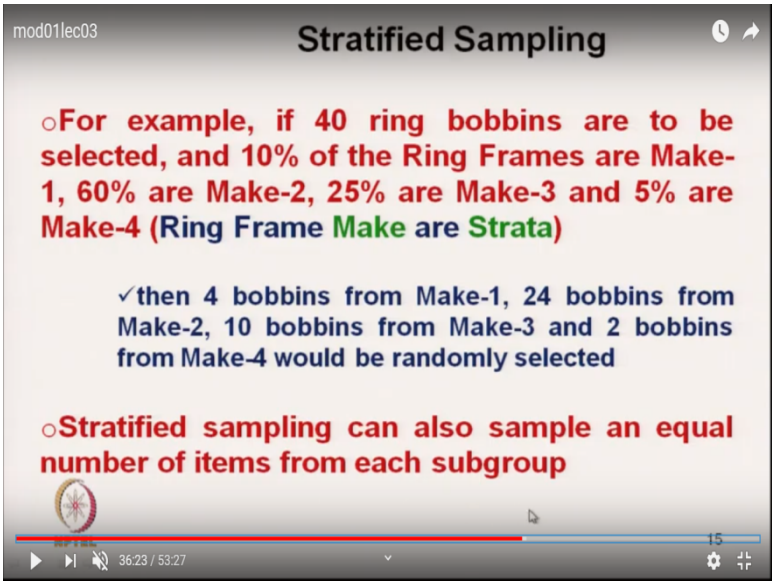

Now example is that if 40 ring bobbins are to be selected, so I want to select 40 ring bobbins where 10 percent of ring frames are make of 1, 60% are of make 2, 25% are of make 3 and a 5% of make 4, 40 you have to take. Now the mutually understand agreeable joke that criteria is that we have to select the bobbins, number of non-based on the proportion of ring frame.

The large proportion we will have larger quantity in the sample. So then in that case 4 bobbins from make 1 because it is a 10% of the ring frame. So 4 bobbins we will take out of 40. As it is 60% of make 2 so then 24 bobbins I will take from there. Okay. Then 10 bobbins from make 3 and 2 bobbins from make 4. So it takes it take care of the 40 bobbins. But we may fix other criteria. Okay.

All, the make should have equal representation. So 4 make10 from each pay whatever maybe the number I will take 10 from each so that it is equal. So it is mutually agreeable criteria. And then once we decide then we have to do random selection. Like 4 bobbins from make 1 this 4 number of bobbins I may use random number. Then we will take 24 bobbins from

make 2. I will use random number to get 24. But it is okay. Stratified samplings can also sample and equal number of items from each sample as we have mentioned okay.

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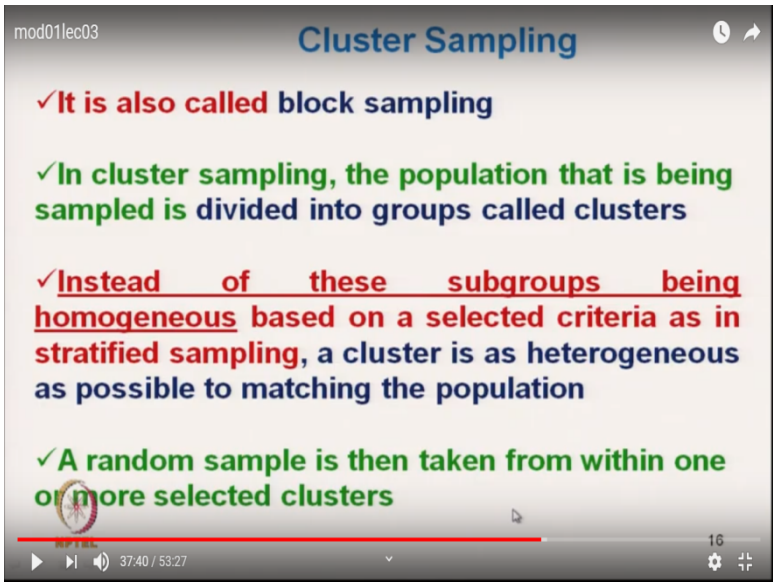

Next is that that it is a Cluster sampling. It is also known as the block sampling. It is different from the stratified sampling. In Cluster sampling, the population that is being sampled is divided into group called Cluster. That means instead of these sub groups being homogeneous based on a selected criteria as in stratified sampling. The cluster sampling is heterogeneous, as heterogeneous as possible, okay to match the population.

Like there is same make say 100 ring frames, we make a cluster. Okay. We will test, today we will test from this cluster, take testing okay sample, then and it is next day we can go for in other cluster. And a random sample is then taken like your stratified sampling once we have clustered, we have blocked the sub group then we can take the random sample.

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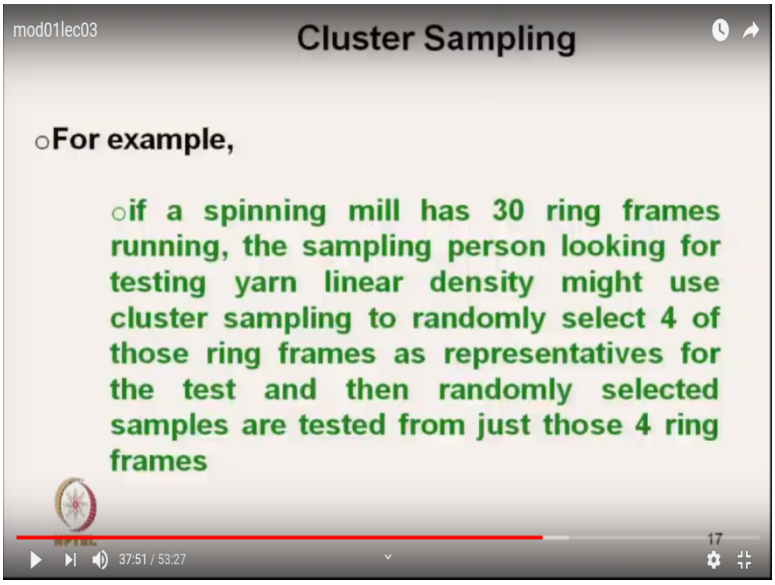

Just for example if a spinning mill has 30 ring frames running, the sampling person looking for testing of yarn. Linear density might use a cluster sampling to randomly selected 4 of those ring frames as representative. Okay only 4 we have selected. And then he is taking cluster. He is not taking from all the ring frames for the test and then randomly selects samples from them. This is actually used in, spinning industries also. This type, he is not taking the entire. Cluster sampling is very popular very commonly used here okay.

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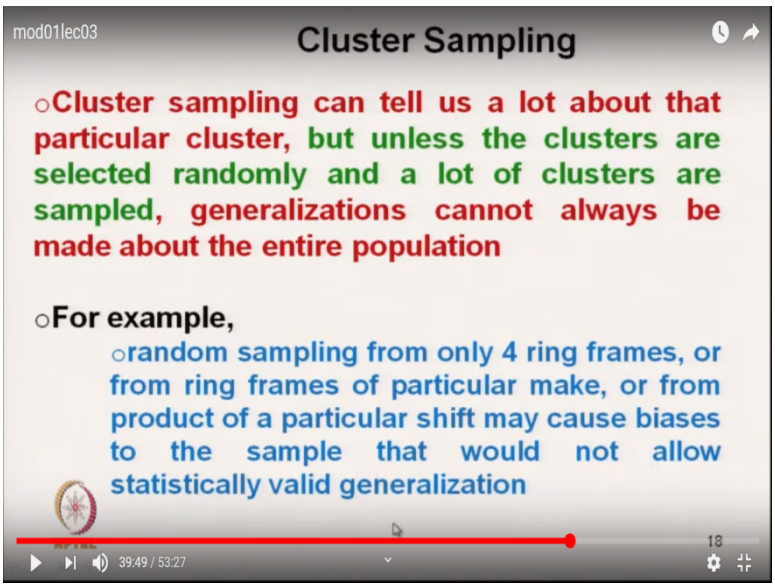

Cluster sampling can tell us a lot about the particular cluster. That is problem here. But unless the clusters are selected randomly, so we have to again select the cluster randomly. Then if it is not done, then it will give us wrong result. Okay. So generalisation cannot always be made about the entire population. So Cluster sampling is used in various ways. Like a different

shift people try to that is, it is a cluster. So at night shift is trying to take the sample from the night shift production, okay.

He is taking and he is testing that may result in entirely different result than the population. So Cluster sampling, they have got draw backs. So random sampling from only 4 ring frames, or ring frames from particular make or from product of a particular shift may cause biases to the sample. That would not allow statistically valid generalization so one cannot generalize. It is a simple one. Okay. It is a feasible one.

But it you cannot generalize. It is not possible some time to test suppose testing person who is working in night shift he will only test the material at night shift. But it gives certain result; it is not giving the population, total population. So that particular cluster particular shift it is giving idea. It is giving that idea of that test results. Say strength. But if you want to know the population then he has to mix all the shifts. Then Cluster sampling is not going to be useful okay.

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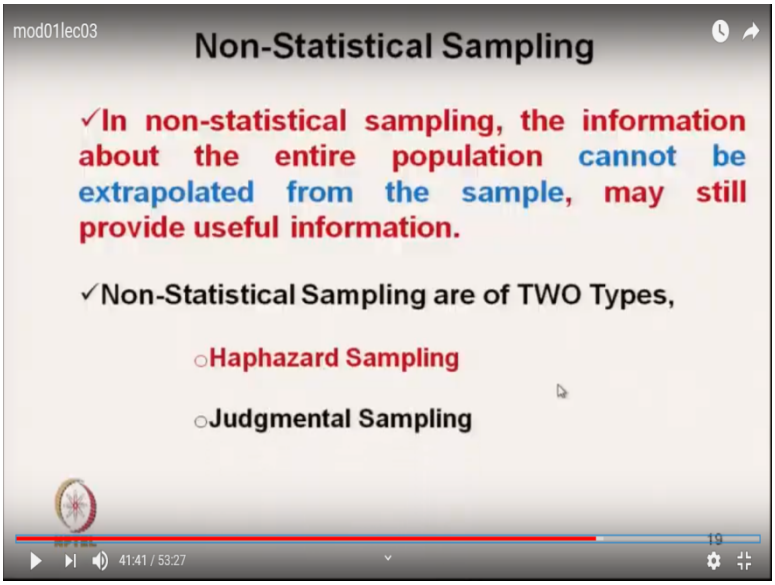

And in Non-statistical sampling there are 2 types of Non-statistical sampling we have discussed. In Non-statistical sampling the information about the entire population cannot be extrapolated from the sample. So we get some information which is quick enough, which is easy very quick and sometime it is useful. But you cannot extrapolate, you cannot predict to the entire population.

Suppose what I am doing I am picking one bobbin from the entire population. I am just throwing a bobbin. I will get some information okay. This lot is s giving yarn strength or like that. But I cannot tell with certain confidence that Entire population is like that. Because I have not I have done in the statistical method. Non-statistical samplings are of 2 types as I have mentioned Haphazard sampling and Judgemental sampling.

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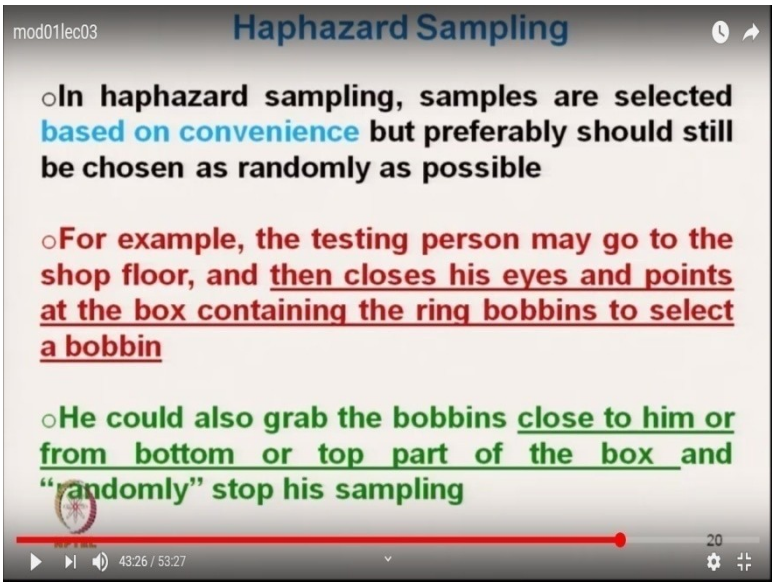

In Haphazard sampling the samples are selected on convenience. But preferably should still be chosen as randomly as possible. The best and convenience means the tester of person is going and he picks our bobbin from the tuft. This is in textile industry it is a very commonly used very common. Like, senior management person, President or some chairman when he is moving, he would like to know the characteristics of the material.

He may ask the person you pick that bobbin. And test and let me know the result, okay. So that will give us the quick idea about the product okay. But we cannot come into any conclusion that because it is not statistically sampled. The example is that are testing person may go to the shop floor and then close his eyes and point at a box containing the ring frame to select a bobbin just You take this one. That is the haphazard sampling.

That is basically here it is not time consuming. He is going there and picking and immediately you will give the result. He could also grab the bobbin close to him, from the bottom or from top anywhere so that is the haphazard sampling.

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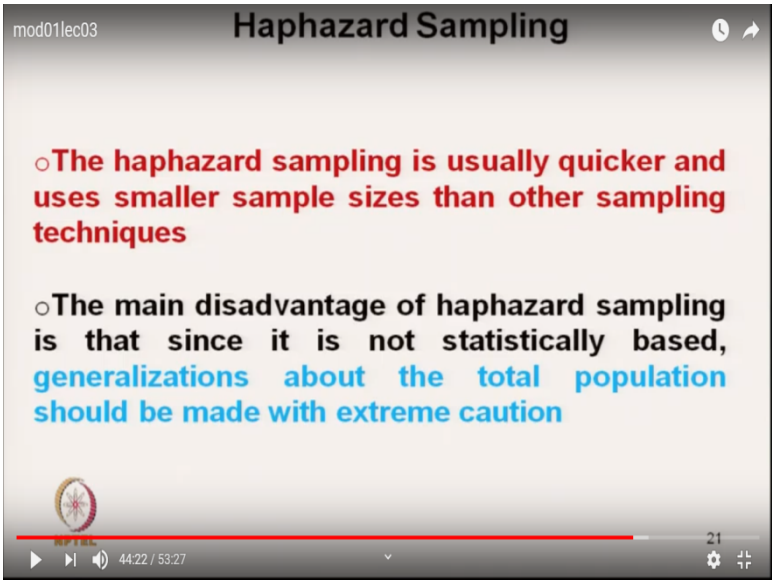

The advantage is that it is quicker and use a smaller sample size than other sampling technique. So you can take, pick okay 2 bobbins and test it so that is the haphazard sampling. Advantage of haphazard sampling and the main disadvantage is that since it is not statistically based generalization we cannot do about the total population should be made with extreme caution. That is very important we may tell okay this is the strength. This is the evenness but we cannot generalize and till we are doing some statistical sampling. It is only for idea

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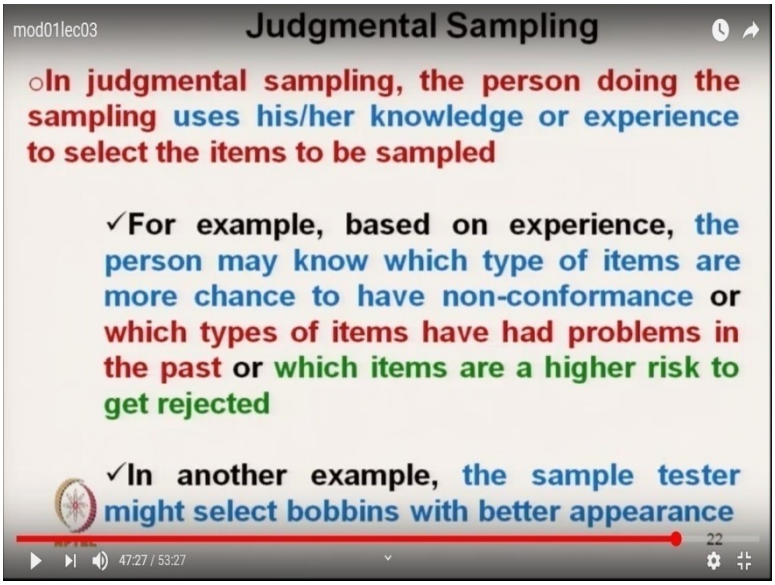

Next is that it is a judgmental sampling. In the judgmental sampling which is again non-statistical a person doing the sampling uses his or her knowledge or experience in selecting sample. It is judgemental. Here suppose particular in a ring frame shed, a particular ring frame gives problem always. It is supposed may be due to some humidity problem in that particular portion or maybe due to vibration.

It generates high unevenness, high U% because of the vibration in spindle. And after trial after various your maintenance this could not be rectified. So the problem would be that then what he will do he will try to avoid that sample. He will try to avoid taking sample from that particular ring frame. That is he is using his judgement so that his sample his total entire population does not get affected.

It is based on his experience. The example is based on his experience. The person may know which type of item have more chance okay, to have non-conformance, what type of item? Like product of night shift suppose sometimes create a problem. Or some product of the see first few lot, first few tuft in the ring frame is not taking, based on his experience because it will get non-conformance.

Or which type of item we have problem in past. This type of item had problem okay I will not take, I will not take risk of the rejection. I will not take any risk. So I will justify like he will try to take the sample which is a bobbin which is very good looking. Not he is not going to take damaged bobbin he is not he is trying to take fresh look sample. So that type of sample he is using his judgement, okay.

So that it is not wrong but he is rejecting some non-conformance basically. He is not trying to take any risk. That is the he is using the judgement. Another example is that the sample tester might select bobbin with better appearance. Or other sample selected he would like to take okay only I will take the problematic one. This is judgement okay. And his judgement sampling is important it is happens in actually buying house, in actual trade.

Like the supplier will always try to use judgmental sampling based on the best quality. He should not take non-conformance. But the customer who will try to see the where is the faulty, where is the fault. Suppose you are sending a consignment to a supplier. He is telling, okay you sample yarns are rejected. It is giving a problem. What is the problem your samples are there, bobbins are damaged.

He will send say 5 to 10 bobbins are of package are damage package. Once you are visiting to his place it is everything is going alright because he is using his judgement wrong judgement. Okay. So it is actually sometime it creates biasness.

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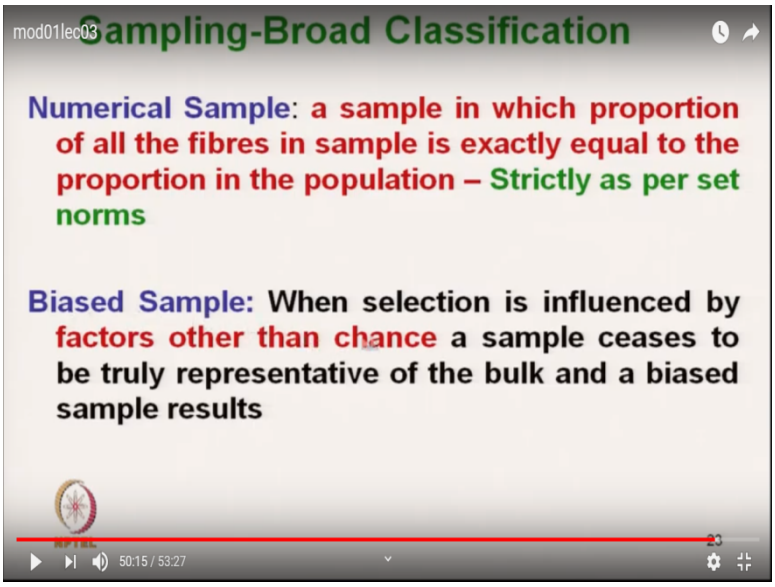

So another way of broad classification of sampling is that one is it is particularly for textile material. Earlier sampling techniques were for general sampling technique and this technique is for specifically for textile material. One is called numerical sampling. Here in this numerical sampling, a sample in which proportion of all the Fibres in sample is exactly equal to the proportion of the population. So that means it is strictly as per set norms.

We have to take that sampling that, which means if you take out if you remove one sample, the race population, the proportion of fibre length will to get affected. That is called the numerical sampling. I will keep example subsequently, okay. And next is the biased sampling. Biased sampling it is a basically in textile, in a fibre, it is called length Biased sampling.

In Biased sampling when the selection is influenced by factors other than chance that is called biased sampling, a sample ceases to be truly representative of the bulk and a biased sample result. So biased sample is actually where is not due to the chance factor variability it is due to something else okay. Now let us see what are the different causes of biasness?

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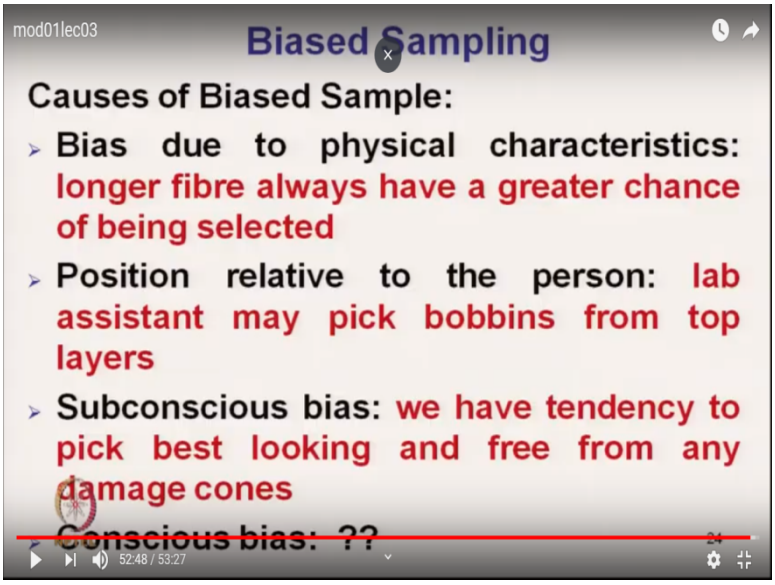

Biasness can happen due to various reasons the causes of biasness is that bias due to physical characteristics. As I have already mentioned the longer fibre we have always greater chance to be selected because it has got higher surface area. So in this sliver it has got long fibre or short fibres mixed. But if I am trying to pick the fibres higher probability will be there that longer fibres are selected, because it is a higher area. Okay higher projection.

Next is that a cause of biasness is that position related to the person who is selecting, he is taking the bias sample. The lab assistant may pick bobbin from the top or may pick bobbin from which is close to him. So that is one cause of biasness. Third cause is that subconscious biasness that I have already mentioned which is called haphazard or this type of sampling, subconscious biasness, we have tendency to pick best looking item and free from any damage.

That type of sample we are taking. That means we are introducing biasness. We are trying to get the best result that is the sample. And also as I have already menti3d sometime it is a conscious biasness is there. As a supplier you are trying to project your product as a best quality. As a customer I am trying to project that your material which is worst. So that type of conscious biasness is also purchased. But it is not that important.

These are the causes of biasness. Next class we will continue with this sampling, okay. Till then okay goodbye.