So, today’s discussion is on Autoleveller. First we must understand what we are going to auto level and why. We have to level the sliver that we produce on carding machine or on draw frame. This sliver is not really uniform over it is entire length. The mass per unit length of the sliver varies, the unit length could be few millimeter to could be few thousand meter, whatever unit length we choose, we will see that the mass per unit length is continuously varying it is not constant.

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That means the count of the sliver is not consistent. And if the count of the sliver is not consistent the count of the yarn is also not going to be consistent.

If there is a mass variation in sliver, there were reflection of this mass variation in sliver in the mass variation of yarn. Therefore, if we want to produce a yarn in which the mass variation is minimum, we cannot totally eliminate it, but we can bring it down to a large extent. And we need it because this will produce a very uniform fabric; a fabric free from or sort of appearance defects. So, the control point starts from sliver.
So, you must first understand why that is a variation in sliver, and then only we can think of taking appropriate measures to control it or to regulate it. The sliver count variation is mainly due to imperfect card feeding. At the feeding process to the carding machine is not really perfect. Sometimes it is feeding more sometime it is feeding less.

So, feed of the material to the carding machine is not constant over a period of time. And therefore, card sliver being produced we will have count variation, and the same card slivers I am feeding to the draw frame. So, whatever draw frame is producing also we will show some amount of variation; though to some extent variation we will get reduced because of doubling action on draw frame. This count variation covers the wide spectrum from very short to very long term variations.

What do you mean by short and long term variations? Some values have been quoted here, mass variations up to 25 centimeter in sliver will be known as very short term variations. Then short term variation is 0.25 to 2.5 meter. Medium term is 2.5 to 25 meter, long term is 25 to 250 meter and very, very long term is 250 meter and more.

Now, how did he classify the variation spectra into these lengths?

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First of all, the very short term variation is mainly because of length variation in fibers. But short medium and long term variations has been chosen on the basis of control inertia of the autoleveller, which depends upon the design of the machine, design of the
machine itself and the control system that we have developed. Because of this inertia effect, the variation spectra has been accordingly classified.

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![Limitations of levelling by doubling](image)

Now, the question that comes to our mind is what doublings can do and what doublings cannot do why do you need autoleveller when we are doubling this slivers on draw frame? So, limitations of levelling by doubling actions yes, doubling indeed we will improve variability to some extent.

Let us see, what are it is limitations. It cannot correct long term mass variations. Variation produced from shift to shift or variations longer then the length of sliver which is there in a can. So, when the variation is changing from one shift to another, shift such very, very long term variations or variation which is over few setup cans that we are produced on carding machines; such longtime variations in the mass cannot be regulated, but cannot be changed much by doubling actions.

Here doubling action fails. But such variations will lead to over the count variation in the yarn that we produce today and with the count that will produce tomorrow or day after tomorrow. The periodic variation is also difficult to suppress by doubling actions; we will see that doubling action cannot remove the periodic variations to a large extent.

Some amount of periodic variation we will definitely be reduced by doubling actions, but it will not be totally eliminated because of doubling alone. Very, very long term mass
irregularity remain unaffected by that passes through draw frame, because the doubling action will fail to take care of such very long term variations. Doubling can reduce CV percentage in a sliver, by the square root of the total number of doublings, we know the doubling law, that we says that CV percentage of the output sliver to be equal to CV percentage of input slivers divided by root n.

And only thing that we have to add is whatever addition irregularity is generated because of the drafting action also here if that remains constant. Then the CV can only be reduced by root number of doubling. And the maximum number of doubling that we resort to is usually 8. You do not go beyond 8, because we have already discussed this point that the improvement beyond 8 is not really much.

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Here with an example, we are looking into it a sliver let us say has a unevenness value of 3. The expected CV with increase in number of doubling is shown in the table. And we see that if we increase number of doubling from 4 to 6, 6 to 8 up to 12, the expected CV will be 1.5, 1.2 to 1.06, here we are ignoring the any additional CV because of the drafting actions.

So, it I see that there the CV expected CV is going down as we are increasing the number of doubling from 4 to 12; from 1.5 it has gone down to 0.86. So, improvement in CV if we consider you see when you go from 4 to 6, there is improvement by 0.28, 6 to 8 0.16, 8 to 10 0.11 and 10 to 12 0.09. So, the improvement in CV is going down if we increase
as you go on increasing the number of doubling. So, therefore, we generally do not go beyond 8, because the improvement is not really much or not very not practically significant.

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So, if reduction of CV due to doubling, suppose is not enough either due to original variation being too high or number of doublings too low. Then a suitable autoleveller can only help us. So, by doubling we may not be able to achieve these desired CV in the sliver. So, in that case what we do? We depend upon autolevellers.

Autoleveller therefore, is suitable for those cases where reaction time is shorter than the length of the variations to be corrected. This is a very important point, is that autoleveller will be suitable to control the mass variation in those length spectra; where it is much longer than the reaction time of the autoleveller. Every autoleveller has a minimum reaction time once it sends and by the time the necessary action is taken there is a little time delay. And by that time some material will pass through. So, this is called the reaction time; that how much time it takes to start controlling the mass variation in the sliver whatever it has sensed.

So, where the reaction time is shorter than the length of variations to be corrected, then autoleveller will be suitable for regulating the mass variation in that length spectra. So, definition of autoleveller is it is an online monitoring and control device which keeps sliver weight per unit length variation under control.
That is the simple definition of autoleveller is an online monitoring and control device to keep the sliver weight per unit length variation under control.

Types of autoleveller, there could be 3 types of autolevellers. They are known as long term autolevelling or autolevellers, medium term autolevellers or short term autolevellers. By long term the length range we have already specified earlier which will be 250 meter or more, medium is around 25 to 250 meters. So, long time autolevelling
only the mean value of count is autolevelled in this case. The actual evening out is undertaken by the doubling actions.

So, this is we have to remember the long term otter levellers can keep the mean count of the sliver at more or less constant level. So, it should keep it within the tolerance, but the actual evening that is the medium term evening actions is taken care of by the doubling, that we do on draw frames. On the breaker draw frame and on the finisher draw frame there is possibilities of doubling. So, doubling action will take care of to manage the medium term variation in this sliver.

Then comes medium term autolevelling. So, the such autolevellers we will able to manage or control both mean value of the sliver as well as complete variance length spectra in the material. Only very short variations remains in the material, which it cannot controlled. So, it controls the length the mass variation in the length spectra starting from medium term variation to long term variation. That entire spectra it will try to control, but short and very short term it cannot control.

So, that means, the autoleveller takes over the normal function of doubling in the medium term; that is, 2.5 meter to 25 millimeter range. And then come short term autolevellers or short term autolevelling in this case besides the mean value, the complete variance length spectra to a large extent is levelled. And it takes care of or the doubling action of the draw frame as well.

So, short term autolevelling means it is trying to control the variation starting from short term length to very long term length.
When we think of an autoleveller, the question that may come to our mind is where we should have the autoleveller in this spinning process. The spinning process as we all know starts from blow room, then card, then draw frame, and then after draft frame, there are 2 more processes left: speed frame and ring spinning.

The comb, but has not been shown here, is another process called combing also. So, in some other course, you will learn that. So, if I say these are the various machines which are there to produce a card radian, they are blow room card draw frame speed frame ring frame. Then on which machine we should have the autoleveller. Typical production rate of the machines are also shown: blow room 500 kg per hour, card typical 40 kg per hour, draw frame 90 kg per hour, speed frame 450 grams per spindle hour, and ring frame 27 grams per spindle hour.

If we want to match the productivity of the blow room by the subsequent machines, then we need at least 12 to 13 cards to take care of the productivity of the blow room.

If we go for production balancing, then I need for one blow room 12 to 13 carding machine, we need at least almost 6 draw frame speed frame spindle we need 1150, and rings frame spindle we needs 1800; that means, there should be 12 card production positions, 6 draw frame production heads, 11 50 speed frame production head or roving frame or so it is known as spindles and we need 18000 spindles or production positions for ring frame.
Now if we want autolevellers for these machines, if it is on blow room then we need only one machine, and one autoleveller it is a very, very attractive propositions.

Whereas if we go for ring frame, for each production position we need one autoleveller and therefore, we will be needing 18000 autoleveller, which is practically not feasible and not possible; commercially, also not possible, technically also not feasible. Speed frame we need also a large number of autolevellers. So, the places or the process where we should have, we have draw frame card and blow room.

Now point is, out of these 3 where we should have? If we suppose or interested to manage the count control of the final yarn, then we will see that the length of the yarn for count control whatever is the length of the yarn that you take while deciding the count value of the yarn, if we back calculate and try to find out what is the corresponding length of lap of the blow room that corresponds to the 120 yards of yarn length.; When we decide the count value of the yarn, then the unit length that we choose is 120 yards which is close to 110 meter of yarn.

So, what length of a blow room lap represents 120 yard or 110 meter of yarn? If we try to find it out, we can do that if we know the draft interpret machines; we will see that the blow room lap length that we need to control will be much less than a inch. Now this very, very short mass of very, very short length is very difficult to control by any levelling machines that we think of designing.

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Therefore autolevellers for blow room is not practically feasible at all. There is no point in thinking of having autolevellers to manage the very, very short term mass variation in blow room lap. What we do therefore, that we have 2 options left it is either card or draw frame. So, autolevellers are generally designed for carding machines or draw frames. If it is in carding machines, then we need 12 autolevellers for 12 machines to manage a production of 500 kg per hour.

Whereas if I go for draw frame, we need how many machine around 6 machines. So, these are the 2 possible locations of the autolevellers. And in the industry, we have autolevellers in the carding machines and also in the draw frame. We will first discuss the autoleveller in the draw frame. So, autolevellers are draw frame stage.

During spinning the card sliver undergoes 2 draw frame passages most of the times. One breaker draw frame passage and the other one is finisher draw frame passage, so that we have discussed earlier. Between breaker and finisher drawing stage, it will be more appropriate to have an autoleveller at the finisher stage. Now because we have a choice on draw frame means, so that we should keep autoleveller with the breaker draw frame or with the finisher draw frame.

So, if we try to analyze this point, then we can say that finisher stage or is better, why? The reasons are all prior sliver irregularities will be evident at the last passage. If I keep it on the breaker draw frame and make a sliver which is regular, then this regular or level sliver is fed to the finisher draw frame in the finisher draw frame generates it is own irregularity shown that will be present in the sliver made on the finisher draw frame.

So, the finisher draw frame can also add some irregularity which is not getting autolevelled. And that irregularity that the machine is going to generate this finisher draw frame will then flow into the yarn. Hence, this is one difficulty we are going to face doubling prior to levelling at breaker stage would already reduce irregularity is to some extent. Hence, less levelling work will be needed, there is the burden on autoleveller will be less and it will work more efficiently if we keep it on the finishers machine. And all faulty sliver placement even in the last draft passage will be levelled.

So, first of all let the breaker draw frame do some job of levelling by the doubling action. So, that will reduce the workload of the autoleveller which will be there on the finisher draw frame stage. And second thing is if the finisher machine generate some irregularity,
then the autoleveller, which is attached to this machine will be able to all to suppress that irregularity which is being generated by the finisher stage. So, these are the points which favor in having an autoleveller at the finisher drawing stage.

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Now, we come to the autolevellers classifications. So, you have seen that you have classified autoleveller earlier on the basis of the length spectrum that it can take care of. So, he had short term autoleveller which had medium term autolevellers, we had long term autolevellers. So, that is on the basis of mass variations spectra that it can control. The other way classifying autoleveller is on the principle of operation. On what principle the autoleveller works? And here there are basically 2 principles known as open loop control and the other one is closed loop control. And the third one is a combination of these 2.

So, this is called mixed loop control. So, autoleveller works on the principle of open loop or closed loop and a mixture of these 2 known as mixed loop. We will just try to explain these points first open loop system or open loop principle.
Now you see a diagram on the left hand side in the slide, read the diagram first carefully. So, what we see in the diagram? That there is an input shown by an arrow and then there is a sensing point. From the sensing point, the arrow most forward and then there is a process. So, this process could be any process for that matter.

In our case, this is the drawing process. So, the process is there (Refer Time: 26:48) on the process there is an output, output is the output sliver. So, in this case, there is an input and there is a output in between we have a process, but the sensing point is placed before the material enters the process.

From the sensing point means there is a sensor which is going to sense the mass of the material which is passing over the sensor. So, sensing point and what is the control? Point the control point is in the process. Therefore, the sensing point is behind the control point. So, control point is within the process, it is in front of the sensing point. The sensor generates signal correspondence to the mass of material present and compares with the reference signal equivalent to the normal mass of sliver.

So, what is does? That we have a reference signal, which is equivalent to the nominal mass of sliver that you would expect. So, and the sensor is sensing the current mass omit; which is passing over it and once it gets a signal this signal is going to be compared with the set value or the reference signal.
After comparing we will get a deviation, that this difference between the strength of the reference signal and the signal that we are currently getting, what is the difference between these 2? That is called the deviations. If this deviation exceeds the tolerable limit suppose we say that I will allow the sliver mass to change by 15 percent plus minus. That means, I will not mind if the thickness or the mass is 15 percent more or 15 percent less.

I will still consider the sliver to be uniform. So, we have to also set this tolerance limit. How much tolerance we should allow? These torrents limit is generally in between in the range of 15 to 25 percent. How much it should be set that depends upon the quality of the final yarn, that we want to produce or the fabric that we want to produce.

So, some tolerance limit of the deviation is allowed. Then the difference signal is amplified and after a necessary delay fed to an actuator. Why do you need a delay? Because from there is a distance between the sensing point and where the process is. So, the material has to reach the process and once it reaches the process, then only we have to take collective action on it.

So, if the time that the material takes to reach the process, is t then the signal will be held back for a period t. And then only the signal is an amplified the deviation signal, then the actuator acts. Actuator means, which will actually now cause a change in the in the draft. How do I control the mass variations? Is a basically by adjusting the draft in the case of draw frame with the mass is more a little stretch the material to make it little thinner if the mass is thinner, we have to reduce this stretch.

So, it is basically the draft within the machine that we need to change as the thickness or the mass of the material keeps changing with time. So, the actuator basically converts the signal into mechanical adjustment of the speed of the drafting rollers. That basically means it is basically changing the draft.
The same diagram is there in the right hand side. What is the disadvantage of this? This is called open loop system, shown in the open loop system, the sensing point is behind the control point, this is you have to always remember.

Sensing point is behind the control point. So, as a result of this, a suitable delay is required to hold back the signal. This delay depends upon the flow velocity, and the distance between the sensing and the controlling point. We have to hold back the signal for some time, because there is a distance between the sensing point to actual control point. And this time t depends upon the velocity of flow of the material and the actual distance between the sensing point and the process where these action to be taken. So, delay is one thing that we need.

Here the other thing is there is no self-monitoring. Once the material moves out of the process, we are not going to check whether the correction that has been taken, if at all we have taken some corrections, whether the correction has resulted in the right value, the right mass of the sliver or not. So, there is no check or no self-monitoring and therefore, there is every possibility of drifting that can exist. Because we do not have there is no self-check.

You have taken an action, but we do not know, but the action taken has been correct or not. This is these are the disadvantages of the system. Against this, the advantages are it does not introduce short term error. And this is very fast in terms of response and quite
simpler in terms of operations. Response times is very, very fast, and quick and it does not introduce short term errors. So, these are the advantages and there are disadvantages also. So, this system has some advantages some disadvantages.

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The other system is closed loop system. So, this is another principle, we call it closed loop. Now let us look at the loop, now if you see the diagram on the right hand side, you can make out one difference in comparison to what you have seen earlier. And that is the sensing point in this case is in front of the process. Earlier the sensing point was behind the process in the closed loop system the sensing point is in front of the process.

Rest is same. So, here also otherwise the way it is sensing is exactly same so, it sends the material that is moving out of the process; instead of sensing the material that enters the process. In the previous case it was sensing while the material was entering the process. In this case, it is sensing and the material is moving out of the process.

So, whatever is moving out of the process? It is sensing, and then it is comparing the signal with the reference signal. Checking how much is the deviation, whether the deviation is more than the tolerance limit or not, or beyond the tolerance limit or not. The signal is amplified it is passed to the actuator, actuator will take actions. If we find that it is within the tolerable limit, the actuator is not going to change the speed of the rollers.
That is the means draft is not going to change in those case. What if it goes on the higher side, suppose we have set a limit of 20 percent deviations allowed it go to up 30 percent; that means, the 10 percent excess material. So, you have to stretch the material more.

So, actuator will once they receive the signal, it will now change the draft within the process. So, by having this closed loop system, therefore, what we see here, in the sensing point the arrow is going to the amplifier from there to the actuator and go into the process. So, it is forming a loop and the loop is closed loop.

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So, advantages and disadvantages of closed loop system let us now see. We have earlier discussed the advantage disadvantages of the open loop system. And now we are discussing the closed loop system, all right? So, what are the advantages? It can self-monitor the chain that it brings in, this is a very important, point earlier it was not there. Action was taken or we never knew where the action taken was correct or not; however, here any action that we take on the process, the material undergoes that action. And whatever changes are brought in the material has to flow through the sensing point, and is getting sense that is checking with the action taken is correct or not.

The system can work faithfully provided, this is important line incoming sliver readability follow the same nature as that of the one being sensed, and hence more suitable for controlling long term irregularity; that means, look at this point very
carefully. Whatever I am sensing, and when I take the actual action in the process, the material that has been sensed that has moved out of the process because that material is ahead of the process. It has already gone through the process.

Therefore, the action being taken is on a material which is different from the one on which we have sensed the mass variations. So, here the basic assumption is, that whatever we have sensed and we expect the similar variation in the mass exists in the material; that is, within the process. That is the basic assumptions here, that whatever the material that is at the sensing point stage, and the material which is behind this there all similar in nature in terms of mass variation.

So, at the sensing point suppose the mass has gone up by 20 percent. We also expect that the material which is there within the process also has an increased mass of 20 percent. That is the basic assumption in this case; that means, if there is a long term variation in mass, then this system will faithfully try to reduce the mass variations.

This is advantages are short term errors cannot be eradicated as the material passes the sensing point by the time a correction is initiated. If you read the next line, when correction is initiated the material at that moment, at the control point may be normal. This point is very important to understand that when the correction is initiated by the actuator in the process.

The material there may be normal, that mean what we have sensed at that point it maybe little thicker, but the part of the material which is there in the process may be normal. Or the material which is there in the process may be opposite in nature, when the sensing point sense the material which is thick the material which is there in the process may be thin; or when it has sense at a thinner region, the actual material in the process could be the opposite in nature and what we do if we take corrective actions in such situations?

Then you will make the sliver more irregular. Because if a normal part is there in the process in a sensing point is sensing a sliver to be thicker, then it will increase the you know draft; and therefore, the normal material which is there in the process will be stressed unnecessarily or if a thin region is there is going to be stretched. So, it will be still thinner.
So, therefore, there is a risk that this particular principle may lead to development of short term errors, or it can very short term errors it will not be able to completely eradicate. And if the thick and thin regions are very, very close to each other, that mean when the variations are over very short lengths, then the system this particular principle is not going to be very, very effective because of these reasons.

Therefore, what we see that the open loop and closed loop principles have their own advantages and disadvantages. And therefore, people have developed autolevellers which works on the principle of both so that we get the basically benefits of both the principles.

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Now, desirable features in a autolevellers. What are the desirable features that we expect in an autoleveller? One is longs term stability. That is the mean value of the sliver count should not drift with time. That is called longs term stability of the autolevelling system. Performance reliability reproducible settings and a wide control range. With chute feed a large variations may occur generally plus minus 25 percent or more, and therefore, it is especially important for chute feed card also.

That is, we must have a wide control range that is plus minus 25 percent variation, we should able to control especially chute feed card system. Nowadays, most of the modern spinning units will have chute feed system and chute feed the carding machines which are there they are directly attached to the blow room line. The variation could be to the
order of plus minus to the 5 percent. And therefore, all the modern chute feed cards are having their own inbuilt autolevellers.

So, these are the features which we expect autoleveller, longs term stability is there also important. For the sliver count on it is own should not drift after autolevelling. The sensors has to be very, very robust, you should not it is you know sensing capability should not change with temperature or with humidity because we all know that as the machines run. The temperature will go up, that will be is humidity also in the card room and in the draw frame that could be deposition of dust; which will be fibrous dust or it could be otherwise dust on the sensors.

So, the sensor should be able to perform under such conditions when temperature change could be there humidity change also is possible, as well as deposition of dust could be there. So, that is what is important that is performance reliability and long term stability of the sensors. And therefore, entire circuitry everything which is associated with autoleveller is very, very crucial for the right performance of the autoleveller.

Now, we come to a typical draw frame autoleveller.

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A diagram is shown here open loop autoleveller which is used on a draw frame. So, what we see here that there is a drafting unit in front it is a 3 over 3 it simple drafting unit
being shown here. And there is a measuring tongue and grooved roller which is actually this sensor in this case.

So, here is the sensing point, and behind that there are 2 guide rollers which is actually this guide rollers are in the creel of the draw frame which is feeding sliver. So, if we look at it this is basically open loop system, because we are measuring the sliver thickness using the tongue and grooved roller which is placed behind the process.

So, the process is here where the drafting zones are there, but the sensing point is behind it. So, sensing point and control points there is it there is a distance between these 2. And the rest of the things are same, the signal flows to signal converter signal output there is a delay because there is distance between the sensing point and the draft zone. Now here we will discuss (Refer Time: 48:06) it is a 3 over 3 drafting; system with 2 drafting zone. In most of the draw frames we have whatever is the rollers meant with the drafting zones are always 2.

So, the question that will come to our mind is that there is a draft in the front zone there is also draft in the middle zone. So, which zone draft needs to be changed in case this sliver is coming thicker or thinner. What we should take the control actions? We will discuss this point, otherwise the signal flows it compares with the reference signal and there is a delay and there is amplifications, and then it goes to the could an actuator, and from there the control motors which will be able to control the draft. So, we will come to the next slide; where we are showing the sensing rollers.
There are 2 types of roller, one is smooth sensing roller as shown in the diagram, another one is grooved sensing roller; you see the sliver cross section is shown. So, all the sliver that we feed in the creel 6 sliver so, 8 slivers. So, the ultimately pass in between these 2 rollers, and the combined thickness of all the 6 or 8 slivers is continuously measured at the entrance of the machine by this pair of scanning rollers.

The sensing is done by this groove and tongue arrangement this scanning rollers are actually the design is look like this; that this sliver is compressed between 2 2 disc. The width of the groove varies from 3 to 10 millimeter depending upon the sliver weight, and the type of fibre that you are going to process; that means, the groove roller that we see here that needs to be changed depending upon the hank of the sliver or the type of fibre that we are going to process. For bulky material and heavy sliver, the groove width will be always more.

Because obviously, the volume is going to be more and hence if we move from quadrant or some other fibre of same hank, who still needs to change the width of the groove because it is a very bulky material density of the fibre is less. There is a pressure which will act on the sliver is not one sliver, but remember there are 6 or 8 sliver being fed.

So, typical load on the sliver is going to be around 120 dekaNewton, that kind of pressure or load is applied. So, the sliver is compressed, and then only we will get to
know how much variation is happening in the thickness of the material which is compressed between the grooved rollers.

For bulky material like crimped polyester acrylic polypropylene the load needs to be increased; which is 160 dekaNewton. And with speed of the delivery the load also needs to be increased. So, depending upon the type of fibre being processed, the hank of the sliver delivery speed, we need to change the load or the width of the grove.

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So, electrical signals are stored into the memory. We have to store it because, this control point is ahead of the sensing point, it is open loop system. So, there is a need to store it, and that has to be delay. The signal there is sent for comparison with reference value already said. Depending upon the nature positive or negative deviations, we are checking because we are comparing with the reference signal.

So, that could be a positive deviation there could be a negative deviation. The thickness is more the deviation is going to be positive the thickness is less than the reference then deviation is going to be negative. And once this deviations goes beyond the tolerance limit we have to change the draft, a draft change is initiated. In the main draft field by altering the speed of the middle roller, why a planetary gear train connected to a servo motor.
So, ultimately what we are doing? Either we are changing the draft, but draft where draft in the main draft zone. So, whenever in the main draft zone I have to change the draft. So, I have 2 options we will discuss this point, should I change the speed of middle roller and change the draft or should we change the speed of the front roller and change the draft; which is the better option and why.

We will come to this point, the speed of feed roller and the sensing rollers are also changed proportionately, when we change the draft, we are changing not only the draft in the main zone, we are also changing the speed of the sensing rollers as well as the guiding rollers, that is feed rollers so, that the tension in the break draft zone and between the sensing and the feed roller do not get changed. So, if I change the draft here, in the middle in the front zone here, we have to see their draft in the back zone should not get disturbed. This should not get disturbed similarly the tension draft which is there should also not get disturbed.

This is what we have to and so; that means, if I change the draft in the front zone, we have to ensure that the draft in the rest of the zones should not change.

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Now, we will come that the regulations of by changing the draft, but where we should change the draft what is the reason. So, control can be exercised either in the front or the back zone as I said both the options are there; front zone draft is high generally, the back
zone we have seen on a draw frame the draft could be around 1.3 to 3.7 or the front zone top could be more than 5.

So, draft is high in the front zone, and the quality of the sliver is less sensitive to the change in draft in front zone. This point is important. See in the back zone, the break draft we call it this draft is generally very, very sensitive to the quality of the sliver. Because here the draft is such where stick slip phenomena can occur in the movement of the fibers.

We have seen if you recall the drafting force versus draft diagram, then you will find that when you are going near to the peak of the drafting force, a drafting force fluctuates. That is basically and very unstable zone. So, if in the back zone the kind of draft that we keep this is very close to this, and therefore, any change of draft in the back zone make fall it in this sensitive draft zone.

And thereby it can create lot of irregularity into the product therefore, to avoid that is better to change the draft to the front zone; where draft anyway is very high maybe around 5 or so, it is very little change the draft I make suppose I reduce the draft from 5 to 4.8 or go from 5 to 5.1. The small change in draft in the front zone we will not create much problem as per as the drafting irregularity getting generated in that particular drafting zone.

Whereas, this small change in draft in the back zone may be very, very dangerous. And therefore, we avoid changing the draft in the back zone, and we generally change draft in the front zone. The correction length also becomes longer due to draft present in the front zone.
Next question that comes to the mind is if draft has to be changed how? We have said that we change the draft in the front zone. One is by changing the delivery speed or by changing the feed speed for that particular zone. A change in delivery speed that if I change the speed of the front roller, in the main draft zone, then what is going to happen? The speed of production is going to change.

A change in delivery speed results in change in production; that means, the production rate from this machine will be continuously oscillating. Because I have to continually change the front roller speed to adjust the draft. And that would make the coiling of the sliver also quite difficult, that also we will continually fluctuate. So, we do not want to do this we keep the speed of the front roller at the same level, we do not change it. What we do? We change the speed of the middle roller.

Accelerating or decelerating the middle roller is speed is always better. That speed change is also little easy, because the speed of the middle roller is almost 5 time less and the speed of the front roller. That was he have to remember, the front roller rotates at a higher speed because of the draft. Whereas, the middle roller speed is much less almost 5 time less.

So, I have to accelerate or decelerate the middle roller which is generally lower in terms of it is diameter. And second thing is speed is being less, changing the speed by any mechanical means is little easier.
We go to now the medium term autolevellers; the other thing that I must say that when you change the speed of the middle roller, we will simultaneously change the speed of the back roller also. So, that there is no change in the draft of in the draft in the back zone.

So, middle roller speed and back roller speed are simultaneously changed, if we need to change the draft in the front zone, in order to take care of the mass variations in the feed sliver. So, that is how the speeds are changed. And the moment I say that we change the speed of middle and back roller simultaneously, then what happens?

We have to immediately simultaneous change the speed of the scanning roller, and the guide roller also. Because if we change the speed of back roller just imagine, but do not change the speed of the scanning roller, or do not change the speed of the guide rollers on the creel.

Then the tension draft which is there is going to be high or going to change continuously. And that will also may create problem with the irregularity that will generating a tension. Draft is more thin place we generated in the sliver because slivers are quite weak in nature. Therefore, too much of tension draft is not good for them.

And therefore, we need to change the speed of guide rollers, scanning roller or the sensing roller, the back roller, and the middle roller all together. And hence we have a
separate drive a planetary gear train through which we will feed an extra speed. And we superimpose on the existing feed that we get from the main motor.

So, here for this we the arrangement which is there the mechanical arrangement which is there, that and excess speed is generated by another motor, and this excess speed and the now (Refer Time: 62:17) speed that we get from the main motor these 2 speeds are basically superimposed on each other, and that is done by an planetary gear system.

Now, comes the medium term autolevellers. The diagram is shown here, principle is closed loop control system is not open loop. Therefore, the sensing point has to be in front of the control point. So, here the measuring trumpet is shown here, where we measure the thickness of the deliver sliver.

So, this trumpet it you know is regulated view of the trumpet is shown in another diagram, the sliver is made to pass through this. And it gets compressed, because there is a trumpet over here and which is passing through this, depending upon the thickness variation, there is a pressure transducer placed and the pressure transducer we will sense the pressure, which is getting generated and that magnitude of that pressure we will give a signal. And that signal that there is become the electrical signal that signal we compared with the reference signal.

So, when the more mass is present in the measuring trumpet, then the pressure transducer we will experience more force on it, and therefore, stronger signal will be generated. So, therefore, there is no mechanical system is used in this case because of very high delivery speed. Today’s draw frames especially will be working at a speed of 400, 500, 600 and 700 meters per minute is very, very high speed.

So, mechanical system, it may not be very you know efficient at such high speed. So, an active pneumatic measurement at the sliver output, x is a sensing point, that is what has been shown here. The control point is similar like the normal drafting unit. Here we are showing only 2 rollers, but actually it could be 3 pair of rollers or any other normal drafting arrangements rollers has been which could be there where we have only 2 zones.

So, he sense by the measuring trumpet and the signal is compared with the reference signal, that remains exactly same, and then depending upon the deviations it is beyond
the tolerance limit. We will change the finally, the speed of the middle roller along with the back roller. So, that the draft in the front zone is only changed.

So, we are changing the speed of both middle and back roller simultaneously. And therefore, the draft between middle and back roller is not going to change, but only the draft in the front zone is going to change. And you are simultaneously also changing the speed of the guide rollers.

So, that the tension draft does not change.

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Need for combination of both open loop and closed loop autolevellers. Open loop control compensates short and at the most middle term or medium term variations. Closed loop control compensates medium and long term variations, that is the advantage of course loop.

So, a system based on only open loop principle has a potential limitation of not being able to detect. The slow shift in the mean value of sliver count and this is sets to have a system that works on the principle of both open and closed loop principle. That is the reason that machine based on only one principle is not good enough.

So, we need a machine or autoleveller which will work on the principle of both so that mean value up count as well as count change or mass change in the very short term medium term long term the entire spectrum of the irregularity can be controlled. System
designed on open loop principle, the correction length has been brought down to 3 centimeter depending upon the operating speed.

Today that is the achievement it has been brought down probably still further. So, correction length has been brought down what is correction length we will be discussing also. And for system designed on closed loop principle the correction length lies between 5 to 10 meter.

So, open loop it is coming into centimeter, for closed loop the correction length is between 5 to 10 meter for sliver length; when the correction is initiated in the main draft zone, or 10 to 20-meter sliver length when correction is initiated in the break draft zone. Generally, we do not take correction in the break draft zone; because as I said there is a chance that it will fall in the stick slip zone of drafting and we will actually generate more irregularity into the drafted product. So, the correction length is more for closed loop autolevellers why it is very small for open loop autolevellers.

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Therefore, to avoid the disadvantage of both open and closed loop principle, both the devices are combined together. So, that is the reason why we have autolevellers where it works on the principle of both open and closed loop. And capacitative sensing is performed at the infeed and mechanical or pneumatic sensing in the delivery.
So, there are sensors which have been developed to sense the mass of material which is on the sensor, and they work on 3 principles one is capacitance principle, we sense the mass like you all know that when we try to sense the mass of yarn on uster evenness tester. And in this uster evenness tester, the sensors will be working on the principle of change in capacitance value as the yarn is passing in between the capacitance plates.

The other one is the mechanical sensor like we have shown earlier grooved rollers are there and between the grooved rollers the material is compressed. So, whenever mass is more the grooved rollers will move up and down. And this up and down movement of the grooved roller is what is actually transformed into an electrical signal. So, there the it is purely mechanical in nature.

The other one is pneumatic sensing; where a funnel is used the metal is passing through it, when this fibers rusts through the funnel, it also carries along with it lot of air. So and when these fibers are getting compressed, as it is passes through the channel, the air which is there in between the fiber, the spaces in between the fibers are occupied with air. And when this fibers are passing through the trumpet, these fibers are getting compressed. The air is wants to escape and yet create pressure, and that pressure is what is actually sensed in this type of pneumatic sensors using the trumpet.

So, what we sensing there is basically air pressure. And why does air pressure? Is because I am compressing the fibers and there is lot of air in between the fibers, and that air is trying to escape and we have placed a sensor there sensor is sensing this. So, that is based on the pneumatic sensing. So, these are 3 types of sensors which are used in the autolevellers, with this we close the discussion today. And we will take it up in another, you know, lecture the autoleveller is not yet you know not yet complete. So, one more lecture will be there on the autolevellers.

Thank you.