Farm Machinery
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Lecture – 48
Combine Harvester

Welcome students to my lecture number 48 on Combine Harvester. In fact, if you a undergone my earlier lecture you might have seen that have talked of the harvesting equipment various types of harvesting equipment for serials root crops, fruit crops, vegetables, etcetera. And then I said at one point of time that combine harvester combine means that you have various operations way for cutting then threshing and then cleaning and then bagging. So, all these are operations which are taking together and that is why we call this machine has combine or also known as combine harvester.

So, we would talk about this particular combine harvester. You would also talked about suppose you have to test this such a combine, then what is the procedure you should follow, what are the parameters that you should measure and how you should certified? Because these machines are also available in the market and the consumer would like to take a product which is acceptable to the farmer and which does not give a lot of losses because the losses are one of the important parameters of this particular machines. If the losses are very high, they will not be accepted by the consumer or the farmer here in question.

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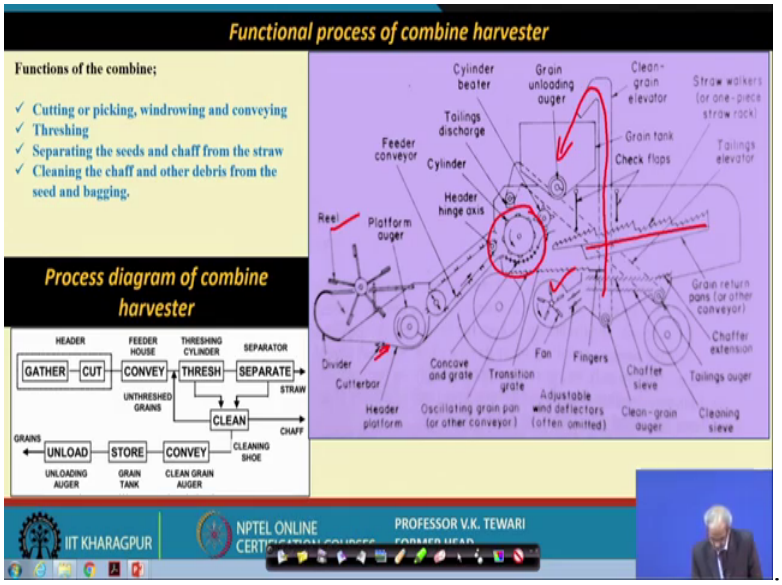

So, let us have a look at this combine what are its details. Well here, I would show I will let you know that the various functions of the combine cutting, picking, windrowing, and convey threshing, separating the seeds chaff from the straw, cleaning the the debris, chaff and other things from the actual grains. Now process or diagram of the combine harvester here what is the procedure? In fact, if you see that there is a reel and this reel is the job of this reel is to bring the crop closer and then the cutter bar is there, this cutter crops are brought together and they have the small you can see the rods and those rods move and they try to bring the crop closer and the cutter bar is there below which will cut and then they are convey it.

You can see here that they conveying is actually this will go on to the threshing drum and on dumb. Once they are threshed and let us go through the deals of the combine harvester, what are the various functions of combine? It includes cutting, picking, windrowing conveying and then threshing separating the seeds and chaff from the straw, cleaning the chaff and other debris from the seed and bagging. Now these are the different operations which are there in this. Now we will like to have some details of this and where they are done? In fact, this is a process diagram which is given gathering initial gathering when the reel is there in front the reel gathers the plants and then the cutter bar is there. So, this is the reel which is this is reel here then this is here the auger and there is a cutter bar is over here then this these one for conveying, this is one for threshing. This is the location where this is which is known as straw walker and then after this the there is a blower here, there is a fan which will try to after harvesting and

the straw will go away from here and the threshed grain will fall into this and then this will be in fact that taken and put to bag.

So, this is this is the process there more details are all given in this particular diagram. Once you go through this diagram you will be in a position to understand each and every aspect, but these are the details of a particular combine. So, as such as I told earlier combine harvester is that combining several operations and functions. Now let us see more details of this particular device and the equipment sorry unit operations and relevant losses in the combine, yes it is very important to know the whether this cutting and gathering.

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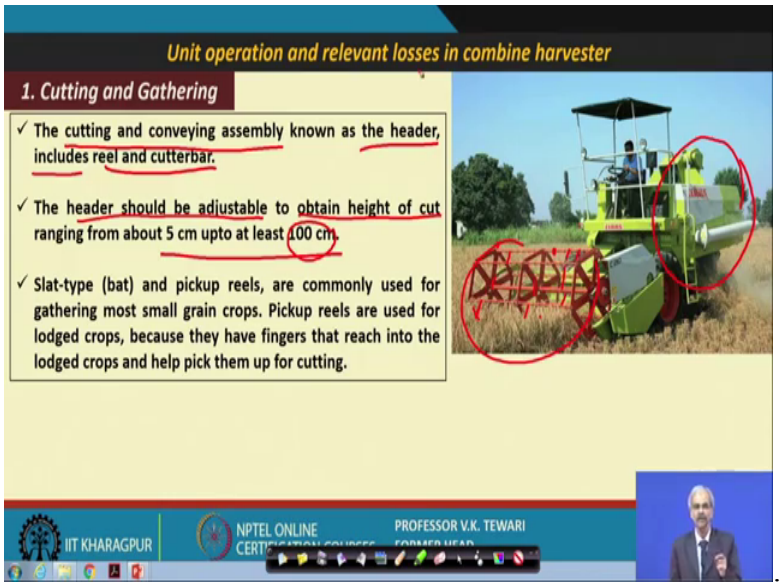

See when the machine is working in the field there are various losses. Now you remember as I told you in the beginning that the crop must be harvested at a certain moisture content. If the moisture content is very low; that means, the crop is very dry. So, if there will be a losses because the moment machine touches the plant, so there will be sheltering losses, they will just shelter.

Then their losses which will so cutting and gathering. So, during cutting and getting there will be loss is taking place. We can check in here cutting and gathering cutting and gathering conveying assembly known as header includes reel and cutter bar yes this is there then headed should be adjustable to obtain height of cut very important. If the height of cut is very much high then you need to cut this again. So, this is important I

need where is from this to about the ranging from 5 centimeter to at least 100 centimeters. I think this is too much 100 centimeters about 1 meter or so.

But this is where is the higher side. Generally we would not like to go over 3 to 4 inches also and it has been seen that in working condition about 20 to 15 to 20 centimeters or so. Now, this is the reel which is there and this reel has a small if you can see this that this reel has small bars and these bars collect the material and the cutter bar is below here, which will cut. Now these are the other portions of the machine which we are discussed.

Let us see what are the relevant losses the losses are important at each and every aspect let us say when a cutting takes place as I said if the cutting is not proper a moisture content then the loss we will start just while taking a touching itself then when it is being conveyed there will be a loss when it is and being threshed there will be losses then there will be losses when the blower is there with the some of the good grains will go away some of the good grains will also be on the straw walker and the straw is going along with that if proper threshing is not done then there will be losses on that. So, these are the losses which are relevant to the various unit operations which happened in combine.

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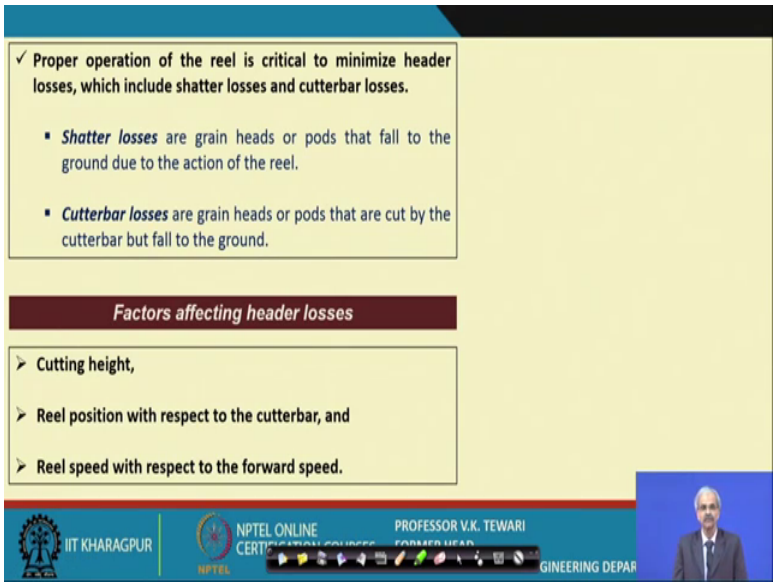

Proper operation of the reel yes if the proper operation, if the reel will not take place as I said then sheltering losses will take we call them shelter losses then cutter bar losses if the cutter bar see the pots etcetera may fall on that itself. So, they will remain because

though they those could not be picked up because the crop has been cut and it has been conveyed for thresh, but those pots and some of the grains which will be there will be cutter bar they will be left there and maybe sometimes left in the field itself. So, there is another loss.

Factors affecting header loss now what are the factors have a have affecting header loss cutting height yes at what height you are cutting this is there will be a loss which is taking place reel position with respect to the cutter bar what is the position of the reel many a times if the reel is not properly aligned with respect to the cutter bar then also there will also losses taking place because when you come across the a plants there will be deflected differently as compared to what is required. Then reel speed with respect to the forward speed yes this is very important. In fact, we will also show you through a problem that what is the importance of reel speed with respect to the forward (Refer Time: 08:08) of travel the if they are yet not unison then you will find that the proper action is not taking place and losses will be increasing.

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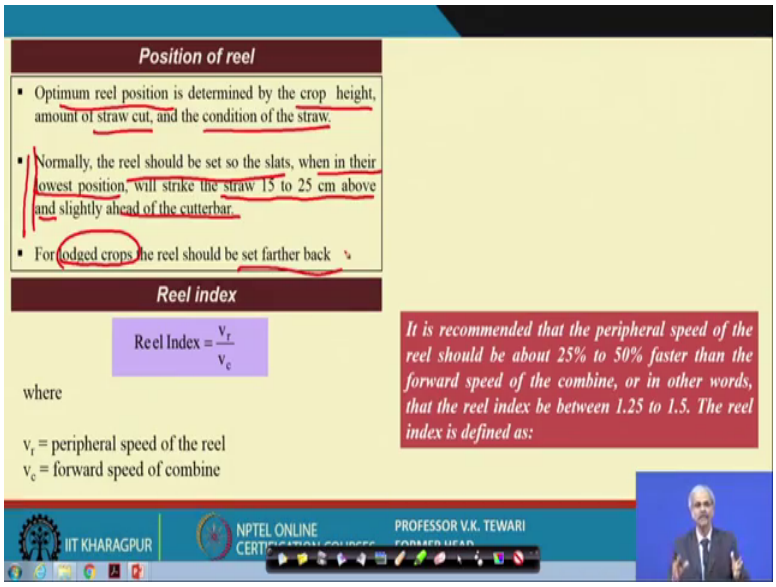

So, position of the reel where is the position of the reel? In fact, as i said the position of the reel should be at the in the front of this. Now what is important here is see optimum reel position is determined by the crop height, this is very important what is the height of the crop because they depending upon the variety of the crop that has been taken the height will also very short duration varieties short height of varieties in heightening

varieties depending on the height. So, you have to be careful and amount of the straw cut and the condition of the straw. So, on the basis of this you have to position the reel with respect to the cutter bar.

The normally the reel should be set to the to show that when in the lowest position it will strike at least 15 to 20 centimeter above and slightly ahead of the cutter bar. This is very important you see that normally this is what we require and why because we want that the crop height has been taken care of the lodged crops, yes this is one of the big problems should be set farther back. In fact, this is one of the biggest problems of the combines or for any harvesting equipment harvesting machine.

Because many a times just to at the time of harvesting will find that there will be a storms sort of thing and then whole crop is completely lost and completely flat position the field and it is very difficult. So, god forgive this situation should not come, but then they do come sometimes and we lose lot of crops. So, for that in fact, there are specific arrangements have to be made. In fact, some of the arrangements in the machines are made and then their cut in such a way that we would recover most of the crop.

Now, what I was talking with respect to the reel here? I said that there has to be proper a speed of the reel and the forward speed of the machine. Now this reel index is very important that is why a reel index have been given here. Now this needs to be maintained. So, this value of this it is recommended that the peripheral speed of the reel should be about 25 to 50 percent faster than the forward speed of the machine or in other words what we say that reel index should be 1.5 to 1.5 this is what it is. So, it is very important because remember that if the reel is not there you are simply not cutting the crop in the proper position and there are lot of losses will take place. It is not gathering in front of the cutter bar. So, these are very important to learn what is reel index and what should be the value maintain.

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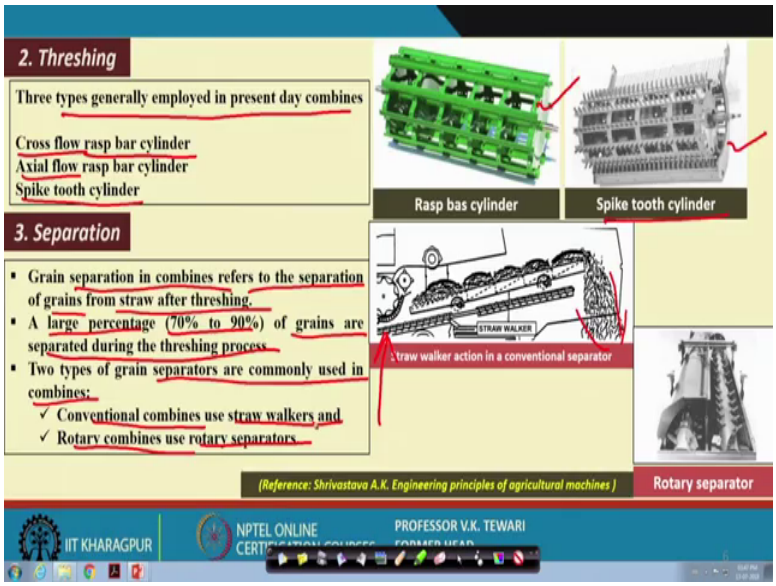

Well we have it since it is a component, although we are we will be teaching threshing separately in the second lecture lectures of today's, but then since it forms the part of combine. So, I have shown you here I am would like to briefly talk about this maybe details of the design etcetera will take up later in a later session of the classes, but here we will briefly tell you what are these are and what are the various types which are used.

See the types generally used in the combines a rasp bar cylinder type axial flow, cross flow, and spike tooth cylinder. Now you could see that these are spike tooth cylinder once this is given here rasp bar type this is one which is rasp bar type and the spike tooth. In fact, some of the you can see that the spikes which are there a rotary cutters have. Now separation what do we how do we separate all this thing? Straw walker action in a conventional width. What is the action of the straw walker? In fact, you can see here that after the thresher now what is this is what is this going on here you can see these details.

. So, the separation is grain separation in combine refers to these separation of the grains from the straw after threshing this is what is exactly is being shown here. So, when a large percentage 72 to 90 percent of the grains are separated during threshing process itself here itself because they were separated from the straw, but then they this process when it is go in the straw walker that is why it is known as straw walker. In fact, there are it is purposely made. So, that whatever is left will be separated farther types of grains the separators are commonly used in the combines two types of grains only conventional

combines use straw walkers and rotary combines used rotary separators. Now these will help farther removing not much, but then we do some of the crop grains here also.

So, these are some of the other aspects of the combine which we have. We have talked of the cutting we have talked of the reel if we have talked of the relationship between the rotation of the reel and the forward speed of the machine then we have talked of the threshing, then we have talked of the separating separation, let us see what else are the parts and how do we understand that.

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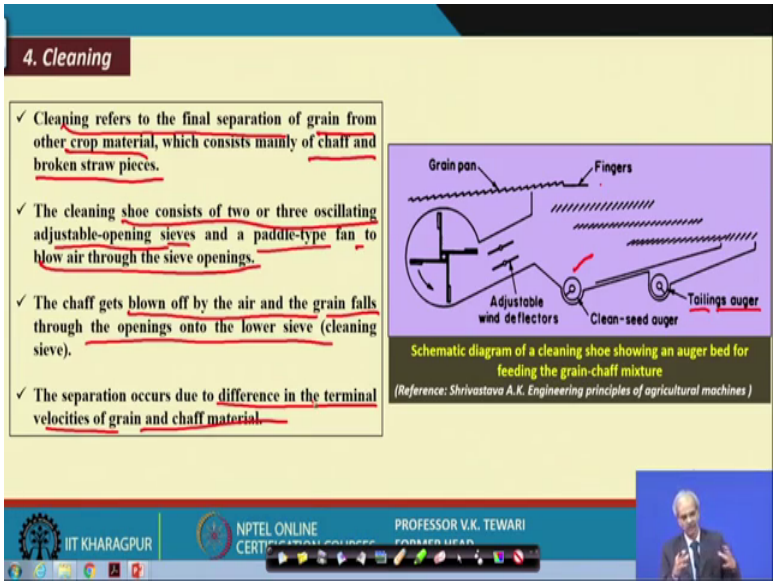

Cleaning very important, because you have got the job done, but then cleaning is very important because otherwise you will need people to clean that generally what is manually how people clean is once the grains are threshed. They will have blowers made and then the whole the chaff and the grains are clean. In the machine we would like to do this. So, how these are done? See the, this particular diagram which we have picked up from the literature and the reference is given here. You will see that how we are trying to create and clean it.

Cleaning refers to the final separation of the grain from the crop material, mainly chaff and broken straw pieces are there with this cleaning shoe consists of two or three oscillating adjustable opening sieves pedal type fan and blower through the sieve opening. So, that you can see here these are the this is the grain pan here, these are the

fingers here, now this is the cleaner clean seed auger here then this is the trail trailing auger and these are the adjustable flats you know here is the one which will blow.

. So, the chaff gets blown off air and the grains falls through the openings. Now this will fall through the openings of these and those will be the other portion other portion will be move to the outside the chaff etcetera. So, the separation occurs due to difference in the terminal velocities of the grain and chaff material. The chaff is lighter one and this is this. So, when the speed the blower is blowing air. So, depending upon the density or the velocity of the grain these will fall because the grain is heavier than the chaff. So, the chaff will be thrown off and the grain will be inside lift it and then brought to the bagging side. So, this is the operation which takes place. A schematic diagram is shown in cleaning shoe showing and auger bed for feeding the grain chaff mixture. This happens in the clinic cleaning process of the combine.

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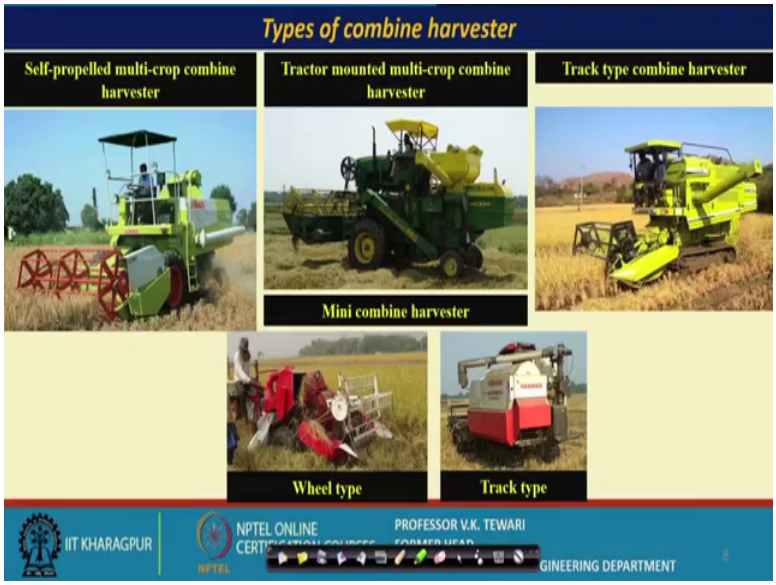

Now, these are the various types of combines, it is I think worth going about this and having a look at it. In fact, there is a question mark which you might have you would like to ask me that why this big machines in the country like ours where 60 percent of the people are having smaller fields less than one hectare or so. So all small fields only 10 percent of the parts are very big, but here now the economics engineering economics works into play.

So, you have to think of this part because then if you do not consider this economics you will have to have a small farm farmer having a small form he will have to have 5 6 machines, see for example, he will have to have machine I might have also give a reference of the same thing in my first lecture or so that you will have to have machines for each and every operation, see the first operation in the preparation of the land and second operation will be the CD , third operation will be weeding, fourth operation plant protection and then harvesting threshing and then bagging etcetera and then transport.

So, for each and everything he has to look for small machines and then that way you will find that he has to have power source and even many a times these small machines will not be that much effective even the person who would like to do it faster than that. So, we have to be very careful about this because if the if we he has to purchase so many machines and to maintain them, there will be problem. Now in order that he does not have to maintain this, but if he can rent it, he can hire these machines and get the thing done. In fact, we will show you some of these machines, which are being operated all over the country. In fact, from the northern belt from Ludhiana and other north of India they come to be various parts of the country in eastern parts in West Bengal and I will show you some of these videos which have been operated here and being operated and above 20 25 30 percent of this machines are very much popular in this area.

And so custom hiring or the concept of self help groups or you can create a group a engineers can come together and I have groups or maintain a setup machines such machines which will give you either a combine or a combine harvester or you can think of two three machines together for a crops setting or for a crop rotation and once those machines are there with you it is possible that you can rent and it will be easier for the farmer, he will get without having an botheration about the about the owning of the machine the maintenance of the machine and its shelter and then paying the insurance and things like that he will have to just pay per unit of time and get the work done and have their machine in have do not have the machine and have the crop bag in his format.

So, for that the various machines are available. Now I will show you what are these self propelled multi crop combine harvester one which is available, mini combine harvester. This is a small machines which are also available then wheel type and track type. In fact, sometimes, what happens even in West Bengal. Here we have seen that water logging is

there and the crop is ready to be harvested. So, at that time this these wheel machines wheel type ones are very difficult to be operated.

Tractor mounted multicrop combine harvester, now there are machines which are available and some of the manufacturers in Ludhiana and other parts in Northern belt there are there and they have the combines which are tractor mounted they are mounted on to the tractor and taking power from there for the operation of the whole system.

Then track type combines yes as I said the track type combines if are very popular now a days because of the slashing conditions of the field and as I said in particularly in West Bengal we have seen that because of the time at the time when the crop is ready for harvesting you will find that the whole field is filled. So, this is not possible. So, these machines have worked very well and in fact, they are very as I said earlier they are very much being taken on custom hiring basis.

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Now, let us have a look at the operation of these machines. Now you see this machine this is being operated in one of the farmers in very in West Midnapore or West Bengal near to IIT Kharagpur and we have taken this video from a to let you know that this is being operated in our country and people are using it and then custom hiring basis. These machines have been brought from you from Ludhiana and there being operated in the field and it is cheaper for them. In fact, on a minute basis because as I said the machine the area is very small; so, on a minute basis they pay.

So, if he this job is done in 20 minutes you will pay for 20 minutes accordingly. So, by minute is the cost that they charge for working these such machines and its worth having look at the operation of such machines you can see this how they are being operated and there is absolutely no problem the farmer faces. So, you can see the um the front side wheel and the back at you see at the back and then the details of falling at this details of this whole machine, you can see all the operations being taken place.

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Let us have operation of this wheel type mini combine. So, wheel type mini combine you see the operation here, this is a small machine and its operation is well except will, because he is less farmer who can afford he will be invocation to get this, but this is a wheel type. So, if the condition is better in this there is no problem here, but if the field is slushy and even some ponding of water is there then you will require different type of machine and I will show you and we would have track type such machines are also there. So, this sieve it is being operated very near to IIT Kharagpur and that is why I have this videos here for your, I mean visual appreciation that look this machines are available.

So, those who are not agriculture engineers if they will look at this they will know that these machines are available and those who are there agricultural engineers they will try to appreciate the principles behind which they are there and what is the economics of working with these machines. You can see that all the bagging are details are there you

can have a look at this , all the operations are being done you can see the hips being created and kept in the field.

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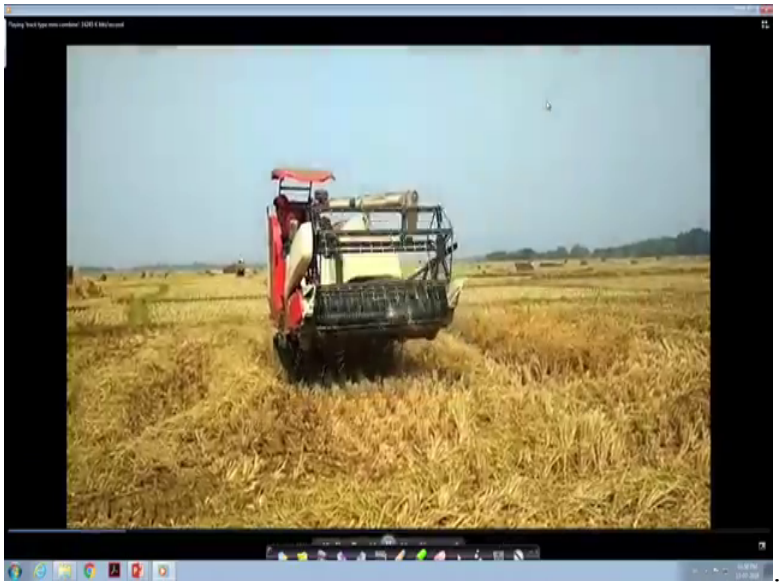

Now, let us see the track type one. Operation of the track type one, this is the track type you can see the big tracks are there have a look at these tracks; you can see the tracks and see you can see the whole area. In fact, you can see at various locations this is the case of West Bengal where people see that mechanization is not reached the mechanization about I can say that about 20 25 percent of the farmers are using these machines and maybe many have purchase, many have using it, these are custom hiring basis, many are using the ones which has come from other locations in the country.

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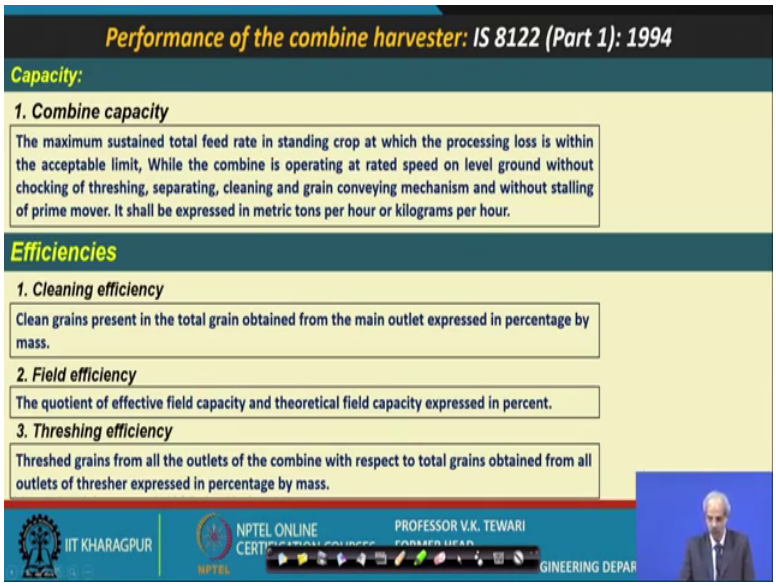

The performance of the combine harvester now, as I told that you should be also in a position to understand that what is this what are these machines and how they can be they tested? So, what are the details of this if you are asked to test the details of these machines when you will have to go about this information's in the combine capacity, what is the capacity of the combine. You must measure the capacity of the combine find out what is the feed rate etcetera and at what are the different types of losses, what are the various efficiencies like cleaning efficiency how clean the task is what is the field efficiency, how much hectare per hour it is doing and then what is the threshing efficiency, etcetera, what are thresh grains? So, these are the some of the important information's which are essential.

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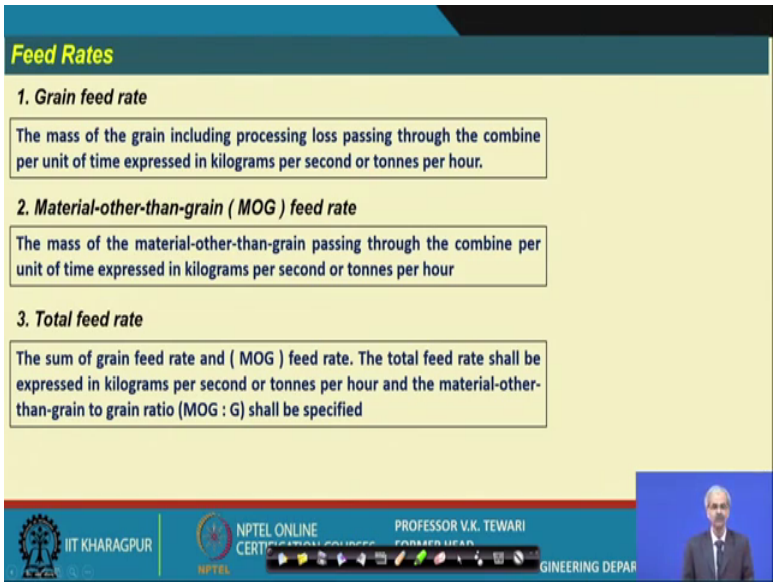

Feed rates, what are the different feed rates you must know? What are the different feed rate thing grain feed rate the material other than grain feed rate what is that feed rate if is a very I mean these details you will have to measure you will have to record and then put it to the person who has given this for testing. Total feed rate you will have to see what is the total feed rate some of the grain feed rate and the materials other than grain feed rate. So, total feed rate also will be essential and you should be in a position to inform the person who has given you.

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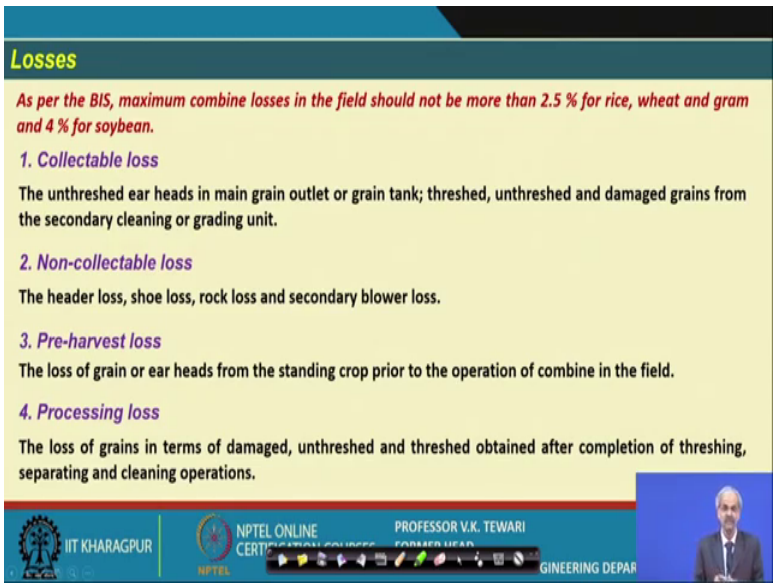

Then losses is a very important. In fact, the machines are rejected and accepted on the basis of the losses. So, the Bureau of Indian standards have check put a check on this that maximum combine losses should not be more than 2.5 percent for rice, wheat, and gram and 4 percent for soybean. Now this is the limiting value the maximum value of losses which you taken. So, that is why the manufacturer have to get it tested and see that their losses total losses are maintaining or being complied with the with these values these data the collectable losses what are the losses happening which could have been collected for example, the header grain loss the from the thresher unthreshed damaged grains etcetera then from the cleaning unit, grading unit then the some of the header loss, shoe rock loss, secondary blower losses yeah. These are the locations where the losses to take place.

So, if the manufacturer has to take care of all the details and see that we do not lose the crop then the processing losses it will be loss of grain terms in terms of the damage which are there unthreshed threshed obtained after completion of the threshing and all that. So, these are the different types of losses which was one must keep in mind and keep a record of this if he has to certify a particular device.

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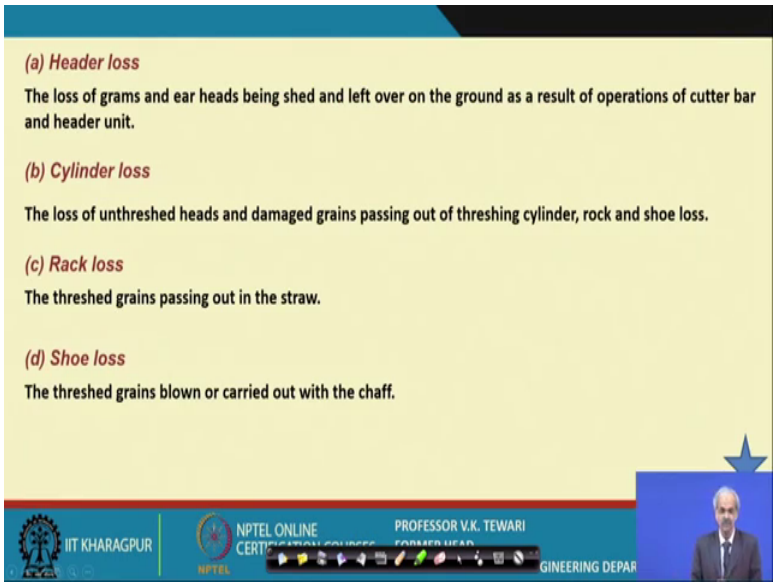

Ah the header loss very important, cylinder lost what are the losses which on the thresh a cylinder losses take place, the rack losses and the shoe losses. Now these are the losses which whom the manufacturers when they give and the engineer as an engineer you

would be interested to measure this record this and then put in a tabular form and then you give your signature that this is the machine on which this is the parameter on which this machine is acceptable not acceptable and things like that.

So, I can say that in this lecture we have just talked about the basics of a combine harvester. What are the various unit operations which happen in a combined harvester? What are the importance of each and every operation and the and the component which is there, what sort of losses do take place and where one as an engineer should be careful about that, what are the values which you should maintain while increasing or decreasing the forward is field of the machine because you have to maintain a reel index and things like that. So, I think we have taken care of the harvesting with respect to the combine harvesters and the smaller harvesters for serials the root crops, fruit crops, etcetera and well you might have several questions in your mind which we can always answer as and when required and look forward to your other queries.

Thank you very much.