Bulk Material Transport and Handling System
Prof. Khanindra Pathak
Department of Mining Engineering
Indian Institute of Technology – Kharagpur

Lecture – 59
Automating Bulk Solids Processes

So, welcome back to our discussions we have been talking about safety maintenance automations and monitoring which are the vital things in deriving the services of the whole systems which you have been studying about. So,. Now in a bulk materials this bulk solid handling is a vast area you may think of what is going on in the cement industry what is going on in the bulk material in the construction projects.

When there will be a very big multi-story building is constructed there also lot of bulk materials are handled when you do a very big bridge on a river is to be made at that time also you do whether in the manufacturing cement whether the manufacturing steel whether manufacturing aluminum manifold or whether you are smelting copper extracting copper everywhere you will be having this bulk material and there many operations are automated.

So, in our last class we just tried to tell you that brief introduction of the what is automations and then how it is there.

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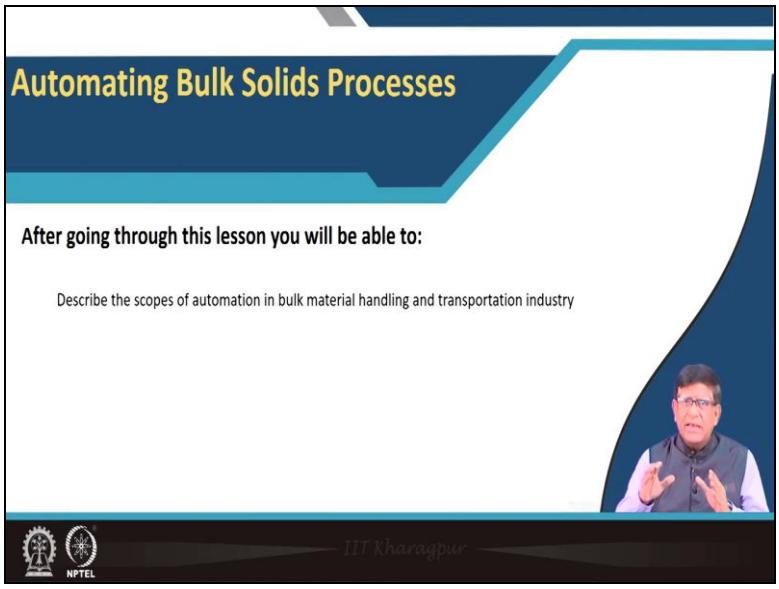

Today we will be discussing little bit of how to describe the scopes of automation in bulk material handling you have learnt something. Now you will be managing the technology in

bulk material handling there what type of automations exactly you should have or how you should hire services for automating your system.

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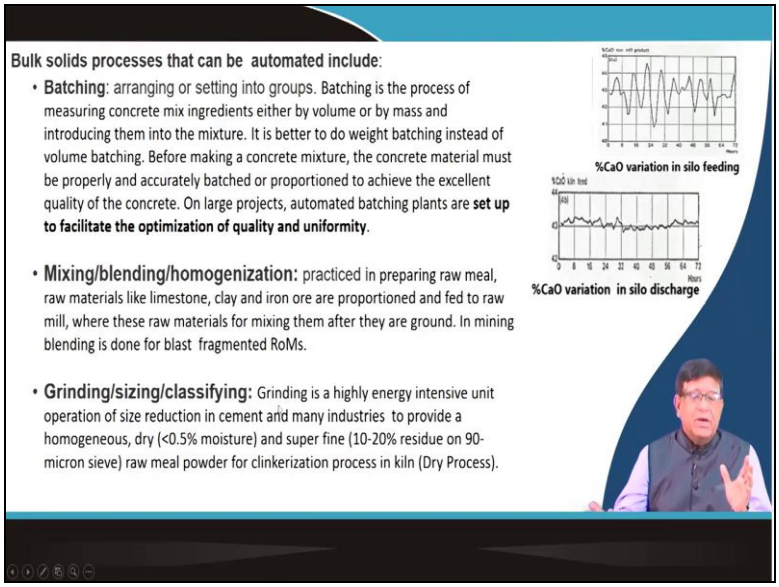

Now there are many types of things that happens in the bulk solid processes we do a lot of work as a batching. That is a batchwise means your arranging setting into some small groups that is your some operations are going this batch of operation is done the next bits of material comes with that you will be working next batch of like that your batch wise the work is coming. Say for example in your in your mixing in a pelletizing plant in a while you are making a pellet of iron or fines you will be bringing some bentonite over there.

Then this your some of your this iron ore fines will be coming and they will be putting over there then they will be going to a pelletizing they sense your rotary vibrations and from there the small pellets will be formed with they will be fed into a grate where they will be burnt and then again this small your the small pellets will be collected. So, this operation is one bench by another batch it will be coming.

Then there will be some operations where your this mixing and blending will take place say that is in say you are having iron ore of different grades with that means different concentration of Fe 2 O 3 will be there. Now if you are coming from different grade material then you want to homogenize it. So, that if you take any sample it will be giving if only a given percentage of the hematite.

So, that that way we need to know that this we need to observe say how the variation is taking place. So, for example in this graph you see when you are feeding to a silo that if your silo is taking up material from two different of your limestone source crust source of limestones are coming but you are allowing them to flow in such a way that when the material is coming out of silo you can see that calcium oxides concentration is coming homogenizing almost to the near to the 43%.

But when they are coming into the silo from different places you are not having any uniformity. So, that means the way you have control the flow rate of incoming material and then allowing them to get stick or get in silo that stored and then when you take out the stored material you are maintaining this. So, whole this process can be done automatically provided you can measure the concentrations the proper quality of this.

So, by monitoring the quality and then managing your storing process then you can maintain the uniformity of the product. So, here is the place where you may be having this automations will be playing. Similarly in grinding sizing and classifying you have learnt about this there is also in the grinding you know that to make the fines from the big lump you are releasing this more surface area what happens in grinding in the grinding when you are getting a small sparkle sizes.

Now that will be always increasing the surface area and also increasing the volume you may have that experience of if you take a potato if you make it ships over there and you can see that one simple product of this much volume will be now this much volume of chips. That means that are exactly when you have made that you have already studied about that in your crushing and all how your good you are getting a very energy will be always spend over there.

Now how exactly this size reductions can be made that is your you will have to make a homogeneous homogeneity will have to be available at the same time the quality of them also will have to be remain proper and for that you will have to automatically measure these things and then put it over there.

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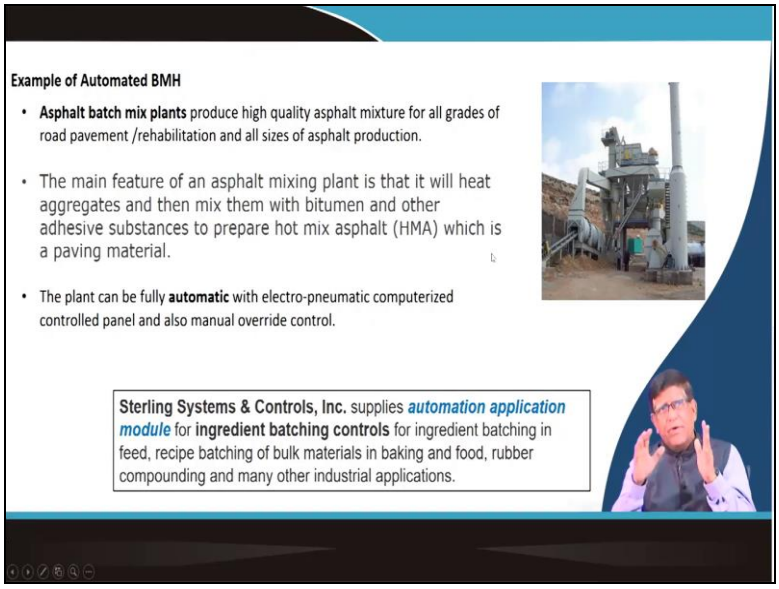

So, these are the area somewhere where you will have to use your automation in the industry. Now for example one that is your the that your when your hot mix has felt when you are preparing the hot mix asphalt in an asphalt plant that is your you are making it a batch mix one big batch is coming and then it is next is coming. So, in a big construction sites they can have a plant like this.

So, that the material your proper material is coming and you can exactly complete your project within a time. So, within a given time so, for that such type of plants which are exactly very modular type they bring it over there on the site they will install and commission within a short period and then when it is over it can be taken to another place also. Now there the operation of mixing and then maintaining the quality those things will have to be that can be done.

So, you when you are studying about this automation channel try to find out such type of applications where things are there it will give you lot of innovative idea that how very some big companies are making it. So, there is one company's website you can study that is sterling system and controls incorporation they provide they supply this automatic application module the automations how they put that how the ingredient control will be done.

And then they have served into that they have learned the technique of automations and they are applying into different field. They can apply in a biscuit factory they can apply in your many food making industry they can apply in the rubber tech industry, they can apply in the

mineral processing industry. A lot of this automation control that type of things will be there in the pharmaceuticals.

If you go to in Pune number of medicine making pharmaceutical units they will be bringing ingredients they are bulk material they are not coming in a packet but yes that bulk here will not be coming as a volume as we talk in the mining industry but the basic principle remain the same.

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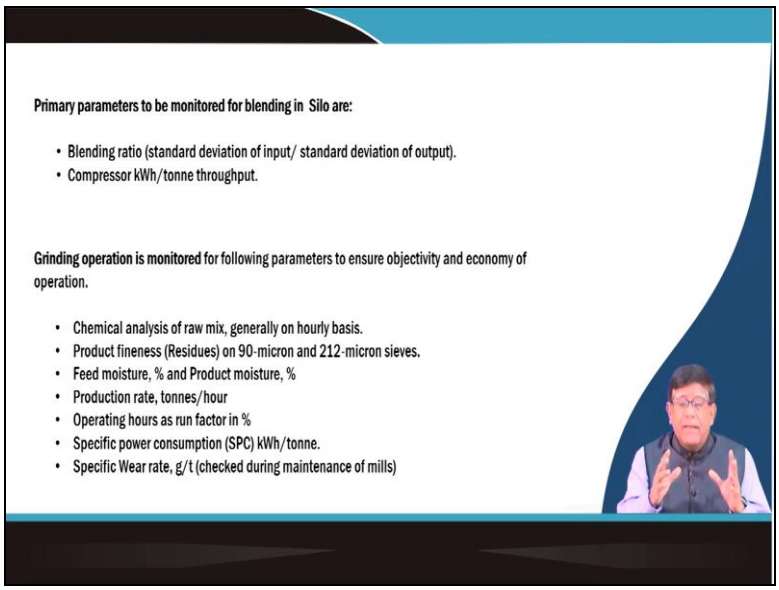

So, you can serve different industry if you know the basic understanding of the system and how it works. Now there is a primary parameters to be monitored in a blending in a silo I in the previous class I was telling you about an example of a silo. Now that in that silo how exactly the blending takes place you will have to measure and what you will be monitoring you will be knowing what is the blending ratio and then how much exactly the thorough put it is coming.

Now if these two things are monitored then your blending ratio can be controlled by allowing the input feed that means that speed by which it is coming you will be controlling the speed and then your the output that which is material going to the silo will be changed. So, that means their whole things will be automatically done. So, your sensing systems by which you are keeping a control of what exactly you deserve.

Similarly in a grinding operation what you will be you will be monitoring you will have to know the chemical analysis of the raw mix that will be sample will be taken and then that

sample test values will be coming then product fineness that is your how much that is yours particle size coming you can know then you can put the feed moisture content product measure production rate.

Then operating hour's specific power consumption specific wear rate all these things are to be measured. So, in any automation control your measuring or the sensing is a very important part.

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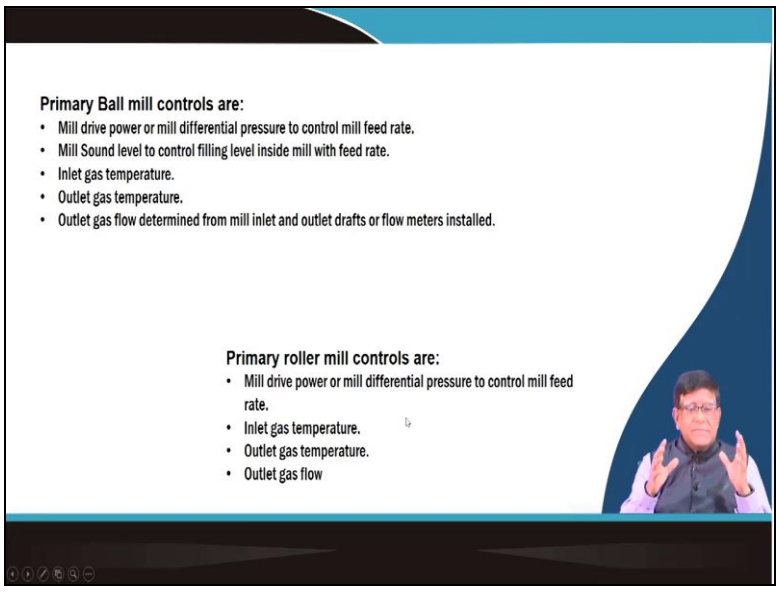

And then same thing happen in your primary ball mill controls you know that ball mill where you are doing the crashing there you will have to know that how the drive power how much it is coming how much sound it is giving. What are the your temperatures coming over there at that inlet gas outlet gas temperature. And by that depending on the system where you are applying the parameters will be different and you will have to measure it.

In case of your said is a in your the tertiary crushing in a iron ore if you think of there you are using a ball mill for after the secondary crushing's by your cone crushers and all you will be putting into a ball mill. Where you are giving the steel balls and your this input material is coming and you started grinding over there. Then how much material you have given and then how much material you are finding it out how much time of it is the material is having what is the residual time for it.

Now whether by increasing the number of balls can you have a different type of that is your the duration time can be reduced that means productivity can be increased for that number of

this automation exercises are done in the laboratory and on the basis they will be doing that how they will be controlling. Similarly the same thing happen in an auto genus mill your auto genus mill also you need to monitor that.

Because when you are rolling it that your the trommel you are moving it for in an auto genus mill but you will have to measure that exactly that crushing is taking place is how much and when it is that. Now that crushing is completed you will have to open the gate. So, that the material can go out. So, these depending on your application site which exactly your the sensing systems will be varying and then the controlling systems will be varying.

But as I said in the previous class that controlling can be your hydraulic pneumatic electromagnetic electro hydraulic that all electronics all these things can be incorporated. But for that you will have to know how this processes are taking place in a primary ruler bill what type of control will be necessary that is your what is the drive power it will be coming and there depending on the systems in case of your cement plants.

And then where you are exactly you are drying the things for the drying you will have to do by application of what gases you can dry. So, that there should not be moisture depending on the technology in that particular plant you will have to apply the things.

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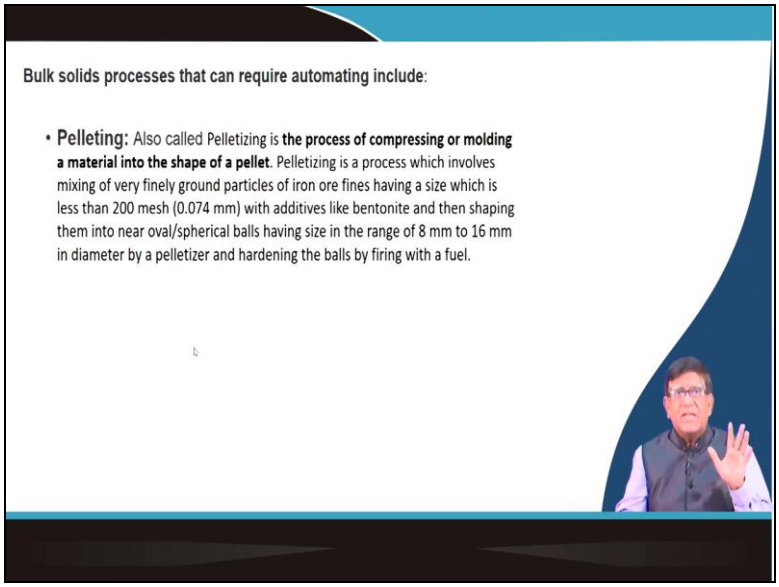

Similarly in your pelleting that is where your fines are combined combine together to make a pellet. As you know in the we have discussed sometimes that a lot of iron ore fines which are coming from the mine you cannot put into the blast furnace. Because if you put that thing in

the blast furnace you know that because of the gases that are coming your fine iron or particle it will be going along with the flue gases.

So, there is a always in the feed of a blast furnace is having a certain lump size but thing is that while producing that lamp size in a crusher you have done the screening and you find a lot of fines they are coming as a reject in India and there are many mines where a huge quantity of such fines are lying. Now that how to use them that when the sponge iron industry came up over there many of them they use this.

But how those fines even sometimes low grade fines they can be made into pellets that means that your all the class material how to make them into a solid pellet form which can be fed into blast furnace same thing was there a pelletizing as if you remember that our kudremukh had this magnetite mines where we are having only iron with a iron oxides were only 29%. So, that is why it is crushed and then beneficiated after beneficiating when it comes to up to 13 and 40% those are at all in a powder form.

So, there from could remove those powders were transferred as a slurry to Mangalore port in the Mangalore port they had this pelletizing plant in which these the iron or fines which were coming and there from the as a slurry that they dewater after dewatering you are taking out the iron ore concentrates and then you go into a pelletizing plant and they make the pellet which are we are exported there through a ship loader they will be a conveyor belt will be bringing to a ship loader.

The ship loader will be giving it to the barges or the ships and then it will be taken out for exporting purposes. Now in this whole operation they how that your pellet will be forming it will depend on a number of parameters that is your how much is it that size how much is its moisture content how much exactly other for pelletizing that how much bentonite you will have to be adding or what you your binding material will be adding.

And then the pellet once it is formed at what temperature that to exactly to form the pellet you will have to give the that your in a grate when it is going in a horizontal grade it is going you are applying the temperature. So, that they make that tight now when they will be transferred over there you will find out that that pellet which you have formed after heating and all it is going quite a large number of percent of it may be a green pellet may break down

then those things again will have to be taken back and then put into again pellet forming things and after that only it will go.

So, this whole operation can be done or it is are done automatically. So, what you will have to know you will have to know how the pellet is formed in the forming what are the parameters that exactly affect the quality of the pellet and that will have to be monitored and then the control will have to be made. The controlling what will do that yourself maybe because by your furnace oil you are giving the heating to the pellets.

Now the furnace all burner depending on the size of nozzle how much gas at what pressure will have to go you will have to automate it.

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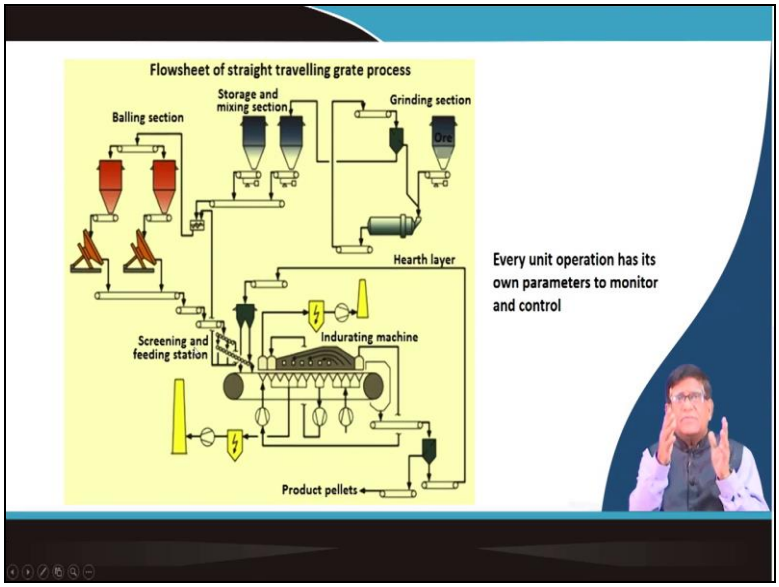

So, this type of things happens in pelleting if this is a pelleting plant you can see over here there are these are the pelletizer in which this is your; in the bowling sections they will make the balls out of it this is a this is having a that eccentric shaft it will be giving a gyration motion and then during that motion this pellet as a green pellet will be coming and then there will be going this is your the grate on which that is exactly the burners for your furnace oil is burned.

And this balls which are prepared from this bowl making machines that are the green bolt very that they are not at all if you drop it will break and to tight it they are going through this heating process after that it is coming over here. Now there is a they are giving a hard layer is some of this hot pellet they will be taken and then put it over there. So, that these green

pellets which are coming over here they will be on those layer of the heart layer means on already on a hot.

So, that the proper heat dissipation can takes place and then those which are exactly the pellets which are produced they are taking it over there and the final product will be changed. So, this you will have to know in any bulk material handling system this material systems at every stage there are some control operations. Now those control operations how they are doing because this will be depending on the mineral processing engineer they will be telling what they require. So, as a bulk material handler you will be giving this automation control that means you have selected this conveyor belt it can be going at a particular speed.

Now when your this from here this hurt how you are transferring them it is going either by you can take it through pneumatically you can take it by conveyor and then when they are coming at what should be the height of that that means they do not fall over here. So, this each and every processes will have to be learned the technology and then you can do the controlling over there.

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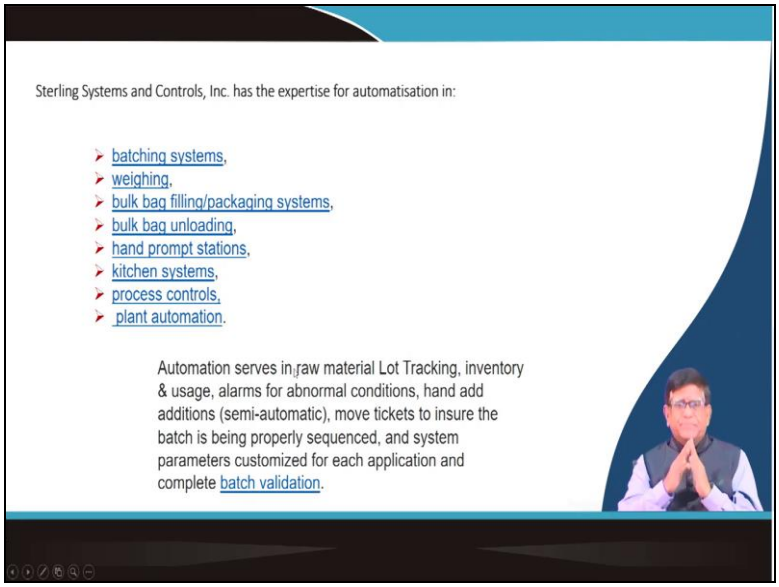

So, here again the sterling system control they develop a lot of they that your exactly the automation process are there for many different type of industries they develop this control and automatic control systems. So, what I suggest you please go through and see the examples of application of this automatic systems. Now when there are coming number of batches as a lot one lot of things are coming they will have to give a tracking.

That means you must know what is that particular lot? Where it is going and what are their performance and all. So, those type of control also will have to be made and then in any product line when a particular lot of material has come and then they are kept over there. So, maybe sometimes when you are say making a particular product a cement when you are depending on your raw materials on all cement may be of different category different grades different price.

So, their inventory will have to make it separately. So, that classifying and sending that also can be done in automatically. So, this automation and this control in a bulk material handling itself is a interesting subject which require a lot of R and D activities also.

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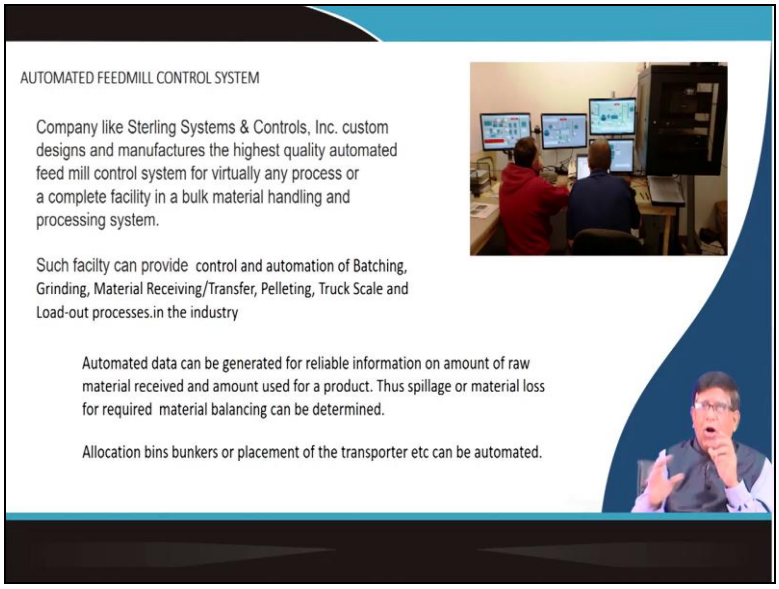

And you can find out that how the modern systems they are exactly getting operated whatever is happening in the mill you can sit in the control room and then you develop in this figure you can see the mimic panels are made. In the mimic panels all operation which are going over there the sensors and things like that and then as an expert you can sit down on the terminal and find out what is going on and from there you can give a signal to control that things.

And this area is developing very fast because of the application of artificial intelligence and machine learning and IOT. This three that what the computers that in your ICT vocabulary has become a very popular these days but to the engineers the same thing that artificial intelligence and this machine learning were being used in the industry for last 20, 30 years and they are only improved over here.

Now the improvement has gone in a first because some of the things which were going unnoticed can be now deciphered. So, if you learn the technology first and then only you can take help of that so, called your artificial intelligence to represent your data in a proper way you can visualize what is happening over there and then you can control. So, your the that your whole facility through your this the control systems can be brought.

And if you are doing a batching operation if you are doing a continuous operations if you are wherever you are there support example you in your receiving section how the material is coming for your plant there you can make them control separate it out and doing things. So, there are lot of possibilities are available.

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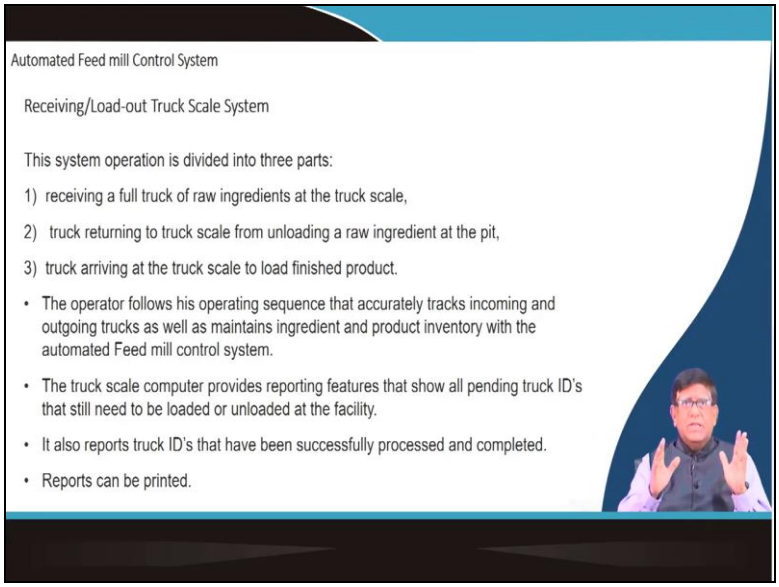

So, this automated feed mill control system that is your receiving load out of the truck scale system that how much material has come how exactly you will be paying for your material which you have done for that you will have to have an automated receiving section. So, that is you might have seen sometimes this trucks are coming and then there is a way bridge on the way bridge it is coming and going there automatically.

But from that you can easily make it this little bit more sensors can be put and then your billing systems can be incorporated over here. So, now in a what is there exactly in an operation of a receiving loading sections receiving of a full truck of raw ingredients at a truck scale they will be finding it out truck will be either it will be dumping by rear discharge or by the bottom discharge.

And then after that the truck will be returning and the truck will be arriving again to the next. So, both the time there that empty weight and the full weight will be measured and on that basis automatically the total how much material has come it will be known to your circuit and then when you know the this much of material then say your at what speed now your the next belt will be moving to take up this material within a given time that can be automatically controlled.

So, and normally in any automatic system your a reporting system is also inbuilt. So, that means whatever has happened they recorded and then properly reported and for that some of you can again develop your expertise in developing the software for controlling purposes. Once you know the system then you know that control and then you know what you have done and if you are keeping the records of it you need to learn how you can present them.

And when you do this whole process automatically a through a document control system you can create the document and if this information is for whom you can make the transportation and communications also a part of the automations and that will give you the total automated control operations of the plan.

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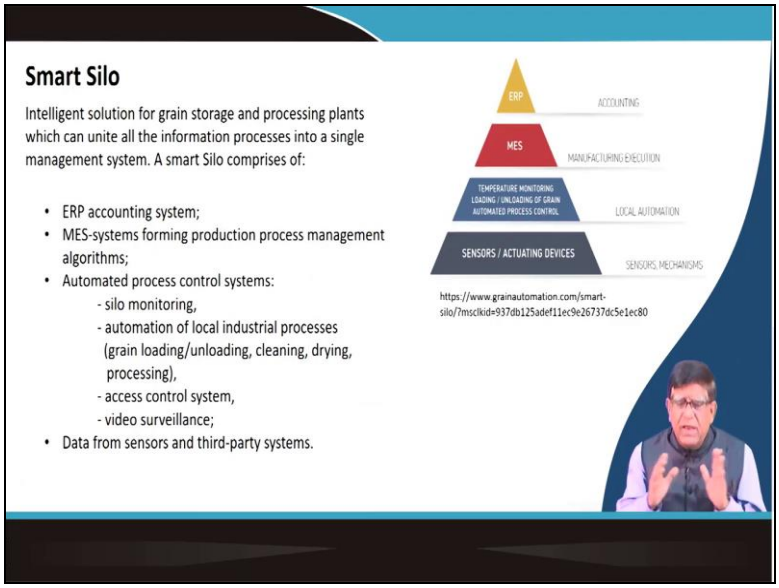

So, we had been telling about this silos which are using there how exactly the total system is done your intelligent solution for the grain storage and processing plants which can unite all the information processes into a single management system and that is a smart silo which

comprises of your you will be having a ERP which will be having its accounting system you will be having a manufacturing execution system.

There that you will be having a local automation where you will be having temperature monitoring loading unloading of grain automated process control all these operational control will be there and at the ground level there will be lot of sensors and thus your mechanisms are there. So, by that exactly what you are doing your automatic process control system will be having all the silo operations monitoring.

And then your total say if you are using it for a very big rice mill where all the rice from different fields are coming different varieties of rice are properly stacked and then say that means if you are having a your that basmati rice or you want a batch of rice or you want a of this Deheradun rice that their rice are coming and then kept in different silo but your meal will have to get their feed.

So, they will have to which one will be loading when which one will be unloading where and then which conveyor will bring it to the which particular stack of the mill that can be controlled by this automated control system. And then done all this data which will be coming then you will be knowing. Now in that mill that last the in the first shift only Dheradun rice has been crushed and their husks are separately sent.

And your this main rice is going for your packeting unit you are putting it over there. Whether the packeting unit also you will be having in a silo first and then from there you will be making these rice bags will be continuously done. So, in a very smart system can be developed you can think of around you there may be many your warehouse of that is your food corporation of India.

Where you may find things are done in a very primitive way with the jute bakes and that lot of labours are there a lot of rice may get damaged during the rainy seasons and all you should go make a visit how those bulk materials are transported you can think of what type of automated smart and then very modern system can be used from there and there all the waste from the rice mill. How the husk will be collected from there how different materials can be developed what could be the alternative uses of those bulk material lot of things can be done over here.

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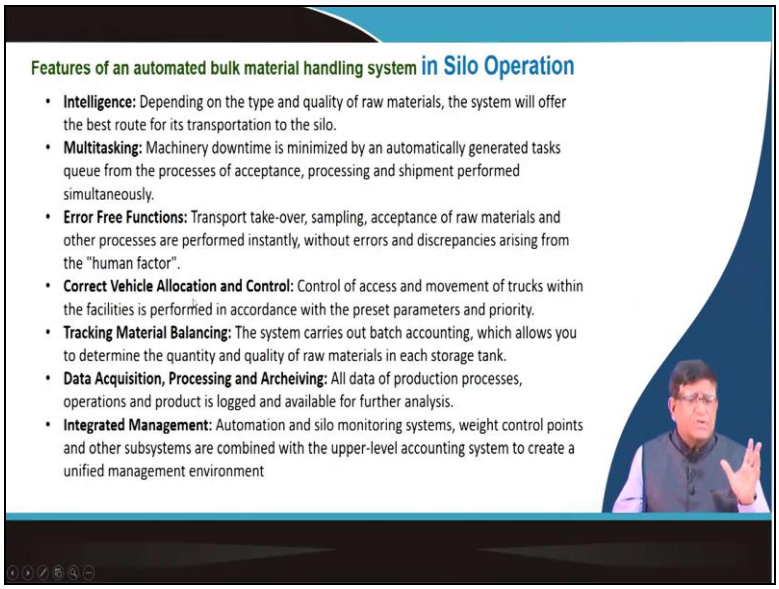

So, features of an automated bulk material handling system the silo operations you will have to have that the intelligence you will have to do some multitasking different operations you will have to have a error free functions you will have to correct vehicle allocation and control that how the materials are coming and taking back then your tracking material balancing then your data acquisition processing and archiving and integrated management can be brought.

So, this can be whether you are you want to do it in a coal silo you want to do a rice cello you want to a mustard seed silo in a master all factory or you want to make a that is a sweet corn processing unit corn flour making unit with floor unit wheat flour making unit everywhere these are the bulk material. You go around anywhere where India need to be served you can do by knowledge of your bulk material handling you can serve the nations in a various way.

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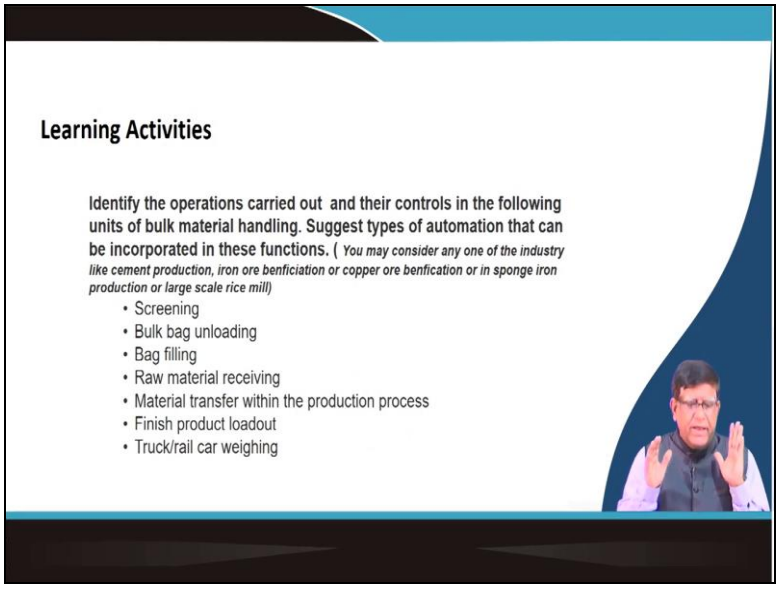

So, I request you please take a learning activity identify the operations carried out and their controls in the following unit bulk material handling that I have given here that screening then your bulk bag loading, big filling, your raw material receiving, material transfer, finish product, loadout truck rail car weighing. These are many operations are there you can take your actions in you may consider that industry like cement productions.

Iron ore beneficial, copper beneficiation, sponge iron procession or rice mill or your oil factory oil mill anywhere you take it because these are directly related to the services which you can render to the common people a quality product health product if you can give it for food or for construction that is your you can serve the nation by these activities.

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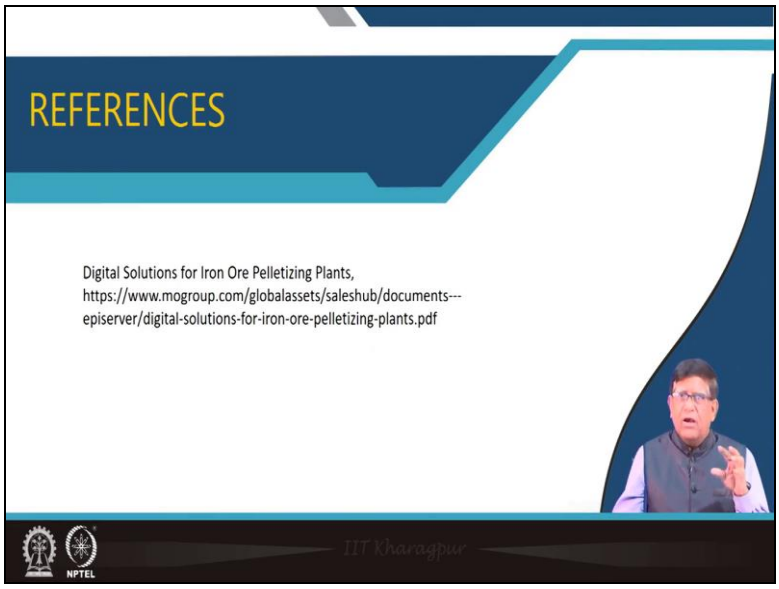

Lot of materials are available in the net in the text books only thing you need to take activity.

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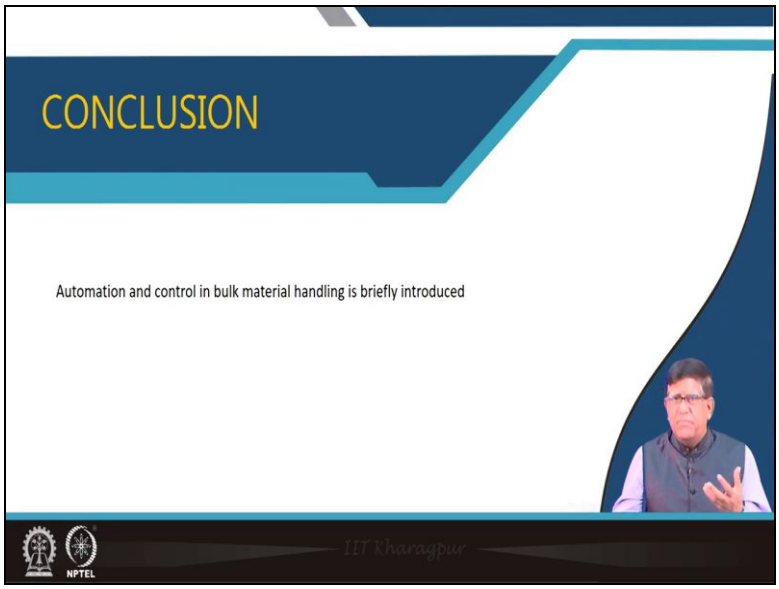

So, I have just given in a very briefly what is automation and control in a bulk material handling. In this subject it was an introductory subject to induce and motivate you towards the services you can provide as a competent engineer to serve in the material handling sector. So, I wish the next class will be our concluding class. I hope you have gone through this will be trying to give a brief summary and then maybe what type of activities you can go or where you can go from here we will be discussing in our next class.