Bulk Material Transport and Handling System
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Lecture - 18
Stackers and Reclaimers: Comparison of Different Types

Welcome back to our discussion on bulk solid handling. We are talking about now stackers and reclaimers which are used in our thermal power stations, port or any metallurgical plant. Now, this, our raw material supply chain, they are being received at the receiving station. Say for example, from the mines the material may come by your railway wagons then there will be a wagon tippler.

From the wagon tippler, the material will be collected by hopper and then it will be fed by say, an apron feeder to a conveyor line. That conveyor belt will take the material to a yard to stock them. Because, you may get material from different places you may need to blend over there. So, we will be forming those stock piles by using stacker. In the last class, we have just given you a general classification of what are the different type of stackers.

Now, we did not mention about that when you go for selecting them then we will have to properly know their differences.

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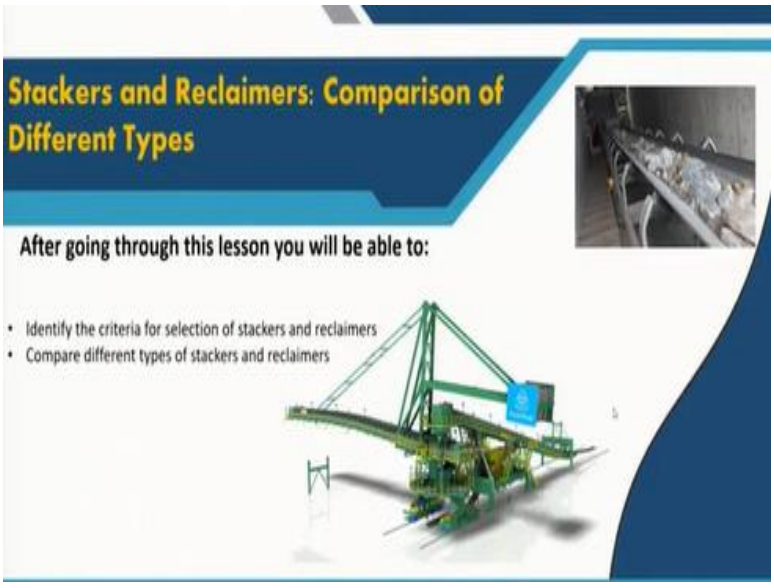

So, today we will be discussing how to identify the criteria for selecting different stackers and reclaimers and also the stacker cum reclaimer. In the last class, we said there are certain stackers that there are from that conveyable tripper how it collects it. And then, there are reclaimers as well as stacker cum reclaimer. The same machine can be working as stacker to form the stockpile that means collecting the material from a conveyor belt to place it on your stock yard.

And then, the same machine can again reclaim it. So, that is a stacker cum reclaimer we have talked about that. Now in this figure, today you have seen there is a stacker, a conveyor belt is there. You can see that both the side of this conveyor belt there are rails. And the rail mounted stacker you are seeing in this.

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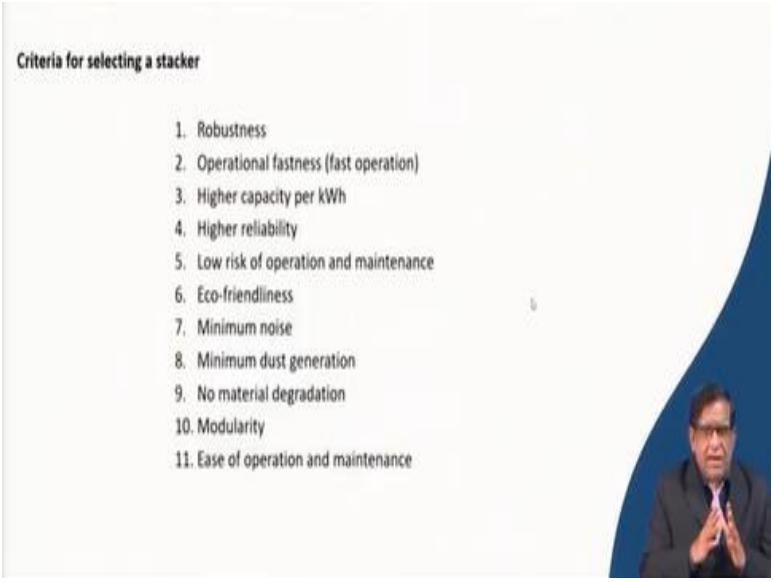

Now, we will be seeing when you were to select in a mines or in your metallurgical plant or in a port particularly in your export terminal where your materials will be coming from different places. And then, you want to do it for the loading on to the ship. At that time, selecting this machine or for that stacker or reclaimer what are the main conditions or the characteristics you will need to look? So, as you said here, the robustness.

Robustness means, it could be able to withstand some mishandling, under handling so that it will not get damaged quickly. So, that is one thing. And then at the same time it will have to be faster in operation. So, that is, whatever the operation is required on it and by it both should be capable

of doing it quickly. When we say the fastness, fastness is also in the maintenance. If there is any problem that is your maintainability of the equipment will have to be such that within a very short time it can be put back into the operation.

That is why, we will be looking into what is called your modular constructions, where the modular construction and that is your component can be easily replaced. You can keep the stocks and share parts so that your maintainability of the machine is more. Similarly, high capacity per kilowatt hour, so, that means that energy efficient machines are always looked into. So, that is specific energy consumption of the machine.

That means for a per meter cube or per million ton per year, how much exactly energy getting consumed, that is important thing. And then, we will be looking into at the reliability. Then this reliability is, that is, it is not only having your availability. Availability is only just that the machine is in operable conditions. But the reliability is it will not fail during its normal operation that is reliability. And also, that low risk of operation and maintenance.

While doing the operation that is your highly safer machine so that during the operation of it the persons working on it, with it, and by the side of it, they should not be having any problem with their, that is straight to their health, or there any accident should not take place. Then, it should be eco-friendliness. We have said that this will have to be environmentally friendly. And that means, it must not create heavy noise.

One of the main problem is as because there will be your conveyor belt, your rollers will be running, then there will be material falling from a height. Then also, there will be that metal to metal contact while it is moving. So, during that type of moving, lot of your vibrating stuff will be there. If the structure is that or with a thin shell the housing is there that during the motion it should not vibrate that it will be giving noise at that, worksite noise, it should be less than 60, 70 decibel if it is there.

But it should not go beyond 90 decibel or so for. That means, as per the; norm for 8 hour shift work the operator’s noise dose should not exceed the permissible noise dose. Then, there should

be minimum dust because you will be handling bulk material so dust generation. So, that means that where the dust getting generated there what type of dust collecting or the suppressing system is there whether those type of things are given or not.

Then the material should not get degraded along with it then, as we have said already modularity. And then ease of operation and maintenance. That means how much control it is given? How exactly the informations are collected in what way and how the display is given to the operator so that he gets the warning? And he exactly knows when to stop, when to take and what precautions that proper warning system by properly collected information.

So, when you see these criteria, we will have to look into the operators that is your manufacturer's manual. When the manufacturers are giving their leaflets at the time when you are selecting you are making that evaluation of different make of company giving the same machine. There you will be requiring analysing this. But before that, you must know that for your requirement what system will be there?

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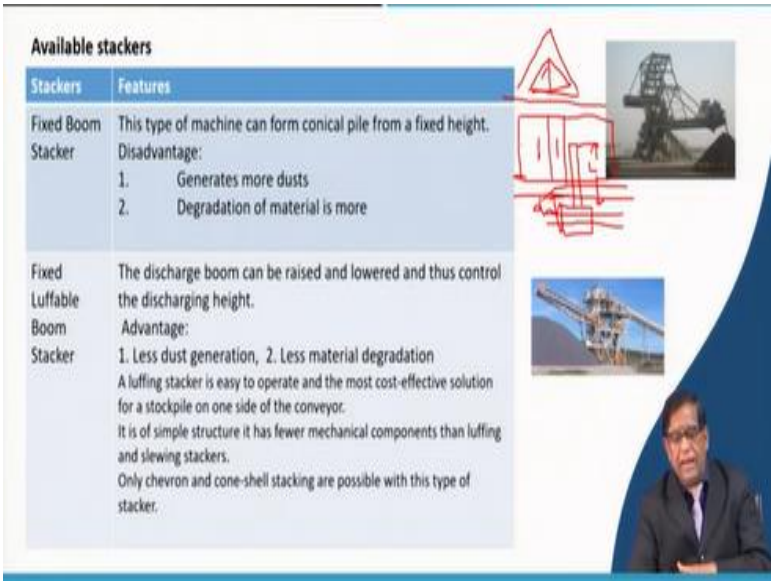

Now, one thing is there when you go for a selecting you will have to look at what are the different things available. As you said, there are some fixed booms. So, that means that stacker which will be coming its boom is fixed. It cannot do a luffing operation. Hoisting and lowering

operation is called luffing operation or it is slewing operation when it is giving your rotation of the machine. So, if these two are not there then it is a fixed. Now, what is there?

If it is a fixed, that initially it will start dumping that full height. Because of the full height dumping the material will fall on the ground and it may get disintegrated. Fines may be more generating dust can be there. But if your machine can be lowered that is when you are making the first stockpile, first your windrow you will be making, at that time you lower and then slowly you can rise.

So, by that what happens if you can keep a fixed only your, in the total stock yard, only a limited volume of space can be utilized. If you can raise this, that your luffable boom, then you can increase. As you can see over here when you are having a luffable boom your height of the stockpile is more. But in this figure, your height of the stockpile is fixed by this height at from which this boom is getting fixed.

So, you will have to now find out that what type of stacker will go. First, you find out where you are going to develop your stock yard. How much area is available? In that area, if you keep a fixed boom how much volume of material you can stock? Or in case of your luffable, how you can stock? But if you are using a slewable that is your luffable boom stacker your volume is increased. You can calculate out. Now what is there?

Normally, these stackers will be, suppose this is your conveyor belt is coming, so your stacker is positioned over here. And then, this is suppose the boom of your stacker so that means from here the material will be falling. So, this is the line on which the material will go. So, if you are having a stock pile, if you see here you are forming like this that means this is your centre line. And then this area you are using. Suppose now here from that height, you can go over here.

That means you are using this area. And in this area only, this height volume is there. So, that means, when you are forming the stock pile here it is going like this. Now as because you can now raise this. So, when you will be going up to here that means you can use more area now. So,

that means, by luffing the boom, you can now use this area, more area. What will be the restrictions here?

From this depending on, if this is your length L of the boom now for this L length of boom, here you are having the conveyor belt. And this at least you will have to keep some small distance d here as a clearance. This distance will have to be kept as a clearance. So, that material should not get that, otherwise in a rainy season and all if this material slides it will bury this conveyor belt and things. So, that is why you will have to maintain a length d.

So, that means of this whole area with a fixed boom, you have got only a limited area you can put. But in case of your luffable, you can do it more. So, then another thing is there, the other type of your stacker which are available are the radial luffable stacker. Here this is exactly you are having a circular part on which, on this one, you are making this stockpile in a circular form. But then one thing here that if you are in the previous one if this boom it could have been given a slewing motion.

Then where your conveyor belt is going like that and your stacker is here. And then, this is your boom which is a single boom. Now, if this boom can be rotated in a circular path like this, then what will happen? You can form the stockpile, say from this, if you consider this is your apex point, if you keep this one shifting by this angle here you can make this as your dumping point. If you shift it another angle further if you slew this angle up to here you will be now dropping the material from here.

So, what will happen? That means you are forming a stockpile like this. And then, again you are forming a stockpile from here. It will make the material over here. And then, so we are making a two windrow and then if it is also luffable that means you can now raise this stopping point. You can put it over here. So, you are ultimately making this big a heap of material over here. So, that is why depending on your size of that is space and area what you are having you can calculate it out that how much volume available exactly can be used.

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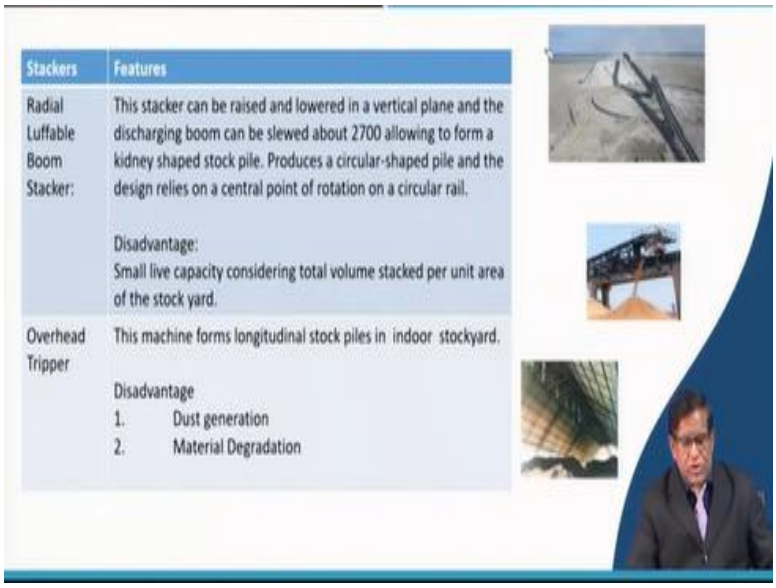

So, that different type of, if it is just an overhead tripper, maybe within a house, if you are to keep your material just free from rain and all there you will have to have an indoor. At that time, your stacking can be just a tripper.

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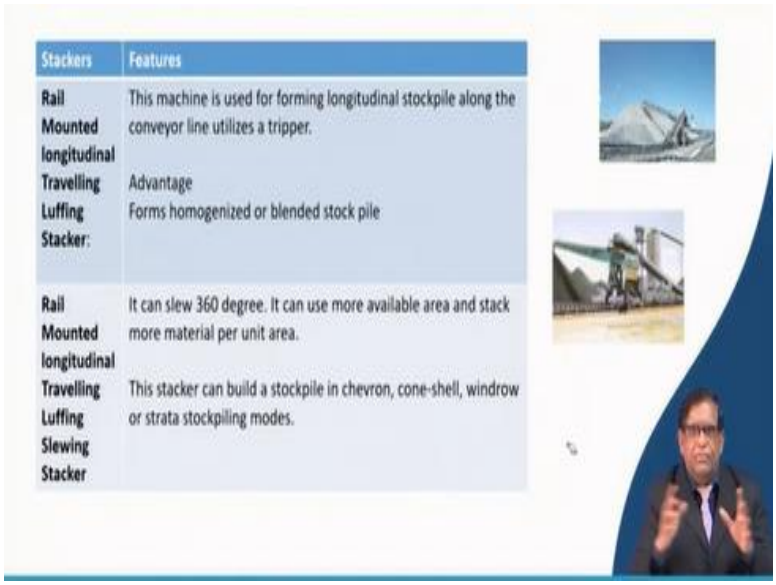

This also we talked about last class. So, here, it can be a rail mounted longitudinal, that means here you are using only the side portions. That means where you are having this conveyor belt the rail mounted stacker it is having a fixed part. Sometimes, if you use a rail that is your crawler mounted instead of having the stacker over here you can just stop it over there. And then, if you can make a flexibility in a movement but there you will have to keep a track.

That means the receiving end that can be negotiated. You can think of a new type of machine. But in case of the stacker, it will have to be there. But you can use a separate reclaimer which can be a crawler mounted that can collect from the other side. Now, when you will be seeing in case of your reclaimer if from the same position you reclaim some of the portions as a dead stock it will remain because you can never collect it over there.

We will come back to that. So, you have seen the stacker can be luffable, slewable and also it can be a circular luffing.

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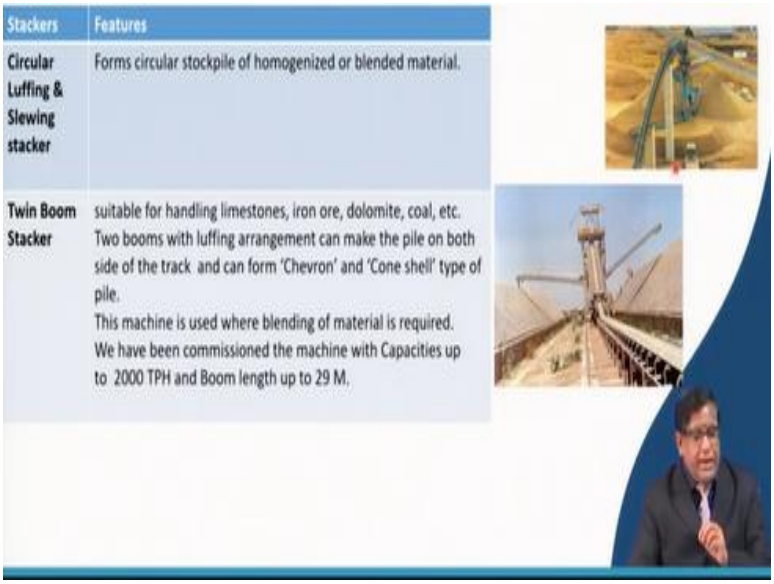

So, you can give the stockpile formed in a different way or we can have a twin boom in which both the sides you can collect it over there.

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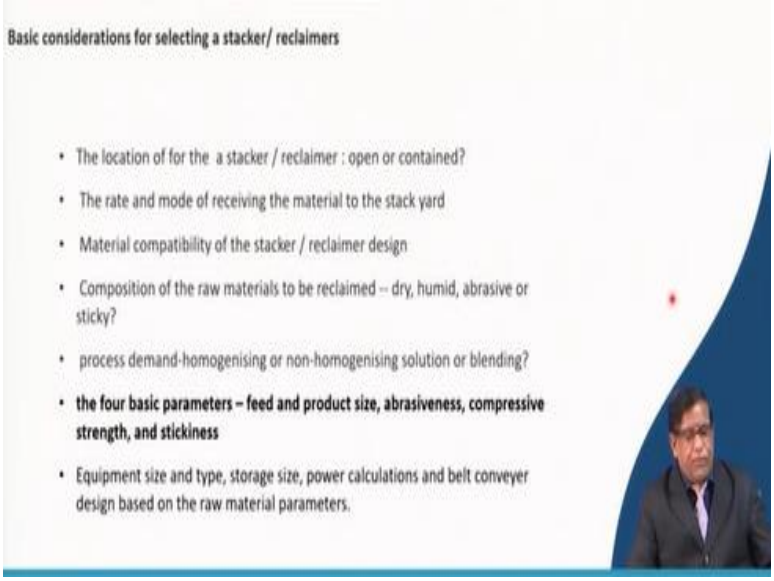

But now that selection of stacker it will be depending on exactly from the stock pile how will you reclaim? Because ultimately, it is not the stacker. You will have to stock and then you will have to reclaim. Now, some of the basic considerations that you will have to take while doing this taking and reclaiming that, where the location? You are doing it in outside open or it is indoor, that is the first decision criteria.

Next at what rate of and what mode? That means it is coming continuously. It is coming batch wise, say, if it is coming from the railway then railway will be giving intermittently. But then, is it there very near to your wagon tippler? Should we have another stockpile? So, that a quite amount will be there. And in your main stock pile, it will be coming continuously. Similarly, you can have that different mode of reclaiming are there as last time you have seen, bucket wheel bridge type, barrel type.

Now whether the material it is compatible with it. Say if the material is very friable, say coal, if you are dumping coal from an overhead tripper if it is falling about say 6 to 10 meter height then the coal will get pulverized. So, it is not wise to put that type of stacker that will be damaging the coal. Similarly, your that composition of the raw material whether it is a dry, humid, abrasive or sticky. Because if it is a sticky material then how it will be reclaimed at that time?

What type of the equipment component should be there? Lot of things need to be considered. Then also, where you are giving? If you are giving, say you are getting iron ore for a steel plant, and your steel plant they need, say, your hematite content of your ferrous oxide that is your F 2 O 3. Their concentrations they may be asking for the 65% below that they will not work. But you have got a mines where it is coming as a 62%.

But in some mines, you may be having an iron ore with a blue dust giving 75%. So, if you want to blend them so that whatever you will be putting in the blast furnace will have to have a 65%. So, that means in that stock yard, you are getting material from different grade. They will have to be stocked. And then, you will have to reclaim in such a way that when you have reclaimed the things will be coming into that particular concentration.

Or sometimes also, required that your furnace requires the sizes, say about 2.5 to 5 centimetre lump size. Now there, you may be having a different mix of your sizes material come. So, when you are giving it, you want to homogenize it. So, during the reclamations, how you can do the homogenize? So, you will have to select the equipment considering in the process of collecting. Is it mixing properly and then taking or it is as it is coming and taking it over there?

So, the basic parameters that what you will have to consider is the feed and product size. That means in your stock yard, sizes are coming at what size? And then in your demand side where you are sending what size they want? And then, what is exactly the abrasiveness? Sometimes, the equipment if you select if the material coming is highly abrasive and you are putting on a, say your shoot or a hopper that their inner sides will be getting eroded out.

Then what is the compressive strength? Will it break or not breaking and also the most important is its stickiness? That is your clay content or how it responds to the moisture. Those type of things also are very necessary. Then of course, what is your size? That means at what rate you need, say, you need 5000 ton per hour or 10,000 ton per hour and for that the size and that your what will be the whole total area?

That means you want to keep a stock pile for 10 days operation or for 40 days operation. So, for example, in our thermal power stations, they may sometimes keep even a 30 days to 40 days stock they will be keeping. You might have heard about a lot of things that recently there were a coal crisis. Then they were telling that these thermal power stations are getting dry for only two days stock, three days stock.

Many of the things are exactly where the media were giving without knowing that really how many days' stocks should be there because the coal cannot be kept for a very long time. And then, they will have to consume so a stock need to be maintained very properly. And then, those parts are there. Again, in that, your reclaiming and stacking machinery should be such that whatever the material is coming everything is collected.

If you are certain remain as a dead stock you are not being able to collect it then dead stock if it is a coal because of spontaneous heating it may catch fire. So, that is why all these conditions, all these criteria will have to be done. So, I request you please make your portfolio about these criteria and then, how exactly they are related to the key performance indicator of your stock yards. That is what you exactly want there?

A performance indicator will be total at what, how much they are matching with the design criteria of supplying that amount or what is your cost per cubic meter handling or what is the energy cost per ton something like that. Whatever the performance indicators are there with which how your selection criteria contributing you can make a note of that.

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Then your reclaimer, we have said about the stackers that reclaimers can be also of different type. Basically, there are radial reclaimers, bridge reclaimer or portal or gantry type of reclaimer. Now, you can see that this reclaimer is a gantry or a structure gantry means structure. On a structure, your reclaimer is mounted and you are doing it. A portal and gentry they are sometimes used as similarly. But the portal one in which you are having a movable structure.

This structure is moving in both this gantry. And there you can see a bucket wheel is there which will be collecting this material. And on this your bridge type portions, there is a conveyor belt. It is taking the material. It is discharging and it is going out to the conveyor belt. So, this type of reclaimer system is there.

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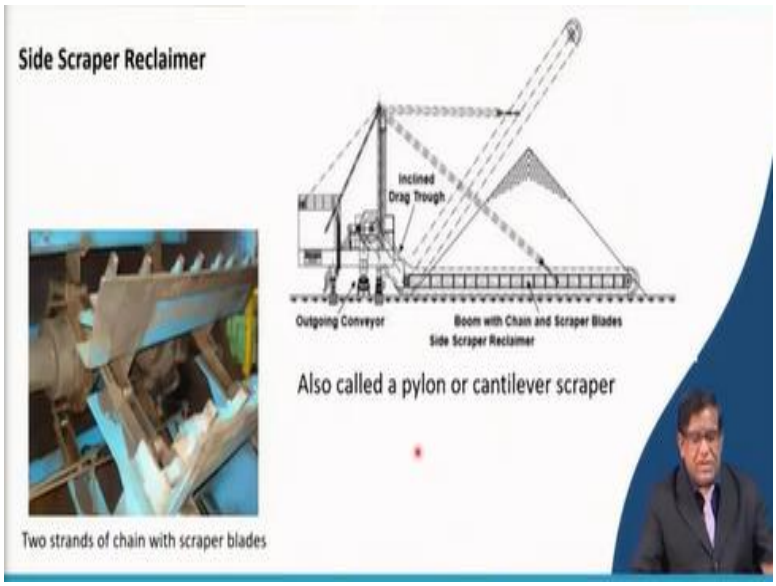

And then, there is another type that is called your scraper reclaimer. In a scraper reclaimer, what is there exactly? You are having a boom or the scraper. Here you can say this type of the scraper that chain, you can see a double chain here, one chain here, one chain here. And then, this is the scraper blade. The scraper blade is mounted. Now, when it will be moving that whole material it will be going and it will scrap over here and it will be loading the charging on to this part.

And then, this material will be discharged over here. So, you can collect the material put it over here and then it is going and then it is going out. And then, what is happening? There this if your whole length will have to be here. But when it will be going and collecting from the top you can see that the whole length is not required from here in because this length will be much more if you just keep it up to here.

Because this top material will be falling down over here you can have a smaller length. But because of this you will have to keep always some additional length over here. That is a disadvantage.

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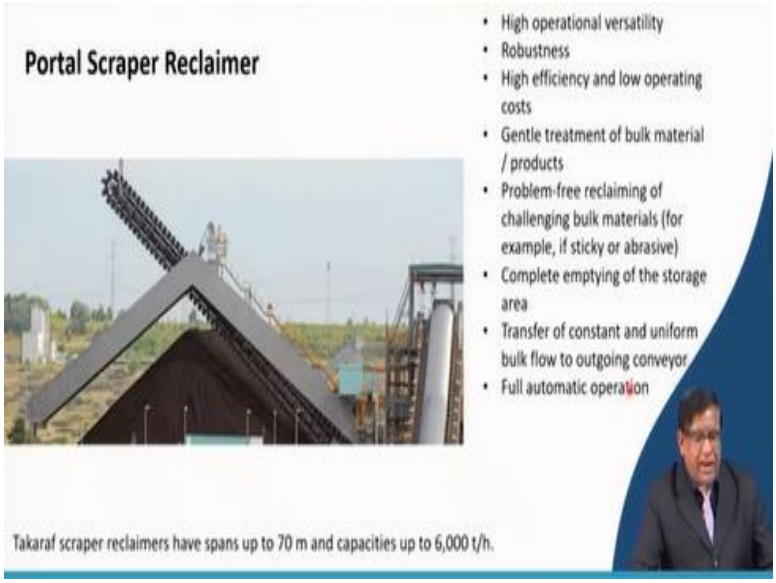

Because of that sometimes they use two scrapers. So, that means here you can see when it is scraping down over here. Only this portion is scraping. But this extra additional length is required. Because when this material will be taking as your stockpiles will get low height. There will be, the length will be, increasing. So, that is why they will be using a double, you can use this side also a scraper.

And then you can make a combination by 2 because otherwise your energy cost for this additional motion is going more. Now this type of scraper which are used exactly you can know that Takaraf is a company which manufactures. There are many companies you can see their leaflets and their some of the technical literature you should read. There exactly high operational versatility they claim because it can be depending on your site you can design. Here they have the robustness.

Their low operating cost they say because we do not have those whole bucket wheel and all the conveyor and a lot of things are not necessary. So, manufacturing time also less so that whole system may be most economic depending on. But only thing is that every system has got their own advantage and disadvantages. You will have to note it down and then compare. But ultimately, this is called your selection is always a techno-economic selection.

Technical, that is your feasibility that is depending on your demand and requirement technically it is available or not. And then, you look into the economic viability and then for this economic viability, the cost equations for a given situation need to be developed. And for that the modelling is done and that is another work. So, you can see here that is your treatment of that material is not getting much. It is not thrown and all.

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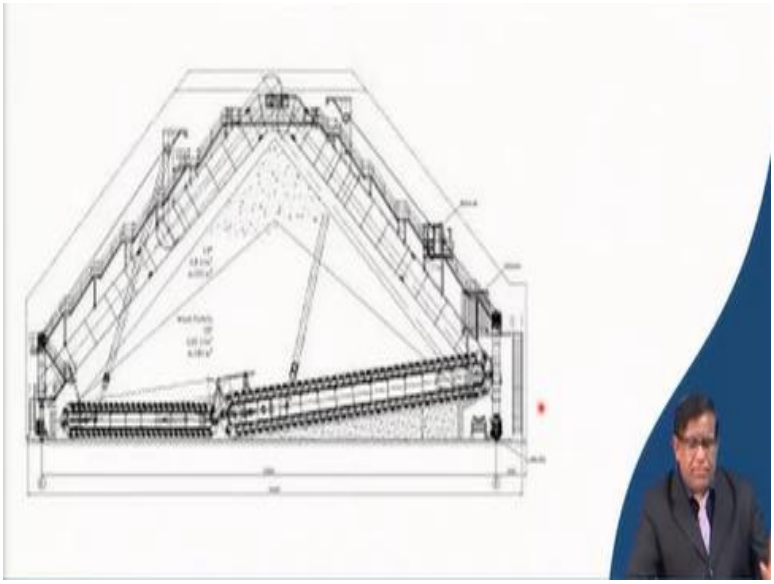

That is why, you can maintain certain quality of the material. So, you can see here instead of that 1 you can have 2 scrapers, 1 smaller size in this side another bigger size in this side. And both the sides they are collecting the material and giving it to this conveyor belt. Here is another conveyor belt. Now this process what happens by that your energy is optimized.

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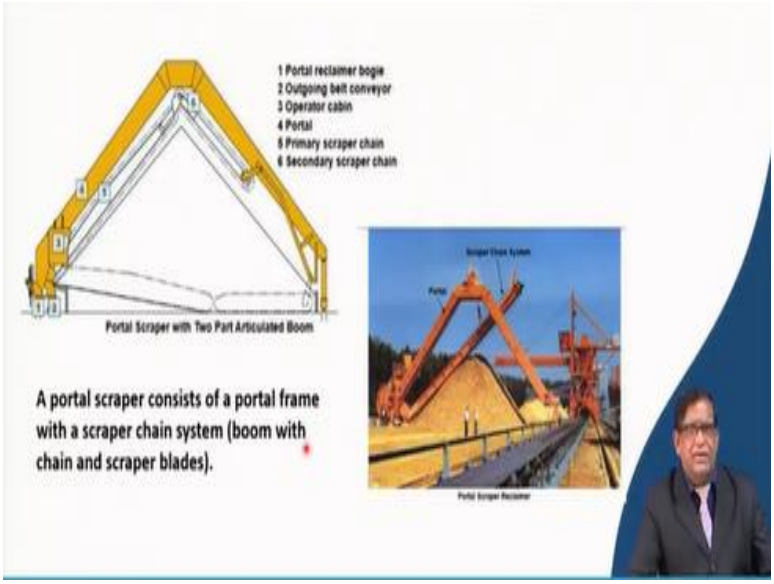

So, there are different systems are there like that you can see here, this is a portal reclaimer. You can see such type of reclaimer this is bringing the material. You can see at the background this is the stacker. And then, once the material is here this side the material is getting collected.

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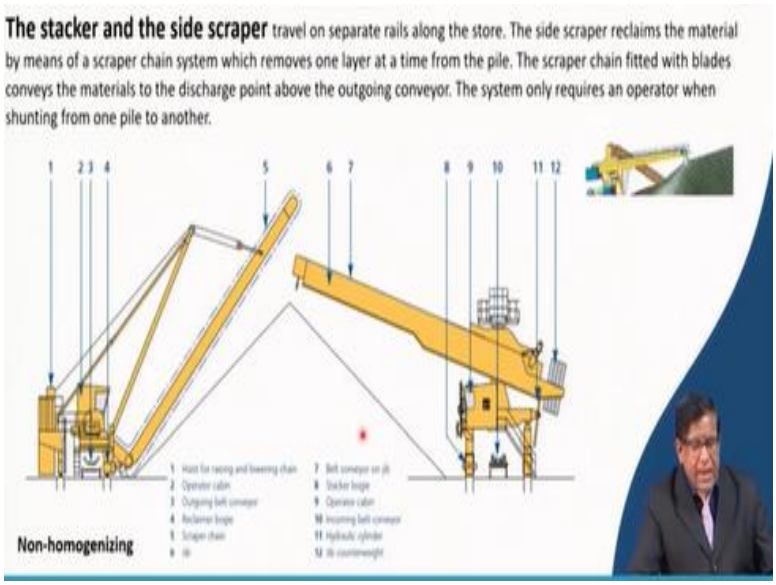

So, if you can see this is a stacker part and this is a reclaimer part. So, these 2 together, they are working for this stock yard. So, here, this that material is being brought over here. From there, with a stacker that arrangement of the tripper that conveyor belt is raised over here and taken into this.

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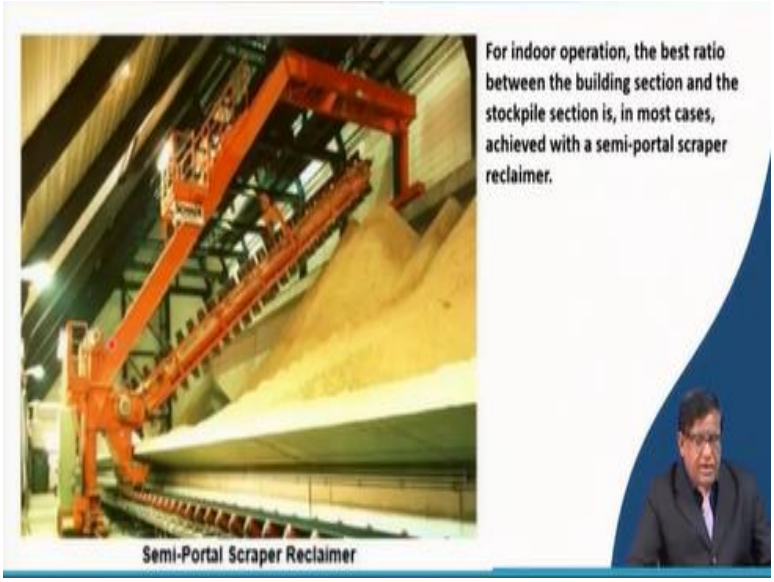

And in this case here so, you can see this. Sometimes, it is a semi portal or hub portal. Inside that, your close type of stock piles, the material is getting stocked over here. So, now, you can see here that how it normally scraps down and then load onto this conveyor.

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But the other type is a bridge type of reclaimer. In a bridge type of reclaimer, you can see here that this whole reclaimer is forming a bridge. There is a rail here and a rail here. And the conveyor belt is here. Now this is scrapping or there is a chain as you have seen in that scraper, that is there. And it will be taking this whole material and then it will be loading onto this conveyor. Now when there will be a big stockpile here this is the harrow.

Harrow is a just a vibrating or it will be moving so that the materials from the hip will be always brought to the bottom. So, that it can scrap and load it over here.

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Now this bridge type reclaimer you can see here the components that is incoming material is coming by that. And then this is the boom jib by which they are forming the stock pile. And then here, we have got the conveyor belt on this boom. And there is a counter weight so that it can be balanced over here. And then there will be a luffing unit by which this boom can be raised and lowered. And there will be an operator cabin that operator will be sitting over here.

And then your this whole thing, this bogie that is your stacker on along this conveyor belt over this rails this will be moving. That is the bogie part. Now this is the reclaimer bogie where this part is moving over. This is your reclaimer one. Here will be this chain so that chain will have to be kept under proper tension. That is why, an engineering unit is there. And then mainly that scraper chain that is your scraper chain conveyor which grabs the material and then raking harrow.

It is just for giving the, here you can see in this that material is hip here this harrow it will be giving vibrations over there so that the material will be falling down because these are all loose material. They will be falling down below here so that it can scrap. And then this harrow it is

kept on a car that it can be moving over here as a translatory motion so that the harrow as it will be keeping on moving. By that some homogenizing also will take place.

Then your operator cabin for the reclaimer part is over here. And they are ultimately loading onto this. So, this type of structure is there. Then you can see over here. This harrow ensures the homogenizing.

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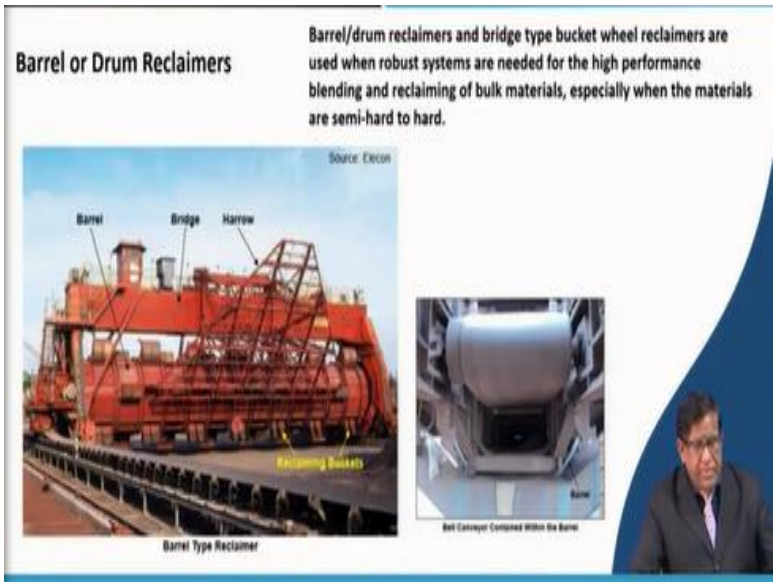

And then there is a barrel type of reclaimer that in which the barrel has got the buckets. Now these buckets will be collecting and inside that there is a conveyor belt. If you see that there a cross section is a circular one in that circular cross sections a conveyor belt is kept so that this bucket which will be dumping the material onto this conveyor belt and they will be taking over here.

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So, like that you can see this how it moves. But maybe in your next class, I will show you the video of this. But the materials collected in these buckets are discharged onto that conveyor belt and it goes. So, you can see over here that how it will be moving.

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And then, the material is getting collected. Your harrow is moving and then your this whole material is given like that.

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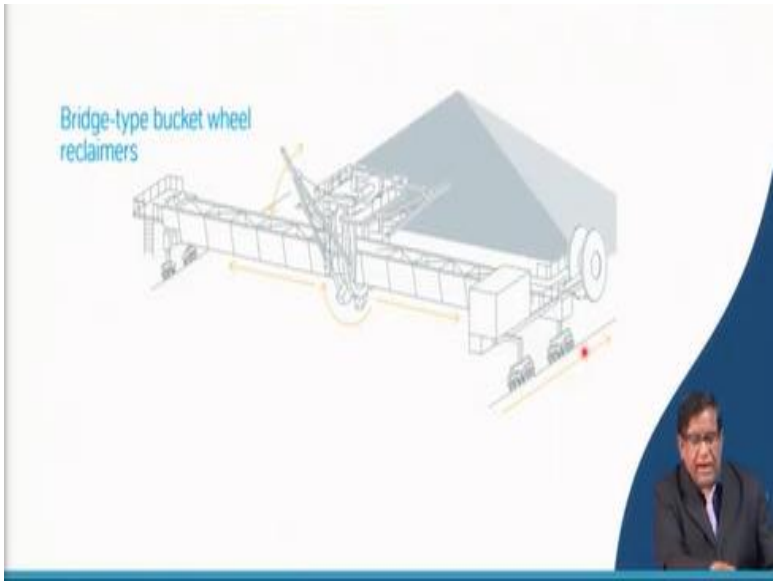

So, in some times, we can have even the bucket wheel ring is there. Now, this is giving a translatory motion over here and the buckets will be in the barrel type, you have seen that

buckets are fixed over here and the whole barrel is rotating but in this type, that buckets are only on one part. Now this whole car which is having this bucket ring it will be moving to and fro and then the material will be collected.

From here that material will be collected. So, this is the way how a bridge type bucket wheel reclaimer work.

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Now that bucket wheel reclaimer, it can have more than one and then say here in this you can see there 2 harrows and 2 bucket wheels are there. And they will be moving collecting the material from this. Both can move in translatory motions here and then the conveyor belt is there in the bridge.

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Then the boom type bucket wheel reclaimer, they can be a fixed boom type of bucket wheel reclaimer which can be a rail mounted or it can be crawler mounted. If in a crawler mounted it can move in the stock yard. And then it can, having its discharge boom, which can be positioned over a conveyor belt and they can do it. If you go to naval ignite corporation, they have got number of crawler mounted this bucket wheel reclaimer for collecting the lignite for sending into the thermal power stations.

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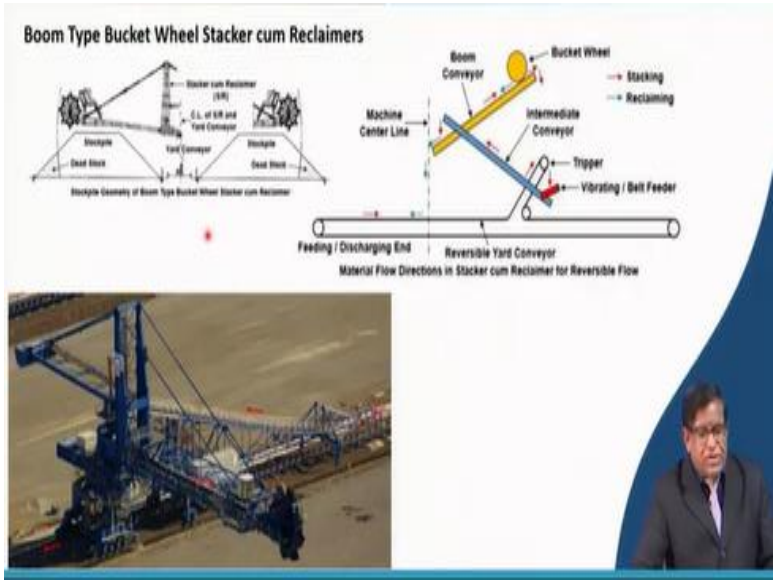

So, that is there, sometimes the same bucket wheel reclaimer can be used as stacker also. So, here you can see the material is coming by that conveyor belt. And then it is coming over here. It is through a hopper; it is and a feeder it is giving to this conveyor belt. And the material is

getting over here. And then the bucket wheel will be fixed during that time. Then there stacker. Now when the bucket wheel start rotating at that time the material will go and it will fall.

And over here, it is given to this time conveyor belt. So, you can see that same conveyor belt after returning over here making it the tripper part it is going and returning to the main part. So, when it is in the reclaiming mode it is working to load in this side. And when it is stacker mode it is getting the material in between this. So, that is how the stacker cum reclaimer works. You can see that the bucket wheel when it is in the reclaimer mode this blue line.

You can see it is collecting and then the material is thrown over here. So, it is fed into this. So, there may be an intermediate conveyor which can be a feeder conveyor for this conveyor belt. And then when it is in the reclaiming mode the material which was coming in these directions, they are coming over here and take it there. So, either you can as I said here it can be in the same directions taking away or it can be in the opposite directions taking away.

When you are taking away in the opposite direction these conveyor belt will be having a reversible drive. That means the drive will be given in the conveyor belt discussions I told you they called belt conveyor can be given a reversible very easily by changing the drive head arrangements. So, this is what is done. Now you can see here when you are making the stock pile over here when it will be collecting these portions cannot get collected.

That is called your dead stock. Now that it can have both, this could be dead stock. So, what is the solution? You will have to keep a dozer so that you push these things to inside when it has gone the stockpile. In the next time it will again remain in dead stock.

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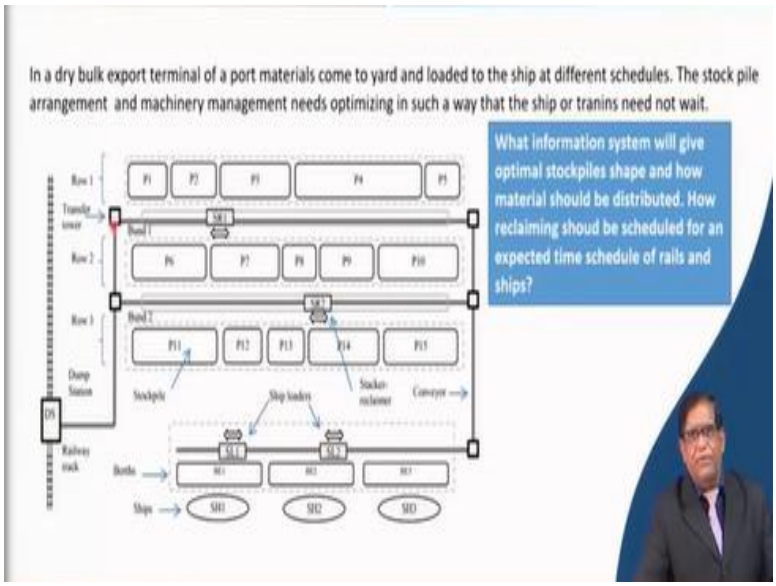

So, in your stock yard there will be always a demand for a dozer. Now just coming to its condition, situation you imagine, there are ships coming into the port. And they have got the different bay on which your berths are there. A ship loader that will be loading on to this. For the ship loader the material is reclaimed from here. These are the stock piles. From the stockpiles material is reclaimed and then they send over here to load it.

Now you see, here different size of stockpiles have been shown. Because there will be different demand by the ship coming from different time, different country. They will have to unload it, that is when they are loading it is an only for the export terminal. That empty ships are coming over here to get loaded. Now your materials which are coming by railway and there is a tippler from the tippler that dishes stations.

They are giving this material through this conveyor. They are distributed over here. Now this is an operation normally which is go in a port. Now your job is how will you optimize this system? There exactly when you will be knowing that how does stacker work? How the reclaimer work? And what is that exactly forming a stock pile? That is whether it will be a triangular one, trapezoidal one, circular one.

And then how much volume it will be there? Taking over there what type of reclaimer? At what rate it will be coming? So, you can imagine how much information is necessary to find out

whether when a ship arrives here you will be able to put the material or not. That is why when these types of problems are the problem of your mathematical modelling these are the work which is done in the operation research.

So, you start learning about what is taking and what is reclaiming. And then if you get an opportunity go to a port maybe you can go at Vizag or at, I think there is a port in Haldia that wherever there is a bulk material exporting pool or that I think near Goa there are some this type of arrangements are there. And you should study whether we are doing the job optimally or not. And you will find there are lot of things there where a proper artificial intelligence.

Or that computer modelling and simulation work can give a very good opportunity for optimizing the cost. So, what information system should give an optimal stockpile shape? And how material should be distributed? How reclaiming should be scheduled for an expected time schedule rails and ship?

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These are the type of work. You can read some of the references.

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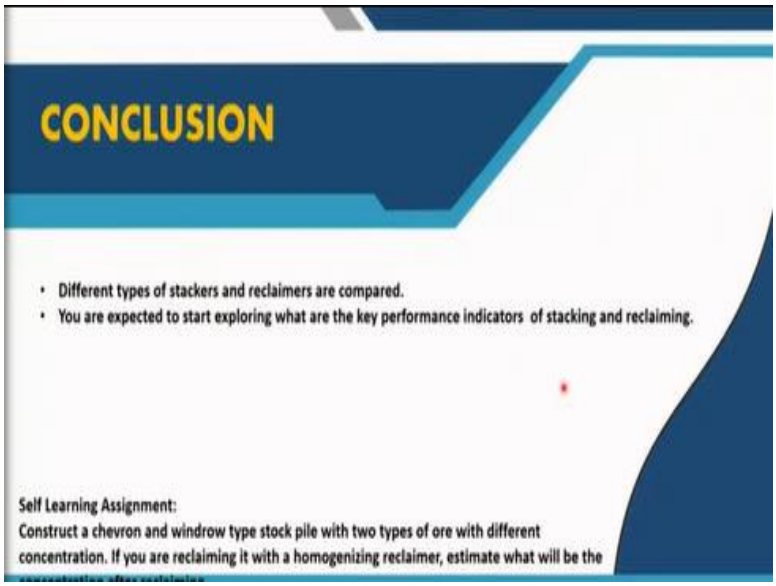

And I hope the different types of stacker and reclaimer's comparison you will be able to do. And you are expected to start exploring what are the key performance indicators for stacking and reclaiming. And as I always tell take some self-learning assessment. Give the assignment yourself. I am not telling you to do it but you can do a self-learning assessment. So, what you can do you construct a chevron and windrow type stockpile.

You can take some rice and you can take some atta or wheat. You make some stockpiles maybe you can use some windrow. And then, you make how you collect it over there. When you collect you find out what is the percent of this. You can take the broken rice and then your good rice you put it over there. And then, you collect it over there and make a mathematical model you estimate that if I collect by this way or if I collect by this way how much will be the concentration of my good rice and the broken rice?

So, this type of small experiment at your home you can do it. And then you can put that thing mathematically that will be a good learning exercise for you. Thank you very much.