Bulk Material Transport and Handling System
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Lecture – 52
Low Profile Dumber

Welcome back to our discussion on the bulk solid handling and transportation, we have been discussing now the transportation machinery for underground mines and in that we have discussed some machinery and system that are used in underground coal mining. Today, I will be discussing about a machine which is used in mostly underground metalliferous mining. This machine called low profile dumper.

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This low profile means that it is its height is lower so that it can work in a very confined space. So, you can see in that figure a dump truck which is of very low height so that it can work in the galleries of a underground mine. So now, in an underground mining, this conditions there is a biggest problem, is manoeuvring the equipment. That is why, as you can see in that figure, this type of truck which is having a box for dumping this box.

And then the front part which is having connections between them is hydraulically articulated. This is an articulated type of dump truck. Regarding the dump truck used in open cast mines. We discussed earlier and you know about the dumper, their operations and other principles which are loaded by in underground mining by a loader which is called a site discharge loader or it can be a load haul dumper.

That is also LHD and SDL. These two machines are operating in combination with this low profile dumper. So, today I will be giving a just brief introduction of what is this low profile dumper. So, that you can explain the application of this in underground mines and you can describe the features that what this type of equipment is having. Also you will be learning few names of manufacturer.

So that you can explore their websites to find out the different models they are now being used across the world. Now, another thing over here is the; you should know that this machine are used in hard rock mining. Because in the hard rock mines the space which can be created in underground is easier and that gallery which is formed also good for maneuvering this machines.

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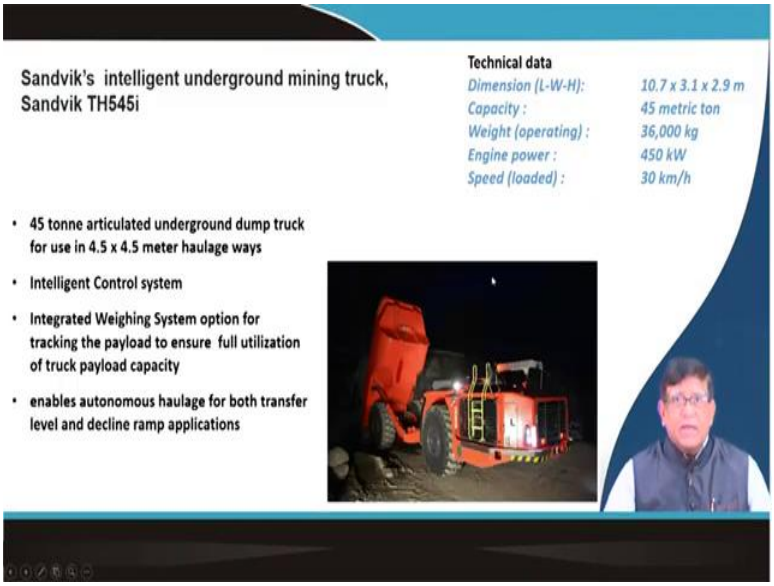

Now, you know that this machines it has got a number of features, particularly that in operating in underground mines its dimensions should be small. At the same time when it is a hard rock, the density of the material is high so that is why the total weight will be coming more. So, in a low height to accommodate nowadays even up to 21, 30 tonne they can be taken over this machine. So, the most important is how you will be powering this machine with engine.

So, as a engine power up to 450 kilowatt, it is being provided there. So, there are lot of development has taken place in the engine manufacturing that has led to development of this machine. One company that is Sandvik. Sandvik is one of the companies like Caterpillar and

other most of the mining machinery manufacturer. They have also got their models but one of the latest model is this TH545i. This i means it is an intelligent machine.

So, in a modern, the low profile dumpers they have incorporated lot of digital applications to make it an intelligent machine. So, as you can see that this TH545i some features are, its dimension is 10.7, 3.1 to 2.9 metre. That is the length of the machine with the dump and the engine equal to 10.7 metre and its width it can work up to 3.1 within a height of 2.9 metre.

Its capacity is 45 metric tonne and weight of that machine that is your at the time of operating it goes 36 tonne. And as I said, engine power is 450 kilowatt and it can work in underground conditions which is speed up to your 30 kilometre per hour and in empty without load. It can be little more. Now, to use this machine in underground mine the roadways, their dimension should be 4.5 metre by 5.5 metre.

That is your height of the; that your roadways it required to be 4.5 metre. So that its 2.9 metre height and then when it is in the; it can also dump in underground with its box elevated. And the intelligent control system which is incorporated here is the special features of this machine. And there is also an integrated weighing system this option exactly is there so that the operator there operating it at that time the loading it controls by the loader.

So that the optimum amount of material are getting filled, so, this machine it can work with more than 90, 95 % bucket filling capacity it can be used. So that by the giving a signal that is even if it is not properly loaded, the operator will not start the machines to go. And is it is also possible that this machine nowadays undergoing automations that is without persons. This machine can work by a program that is autonomous vehicle concept; has been used in underground to operate it.

And also all the data that can be transferred to surface, so that the whole operations can be controlled even remotely. Now, this one another important feature is that this machine, so that the all operations can be done safely and the maintenance operations can be done promptly that is why all the necessary monitoring instrumentations and your equipments are also provided over here.

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So, this machine is always a high power and low machine own weight. The there is a the materials which are used for construction of the chassis and the body and the parts they are selected in such a way that the self weight of the machine is less. So that it can carry maximum material by that this productivity is increased. And that you have seen in the previous one, that this machine, there are certain this components are given.

Just like this you can see here lot of this ladder and other com parts are provided in the machine. So that you can also examine that while maintenance and all are there in the machine whenever it is required that access to the top also is possible. That is you need not take the machine to the garage for inspecting and checking. There itself the persons can do the operation they can get access to the height also.

Now, high engine peak torque and the torque rise allow there is a less downshifting and better acceleration. This is an important feature because that engine is now capable of providing that required additional torque when it is to negotiate a curve when it is driving at its high speed. So, at that time, so that say the engines provided are of a advanced capability which can with when the speed is there at that time also, it can increase its torque.

That is your high engine, peak torque and the torque rise for that they need not normally what is done whenever extra resistances are coming then we shift the driver go to the lower gear. Now that even at a higher gear it can get additional extra torque that system is there. Then peak torque is delivered at low engine RPM for better fuel economy and reduced noise. This is another feature it is claimed by sandbag.

They incorporate many of the machines they use Volvo engines. Then using a 90 % fuel factor the in box selection that ensures that the truck can be it truck can use its whole capacity. Because it has got a 45 tonne maximum capacity but if the box is not properly filled and if the spillage takes place then there will be reduced productivity. So that is why the box is designed in such a way and you can select from the different designs, depending on your material.

And your loading system that by which machine you are loading and then what type of material you are loading. That depending on in which way you have owned the material, whether you have it is a blasted rock or it is a loose rock which you have mechanically excavated without blasting. That type of material has got different property and then to put it on that box that is that the body we say sometime.

This, they will be done in such a way that at least 90 % fill factor is attained. And also there is an ejector box that means in the box they have got a hydraulic mechanism at the bottom at the place of your where you are to dump the material. You need not even raise the dump body vertically so that you can push from the back the whole material and it can be released. So that type of system makes this machine to work even in a confined space also, it can dump.

Particularly from the phase it will be bringing the material and it will be giving to the chute where it is that ore boxes for lowering and then after that it can be loaded to a conveyor belt in underground. So that type of unloading arrangement requires a ejector type of box.

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Then, maintenance and serviceability of this machine is also very important. So, to make it the so that the machine the designed in such a way that it has got automatic central lubrication system. Now, the lubrication is a very very important thing in any machinery because if the that do not do a proper lubrications, the heat generated may give a seizer and then your the parts get damaged.

Now, here the automatic central lubrication is such that you are having your that your machine is in a stop position and your parking brake is there. If you these engage the parking brake automatically, your automatic lubrication will start so, this type of arrangements are there. And as we said that there are safer maintenance access that your separate ladder and other barricades are given.

So that when you are to do the maintenance they can put these things up. And then, when you are not doing it, you can remove it very easily and then place it over there. So that that is called in machinery design called maintainability. That is the maintainability factor as of the bed b maintainability factor the manufacturers ensure that by accessing the components by operational is that is for whatever the maintenance activities are forcing.

They are kept in mind in designing in provisioning the facilities. So that the time required for maintenance is less by that in a real operation that mean time to repair is reduced. So, this is always done by improving the maintainability. Sometimes, when you, if you can analyze the different makes of machine, say a Caterpillar machine, Sandvik machine or Roxmech machines.

You take over there consider the features and find out that which machine is more maintainable. Because if you are to select a machine for your operation, you will have to see that how you will manage the technology? So that you can get better productivity. For that purpose this maintainability aspects need to be seen and here these machines they claim they have got a safer maintenance access.

And there is also the engine cooler. That is a very important thing because if engine get heated up then there will be problem and for that they have added additional features so that it gives a very easy engine cooling systems.

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So, you have got these machines of very high capacity machines. You can see here the specifications that are the heat capacity is 45000 kg. That you know about the capacity of these are of dumpers are given by the society of automobile engineers specification. They give as a stuck capacity and heap capacity. Stuck capacity is just like when you fill a glass full of water at that time it is called your stuck capacity up to the brim.

But if you put some rice or some other type of sand in a mug then you always get a heap at the top. So that portion is called your heap capacity. The triangular upper portions, it is kept over there, the twice that is the slant height and then one is the that is 2:1 ratio they make it and that when it is full, it will be giving 45000 kg. And then normally that bucket for such a machine, the capacity of the bucket and volume capacity is 22 metre cube.

So then, depending on this, if you are deploying these machines in a very high density material mining there you can calculate out how much tonne you will be getting over there. Now, this there could be always different ranges. Now, this machine works in 7 gears. So, you can see that the minimum velocity we can get speed you can get 5.4 kilometre per hour. And then at the 7th gear it is capable of giving 30 kilometre per hour.

And then that while operating the operating weight it can go that is 36 tonne and then this load is distributed. That is a your bucket or that box is designed in such a way when the box is completely filled at that time your front, axle and rear axle will be sharing the total load as a ratio of 26 tonne and 9 tonne. And then another important thing is that the tire, the dimensions of the tire is given as a 29.5 R to 25 E4.

That is the specifications of the tire manufacturer they can standard. You can get it from any of that standard manufacturer tire. So, these are the special features of this machine you can see that when it is totally loaded at that time, it can go up to 81 tonne.

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So, that that is why the power calculation that is what will be the driving power up to 450 kilowatt. Now, here in this figure, you can see the how operation that is your dimensional things is there? So, that you will have to make the select a machine for a particular mining condition making it compatible to operate over here. As you can see here, in an underground mine or in a tunneling operation, the tunnel, it is giving a you are having a semicircular opening.

And even that it will be working the tunnel may be having a curvature. So that negotiating the curvature this will require that this articulation that articulated where you are having the hinge point here at that how you can take the turn within this. So, as a 45 degree, you can have it over here and then from there. You can find out from the machine dimensions you can design the for that your mining requirement.

But in many time the mining conditions, geo mining conditions is the main constraint. And for that constraint, what you need to do is you will have to just take this part that is your diameter dimension and then you check in the design. So, it may so, happen that certain mix machine in spite of matching with the capacity because of the dimensional conditions you cannot select.

So, you should always that refer to the leaflets or the design specifications given by the machines. And see that whether, under your operating conditions these are comfortable or not. So, similarly, your height that is if your ore passes where you want to unload over there. What should be the height required? That will be given by that from the manufacturer catalogue. So, these operating dimensions are very important.

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Now, another feature of this modern machinery which are being used in tunneling operations and in many of their underground mining operations. Particularly in the hard rock mining you can see that many of these machines are being used in Finland. Finland is known for its very deep hard rock mines and there the digital applications are doing a lot of services, out of which some of the standard commercially available.

That solutions are this automine, optimine and this knowledge box. These are their operating with the different machinery manufacturer. Now, this automine it is a fleet management that is truck fleet management system. This automine it is also used in surface mining terms to for the total, fleet management and then the autonomous production system they control over there.

What they do? There is your that machine safety, whether it is while moving within the mines with the different negotiating, different curves. And then how much exactly the cycle time it is taking? So, it will be controlling that it gives the equipment that even your access remotely or it can operate over there. So that the cycle time is reduced and that your productions can be improved.

Then there are optimine that for optimizing underground hard rock mining production for and that that by day integrate with the different assets. That is the operation of this machine it is also dependent on the loading side, whether you are loading it by side discharge loader, front end loader or by ore pass depending on where you are deploying. And also it will be having some operator will be there.

There may be at some places in the mine, you have got a signal for the controlling the traffic. So, all those different assets are combined together. Their total integrated solution is given and such type of this digitalization of the system it increase the productivity. And also give a the total operating cost can be reduced for enhanced profitability. Now, there is also a knowledge box is the concept in which they are having a lot of sensors.

They use in the machine and then while it is operating all the required informations are accumulated they collected and from that receiver it is transferred. In surface mine it is easily through the transfer from underground mine. It can be transferred from to their intermediate stations and from there it can transfer to the surface and that may be in remotely. So, this type of automated and then digital control systems are in that is your information technology and communication technology that have been in incorporated smartly.

So that this machine they have been very smart today. And that is why it is called a digital machine and that is why that model it gives that this is an i; intelligent machine. So, another

important thing is that this proximity detection system it is also a very widely used these days in machinery. And here because in a constrained spaces, you will be working so, whether it is coming that is your dangerous proximity to another machine or another obstructions.

At that time it can automatically control it because now there is a engine control Electronic control unit is there. That electronic control unit it is nowadays they are working in the principle of that your IOT, by which exactly the control is automated. The lot of development in the; engine side and engine governing side. So, this is the way the modern machinery is digitalized.

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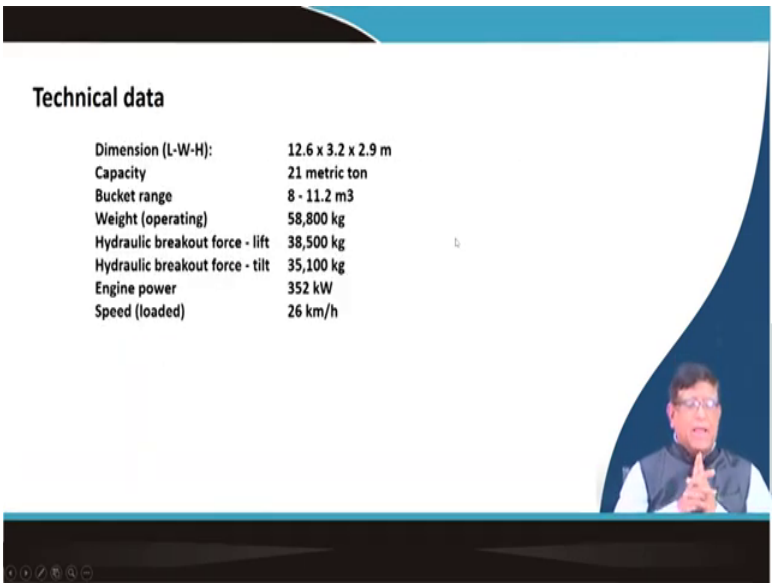

So, there are different models and their dimensions are given.

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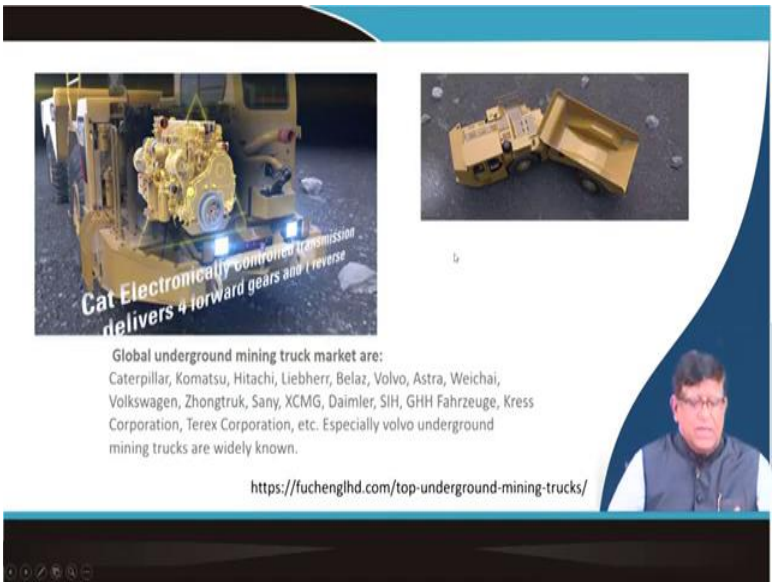

It is now, you can see here it is a Caterpillar machine in that Caterpillar machine also, you can see from this figure how the material is exactly kept in? So that it can get an easy flow. So, when it is little with race condition that this becomes just like a shoot and so that the material will be coming out. You can see that different your engines are located in such a way which is the very very important component of the whole machine and these are all turbocharged machine.

They need to take care of that how that your air which is coming up and then that exhaust it is using for exactly enhancing the power by turbo charging? And you can see now that globally, a lot of companies are there particularly Caterpillar, Komatsu, Hitachi, Liebherr, Belaz, Volvo, Astra, Weichai. This and then Volkswagen and the Zhongtruk, Sany this other automobile manufacturers are also manufacturing this type of machines.

Because the component manufacturers are globally; few that hydraulics they take it from the front and then they design and depending on the situations they can be there. So, as a learning exercise, what you need to do take the some of the model base model and the latest model of these companies and compare their different features. What features? Features of their engine that is features of their articulations, features of their box type.

Then their control their maintainability under few headings. If you compare then you will be knowing that what is the present level of technology of this machines are there?

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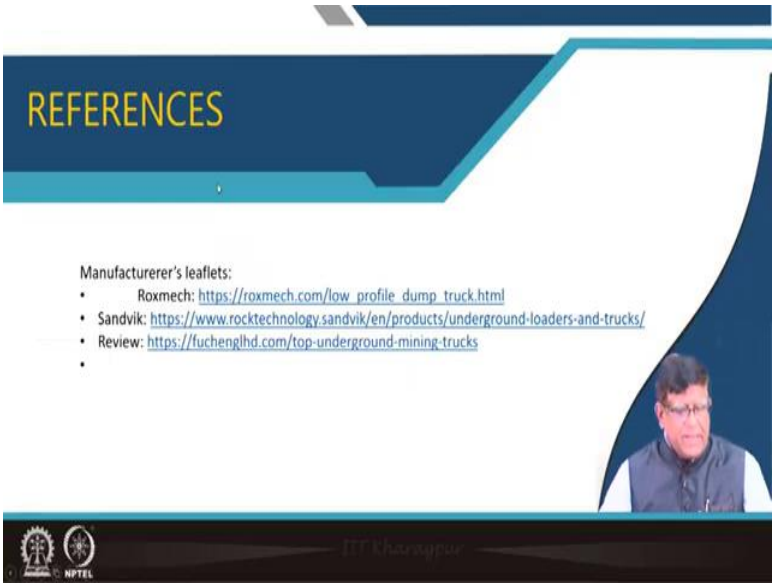

So, there are number of references. I have said that Roxmech machines, you can study. Sandvik's and then, as a overall that about more than 10, 12 companies review you can find out there is a website of this Chinese manufacturer. The Chinese manufacturer's website has given a brief review of all the different leading manufacturers. So, you can study about that and you will be knowing.

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So, the basic introduction of the underground mining trucks will help you in studying the machine for developing expertise in technology selection. Now, why I have introduced it so briefly about this machine is ultimately, if you are working in a field you will have to be selecting, you will be a selection person for different applications. So, equipment selection is a area and for that you need to start at least having the basic information and baseline knowledge about this subject.

So, as a learning activity, you develop a model for estimating the operating cost of operating low profile dumper in underground mining. Some of you for your project work for your other that is your own academic interest you can take it and then possible site for case study is uranium mines. In the uranium corporation of India limited their mines they are using this low profile dumper.

And you can easily communicate with them, get their data for academic purposes and if you can develop a cost optimizing model for it will be useful. And maintenance analysis of low profile dumper and prediction of maintenance cost. So, this could be a title for your; another

study. Some of you should come and if you need to know that what should be the type of your algorithm you should use and in which way the data should be presented this.

If you are more prone to the digitalization of the systems, you can do it over there and if you need any help, you can contact us. Thank you.