Mining Machinery
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Module - 07
Lecture - 37
Mine Pumps: Special Pumps

We have started discussing about the Mining Pumps that is pumping operations in the mining industry. We have discussed in our last class about the centrifugal pump and reciprocating pump in general, their brief introductions were given to you. Now, today, we will be discussing some of the examples of few pumps which are used in the mining industry.

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And basically, some construction and operations will be discussed here.

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And so that you can know about what are the different pumps used in the oil and mining industry.

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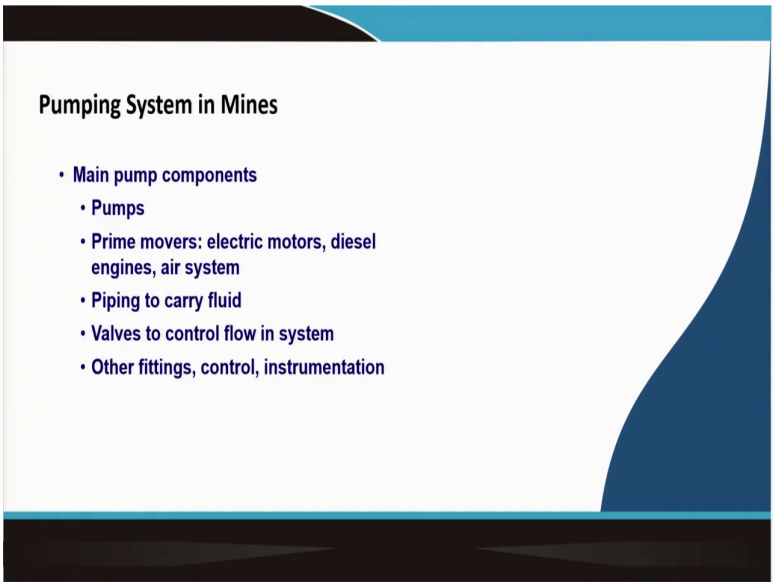

So, in a pumping system, that is a when you are working in mines, this is a pump alone is not the issue, that how a whole system is working that is very very important. We need to identify what are the different parameters they effect the performance of this system. Because the your productivity of the mine, it depends on the overall performance of your whole system; only with the pump alone will not help. That is why whenever you learn the pumping you need to know about the pumps along with what is its prime movers.

The prime mover of pump, it can be electric motor, diesel engine or air system. There are many pneumatically operated pumps are also there. So, where the prime mover is the compressed air. Now, we will be discussing in our next lectures about these compressors, how exactly a your air can be used as a prime mover.

And then, there will have to be a piping is very very important that how your the pipes will be connected and when the pipes are connected that these they will have to be different joints on the pipes which may affect the operations. The detailed when we do the theory of pumping that is losses of head in the pipe in its bands all are taken care of.

In your normally at the third year mining engineering studies, you have the mining machinery practical, where you study this pumping system by doing your practical on the total head loss or the determining the characteristics of the pump on a particular installations with all these things.

So, we will be seeing that how the pump characteristics are determined, it is in a different lectures; then also, there are different valves to control the flow in the system that how the valves work that is also an another area and there will be different controls, fittings and instrumentations. Today, why you need to study the mine pumps is to how can you automate the operation and maintenance of the pump. This they are the very good candidate of IOT and machine learning, we can go for it.

For example, I give you a problem. Say for example, in a mining area, there could be that a mine say for northern coalfield, it has got number of mines. Each mine has got number of locations, where pumps are working. So, if you see that whole area, there may be 40-50 pumps are working at different locations every day. They have got their either individual diesel operated or electrical operated.

Now, the flow requirement and then their water pumping requirements very seasonally at different seasons. Now, how will you develop a information system for proper operation and maintenance and cost control of this system? So, for that you will have to learn the whole pumping operations as a system.

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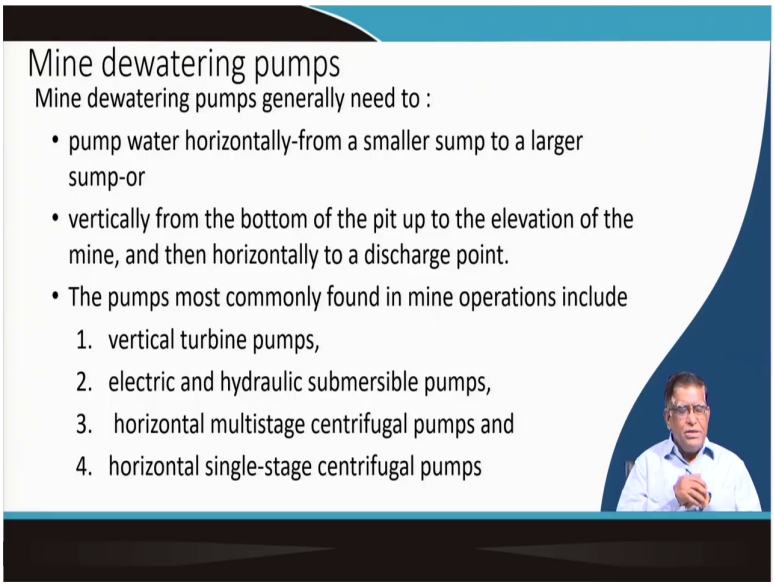

Now, there are as I said that mine dewatering pump that mine dewatering, it is again we have got a two type of dewatering; in opencast mines, you are dewatering the sumps where that water is accumulated from the underlying aquifers when you are or there will be in underground also.

There will be in the sump or because of the water shipping into the underground, they may be carried to a sump and from there, it will have to be dewatered. Now, this pump water can horizontally from a smaller sump to a larger sump. That is, sometimes they are taken from the different galleries, different places, it is brought and pump to a separate locations and then from there, that it will have to be lifted vertically.

Now, there are different types of pumps are there. You will have to make a your self-effort to learn what is called vertical turbine pumps. There are axial flow pumps are used. Electric and

hydraulic submersible pump; this submersible pump is another one, another type of centrifugal pump, where it is kept under water and then, it will be doing.

So, if any submersible pump that do not require priming will be the submersible pump. Then, horizontal and multistage centrifugal pumps are also used for dewatering and then, there will be a single stage pumps are also used for mine dewatering.

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Here, you can see that how a multistage vertical turbine pump is used in a mines or we have got here a horizontal turbine pumps are used in a sump from their underground mines to take out the things. This type of situations you can see in the underground.

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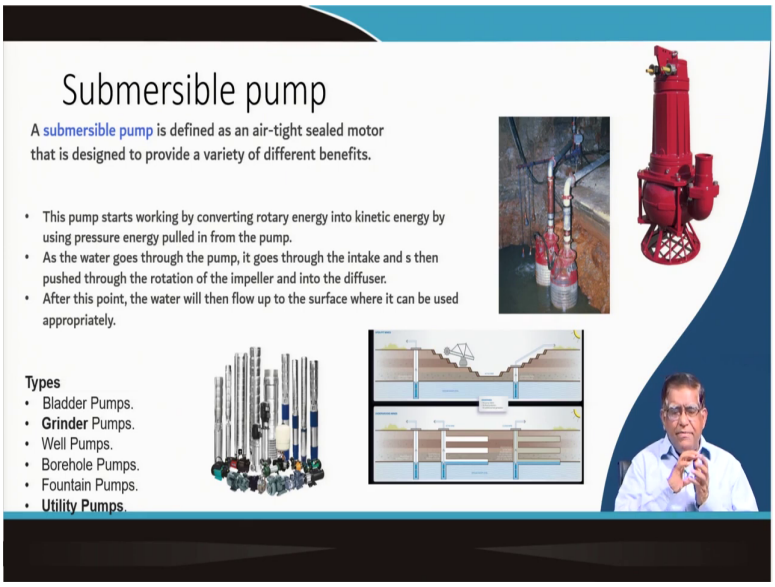

Similarly, the special pump is your submersible pump. This submersible pump is used in underground as well as in open cast mines and there are quite a large varieties of this submersible pumps are there. Now, what is a submersible pump? It is an air tight sealed motor that is designed to provide the variety of different types of; you can see here that is the pump is associated with the motor.

And the whole unit is lowered into the water and kept under there and then, it pumps the water to the surface. So, this is as you can see here it is the skim of naively lignite corporation. In the naively lignite, whenever you have to do the mining over here because this water table need to be that is kept below.

So, that is why that pumping a lot of amount of pumping will have to be done; otherwise, this will at a high pressure, this will inundate the pit floor. So, this operation is done by this

submersible pump. Now, in submersible pump, they exactly that converts the rotary energy into a kinetic energy by using pressure energy pool from the pump. That the pump is basically giving a motion through the water so that it can goes through the pump and then, goes to the intake, then to the your delivery sites.

So, this the there are different manufacturers, who make different type of this submersible pump. There are bladder type, grinder type, well pump, borehole pump, fountain pump, utility pump; different names are given by different manufacturer. So, what you need to do? You will have to study the construction and operation of these machines because they have got certain basic advantage and disadvantage.

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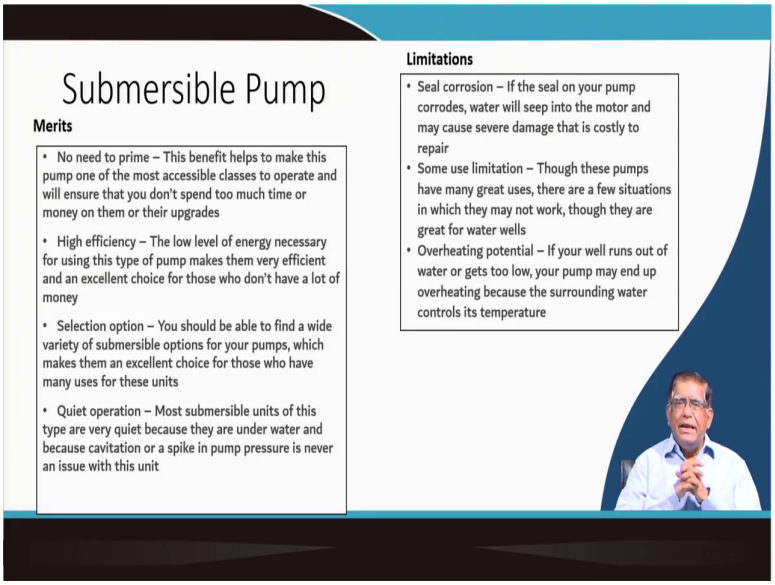

Now, what is the basic advantage of a submersible pump? As I said that, there will not be any requirement of the priming because it is always submersed in water. They are very high

efficiency pump that is your low level of energy is required there and that is very they are very good.

But only thing is the they need to be seen that how your that electric motor which will be going and kept under this your submerse conditions, their insulations and there the operations, it will have to be specially design motor, then it will be having a very high efficiency.

And then, there will be the for the depending on the pumping actions; that means, that hole which you will be creating, it can we can make that a wide range are available even for a very small one to a very large one because they work on a multi stage basis. So, even in a small hole having a number of pumps can be together. They are multistage pumping sometimes we have got even 80 stages of pumpings are also manufactured this days.

And then, another thing is such type of pumps will never make much noise, they are the they will be always having a low noise operations. But only thing is that depending on the type of fluid, it may have a problem of corrosions and then, there would be other problems like a that is sometimes the insulations failure, it may burnt the motor and then, if there is a the to monitor them, you will have to make a special submersible instrumentation that is also difficult.

As other motor to install a monitoring instrumentations and then, to carry out the information's is easier than in a submersible pump; but their systems already has been developed.

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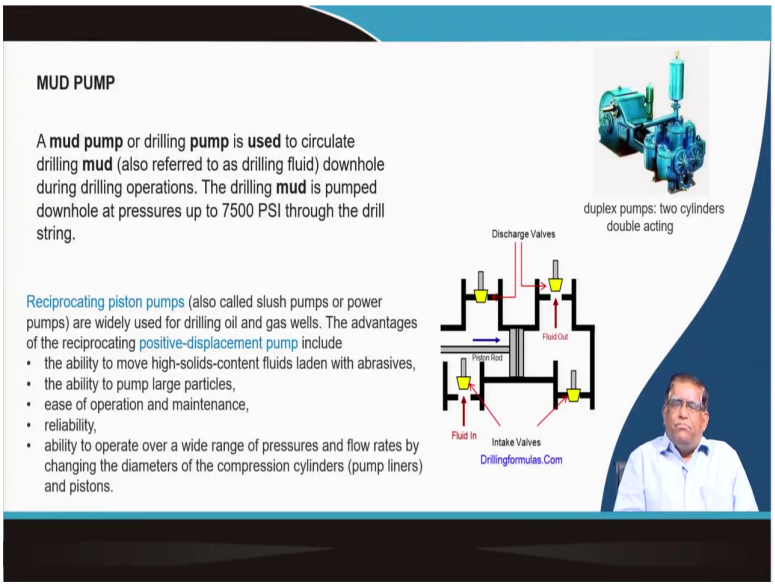

So, you know that submersible pump, it can be another type of pump which is a special pump, we can tell about is the mud pump. Now, what is a Mud pump? As I said that in a drilling machines, the oil and gas well-drilling, you need to have the mud pump and also, that is mud pump to send the mud to drilling mud to the borehole or drill hole to do the flushing operations of the plus drill hole.

The other mud pump which could be exactly for your as a slurry pump. Another form is a slurry pump, where you create the slurries and send it. Sometimes when you are working, I we told about dredger. When dredge is mining, dredger mining or the un sub underwater mining, there your whole thing in a form of a mud, it will have to be taken and then send it through the pump. So, there you will have to have this mud pump.

So, basically when we say mud pump, it is what is used in the oil industry as a drill ring and there sometimes are very high pressure pump, they will have to work at a very high pressures. Now, there mostly a reciprocating piston pumps are used. Now, you know that this is a principle of reciprocating pump, you have learnt in your school days that is exactly what is there a piston or rod is there.

When this will be moving, here it is a double acting because it is a two cylinders are there. Now, when it is going in these direction, then you can see here it is sucking the fluid in and that fluid will be out and when it will be going towards these directions, this will be fluid will be in from here and the fluid will be out from here.

So, in both the cases, the discharge pipe which will be going from here will be getting a cantilever. So, this is a double acting or duplex pump which is used in a oil pump.

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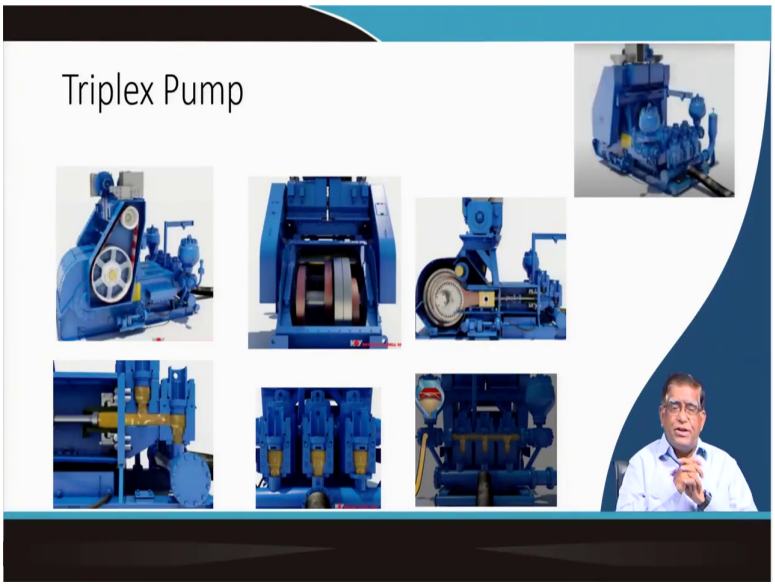

Now, sometimes there is a mud pump in your that is a triplex pump. Now, you can see here this is a diagram of a triplex pump. You can see one delivery side is here and then, there are three, three your intake side is there that is a triplex three dots are there. Now, just to see with these diagrams, you can try to understand the triplex pump operations.

You have got the shaft of the main pump that is a three, three cylinders are there. Here you can see one, two, three; three cylinders are there which has got the three pistons by this crank operation, there will be three pistons will be moving and they are operated by one single shaft.

And that shaft is driven by there is a electric motor. With that motor, we are having a bill drive and through this the drive the power is given to the three rods. Now, when these three

rods will be moving, these will be doing the reciprocating movement and then the mud will be that is your mud will be pushed to this.

So, you can see the three cylinder that is as this will be having a crank shaft so that the three pistons will be keep on moving that reciprocation move on motion, it will push and then through this one manifold, they are going to get exactly all that mud will be going through one.

So, you understand that a triplex pump is a reciprocating pump in which basically you are having a well driven shaft by which this crank is running for three pistons and the three pistons are pushing that is from the three cylinder, the mud is going and then to the other delivery one discharge or delivery point.

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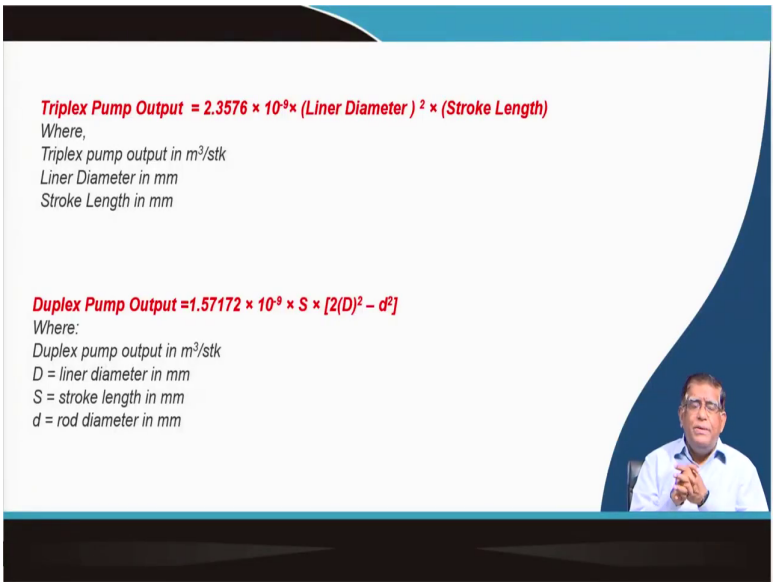

So, now the thing is that what you need to do exactly knowing how the output will be there. Now, in case of your this triplex pump or duplex pump, the output formula is given by this depending on that Stroke length.

Exactly, what is the length of this, how much it is moving the piston is moving inside the cylinder that is giving the stroke length and then, there will be the depending on the diameters, what is the total area swapped that gives the that is your main output.

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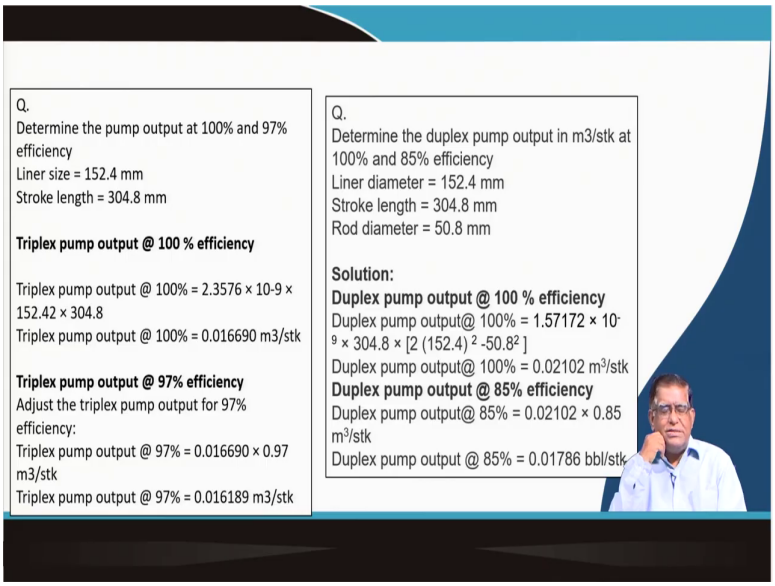

So, this you can do a simple calculations and see how it is done in a triplex pump, that is your they if you have to find out the pump output at different that your percent of your efficiency.

Now, as this formula is already given, then you can easily put it over here. Using this formula, you can calculate this what is the output. You can see here that how much meter cube per

stroke it is given. Then, if you know that is what is the total number of stroke per hour it is giving, you can find out that what is the hourly capacity.

So, in this way, you are in a that is a when you are working as a drilling, depending on the penetration rate and then you will have to find out at what rate you will have to send mud and those are the mud calculations which is done in the drilling technology. So, when you will be studying drilling technology, there will be learning the other thing; but as a pump its importance is to be known.

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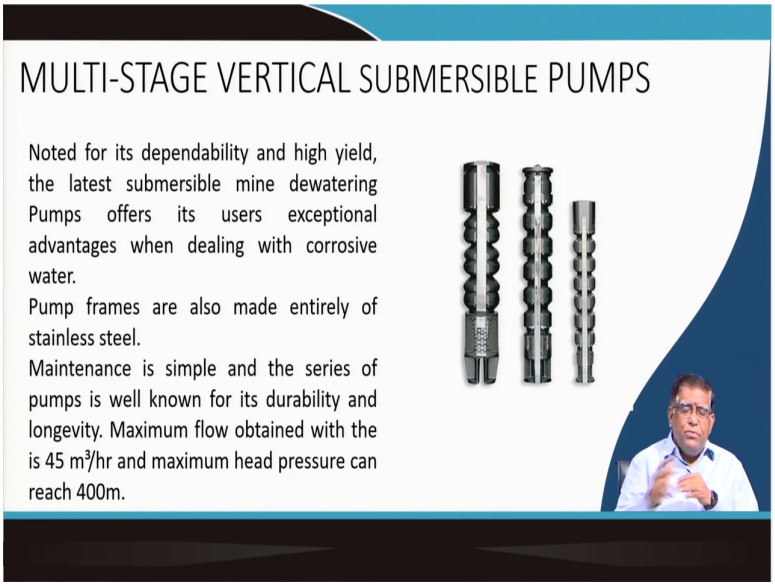

Now, the other special pump, we have said that the submersible pump which is exactly as a multistage turbine pumps or sometimes you can have these are multistage pumping. Turbine pumps means you are exactly when the drilling fluid will be going and that fluids.

Because if you are working as a 2000 meter below, at that time that is your in in a turbine pump, there will be a impeller will start rotating because of the fluid which is coming over there and it will be giving a pressures and from that, you can get the required suctions created and done. That is in the (Refer Time: 17:51).

In case of your vertical submersible pump that is your you can make this the whole pump will be in a very that say diameter is less that is why number of stages are given. It can be a longer type of pump.

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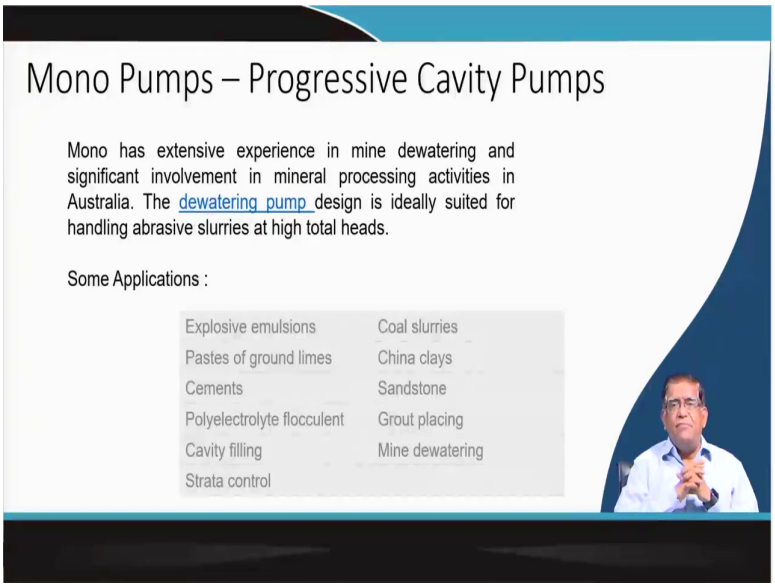

The other pump which is there used in the mining industry is the Mono pump which is called a Progressive Cavity pumps. This is Australian's design which came and it is exactly a very

good for dewatering with a slurries or with a highly solid laden can be used with this and that once it was decided, it can be used in many others also.

The basic principle is just like a screw pump. In a in a screw pump, you might have in transportation, we will be discussing about the screw conveyor; the same screw conveyor principle has been used in a pumping in case of a mono pump.

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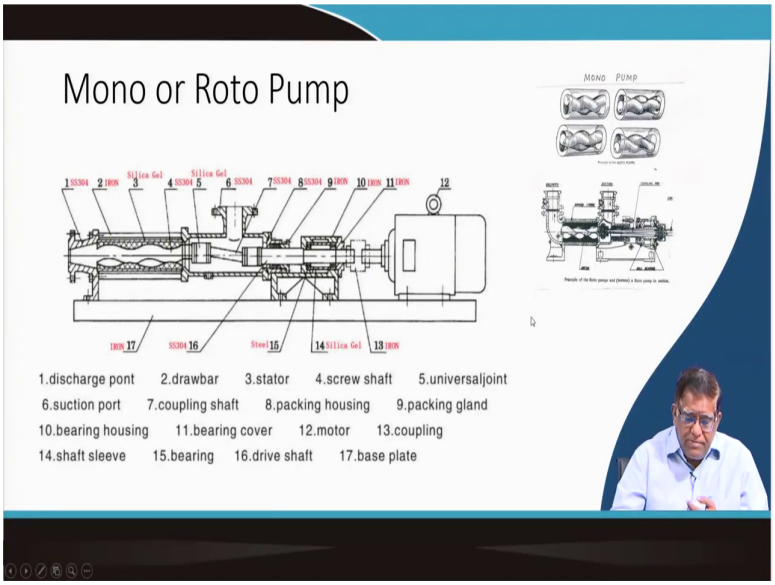

Or a which is a in a mono pump, you can see here that a special type of rotter is there. This your discharge point and that your we are having that that unit wise that component wise we have got that your a drawbar and we are having this stator and inside that, we have got this screw shafts; as a screw type of this shaft is there and then, we have got this universal joint by which they are connected together and from here the fluid is suction.

Now, your this whole shaft is given to the drive motor where by coupling it with this and then, it is kept inside the packing houses and that are packing glands are there and then, you are supported on the bearing and then, with a all things the bearing cover and then ultimately, it is the drive motor. Now, here, they have whenever that is two shafts, there is a particular type of coupling and then, there will be the sleeves.

So, this is a whole unit basic operating principle in a mono pump is this helical curve which is when it will be moving, it will be creating a moving cavity and this will be shucking the material out. This has exactly got very popular in having the that your in the mine dewatering purposes because there, lot of muds and all are there.

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So, if this in a simple one; this is a progressive cavity is created and then, its main feature is it is a positive displacement pump that hole things are pushed out and then, it is just a very high

heat and then, if we are using such type of pump, you can replace this multi stage pumping. Because in the multi stage pumping and all because of their more units and there have been more maintenance problem, there is also more energy consumptions.

So, this mono pump because it has no valves, it is called a valve less pumping that is why it has got a less maintenance and it can easily use those the pastes for the slurries and then, this type of fluid can be very easily taken. So, that is why for back filling of our mines or sometimes dewatering slushy material, for that purpose this mono pump or that progressive cavity pumps are very much used.

So, this is a special pump which has developed in last about 20-25 years such type of pumps are working. There are wide range of this type of pumps are there.

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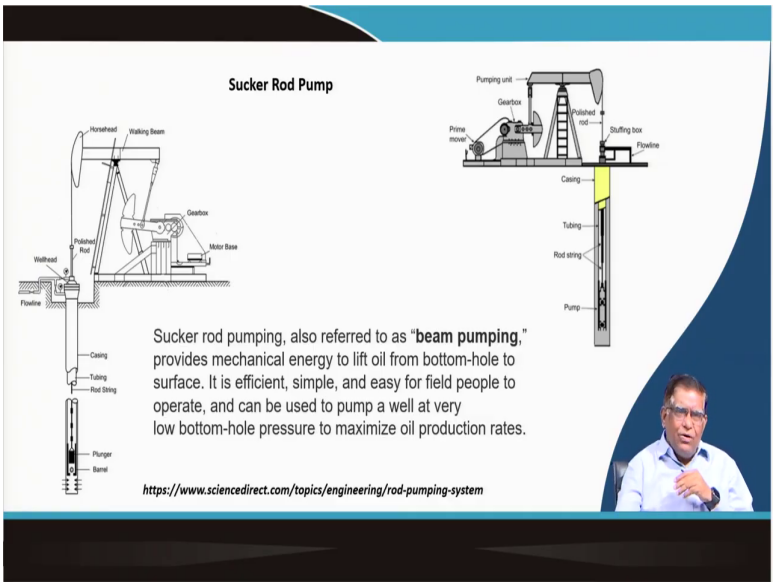

Then, the other, I just briefly will tell you about the next special pump or which is a very old in the oil industry. If you go to any oil field, you will always keep on seeing this one just like your reciprocating parts over here, which is called your sucker rod pump. This which is also called sometimes “beam pumping”, where is there this will be making a very long that is a deep hole is made and there with a rod, they are connecting there is exactly the that casings and tubing and then there is a rod string.

Basic hole pumping operation is by this rod string and at the bottom, there is a plunger and there is the barrel. Now, when they are to do the that is your pumping taking out this is also sometimes called your artificial lift method of that is your oil and gas. So, that whole system in the field, you will find a prime mover is there and that will be a gear box will be giving a main pumping unit which is having we are having a walking beam.

This beam is also called walking beam which is over a house head that it is moving over there and this stuffing the stuffing block is there. The fluid which will be coming out, it will be taken to the flow line; from here, the it will be collected.

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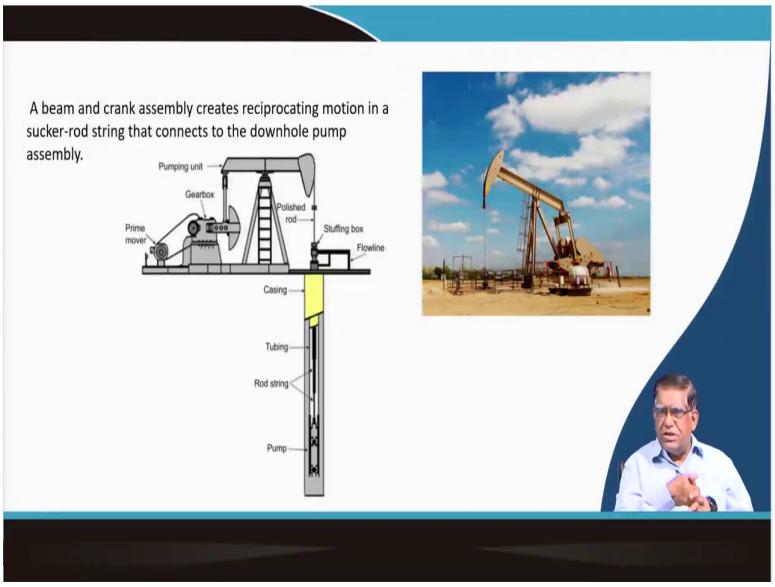

So, this this is a scenario in any oilfield, wherever you are doing an artificial lift by this sucker rod pump. So, this is basically a beam and crank assembly that creates the reciprocating motion. Sucker rod pump is nothing but a reciprocating pumping motions; but it is a down hole assembly which is doing the pumping, it can be much deeper.

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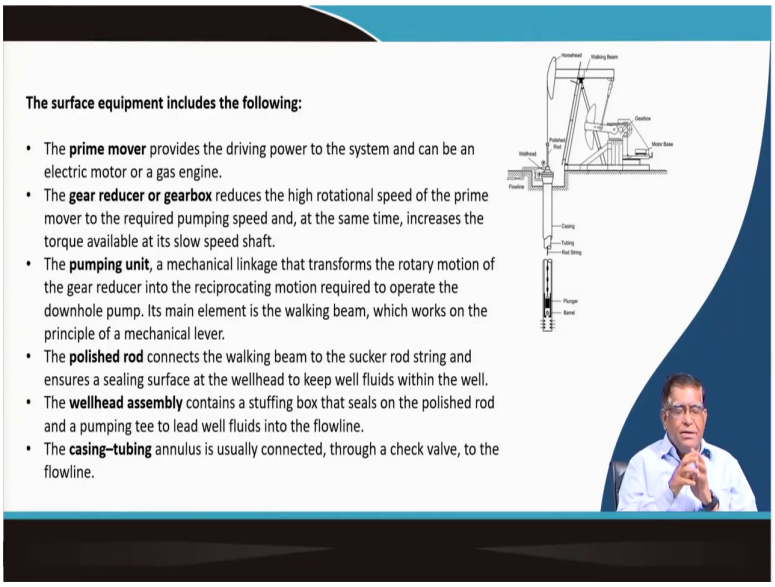

So, the surface equipment, where as we have seen in the previous diagram, we have got the prime mover, we have got the gear reducer, we have got the pumping unit, we have got this rod and then, wellhead assembly and the casing-tubing.

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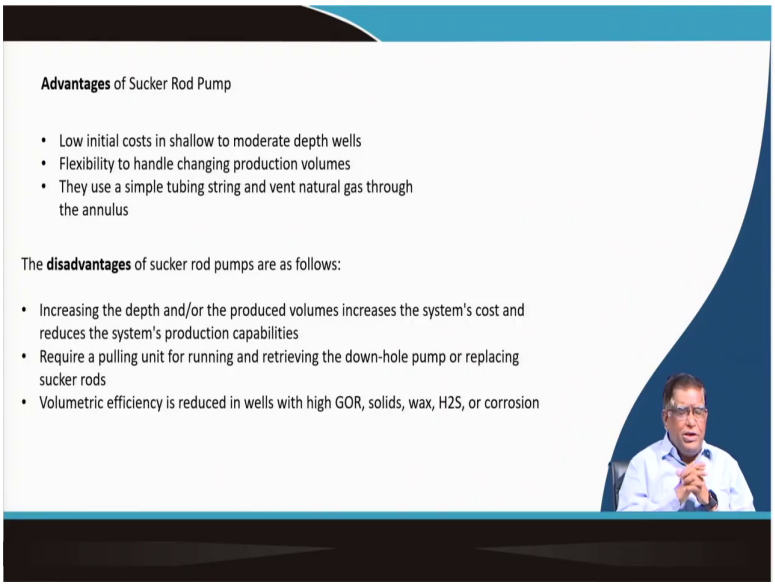

So, this the sucker rod pumps, their basic advantage is they do not have a very high cost; law in low initial costs and at a very shallow to moderate depth wells can be very easily done by this and the flexibility to handle changing rod and productions can be done.

The use are very simple. If you know that in our Moonidih mines, when the first the coal bed methane extractions they had to do it, there they were using the sucker rod pump for dewatering the things hole and then, get the collection of the gas.

So, that is that was used over there. Then, the advantages of sucker rod pump is they increases increasing the depth and are produced volume volumes increases the system's cost and reduces the system's production capabilities. To very deeper, it cannot work that is the things

and then, it require a pulling unit running and retrieving the down-hole pump for replacing sucker rod.

So, that means, there is a bottom, bottom unit that is at the and the bottom of the hole, there is a one unit are maintaining that is also the problem over there. So, their volumetric efficiency is less, that is right; but as a history, this pump has been there in the field and still being used.

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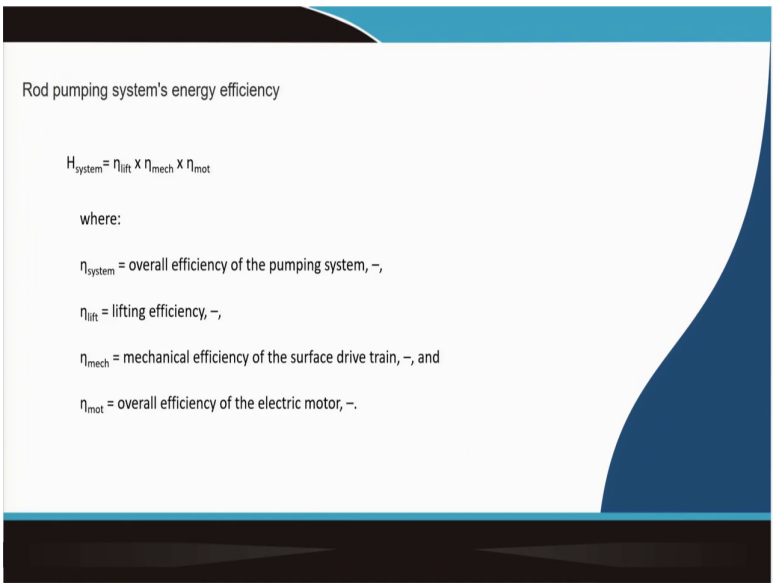

And then, their efficiency as it is a product of this three type of efficiency, that is your lifting efficiency, mechanical efficiency and overall efficiency of the electric motor and if anything goes down, the total overall efficiency will be going down.

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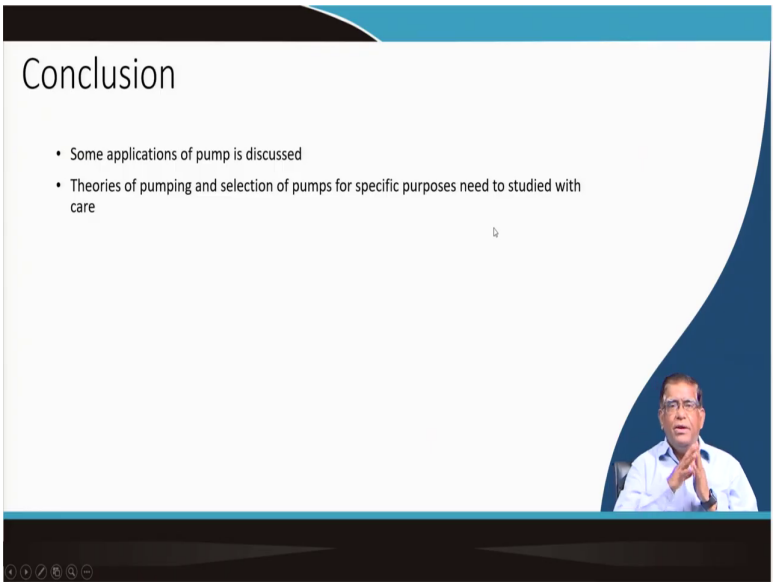

So, coming to this, exactly you have got here the idea about that there are different types of pumps which are used.

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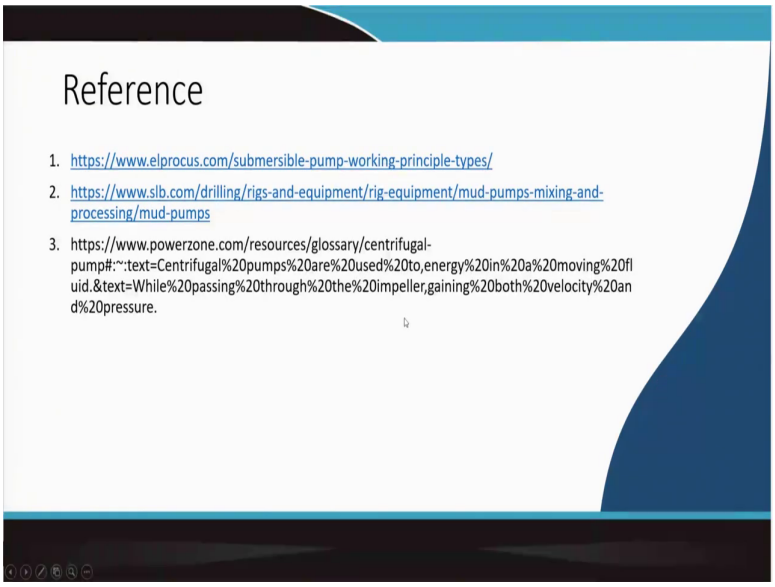

Now, our main discussions will be in our next class, we will talk about what are the pumping principles particularly, what is you mean by your suction heads, net positive suction head and the principle behind this cavitation; how the cavitation takes place, what are the problems in the pumping, we will be giving in a very brief idea about that and then, we will be discussing about the compressors.

So, that is one thing you need to know that pump, fan and compressors are three main machinery, which need to be learned by the mining engineers for their better operational control in the mines.

Thank you very much.