Oil Hydraulics and Pneumatics
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Part – 4: Construction features and operations of Internal Gear Pump, Gerotor Pump and Screw Pump
Lecture - 16
Hydraulic Pumps

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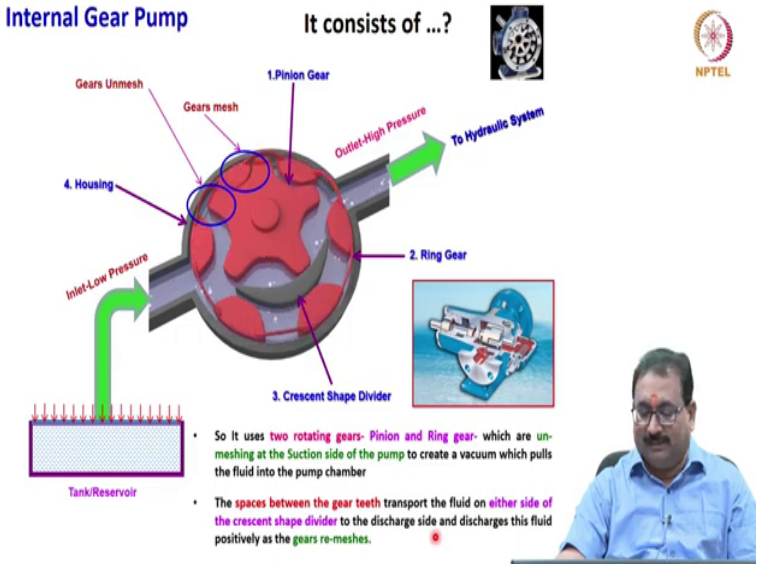

My name is Somashekhar, course faculty for this course. Next, we are seen to transport the fluid in previous one external meshing takes place. Now, we will see the internal meshing, what you can call the internal gear pumps are commercially available in the market. Please see and here friends; how the fluid is sucked and how it is transport to the your hydraulic system through the various walls. Meaning; again inlet is there, outlet is there, some matting elements are there.

Can you please see here how it is, what are those? Please carefully observe the inlet outlet and then here I marked here, the two gears here, two gears, correct. Then you will see some of the things are there, you will observe very neatly; I will tell you, I will explain to you the constructional future of internal gear pump.

Can you please think how many elements are there here? Yes, as usual two gears are there in the housing, but they are meshing internally. Then what are those elements? One pinion is there, you will see external teeth pinion; pinion gear what I am showing you small one here.

Then it is a ring gear, bigger one ring gear; then here you will see one crescent shaped divider, some projections in the body sink. What we will call, it is known as crescent shaped divider, which will separate the inlet and outlet. So, due to this crescent shaped, the pinion and the ring gear are upset always; the axis of this and axis of may that ring gear are not aligned, this is very very important.

Pinion gear is a driver which is connected to the shaft, this is only driven gear; then as usual the housing. The pinion gear, ring gear are upset, and crescent shaped divider divides the inlet and outlet; divides means separates the inlet and outlet, all are enclosed in the housing. So, it uses the two rotating gears pinion and a ring gear, which are un-meshing at the suction side; you will see here, why it is this suction? You will see here friends, here please you will see the gears are un-meshing, un-meshing here.

The un-meshing at the suction side of the pump to create the partial vacuum which pulls the, which pulls the fluid into the pumping chamber; because it will kept at the one bar and here beginning no fluid, when it will starts rotating pinion, automatically where un-meshing takes place, the partial vacuum will create.

Then immediately due to delta P, the oil will be sucked from the tank to here. Once it is catched, no need to worry friends; automatically it will transport the fluid, how would you will see on either side of the crescent shaped divider.

The space between the gear teeth, transport the fluid on either side of the crescent shaped divider to the discharge side and the discharges this fluid positively as the gear re-meshes. You will see here, the meshing you will observe when it will rotate; again it will re-meshes in this place, you will see re-meshing will taking place.

Again un-meshing, un-meshing always a suction side; then re-meshing discharge side. Meaning; increasing volume and decreasing volume again you are seeing here minutely correct, you have to see this; this is the principle of pumping.

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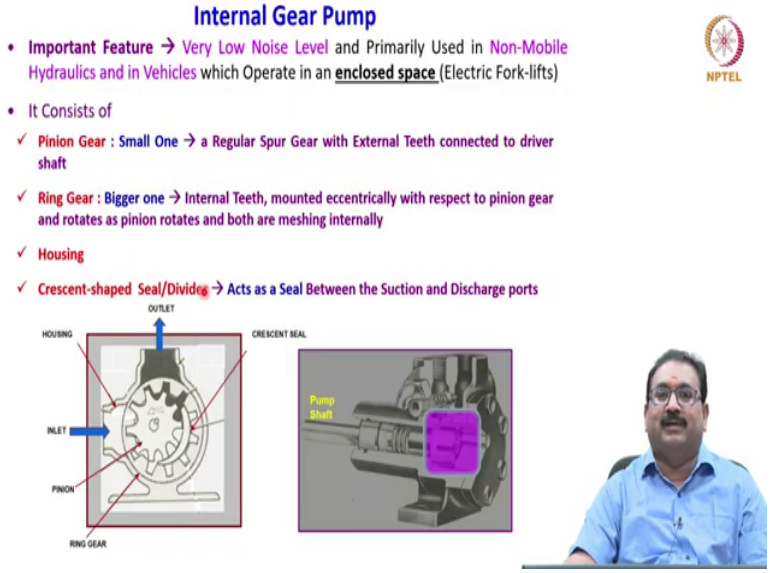

So, important features are here, very low noise level and primarily used in non mobile hydraulics, and in vehicles which operate in an enclosed space like a electric forklifts. It consists of, you will see here I have shown the sketch again here; you will see here driver and

driven and two gears which will mesh internally, you will see here two gears which will mesh internally.

I have shown the inlet and outlet and a housing; it is a pinion, what I am showing you here is a very small, small one pinion, a regular spur gear with external teeth connected to the driver shaft. Similarly, we will see the ring gear bigger one, which has a internal teeth, mounted eccentrically with respect to the pinion gear and rotates as a pinion rotates and both are meshing internally. Housing and then crescent shaped seal or a divider, acts as a seal between the suction and discharge ports.

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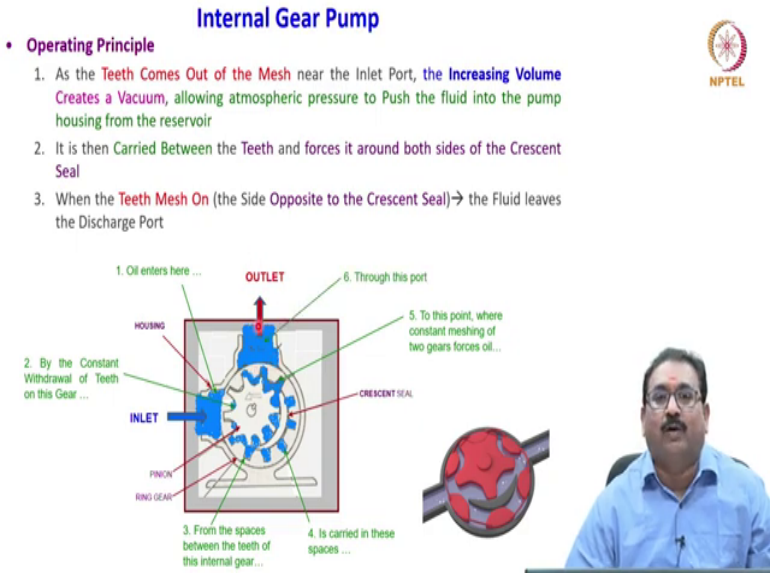

This is simple construction, again two gears; internally a meshing mounted with upset crescent shaped divider and housing, these are the very very important elements in the internal gear pumps. Operating principle as usual as I have told you, as the teeth comes out of

the mesh near the inlet port; the increasing volume creates a vacuum, allowing the atmospheric pressure to push the fluid into the pump housing from the reservoir. It is then carried between the teeth and forces around both sides of the crescent seal.

When the teeth meshes again, the fluid leaves the discharge port. Here though oil enters here, oil carried here in the pockets, forms the space between the teeth and the internal gear is carried here, and it will discharge; see here discharge through this port, outlet port.

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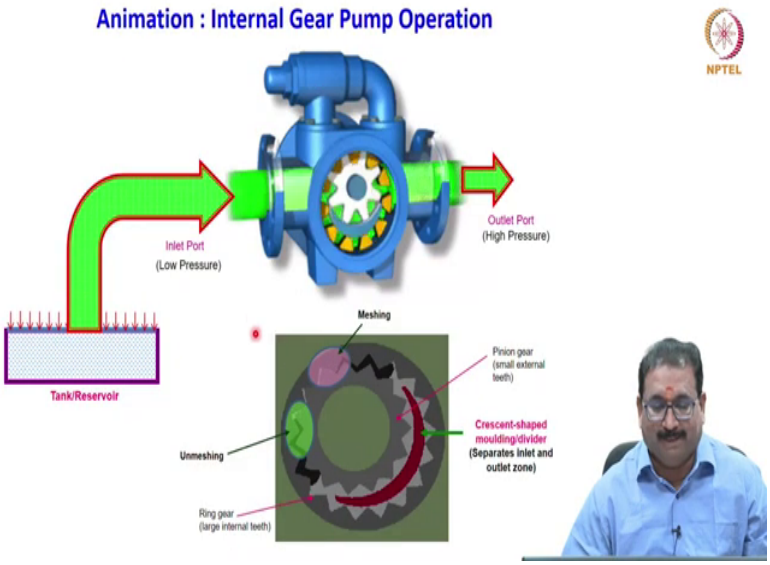

You will see very clearly in the animation of the internal gear pump; you all see all meshing and un-meshing as I have marked you, the fluid will suck here and discharge here, you will see this is crescent shaped divider, pinion and yellow one is there know that is what we will call the ring gear, which has a internal teeth both are upset. They see the crescent shape divider; once the fluid is ejected it will not come back; it is separates the inlet and the outlet.

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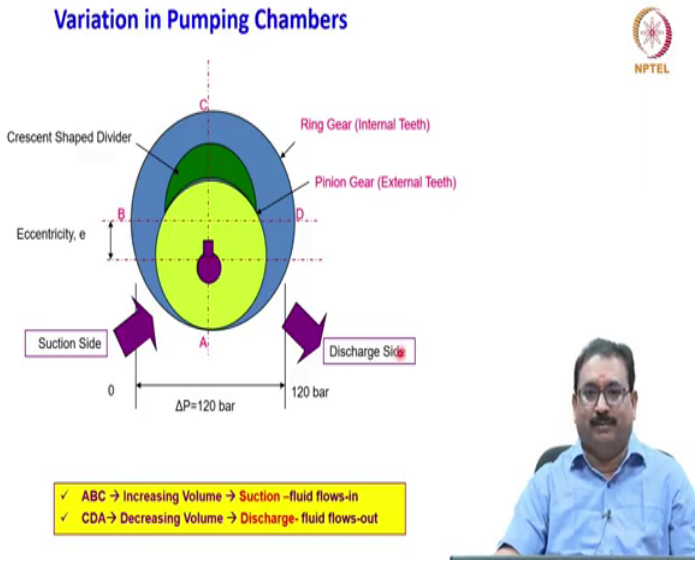

Then, I will quickly I will show you this variation in the pumping chamber with simples schematic diagram; you will see here friends as I have told you, the ring gear is a big one and axis is here I marked and it is see here pinion gear which has a external teeth mounted eccentrically.

The eccentricity is there between the pinion and the ring gear; then this is what we can call, it is a crescent shaped divider is there. This will show you clearly the increasing volume and decreasing volume; that is why I have drawn you here the variation in the pumping chamber, what happens pumping chamber.

You will see here friends, the pinion is connected to the what you can call the motor shaft; this that is why it is a rotor, it is nothing but it will follower it is the ring gear. You will see friends here, when this will rotates; you will see friends here, when it will rotates what

happened here, in the half revolution I marked with the quadrant here A, B, C. See this area friends, see this area A B C half; it is will see the area goes on increasing, here area goes on increasing here, that is why it is a suction side always.

When again it will rotate another half, what happened we will see your friends; see here the volume decreasing here, this is discharge. The whole pump is designed for the certain delta P; what I have shown you here it is a delta P is, it will the pump will withstand for up to 120 bar capacity, this 120 bar is coming from the load.

Each pump is designed for certain pressure. Now, please understand here the increasing volume A B C increasing volume, here is a suction, oil will suck and discharged to the outlet; when the volume decreases C D A you will see this volume goes on decreasing.

Now, same thing A B C increasing volume, suction fluid flows in; C D A decreasing volume, discharge the fluid flows out of the pump, half revolution A B C, C D A is the another half revolution of the your pinion gear.

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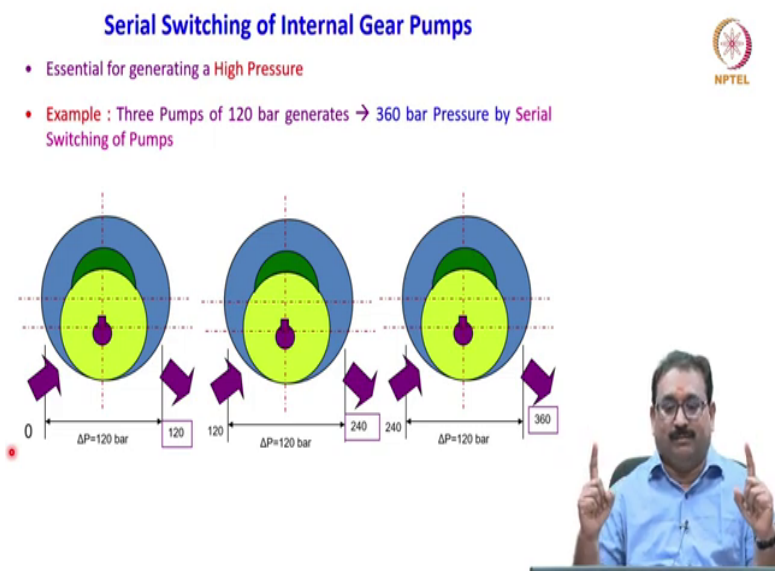

Now, very very important thing in the internal gear pump is serial switching of the internal gear pump is possible. For example, look here as I have told you in the previous slide, the pump is designed for the certain pressure; for example, delta P is 120 bar. You cannot use this pump beyond 120 bar; otherwise the pump elements will get destroyed or what happens the pump efficiency will go off for the continuous usage.

Then what is the beauty here in the internal gear pump, if you are have a three, four pumps of the capacity 120 bar, 120 bar, 120 bar; then serial switching of the internal gear pump is possible, then you will use whole unit for the higher pressures rating whatever you required, you no need to buy the one more pump of higher capacity. How they will do? You will see here friends the, this is serial switching is possible for generating the high pressure.

Example, here you will see, these are used for generating the high pressure; here I am showing you three pumps of 120 bar generates a 360 bar pressure by serial switching of the pumps, this is a beauty in the internal gear pumps. You will see here three pumps; each is having the 120 bar, 120 bar, 120 bar capacity.

What I am doing here? I am serially switching; meaning here the fluid will be suck, outlet of this is connected to the inlet, the outlet of this is connected to the inlet, then outlet. The whole unit with withstand for 120, 120, 120; meaning the 360 bar capacity the whole unit will work. Otherwise you have to buy the again 360 bar capacity pump; no need to worry here, serial switching is possible, ok.

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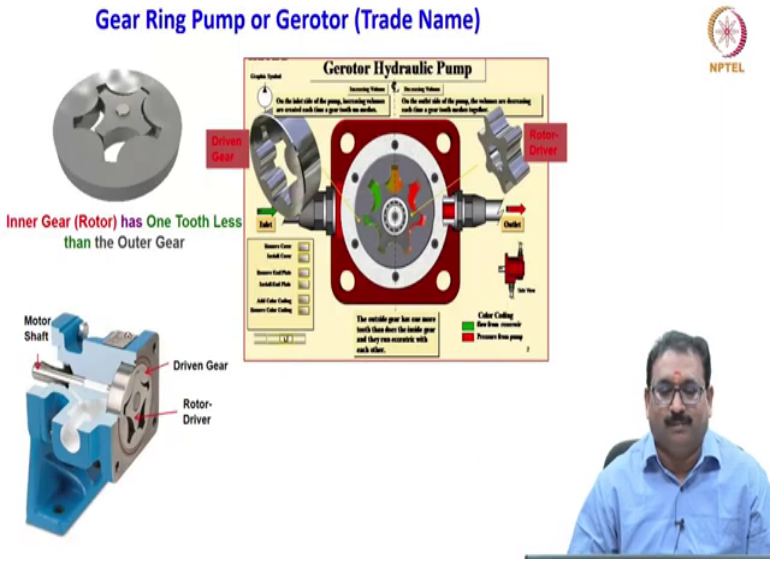

Very simple it is friends, very very simple. Another one I am showing you here; you will see here friends, how the meshing takes place now, you will see here very clearly in the figure

what I have shown. Now, we are discussing the gear ring pump or gerotor; gerotor means it is a trade name friends, gerotor is nothing, but generated rotor, generated rotor trade name for the gear ring pump.

Here you will see here, you are seeing internally meshing; but you will see there is no crescent shaped divider in the gear ring pump. Then where the meshing takes place you will see here all how it is; meaning how they are designed here, you will see the big one the ring gear and the pinion.

How many teeth's are there you will observe; the pinion is having one tooth less than that of the bigger one ring gear. Meaning; the inner gear has one tooth less than the outer gear, outer gear means what we will call the ring gear, that is a beauty here ok, we will see here also. See the this is a rotor and a driven gear; the rotor having one tooth less, pinion is having one tooth less than the driven gear, again it is a motor shaft, cut section model of the gerotor pump.

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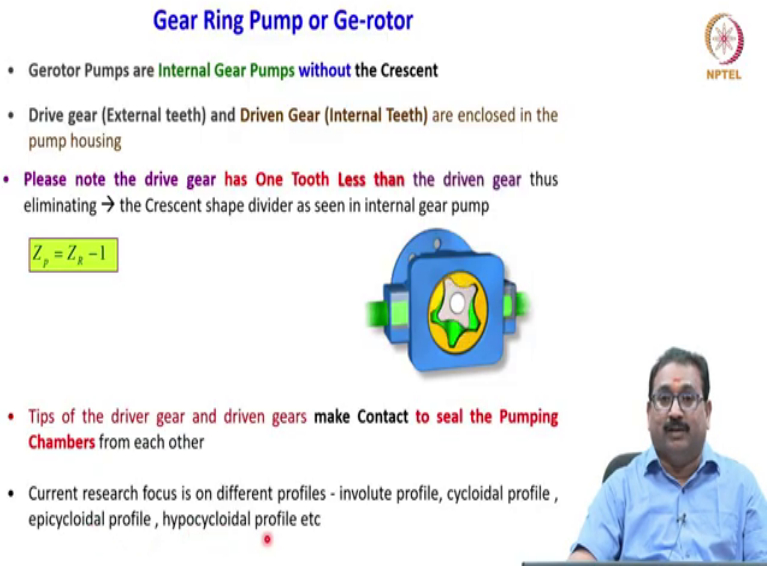

What is this? Gerotor pumps are a again a internal gear pumps without the crescent shaped divider. You will see here, the driver gear, meaning the driver external teeth; meaning is a pinion it is, remember external teeth, external teeth and a driven gear internal teeth with what we will call bigger gear are enclosed in the pump housing.

Please note, the driver gear has one tooth less than that of the driven gear; thus eliminating the crescent shaped divider as seen in the internal gear pump. Please note friends, gerotor pump Z P number of teeth on the pinion is one tooth less than the ring gear, the tip.

So, the tips of the driver gear and a driven gear make a contact to seal the pumping chamber from each other; otherwise crescent shaped divider we are using. Due to this you will see

here, the ceiling is established between the tooth tip and the what we can call the pumping chamber, pumping chamber.

Current research focus is on different profiles, people are started in the gerotor pump; different involute profiles are using, cycloidal profiles are using, epicycloidal profiles and hypocycloidal profiles are using to make this as a popular. It has a wide number of applications in aero industry as well as in manufacturing industry, Gerotor pumps. People are trying the different profiles, as I have told you here; the plenty of research papers are also available.

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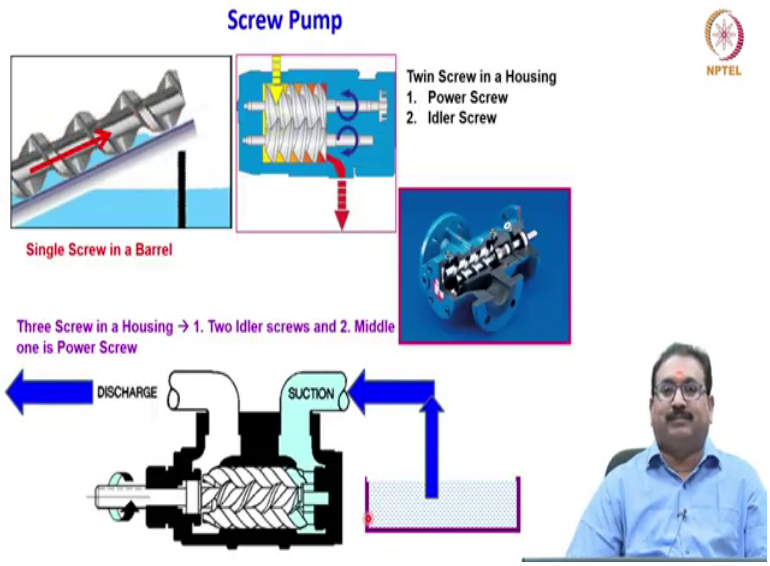

Now, we will see friends, the last one what we are seeing in today's class is a screw pump. Screw pump you will see or also you will see Archimedes pump you have used, wherever you are visiting for the science exhibition or many places.

What is this here you will see, you will see how it is; see here what are the things are there? Two screws inside the housing; but you will see here friends, flow is transmitting axially along the screws, now that is the beauty screw pumps, screw pump fluid is transmitted axially.

Again here you will see, the two screws or a three screw or a mono screw; mono screw means one screw is in the barrel. People are using various category here, a single screw in a barrel or a twin screw; we will see twin screw, one is what we have called this is called a rotor, this is called a follower.

Fluid is transmitting in all the cases axially; you will see axially in the two screws. You will see here friends three screws; for middle one is connected to the shaft, another two are the follower. How the fluid will suck you will see and transmitting along the, along the screw axially and discharges, correct. Two idle screws and middle one is a power screw; power screw is one which is rotating using the electric motor shaft, both are coupled, that is why I am showing you here.

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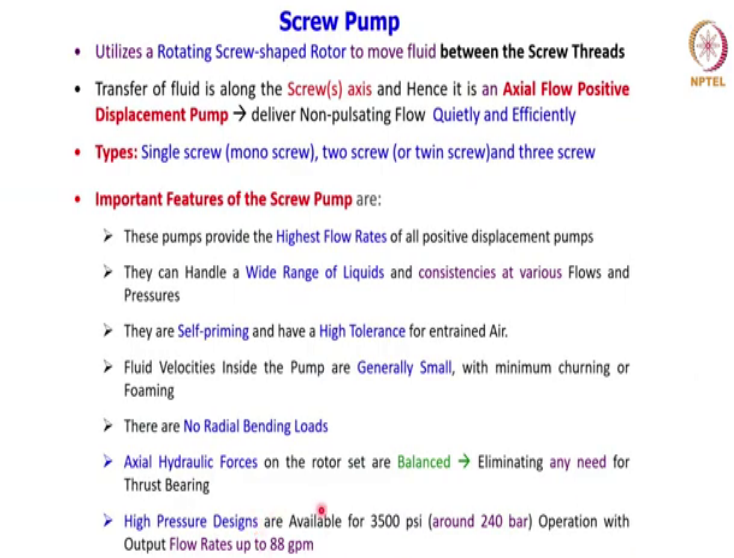

Very simple friends, this is screw pump; utilizes a rotating screw shaped rotor to move fluid between the screw threads. Transfer of fluid is along the screw axis, hence it is axial flow positive displacement pump; deliver non pulsating flow quietly and efficiently. Various types, single screw what they will call mono screw pumps two screw or twin screw it is called and a through three screw are also available commercially.

Important feature of the screw pumps are, these pumps provides a highest flow rates of all the positive displacement pumps. They can handle a wide range of liquids and consistently at various flows and pressures.

They are self priming and have a high tolerance for the entrained air. Fluid velocity inside the pump are generally small, with minimum churning or a foaming. There are no radial bending loads; axially hydraulic forces on the rotor set are balanced, eliminating any need for thrust

bearing here. High pressure designs are available. See around 240 bar operating is possible; flow rates you will see very high flow rates 88 gallons per minutes, ok.

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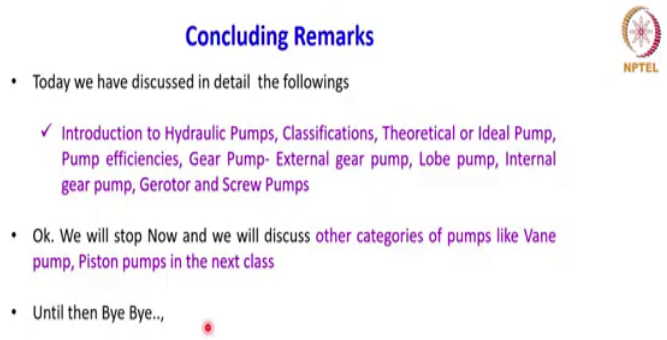

Friends, today we have discussed in detail the followings; introduction through hydraulic pumps, classifications you have seen, theoretical or a ideal pump, pump efficiencies, focused more on gear pumps, external gear pump, lobe pump, internal gear pump, gerotor and a screw pumps, ok.

We will stop now and we will discuss other categories of pumps like a vane pump, piston pumps in the next class. Until then, bye bye.

Thank you one and all for your kind attention, [FL] bye bye to all.