

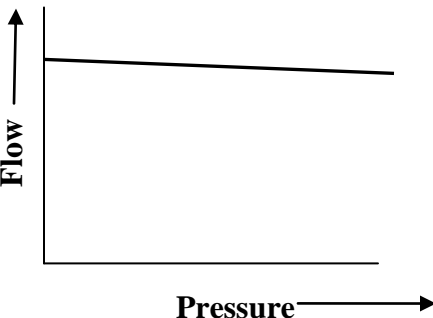
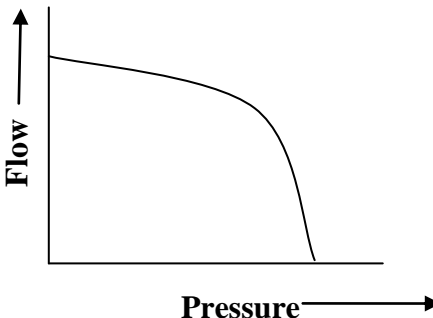
LECTURE 7 TO 9 HYDRAULIC PUMPS

FREQUENTLY ASKED QUESTIONS

1. What is the purpose of a hydraulic pump in a fluid power system ?

Purpose of hydraulic pump is to generate flow so that energy conversion from mechanical to fluid energy is possible. Mechanical energy is provided to pump by electric motor.

2 Differentiate between positive displacement and non-positive displacement pump

| | |
|--|---|
| Positive displacement pump is a pump in which there is a physical displacement of boundary of fluid mass | Centrifugal pump is a non positive displacement pump. In this there is a relative motion between the fluid and motor |
| In positive displacement pump, outlet flow is (almost) independent of system pressure. | In centrifugal pump, the outlet flow is dependent on system pressure, so when pressure increases, the flow reduces |
|  <p>The graph shows a vertical axis labeled 'Flow' and a horizontal axis labeled 'Pressure'. A horizontal line is drawn across the graph, indicating that the flow rate is constant and does not change with pressure.</p> |  <p>The graph shows a vertical axis labeled 'Flow' and a horizontal axis labeled 'Pressure'. The curve starts at a high flow rate at low pressure and gradually decreases as pressure increases. At a certain point, the flow drops sharply to zero, representing the pump's maximum pressure limit.</p> |

3. What is the principle of operation of a pump?

Pumps operate on the principle whereby a partial vacuum is created at the pump inlet due to the internal operation of a pump. This allows atmospheric pressure to push the fluid out of the oil tank (reservoir) and into the pump intake. The pump then mechanically pushes fluid out of the discharge line.

4. What are the three pumps classifications?

1. Classification based on **displacement**

- Non positive displacement pumps (hydrodynamic pumps)
- Positive displacement pumps (hydrostatic pumps)

2. Classification based on **delivery**

- Constant delivery pumps
- Variable delivery pumps

3. Classification based on **motion**

- Rotary pump
- Reciprocating pump.

5. Classify the positive displacement pumps

Based on the construction, Hydrostatic pumps are classified

1. Gear Pumps (fixed displacement pumps)
 - (a) External gear pump
 - (b) Internal gear pump
 - a. Lobe pump
 - b. Gerotor pump
 - (c) Screw pump
2. Vane Pumps (fixed or variable displacement pumps)
 - (a) Balanced Vane pump
 - (b) Unbalanced Vane pump
3. Piston Pumps (fixed or variable displacement pumps)
 - (a) Axial piston pump
 - b)Radial piston pump

6. Why must positive displacement pumps are protected by relief valves ?

Pumps are expensive items and if pressure shoots up do to some reason, then relief valve will allow the fluid to go back to the tank, if not pressure will rise to due to blockage of fluid and parts of pumps may fail. Relief valve thus limits the maximum pressure to which pump components can be subjected with.

9. Why are centrifugal pumps used so little in fluid power system?

Flow output of a centrifugal pump is not constant. Therefore it cannot be used for fluid power application. It is useful in fluid transport systems.

10. Why gear pumps cannot be used as a variable displacement pump

In the gear pump, once the design parameters are finalized all the dimensions of gear pair is fixed and there is no way to vary the displacement.

11. What are the reasons for the popularity of external gear pumps?

- Simple to design
- Because gear pumps have only two moving parts, they are reliable, simple to operate, and easy to maintain.
- Low cost compared to other pumps

12. What is the most important application for internal gear pumps?

- The speed of the internal gear pumps is considered relatively slow compared to centrifugal types. Speeds up to 1,150 rpm are considered common. Because of their ability to operate at low speeds, internal gear pumps are well suited for high – viscosity applications and where suction conditions call for a pump with minimal inlet pressure requirements
- They're also bi-rotational, meaning that the same pump can be used to load and unload applications

13. How does the lobe pump differ from the other gear type pump

Lobe pumps are frequently used in food applications because they handle solids without damaging the product. Particle size pumped can be much larger in lobe pumps than in other PD types. Since the lobes do not make contact, and clearances are not as close as in other PD pumps, this design handles low viscosity liquids with diminished performance. Loading characteristics are not as good as other designs, and suction ability is low. High-viscosity liquids require reduced speeds to achieve satisfactory performance. Reductions of 25% of rated speed and lower are common with high-viscosity liquids

14. What is the most significant characteristic of the screw pump

- They are quiet pumps
- Screws are continuous , most reliable
- No pressure pulsation will occur
- High speed operation is possible
- No pump turbulence and oil churning

15. List four parameters that affect noise level of hydrostatic pump

- Pressure
- Size of the pump
- Speed of the pump
- Entrained air bubbles

16. How is the output of an unbalanced vane pump varied?

Output of the unbalance vane pump is varied by mechanically varying eccentricity between the cam ring and rotor.

17. How can the displacement of an axial piston pump be varied

In axial piston pumps, by varying the stroke length the displacement can be varied . In bent axis type, by varying the angle between the cylinder block and drive shaft centerline, the stroke length is varied. In swash plate type by varying the swash plate angle the stroke length can be varied.

18. What is cavitation?. Name four popular methods to reduce cavitation

During the working of positive displacement pump a vacuum is created at the inlet of the pump. This allows atmospheric pressure to push the fluid in. In some situations the vacuum may become excessive, and a phenomenon known as Cavitation occurs.

- 1) Keep the suction line velocities below 1.5 m/s
- 2) Keep the pump inlet as short as possible
- 3) Minimize the number of fittings in the inlet line
- 4) Mount the pump as close as possible to the reservoir.

19. What is pressure compensated vane pump and how does it work

In the unbalanced vane pump, the displacement can be varied by varying eccentricity. By a compensator piston arrangement, the eccentricity is varied depending on the system pressure there by pump delivery is varied.

20. Why is the operation of screw pump quiet

In the screw pump, the fluid moves linearly and do not rotate. Therefore even at high speed there is no pulsations and operates quietly.

21. Define: Volumetric efficiency, Mechanical efficiency and overall efficiency

Volumetric efficiency (η_v)

$$\text{Volumetric efficiency, } \eta_v = \frac{\text{Actual flow rate of the pump}}{\text{Theoretical flow rate of the pump}} = \frac{Q_A}{Q_T}$$

Mechanical efficiency (η_m)

$$\text{Mechanical efficiency } \eta_m = \frac{\text{Pump output power assuming no leakages}}{\text{Actual power delivered to pump}}$$

Overall efficiency (η_o)

$$\text{Overall Efficiency } \eta_o = \frac{\text{Actual power delivered by pump}}{\text{Actual power delivered to pump}}$$

22. Draw the characteristics curves of different types of pumps used in Industry

See Figure 7.19

23. List the important considerations in the selection of a pump for any given application

- 1) Flow rate requirement
- 2) Operating speed of pump
- 3) Pressure rating
- 4) Performance/application
- 5) Reliability
- 6) Maintenance
- 7) Cost
- 8) Noise level of the pump
- 9) Oil compatibility
- 10) Type of pump control
- 11) Pump contamination tolerance
- 12) Availability of pump and spars

24. Name the three ways by which noise of pump can be reduced

- By proper design of pump
- By proper clamping of hydraulic distribution like pipes , fittings etc.
- By using sound absorption material in the design of fluid power systems.

25 Why should the suction head of pump not exceed 35 kPa.

This is to avoid the cavitation. When the suction head pressure is too low and if the below the vaporization pressure of the oil, then the bubbles will form and these bubbles produce very large impact forces on the metallic components of pump and erodes them.