Hydraulic Pump Theory

- Non Positive Displacement Pumps are like:- Centrifugal Pumps

- Due to large clearance in centrifugal pump between impeller & body the fluid ships from outlet to inlet on the pump operates under load and situation comes when beyond a pressure the flow to the system almost stops.

- Such pumps cannot be used in Hydraulic as we need constant flow under load pressure.

- Positive Displacement Pumps

- The pumps delivers precise flow per revolution of the pump and once the fluid is entrapped in the pump will not have any passage to return, but to get delivered to system.
The clearance between the inlet to outlet section is very precision monitored so that outlet fluid does not return to inlet.

Hence most suited for Hydraulic application.

**Flow of the pump will be**

1. \[ Q = \frac{CC}{Rev \times rpm} \times \frac{lpm}{1000} \]

   e.g. 8 CC pump at 1500 rpm will give fluid

   \[ Q = \frac{8 \times 1500}{1000} = 12 \text{ lpm} \]

2. \[ Q \propto \sqrt{\Delta P} \]

   where, \( Q = \text{flow} \)
   \( \Delta P = \text{pressure differential} \)

For flow to take place a pressure differential is necessary.

Creation of low pressure in the pump will lead to filling of pump due to atmosphere pressure acing on the oil in the reservoir.

The limiting pressure on suction side of pump will be 0.8 bar absolute.

**Factors needs to be focused for selecting the pumps**

- Max pressure
- Operating medium/fluid
- Mounting parameters
- Fixed/variable delivery
- Flow of the pump
- Operating Temperature
- Control on pumps
- Noise level
- Cost of pumps
- Volumetric efficiencies

**Symbol of hydraulic pump**
- **Formulae**

- **Volumetric efficiency of the pump**

  \[
  \text{Volumetric efficiency} = \frac{\text{Actual flow of pump (lpm) } \times 100}{\text{Theoretical flow}}
  \]

- **Power required to drive the pump**

  \[\text{Kw} = \frac{P \times Q}{600 \times n}\]

  where, 
  \(P\) = pressure in Kg/cm²
  \(Q\) = lpm flow
  \(n\) = Hydromechanical efficiency

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- **Application theory of Pumps**

  The pumps operation principle can be explained with the help of a simple piston pump arrangement.
- Check valve 1 is connected to the pump inlet line and allows to enter the fluid only at this location
- Check valve 2 is connected to the pump discharge line and allows the fluid to leave the pump at this location

As the piston is pulled to the left, a partial vacuum is generated in the pump cavity 3, because the close tolerance between piston and cylinder prevents air inside cavity 4 from traveling into cavity 3. The vacuum holds the ball in check valve 2 against the seat and allows atmospheric pressure to push fluid from reservoir into pump via check valve 1. This inlet flow occurs because the force of the fluid pushes the ball of check valve 1 off its seat.

When the piston is pushed to the right, the fluid movement closes the inlet check valve 1 and opens outlet check valve 2. The quantity of fluid, displaced by the piston is forcibly ejected out the discharge line leading to the hydraulic system. The volume of oil displaced by the piston during the discharge stroke is called the displacement volume of the pump.

**Probable Questions:**

1. What types of pumps are used in Hydraulic system and explain the principle of working of the pump.

2. What factors influence the selection of pumps in the hydraulic system?

3. Calculate the electric motor capacity for driving 10 cc pump at 1500 rpm with hydro-mechanical efficiency of 85% at a pressure of 70 Kg/cm²?
Hydraulic Drives

- Pump is driven by electric motor or internal combustion engine which creates flow and in turn converts Mechanical energy into Hydraulic energy.

- Hydraulic energy is controlled with the help of control valves to achieve the benefits of step less control and through the actuator convert back the Hydraulic energy into Mechanical energy by movement of load.

- Though there is conversion of mechanical energy to hydraulic energy and again to mechanical energy. The advantage of hydraulics like step less control and better integration with electrical –electronics help you to achieve automation of systems.

Applications

- Hydraulic systems find use in each and every industry.

- Versatile drive for application in the field of
  - Machine tools
  - Plastic Injection/Blow Molding
  - Material handling systems
  - Steel plant application
    - Primary metal application
⇒ Continuous casting machine
⇒ Rolling mills
⇒ Reheating furnaces
⇒ Finishing mills
⇒ Coke Owens
⇒ Transfer lines

- Simulator and test stands
- Power generation and civil engineering applications
- Mobile equipment for
  - Mining
  - Road construction
  - Cranes
  - Material handling
- Leisure industry
Hydraulic Pump Theory

- **Classification of pump**
  1. Positive Displacement Pump
  2. Non-Positive Displacement Pump

- **Non Positive Displacement Pumps are like:- Centrifugal Pumps**
  - Due to large clearance in centrifugal pump between impeller and body, the fluid slips from outlet to inlet as the pump operates under load and situation comes when beyond a pressure the flow to the system almost stops.
  - Such pumps cannot be used in Hydraulic as we need constant flow under load pressure
  - Hence Centrifugal Pumps are used for transferring fluid.

- **Positive Displacement Pumps**
  - These pumps delivers precise flow per revolution of the pump and once the fluid is entrapped in the pump will not have any passage to return, but to get delivered to system.
  - The clearance between the inlets to outlet section are very precisely monitored so that outlet fluid does not return to inlet.
  - Hence most suited for Hydraulic application.

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- **Factors needs to be focused for selecting the pumps**
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- **Symbol of hydraulic pump**

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<tr>
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<tr>
<td>Hydraulic pump with fixed displacement volume with one flow direction</td>
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