**CENTRIFUGAL PUMP**

**Working principle**

If the mechanical energy is converted into pressure energy by means of centrifugal force acting

on the fluid, the hydraulic machine is called centrifugal pump. The centrifugal pump acts as a reversed of an inward radial flow reaction turbine

**Performance Characteristics of Pumps**

The fluid quantities involved in all hydraulic machines are the flow rate (Q) and the head (H), whereas the mechanical quantities associated with the machine itself are the power (P), speed (N), size (D) and efficiency ( ). Although they are of equal importance, the emphasis placed on certain of these quantities is different for different pumps. The output of a pump running at a given speed is the flow rate delivered by it and the head developed. Thus, a plot of head and flow rate at a given speed forms the fundamental performance characteristic of a pump. In order to achieve this performance, a power input is required which involves efficiency of energy transfer. Thus, it is useful to plot also the power P and the efficiency  against Q.

Over all efficiency of a pump ( ) = Fluid power output / Power input to the shaft = gHQ / P

Type number or Specific speed of pump, nS = NQ1/2 / (gH)3/4 (it is a dimensionless number)

**Centrifugal pump Performance**

In the volute of the centrifugal pump, the cross section of the liquid path is greater than in the impeller, and in an ideal frictionless pump the drop from the velocity V to the lower velocity is converted according to Bernoulli's equation, to an increased pressure. This is the source of the discharge pressure of a centrifugal pump.

If the speed of the impeller is increased from N1 to N2 rpm, the flow rate will increase from Q1 to Q2 as per the given formula:$\frac{Q1}{Q2}=\frac{N1}{N2}$

The head developed(H) will be proportional to the square of the quantity discharged, so that

The power consumed(W) will be the product of H and Q, and, therefore

These relationships, however, form only the roughest guide to the performance of centrifugal pumps.

**Characteristic curves**

Pump action and the performance of a pump are defined interms of their *characteristic curves*. These curves correlate the capacity of the pump in unit volume perunit time versus discharge or differential pressures. These curves usually supplied by pump manufacturers are for water only.

These curves usually shows the following relationships (for centrifugal pump).

        A plot of capacity versus differential head. The differential head is the difference in pressure between the suction and discharge.

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        The pump efficiency as a percentage versus capacity.

        The break horsepower of the pump versus capacity.

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The net poisitive head required by the pump versus capacity. The required NPSH for the pump is a characteristic determined by the manufacturer.

Centrifugal pumps are usually rated on the basis of head and capacity at the point of maximum efficiency.

**RECIPROCATING PUMPS**

**Working principle**

If the mechanical energy is converted into hydraulic energy (or pressure energy) by sucking the liquid into a cylinder in which a piston is reciprocating (moving backwards and forwards), which exerts the thrust on the liquid and increases its hydraulic energy (pressure energy), the pump is known as reciprocating pump

**Main ports of a reciprocating pump**

1.A cylinder with a piston, piston rod, connecting rod and a crank,

2. Suction pipe

 3.Delivery pipe,

4. Suction valve   and

5.Delivery valve.

**Slip of Reciprocating Pump**

Slip of a reciprocating pump is defined as the difference between the theoretical discharge and the actual discharge of the pump.

**Characteristic Curves Of Reciprocatring Pumps**

1.According to the water being on contact with one side or both sides of the piston

(i.) Single acting pump         (ii.) Double-acting pump

2.According to the number of cylinders provided

(i.) Single acting pump                                    (ii.) Double-acting pump    (iii.) Triple-acting pump

**Reciprocating pumps Vs centrifugal pumps**

The advantages of reciprocating pumps in general over centrifugal pumps may be summarized as follows:

1.     They can be designed for higher heads than centrifugal pumps.

2.     They are not subject to air binding, and the suction may be under a pressure less than atmospheric without necessitating special devices for priming.

3.     They are more flexible in operation than centrifugal pumps.

4.     They operate at nearly constant efficiency over a wide range of flow rates.

The advantages of centrifugal pumps over reciprocating pumps are:

1.     The simplest centrifugal pumps are cheaper than the simplest reciprocating pumps.

2.     Centrifugal pumps deliver liquid at uniform pressure without shocks or pulsations.

3.       They can be directly connected to motor derive without the use of gears or belts.

4.       Valves in the discharge line may be completely closed without injuring them.

5.       They can handle liquid s with large amounts of solids in suspension.

**1.  What is meant by Pump?**

A pump is device which converts mechanical energy into hydraulic energy.

**2. Define a centrifugal pump**

If the mechanical energy is converted into pressure energy by means of centrifugal force cutting on the fluid, the hydraulic machine is called centrifugal pump.

**3. Define suction head (hs).**

Suction head is the vertical height of the centre lines of the centrifugal pump above the water surface in the tank or pump from which water is to be lifted. This height is also called suction lift and is denoted by hs.

**4. Define delivery head (hd).**

The vertical distance between the center line of the pump and the water surface in the tank to which water is delivered is known as delivery head. This is denoted by hd.

**5. Define static head (Hs).**

The sum of suction head and delivery head is known as static head. This is represented by 'Hs' and is written as,

Hs = hs+ hd

**6.**   **Mention main components of Centrifugal pump.**

i)  Impeller ii) Casing

iii) Suction pipe,strainer & Foot valve   iv) Delivery pipe & Delivery valve

**7. What is meant by Priming?**

The delivery valve is closed and the suction pipe, casing and portion of the delivery pipe upto delivery valve are completely filled with the liquid so that no air pocket is left. This is called as priming.

**8. Define Manometric head.**

It is the head against which a centrifugal pump work.

**9. Describe multistage pump with**

**a. impellers in parallel   b. impellers in series. In multi stage centrifugal pump,**

a. when the impellers are connected in series ( or on the same shaft) high head can be developed.

b. When the impellers are in parallel (or pumps) large quantity of liquid can be discharged.

**10.. Define specific speed of a centrifugal pump (Ns).**

The specific speed of a centrifugal pump is defined as the speed of a geometrically circular pump which would deliver one cubic meter of liquid per second against a head of one meter. It is denoted by 'Ns'.

**11. What do you understand by characteristic curves of the pump?**

Characteristic curves of centrifugal pumps are defined those curves which are plotted from the results of a number of tests on the centrifugal pump.

**12. Why are centrifugal pumps used sometimes in series and sometimes in parallel?**

The centrifugal pumps used sometimes in series because for high heads and in parallel for high discharge

**13.Define Mechanical efficiency.**

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t is defined as the ratio of the power actually delivered by the impeller to the power supplied to the shaft.

**14. Define overall efficiency.**

It is the ratio of power output of the pump to the power input to the pump.

**15. Define speed ratio, flow ratio.**

Speed ratio: It is the ratio of peripheral speed at outlet to the theoretical velocity of jet corresponding to manometric head.

Flow ratio: It is the ratio of the velocity of flow at exit to the theoretical velocity of jet corresponding to manometric head.

**16..**         **Mention main components of Reciprocating pump.**

#    Piton or Plunger

#    Suction and delivery pipe

#    Crank and Connecting rod

**17.. Define Slip of reciprocating pump. When the negative slip does occur?**

The difference between the theoretical discharge and actual discharge is called slip of the pump.

But in sometimes actual discharge may be higher then theoretical discharge, in such a case coefficient of discharge is greater then unity and the slip will be negative called as negative slip.

**18. What is indicator diagram?**

Indicator diagram is nothing but a graph plotted between the pressure head in the cylinder and the distance traveled by the piston from inner dead center for one complete revolution of the crank

**19. What is meant by Cavitations?**

It is defined phenomenon of formation of vapor bubbles of a flowing liquid in a region where the pressure of the liquid falls below its vapor pressure and the sudden collapsing of theses vapor bubbles in a region of high pressure.

**20. What are rotary pumps?**

Rotary pumps resemble like a centrifugal pumps in appearance. But the working method differs. Uniform discharge and positive displacement can be obtained by using these rotary pumps, It has the combined advantages of both centrifugal and reciprocating pumps.





















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