Centrifugal Pumps

The hydraulic machines which converts the mechanical energy into hydraulic energy are called Pumps.

This hydraulic energy is in the form of pressure energy.

In Centrifugal pump, the mechanical energy is converted into Pressure energy by means of Centrifugal force acting on the fluid.

IMPORTANT POINTS

The centrifugal pump acts as a reversed of an inward radial flow reaction turbine.

" This means the direction of flow in centrifugal Pump is in radial outward direction. "

Principle On which Centrifugal pump works

It works on the Principle of forced vortex flow.

Main Parts of Centrifugal Pumps

→ Impeller

→ Casing

→ Suction pipe with a foot valve and a strainer

→ Delivery Pipe.

Impeller is a rotating part of a Centrifugal Pump. It consists of a series of backward curved vanes. Impeller is mounted on a Shaft which is connected to the Shaft of an electric motor.

"Backward Curved Vanes are the most preferred vanes".

Casing :- It is an air-tight passage surrounding the impeller. Casing is designed in such a fashion that the Kinetic energy of the water discharged at the Outlet of the impeller is converted into Pressure energy before water leaves the casing and enters the delivery pipe.

Suction Pipe ~~an~~ with a Foot-valve and a strainer

A pipe whose one end is connected to the inlet of the Pump and the other end dips into water in a sump is known as suction pipe. A foot valve is one way or a non-return valve which is fitted at the lower end of the suction pipe. Foot valve only opens in ~~one~~ direction i.e, upward direction. We also fit a Strainer at the lower end of the suction pipe for removing the impurities.

Delivery Pipe :

A pipe whose one end is connected to the outlet of the pump and the other end delivers the water at a required height is known as delivery pipe

Definitions of Heads and Efficiencies of a Centrifugal Pump :-

1. Suction Head :- It is the vertical height of the centre line of the centrifugal pump above the water surface in the tank or pump from which water is to be lifted.

2. Delivery Head :- The vertical distance between the centre line of the pump and the water surface in the tank to which water is delivered is known as delivery head.

3. Static Head :- The sum of suction head and delivery head is known as static head.

Static Head = Suction head + Delivery head

4. Manometric Head :- The manometric head is defined as the head against which a centrifugal pump has to work.

Monometric head, H_m = suction head + delivery head + friction loss in suction pipe + friction loss in delivery pipe + velocity of water in delivery pipe

$$H_m = h_s + h_d + h_{fs} + h_{fd} + \frac{V_d^2}{2g}$$

h_s = Suction head

h_d = Delivery head

h_{fs} = frictional head loss in suction pipe

h_{fd} = Frictional head loss in delivery pipe

V_d = velocity of water in delivery pipe.

5. Efficiences of a Centrifugal Pump.

(a) Manometric Efficiency (η_{man})

It is the ratio of the manometric head to the head imparted by the impeller to the water.

$$\eta_{man} = \frac{\text{Manometric Head}}{\text{Head imparted by impeller to water}}$$

$$\eta_{man} = \frac{H_m}{\left(\frac{V_{w_2} u_2}{g}\right)} = \frac{g H_m}{V_{w_2} u_2}$$

(b) Mechanical Efficiency (η_m)

It is the ratio of the power available at the impeller to the power at the shaft of the cent-rifugal pump. ~~is~~

$$\eta_m = \frac{\text{Power at the impeller}}{\text{Power at the shaft}}$$

Overall Efficiency :-

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

Overall efficiency = manometric efficiency x mechanical efficiency