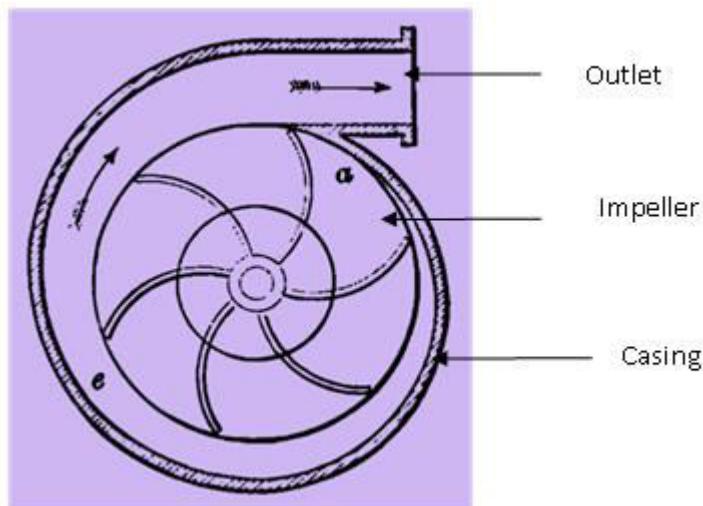


Module5: HYDRAULIC PUMPS

Centrifugal pumps

They use a rotating impeller to increase the pressure of a fluid. Centrifugal pumps are commonly used to move liquids through a piping system. The fluid enters the pump impeller along or near to the rotating axis and is accelerated by the impeller, flowing radially outward into a diffuser or volute chamber (casing), from where it exits into the downstream piping system. Centrifugal pumps are used for large discharge through smaller heads. These types of pumps are used for supply of water and handling of milk in dairy plants.



Types of Centrifugal Pumps

Based on Casing Designs

Radially and axially split pump casings are two different designs discussed below:

Radial Split

If a centrifugal pump casing has a vertical connection to the shaft (perpendicular to the shaft and parallel to the impeller), this is a radially split casing.

Axial Split

An axially split casing of a centrifugal pump has a design in which the casing is split along the center line of the shaft. The casing is divided into two halves that are separated horizontally, parallel to the shaft axis.

Based on Shaft Orientation

Accordingly, centrifugal pumps have either vertical or horizontal shaft positions.

Vertical Shaft

In a vertical pump, the shaft is in a vertical orientation, and the pump is usually placed in the sump. These pumps are used in limited spaces. For example, pump in borewell and sump collection are of this type.

Horizontal Shaft

Horizontal pumps are more commonly used because they are easy to maintain. In this type, the shaft is positioned horizontally.

Based on Impeller Position

Accordingly, centrifugal pumps are classified into overhung impeller pumps and between bearing pumps.

Overhung Impeller Pump

In an overhung impeller pump, the impeller is installed on the end of a shaft, which overhangs its bearings. In this pump, the impeller is suspended through a single bearing. This configuration facilitates both vertical and horizontal installation of the pump.

Between Bearing Pump

In between bearing type of centrifugal pump, the impeller is placed on the shaft, and the shaft is suspended at both ends between two bearings. Horizontal multistage pumps are provided in this design

Based on the Flow Type

Accordingly, radial, Axial, and Mixed flow are three types of centrifugal pumps.

Radial Pumps

In radial pumps, the fluid comes out of the impeller after 90 degrees of rotation relative to the suction. The most common centrifugal pumps are in this category. Fluid enters the horizontal suction flange and exits through a vertical outflow flange. So, the discharge is perpendicular to the shaft of the pump. This design is

applied when there is a flow limitation and you want to raise discharge pressure. Therefore, radial design is high pressure and low flow rate pump. Most pumps utilized in the oil and gas industries fall into this category.

Axial Pumps

In an axial flow pump, the fluid moves parallel to the shaft. This procedure resembles the working of a propellant. The most significant application of this pump is when there is a large flow rate and very little pressure head. For example, they are common in dewatering pumps and water circulation pumps.

Mixed Pumps

As the name implies, in a mixed flow pump, the fluid flows mixing both radial and axial properties. So, that is a tradeoff between axial and radial pumps. Mixed pumps operate at high flow rates with a decent increase in the head.

Based on Number of Stages

Two or more impellers can be utilized in the pump, depending on the requirements and on-site operating conditions.

Single Stage Pumps

This pump has only one impeller and the highest increase in pressure head is 125 meters. The simple structure, stable operation, high speed, lightweight, small volume, high efficiency, large flow capacity, and easy maintenance are essential advantages of single-stage pumps. Single-stage centrifugal pumps can be classified into horizontal pumps, vertical pumps, single-suction pumps, and double-suction pumps

Multistage Pumps

The fluid pressure at the outlet of the pump can be very large. Therefore, if a very high head at discharge is needed, the multistage pump is used. In this design, impellers are connected in series to increase the fluid pressure at each stage.

Based on Types of Volute

Pumps are divided into two categories, single-volute or double-volute, depending on their casing type.

Single Volute

In a single volute casing, the flow is discharged from the impeller into one volute, which winds completely around the impeller. This casing has one cut-water that delivers the fluid flow towards the outlet of the pump. Most of the pumps in the refinery are of single volute types.

Double Volute

A double volute casing has two cut-waters positioned 180 degrees apart. Double volute has a benefit over the single. It minimizes the deflection of the shaft when the pump works outside the BEP best efficiency point (BEP).

MINIMUM STARTING SPEED OF CENTRIFUGAL PUMP

To get the ***minimum starting speed of a centrifugal pump***, it is notice that if the pressure rise in the Impeller is more than or equal to manometric head (H_m) then the [centrifugal pump](#) will start to deliver water. Otherwise the pump will not discharge any water, the impeller is rotating. If the impeller is rotating, the water in contact with the Impeller is also rotating. This is called forced vortex. In this case, the centrifugal head or head due to pressure rise in the impeller.

PUMPS IN SERIES AND PUMPS IN PARALLEL

When pumps are connected in series, discharge will be the same and head loss will be the sum of head losses of their respective pumps.

When pumps are connected in parallel, head loss will be the same and discharge will be the sum of discharges of their respective pumps.

NET POSITIVE SUCTION HEAD (NPSH)

NPSH (Net Positive Suction Head) is a measure of the pressure experienced by a fluid on the suction side of a centrifugal pump. It is used to avoid running a pump under conditions which favour cavitation.

PRIMING OF A PUMP

Priming is the action of filling the casing with fluid before start-up. With the exception of self-priming pumps, no centrifugal pump should ever be started until it

is fully primed. That is, until it has been filled with the liquid pumped and all the air contained in the pump has been expelled.