JOB ROLE: MICRO-IRRIGATION TECHNICIAN

Sector – Agriculture
(Qualification Pack Code : AGR/Q1002)

PSS Central Institute of Vocational Education
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Unit 2: Installation of Sprinkler Irrigation System

Session 3: Classification and Suitability of Pumps

Content

Session Objectives

The students will be able to:

- Differentiate between various types of positive displacement pump and their uses;
- Explain various types of non-positive displacement pump and their uses and
- Determine the suitability of a pump for a micro-irrigation system.

Introduction

A pump is used for irrigation purposes. It is an electro-mechanical device, which lifts water from one level to another with pressure. The pump selected must be capable of supplying water at the required pressure and discharge the same for efficient functioning of a micro- irrigation system.

Types of Pumps

Pumps can broadly be classified into two types — (i) positive displacement and (ii) non-positive displacement pumps.

Positive Displacement Pump	Non-positive Displacement Pump
It makes water move by trapping a fixed amount and forcing (displacing) that trapped volume into the discharge pipe. Pumping takes place by to and fro motion of the piston or diaphragm in the cylinder.	In non-positive displacement pumps, water is pressurised by the rotation of propeller and the water pressure is proportional to the speed of the rotor.

Positive Displacement Pumps

Positive Displacement Pumps can be classified as (i) Rotary or Continuous Type and (ii) Reciprocating or Cyclic Type

Rotary or Continuous Type	Reciprocating or Cyclic Type
Lobe pump	Piston pump
Screw pump	Bucket pump
Gear pump	Plunger pump
Vane pump	Diaphragm pump
Radial plunger pump	Petro pump
	Semi-rotary pump
	Gas or vapour displacement

Positive Displacement Pumps

On the basis of **mechanical operation**, positive displacement pumps can be classified as piston, diaphragm and plunger pumps.

Piston pump

The high-pressure seal reciprocates with the piston. The pump has a piston cylinder arrangement. As the piston goes away after the delivery stroke, low pressure is created in the cylinder, which opens the suction valve. On forward stroke, the water trapped inside the cylinder is compressed, which in turn opens the delivery valve.

Diaphragm pump

This pump uses a combination of reciprocating action of a rubber, thermoplastic or Teflon diaphragm, and non-return check valves to pump water.

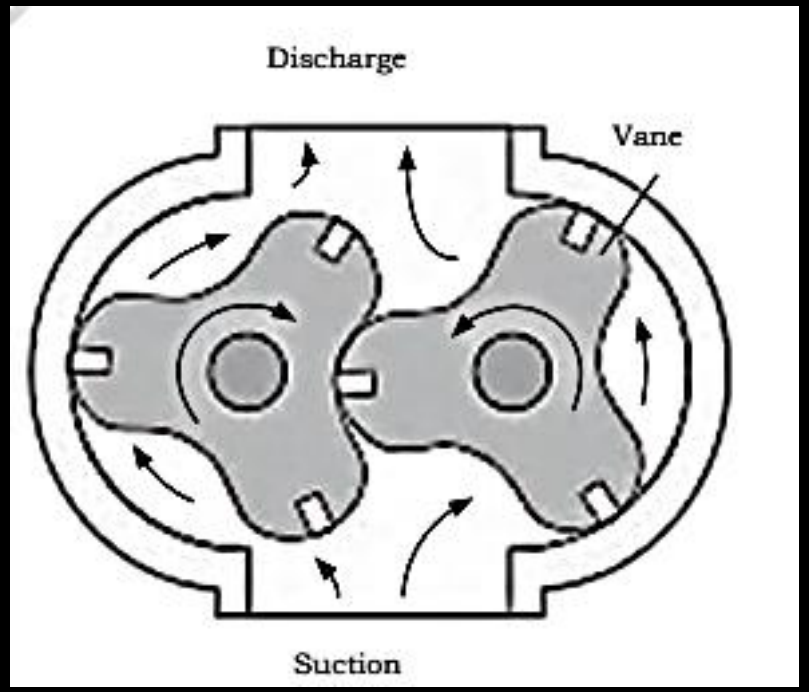
Plunger pump

It is the one, in which there is a high-pressure stationary seal and a smooth cylindrical plunger, which slides through the seal.

Positive Displacement Pumps

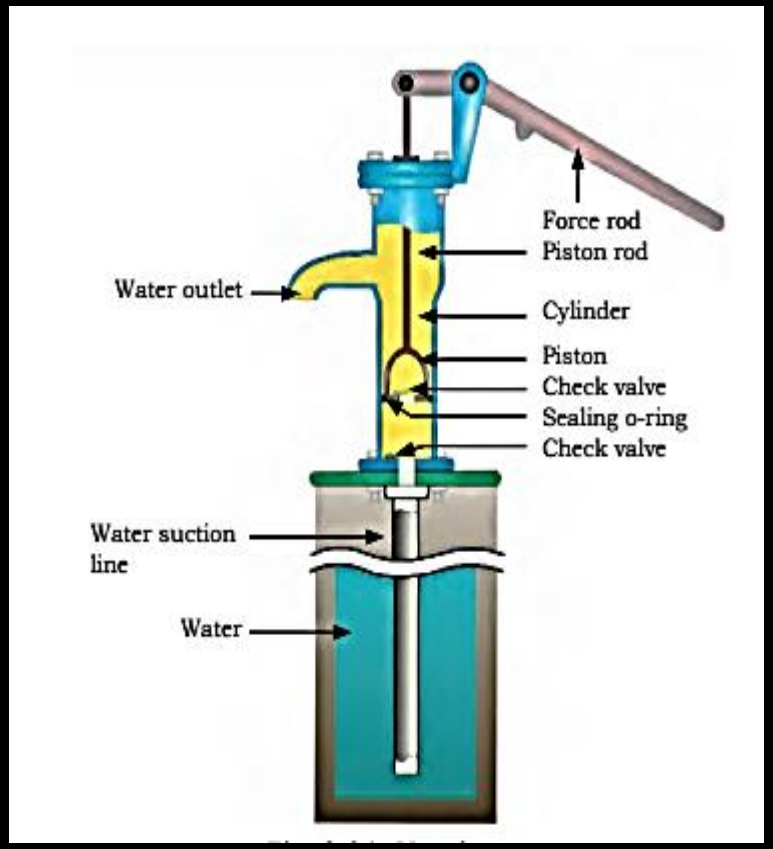
On the basis of **working principle**, positive displacement pumps are of two types — Rotary or continuous pump and Reciprocating or cyclic pump

Rotary or Continuous Pumps move water using the 'principle of rotation'. The vacuum created by the rotation of the pump captures and draws in the water. These pumps are capable of pumping more water than reciprocating pump. For example, lobe pump, screw pump and radial plunger pump.



Classification of Positive Displacement Pumps

Reciprocating or Cyclic Pumps:
Reciprocating or cyclic pumps operate by drawing liquid into a chamber or cylinder by the action of a piston, plunger or diaphragm. The water is discharged in the required direction by the use of check valves. This results in pulsed flow. For example, piston pump and bucket pump.



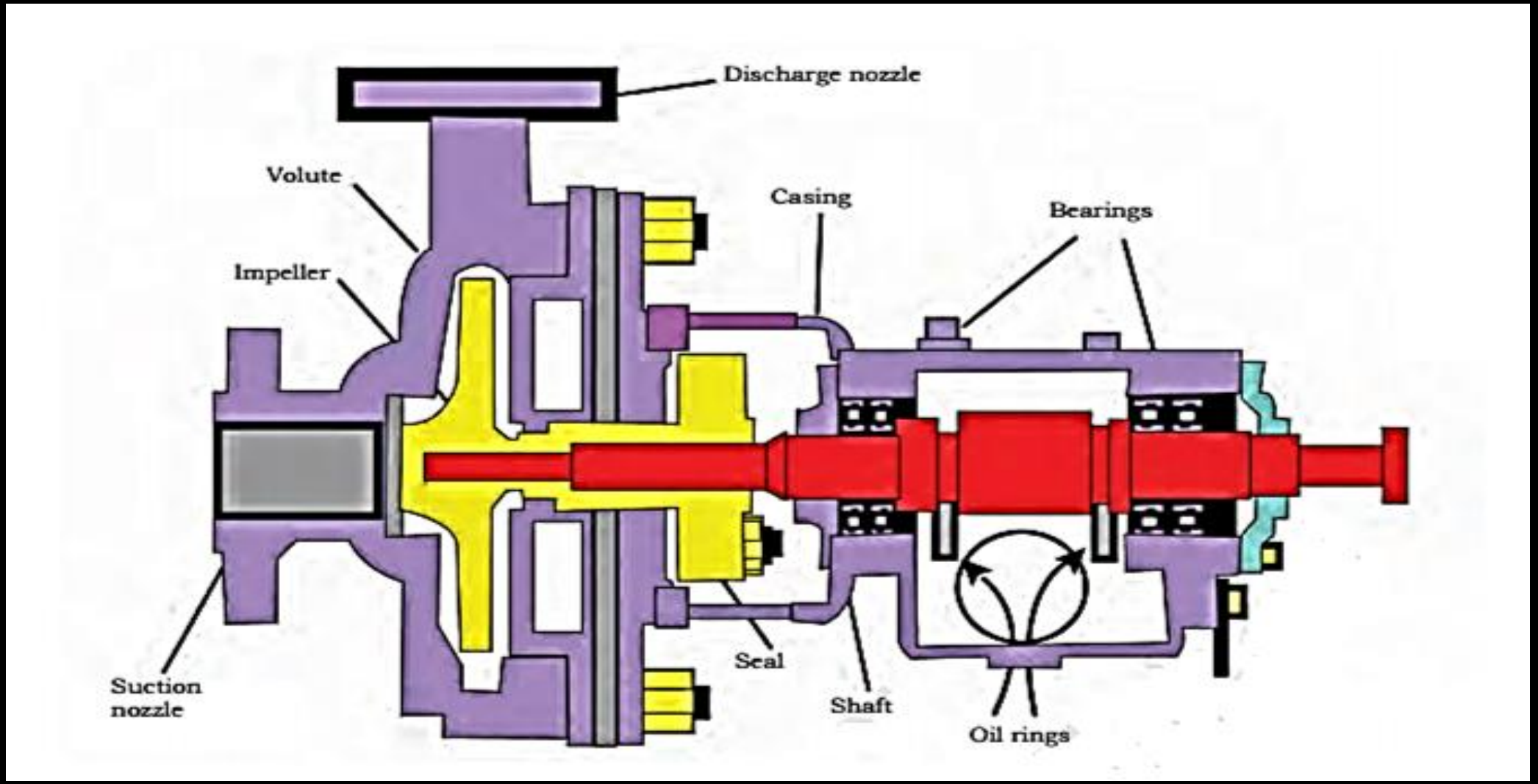
Non-Positive Displacement Pumps

In non-positive displacement pumps, water is pressurized by the rotation of propeller and the water pressure is proportional to the speed of the rotor. These pumps provide smooth and continuous flow of water. For example, centrifugal pump.

Non-Positive Displacement Pumps

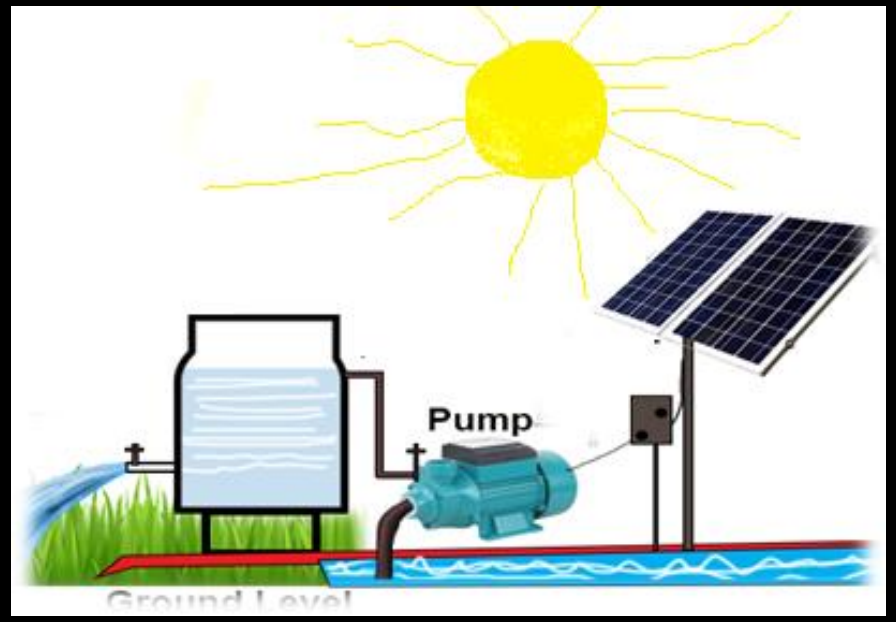
A Centrifugal Pump operates when water is drawn into the central chamber of a spinning impeller. It is, then, engaged by the vanes that drive the water outside the pump volute casing. This process transforms the kinetic energy of the impeller into the pressure head used to discharge water from sprinklers or emitters located in the area to be irrigated. One of the limitations of centrifugal pump is that before starting, the impeller casing and intake (suction) pipe must be filled with water. This process is called 'priming'.

Cross-sectional View of Centrifugal Pump



Solar-Powered Pump

A solar-powered pump runs on electricity generated by photo-voltaic panels, which collect thermal energy. It is later converted into electrical energy for pump operation. Generally, a 5 HP (horsepower) AC (alternating current) solar pump sets with 4800 wp capacity must be used for lifting water from an open well or other surface storage structure.



Suitability of Pump

Suction and lift are the factors that must be considered when pumping water.

'Suction' is the vertical distance between the water to be pumped and the centre of the pump, while 'lift' is the vertical distance between the pump and the delivery point like emitters and sprinklers.

Suitability of Pump

Pumps develop differential head or differential pressure. This means the pumps take suction pressure, add more pressure (design pressure) and generate discharge pressure. So, the discharge pressure is equal to the suction pressure plus the pumps' design pressure.

Discharge pressure is determined on the basis of desired operating pressure, loss of pressure due to friction and change in elevation within the field.

While selecting a pump, one must take into consideration the maximum total head against which it is expected to operate and deliver the required discharge.

Horsepower of Pump

Horsepower of a pump is the sum of the system's total head plus the pumping lift. The brake horsepower formula is:

$$\frac{HP = Q \times H}{75 \times a \times b}$$

Where, Q: is the flow capacity in litres per hour

H: is the total head expressed in metres

a: is the pump efficiency

b: is the driving efficiency

Summary

In this session, you have learnt about the positive displacement pumps and non-positive displacement pumps and the suitability of a pump for a micro-irrigation system.

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