

JOB ROLE: MICRO-IRRIGATION TECHNICIAN

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



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UNIT 1: INTRODUCTION TO MICRO-IRRIGATION SYSTEM

Session 3: Design and Layout of Micro-irrigation System

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Session Objectives

The students will be able to:

- Describe the layout and design of a micro-irrigation system;
- Identify components of drip irrigation system; and
- Identify the components of a sprinkler irrigation system.

Introduction

Microirrigation systems must aim at maximising the returns and minimising the cost per unit volume of water used. A properly designed micro-irrigation system addresses uniform irrigation application, while minimizing losses and damage to soil, water, air, plant, and animal resources. Thus, contributing to the overall reduction in the total investment on irrigation. Purchasing and installing the specified and standard components are the key factors for the installation and smooth functioning of a microirrigation system.

Design and Layout of Micro-irrigation System

The design and layout of a micro-irrigation includes the partitioning the whole field into blocks of desired dimensions and preparing the layout for the control head, main, sub-main and lateral pipe and connection to the water source.

The goal of efficient irrigation design and management should be to **minimize the loss of water to runoff, deep percolation, and evaporation, and to maximize water used for crop transpiration.** Efficient irrigation requires careful management and is attainable if an understanding of crop water use and stress response is applied.

Design and Layout of Micro-irrigation System

Preparing a layout requires collection of basic farm data.

Farm data may include layout of the area, details of (i) water source, (ii) soil type, (iii) agronomic details, such as plants to be grown, crop spacing, crop period, etc. and (iv) climatic data, such as temperature, rainfall, evapo-transpiration, etc.

Design and Layout of Micro-irrigation System

Farm Data

(i) Water Source: The various sources of irrigation include tank, well, canal, lakes, rivers, ponds, reservoirs, streams, groundwater, etc. The following information with regard to the water source must be collected: (i) Height above the ground level or depth from the ground surface, (ii) Details of the pump to be installed, (iii) Quality of water in terms of impurities present (sand, silt, algae, etc.). Surface water contains large amount of impurities, therefore, it must be filtered before use.

Design and Layout of Micro-irrigation System

Farm Data

(ii) Soil type: A major consideration in the design of surface drip irrigation system is drip tubing lateral spacing. Drip line depth will depend on soil characteristics, rooting depth and cultivation practice being followed in a field.

Soil having **more sand content** requires closer spacing of drip tubing laterals, which increases the cost of the drip irrigation system.

Wider spacing's are possible with **heavy soil**, which contains **more clay** (e.g., black soil), as lateral movement of water is greater in such soil.

Design and Layout of Micro-irrigation System

Farm Data

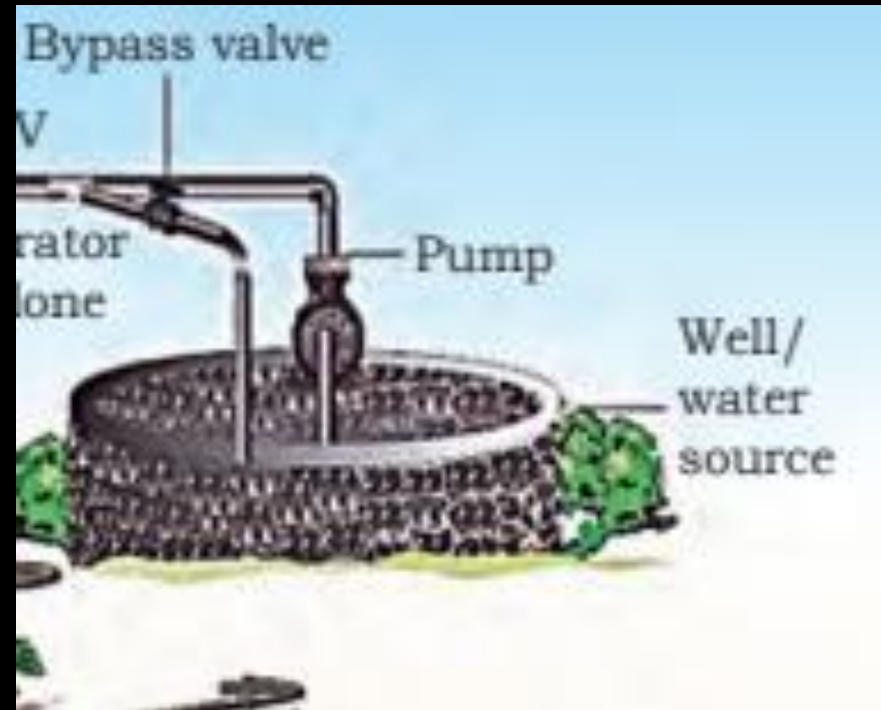
(iii) Agronomic details: It includes plants to be grown, crop spacing and crop period or growing cycle. The growing cycle is the period required for an annual crop to complete its annual cycle of establishment, growth and production of harvested part. The most sensitive growth stages for most crops coincide with time intervals during which the crop is also utilizing the most water. Most crops have their **highest water requirements** and water-stress sensitivity during **late vegetative** and **early reproductive phases** of growth.

Design and Layout of Micro-irrigation System

- The whole field area is divided into units, depending on the number of sub-mains to be installed, keeping in view the pumping capacity of the pump.
- The **main line** is then planned for connecting to the **sub-mains** by considering the shortest possible route. The length of the main line is determined on the basis of the water flow rate so that the frictional head loss is within the specified limits and the total pressure head required for the system is within the pump capacity.

Components of Drip Irrigation System

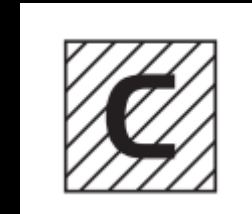
Pump unit: The pump unit lifts water and produces the desired pressure for distributing water through emitters. Electric motor driven pumps can be activated using a pump start relay that is activated by a computer.



Components of Drip Irrigation System

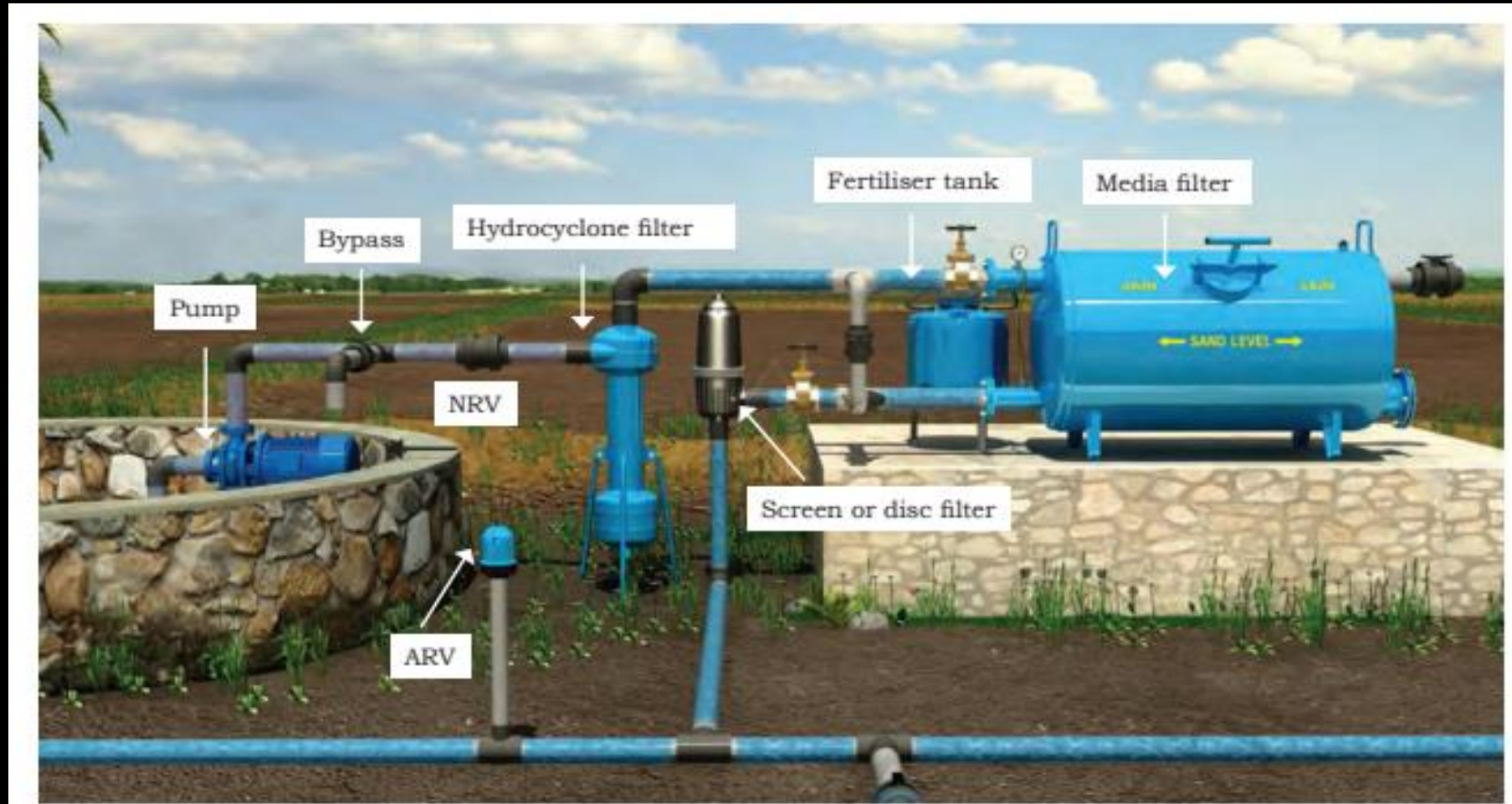
Control or Head Control Unit:

It consists of valves to control the discharge and pressure of water in the entire system. It may also have filters to clean the water. The head control unit turns the automatic valves on or off through control signals. These valves then run water to the required sections.



Symbol for Head Control Unit

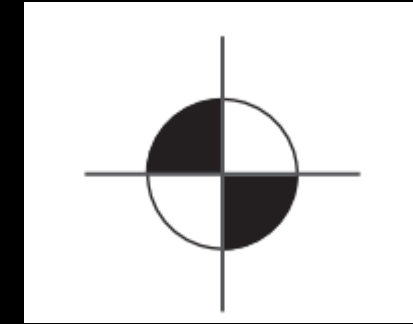
Components of Drip Irrigation System



Components of Head Control Unit

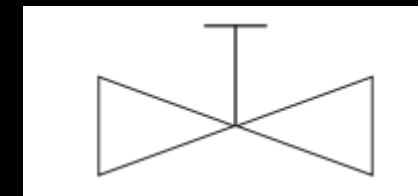
Components of Drip Irrigation System

Automatic control valve : Valves allow to turn different sections on and off automatically.



Symbol for Automatic Control Valve

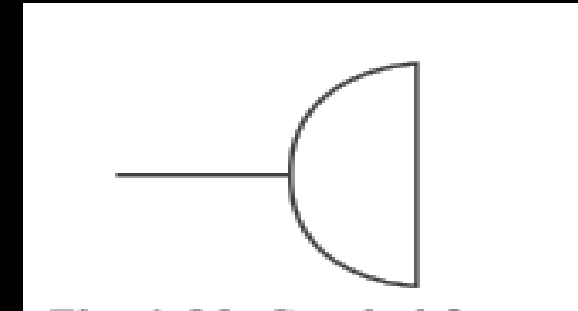
Gate valve : Gate valve may be used in place of electric valves to turn different sections on or off. They are manually operated isolation valves.



Symbol for Gate Valve

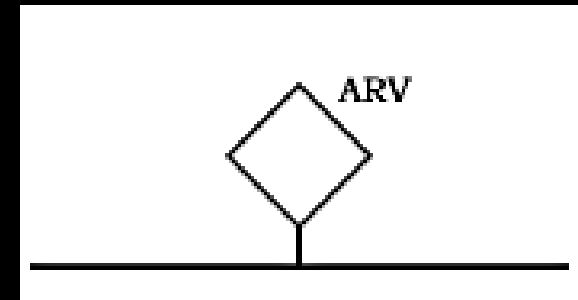
Components of Drip Irrigation System

Flush valve : It is a self-opening valve that allows lines to be flushed when the pipe pressure is low. It shuts when the pressure builds up.



Symbol for Flush Valve

Automatic air release valve: Automatic air release valves are used to displace air contained within an irrigation system, which can adversely affect its performance.

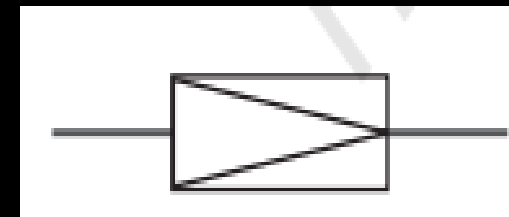


Symbol for Automatic Air Release Valve

Components of Drip Irrigation System

Check valve : A check valve, also called ‘**non-return valve**’, is a mechanical device in a pipe that permits the flow of water in one direction only. It prevents the backward flow of water.

Pressure reducing valve: It is commonly used when installing a drip irrigation system or where high pressures can pose a problem.



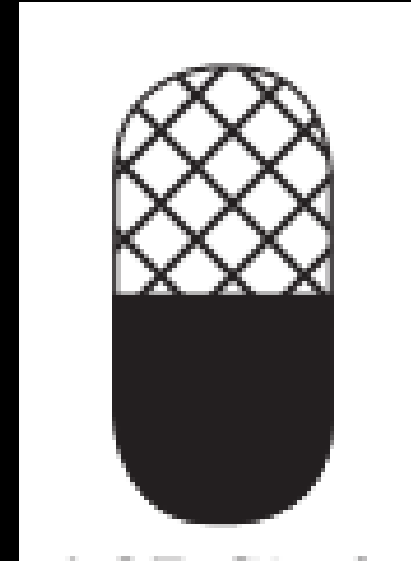
Symbol for Pressure Reducing Valve

Components of Drip Irrigation System

Filtration unit: It is required to remove the impurities present in the irrigation water. Hydro-cyclone, media and screen are the different types of filters. The choice of filter depends on the quality of water. Design of filtration systems requiring sand media filters shall consider flow rates and filtration during backflushing. If the quality of water is poor, then a filter of higher mesh size is used.

Components of Drip Irrigation System

Filter : Common types of filter include **screen** and **graded sand filters**, which remove fine material suspended in water. There are filters with mesh, disc and media type. Filters come in different volume capacities and mesh sizes (filtration particle exclusion capacities).



Symbol for Screen Filter

Components of Drip Irrigation System

Main lines, sub-mains and **laterals** supply water from the control head into the fields. They are, normally, made of flexible material, such as PVC pipes.

Pipes of 63 mm diameter and above with a pressure of 4–10 kg/cm² are recommended for main lines.

Pipes having an outer diameter of 32–75 mm with a pressure of 2.5-4.0kg/cm² are normally used as sub-mains.



Components of Drip Irrigation System

Emitters or Drippers: These are fixed at regular intervals in the laterals. They are, usually, spaced more than 1 m apart. For row crops, more closely spaced emitters may be used to wet a strip of soil. They supply specified quantity of water to plants in a field. Emitters are selected on the basis of soil texture and crop root zone system.



Components of Drip Irrigation System

Emitter Spacing

Typical spacing of 4 lph (1.06 gph) emitters

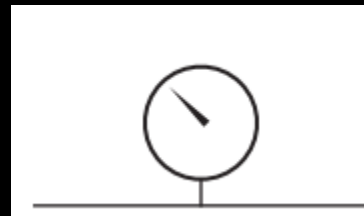
- Coarse soil (sand): 60 cm (24")
- Medium soil: 1m (39")
- Fine soil (clay): 1.3 m (48")

Typical spacing of 2 lph (0.53 gph) emitters

- Coarse soil (sand): 30 cm (12")
- Medium soil: 60 cm (24")
- Fine soil (clay): 1 m (39")

Components of Drip Irrigation System

Pressure gauge: To measure the anticipated variations in the discharge of water in emitters, a pressure gauge is used.



Symbol for Pressure Guage

Components of Sprinkler Irrigation System

The major components of a sprinkler irrigation system are as follows:

- Pumping unit
- Filtration unit
- Pipeline
- Sprinklers

Components of Sprinkler Irrigation System

Since other components of sprinkler irrigation are the same as those required for drip irrigation, here we will learn only about the sprinkler

Sprinkler: Good distribution uniformity of water through sprinkler depends on the nozzle size and the pressure with which the sprinkler discharges water. Therefore, selection of right sprinkler is important.

A sprinkler can be properly selected only after gaining knowledge of all the factors of sprinkler performance and sprinkler spacing pattern.



Units of Measurement

Units		Units	
Psi	Pound per square inch	Mm/h	Millilitre per hour
kPa	Kilopascal	cm	Centimeter
Gal	Gallon	mm	Millimeter
Gpm	Gallon per minute	m	Meter
Gph	Gallon per hour	m/sec	Metre per second
l	Litre	A	Area
lph	Litre per hour	in/hr	Inches per hour
lps	Litre per second	ft	Feet
ml	Millilitre	ft/sec	Feet per second
ml/min	Millilitre per minute	cm	Centimeter

Summary

In this session, you have learnt about the various factors that influence the design and layout of a micro-irrigation system. You have also learnt about the various components of drip and sprinkler irrigation system.

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