SPRINKLER IRRIGATION:

Sprinkler Irrigation water is applied through a pressurized system. The pressure causes the water to flow out through the sprinkler nozzle and fly through the air and falls onto the soil surface.

Godavari HDPE Sprinkler Systems are extruded using HDPE virgin raw material and are made as per IS 14151 (Part I and II). Sophisticated extrusion techniques in the Godavari factory make Godavari HDPE Sprinkler Systems high class and are acceptable in the Indian Market.

- Sprinkler lines are light in weight, hence can be easily transported and installed in the field.
- Highly flexible, crack and impact-proof, sustains high pressure and temperature, hence more durable than other sprinkler systems.
- Godavari Sprinkler system is manufactured from 100% virgin quality raw materials.
- 50% water saving in comparison with conventional irrigation

☞ COMPONENTS OF SPRINKLER IRRIGATION SYSTEM

- A pump unit
- Tubings- main/sub-mains and laterals
- Couplers
- Sprinkler head
- Other accessories such as valves, bends, plugs and risers.

Pumping Unit:

Sprinkler irrigation systems distribute water by spraying it over the fields. The water is pumped...
under pressure to the fields. The pressure forces the water through sprinklers or through perforations or nozzles in pipelines and then forms a spray. A high speed centrifugal or turbine pump can be used for operating sprinkler irrigation for individual fields. Centrifugal pump is used when the distance from the pump inlet to the water surface is less than eight meters. For pumping water from deep wells or more than eight meters, a turbine pump is suggested.

**Tubings:**

Mains/sub-mains: The Tubings consist of mainline, sub-mains. Main line conveys water from the source and distributes it to the sub-mains. The sub-mains convey water to the laterals which in turn supply water to the sprinklers. HDPE (HIGH DENSITY POLY ETHYLENE) pipes are used for sub-mains, PVC e usually used for main lines.

- Durable and light weight - lasts for more than 50 years
- Smooth external and internal finish - flow is almost frictionless, so energy savings are up to 33.50%
- Corrosion resistant - inert to most acids & alkalis.
- Comprehensive range – available from DN 20 to DN 500.
- Joins easily & is leak proof.
- Strong enough to last uneven static and dynamic loads
- Flexibility ensures smooth installation and trouble free functioning

**Couplers:**

Are used for connecting two pipes and uncoupling quickly and easily. Essentially a coupler should provide
(a) a reuse and flexible connection

(b) not leak at the joint

(c) be simple and easy to couple and uncouple

(d) Be light, non-corrosive, durable.

Sprinkler Head:
Sprinkler head distribute water uniformly over the field without runoff or excessive loss due to deep percolation. Different types of sprinklers are available. They are either rotating or fixed type. The rotating type can be adapted for a wide range of application rates and spacing. They are effective with pressure of about 10 to 70 m head at the sprinkler. Pressures ranging from 16 to 40 m head are considered the most practical for most farmers.

Fixed head sprinklers are commonly used to irrigate small lawns and gardens. Perforated lateral lines are sometimes used as sprinklers. They require less pressure than rotating sprinklers. They
release more water per unit area than rotating sprinklers. Hence fixed head sprinklers are adaptable for soils with high intake rate.

**Fittings and accessories:**

The following are some of the important fittings and accessories used in sprinkler system.

(a) **Water meters:** It is used to measure the volume of water delivered. This is necessary to operate the system to give the required quantity of water.

(b) Flange, couplings and nipple used for proper connection to the pump, suction and delivery.

(c) **Pressure gauge:** It is necessary to know whether the sprinkler system is working with desired pressure to ensure application uniformity.

(d) Bend, tees, reducers, elbows, hydrants, butterfly valve and plugs.

(e) **Fertilizer applicator:** Soluble chemical fertilizers can be injected into the sprinkler system and applied to the crop. The equipment for fertilizer application is relatively cheap and simple and can be fabricated locally. The fertilizer applicator consists of a sealed fertilizer tank with necessary tubings and connections. A venturi injector can be arranged in the main line, which creates the differential pressure suction and allows the fertilizer solution to flow in the main water line.

Fig 27: Sprinkler system
Godavari HDPE pipe offers a number of techno commercial advantages over the conventional piping system

- The smooth interior surface provides a high flow factor that does not decrease over time.
- Longer lengths, which reduces the number of unions (smaller cost) and reduces the possibilities of human errors in the installation.
- Corrosion resistant.
- Easy transport.
- Flexibility, Longevity.
- It doesn’t maintain permanent deformations.
- Light weight, Cost effective Installation.
- Bacteria and chemical; resistant.
- Resistant to seismic movement.

**TYPES OF SPRINKLERS AND RAIN GUNS:**

i. Shiftable

ii. Semi permanent

iii. Permanent.

**Shiftable:** In shiftable sprinklers total QRC (Quick Releasing Couple) is shiftable.

**Semi permanent:** Main line, Sub-mains is fixed and laterals and heads rotate from one place to another.

**Permanent:** Main, sub-main, laterals, heads are fixed at particular places. Sections are divided according to the water availability.

**SPRINKLER IRRIGATION SYSTEM DESIGN**

- Table 8: Estimation of the total available water capacity (TWAC), also termed as Water retention.
Table 9: Estimation of design TWAC:

<table>
<thead>
<tr>
<th>Soil type</th>
<th>TWAC limits max &amp; min (mm/m)</th>
<th>Avg. limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine sand</td>
<td>20-40</td>
<td>30</td>
</tr>
<tr>
<td>Sandy loam</td>
<td>40-110</td>
<td>75</td>
</tr>
<tr>
<td>Silt loam</td>
<td>60-130</td>
<td>95</td>
</tr>
<tr>
<td>Clay loam</td>
<td>100-180</td>
<td>140</td>
</tr>
<tr>
<td>Clay</td>
<td>160-300</td>
<td>230</td>
</tr>
</tbody>
</table>

Hence, design TWAC = TWAC (mm) x DZR (cm) /100.

Estimation of design Net Water Requirement (NWR) :
NWR (mm) = Design TWAC x MAD (%) / 100.

Where, MAD is Management Allowed Deficit, generally MAD should be considered as 50%.

- **Estimation Of Gross Water Requirement (GWR):**

  \[
  \text{GWR} = \frac{\text{NWR (mm)} \times 100}{\text{Design efficiency} \%}
  \]

  Design efficiency (%)

  Design efficiency for sprinkler may consider as 80-85%.

- **Calculation of design irrigation interval:**

  \[
  \text{Design irrigation interval (days)} = \frac{\text{NWR (mm)} \times 100}{\text{Design efficiency} \%}
  \]

- **Infiltration rate of soil:**

  **Table 10:**

<table>
<thead>
<tr>
<th>Soil Structure</th>
<th>Infiltration rate limit (mm/hr)</th>
<th>Avg. Rate (mm/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy</td>
<td>12-250</td>
<td>50</td>
</tr>
<tr>
<td>Sandy loam</td>
<td>13-76</td>
<td>25</td>
</tr>
<tr>
<td>Loamy</td>
<td>8-20</td>
<td>13</td>
</tr>
</tbody>
</table>
## Calculation of irrigation hours:

\[
\text{Duration of application (hours) = \frac{\text{GWR (mm)}}{\text{Ppt. rate of sprinkler system (mm/hr)}}}
\]

\[
\text{Ppt. rate of sprinkler system (mm/hr) = \frac{\text{Discharge of one sprinkler (lph)}}{S1 \times S2}}
\]

- **S1** = Spacing between Sprinklers (m)
- **S2** = Spacing between Lateral line (m)

### General rules for sprinkler irrigation system design:

- Main should be laid up and down hill
- Lateral should be laid across the slope or nearly on the contour
- For multiple lateral operation, lateral pipe sizes should be more than two diameter
- Water supply source should be nearest to the center of the area
- Layout should facilitate and minimize lateral movement during the season
- Booster pump should be considered where small portion of field would require high pressure at the pump
Layout should be modified to apply different rates and amount of water soils are greatly different in the design area.

**Selecting the most appropriate sprinkler system:**

While selecting a sprinkler system, the most important physical parameters to be considered are:

1) The crop or crops to be cultivated.

2) The shape and size (acres) of the field.

3) The topography of the field.

4) The amount of time and labor to operate the system.

**Selecting sprinkler system capacity:**

A sprinkler system must be designed to apply water uniformly without runoff or erosion. The application rate of the sprinkler system must be matched to the infiltration rate of the most restrictive soil in the field. If the application rate exceeds the soil intake rate, the water will run off the field or relocates within the field resulting in over and under watered areas.

**Constraints in the application of sprinkler irrigation:**

I. Uneven water distribution due to high winds.

II. Evaporation loss when opening under high temperatures.

III. Highly impermeable soils are not suitable.

IV. Initial cost is high.

V. Proper design.

VI. Lack of package of practices.

VII. Lack of awareness.
VIII. Lack of social concern to save natural resources.

IX. High water pressure required in sprinkler (>2.5 kg/cm²).

X. Difficulty in irrigation during wind in sprinkler.

**JOINTING OF HDPE PIPE:**

**Fusion jointing:**

The principle of heat fusion is to heat two surfaces to a designated temperature, and then fuse them together by application of forces. This pressure causes flow of the melted materials, which causes mixing and thus fusion. When the polyethylene material is heated, the molecular structure is transformed from a crystalline state into an amorphous condition. When fusion pressure is applied, the molecules from each polyethylene part mix. As the joint cools, the molecules return to their crystalline form, the original interfaces are gone, and the two pipes become one homogeneous unit.

- **Two types of jointing HDPE pipe:**
  1. Butt fusion Jointing
  2. Electro fusion Jointing

1) **Butt fusion:** This technique consists of heating the squared ends of two pipes a pipe and fittings by holding them against a heated plate, removing the plate when the proper melt is obtained, promptly bringing the ends together and allowing the joint to cool while maintaining the appropriate applied force.

**Butt fusion procedure:**
The principle operations include:

- **Clamping:** The pipe pieces held axially to allow all subsequent operations to take place.

- **Facing:** The pipe ends must be faced to establish clean, parallel mating surfaces perpendicular to the central axis line of the pipes.

- **Alignment:** The pipe ends must be aligned with each other to minimize mismatch or high-low of the pipe wall.

- **Heating:** A melt pattern penetrates into the pipe must be formed around both pipe ends.

- **Joining:** The melt pattern must be joined with a specified force. Then force must be constant around the interface area.

- **Holding:** The molten joint must be held immobile with a specified force until adequately cooled.

2) **Electro fusion:** The main principle behind the electro fusion jointing, an electric resistance element is incorporated in the socket of the fitting, which when connected to an appropriate power supply, melts and fuses the materials of the pipe and fitting together. The effectiveness of this technique depends on attention to preparation of the jointing of the surfaces and ensuring the surfaces to be welded have satisfactory contact during welding and cooling cycles. Pipe clamps or other approved methods of restraining, aligning and re-rounding the pipes during the fusion cycle should be used.

- **Pipe laying and jointing:**
Because of high integrity of properly made butt fusion joints, PE pipes can be used with special installation techniques such as horizontal directional drilling, pipe brushing micro tunneling methods of trench less technologies.

- **Installation:**

The pipeline duly joined and ready alongside the trench may be placed inside the trench manually for diameters less than 160mm. For larger diameters appropriate mechanical handling equipment shall be used. While installing the pipes in trenches, the bed of the trench should be level and free from sharp edges stones. While lying in rocky areas suitable bed of sand or gravel should be provided. The initial backfill to about 10 to 15 cm above the pipe should be fine sand or screened excavated material.

- **Refilling of trenches:**

On completion of pipe laying operations in any section, for a length of about 100 meters and while further work is still in progress, refilling of trenches shall be carried out up to 300mm above pipe line. Pipe laying shall follow closely upon the progress trench excavation. The trench shall be filled by borrowed gravel or material up to 30cms.

Above top of the pipe, care shall be taken when back filling, not to injure or disturb the pipe or joints. Filling has to be carried out simultaneously on the both sides of the pipes so that unequal pressure does not occur.

⚠️ **OPERATION AND MAINTENANCE OF THE SPRINKLER SYSTEM:**

Proper design of a sprinkler system does not in itself ensure success. It should be ensured that the prime mover and the pump are in alignment, particularly in the case of tractor - driven pumps. For these the drive shaft as well as the pump shaft lay nearly the same height to prevent too great an angle on the universal shaft.
While laying the man and lateral pipes, always begin lying at the pump. This necessarily gives the correct connection of all quick coupling pipes. While joining couplings, it is ensured that both the couplings and rubber seal rings are clean.

In starting sprinkler system, the motor or engine is started with valves closed. The pump must attain the pressure stated on type-plate or otherwise there is a fault in the suction line. After the pump reaches the regulation pressure, the delivery valve is closed after stopping power unit.

➢ **Maintenance:**

- **Pipes and Fittings:**
  
  The pipes and fittings require virtually no maintenance but attention must be given to the following procedures.
  
  a) Occasionally clean any dirt or sand out of the groove in the coupler in which the rubber sealing ring fits. Any accumulation of dirt or sand will affect the performance of the rubber sealing ring.
  
  b) Keep all nuts and bolts tight.
  
  c) Do not lay pipes on new damp concrete or piles of fertilizer.

- **Sprinkler heads:**
  
  The sprinkler heads should be given the following attention:
  
  a) When moving the sprinkler lines, make sure that all sprinklers are not damages or pushed into the soil.
  
  b) Do not apply oil, grease or any lubricant to the sprinklers. They are water lubricated and using oil, grease or any other lubricant may stop them from working.
c) Sprinklers usually have a sealed bearing and at the bottom of the bearing there are washers. Usually it is the washers that wear and not the more expensive metal parts.

d) After several seasons’ operation the swing arm spring may need tightening. This is done by pulling out the spring end at the top and re-bending it. This will increase the spring tension.

➢ Storage:

The following points are to be observed while storing the sprinkler equipment during the off season.

a) Remove the sprinkler and store in a cool, dry place.

b) Remove the rubber sealing rings from the couplers and fittings and store them in a cool, dark place.

c) The pipes can be stored outdoors in which case they should be placed in racks with one end higher than the other. Do not store the pipe along with the fertilizer.

d) Disconnect the suction and delivery pipe -work from the pump and pour in a small quantity of medium grade oil. Rotate the pump for a few minutes. Blank the suction and delivery branches. This will prevent the pump from rusting. Grease the shaft.
Fig 29: Sprinkler Irrigation system Layout