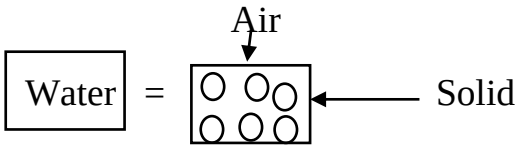
Apparent Specific Gravity: (AS)

The apparent gravity of a soil is defined as the ratio of the weight of a given volume of dry soil, air, space included, to the weight of an equal volume of water. This ratio is known also as the "volume weight" or "bulk density". Whereas apparent specific gravity is dimensionless quantity, being weight of soil per weight of water. It influenced by structure, texture, and compactness, Also it effected on permeability and (W.H.C).

$$AS = \frac{WS}{\gamma W.V} = \frac{Weight\ of\ solid}{total\ weight\ of\ water}$$



Ratio of Weight of water & Wt. of (solid + air)

Real Specific Gravity (Rs)

The real specific gravity of a soil is dimensionless quantality is defined as the ratio of the weight of a single soil particle to the weight of a volume of water equal to the volume of the particle of the soil

- The specific gravity (Rs) of the common soil forming minerals varies from 2.5 to more than 5.
- Rs of the soils which have a low percentage of organic matter varies but little ≈ 2.65.
- Some irrigated soils, which are formed largely of organic matter, have a real specific gravity (1.5 – 2.0) depending on the amount of mineral matter present

$\frac{Weight\ of\ solid}{weight\ of\ water}$ = Rs = $\frac{W_s}{\gamma_W.V_s}$, Water = solid only (excluded air)

Pore space (porosity) (n)

The term porosity, equivalent to pore space is defined as the ratio of the volume of voids (air-and water filled space) to the volume of soil plus water and air.

In general , coarse – textured , gravelly , and sandy soil have a smaller percentage of total pore space, and fine textured clay loams and clays have a greater percentage it is not unusual in irrigated soils for the pore space to vary from (35 – 55) % ⟶ why ? n for sand < n for clean , because (vs/v)sand > (vs/v)clay

$$n = 100 \left(1 - \frac{A_s}{R_s}\right)$$

n= the percentage pore space

A_s = the apparent specific gravity

R_s = the real specific gravity, approximately 2.65 most agricultural soil.

It effect on (W-H-C), movement of air, water, and roots through the soil.

$n=\frac{v_v}{v} * 100$

$n= \frac{v - V_s}{v} * 100 \longrightarrow n = \left(1 - \frac{V_s}{v}\right) * 100$

$\longrightarrow \left(\frac{1 - \frac{w}{\gamma . R_s}}{n}\right) * 100 (1 - \frac{\frac{w_s}{\gamma w . Rs}}{\frac{w_s}{\gamma w . As}}) * 100$

*Degree of saturation = $V_w = \frac{V_w}{Va + V_w}$

$$Vf = V_v$$

Infiltration

A property of soil of great importance to irrigators is the time rate at which water percolate into soil, or rate of infiltration. It is influenced by soil properties and also by moisture gradient.

Intake

The rate of infiltration from a furrow into the soil is referred to as the intake rate. Intake rate is therefore influenced by furrow size and shape.

Permeability

Is the velocity of water flow through the pore spaces causes by a given force.

Depth of soil

The importance of having an adequate depth of soil in which to store satisfactory amounts of irrigation water at each irrigation should be emphasized.

Excessive deep percolation losses usually occurs when shallow soil overlying coarse – textured, highly permeable sands and gravels are irrigated. Deep soil of medium texture and loose structure permit plants to root deeply provide for storage of large volumes of irrigation water in the soil.

Moisture content

Samples of 100 or more grams of moist soil are kept in an oven having a temperature of (105° - 110°C) until the soil is free from moisture. The loss of weight in dry in divided by the weight of the water – free soil, yields the moisture percentage on the dry – weight basis, represent by the symbol Pw.

The moisture content can be find by :-

1) By dry weight $p_w = \frac{W_w}{W_s} * 100$ (By dry weight)

Ex weight of moist soil = 100 gm , weight of water free

$\therefore p_w = (\frac{20}{80}) = 25\ \%$

Note: p_w اذا لم تذكر في المسائل أي نوع من الرطوبة فهي

2) By wet weight

$$p_{ww} = \frac{W_w}{w} = (\frac{weight\ of\ water}{total\ moist\ weight})$$

In above example moisture percentage on the weight basis is 20 % $(\frac{20}{100})$

3) By volume

The percentage on a volume basis is defined as the volume of water per until volume of space within the body of soil.

$$p_v = \frac{v_w}{v} (\frac{volume\ of\ water}{total\ volume})$$

Ex: ¼ ft^3 air, ¼ ft^3 water, ½ ft^3 solid soil

$\therefore P_V = 25\ \%$, ($v_w = \frac{1}{4} ft^3\ v_{total} = \frac{1}{2} + \frac{1}{4} + \frac{1}{4} =$ ft

S w A (S=Solid, w= water, A= Air)

4) By depth

d= $\frac{p_v}{100} * D$

or

d= $\frac{p_v}{100} * A_s * D$

D= depth of root & one (depth of soil)

d= depth of water irrigation

A_s = Apparent specific gravity

$P_v = \frac{v_w}{v} * 100 \Rightarrow P_v = \frac{d*A}{D*A} * 100 \Longrightarrow P_v = \frac{d}{D} * 100$

It is therefore desirable to convert dry – weight basis moisture percentages p_w to volume percentages p_v.

$P_v = P_w * A_s$

Classes and Availability of soil water

1- **Hygroscopic water**: It is the water on the surface of the oil grains and it is not capable of movement by the action of gravity or capillary forces.
2- **Capillary water:** It is that part in excess of the hygroscopic water which exists in the pore space of the soil and is retained against the force of gravity in a soil that per mist unobstructed drainage.
3- **Gravitational water:** It is that part in excess of hygroscopic and capillary water which will move out of the soil if favorable drainage is provided.

The proportion of each class depends on soil texture structure, organic matter contents, temperature, and depth of soil column considered.

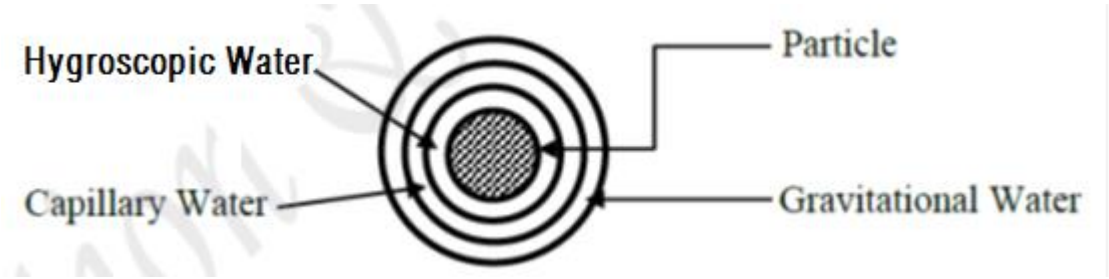


Fig. 1 Availability of water around the soil particle

Water may also be classified as unavailable, available and gravitation or superfluous.

Gravitation water, It is the water that drains quick from the root zone under normal drainage conditions.

1- **Unavailable water**: It is the water held too tightly by capillary forces and is generally not accessible to plant roots.
2- **Available water:** It is the difference between gravitation and unavailable water.

Field capacity (F. C)

It is the moisture content of soil when gravitational water has been removed. In practice, field capacity is usually determined 2 days after irrigation

For coarse texture	→	1 day is used for drain
For fine texture	→	4 day are used for drain

Wilting point (w.p)

The soil – moisture content when plants wilt is called the wilting point – wilting point can be divided into :