26th Oct,
SUNDAY

08. QUALITY OF IRRIGATION WATER

→ Electric Conductivity

~~Abou~~ Units : millimhos/cm
or
micromhos/cm

- Irrigation water contains. Na, K, Ca & Mg ions. which represents quality of irrigation water.

- concentration of salt = m. eq/L or mg/L or ppm.

$$m.eq/L = \frac{mg/L}{\text{Equivalent wt.}}$$

→ Coagulated clod.

- assemblage of soil particles.
- occurs due to cementing properties imparted by Ca, Mg silicates and aluminates.
- when water with Na content is added to above, following reactions take place.

$$Na + \begin{matrix} Ca \\ Mg \end{matrix} \text{ silicates} \longrightarrow Na \text{ silicates} + Ca, Mg$$

- when this happens cementing property is lost. As a result, chumbling and disintegration of clod occurs.
- Silica settles down and fills the voids, thus reducing the permeability of soil.

Sodium hazard of water is assessed in terms of Exchangeable Sodium Ions. (

* Exchangeable Sodium Ratio, ESR $= \dfrac{Na^+}{Ca^{++} + Mg^{++} + K^+}$

If sodium hazard is represented as percentage, called as Exchangeable Sodium Percentage (ESP),

$$ESP = \left(\frac{ESR}{1 + ESR}\right) * 100 = \frac{Na^+}{Ca^{++} + Mg^{++} + K^+ + Na^+}$$

→ Sodium Adsorption Ratio (SAR).

$$SAR = \frac{Na^+}{\sqrt{\dfrac{Ca^{++} + Mg^{++}}{2}}} \; ; \; (m.eq/L)$$

Irrigation water rich in bicarbonate content tend to precipitate Ca & Mg in soil as their carbonates which are insoluble.

$$Ca + 2HCO_3 \rightleftharpoons \underset{(ppt)}{CaCO_3} \downarrow + H_2O + CO_2$$

$$Mg + 2HCO_3 \rightleftharpoons \underset{(ppt)}{MgCO_3} \downarrow + H_2O + CO_2$$

∴ SAR increases.

* Residual Sodium Carbonate (RSC)

$$RSC = (CO_3^{--} + HCO_3^{-}) - (Ca^{++} + Mg^{++}).$$

RSC < 1.25 ⇒ fit for irrigation water.

Irrigation water must have low conc. of dissolved salts or low salinity. High conc. of dissolved salts may result in dehydration of plants due to osmotic effects.

→ Saline Soil.

- presence of NaCl.

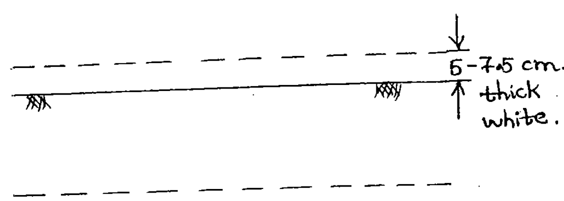
→ Sodic Soil / Alkaline Soil.

- presence of Na_2CO_3.

- Saline soil is reclaimed by leaching (not difficult).
- Sodic soil is difficult to be reclaimed. Sulphur + gypour is added first and then leaching is done.

→ Salt Efflorescence.

When water with dissolved salts of NaCl, Na_2SO_4, Na_2CO_3



→ Standards of Irrigation Water

(i) Electrical Conductivity, EC = 0 - 1000 micromhos/cm

(ii) TDS = 0 - 700 ppm

(iii) ESP = 0 - 60 ppm

(iv) Chloride = 0 - 142

(v) Sulphate = 0 - 192

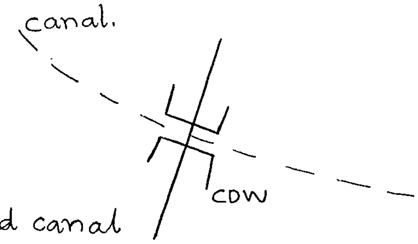
(vi) Boron = 0 - 0.5

(vii)

CROSS DRAINAGE WORKS

Type I : Canal above the drain.

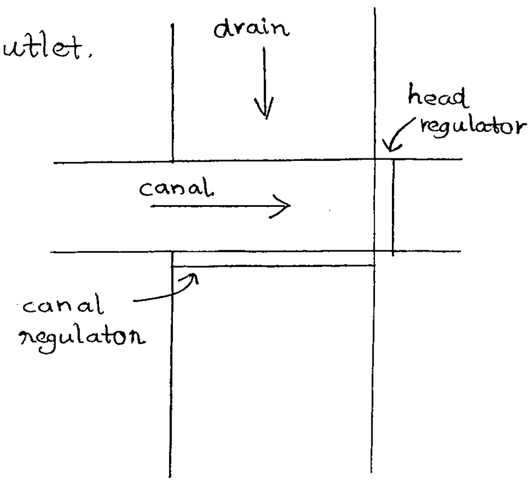
Eg: Aquaduct, Syphon aquaduct.



Type II : Drain above the canal.

Type III : Bed level of the drain and canal meet at the same level.

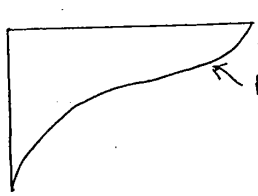
Eg: Level crossing inlet and outlet.



Q. When seepage takes place below a horizontal floor without any sheet piles, streamlines and equipotential lines are ______

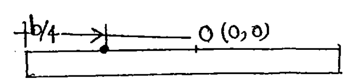
a) Hyperbolas & Parabolas.
c) Parabola & Ellipse
b) Ellipses & Hyperbolas ✓
d) Circles & Ellipse.

Q. When seepage of flow takes place below a flat floor without any sheet piles, the potential ϕ_x below the floor at one-fourth the floor length from u/s end is ____



$$p = \frac{H}{\pi}\cos^{-1}\left(\frac{2x}{b}\right).$$

$$\phi = \frac{P}{H} = \frac{1}{\pi}\cos^{-1}\left(\frac{2x}{b}\right).$$



Put $x = -\frac{b}{4}$

$$\phi_x = \frac{1}{\pi} \cos^{-1}\left(\frac{-2\frac{b}{4}}{b}\right)$$

$$\Rightarrow \phi_x = 66.6\ \%$$

Q. At a certain point in the floor of the weir, the uplift pressure head due to seepage is 3. The relative density of concrete is 2.5. The min. thickness of floor is

Q. In an unlined canal, if the depth of floor changes from 1 m to 1.2 m, find the corresponding % change in non-silting, non scouring velocity of flow.

As per Kennedy's theory,

$$V_o = 0.55\, D^{0.64}$$

$$\frac{V_{o1}}{V_{o2}} = \left(\frac{D_1}{D_2}\right)^{0.64}.$$

$$V_{o2} = V_{o1} \times \left(\frac{1.2}{1}\right)^{0.64} = 1.124\, V_{o1}$$

$\Rightarrow$ % change in velocity $=$ **12.4%**

Q. A non cohesive soil has a porosity of 30%, and relative density of soil particles 2.7. Value of critical exit gradient is ——

$$i_c = (1-n)(G-1) = (1-0.3)(2.7-1) = 1.19$$

Q. Assertion : Duty of water decreases as the point of its measurement moves away from field of application. 40

Reason : Duty depends on soil characteristics.