Problem:-

Calculate the evaporation rate from an open water Surface using Bowen's Equation from the following Data:

$R_n = 200 \frac{Watt}{m^2}$ $I_v = 2500 \times 10^3 \frac{Joule}{Kg}$ $\rho_w = 1000 \frac{kg}{m^3}$

Solution:-

$$E_r = \frac{R_n}{I_v \rho_w}$$

$$E_r = \frac{200}{2500 \times 10^3 \times 1000}$$

$$E_r = 8 \times 10^{-8} \ m/sec.$$

$$E_r = 8 \times 10^{-8} \times 1000 \times (1 \times 60 \times 60 \times 24)$$

$$\boxed{E_r = 7 \frac{mm}{day}}$$

(iii) **Mass Transfer Approach:-**

The Mass transfer approach contain Dalton's Equation

$$E = C \cdot (e_s - e_a)$$

e_a = Air vapour pressure (m bar).
e_s = Saturation Vapour pressure (m bar)
C = Constant of Dalton.

$$C = \frac{0.622\, K^2 \rho_a V}{P \rho_w \left[\ln\left(\frac{Z}{Z_0}\right) \right]^2}$$

K = Von Karman Constant = 0.4

ρ_a = Density of air.

V = Velocity of wind at elevation Z above the water surface.

P = Air pressure.

ρ_a = Density of water.

Z = Elevation at which "V" is measured

Z_0 = Height of Roughness

Problem:- Calculate evaporation from an open water surface in a region where air pressure is $105 \frac{KN}{m^2}$. The vapour pressure of water is $3.167 \frac{KN}{m^2}$. and that of air is $1.583 \frac{KN}{m^2}$. The wind speed measured at elevation of 1.75 m above water surface is 2.7 m/sec. Assume height of surface roughness as 0.3 mm. The density of water and air may be taken as $1000 \frac{Kg}{m^3}$ and $1.2 \frac{Kg}{m^3}$ and the Von Karman Constant is 0.4.

Solution :-

$K = 0.4$ $\rho_a = 1.2\ kg/m^3$

$V = 2.7\ m/sec$ $P = 105 \times 10^3\ N/m^2$

$\rho_w = 1000\ kg/m^3$ $Z = 1.75\ m$

$Z_0 = 0.0003\ m$ $e_0 = 3167\ N/m^2$

$e_a = 1583\ N/m^2$

As we know that.

$$C = \frac{0.622\ K^2 \rho_a V}{P \rho_w \left[\ln\left(\frac{Z}{Z_0}\right)^2\right]} = \frac{0.622 \times (0.4)^2 \times 1.2 \times 2.7}{105 \times 10^3 \times 1000 \left[\left[\ln\left(\frac{1.75}{0.0003}\right)\right]^2\right]}$$

$$C = \frac{0.3224448}{105 \times 10^3 \times 1000 \times (8.67)^2}$$

$$C = \frac{0.3224448}{7892734500}$$

$$C = 4.19 \times 10^{-11}$$

$$E = C\,(e_0 - e_a) = 4.19 \times 10^{-11}(3167 - 1583)$$

$$E = 6.63 \times 10^{-8}\ m/sec$$

$$E = 6.63 \times 10^{-8} \times 1000 \times (1 \times 60 \times 60 \times 24)$$

$$\boxed{E = 5.7\ mm/day}$$ Answer.

Measuring Evaporation by pans

Pan Evaporation Method

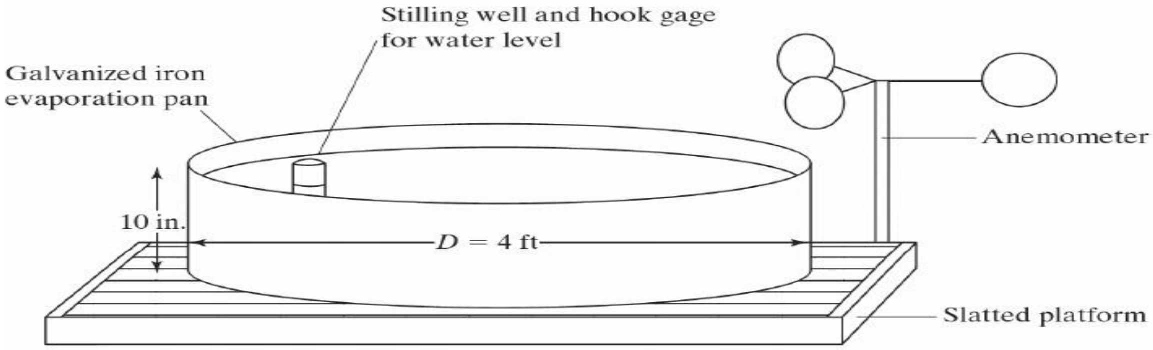

Figure 1.18
Standard Class A evaporation pan with cup anemometer and rain gage.

Pan evaporation Values are higher than the actual lake evaporation.

$$E_{actual} = E_{pan} \times K$$

K = Adjustment Factor (pan Coefficient).
K = 0.60 to 0.81

Problem:- The rainfall during a particular day was 10mm. Class-A pan is installed in this area. If water added to pan on that particular day was 12mm. Find the evaporation. Take the pan Coefficient as 0.60.

Solution:-

Rainfall = 10 mm
water added = 12 mm

Depth of water evaporated from pan = 10+12
= 22 mm

$E_{actual} = E_{pan} \times K = 22 \times 0.60$

$E_{actual} = 13\ mm$

Measurement of Evapotranspiration:-

There are many methods of measuring evapotranspiration. The instrument most commonly used for the measurement of evapotranspiration is known as "Lysimeter"

Lysimeter:-

- The Lysimeter consists of a small tank filled with soil and having the same vegetation cover as that of the adjacent area.
- It contains a drain and all facilities for measuring the quantity of water entering and leaving the tank.
- The vegetation in the tank is either watered from lower side of the tank by maintaining a constant water table or from above.

Some Common uses.

(1) To provide direct measurement of evapotranspiration from soil surfaces on which plants are grown, for use in studies of factors affecting this process.

(2) To provide accurate measures of water loss from soil in studies of upward movement of water in soil as a result of surface drying.