

MODULE # 3(a)

Evaporation:-

The few terms related to evaporation are defined below:-

Vaporization:- It is a physical process in which liquid changes to gaseous state without boiling from free surfaces of water bodies and wet soil masses are returned to atmosphere due to high temperature effects.

Evaporation:- Water losses due to vaporization is called evaporation. It is measured in depth units.

Transpiration:- The process by which water is returned to the atmosphere by evaporation from the surface of the leaves after movement from the soil through the root and stem system of the plant is called transpiration.

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Evapo transpiration:-

It is combined evaporation & transpiration. The total water loss of soil or free water surface and from trees and plants is termed as evapo-transpiration.

Factors Affecting Evaporation:-

- ① Temperature:- Evaporation is highly dependent upon temperature. Higher the temperature greater will be the evaporation.
- ② Surface Area of water body:- Evaporation takes place from free surface of water body. Larger the area exposed to atmosphere, greater will be evaporation.
- ③ Humidity:- Greater the humidity, lesser will be evaporation.
- ④ Wind speed:- Higher the wind speed more will be evaporation.
- ⑤ Solar Radiation:- Evaporation increases with increasing solar radiation.

⑥ Atmospheric Pressure:-

Evaporation decreases with increasing atmospheric pressure.

⑦ Depth of Water:-

Greater the depth of water, lesser will be the evaporation.

Measurement of Evaporation:-

Evaporation can be estimated by:

- (a) Indirect or Theoretical Method.
- (b) Direct Measurement

(a) Indirect or theoretical Method:-

From theoretical point of view there are three recognized approaches and are named as:

- (i) - Water budget approach.
- (ii) - Energy budget approach
- (iii) - Mass transfer Approach.

(i) Water Budget Approach:-

The water budget approach is the least complicated method of estimating evaporation but results obtained from it are not so accurate.

It is based on the assumptions that change

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in storage " ΔS " and all components of inflow " I " (Mainly precipitation " P ") and outflow " O " (Run off " R ") along with Losses " L " except evaporation " E " can be measured and evaporation is the quantity of water required to balance the continuity equation.

$$E = P - R - L - \Delta S$$

Problem:- From a 50mm rainfall 35mm of runoff is generated that was measured at stream gauging station. If infiltration losses are estimated as 10mm - determine the evaporation loss assume there is no storage in system.

Solution:-

$$P = 50 \text{ mm}$$

$$R = 35 \text{ mm}$$

$$L = 10 \text{ mm}$$

$$\Delta S = 0$$

$$E = P - R - L - \Delta S$$

$$E = 50 - 35 - 10 - 0$$

$$E = 5 \text{ mm}$$

ii) Energy Budget Approach:-

This method is based on the application of the Conservation of energy. The continuity equation for energy budget approach is given below.

$$Q_e = Q_s - Q_r - Q_b - Q_h - Q_t \pm Q_v.$$

Q_e = The energy available for evaporation.

Q_s = The solar radiation Energy

Q_r = Reflected Solar Energy.

Q_b = Long wave Loss.

Q_h = (Unused) Latent heat between the water surface and the atmosphere.

Q_t = Heat transfer to and from the lake

Q_v = Increases in stored Energy.

All these quantities can be measured or estimated indirectly. The evaporation then is estimated by some relationship b/w heat available for evaporation and evaporated water quantity.

Many researchers have worked on relationship

As;

$$E_r = \frac{R_n}{(I_v \rho_w)} \quad E_r = \text{Evaporation Rate}$$

R_n = Net Radiation at Earth's surface.

I_v = Latent Heat of Vaporization.

ρ_w = Density of water.