I EVAPORATION

Evaporation from free water surfaces and soil are of great importance in hydro-meterological studies.

1.1 Evaporation from water surfaces (Lake evaporation):

The factors affecting evaporation are air and water temperature, relative humidity, wind velocity, surface area(exposed), barometric pressure and salinity of the water, the last two having a minor effect.

The rate ofevaporation is a function of the differences in vapour pressure at the water surface and in the atmosphere, and the

Dalton's law of evaporation is given by

$$E = K (ew – ea)$$

where E = daily evaporation

ew = saturated vapour pressure at the temperature of water

ea = vapour pressure of the air (about 2 m above)

K = a constant.

The Dalton's law states that the evaporation is proportional to the difference in vapour pressuresew and ea. A more general form of the Eq. (3.2) is given by

$$E = K' (ew – ea) (a + bV)$$

where K′, a, b = constants

and V = wind velocity.

1.3 EVAPORATION PANS:

(i) Floating pans (made of GI) of 90 cm square and 45 cm deep are mounted on a raft floating in water. The volume of water lost due to evaporation in the pan is determined by knowing the volume of water required to bring the level of water up to the original mark daily and after making allowance for rainfall, if there has been any.

(ii) Land pan. Evaporation pans are installed in the vicinity of the reservoir or lake to determine the lake evaporation. The IMD Land pan is 122 cm diameter and 25.5 cm deep,made of unpainted GI; and set on wood grillage 10 cm above ground to permit circulation of air under the pan. The pan has a stilling well, vernier point gauge, a thermometer with clip and may becovered with a wire screen. The amount of water lost by evaporation from the pan can be

directlymeasured by the point gauge. Readings are taken twice daily at 08.30 and 17.30 hours I.S.T. Theair temperature is determined by reading a dry bulb thermometer kept in the Stevenson's screenerected in the same enclosure of the pan. A totalising anemometer is normally mounted at thelevel of the instrument to provide the wind speed information

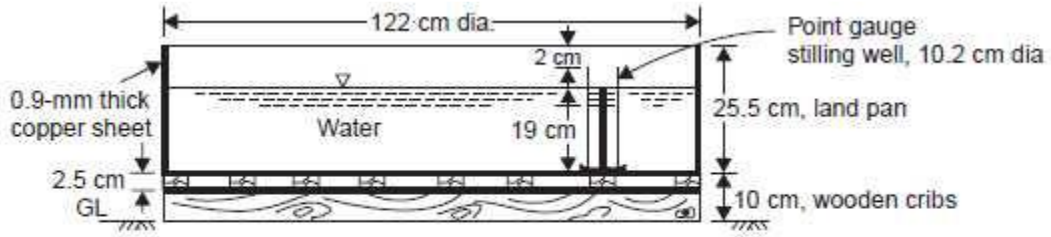

Fig. 3.2 IMD land pan

required. Allowance has to be made for rainfall, if there has been any. Water is added to the pan from a graduated cylinder to bring the water level to the original mark, i.e., 5 cm below the top ofthe pan. Experiments have shown that the unscreened pan evaporation is 1.144 times that of the screened one.

(iii) Colarado sunken pan. This is 92 cm square and 42-92 cm deep and is sunk in the ground suchthat only 5-15 cm depth projects above the ground surface and thus the water level is maintainedalmost at the ground level. The evaporation is measured by a point gauge

Pan coefficient

Evaporation pan data cannot be applied to free water surfaces directly but must beadjusted for the differences in physical and climatological factors. For ex- ample, a lake is larger anddeeper and may be exposed to different wind speed, as compared to a pan. The small volume ofwater in the metallic pan is greatly affected by temperature fluctuations in the air or by solarradiations in contrast with large bodies of water (in the reservoir) with little temperaturefluctuations. Thus the pan evaporation data have to be corrected to obtain the actualevaporation from water surfaces of lakes and reservoirs, i.e., by multiplying by a coefficient calledpan coefficient

1.4 TRANSPIRATION:

Tanspiration is the process by which the water vapour escapes from the living plant leaves andenters the atmosphere. Various methods are devised by botanists for the measurement oftranspiration and one of the widely used methods is by phytometer. It consists of a closed

water tight tank with sufficient soil for plant growth with only the plant exposed; water isapplied artificially till the plant growth is complete. The equipment is weighed in the beginning(W1) and at the end of the experiment (W2). Water applied during the growth (w) is measured
and the water consumed by transpiration (Wt) is obtained as

$$Wt = (W1 + w) – W2$$

The experimental values (from the protected growth of the plant in the laboratory) haveto be multiplied by a coefficient to obtain the possible field results.Transpiration ratio is the ratio of the weight of water absorbed (through the root system),conveyed through and transpired from a plant during the growing season to the weight ofthe dry matter produced exclusive of roots.
For the weight of dry matter produced, sometimes, the useful crop such as grains ofwheat, gram, etc. is weighed. The values of transpiration ratio for different crops vary from300 to 800 and for rice it varies from 600 to 800 the average being 700.Evaporation losses are high in arid regions where water is impounded while transpirationis the major water loss in humid regions.

1.5 EVAPOTRANSPIRATION

Evapotranspiration (Et) or consumptive use (U) is the total water lost from a cropped (or irrigated)land due to evaporation from the soil and transpiration by the plants or used by the plants in building up of plant tissue. Potential evapotranspiration (Ept) is the evapotranspiration from the short green vegetation when the roots are supplied with unlimited water covering the soil. It is usually expressed as a depth (cm, mm) over the area.

1.5.1 Estimation of Evapotranspiration

The following are some of the methods of estimating evapotranspiration:
(i) Tanks and lysimeter experiments
(ii) Field experimental plots
(iii) Installation of sunken (colarado) tanks
(iv) Evapotranspiration equations as developed by Lowry-Johnson, Penman,Thornthwaite, Blaney-Criddle, etc.
(v) Evaporation index method, i.e., from pan evaporation data as developed byHargreaves and Christiansen.

1.5.2 Factors Affecting Evapotranspiration

From the above equations it can be seen that the following factors affect the evapotranspiration:

(i) Climatological factors like percentage sunshine hours, wind speed, mean monthlytemperature and humidity.

(ii) Crop factors like the type of crop and the percentage growing season.

(iii) The moisture level in the soil.

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