# Important Losses from Precipitation Formulas PDF

**Formulas**
**Examples**
**with Units**

**List of 25**
**Important Losses from Precipitation Formulas**

## 1) Determination of Evapotranspiration Formulas

### 1.1) Consumptive Use of Water for Large Areas Formula

Evaluate Formula

Formula

$$Cu = I + P_{mm} + \left( G_s - G_e \right) - V_o$$

Example with Units

$$45.035\,\text{m}^3/\text{s} = 20\,\text{m}^3/\text{s} + 35\,\text{mm} + \left( 80\,\text{m}^3 - 30\,\text{m}^3 \right) - 25\,\text{m}^3$$

### 1.2) Equation for Constant depending upon Latitude in Net Radiation of Evaporable Water Equation Formula

Evaluate Formula

Formula

$$a = 0.29 \cdot \cos\left( \Phi \right)$$

Example with Units

$$0.145 = 0.29 \cdot \cos\left( 60° \right)$$

### 1.3) Equation for Parameter Including Wind Velocity and Saturation Deficit Formula

Evaluate Formula

Formula

$$E_a = 0.35 \cdot \left( 1 + \left( \frac{W_v}{160} \right) \right) \cdot \left( e_s - e_a \right)$$

Example with Units

$$5.0896 = 0.35 \cdot \left( 1 + \left( \frac{2\,\text{cm/s}}{160} \right) \right) \cdot \left( 17.54\,\text{mmHg} - 3\,\text{mmHg} \right)$$

### 1.4) Transpiration ratio Formula

Evaluate Formula

Formula

$$T = \frac{W_w}{W_m}$$

Example with Units

$$2.5 = \frac{5\,\text{kg}}{2.0\,\text{kg}}$$

### 1.5) Water Consumed by Transpiration Formula

Evaluate Formula

Formula

$$W_t = \left( W_1 + W \right) - W_2$$

Example with Units

$$6\,\text{kg} = \left( 8\,\text{kg} + 2\,\text{kg} \right) - 4\,\text{kg}$$

# 2) Evaporation Formulas

## 2.1) Dalton's Law of Evaporation Formula

Evaluate Formula

Formula

$$E = K_o \cdot \left( e_s - e_a \right)$$

Example with Units

$$2907.7528 = 1.5 \cdot \left( 17.54\,\text{mmHg} - 3\,\text{mmHg} \right)$$

## 2.2) Dalton-Type Equation Formula

Evaluate Formula

Formula

$$E_{lake} = K \cdot f_u \cdot \left( e_s - e_a \right)$$

Example with Units

$$12.359 = 0.5 \cdot 1.7 \cdot \left( 17.54\,\text{mmHg} - 3\,\text{mmHg} \right)$$

## 2.3) Meyers formula (1915) Formula

Evaluate Formula

Formula

$$E_{lake} = K_m \cdot \left( e_s - e_a \right) \cdot \left( 1 + \frac{u_9}{16} \right)$$

Example with Units

$$12.399 = 0.36 \cdot \left( 17.54\,\text{mmHg} - 3\,\text{mmHg} \right) \cdot \left( 1 + \frac{21.9\,\text{km/h}}{16} \right)$$

## 2.4) Rohwers formula (1931) Formula

Evaluate Formula

Formula

$$E_{lake} = 0.771 \cdot \left( 1.465 - 0.00073 \cdot P_a \right) \cdot \left( 0.44 + 0.0733 \cdot u_0 \right) \cdot \left( e_s - e_a \right)$$

Example with Units

$$12.3779 = 0.771 \cdot \left( 1.465 - 0.00073 \cdot 4\,\text{mmHg} \right) \cdot \left( 0.44 + 0.0733 \cdot 4.3\,\text{km/h} \right) \cdot \left( 17.54\,\text{mmHg} - 3\,\text{mmHg} \right)$$

## 2.5) Vapour Pressure of Air using Dalton's Law Formula

Evaluate Formula

Formula

$$e_a = e_s - \left( \frac{E}{K_o} \right)$$

Example with Units

$$3.0038\,\text{mmHg} = 17.54\,\text{mmHg} - \left( \frac{2907}{1.5} \right)$$

## 2.6) Vapour Pressure of Water at given Temperature for Evaporation in Water Bodies Formula

Evaluate Formula

Formula

$$e_s = \left( \frac{E}{K_o} \right) + e_a$$

Example with Units

$$17.5362\,\text{mmHg} = \left( \frac{2907}{1.5} \right) + 3\,\text{mmHg}$$

# 3) Interception Formulas

## 3.1) Duration of Rainfall given Interception Loss Formula

Evaluate Formula

Formula

$$t = \frac{I_i - S_i}{K_i \cdot E_r}$$

Example with Units

$$1.5\,\text{h} = \frac{8.7\,\text{mm} - 1.2\,\text{mm}}{2 \cdot 2.5\,\text{mm/h}}$$

## 3.2) Evaporation Rate given Interception Loss Formula

Evaluate Formula

Formula

$$E_r = \frac{I_i - S_i}{K_i \cdot t}$$

Example with Units

$$2.5\,\text{mm/h} = \frac{8.7\,\text{mm} - 1.2\,\text{mm}}{2 \cdot 1.5\,\text{h}}$$

## 3.3) Interception Loss Formula

Evaluate Formula

Formula

$$I_i = S_i + \left(K_i \cdot E_r \cdot t\right)$$

Example with Units

$$1.2\,\text{mm} = 1.2\,\text{mm} + \left(2 \cdot 2.5\,\text{mm/h} \cdot 1.5\,\text{h}\right)$$

## 3.4) Interception Storage given Interception Loss Formula

Evaluate Formula

Formula

$$S_i = I_i - \left(K_i \cdot E_r \cdot t\right)$$

Example with Units

$$1.2\,\text{mm} = 8.7\,\text{mm} - \left(2 \cdot 2.5\,\text{mm/h} \cdot 1.5\,\text{h}\right)$$

## 3.5) Ratio of Vegetal Surface Area to its Projected Area given Interception Loss Formula

Evaluate Formula

Formula

$$K_i = \frac{I_i - S_i}{E_r \cdot t}$$

Example with Units

$$2 = \frac{8.7\,\text{mm} - 1.2\,\text{mm}}{2.5\,\text{mm/h} \cdot 1.5\,\text{h}}$$

# 4) Measurement of Evaporation Formulas

## 4.1) Budget Method Formulas

### 4.1.1) Bowen's Ratio Formula

Evaluate Formula

Formula

$$\beta = \frac{H_a}{\rho_{water} \cdot L \cdot E_L}$$

Example with Units

$$0.051 = \frac{20\,\text{J}}{1000\,\text{kg/m}^3 \cdot 7\,\text{J/kg} \cdot 56\,\text{mm}}$$

### 4.1.2) Energy Balance to Evaporating Surface for Period of One Day Formula

Evaluate Formula

Formula

$$H_n = H_a + H_e + H_g + H_s + H_i$$

Example with Units

$$388.21\,\text{W/m}^2 = 20\,\text{J} + 336\,\text{W/m}^2 + 0.21\,\text{W/m}^2 + 22.0\,\text{W/m}^2 + 10\,\text{W/m}^2$$

### 4.1.3) Evaporation from Energy Budget Method Formula

Evaluate Formula

Formula

$$E_L = \frac{H_n - H_g - H_s - H_i}{\rho_{water} \cdot L \cdot (1 + \beta)}$$

Example with Units

$$48.2689\,\text{mm} = \frac{388\,\text{W/m}^2 - 0.21\,\text{W/m}^2 - 22.0\,\text{W/m}^2 - 10\,\text{W/m}^2}{1000\,\text{kg/m}^3 \cdot 7\,\text{J/kg} \cdot (1 + 0.053)}$$

### 4.1.4) Heat Energy used up in Evaporation Formula

Evaluate Formula

Formula

$$H_e = \rho_{water} \cdot L \cdot E_L$$

Example with Units

$$392\,\text{W/m}^2 = 1000\,\text{kg/m}^3 \cdot 7\,\text{J/kg} \cdot 56\,\text{mm}$$

## 5) Reservoir Evaporation and Methods of Reduction Formulas

### 5.1) Average Reservoir Area during Month given Volume of Water Lost in Evaporation Formula

Evaluate Formula

Formula

$$A_R = \frac{V_E}{E_{pm} \cdot C_p}$$

Example with Units

$$10\,\text{m}^2 = \frac{56\,\text{m}^3}{16\,\text{m} \cdot 0.35}$$

### 5.2) Pan Evaporation Loss Formula

Evaluate Formula

Formula

$$E_{pm} = E_{lake} \cdot n \cdot 10^{-3}$$

Example with Units

$$0.369\,\text{m} = 12.3 \cdot 30 \cdot 10^{-3}$$

### 5.3) Pan Evaporation Loss given Volume of Water Lost in Evaporation in Month Formula

Evaluate Formula

Formula

$$E_{pm} = \frac{V_E}{A_R \cdot C_p}$$

Example with Units

$$16\,\text{m} = \frac{56\,\text{m}^3}{10\,\text{m}^2 \cdot 0.35}$$

### 5.4) Relevant Pan Coefficient given Volume of Water Lost in Evaporation in Month Formula

Evaluate Formula

Formula

$$C_p = \frac{V_E}{A_R \cdot E_{pm}}$$

Example with Units

$$0.35 = \frac{56\,\text{m}^3}{10\,\text{m}^2 \cdot 16\,\text{m}}$$

## 5.5) Volume of Water Lost in Evaporation in Month Formula

Evaluate Formula

Formula

$$V_E = A_R \cdot E_{pm} \cdot C_p$$

Example with Units

$$56\,\text{m}^3 = 10\,\text{m}^2 \cdot 16\,\text{m} \cdot 0.35$$

## Variables used in list of Losses from Precipitation Formulas above

- **a** Constant depending on Latitude
- $A_R$ Average Reservoir Area *(Square Meter)*
- $C_p$ Relevant Pan Coefficient
- **Cu** Consumptive Use of Water for Large Areas *(Cubic Meter per Second)*
- **E** Evaporation from Water Body
- $e_a$ Actual Vapour Pressure *(Millimeter Mercury (0 °C))*
- $E_a$ Actual Mean Vapor Pressure
- $E_L$ Daily Lake Evaporation *(Millimeter)*
- $E_{lake}$ Lake Evaporation
- $E_{pm}$ Pan Evaporation Loss *(Meter)*
- $E_r$ Evaporation Rate *(Millimeter per Hour)*
- $e_s$ Saturation Vapour Pressure *(Millimeter Mercury (0 °C))*
- $f_u$ Wind Speed Correction Factor
- $G_e$ Ground Water Storage at the End *(Cubic Meter)*
- $G_s$ Ground Water Storage *(Cubic Meter)*
- $H_a$ Sensible Heat Transfer from Water Body *(Joule)*
- $H_e$ Heat Energy used up in Evaporation *(Watt per Square Meter)*
- $H_g$ Heat Flux into the Ground *(Watt per Square Meter)*
- $H_i$ Net Heat Conducted out system by Water Flow *(Watt per Square Meter)*
- $H_n$ Net Heat Received by Water Surface *(Watt per Square Meter)*
- $H_s$ Head Stored in Water Body *(Watt per Square Meter)*
- **I** Inflow *(Cubic Meter per Second)*
- $I_i$ Interception Loss *(Millimeter)*
- **K** Coefficient

## Constants, Functions, Measurements used in list of Losses from Precipitation Formulas above

- Functions: **cos**, cos(Angle)
  *Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.*
- Measurement: **Length** in Millimeter (mm), Meter (m)
  *Length Unit Conversion*
- Measurement: **Weight** in Kilogram (kg)
  *Weight Unit Conversion*
- Measurement: **Time** in Hour (h)
  *Time Unit Conversion*
- Measurement: **Volume** in Cubic Meter ($m^3$)
  *Volume Unit Conversion*
- Measurement: **Area** in Square Meter ($m^2$)
  *Area Unit Conversion*
- Measurement: **Pressure** in Millimeter Mercury (0 °C) (mmHg)
  *Pressure Unit Conversion*
- Measurement: **Speed** in Centimeter per Second (cm/s), Kilometer per Hour (km/h), Millimeter per Hour (mm/h)
  *Speed Unit Conversion*
- Measurement: **Energy** in Joule (J)
  *Energy Unit Conversion*
- Measurement: **Angle** in Degree (°)
  *Angle Unit Conversion*
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second ($m^3/s$)
  *Volumetric Flow Rate Unit Conversion*
- Measurement: **Heat Flux Density** in Watt per Square Meter ($W/m^2$)
  *Heat Flux Density Unit Conversion*
- Measurement: **Density** in Kilogram per Cubic Meter ($kg/m^3$)
  *Density Unit Conversion*
- Measurement: **Latent Heat** in Joule per Kilogram (J/kg)
  *Latent Heat Unit Conversion*

- $K_i$ Ratio of Vegetal Surface Area to Projected Area
- $K_m$ Coefficient Accounting for Other Factors
- $K_o$ Proportionality Constant
- **L** Latent Heat of Evaporation *(Joule per Kilogram)*
- **n** Number of Days in a Month
- $P_a$ Atmospheric Pressure *(Millimeter Mercury (0 °C))*
- $P_{mm}$ Precipitation *(Millimeter)*
- $S_i$ Interception Storage *(Millimeter)*
- **t** Duration of the Rainfall *(Hour)*
- **T** Transpiration Ratio
- $u_0$ Mean Wind Velocity at Ground Level *(Kilometer per Hour)*
- $u_9$ Monthly Mean Wind Velocity *(Kilometer per Hour)*
- $V_E$ Volume of Water Lost in Evaporation *(Cubic Meter)*
- $V_o$ Mass Outflow *(Cubic Meter)*
- **W** Amount of Water applied during Growth *(Kilogram)*
- $W_1$ Entire Plant Set Up Weighed in the Beginning *(Kilogram)*
- $W_2$ Entire Plant Set Up Weighed at the End *(Kilogram)*
- $W_m$ Weight of Dry Mass produced *(Kilogram)*
- $W_t$ Water Consumed by Transpiration *(Kilogram)*
- $W_v$ Mean Wind Velocity *(Centimeter per Second)*
- $W_w$ Weight of Water Transpired *(Kilogram)*
- **β** Bowen's Ratio
- $\rho_{water}$ Water Density *(Kilogram per Cubic Meter)*
- **Φ** Latitude *(Degree)*

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