

Important Thermal Power Plant Formulas PDF



Formulas Examples with Units

List of 12 Important Thermal Power Plant Formulas

1) Consumption of Coal per Hour Formula ↻

Formula

$$CCP_{\text{coal}} = \frac{Q_h}{CV_{\text{coal}}}$$

Example with Units

$$1.4904_{\text{AT (UK)}} = \frac{311.6_{\text{J/K}}}{6400_{\text{J/K}}}$$

Evaluate Formula ↻

2) Current Density from Cathode to Anode Formula ↻

Formula

$$J_c = A \cdot T_c^2 \cdot \exp\left(-\frac{[\text{Charge-e}] \cdot V_c}{[\text{BoltZ}] \cdot T_c}\right)$$

Example with Units

$$0.4714_{\text{A/cm}^2} = 120 \cdot 1350_{\text{K}}^2 \cdot \exp\left(-\frac{1.6\text{E-}19_{\text{c}} \cdot 1.25_{\text{v}}}{1.4\text{E-}23_{\text{J/K}} \cdot 1350_{\text{K}}}\right)$$

Evaluate Formula ↻

3) Maximum Electron Current per Unit Area Formula ↻

Formula

$$J = A \cdot T^2 \cdot \exp\left(-\frac{\Phi}{[\text{BoltZ}] \cdot T}\right)$$

Example with Units

$$3.1381_{\text{A/cm}^2} = 120 \cdot 1100_{\text{K}}^2 \cdot \exp\left(-\frac{0.8_{\text{eV}}}{1.4\text{E-}23_{\text{J/K}} \cdot 1100_{\text{K}}}\right)$$

Evaluate Formula ↻

4) Minimum Energy required by Electron to Leave Cathode Formula ↻

Formula

$$Q = J_c \cdot V_c$$

Example with Units

$$0.5875_{\text{W/cm}^2} = 0.47_{\text{A/cm}^2} \cdot 1.25_{\text{v}}$$

Evaluate Formula ↻



5) Net Kinetic Energy of Electron Formula ↻

Formula

$$Q_e = J_c \cdot \left(\frac{2 \cdot [\text{BoltZ}] \cdot T_c}{[\text{Charge-e}]} \right)$$

Example with Units

$$0.1094 \text{ W/cm}^2 = 0.47 \text{ A/cm}^2 \cdot \left(\frac{2 \cdot 1.4\text{E-}23/\text{K} \cdot 1350 \text{ K}}{1.6\text{E-}19\text{C}} \right)$$

Evaluate Formula ↻

6) Output Voltage given Anode and Cathode Voltages Formula ↻

Formula

$$V_{\text{out}} = V_c - V_a$$

Example with Units

$$0.27 \text{ V} = 1.25 \text{ V} - 0.98 \text{ V}$$

Evaluate Formula ↻

7) Output Voltage given Anode and Cathode Work Functions Formula ↻

Formula

$$V_{\text{out}} = \Phi_c - \Phi_a$$

Example with Units

$$0.27 \text{ V} = 1.42 \text{ V} - 1.15 \text{ V}$$

Evaluate Formula ↻

8) Output Voltage given Fermi Energy Levels Formula ↻

Formula

$$V_{\text{out}} = \frac{\epsilon f_a - \epsilon f_c}{[\text{Charge-e}]}$$

Example with Units

$$0.27 \text{ V} = \frac{2.87 \text{ eV} - 2.6 \text{ eV}}{1.6\text{E-}19\text{C}}$$

Evaluate Formula ↻

9) Overall Efficiency of Power Station Formula ↻

Formula

$$\eta_{\text{overall}} = \eta_{\text{thermal}} \cdot \eta_{\text{electrical}}$$

Example

$$0.276 = 0.3 \cdot 0.92$$

Evaluate Formula ↻

10) Power Output from Generator Formula ↻

Formula

$$P_{\text{out}} = V_{\text{out}} \cdot (J_c - J_a)$$

Example with Units

$$0.0567 \text{ W/cm}^2 = 0.27 \text{ V} \cdot (0.47 \text{ A/cm}^2 - 0.26 \text{ A/cm}^2)$$

Evaluate Formula ↻

11) Rankine Cycle Efficiency Formula ↻

Formula

$$\eta_R = \frac{W_{\text{net}}}{q_s}$$

Example

$$0.9958 = \frac{947.35}{951.37}$$

Evaluate Formula ↻

12) Thermal Efficiency of Power Station Formula ↻

Formula

$$\eta_{\text{thermal}} = \frac{\eta_{\text{overall}}}{\eta_{\text{electrical}}}$$

Example

$$0.3 = \frac{0.276}{0.92}$$

Evaluate Formula ↻



Variables used in list of Thermal Power Plant Formulas above

- **A** Emission Constant
- **CCP_{coal}** Consumption of Coal per Hour (Ton (Assay) (UK))
- **CV_{coal}** Calorific Value of Coal (Joule per Kelvin)
- **J** Current Density (Ampere per Square Centimeter)
- **J_a** Anode Current Density (Ampere per Square Centimeter)
- **J_c** Cathode Current Density (Ampere per Square Centimeter)
- **P_{out}** Power Output (Watt per Square Centimeter)
- **Q** Net Energy (Watt per Square Centimeter)
- **Q_e** Electron Net Energy (Watt per Square Centimeter)
- **Q_h** Heat Input per Hour (Joule per Kelvin)
- **q_s** Heat Supplied
- **T** Temperature (Kelvin)
- **T_c** Cathode Temperature (Kelvin)
- **V_a** Anode Voltage (Volt)
- **V_c** Cathode Voltage (Volt)
- **V_{out}** Output Voltage (Volt)
- **W_{net}** Net Work Output
- **εf_a** Anode Fermi Energy Level (Electron-Volt)
- **εf_c** Cathode Fermi Energy Level (Electron-Volt)
- **η_{electrical}** Electrical Efficiency
- **η_{overall}** Overall Efficiency
- **η_R** Rankine Cycle Efficiency
- **η_{thermal}** Thermal Efficiency
- **Φ** Work Function (Electron-Volt)
- **Φ_a** Anode Work Function (Volt)
- **Φ_c** Cathode Work Function (Volt)

Constants, Functions, Measurements used in list of Thermal Power Plant Formulas above

- **constant(s): [BoltZ]**, 1.38064852E-23
Boltzmann constant
- **constant(s): [Charge-e]**, 1.60217662E-19
Charge of electron
- **Functions: exp**, exp(Number)
n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.
- **Measurement: Weight** in Ton (Assay) (UK) (AT (UK))
Weight Unit Conversion 
- **Measurement: Temperature** in Kelvin (K)
Temperature Unit Conversion 
- **Measurement: Energy** in Electron-Volt (eV)
Energy Unit Conversion 
- **Measurement: Surface Current Density** in Ampere per Square Centimeter (A/cm²)
Surface Current Density Unit Conversion 
- **Measurement: Electric Potential** in Volt (V)
Electric Potential Unit Conversion 
- **Measurement: Heat Capacity** in Joule per Kelvin (J/K)
Heat Capacity Unit Conversion 
- **Measurement: Intensity** in Watt per Square Centimeter (W/cm²)
Intensity Unit Conversion 



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