

Evaluation of Flat Plate Solar Collector Parameters Experimentally

A flat plate solar collector of 2 m² absorber area was tested under various values of irradiance, working fluid inlet temperature and mass flow rate. The working fluid outlet temperature was measured. Take $c_p=4180 \text{ J/(kg } ^\circ\text{C)}$ and ambient temperature to be 10 °C and make use of the data in the following table to evaluate:

- 1- Collector efficiency at each reading.
- 2- Transmittance–Absorptance product.
- 3- Heat Removal Factor.
- 4- Overall Heat loss Coefficient.

Irradiance I_T (W/m ²)	Working fluid inlet temp. T_i (°C)	Working fluid outlet temp. T_o (°C)	Mass flow rate (kg/s)	Collector efficiency
715	25	31.64	0.035	
725	40	47.17	0.03	
745	55	61.84	0.025	
780	70	78.21	0.02	
810	85	92.75	0.015	

$$Q_u = F_R A_c [I_T \tau \alpha - U_L (T_i - T_a)] = \dot{m} c_p (T_o - T_i)$$

$$\eta_c = \frac{Q_u}{A_c I_T} = F_R \tau \alpha - F_R U_L \left(\frac{T_i - T_a}{I_T} \right)$$

$$\frac{d\eta_c}{d\left(\frac{T_i - T_a}{I_T}\right)} = -F_R U_L = -\frac{y}{x}$$

