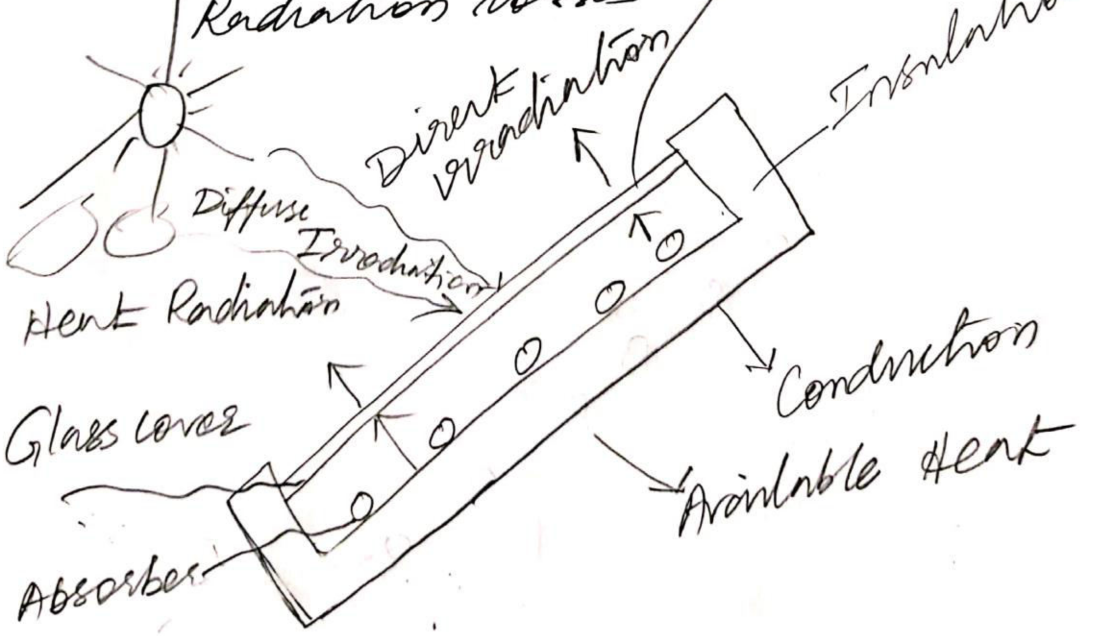
Heat transfer Processes and efficiency of a Solar Collector :-

Process involving:

- Conduction
- convection
- Radiation

Losses in the flat plate collectors occurring are:

- Reflection losses
- convection losses
- conduction losses
- Radiation losses



A fundamental concept of thermal analysis of any thermal system is the conservation of energy, which can be analysed through energy balance calculations under steady state conditions.

In steady state, the useful energy output of the collector is the difference between the absorbed solar radiation and the total thermal losses from the collector.

Useful energy = Absorbed solar energy − Thermal losses.

Obviously, the higher the useful energy output from a particular design, the higher the expected efficiency.

Thermal efficiency of the collector is an important parameter to consider in this kind of analysis as it creates the basis for comparison of different materials and modifications of collector system.

Efficiency

(i) Closed loop set-up for testing liquid flat plate collectors

$$\eta_i = \frac{q_u}{A_c I_T}$$

$$\eta_i = \dot{m} c_p \frac{(T_{fo} - T_{fi})}{A_c I_T}$$

$\dot{m}$ - Fluid flow rate
f_i - fluid inlet temp
f_o - Fluid outlet temp
I_T - Solar radiation incident on the collector plate.
T_a - The ambient temperature
V_∞ - Wind speed

(ii) Evacuated Tube collectors

$$\eta_i = 0.527 - 1.736 (T_{fi} - T_a) / I_T$$

Likewise the performance and η of specific collector depends on the design parameters and solar irradiation of the particular longitude.