1.Summary about The Convective Heat Transfer

Convection is the primary means of heat transfer in liquids and gases, and convection of gases is more pronounced than liquids. When using convection heating or cooling, two conditions must be met: one is that the material can flow, and the other is that the heating method must promote the flow of the material.

Convection can be divided into natural convection and forced convection: natural convection is the natural flow formed by the internal density or pressure change of the fluid due to the uneven temperature of the fluid. Forced convection is forced convection due to external forces or contact with hot objects.

Natural convection: winter indoor heating flow (radiator installed in the lower part), summer air conditioning (installed in the upper part), atmospheric flow, including wind, ocean upper layer high temperature water body and bottom low temperature water body exchange, boiling water process.

Forced convection: the operation of the hair dryer, the cooling principle of the fan inside the computer case, the pump inside the pond and the fish pond.

Controlling the convection of gases and liquids is the primary means of increasing or decreasing heat transfer. Opening doors and windows in summer can promote indoor and outdoor air convection to achieve heat dissipation. Close the doors and windows in winter to avoid indoor and outdoor air convection, to achieve warmth. Sometimes curtains are hung to prevent convective airflow from reaching the window, further reducing heat loss in the room.

The main factors affecting thermal convection are: temperature difference, thermal conductivity and thickness and cross-sectional area of the heat-conducting object. The greater the thermal conductivity, the smaller the thickness, and the more heat is transferred.

Why increasing the thickness of a single pane glass does not increase the total resistance?

The thermal conductivity of glass is very high, so the thermal resistance of glass is very small, which is one tenth of the thermal resistance of air convection. So although increasing the glass thickness can increase the thermal resistance of the glass, the effect on the total thermal resistance is minimal.

2.Write an explanation about what mistakes you made in the class.

The unit conversion error during calculation is because the basic calculation problem has not been done for a long time.

3.Solve the same probelm as that of double pane window with the air-gap thickness of 13 mm and glass thickness of 6 mm.

A=0.8*1.5=1.2m^2

$$R_{g1} = R_{g2} = \frac{L_g}{K_g * A} = \frac{0.006}{0.78 * 1.2} = 0.00641℃/W$$

$$R_{airgap} = \frac{L_{airgap}}{K_{airgap} * A} = \frac{0.013}{0.026 * 1.2} = 0.41667℃/W$$

$$R_{conv1} = \frac{1}{h_1 * A} = \frac{1}{10 * 1.2} = 0.08333℃/W$$

$$R_{conv2} = \frac{1}{h_2 * A} = \frac{1}{40 * 1.2} = 0.02083℃/W$$

$$R_{total} = R_g * 2 + R_{airgap} + R_{conv1} + R_{conv2} = 0.01282 + 0.41667 + 0.08333 + 0.02083 = 0.53365℃/W$$

$$\dot{Q} = \frac{\Delta T}{R_{total}} = \frac{20+10}{0.53365} = 56.21662W$$

$$T_1 = T_{\infty 1} - \dot{Q} * R_{conv1} = 20 - 56.21662 * 0.08333 \approx 15.3℃$$

$$T_4 = \dot{Q} * R_{conv2} + T_{\infty 2} = 56.21662 * 0.02083 - 10 \approx 1.7℃$$

Why we have an optimal range for the air-gap's distance?

Because when the thickness of the gas layer is increased to a certain extent, the gas will have a certain convection under the effect of the temperature difference between the glass, thereby reducing the effect of thickening of the gas layer.