1. Summary about The Convective Heat Transfer

Convective heat transfer is a transfer transfer phenomenon that occurs during the flow of a fluid, a transient that is perpendicular to the direction of fluid flow as the fluid flows as a laminar flow. Passing, mainly in the form of heat replacement (also weaker natural convection)

Feature:

(1) The complex heat transfer process that exists simultaneously with heat conduction and heat convection.

(2) There must be direct contact (fluid and wall) and macroscopic motion; there must also be a temperature difference.

Due to the different causes of flow, convection can be divided into two categories: forced convection and natural convection heat transfer. The causes of the two flows are different, and the velocity fields in the fluid are different, so the heat transfer law is different.

When the fluid has no phase change, the heat exchange in convective heat transfer is realized by the sensible heat change of the fluid; in the heat exchange process with phase change (such as boiling or condensation), the latent heat of the phase change of the fluid often plays a major role. Therefore, the heat transfer law is different from when there is no phase change.

During the laminar flow, the fluid micelles flow regularly along the main flow direction, and the turbulent flow is strongly mixed between the various parts of the fluid, so the heat exchange capacity is different.

The fluid density, dynamic viscosity, thermal conductivity, etc. not only have an effect on the flow of the fluid, but also on the heat transfer in the fluid, so the physical properties of the fluid have a great influence on the heat transfer of the fluid.

The geometric factors here refer to the shape and size of the heat transfer surface, the relative direction of the heat transfer surface and the movement of the fluid, and the state of the heat transfer surface (smooth or rough).

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

While the thickness increase, 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.

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

Unit was not converted while calculating, which caused a wrong answer.

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=1.2m2

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

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

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

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

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

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

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

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

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.