

## 1 The summary of convective heat transfer

Convective heat transfer, in other words heat convection, is one of the three ways of transfer heat. Different from conduction, heat convective transfer occurs in the fluid (such as gasses or liquids). There are two ways of heat convective according to the different reasons.

First one is a natural way. because of the different temperature, fluid has different density.

The fluid with high temperature is lighter than the cold, so the warm fluid would rise up and the cold sink down. for example, when we boiling a kettle of water, the water at the bottom will be heated at first .so the hot water will rise up ,and the cold water will come to the bottom, this process will repeat again and again until the whole kettle of water reach the same temperature.

The second is Forced Convection: It generates the movement of particles but not due to temperature difference and density, but by external elements. If we consider an outdoor environment, this factor may be wind; and indoors, a fan.

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

The thermal resistance of glass is a of a small value compared to the thermal resistance of convection between glass and air. Increasing the thickness of a single pane glass can increase the thermal resistance of the glass, but it does not significantly increase the total thermal resistance.

## 2 what mistakes you made

when I did the first exercise ,I converted 4 mm to 0.04m instead of 0.004m.

3 solve the same problem as that of double pane window with the air-gap thickness of 13 mm and glass thickness of 6 mm, comment on your results and explain why we have an optimal range for the air-gap's distance!

- $A = 0.8 * 1.5 = 1.2$
- $R_{g1} = R_{g2} = L/K*A=0.0064^{\circ}C/W$
- $R_{air}=L / K*A=0.4166^{\circ}C/W$
- $R_{conv1}= 1/h_1*A= 0.0833 ^{\circ}C/W$
- $R_{conv2}= 1/h_2*A=0.0208 ^{\circ}C/W$
- $R_{total}=0.0064*2+0.0833+0.0208+0.4166=0.5335^{\circ}C/W$
- $Q= \Delta T/ R_{total}= 56.23 W$
- $Q=T_{inf1}-T_{s1}/ R_{conv1} =56.23$

$$20- T_{s1}/0.0833=56.23$$

$$T_{s1}=15.31^{\circ} C$$

The air trapped between the two panes increase the total resistance of the window, so that less heat will be lost.