week2_TPletneva

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SUMMARY:

Convection is a heat transfer that happens within a fluid that is in motion (liquid or gas) or a solid surface and the fluid surrounding it (influenced by conduction). For instance, in a room the heat will move from warmer areas to cooler areas, creating circulation. Hotter areas of air (less dense)will rise above the cooler areas. This happens because of the difference in temperatures between the wall's inner surface and the air in the room.

There are two types of convection: Forced convection - where fluids are forced to move (e.g. hairdryer) and Natural convection - where fluids move in a natural way (e.g. cold air & hot air)

Convective heat transfer rate depends on several parameters:

- Temperatures
- Area
- Type of liquid or gas
- Speed of wind (forced convection)

WHY INCREASING THE THICKNESS OF A SINGLE PANE GLASS DOES NOT INCREASE THE TOTAL RESISTANCE:

The thermal resistance of glass is very low. It will make such a slight change, that will almost in no way affect the total resistance. The only parameter that can affect the heat resistance in that case is the air gap.

MISTAKES:

Left mm not converted to m, which resulted in the wrong answer.

SOLVING THE EXERCISE

Given the height and the wide of the layer we can assume its surface is the one of a rectangle, therefore:

A=0.8*1.5 --> A=1.2 m2

To respect the units given in both the convection and conduction coefficients we swift the lengths measurements from mm to m:

L1=0.006 m
L2=0.013 m

To determine the steady rate of heat transfer (Q dot) we can appreciate that the value mentioned above is our unknow so all the remaining parameters should be given or known. Analyzing the equation studied in class:

Q=(20-(-10))/Rtotal

Where:

Rtotal=1/(h1*A)+L1*2/(k1*A)+L2/(k2*A)+1/(h2*A)

Being k1 the conduction coefficient of the glass layer and k2 the conduction coefficient of the stagnant air space.

Rtotal=0.0833+0.0128+0.4167+0.0208

Rtotal=0.534 (°C/W)

Q=30/0.534 --> Q=56.222 W

Then, knowing Q dot to obtain the inner wall temperature we proceed:

Q=(20-T1)/Rair in
56.222*0.0833=20-T1 --> T1=15.317 °C

WHY WE HAVE AN OPTIMAL RANGE FOR THE AIR-GAP'S DISTANCE:

Because increasing the air gap will significantly reduce the thermal resistance of the window due to the emergence of natural convection inside the gap. Reducing the gap will also reduce the thermal resistance because the conductivity of the air gap will grow.