WEEK 3 - POJER

Task 1: In own words (which means in your own words) write a summary of the topics about radiative heat transfer we went through including the definitions of emissivity, absorptivity and reflectivity, the view factor, the heat exchange between two black surfaces, the heat exchange between the two gray surface and finally the definition of radiative resistances.

RADIATIVE HEAT TRANSFER ~ EMISSIVITY

Emissivity is the ratio of the radiation flux emitted per unit area on the surface of an object to the radiation flux emitted by the black body at the same temperature.
The specific emissivity varies with the dielectric constant, surface roughness, temperature, wavelength and observation direction and its value is between 0 and 1

~ REFLECTIVITY

Reflectivity is the amount of radiant energy reflected by an object as a percentage of the total radiant energy is called reflectivity.
Different objects have different reflectivity, which mainly depends on the nature of the object itself and on the wavelength of incident electromagnetic wave and incident angle.

~ ABSORPTIVITY:

A measure of a substance's ability to absorb light at a given wavelength expressed by symbol epsilon

## ABSORPTIVITY:

$$\alpha = \frac{\text{Absorbed radiation}}{\text{incident radiation}} = \frac{G_{abs}}{G} \quad 0<\alpha<1$$

## EMISSIVITY

$$\varepsilon = \frac{E \text{ the real one}}{E \text{ blackbody at that temperature}} = \frac{E \text{ the real one}}{\sigma T^4}$$

$$0 \leq \varepsilon \leq 1$$

## REFLECTIVITY

$$\rho = \frac{\text{reflected radiation}}{\text{incident radiation}} = \frac{G_{ref}}{G}$$

irradiation = $G$

## Influencing factors for ABSORPTIVITY

The size of the molar absorption coefficient is related to the properties of the substance to be measured, the solvent and the wavelength of light.
Molar absorption coefficient = constant of the substance
The absorption coefficient of light varies with the wavelength of light.
The higher the purity of monocromatic light, the larger the molar absorption coefficient

## VIEW FACTOR

The view factor, is a geometrical quantity correspon=ding to the fraction of the radiation leaving surface $i$ that is intercepted by the surface $j$.
It doesn't depend on the surface properties.
It's also called shape factor, configuration factor, and angle factor.

## HEAT EXCHANGE (black surfaces)

The heat exchange between two black surfaces refers, to the process in which one black surface emits radiation to another black surface and is completely absorbed, while the other black surface also emits radiation and is also completely absorbed by the first black surface. Can be expressed by a formula: A1Eb1F1-2-, -A2Eb2F2-1, (A represents the area of the black surface, Eb represents the amount of radiation emitted per unit area per unit time, F represents the view factor), and applying the reciprocity relation: A1F1-2 = A2F2-1, so:

$$\dot{Q}_{1\to 2} = A_1 \cdot F_{12} \cdot \sigma \left(T_1^4 - T_2^4\right)$$

## HEAT EXCHANGE (Grey surfaces)

The heat exchange between 2 gray surfaces absorbs and reflects only a portion of the radiation. A grey surface i emits radiation to another grey surface j that strikes surface i.

$$A_i J_i F_{i-j} - A_j J_j F_{j-i}$$

$A=$ area surface $J=$ radiation emitted per unit area per unit time

$F=$ view factor

A1F1-2 = A2F2-1 ... so:

$$\dot{Q}_{i\to j} = A_i \cdot F_{i-j} \cdot (J_i - J_j)$$

## RADIATIVE RESISTENCES

The radiative resistences is a value used to measure the loss resistance energy, and the loss energy is converted into heat radiation; the energy lost by the radiative resistance is converted into radio waves.

Task 2: Solve the last exemple you solved in the class (radiative heat exchange between two parallel plates) while considering the two emissivities to be 0,1, what can you conclude from the result?

- Find the net heat exchange between the surface 1 and 2 where $A1 = 1,5\ m^2$; $F_{12} = 0,01$; $T_1 = 298\ K$; $T_2 = 308\ K$, $\epsilon_1 = 0,1$; $\epsilon_2 = 0,1$ $\sigma = 5,67 \cdot 10^{-8}\ \frac{W}{m^2 \cdot K^4}$

$$\dot{Q}_{1\to2} = \frac{A_1 \sigma (T_1^4 - T_2^4)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1} =$$

$$= \frac{1,5 \cdot 5,67 \cdot 10^{-8} \cdot (308^4 - 298^4)}{\frac{1}{0,1} + \frac{1}{0,1} - 1} = 4,9821\ W$$

$$F_{12} = \frac{1}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1} = \frac{1}{\frac{1}{0,1} + \frac{1}{0,1} - 1} = 0,0526$$

The exemple solved in class:

$F_{12} = 0,01$

$$\dot{Q}_{1\to2} = A_1 \cdot F_{12} \cdot \sigma (T_1^4 - T_2^4) = 1,5 \cdot 0,01 \cdot 5,67 \cdot 10^{-8} \cdot$$
$$\cdot (298^4 - 308^4) = -0,9466\ W$$

$$\dot{Q}_{2\to1} = -\dot{Q}_{1\to2} = 0,9466\ W$$

We can see that when the value of emissivity increases the view factor will increase more obviously, and the value of radiative heat transfer will also increase significantly