Week 5

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TASK 1. 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 surfaces and finally the definition of radiative resistances.

Emissivity (ε). Measure of how much radiation is emitted in relation or in comparison to a black body where $0 \leq \varepsilon \leq 1$ where 1 is a black body.

Absorptivity (α). The amount by which an object absorbs radiation where $0 \leq \varepsilon \leq 1$; is applicable to both semi-transparent and opaque surfaces.

Reflectivity (ρ). The amount by which an object reflects radiation where $0 \leq \rho \leq 1$; is applicable to both semi-transparent and opaque surfaces.

View Factor (F). The emission generated by one object and received by the other and vice versa shown with the equation $A_i F_{ij} = A_j F_{ji}$.

Heat Exchange between 2 Black Surfaces. In black bodies, radiation heat transfer is simply $\dot{Q} = A\,F\,\sigma\,T^4$.

Heat Exchange between 2 Gray Surfaces. When an Incident Radiation (G) hits a gray surface, the radiation is partially absorbed, emitted, and reflected. The sum of the emitted and reflected radiation is called Radiosity (J).

Radiative Resistance. Similar to conduction and convection, it is the resistance by the medium as defined by the equation $R_i = \frac{1-\varepsilon_i}{A_i \varepsilon_i}$

TASK 2. Solve the last example 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?

Previous Example.

$$Q_{12} = \frac{A\alpha\,(T_1^4 - T_2^4)}{\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1}$$

$$\frac{Q_{12}}{A} = \frac{(5.67)(10^{-8})(800^4 - 500^4)}{\frac{1}{0.2} + \frac{1}{0.7} - 1}$$

$$\frac{Q_{12}}{A} = 3625.36\ W/m^2$$

With $\boldsymbol{\varepsilon = 0.1}$.

$$Q_{12} = \frac{A\alpha\,(T_1^4 - T_2^4)}{\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1}$$

$$\frac{Q_{12}}{A} = \frac{(5.67)(10^{-8})(800^4 - 500^4)}{\frac{1}{0.1} + \frac{1}{0.1} - 1}$$

$$\frac{Q_{12}}{A} = 1035.81\ W/m^2$$

Summary.

Emissivity is directly proportional to the heat exchange. The lower the emissivity, the lower the heat exchange per unit area.