Week 5

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Summary:

Emissivity:

Is the ability to measure the relative strength of a object surface in the form of radiation, where the black body's emissivity equals 1 and the emissivity of other objects is less than 1.

Absorpitivity:

The ratio of absorbed radiation to incident radian hitting a surface and is between 0 and 1.

Reflectivity:

Ratio of amount of radiation reflected by surface to inciden radiation that hit the surface. It depends on the wavelength of light, direction of the incident and reflected light, type of the material, chemical composition and structure of the material and state of the material.

View factor:

The fraction of radiation leaving a surface which is intercepted by the second surface. The factor is based on angle of leaving the first surface and angle of hitting the second surface.

Heat exchange between two black surfaces:

A black or ideal surface, will have not surface resistance, so radiosity and emissive power will be equal.

Heat exchange between two grey surfaces:

Grey bodies absorb a certain amount of radiation on the surface as well as reflect a portion of radiation off of the surface. If there are two surfaces, the reflected radiation of one object will be absorbed by the other object for a certain fraction and reflect the other radiation.

Radiation Resistance

It is the resistance of a specific medium or system to heat flow across its boundaries and depends on medium's geometric and thermal properties such as thermal conductivity.

Task 2:

$\epsilon_1 = \epsilon_2 = 0.1$

$R'_{total} = \frac{1}{0.1} + \frac{1}{0.1} - 1 = 19$

$\dot{Q}'_{12} = \frac{A\sigma(T_1^4 - T_2^4)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1} = A \times 5.67 \times 10^{-8} \times \frac{800^4 - 500^4}{\frac{1}{0.1} + \frac{1}{0.1} - 1} = 1035.72\ W/A$

$\epsilon_1 = 0.2, \quad \epsilon_2 = 0.7$

$R_{total} = \frac{1}{0.2} + \frac{1}{0.7} - 1 = 5.43$

$\dot{Q}_{12} = \frac{A\sigma(T_1^4 - T_2^4)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1} = A \times 5.67 \times 10^{-8} \times \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1} = 3624.68\ W/A$

When the emissivity of a surface is lower, the heat transfer is lower.