Stefan’s law

Created: Tuesday, 30 August 2011 05:11 | Published: Tuesday, 30 August 2011 05:11 | Written by Super User | Print

Introduction to Stefan’s law

What is Stefan’s Law?

Scientists had studied radiation even before the concept of a black body had emerged. From the studies, they concluded that the total energy E emitted per unit area per second is related to the absolute temperature T of the body. They even got an empirical relationship between E and T. Stefan’s law can also be applied to work out the temperature of the Earth.

The law states:

“The total radiant energy emitted E per unit time by a black body of surface A is proportional to the fourth power of its absolute temperature.”

$E \propto T^4$

or $E = \sigma AT^4$ σ = Stefan's const

For a body which is not a black body

$E = \varepsilon \sigma AT^4$ ε = emmisitivity of the Black Body.

Note: Emmisitivity and absorptive power have the same value.

Net loss of thermal Energy

If a body of surface area A is kept at absolute temp T in a surrounding of temperature $T_0 (T_0 > T)$, then the energy emitted by the body per unit time will equal:

$E = \varepsilon \sigma AT^4$

And the energy absorbed per unit time by the body will equal:

$E_0 = \varepsilon \sigma AT_0^4$

The net loss of thermal energy per unit time can then be represented as:

$?E = E - E_0 = ?? A[T^4 - T_0^4]$

Absorptive Power a:

The absorptive power of a body is defined as the fraction of the incidentradiation that the body absorbs.

$$\text{Absorptive Power a} = \frac{\text{Energy Absorbed}}{\text{Energy incident}}$$

Emissive Power E:

The emissive power of a body denotes theenergy radiated per unit time per unit area of the surface.

Emmisitivity E:

The emmisitivity of a surface is the ratio of the emissive power of the surface to the emissive power of the black body at that temperature.

$$E = \frac{\text{Emmisive Power of the surface}}{\text{Emmisive Power of the Black Body}}$$

Black Body:

A perfectly black body is one which completely absorbs all the radiations of whatever wavelengths are incident on it. No electromagnetic radiation passes through it and none are reflected. Because no light is reflected or transmitted, the object appears black. If a small window is opened into an oven, any light that enters the window has a very low probability of leaving without being absorbed. Conversely, the hole acts as a nearly ideal black-body radiator. This makes peepholes into furnaces good sources of blackbody radiation.

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Reference links:

- http://www.en.wikipedia.org/wiki/Radiation
- http://www.scienceworld.wolfram.com/physics/AbsoluteTemperature.html
- http://www.wisegeek.com/what-is-thermal-energy.htm

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