Convection and radiation

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In last issue's *calculation corner,*a simple 1-dimensional conduction calculation was described. This time, we look at the other two basic heat transfer processes, namely convection and radiation.

In actual applications with multiple heat sources with complicated geometries, the effect of each of these mechanisms on the heat transfer process can be quite difficult to calculate. However, for geometries that can be reasonably approximated by a plane with a low-profile heat source, the concept of an area-averaged heat transfer coefficient can be used to estimate the heat loss due to convection and radiation.

The heat, Q, removed from a surface is simply equal to:

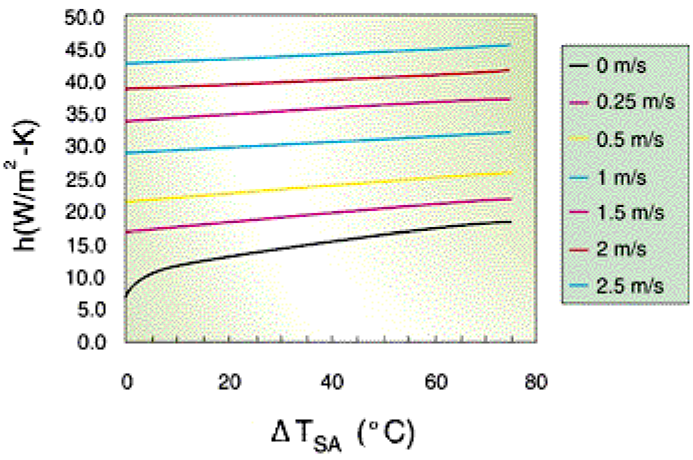
$$Q = A \times h \times \Delta T_{SA}$$

where A is the surface area, h is the heat transfer coefficient, and ΔT_{SA} is the temperature difference between the surface and the ambient air.

Rearranging the terms in this equation provides an expression for the thermal resistance for heat removal from the surface by convection and radiation, Θ_{SA}. In subsequent issues, we shall be applying this equation to more complicated heat transfer problems.

$$\Theta_{SA} = \Delta T_{SA} / Q = 1 / A \times h$$

The following graph offers a convenient means of estimating h as a function of ΔT_{SA} at various values of the forced air velocity from 0 to 2.5 m/s. These curves were calculated using values of h from a standard reference for a 75 mm sq. plate and include the effects of radiation. h is most dependent on ΔT_{SA} at 0 m/s (natural convection) and least dependent at the higher air velocities.



Reference

G.N. Ellison, Thermal Computations for Electronic Equipment, Krieger Publishing, Matabar, Florida, 1989.

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