Example 5.3.2

Calculate the solar transmittance at incidence angles of zero and 60° for two glass covers each 2.3 mm thick. The extinction of the glass is 16.1 m^{-1}, and the refractive index is 1.526.

Solution

For one sheet at normal incidence,

$$KL = 16.1 \times 2.3/1000 = 0.0370$$

The transmittance τ_a is given as

$$\tau_a(0) = \exp[-2(0.0370)] = 0.93$$

The transmittance accounting for reflection, from

$$\tau_r(0) = \frac{1 - 0.0434}{1 + 3.(0.0434)} = 0.85$$

(0.0434 → reflection from one surface; only reflection losses)

The total transmittance is then found from

$$\tau(0) = \tau_r(0).\tau_a(0) = 0.85.(0.93) = 0.79$$

$$\theta_1 = 60° \qquad \theta_2 = \sin^{-1}\left(\frac{\sin 60}{1.526}\right)$$

$$\theta_2 = 34.57°$$

$$\tau_a(60) = \exp\left(-\frac{2\,(0.0370)}{\cos 34.57}\right) = 0.91$$

and the total transmittance (with $\tau_r(60) = \frac{1}{2}\left[\frac{1-0.185}{1+3.(0.185)} + \frac{1-0.001}{1+3.(0.001)}\right]$ $\tau_r = 0.76$)

$$\tau(60) = \tau_r(60).\tau_a(60) = 0.76.(0.91) = 0.69$$