Thermique Environnement Matériaux Contrôle de Structures
Themacs Ingénierie

Thermal expertise,
Thermal characterisation of materials,
Specific instrumentation in the field of buildings,
structures and the environment

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What is SRI?

SRI is an index used to classify coatings (paints, plasters, etc.) according to their ability to resist heating up under solar radiation.

ASTM E1980 is the standardised method for calculating the Solar Reflectance Index (SRI). The SRI calculated in this way applies to opaque horizontal surfaces with a slight slope under standard conditions (sunlight, wind, etc.). The method is designed to calculate the SRI for surfaces with an emissivity greater than 0.1.

The principle consists of classifying coatings from 0 to 100. The theoretical equilibrium temperature of a black paint is calculated and assigned an index of 0, and a white paint is assigned an index of 100. The SRI is a classification proportional to the temperature of the coating under the same conditions.

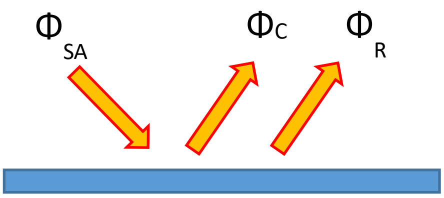
The reference white paint is a paint with an albedo of 80% (albedo is the proportion of solar flux reflected by the coating) and an emissivity of 0.9.

The reference black paint has an albedo of 5% and an emissivity of 0.9.

To calculate the SRI, we therefore need to know the albedo, which is the solar reflection factor (calculated according to the ASTM E903 standard, for example), as well as the thermal emissivity, a property that determines heat exchange through radiation.

Calculation procedure:
Assumption:
The ambient air temperature is 310K, or 33°C.
The radiation temperature of the sky T_{Sky} is set at 300K, or 23°C
The solar flux is set at 1000 W/m2.

The surface exchanges energy with the environment:



The surface absorbs part of the solar flux: $\Phi_{SA} = \alpha \cdot \Phi_S$
Φ_{SA} is the solar flux absorbed per unit area in W/m2.
Φ_S is the total solar flux per unit area in W/m2 (Φ_S = 1000 W/m2).
Φ_C is the flux exchanged by convection with the ambient air in W/m2
Φ_R is the flux exchanged by radiation with the environment in W/m2
α is the solar absorption factor: α=1-a where a is the albedo.

The surface exchanges heat by convection with the ambient air:

$$\Phi_C = h_C \cdot (T_S - T_A)$$

T_S is the surface temperature,T_A is the ambient air temperatureh_C is the convective exchange coefficient in W/K/m2.
Φ_C is the convective heat flux per unit area in W/m².

h_CThe SRI is calculated for three wind conditions. This gives three different R-value values:

Wind speed	0 to 2 m/s	^{2} to 6 m/s	6 to 10 m/s
h_C (W/K/m²)	5	12	30

The results of the calculations must be provided for the three wind conditions. The SRI varies little with wind speed for coatings with high emissivity.

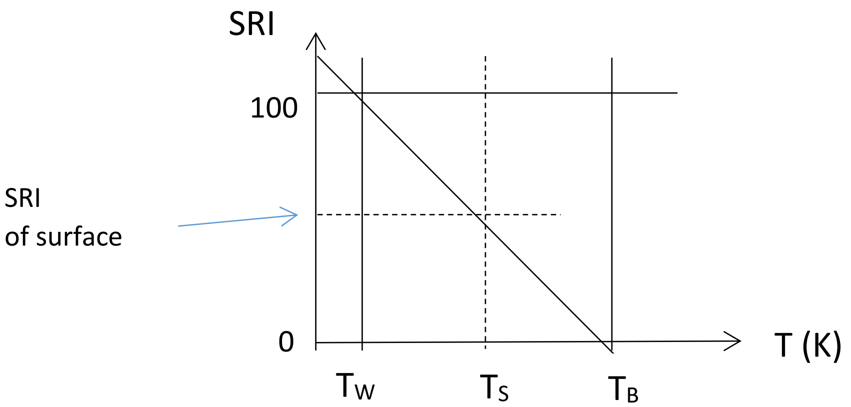
Radiative exchanges are deduced from Stefan-Boltzmann's law:

$$\Phi_R = \varepsilon \cdot \sigma \cdot (T_S{}^4 - T_{Sky}{}^4)$$

The temperature of the surface under study is determined by solving the following equation:

$$\Phi_{SA} = \Phi_C + \Phi_R$$

After calculating the temperature of the surface under study T_S, the black reference surface T_B and the white reference surface T_W , the SRI can be deduced:



The SRI can therefore be calculated as follows:

$$SRI = \frac{T_B - T_S}{T_B - T_W}$$

PLEASE NOTE! The SRI may exceed 100 for paints that are more reflective than standard white paint, and may even be negative for black or very low-emissivity coatings (such as metals, for example).