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REPORT

29 October, 2010

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Your order:		4500003406 dated 05.10.2010
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Subject of investigation:		Determination of the SRI value of two samples.
ZAE co-workers involved:		Dipl.-Ing. M. Arduini-Schuster, Dr. J. Manara.
Number of	**Pages:**	9
	Figures:	4
	Tables:	1

1 Aim of the Investigation

The aim of the investigation is to measure the spectral directional-hemispherical reflectance R_{dh} of two samples (Fatrafol P916 RAL 9003 and Fatrafol 810/V RAL 9010) in the wavelength region between 0.25 µm and 35 µm. From R_{dh} the solar reflectance R_{solar} and the thermal emittance ε_{IR} are calculated and the SRI value (Solar Reflectance Index = SRI) is determined.

2 Theoretical Background

2.1 Determining the spectral reflectance R_{dh} and the spectral transmittance T_{dh}

First, the spectral directional-hemispherical reflectance R_{dh} and transmittance T_{dh} of the samples were measured at ambient temperature by an integrating sphere (Fig. 1). The spectral emittance ε_λ can be calculated from the spectral directional-hemispherical reflectance R_{dh} and transmittance T_{dh}:

$$\varepsilon_\lambda = 1 - R_{dh} - T_{dh} \quad . \tag{1}$$

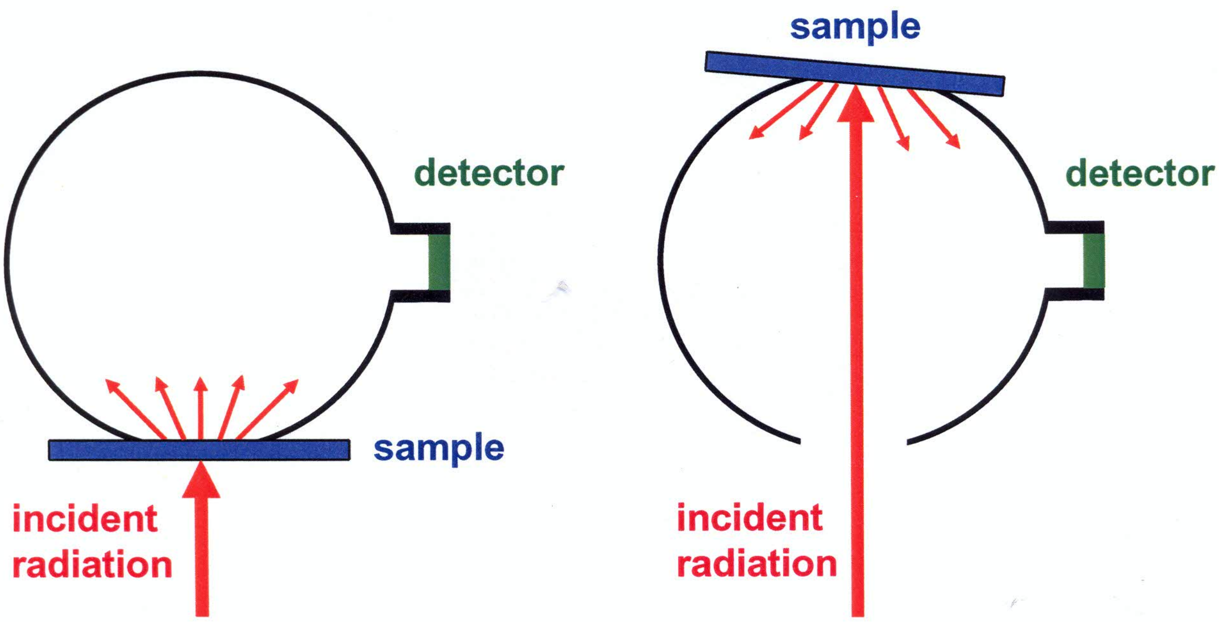

Fig. 1: Measurement of the directional-hemispherical transmittance T_{dh} (on the left side) and the directional-hemispherical reflectance R_{dh} (on the right side) with an integrating sphere.

The samples were measured with one FTIR-spectrometer from Bruker in the wavelength range between 1.4 µm and 35 µm. The thermal emittance ε_{IR} was then derived from the spectral emittance ε_λ as described in Chapter 2.2.

The wavelength range between 0.25 µm and 2.5 µm is covered by a diffraction spectrometer from Perkin Elmer. The solar reflectance R_{solar} was derived from the spectral reflectance R_{dh} as described in Chapter 2.3.

2.2 Determining the thermal emittance ε_{IR}

The thermal or infrared emittance ε_{IR} gives the amount of thermal radiation that is absorbed by the surface. The thermal absorbance is equal to the thermal emittance ε_{IR} and gives the total amount of thermal radiation at ambient temperature, which is emitted or absorbed by a surface. The thermal emittance ε_{IR} with respect to the temperature T can be calculated by integrating the spectral emittance ε_λ over all wavelengths with the Planck-function $i_\lambda(T)$ as a weight function:

$$\varepsilon_{IR} = \alpha_{IR} = \frac{\int_{1.4}^{35} \varepsilon_\lambda(T) \cdot i_\lambda(T) \cdot d\lambda}{\int_{1.4}^{35} i_\lambda(T) \cdot d\lambda} \quad . \tag{2}$$

The Planck-function $i_\lambda(T)$ gives the intensity emitted by a black body at a certain temperature T. At room temperature, the wavelength range between 1.4 µm and 35 µm is significant.

Besides the normal thermal emittance ε_{IR} (= total emittance normal to the surface) it is also possible to determine the hemispherical thermal emittance ε_h (= total emittance for the hemisphere in front of the surface) in accordance with DIN EN 12898 or ASTM E1585-93.

2.3 Determining the solar reflectance ρ_{solar}

The solar reflectance ρ_{solar} is calculated by integrating the spectral reflectance R_{dh} over all wavelengths with the solar radiation onto the soil s_λ as weight function:

$$\rho_{solar} = \frac{\int_{0.3}^{2.5} R_{gh} \cdot s_\lambda \cdot d\lambda}{\int_{0.3}^{2.5} s_\lambda \cdot d\lambda} \quad . \tag{3}$$

The calculations are done in accordance with DIN EN 410 or ISO 9050.

3 Results

The spectral reflectance R_{dh} and transmittance T_{dh} of the investigated samples are depicted in Fig. 2 and Fig. 3 as a function of the wavelength. The solar reflectance ρ_{solar} of the samples is shown in Tab.1.

The spectral emittance ε_{λ} of the investigated samples is depicted in Fig. 4 as a function of the wavelength. The resulting hemispherical thermal emittance ε_{IR} of the samples at ambient temperature ($T = 300$ K) is given in Tab. 1 as well as the SRI-values for medium wind conditions (12 W m^{-2} K^{-1}) according to ASTM E 1980-01.

Tab. 1: Solar reflectance ρ_{solar}, thermal emittance ε_{IR} and SRI-values of the Fatrafol samples.

sample number	**solar reflectance ρ_{solar}**	**hemispherical thermal emittance ε_h at $T = 300$ K**	**SRI wind 12**
1: P916 RAL 9003	0.82 ± 0.02	0.89 ± 0.02	103
2: 810/V RAL 9010	0.86 ± 0.02	0.89 ± 0.02	108

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