

**Solar Reflectance Index
of Snow White Calcite**

A Report to: Coloured Aggregates Inc.
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1.0 INTRODUCTION

A sample of white stone was submitted by Coloured Aggregates Inc. for measurement of solar reflectance and thermal emissivity, and for the calculation of the Solar Reflectance Index.

The sample consisted of a single piece of white opaque rock. The sample was sliced in two as shown in Figure 1, so that one surface could be measured. The measured surface was the flat surface of the smaller of the two pieces. The measured surface was flat, with slight roughness due to saw marks, and was diffusely reflecting. The sample was assigned the following Sample Number.

Client Identification
Snow White Calcite

Bodycote Sample Number
07-08-0518-2



Figure 1: Photo of the test sample. The measured surface is the flat surface on the smaller piece.

2.0 PROCEDURE

2.1 Measurement of Solar Reflectance per ASTM E903-96(Withdrawn)

The flat cut surface of the sample was placed against the measurement port of Cary 5000 UV-VIS-NIR Spectrophotometer S/N EL0427203, fitted with an integrating sphere attachment, and set up to make specular-included reflectance measurements. The Cary 5000 was set in accordance with ASTM E903-96, and the spectral reflectance was measured. The solar-weighted reflectance was then calculated from the spectral reflectance measurements using the weighted ordinates method of ASTM E903-96. The results are listed in Section 3.1 of this report.

2.2 ASTM E408-71(2002) Method A Measurement

A Gier Dunkle DB-100 IR reflectometer (MII #B05652, calibrated before use) was used to measure total normal IR reflectance of the sample. The measurements were made on the flat smooth cut surface of the sample.

Six measurements of IR reflectance were made. The total normal thermal emissivity of the sample was calculated by subtracting the average total normal IR reflectance from 1.0.

The conversion of the measured total normal thermal emissivity to total hemispheric thermal emissivity was done according to the method described in the text by Siegle and Howell¹. For a smooth flat surface with total normal emissivity of 0.89, the ratio of total hemispheric emissivity to total normal emissivity is 0.94. Therefore, the total hemispheric emissivity was estimated by multiplying the measured total normal emissivity by the factor 0.94. The result is summarized below in Section 3.2.

A **deviation from ASTM E408-71(2002)** that we followed was that, while the reference IR reflectance standard disk that we used to calibrate the instrument before each use has been measured by Gier Dunkle, that measurement of the IR reflectance of that disk is not traceable to national standards.

2.3 ASTM E1980-01 Calculation

The Solar reflectance Index (SRI) of the white stone was calculated for three different values of wind convection coefficients (5, 12 and 30 $\text{W}\cdot\text{m}^{-2}\cdot\text{K}^{-1}$), in accordance with ASTM E1980-01. The results are listed below in Section 3.3.

3.0 RESULTS

3.1 ASTM E903-96 Results for Solar Reflectance

The measured spectral reflectance is plotted in Figure 2, along with the calculated solar-weighted reflectance. The solar reflectance was calculated to be **0.638**. The estimated total uncertainty of this measurement, as stated in the ASTM E903-96 test method is “ ± 3 to 4 % for the bias of the measured solar optical property for a particular site over a year’s average”.

¹ Siegel and Howell: *Thermal Radiation Heat Transfer*, McGraw-Hill, 1972.

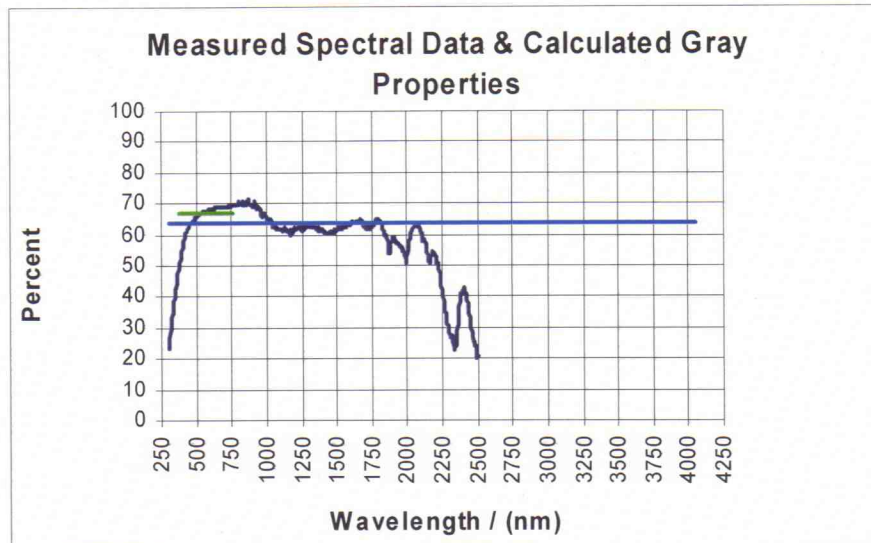


Figure 2: Plot of the spectral reflectance of the sample as a function of wavelength of light. The long flat blue line represents the solar-weighted reflectance. The short green line represents the visual reflectance, calculated to be 67.2%.

3.2 ASTM E408-71 (2002) Method A Emissivity Results

The six measurements of IR reflectance ranged from 0.112 to 0.114, with an average of 0.113. Subtracting the average IR reflectance from 1.00 yielded a total normal emissivity of 0.89 for this material. Applying the method described above in Section 2.2 for conversion to hemispherical emissivity, the calculated total hemispherical emissivity is **0.834**. The estimated uncertainty of this figure is ± 0.050 .


3.3 ASTM E1980-01 SRI Calculation Results

Using the value of solar reflectance 0.638 from Section 3.1 above and the results of thermal emissivity 0.834 from Section 3.2 above, the following SRI values were obtained.

Table 1: Calculated SRI Values

Wind Convective Coefficient	SRI
5 W.m ⁻² .K ⁻¹	74
12 W.m ⁻² .K ⁻¹	75
30 W.m ⁻² .K ⁻¹	76

Reported and Approved by:


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This report refers only to the particular samples, units, material, instrument, or other subject used and referred to in it, and is limited by the tests and/or analyses performed. Similar articles may not be of like quality, and other testing and/or analysis programs might be desirable and might give different results.

REGISTRATION

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