

Countermeasure technique against heat island phenomenon - Evaluation of solar reflective paint material -

In recent years, solar reflective material attracts attention as one of remarkable countermeasure technique against heat island phenomenon and as sustainable household building material. These cutting edge sustainable materials have been evaluated by an independent organization as Environmental Technology Verification Project under Ministry of the Environment and its evaluation criterion is in process to be studied and to be established as standard regulation in JIS*.

There is solar reflective paint material as sustainable material which has been approved by JIS* regulation, As shown in Fig.1, solar light has significant energy in near IR region. This solar reflective paint material has specific capability to reflect NIR region light of solar with higher efficiency than the other general paint materials. This capability reduces thermal energy on surface to penetrate into buildings, helping to improve an efficiency of air conditioner and contributes to saving energy.

* JIS : Japanese Industrial Standard

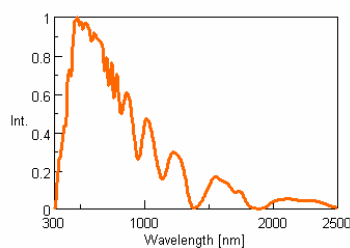


Fig. 1 Standard solar intensity

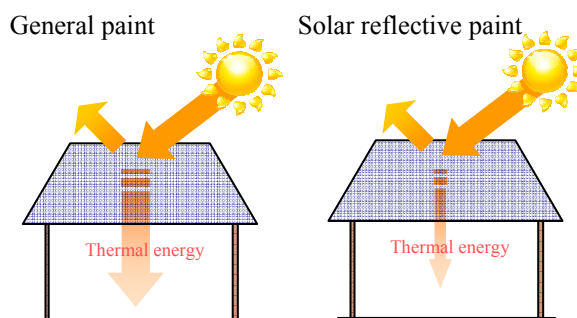


Fig. 2 Conduction of solar thermal energy

In this Application Note, some example of evaluation about solar reflective paint material based on JIS K5602 is explained.

System configuration

V-670 UV/VIS/NIR Spectrometer
ISN-723 60 mm dia. Integrating sphere (UV/VIS/NIR)
Standard white plate for integrating sphere

Measurement/ Analysis programs

VWST-774 Solar/visible light measurement program
VWCD-790 Color diagnosis program



Fig. 3 Integrating sphere unit

Sample

Two aluminum plates were painted by both general water paint and solar reflective material paint in two different colors such as Gray and Red and dried completely for 7 days.

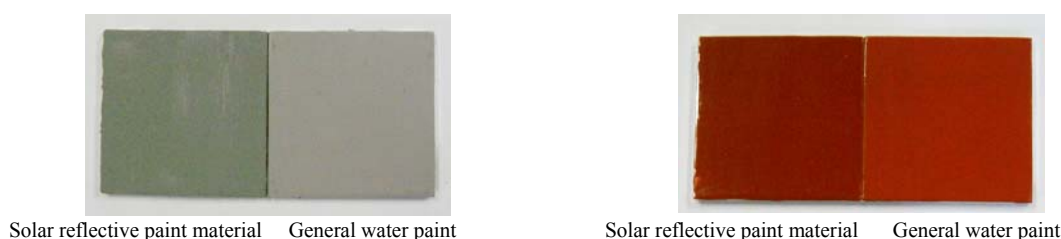


Fig. 4 Sample surface (Left : Gray / Right : Red)

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1: Spectral measurement result

Diffuse reflectance of samples was measured using [Spectral measurement] program under measurement condition shown in Table 1. By comparing the results shown in Fig. 5, it is known that the solar reflective material paint has remarkably higher reflectance in NIR region than general water paint material.

Table 1 Measurement condition

Measurement range	300 - 2500 nm
Data interval	1 nm
UV/Vis bandwidth	5.0 nm
NIR bandwidth	20.0 nm
Response	Fast
Scan speed	1000 nm/min
Correction	Base line / Dark

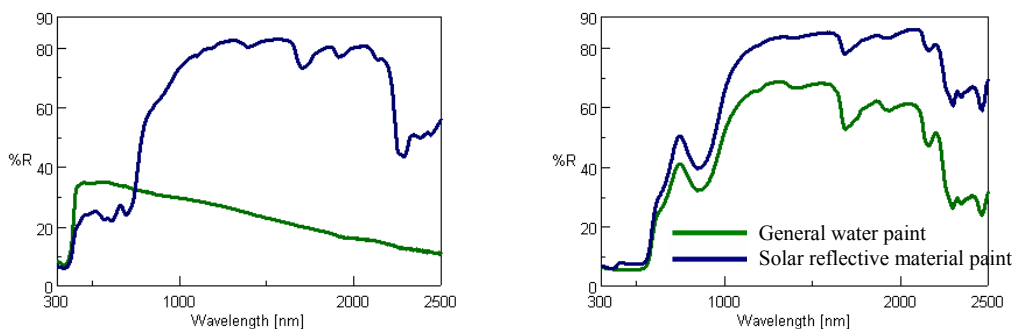


Fig. 5 Diffuse reflectance spectra of solar reflective paint material and general water paint

2: Color Analysis result

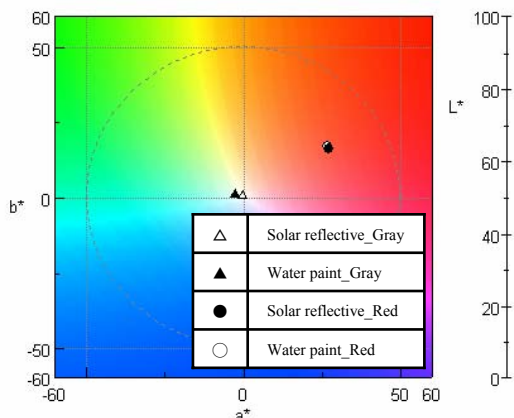


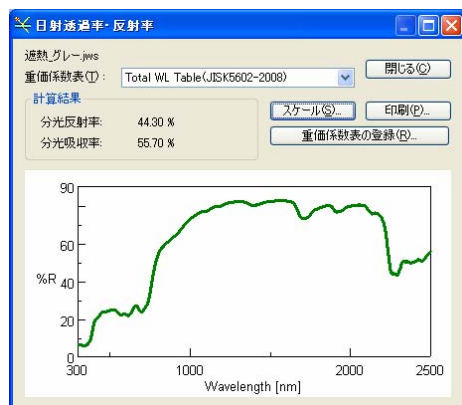
Fig. 6 Chromaticity diagram

By using the spectra obtained, the color analysis of both different paint materials was implemented using Color Analysis program and the results are shown in Fig. 6, indicating the very similar color positions for both Gray and Red on chromaticity diagram.

Even colors of two kinds of paint material are quite similar, the characteristics are completely different.

Spectral measurement in UV/Vis/NIR region is a very useful method to obtain various important information to investigate such differences.

3: Calculation result of reflectance of solar light



Reflectance of solar light in three different wavelength ranges was calculated using Solar/visible light measurement program based on JIS K5602. It is clearly seen that solar reflective paint material has higher reflectance in all wavelength region and in NIR region.

	Gray		Red	
	Solar reflective	Water paint	Solar reflective	Water paint
UV/Vis region	24.09	32.19	21.67	17.60
NIR region	70.39	26.68	64.98	50.61
All wavelength region	44.30	29.75	40.53	31.95

Fig. 7 Calculation result of reflectance of solar light