COLORSTEEL® MAXX® and reflectivity

DEFINITIONS

The sun emits energy across a wide range of wavelengths, from ultraviolet rays (typically less than 400nm), visible light (400 – 800nm) to infrared (greater than 800nm). While the majority of the sun's energy reaches the earth as visible light or infrared rays, a small amount is ultraviolet. These are the rays that cause sunburn and ultimately break down a wide variety of materials, including paints.

The colour of an object is determined by its ability to absorb or reflect visible light. Equally, objects can absorb or reflect solar energy in the ultraviolet and infrared spectrums. The temperature an object reaches when exposed to solar radiation is determined by its ability to absorb or reflect solar energy and the surrounding ambient temperature.

To determine the Total Solar Reflectance (TSR) of COLORSTEEL® MAXX® prepainted steel colours, BlueScope Steel's research laboratories exposed a sample of each colour to a full range of wavelengths between 250nm and 2500nm and measured the reflectance at each ½nm step. Solar weighting factors from ASTM E981-87 were then applied to each measurement to obtain a TSR figure.

Light Reflectance Value (LRV) is an alternative reflectance measure. It refers to the total quantity of visible light that when illuminated by a light source is reflected by a surface in all directions and at all wavelengths. LRV runs on a scale from 0% (absolute black) to 100% (perfectly reflective white) with all other colours fitting within these extremes. With a LRV of 0%, black absorbs all light; white, on the other hand, has a light reflectance of 100% and absorbs no light.

To obtain the LRV of COLORSTEEL® MAXX® prepainted steel colours, a full range of wavelengths between 4W0nm and 800nm (the range visible to the human eye) were measured with a spectrophotometer and were then weighted using the CIE Standard Observer methodology.

WHY HAVE TWO MEASURES?

At first glance, these two measurements appear to be referring to the same thing; however they are used for two quite different purposes. LRV focuses solely on visible light and consequently is an indicator of how the human eye sees a colour. It's also a good measure of a colour's brightness.

TSR measures the amount of solar energy across the entire spectrum that is reflected away from an object. This correlates closely to the temperature that the object will reach on a hot summer's day.

It is therefore possible to have colours that look the same and have the same or similar Light Reflectance Values but reach quite different temperatures in the sun. Similarly you could have two colours where one looks darker than the other but both reach the same temperature, when exposed to the sun.

INFRARED (IR) REFLECTANCE TECHNOLOGY AND ENERGY SAVINGS

Over 50% of the sun's energy falls within the infrared spectrum and cooler temperatures can be achieved on hot summer days by reflecting this unseen energy away from the painted surface of the roof.

BlueScope Steel (New Zealand Steel's parent company) and its suppliers have developed a range of pigments that reflect a larger proportion of the sun's energy in the near infrared region. This technology has been incorporated into New Zealand Steel's COLORSTEEL® MAXX® paint systems[1].

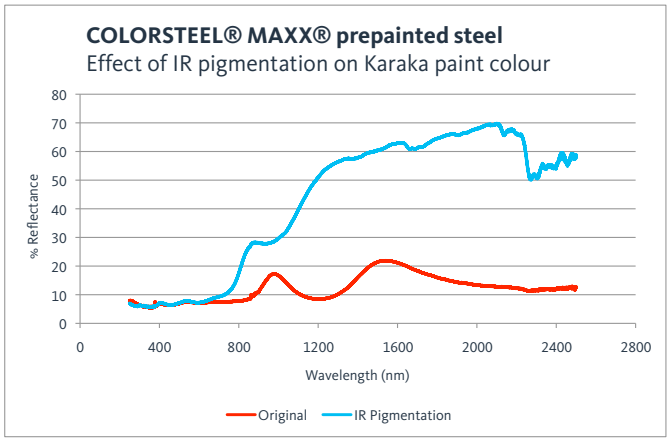

Figure 1 Shows the effect of IR pigmentation on Karaka coloured COLORSTEEL® MAXX® paint. In the visible 400 – 800nm range the two reflectance curves match each other but in the non-visible infrared range (above 800nm) the IR pigmentation reflects a significant amount of energy. The Total Solar Reflectance in Karaka paint has increased from 10% to 25%.

IR technology enables popular dark COLORSTEEL® MAXX® colours like Karaka and Ironsand to remain visually identical while providing a significantly cooler roof surface on hot summer days. The technology is available in every standard COLORSTEEL® MAXX® colour (excluding Ebony) although the effect varies with colour and the greatest increase in TSR is shown in the darkest colours.

SUMMER SAVINGS

During summer months, when the sun is high in the sky for long sunlight hours, high levels of solar energy land on a roof. Depending on a building's details, this can result in a large amount of heat radiating into the building often requiring the use of electric cooling systems.

IR technology enables a reduction in roof temperature, particularly in darker colours, that potentially moderates the temperature of the internal environment, reducing cooling costs by up to 20% compared to roofing materials of similar colour with low solar reflectance.

Depth of colour has a major impact on a roof's heat. Although IR technology has a marked effect on the summer temperatures of darker roofs, specifying a light coloured roof will provide a much greater impact. However, building design and insulation also has a major impact on the internal environment.

The Metal Roofing Manufacturers' (MRM) Code of Practice provides the following approximate temperatures that a lightweight metal roof will reach on a hot summer's day in New Zealand:

COLOUR DEPTH/INSULATION	DEGREES CELSIUS
Insulated dark colour	80°
Insulated light colour	60°
Uninsulated dark colour	65°
Uninsulated light colour	50°

In situations where preference or local regulations dictate a darker colour, the use of COLORSTEEL® MAXX® with IR reflectance technology will successfully lower roof temperatures on hot summer days. Research undertaken by BlueScope Steel in Australian conditions indicates that on a hot, sunny day IR technology can reduce the temperature of a COLORSTEEL® prepainted steel sheet by up to 8°, depending on the depth of colour.

WINTER WARMTH

In winter, there is less warming of a roof because the sun is lower in the sky, the cloud cover is greater and the daylight hours are shorter. Therefore, the effect of IR reflectance technology is greatly reduced.

LRV VALUES RECOMMENDED TO MEET ENVIRONMENTAL BUILDING REQUIREMENTS

In their district plans or guidelines many local authorities now incorporate restrictions around the reflectivity of roofing and cladding materials. Restrictions are generally applied to sensitive areas like coastal or other visually attractive or notable landscapes and are principally designed to preserve the natural amenity and character of the area and to reduce the impact of the building environment. To ensure compliance to these restrictions, LRV will provide the best measure of visible reflectance.

DISCLAIMER:

EFFECT OF SOLAR RELECTANCE ON STANDARD COLORSTEEL® PREPAINTED STEEL

ENDURA®	TOTAL SOLAR REFLECTANCE %	LIGHT REFLECTANCE VALUE %
Azure	24	17
Bone White	56	53
Cloud	69	74
Desert Sand	51	48
Ebony	7	5
Grey Friars	12	10
Gull Grey	56	50
Ironsand	10	7
Karaka	10	7
Lichen	38	27
Lignite	13	10
Mist Green	40	25
New Denim Blue	13	11
Pacific Blue	23	14
Permanent Green	24	10
Pioneer Red	36	12
Rivergum	33	18
Sandstone Grey	35	27
Scoria	20	10
Smooth Cream	68	71
Stone	43	34
Storm Blue	28	9
Titania	65	67
Terracotta	44	22

MAXX®	TOTAL SOLAR REFLECTANCE %	LIGHT REFLECTANCE VALUE %
Ebony	7	5
Foam	70	75
Gable Green	23	14
Grey Friars	26	10
Indigo Blue	24	11
Ironsand	25	8
Ivorie	58	53
Karaka	25	8
Kelp	25	11
Maple	38	12
Mirage	23	15
New Denim Blue	26	12
Sandstone Grey	38	27
Smokey	40	28
Sorrell	34	16
Spring Green	31	21
Straw	56	42
Titania	64	67
Thunder Grey	29	12

1. Ebony cannot be produced with solar reflectance technology due to its pigment composition.
2. Results depend on level of insulation, building shape and function. Average reduction is approximately 5%.

For more information about COLORSTEEL® prepainted steel call 0800 100 523, visit colorsteel.co.nz or email us at info@colorsteel.co.nz.