Mercury Environment and Ageing Analysis

Customer:

Aurubis
Our Copper for your Life

Aurubis Finland Oy
FI-28100 Pori
Finland

Research Contract:

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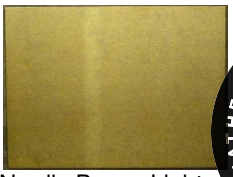
AurubisJuhola__ta131111HS.pdf

Target:

Nordic Brown Light sample 15x21 cm²



Nordic Brown Light

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SOSIFI®
COLOUR

Testing time:

Start of the Test: 18th of May, 2009
End of the Test: 8th of July, 2009
Total test hours 1000h

The Purpose of the Test:

To test the long term endurance of the sample to solar radiation and humidity with corrosive elements of sulphur.

Test Method:

Solar radiation: 1500 W/m² (simulated solar radiation, UV+VIS+IR)
Black plate temperature: 80°C during radiation, 30°C during water spray
Test cycle: 20h of radiation and 4h of pH5 water mist at 30°C
Water spray: tap water with H_2SO_4 (pH5)
Test hours: 1000 h
Optical analysis: The colour and gloss of the samples are measured at an interval of 168 hours

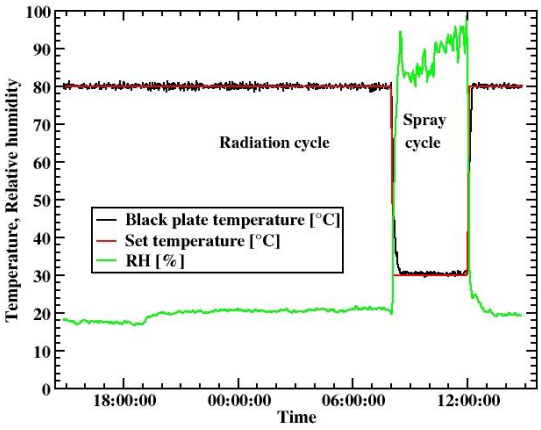
Validation of test method:

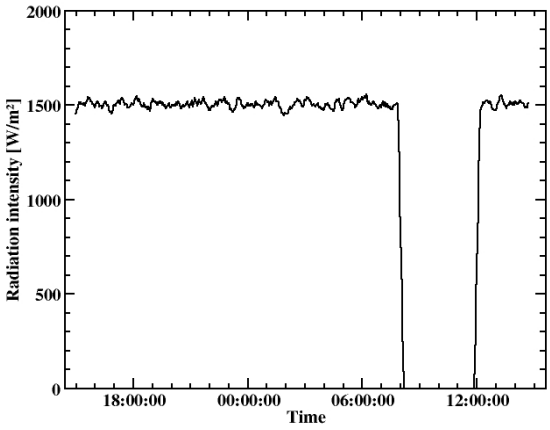
The temperature of a black surface on a roof can be around 70 - 80°C on a sunny day. The maximum solar radiation during a sunny day onto a surface can be around 1100 W/m². Higher radiation intensities accelerate the degrading effects of solar radiation. However, the surface temperature of the samples should be kept by fans at around 80°C.

Nowadays the amount of sulphur is diminishing in the atmosphere. However, at industrial surroundings the amount of sulphur can be remarkable and thus he rain can be acidic. As the sprayed water was used tap water made acidic (pH5) by a few drops of H_2SO_4.

Performed actions:

The 24 h test cycle was as 20 h of solar radiation and 4 h of pH5 tap water spray. The spray liquid was made increasing few drops of H2SO4 to tap water. The mean intensity of solar radiation was 1500 ± 100 W/m². The mean black plate temperature was 80 ± 2°C during solar radiation cycles and 29 ± 2°C during water spray cycles. The samples were situated on test stands at an angle of 45°. Some of the sprayed liquid stayed on the sample stands which caused degradation of those edges of the samples. The black plate temperature, set temperature and relative humidity in the test chamber during one 24 hours cycle are in the figure on the left. On the right is the figure of a 24 h cycle radiation intensity.





Test chambers were controlled and functioned by Mitsubishi PLC.
Solar radiation: Kipp&Zonen CM11, calibrated 11th June, 2007, calibration is valid
Photodiode, calibrated 18th May, 2009, calibration is valid
Temperatures: PT100, calibrated 19th February, 2009, calibration is valid
Relative humidity: HTM1735, calibrated 19th February, 2009, calibration is valid

The accuracy of the radiation measurement was ± 1.5 %.
The accuracy of the temperature measurement was ± 0.5 %.
The accuracy of the humidity measurement was ± 3.0 %.

Luna Optical Analysis

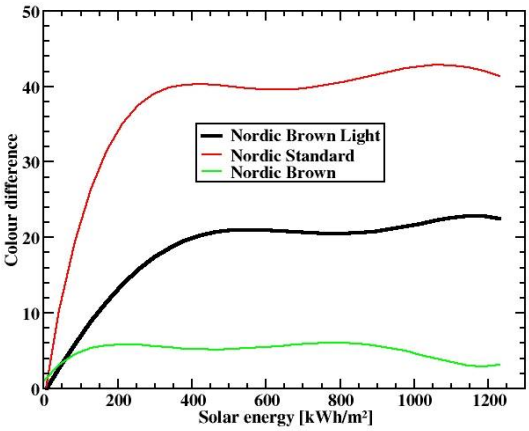
The L*a*b* colour coordinate values and gloss values of the samples were measured. The reflected specular component from the samples is included in the L*a*b* values. The colour difference DE represents the Eucledian distance between two colours.

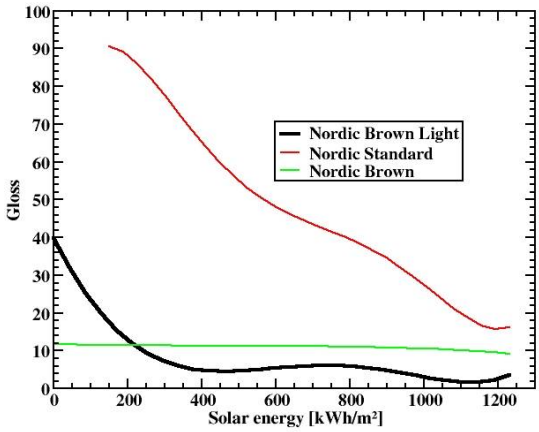
The colour difference DE compared to the original colour coordinates and glosses are figured. The accuracy of the colour and gloss measurements was ± 2.0 %.

L*-coordinate indicates the lightness of the sample. The bigger the value the lighter the sample.
+a*-coordinate indicates the red direction and -a* indicates the green direction.
+b*-coordinate indicates the yellow direction and -b* indicates the blue direction.

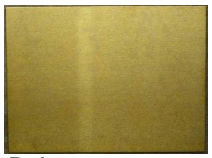
Under ideal viewing conditions a DE value of 1 represents a just perceptible colour difference to the human eye. However, the human eye sees differently colour differences in different colours. The differences in darker colours are more perceptible to the eye.

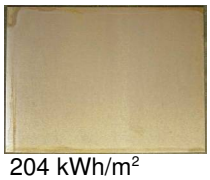
Conclusions:

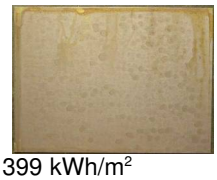


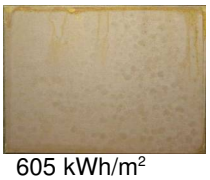


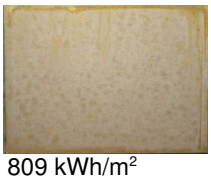
Nordic Brown Light:

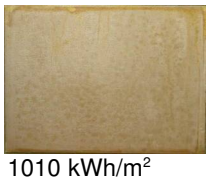

Before test


204 kWh/m²


399 kWh/m²


605 kWh/m²


809 kWh/m²


1010 kWh/m²


1224 kWh/m²

Location	Corresponding time for radiation of 1224 kWh/m² [years]
Northern Europe	1.3
Southern Europe	0.7

Remarks:

Actions, operations and reporting are in accordance with IEC/ISO 17025 'General requirements for the competence of testing laboratories'.

Signatures:

Littoinen

Timo Oksa
5th of August, 2009

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