Uranus Comparative Analysis

Customer:

Okram Oy
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Target:

Sample 29: TM-7742, Väritiimi Petrooliöljymaali uusi C-pohja
Sample 31: TM-7411, Väritiimi Petrooliöljymaali uusi C-pohja
Sample 35: TM-7821, Väritiimi Petrooliöljymaali uusi C-pohja

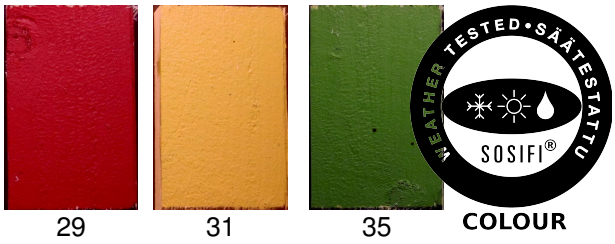

Fig. 1. *Samples under test, photographed before the exposure. The test samples were 3 paints, painted on boards. The size of a board was 29.7 cm × 7.0 × 2.2 cm.*

Purpose of the test:

To get information of the colour and gloss changes of the paints when under natural solar radiation.

Test method:

The test method is based on standard ISO 4892-3:2006(E), Method A (artificial weathering), Cycle No. 1.
The cycle consists of 20 hours exposure to UV light irradiation with an irradiance of 60 W/m^2 at the temperature of 60°C and 4 hours of condensation in dark at the temperature of 50°C. The cycle is repeated until the total test duration of 1000 h is reached.
Colour and gloss measurements are performed after 0 h, 500 h, and 1000 h of exposure.

Validation of the test method:

The amount of UV-radiation from the sun is about 60 W/m^2 and the surface temperatures can rise especially in darker paints under direct solar radiation to 60 – 70°C. In this test the effect of the visual and infra-red radiation of the sun is not tested. However, UV-radiation is often the main reason for the degradation of the paints.

Research Contract:

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Testing time:

The start of the test: 25th of September, 2012
The end of the test: 8th of November, 2012

Performed actions:

The samples were mounted into sample holders and then placed into the test chamber. The sample holder partly covers the surface from radiation, the rectangular area exposed to the radiation was 9.5 cm × 6.3 cm.

The test cycle was 20 h of UV radiation at the black plate temperature of 60°C and 4 h of condensation in dark at the temperature of 50°C. The cycle was repeated until the total time of 1000 h was reached.

Spectrum of the used UV-lamp and that of the sun are in Fig. 2 (a). The mean UV-radiation intensity was 60 W/m^2 and thus the total UV-energy incident onto the samples was 50 kWh/m^2. In Fig. 2 (b), the conditions during the test cycle are described.

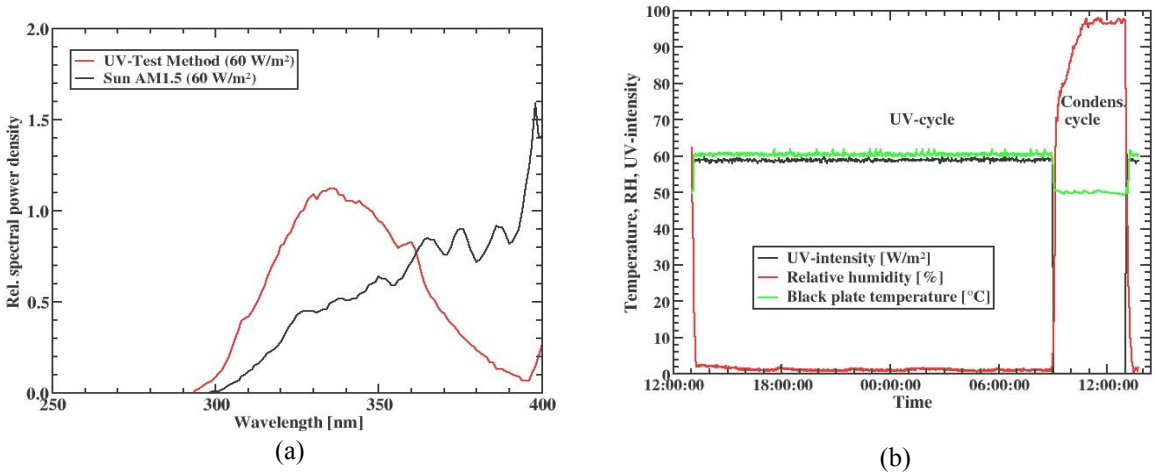

Fig. 2. *(a) Spectrum of the used UV-lamp and that of the sun. (b) Schematic of the intensity of UV-radiation, temperature, and relative humidity during the exposure cycle.*

Used equipment:

QUV Test chamber, No. 43
UV-radiation: No. 43 / Photodiode, calibrated 14th of February, 2012, calibration is valid
Temperature: No. 43 / TBlackPlate, calibrated 14th of February, 2012, calibration is valid
Relative humidity: No. 43 / RH, calibrated 14th of February, 2012, calibration is valid
Colour: No. 8, calibration is made before every measurement session, calibration is valid
Gloss: No. 10, calibration is made before every measurement session, calibration is valid

The colour and gloss measurements were performed before the exposure (0 h), at half-way (500 h), and after the exposure (1000 h). The degradation of the paints was quite insignificant and can hardly be seen from images taken after 1000 h in Fig. 3.

Fig. 3. Upper row: *Samples imaged before the exposure (0 h).* ***Lower row:*** *Samples imaged after 1000 hours of the exposure. Samples from left: 29, 31, and 35.*

Radiation correspondence:
The mean UV radiation energy in Southern Finland during one year is 54 kWh/m² onto a horizontal surface and 47 kW/m² onto a south facing vertical surface. Thus at this test the total UV-energy of 50 kWh/m² corresponds to 1.1 years of UV-energy onto a vertical surface in Southern Finland. However, the continuously high surface temperature and nearly continuous UV-radiation accelerate the test and one can approximate that the test correspond to 2 – 2.5 years in Southern Finland.

Luna Optical analysis

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

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 ΔE 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.

The SCI (Specular Component Included) colour differences, ΔE, and the residual glosses of the samples as a function of UV energy are shown in Fig. 4. The residual gloss depicts the change in gloss. A value of 100 is given to the original gloss and the other glosses are given in relation to that.

Specific information of the colour changes of the samples can be found from Table 1, where the *L**-, *a**-, and *b**-coordinates and the gloss values, measured before and after the exposure, are given.

Table 1. *L*a*b** coordinate (SCI) and gloss values before and after the exposure.

Sample No.	Before				After			
	L*	***a****	***b****	**Gloss**	***L****	***a****	***b****	**Gloss**
29	40.12	33.95	20.05	3.1	38.98	32.34	20.60	2.1
31	68.80	5.30	36.53	4.3	67.47	5.69	35.34	3.7
35	48.59	-11.20	19.71	4.5	46.39	-10.41	20.20	2.1

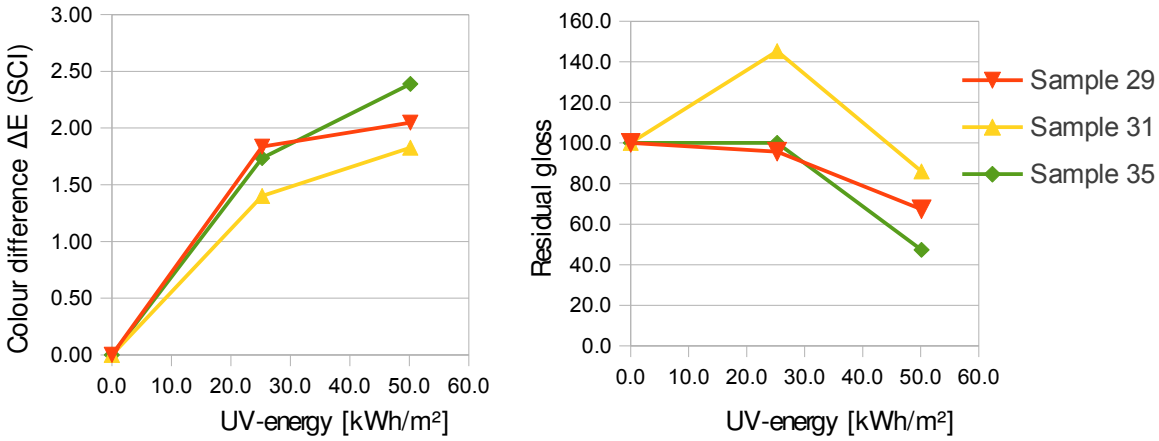

Fig. 4. *Left: colour difference ΔE (SCI) and right: residual gloss as a function of UV-radiation energy.*

Conclusions:

The stress to the samples was UV-radiation, heat, and moisture.

The colour changes ΔE (from SCI) and residual glosses of the samples, induced by the stress, are summarized in Table 2.

Table 2. Colour changes ΔE (SCI) and residual glosses of the samples.

Sample	ΔE	Residual gloss
No. 29 TM-7742, Väritiimi Petroolioljymaali uusi C-pohja	2.05	67.4
No. 31 TM-7411, Väritiimi Petroolioljymaali uusi C-pohja	1.83	85.9
No. 35 TM-7821, Väritiimi Petroolioljymaali uusi C-pohja	2.39	47.4

Remarks:

Document history: This Executive Summary -report reviews the test reports *OkramSuomi__tr190912HS.pdf* and *OkramMikola__tr090413RP.pdf.*

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

Signatures:

Riitta Perälä
Littoinen, April 11th, 2013

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