Uranus Comparative UV Analysis

Customer:

Okram Oy
Virtasen Maalitehdas
Parainen

Target:

Sample 1: Virtasen 4 Öljyn Laatumaali C-pohja Teknoksen TS-pastalla sävytettynä
Sample 2: Virtasen 4 Öljyn Laatumaali C-pohja Teknoksen TO-pastalla sävytettynä
Sample 3: Virtasen 4 Öljyn Laatumaali C-pohja Teknoksen TL-pastalla sävytettynä
Sample 4: Virtasen 4 Öljyn Laatumaali NANO C-pohja Teknoksen TS-pastalla sävytettynä
Sample 5: Virtasen 4 Öljyn Laatumaali NANO C-pohja Teknoksen TO-pastalla sävytettynä
Sample 6: Virtasen 4 Öljyn Laatumaali NANO C-pohja Teknoksen TL-pastalla sävytettynä
Sample 7: Virtasen 4 Öljyn Laatumaali Wanha Punainen tehdassävy (rautaoksidipigmentti)
Sample 8: as a reference: perinteinen pellavaöljymaali Teknoksen TS-pastalla sävytettynä
Sample 9: Virtasen 4 Öljyn A-pohja sävy EXT-TV-9612

Fig. 1. *Samples under test, photographed before the exposure. The test samples were 9 paints, painted on boards. The size of a board was 29.7 cm × 7.0 cm × 2.2 cm.*

The 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 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 before the test (0 h), after 500 h, and at the end of the test (1000 h). The test method is based on standard ISO 4892-3:2006(E), Method A (artificial weathering), Cycle No. 1.

Validation of 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:

ref.no: OkramHolmstrom__ta110612HS.pdf
ref.no: OkramSuomi__ta070912HS.pdf

Testing time:

The start of the test: 20th of June, 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 (see Fig. 3).

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 (on the left). 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, the conditions during the test cycle are described, too.

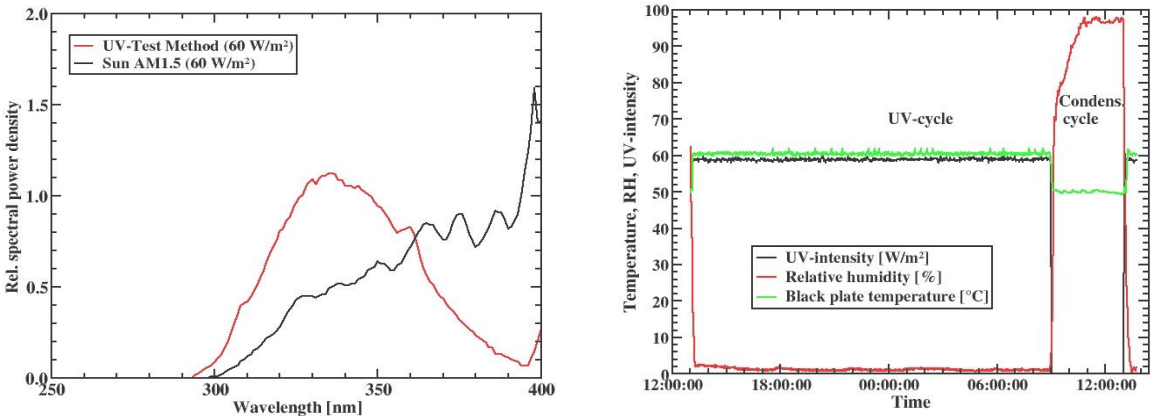

Fig. 2. Left: *Spectrum of the used UV-lamp and that of the sun.* ***Right:*** *Schematic of the intensity of UV-radiation, temperature, and relative humidity during the exposure cycle.*

Used measuring equipment:

UV test chamber, No. 43
UV-radiation: No. 43 / Photodiode, calibrated 21st of February, 2012, calibration is valid
Temperature: No. 43 / TBlackPlate, calibrated 21st of February, 2012, calibration is valid
Relative humidity: No. 43 / RH, calibrated 21st 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 some of the paints can be seen from images taken after 500 h, Fig. 3, and after 1000 h, Fig. 4. The appearance of samples No. 1, 2, 3, and 8 has changed most remarkably after 500 hours, and after 1000 hours also sample 7 shows clear changes.

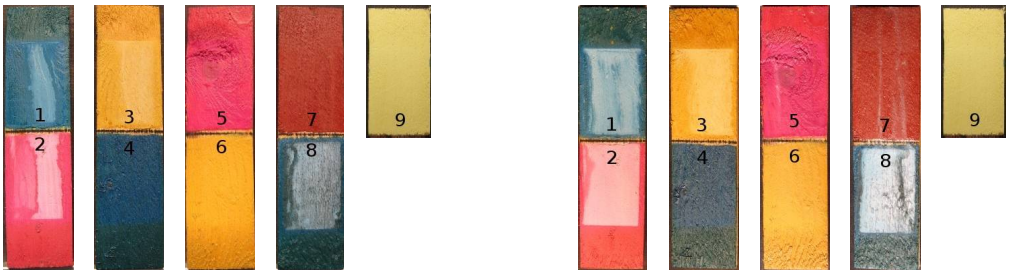

Fig. 3. Left: *Samples imaged after 500 hours of exposure. Some of the samples, No. 1, 2, 3 and 8, have clearly visible signs of degradation.* ***Right:*** *Samples imaged after end of the exposure, i.e. after 1000 hours. The signs of degradation have become more apparent than after 500 hours. The rectangular area exposed to radiation can be distinguished from the non-radiated surface for example for samples No. 1 and 2.*

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. A value of 100 is given to the original gloss. For sample 7, the measurement was done from the major area showing only moderate changes.

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. In addition, the $L^*a^*b^*$ coordinate and the gloss values measured after the exposure from the degraded area for sample 7.

Table 1. The *L*a*b** coordinate and the gloss values before and after the exposure.

Sample No.	Before				After			
	L*	***a****	***b****	**Gloss**	***L****	***a****	***b****	**Gloss**
1	47.33	-20.06	-27.49	4.8	61.77	-17.38	-19.14	1.5
2	54.86	39.84	-5.36	7.8	73.48	19.99	-8.86	2.1
3	69.30	12.95	45.76	4.5	73.55	6.11	26.96	2.1
4	41.91	-17.48	-23.48	2.1	34.01	-11.19	-14.60	2.4
5	50.18	44.30	1.60	10.1	42.04	35.56	2.43	4.4
6	67.67	17.94	50.92	6.9	61.14	16.67	44.74	4.1
7	36.45	21.77	13.88	2.2	35.31	22.51	14.35	3.0
8	44.25	-19.36	-25.08	8.7	63.03	-12.49	-12.46	1.7
9	83.76	4.38	35.66	4.9	82.62	5.02	35.84	3.8

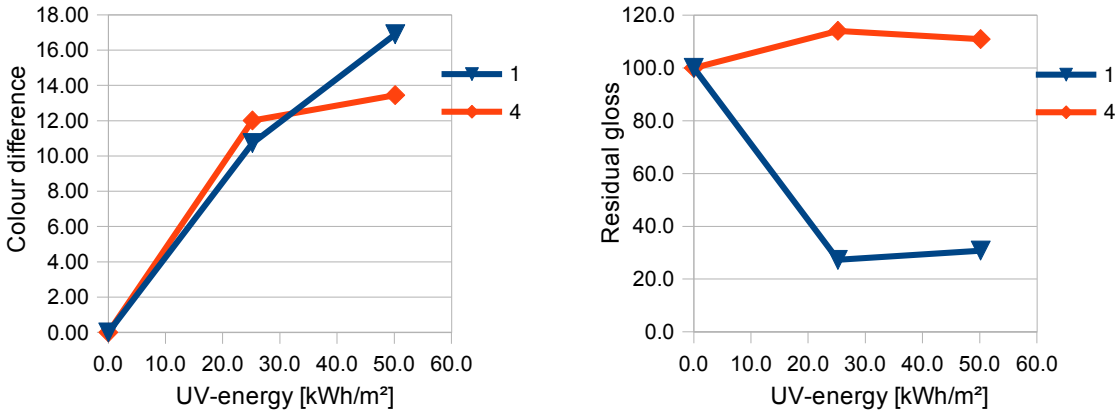

Fig. 4. *To be continued.*

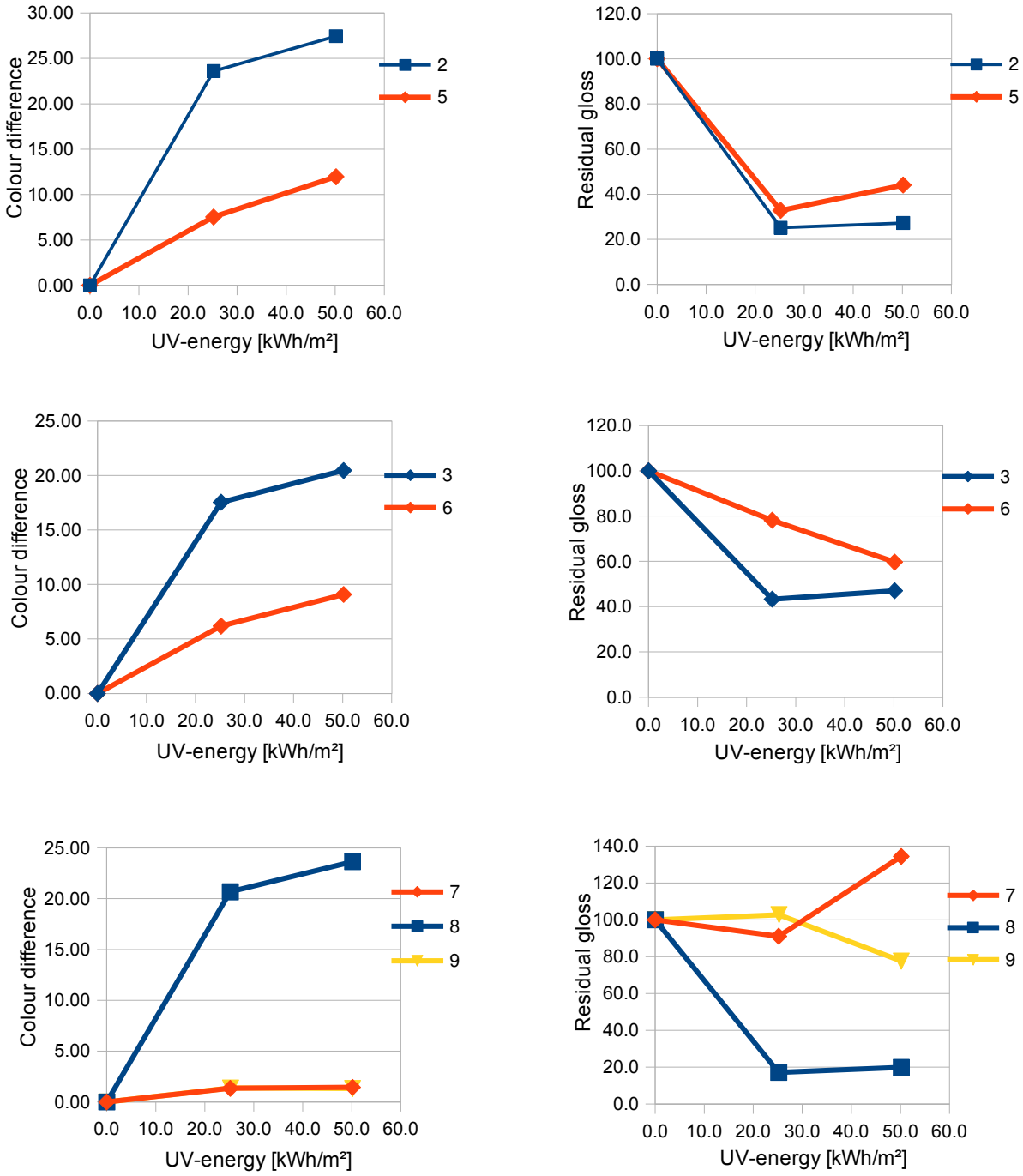

Fig. 4. *Left: colour difference ΔE (SCI) and right: residual gloss as a function of UV-radiation energy. Please note that the colour difference for samples 7 (red curve) and 9 (yellow curve) is almost equal, and therefore, the curves are one on the other in the figure.*

Conclusions:

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

The colour changes ΔE (from SCI) and residual glosses for the samples are shown in the table.

Sample	ΔE	Residual gloss
No. 1 Virtasen 4 Öljyn Laatumaali C-pohja Teknoksen TS-pastalla sävytettynä	16.89	30.8
No. 2 Virtasen 4 Öljyn Laatumaali C-pohja Teknoksen TO-pastalla sävytettynä	27.44	27.2
No. 3 Virtasen 4 Öljyn Laatumaali C-pohja Teknoksen TL-pastalla sävytettynä	20.46	47.0
No. 4 Virtasen 4 Öljyn Laatumaali NANO C-pohja Teknoksen TS-pastalla sävytettynä	13.45	110.9
No. 5 Virtasen 4 Öljyn Laatumaali NANO C-pohja Teknoksen TO-pastalla sävytettynä	11.97	44.0
No. 6 Virtasen 4 Öljyn Laatumaali NANO C-pohja Teknoksen TL-pastalla sävytettynä	9.08	59.7
No. 7 Virtasen 4 Öljyn Laatumaali Wanha Punainen tehdassävy (rautaoksidipigmentti)	1.44	134.3
No. 8 as a reference: perinteinen pellavaöljymaali Teknoksen TS-pastalla sävytettynä	23.64	19.9
No. 9 4 Öljyn A-pohja sävy EXT-TV-9612	1.32	77.6

Remarks:

Document history: This Executive Summary -report reviews the test reports *OkramHolmstrom__tr230812RP.pdf* and *OkramSuomi__tr190912HS.pdf*.

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

Signatures:

Hannu Suokivi
Littoinen, 12th of November, 2012

WEATHER TESTED • SÄÄTESTATTU
SOSIFI®
COLOUR