

## Mercury Environment and Ageing Analysis

**Customer:**

 **Aurubis**  
Our Copper for your Life

Aurubis Finland Oy  
FI-28100 Pori  
Finland

**Research Contract:**

LuvataJuholata180509HS.pdf  
AurubisJuhola\_\_ta131111HS.pdf

**Target:**

Nordic Blue Living sample 15x21 cm<sup>2</sup>



**Testing time:**

Start of the Test: 18<sup>th</sup> of May, 2009  
End of the Test: 8<sup>th</sup> 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/m<sup>2</sup> (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<sub>2</sub>SO<sub>4</sub> (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:**

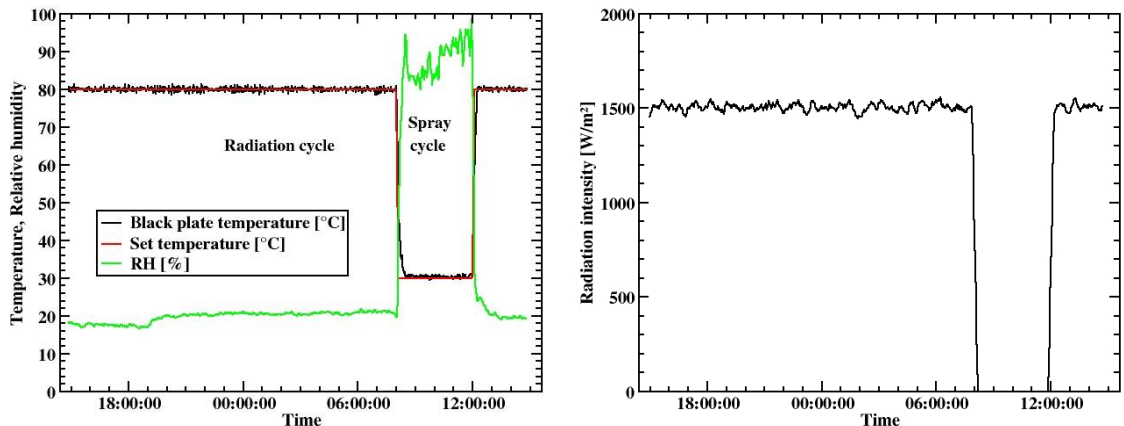
The temperature of a black surface on a roof can be around 70 - 80 °C on a sunny day. The maximum solar radiation during a sunny day onto a surface can be around 1100 W/m<sup>2</sup>. Higher radiation intensities accelerate the degrading effects of solar radiation. However, the surface temperature of 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 the rain can be acidic. As the sprayed water was used tap water made acidic (pH5) by a few drops of H<sub>2</sub>SO<sub>4</sub>.



## 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 H<sub>2</sub>SO<sub>4</sub> to tap water. The mean intensity of solar radiation was  $1500 \pm 100$  W/m<sup>2</sup>. The mean black plate temperature was  $80 \pm 2^\circ\text{C}$  during solar radiation cycles and  $29 \pm 2^\circ\text{C}$  during water spray cycles. The samples were situated on test stands at an angle of  $45^\circ$ . 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 11<sup>th</sup> June, 2007, calibration is valid

Photodiode, calibrated 18<sup>th</sup> May, 2009, calibration is valid

Temperatures: PT100, calibrated 19<sup>th</sup> February, 2009, calibration is valid

Relative humidity: HTM1735, calibrated 19<sup>th</sup> February, 2009, calibration is valid

The accuracy of the radiation measurement was  $\pm 1.5\%$ .

The accuracy of the temperature measurement was  $\pm 0.5\%$ .

The accuracy of the humidity measurement was  $\pm 3.0\%$ .

## 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 Euclidian 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  $\pm 2.0\%$ .

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.

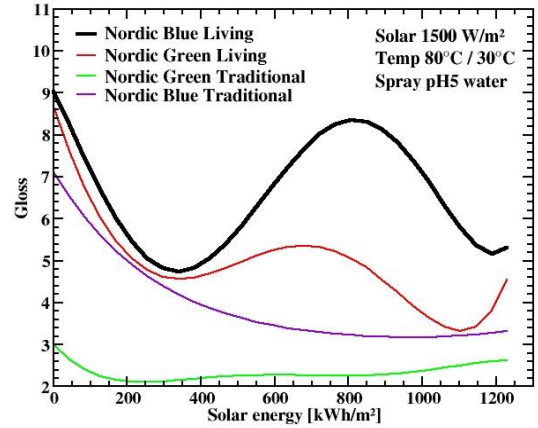
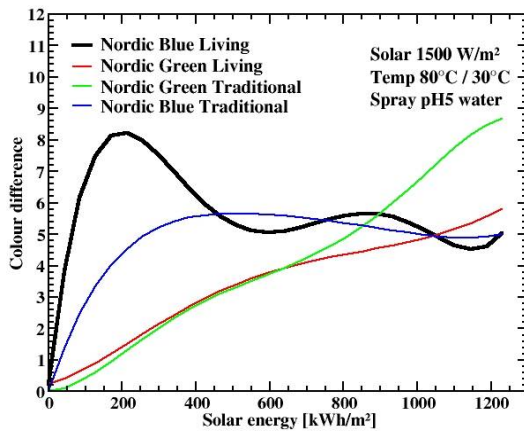
Under ideal viewing conditions a DE value of 1 represents a just perceptible colour difference to the human eye. However, the human eye sees differently colour differences in different colours. The differences in darker colours are more perceptible to the eye.



# Solar Simulator

Solar Simulator Finland Ltd.

## Conclusions:



## Nordic Blue Living:



Before test



204 kWh/m<sup>2</sup>



399 kWh/m<sup>2</sup>



605 kWh/m<sup>2</sup>



809 kWh/m<sup>2</sup>



1010 kWh/m<sup>2</sup>



1224 kWh/m<sup>2</sup>

Location	Corresponding time for radiation of 1224 kWh/m <sup>2</sup> [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  
5<sup>th</sup> of August, 2009

