Report

Testing of colour resistance for Rapido Tynnpuss (thin finishing mortar)

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The name of Rapido Tynnpuss is today RVL

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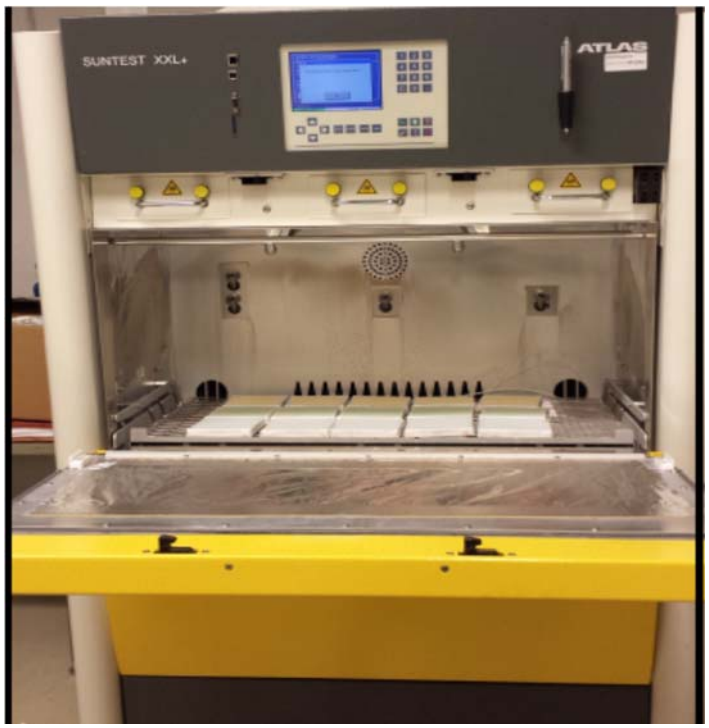

SINTEF Building and Infrastructure
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Abstract
SINTEF Building and infrastructure has, on behalf of RVL Products AS, performed tests on Rapido Tynnpuss (thin finishing mortar) to document the colour resistance for the product before and after ageing. The testing was carried out in Suntest XXL+ (laboratory accelerating ageing device) according to the procedures in ISO 4892-2. Mercury spectrophotometer and a digital colour imaging system (DigiEye) were used to measure the rate of discolouration of the specimens before, during and after ageing. The goal with the testing was to simulate 30 years exposure in Norwegian climate. Results and a summary is given in chapter 5.

Conclusion
After 90 days of ageing of Rapido Tynnpuss (Yellow, Green and Blue specimens), SINTEF assess that the total colour change, ΔE*, is small (ΔE*<10).

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1. Introduction

SINTEF Building and infrastructure (SINTEF) has, on behalf of RVL Products AS performed tests on Rapido Tynnpuss (thin finishing mortar) to document the colour resistance for the product before and after ageing.

2. Test specimens

The accelerated ageing test was carried out for three different test series where each series exists of five different specimens. Each test series had different mortar colour, respectively Yellow, Green and Blue. The specimens were made by the client, sent to SINTEF, and arrived at our laboratory at 25th of February 2014. The specimens were given arrival number 34-14.

3. Laboratory testing

The test specimens were exposed to durability testing in Suntest XXL+ (laboratory accelerating ageing device) according to the procedures in ISO 4892-2. The method describes an ageing period of three months that can be estimated to about 30 years exposure in Norwegian climate.

4. Evaluation method

Mercury spectrophotometer and a digital colour imaging system (DigiEye) were used to measure the rate of discolouration of the specimens before, during and after ageing. The change in colour during ageing is described using the CIELab colour system, which represents each colour by means of three dimensional colour space:

- L* represents the lightness, which extends from 0 (black) to 100 (white)
- a* associated with changes in redness-greenness (positive a* is red and negative a* is green)
- b* associated with changes in yellowness-blueness (positive b* is yellow and negative a* is blue)

In order to describe and compare the observed colour changes, the overall colour difference, ΔE*, was calculated using the following equation:

$$\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2} \quad (1)$$

Where

$\Delta L^* = L^*_{\text{after ageing}} - L^*_{\text{before ageing}}$, $\Delta a^* = a^*_{\text{after ageing}} - a^*_{\text{before ageing}}$ and $\Delta b^* = b^*_{\text{after ageing}} - b^*_{\text{before ageing}}$

For each mortar specimen, a minimum number of three measurements were performed before, during and after aging, and the average value is presented in this report.

5. Results/summary

The colour changes are recorded with Mercury spectrophotometer before, during and after ageing are evaluated. The images and CIELab color values, obtained from DigiEye, are attached in Annex 1 and Annex 2, respectively.

The overall colour change (*ΔE**) of the specimens, as a function of exposure time, is given in Figure 1 below. The results show rapid colour changes after initial exposure (up to a maximum value of *ΔE**=3.51 for Yellow after 15 days, *ΔE**=5.73 for Green after 28 days, and *ΔE**=3.22 for Blue after 21 days of exposure).

*ΔE** values for Green specimens then decrease while for Yellow and Blue specimens, *ΔE** value increases (up to a maximum of *ΔE**=3.77 for Yellow and *ΔE**=8.17 for Blue after 90 days of exposure).

Hence, a maximum *ΔE** values of 3.77 (after 90 days), 5.73 (after 28 days) and 8.17 (after 90 days) were obtained respectively for Yellow, Green and Blue, which are above the stated visual colour difference threshold (*ΔE**<5).

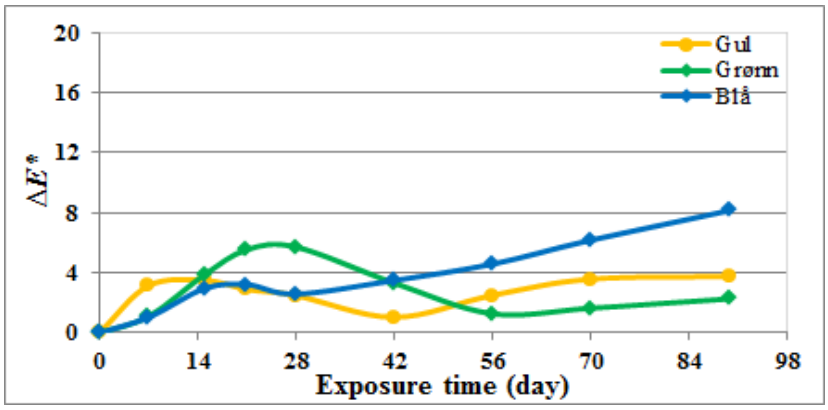
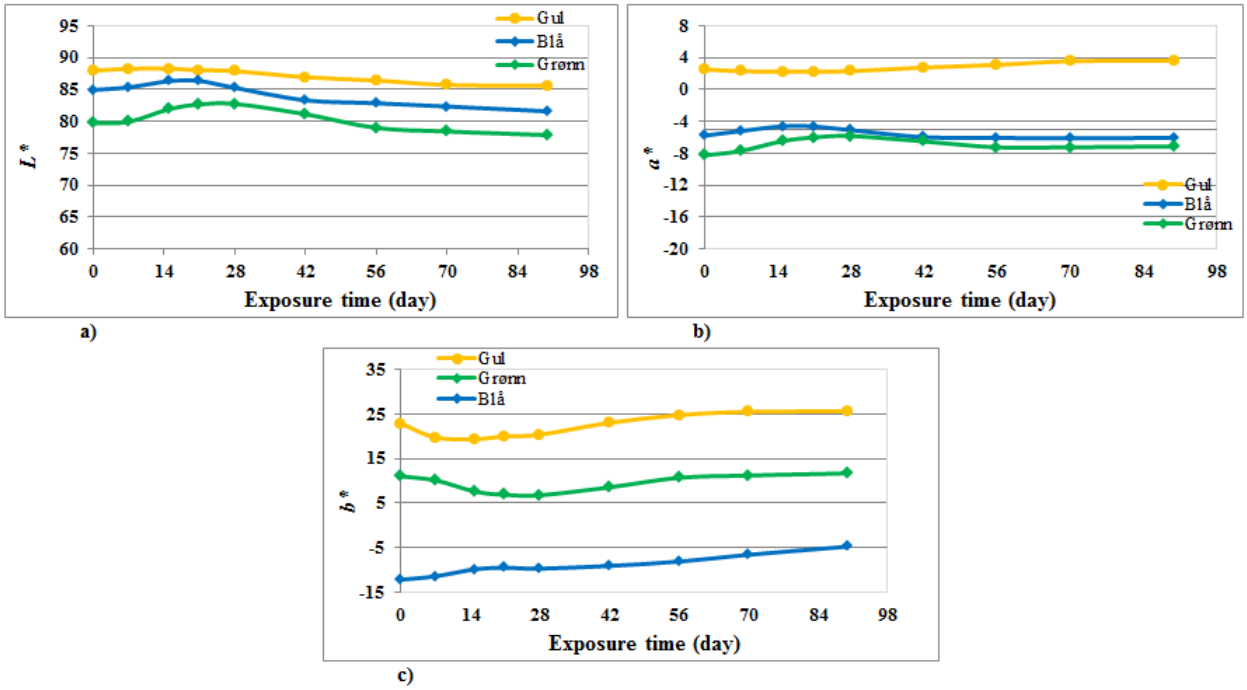


Figure 1. Total colour change ΔE, as a function of exposure time*

(Gul=Yellow, Grønn=green and Blå=Blue)

Although the *ΔE** value show magnitudes of the total colour change of the specimens up on ageing, they do not specify in what way colours vary. For further analysis, *L**, *a** and *b** chromatic coordinates are presented in Fig. 2.



Figur 2. Colour values for Yellow, Green and Blue specimens are indicated in:
*a) lightness, L**
*b) red-green, a**
*c) yellow-blue, b**

(Gul=Yellow, Grønn=green and Blå=Blue)

All specimens show slightly increase in lightness at the beginning of the exposure, characterized by an increase in L^* values (Green from L^*=79.72 before ageing to L^*=82.74 after 28 days of exposure, Yellow from L^*=87.96 before ageing to L^*=88.26 after 15 days of exposure and Blue from L^*=84.94 before ageing to L^*=86.35 after 21 days of exposure).

Darkening of the specimens until the end of the test, is characterized by decrease in L^* values (L^*= 77.85, L^*= 85.58 and L^*= 81.58 for Green, Yellow and Blue specimens, respectively), see Figure 2a. The least decrease in L^* values was observed in Yellow, and the most for Green.

The results in Figure 2b show that Green and Blue specimens decrease in the green colour value (from a^*=-8.25 before ageing to a^*=-7.13 after 90 days of ageing, and from a^*=-5.77 before ageing to a^*=-6.06 after 90 days of ageing, respectively). Yellow specimens initial decrease in red colour value (from a^*=2.52 before ageing to a^*=2.31 after 28 days of ageing), and then increase after 28 days of exposure (with a maximum value of a^*=3.62 after 90 days of exposure).

The b* results (Figure 2c) show, Yellow and Green specimens become bluer during early ageing (shown by reduction of b^*=22.85 before ageing to b^*=20.37 after 28 days of ageing for Yellow, and from b^*=11.03 before ageing to b^*=10.69 after 56 days of ageing for Green), then the specimens slightly become yellower (with a maximum value of b^*=25.56 and b^*=11.70 after 90 days of

exposure for Yellow and Green specimens, respectively). Blue specimens reduce in blue colour value during ageing.

Summarized, Green specimens exhibited a slight reduction in lightness, and a red-yellow shift; and Blue specimens exhibited a slightly reduction in lightness, and a green-yellow shift up on ageing. Yellow specimens exhibited slight reduction in lightness, and a red-yellow shift. Hence, the overall color changes, ΔE*, resulted from ageing of Yellow, Green and Blue specimens were due to the higher contribution from the chromaticity coordinates, a* and b*, while the contribution from L* was relatively lower.

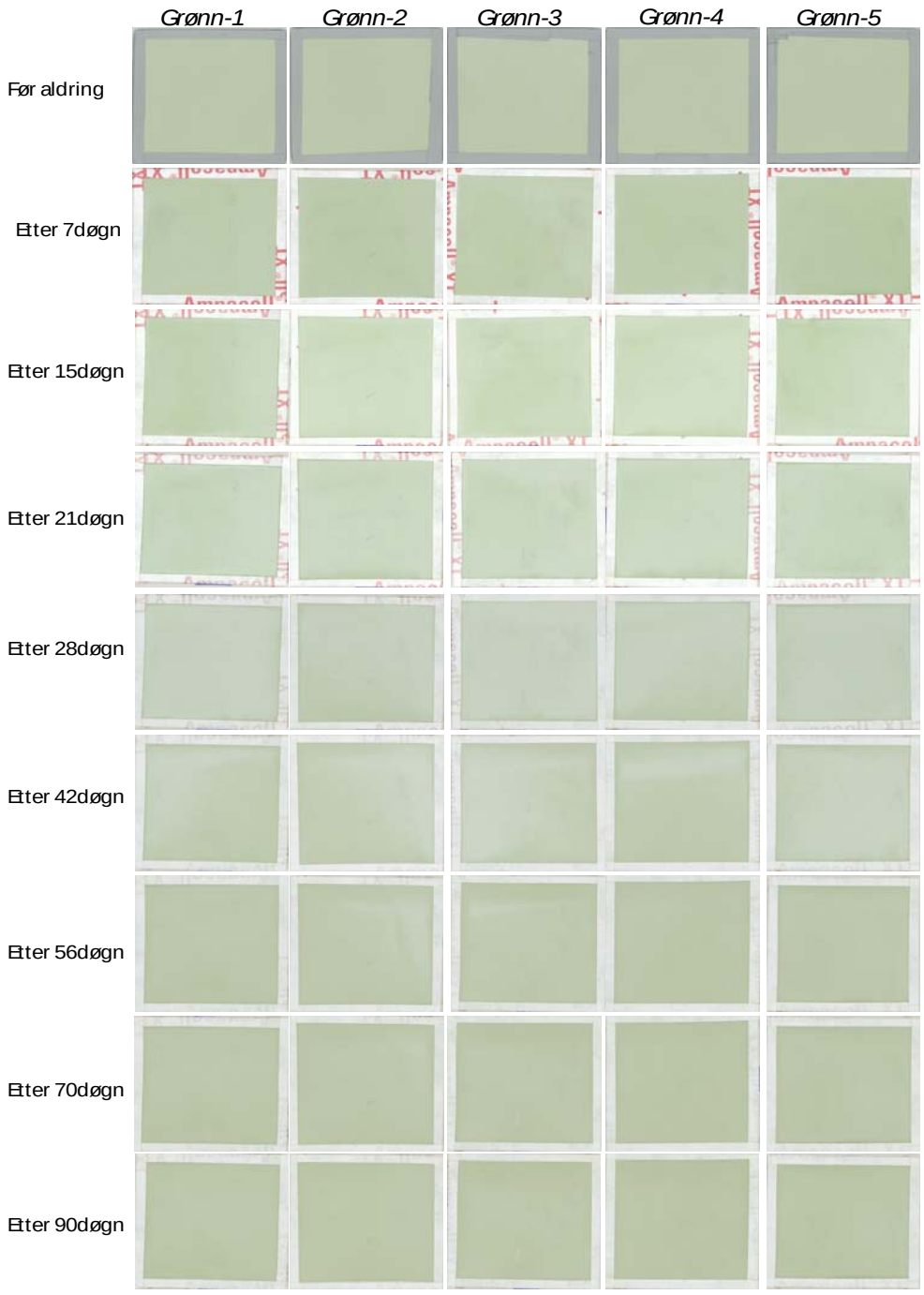
6. Conclusion

After 90 days of ageing of Rapido Tynnpuss (Yellow, Green and Blue specimens), SINTEF assess that the total colour change, ΔE*, is small (ΔE*<10).

Appendix 1.1: Photos of Blue specimens during the ageing

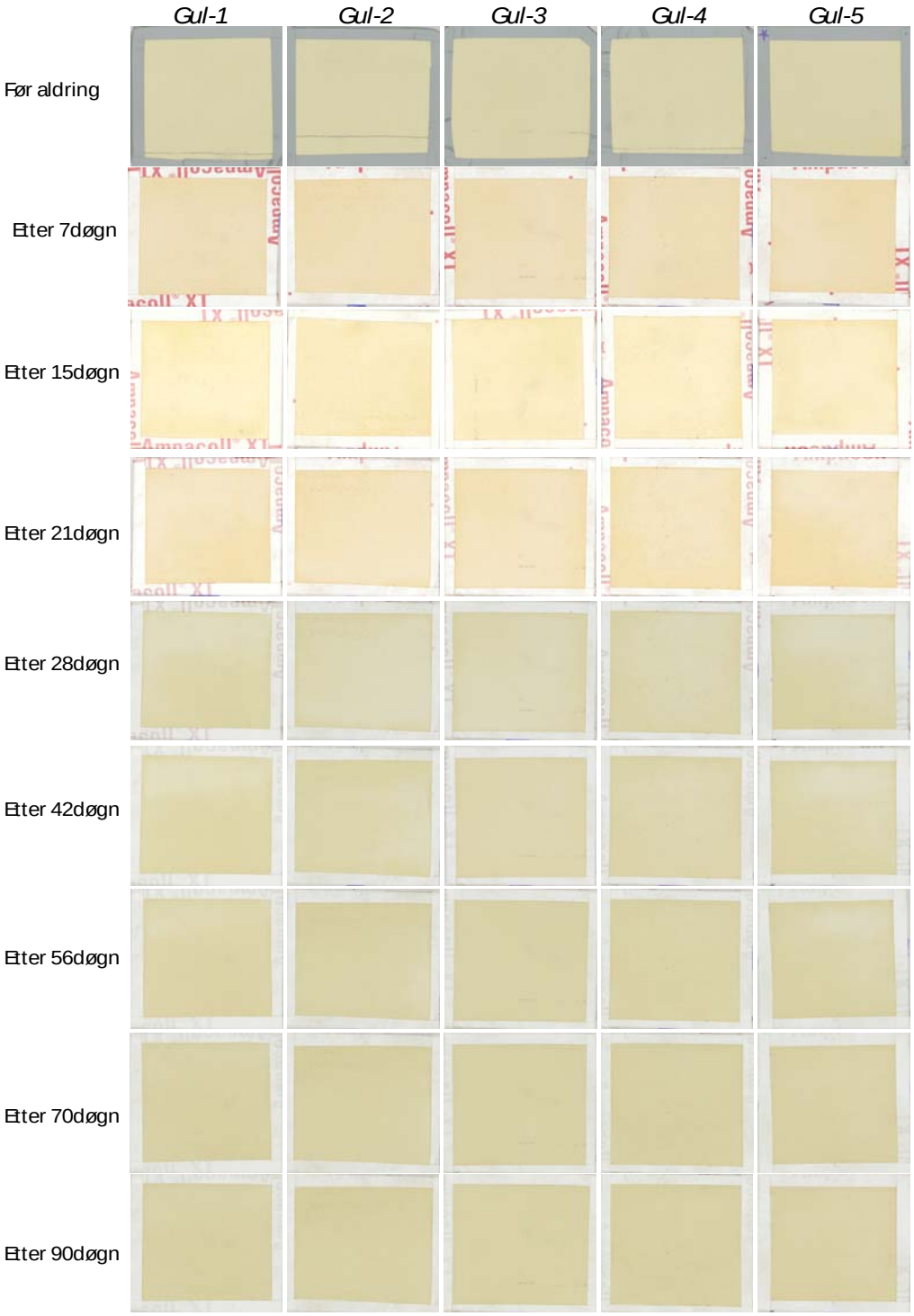
(Blå=Blue, Før=before, Aldring=ageing, , Etter=after, Døgn=days)

Appendix 1.2: Photos of Green specimens during the ageing



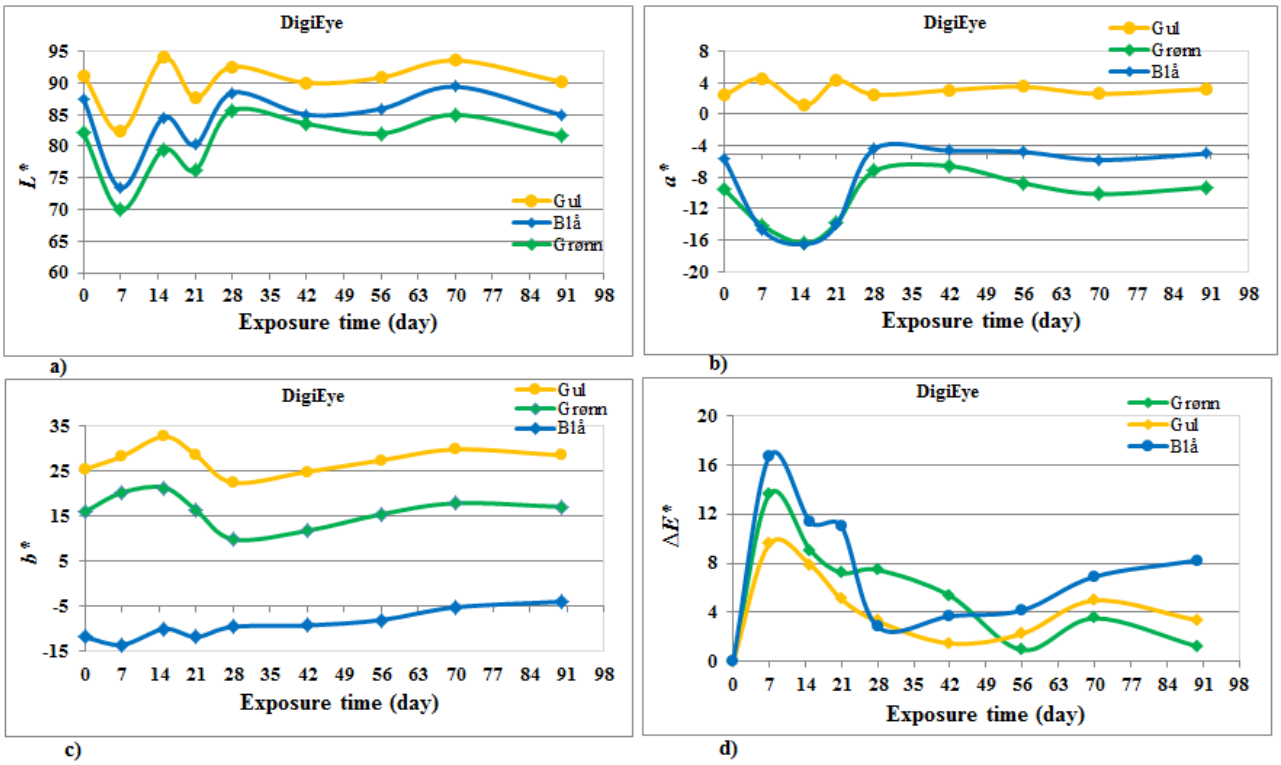
(Grønn=Green, Før=before, Aldring=ageing, , Etter=after, Døgn=days)

Appendix 1.3: Photos of Yellow specimens during the ageing



(Gul=Yellow, Før=before, Aldring=ageing, , Etter=after, Døgn=days)

Appendix 2: CIELab colour-values obtained from DigiEye



Figur 3: Colour values and colour change for Yellow, Green and Blue specimens are indicated in:
*a) lightness, L**
*b) red-green, a**
*c) yellow-blue, b**
d) total colour change ΔE

(Gul=Yellow, Grønn=green and Blå=Blue)

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