A study of varnish influence on inkjet printing lightfastness

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Abstract: *Protection of the colour photographs and prints seems as an inevitable step in the preservation of the cultural heritage, because up to 80% of the institutions dealing with cultural heritage have inkjet prints in their collections. Thus it is important to know how they behave when exposed to the environmental conditions. The most harming are light and airborne pollutants. Appling barrier layer, which should protect these prints from ozone and UV light harm, seems like an elegant solution.*

As the test target was selected i-1 RGB 1.5 target and this target was printed on microporous Ilford Smooth Gloss inkjet paper with dye-based ink set and one pigment ink set. The accelerated ageing test was performed in xenon test chamber Q-Sun with daylight filter on inkjet prints protected by Hahnemühle and Tetenal varnishes. The varnishes were also applied on clear PP films for determination of their spectral change during the light exposure. The reflectance spectra of samples were measured by spectrophotometer i-1. The changes in the gamut volumes were plotted as a function of exposure dose. From this function, fading rate coefficient was determined for each sample. Gamut volumes, fading rate coefficients and gamut visualizations were calculated and made by using VolGa utility.

Keywords: *lightfastness, varnish*

Introduction

Photography was at the crossroad from the beginning of the 21st century. The technology for how the images are printed changed at a ferocious pace. In 1995, an inkjet print largely came in for object of interest. The lightfastness of colour prints is influenced by many factors, e.g. light, airborne pollutants etc. Thus it is important to shield the prints as much as possible from the harming influences and conditions. Focus of this work was aimed at lightfastness, more precisely at print protection by varnishing.

Experimental

Sample preparation

The test target i-1 RGB 1.5 was printed on Epson P50 printer with Epson Claria dye ink set and Epson R 3880 with Ultrachrome K3 pigment ink set on microporous Ilford smooth gloss inkjet paper. After 24 hours of drying in laboratory conditions, the samples were sprayed with varnishes Tetenal Glossy and Hahnemühle. Along with prints, at the same time, were sprayed pieces 2×3 cm of PP film. After another 24 hour drying period samples were weighted to obtain amount of the deposited varnish.

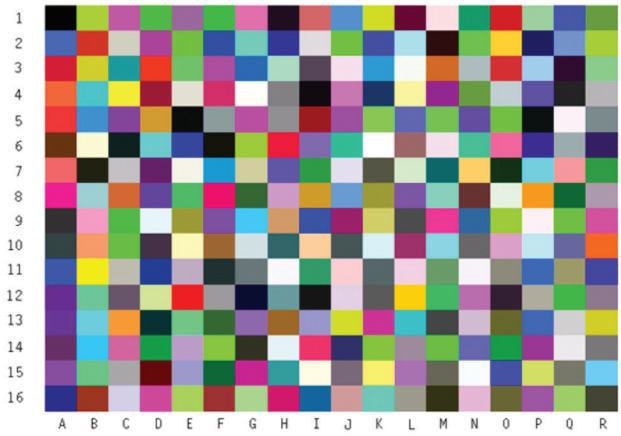

Figure 1: Test target i-1 RGB 1.5

Measurement

The reflectance spectra were measured on the prints with spectrophotometer Gretag MacBeth i-1 Pro. PP films were measured with UV-VIS Cary 100 and absorbance spectra were recorded. The absorbance spectra were recorded in order to determine change in the light-protective property.

Exposure

The samples have undergone an accelerated ageing test in xenon test chamber Q-Sun 1B with daylight filter and intensity of 0.35 $Wcm^{-2}nm^{-1}$. The total exposure dose was 222 hours.

Results and discussion

Absorbance spectra of PP films

Absorbance spectra were measured before the experiment and after each exposure step.

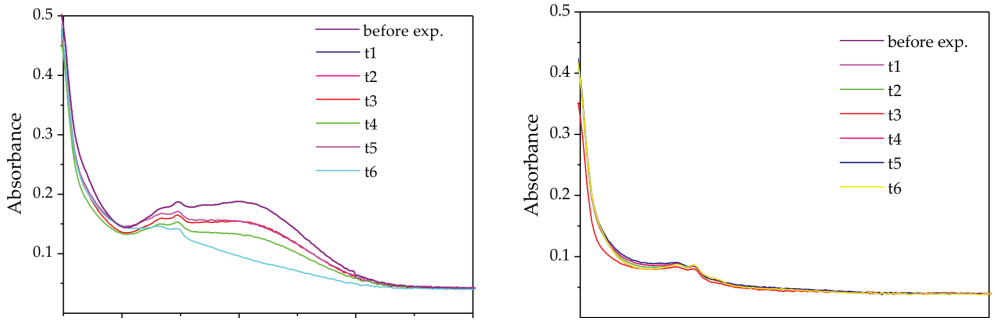

Figure 2: Absorbance spectra of PP films with varnishes Hahnemühle (left) and Tetenal (right)

During exposure spectra of Hahnemühle varnish changed in the region of wavelength range 250–350 nm. Particularly in that area varnish absorbance decreased by half. Changes in absorbance spectra of Tetenal varnish were very small, and can be accounted for measurement error.

Gamut volume changes

From reflectance spectra of test targets L*a*b* values were calculated with Gretag MacBeth Masure Tool 5.0.5. These data sets were used in VolGa utility for normalized gamut volume calculation and visualization in CIELab colour space. Transparent grid belongs to the sample before exposure, solid grid after the exposure.

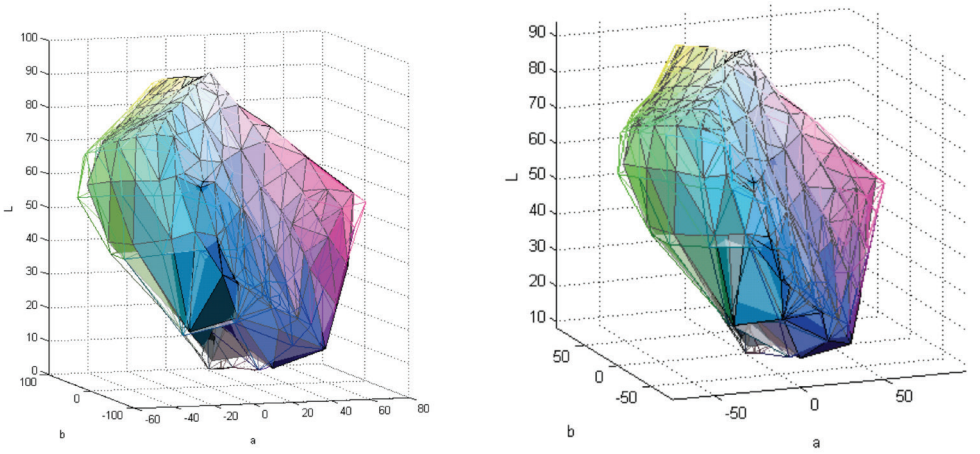

Figure 3: Colour gamut volume changes for samples P50 unprotected (left) and P50 with Hahnemühle varnish (right)

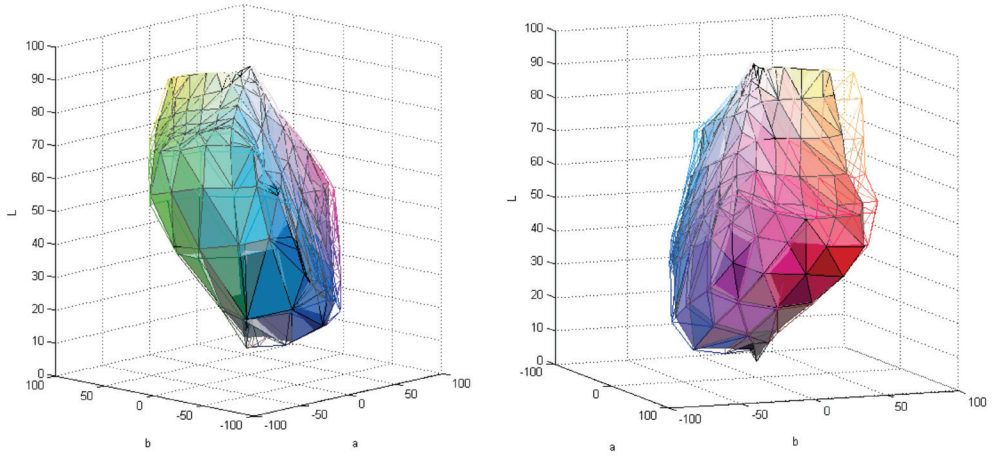

Figure 4: Colour gamut volume changes for samples P50 with Tetenal varnish (left) and R3880 unprotected (right)

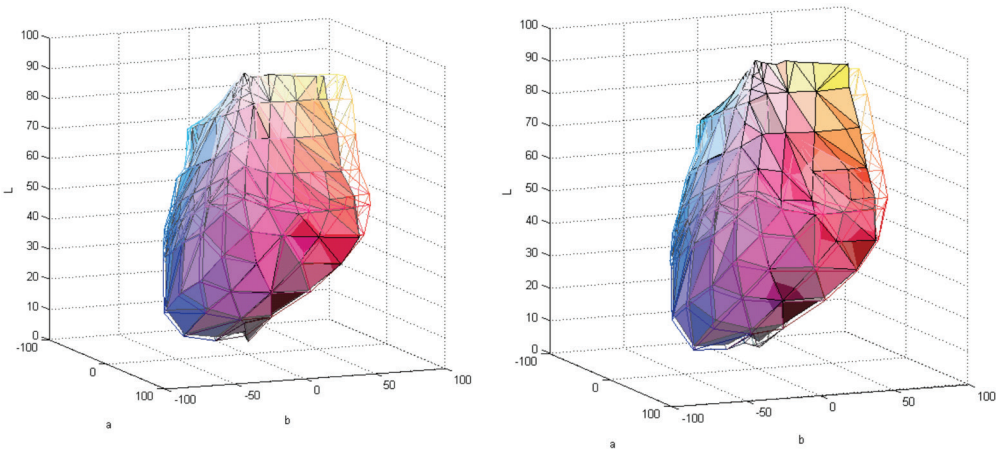

Figure 5: Colour gamut volume changes for samples R3880 with Tetenal varnish (left) and R3880 with Hahnemühle (right)

Table 1: The overview of normalized gamut volumes of the samples after the 222 hours of total exposure dose

Sample	Normalized gamut volume after exposure
P50 unprotected	89%
P50 Hahnemühle	90%
P50 Tetenal	90%
R3880 unprotected	91%
R3880 Hahnemühle	93%
R3880 Tetenal	89%

Both sets of prints, dye and pigment based have shown high light stability. In case of dye-based inkjet there has not been any difference between the two varnishes. In case of pigment based ink print, the Hahnemühle varnish has provided higher light protection. Although, the authors have tried to apply the same amount of varnish in both cases, spraying as the varnish application is not the most uniform one. In this method there are many variables e.g. the spraying nozzle and human factor, which influence the amount of applied varnish. Nevertheless by comparing the effect and the amount of the varnish on the samples, the Hahnemühle varnish provides higher protection even though that it has been applied in half the amount of Tetenal varnish. In Hahnemühle varnish are UV absorbers present, during the exposure burn-out of UV absorbers occurred.

Conclusion

The lightfastness ageing test was performed with use of print protection varnishes. Even after 222 hours of exposure it has not been proved, whether it is a suitable form of protection. In all cases the normalized gamut volume decreased by approximately 10 %. In the sets of samples the all three samples have shown similar degradation behaviour, which can be observed in figures 3–5.

During exposure the absorbance spectra of Hahnemühle varnish changed. In range 250–350 nm absorbance decreased by half. Both sets of prints were considered as ones with high light stability.

Acknowledgement

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