Dark Stability of Photographs–The Forgotten Parameter

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Introduction

In the recent literature there has been much mention of longevity of digitally-generated prints. What is not always understood by consumers is that these numbers are usually the print display ratings which have very little to do with the album making industry. For this group of consumers, the most important stability parameters are album keeping and gas fade, both of which are actually dark stability parameters because neither requires the presence of light to affect the print material.

For these reasons, we have subjected print materials to various household chemicals, which are known in the photographic folklore for print cleaning or to alter the surface characteristics of the print. Since household chemicals may take a long time to react with the prints, we ran an accelerated test at 60ºC and 50% RH in foil bags vs. a control similarly treated without the presence of household chemicals. We have also examined a number of print materials exposed to ozone or NOx.

Experimental

To test household chemicals, we conditioned print materials at 23ºC and 50% RH for 24 h. We then applied a thin layer of the chemical and lightly wiped the surface with a paper towel to remove excess chemicals. We sandwiched the treated sample in 3 mil Mylar™ and placed it in a trilayer foil bag. We conditioned and bagged control samples without the application of any chemicals. We examined specimens for excess liquid, oil or grease and wiped. those samples showing excess material with a paper towel before color analysis.

We treated materials at the Image Permanence Institute at Rochester Institute of Technology either with 1 ppm of ozone for 7, 14 and 21 days[1] or with 10 ppm of NOx for 3, 7, 10 and 14 days. These levels are higher than typical environmental exposures but the exposure is for a shorter length of time. A discussion of reciprocity effects is beyond the scope of this paper. We measured the color of all samples before and after with a GretagMacbeth Spectrolino Spectrophotometer.

Results and Discussion

We selected Pledge, Swiffer, and WD-40 as representative household chemicals. Pledge and Swiffer are aqueous based, although Swiffer does contain various glycols. WD-40 is representative of the various organic chemicals, which might be present around the home.

No one chemical adversely affected all print types. Pledge® specifically decreased cyan density in one of the two chromogenic materials and in the inkjet material, Table 1. Swiffer®, on the other hand, affects the magenta dye in the thermal material and causes a Dmin increase in black and white fiber-based paper, Table 2.

Table 1: Effect of Pledge Treatment

Print Type	Change
Kodak DuraLife	Very little change
Kodak Thermal	No difference
Fuji Crystal Archive	20% Cyan loss
CM Inkjet	10% Cyan loss
FB B&W	Not tested

Table 2: Effect of Swiffer® Treatment

Print Type	Change
Kodak DuraLife	5% C and Y loss
Kodak Thermal	30% M and 15% Y loss
Fuji Crystal Archive	Little change
CM Inkjet	Print destroyed
FB B&W	0.06 Blue Dmin Increase

Figure 1. Inkjet material in the presence of Swiffer®. was so badly softened that it transferred to the MYLARTM.

Table 3: Effect of WD-40 Treatment

Print Type	Change
Kodak DuraLife	No difference
Kodak Thermal	16% C 20% M 10% Y loss
Fuji Crystal Archive	No difference
CM Inkjet	12% C 3% M and Y loss
FB B&W	No difference

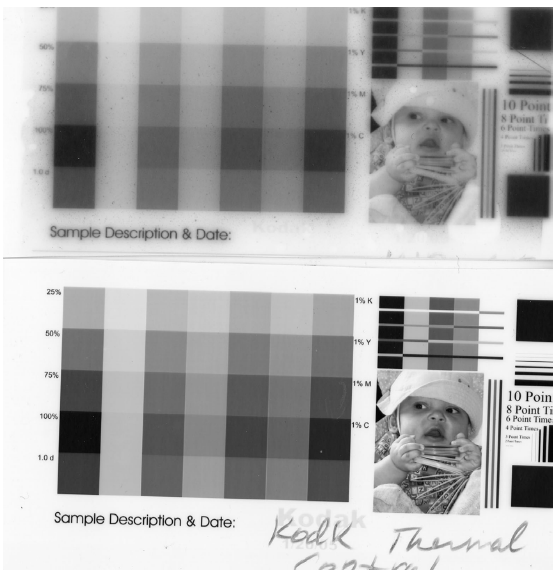

Figure 2. Loss in sharpness that results when thermal material is in contact with WD-40

Swiffer® also destroyed the inkjet receptor coating of the inkjet material, Figure 1.

WD-40 had its greatest effect on the thermal material but also caused some dye loss with the inkjet material, Table 3.

WD-40 also severely reduced image sharpness for the thermal material, Figure 2.

We have previously reported the effect of ozone (1). In this earlier study, the inkjet/dye combination was most severely affected by the ozone while the chromogenic color and the pigmented inkjet were unaffected.

NOx is also present in the environment. With NOx, we found significant staining of the black and white fiber base print and one of the two chromogenic color print materials, Table 4. In addition, this chromogenic material showed cyan dye loss. Finally, the yellow dye in the inkjet print faded. We were unable to identify the reason for the stain on the fiber base paper in spite of attempts to compare the NOx treated prints to control prints.

Table 4: Effect of 10 ppm NOx for 14 Days

Print	Effect at 14 days of 10 ppm NOx
BW Fiber Base	Staining
FujI Crystal Archive	Stain and Cyan dye loss
Kodak DuraLife	No effect
CM Inkjet Epson	
960 Printer	Yellow dye loss
Epson Matte paper	0.02 Blue Dmin Increase
Epson C-84 Printer	

Conclusions

Household chemicals affect digital prints differently than traditional prints. For digital prints changes may take the form of dye migration or in severe cases total destruction of the print

Reference

1. David F. Kopperl and Mark B. Mizen, The Effect of Ozone on the Quality and Stability of Inkjet, Chromogenic and Silver Digital Images, Proc NIP 19, pp 458-459 (2003).

Author Biography

David Kopperl has been working as a Senior Materials Scientist at Creative Memories where he specializes in digital photography and predicting the longevity of paper, albums and journaling supplies. He holds a BS degree in Chemistry from Case Institute of Technology and an MS degree in Chemistry from Rochester Institute of Technology.