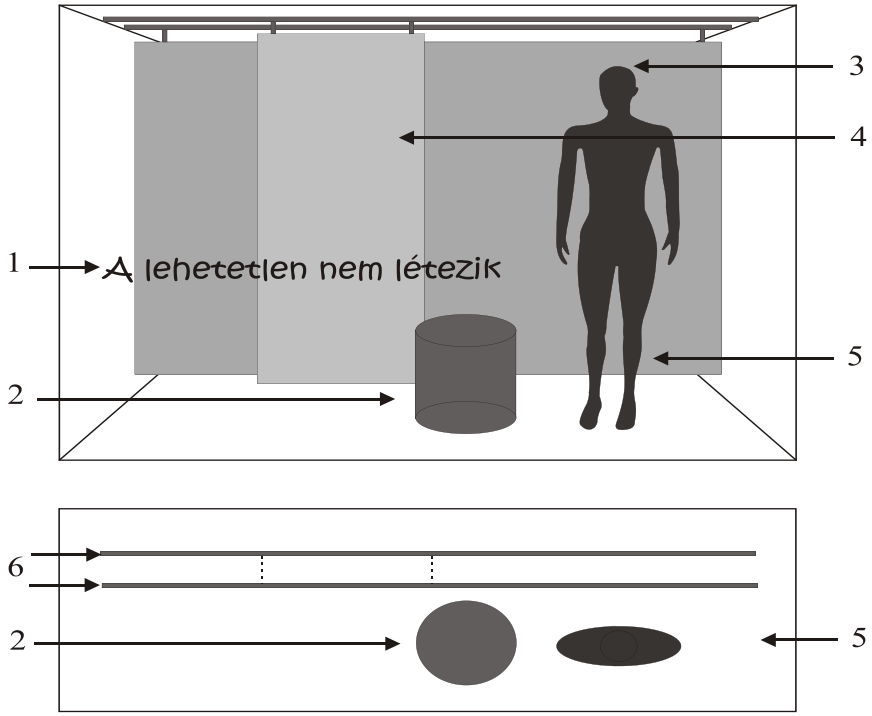
Investigation of the aging process of printed products in display windows

Rozália Szentgyörgyvölgyi, Ákos Borbély

Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Doberdó u. 6., Hungary

Introduction



Display window

1 Self-adhesive foil, 2 Display, 3 Printed back banner,

4 Printed front banner, 5 Manikin, 6 Track

Introduction

• The visual quality of printed products is vulnerable to this kind of radiation; the aging process has definitely visible signs.
• Mechanical and optical changes are induced by the joint effect of incoming optical radiation and temperature fluctuations.

• Our study focused on the changes in visual quality of test prints on different substrates printed by digital technologies. We used weathering instrument to investigate the resistance of digital prints against filtered sunlight.

Examination methods

Test printing was performed under normal operating conditions: t=21-23 ºC, RH 40–45%

Digital printers:

Mimaki JV3-160sp solvent inkjet

Durst RHO 320 R UV inkjet

Examination methods

We used a Suntest XLS+ weathering instrument to investigate the resistance of digital prints against filtered sunlight.

Examination methods

Optical density, tone value increase and color differences and color gamut changes were measured during stages of the accelerated aging process.

Printing materials

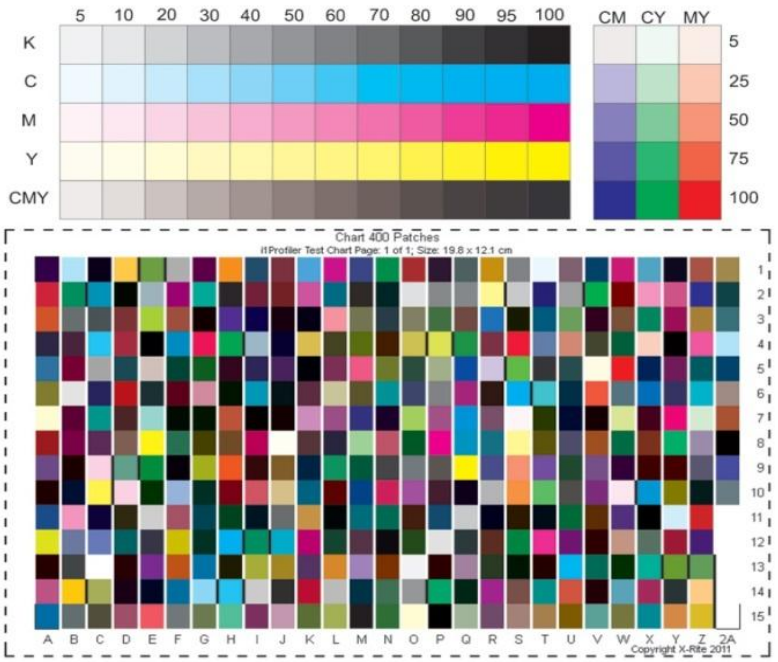
Substrate	type	type name	material
#1	self-adhesive foil	Avery MPI 3001	PVC
#2	canvas	Ferrari Decolit 251 frontlit	polyester, with PVC coating
#3	paper	Emblem Poster	paper

Printing materials

Substrates properties

Properties	#1	#2	#3
Caliper, µm	90	300	160
Grammage, g/m^2	120	270	200
Lifetime outside, year	2	3	10/54

Test prints



← 1.

← 2.

1 – color control patches of primary and secondary colors

2 – 400 patch test chart for gamut sampling

Optical properties

- Reflectance spectrophotmeter with 45a:0 measurement geometry
- Spectral range: 380 nm – 730 nm
- Process colours
- Secondary colours
- Tone value increase
- Colour differences

Results – TVI

Measured optical density values of CMYK process colors on substrates printed with both printers

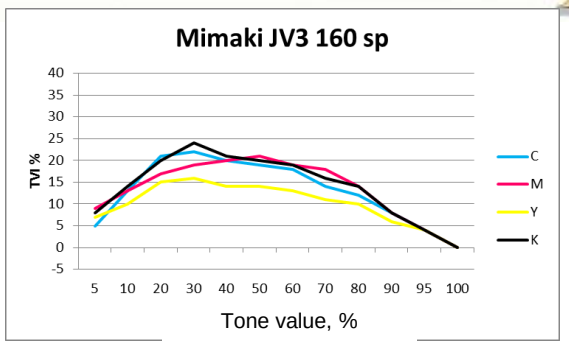
Sub-strate	Optical density							
	Mimaki JV3-160sp solvent inkjet				Durst RHO 320 R UV inkjet			
	C	M	Y	K	C	M	Y	K
1	2.33	1.95	1.48	2.24	1.08	1.37	1.39	1.94
2	1.75	1.49	1.30	1.75	1.21	2.18	1.31	2.18
3	1.69	1.61	1.36	1.70	0.95	1.39	1.33	1.91

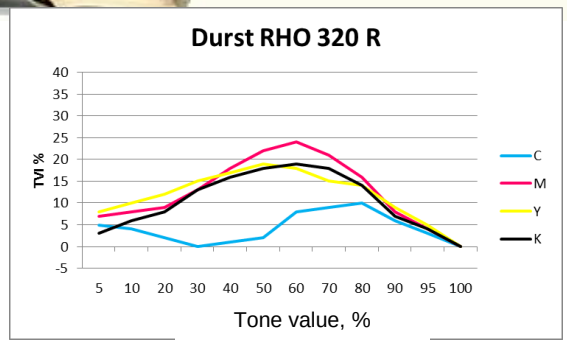
Results – TVI

Universitas Budensis

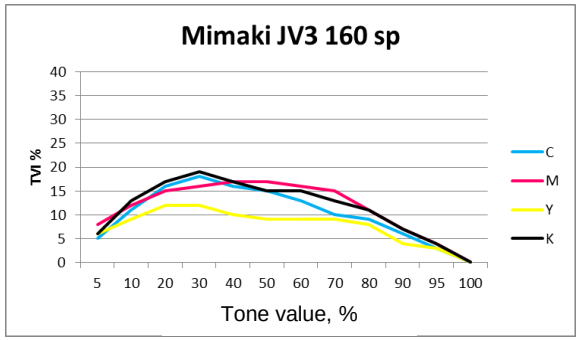
UNIVERSITAS BUDENSIS

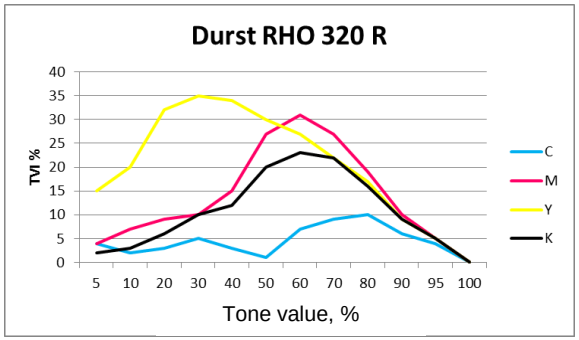
Substrate



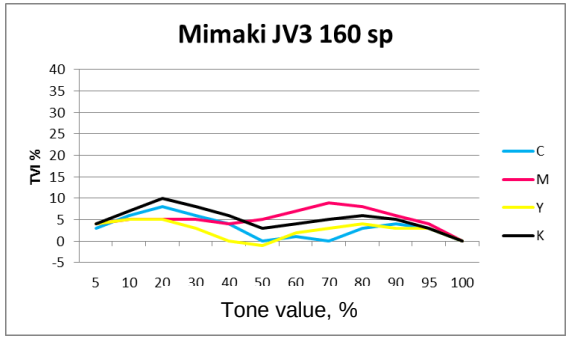


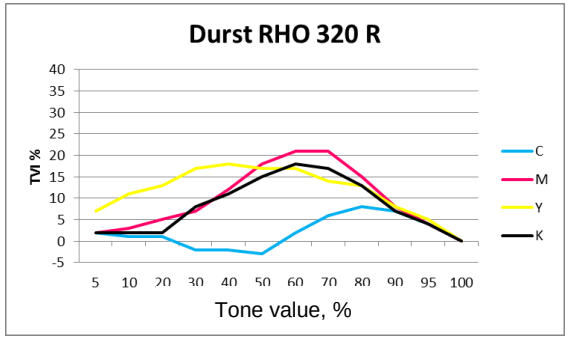
← 1.





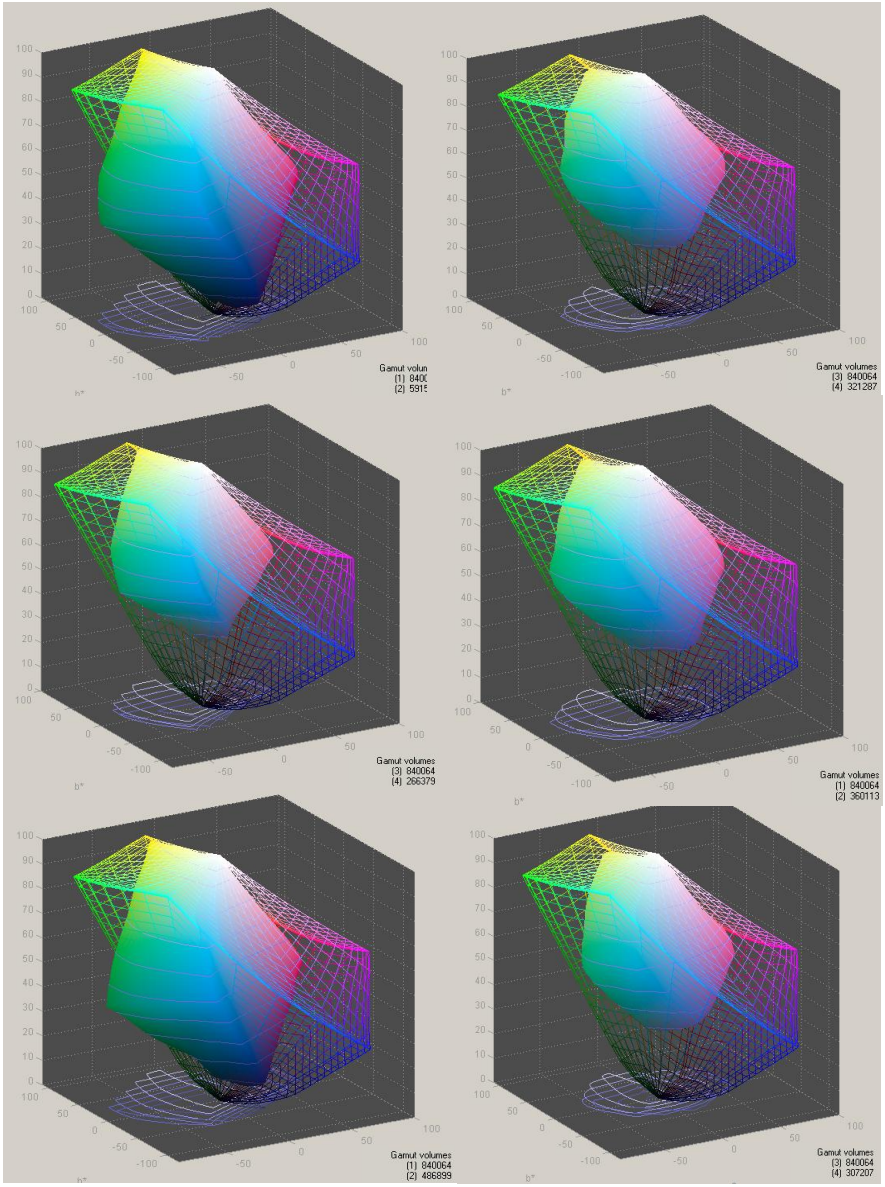
← 2.





← 3.

Results – Colour gamut



Substrate

← 1.

← 2.

← 3.

solvent inkjet

UV inkjet

UNIVERSITAS BUDENSIS

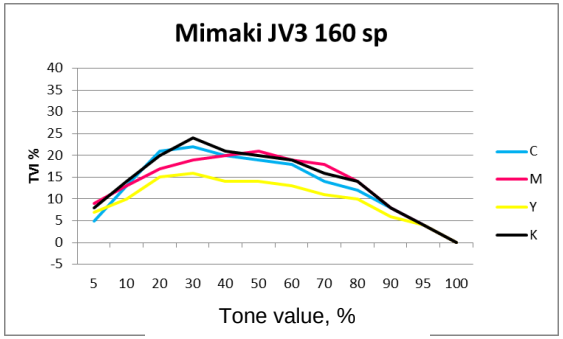
Investigation of the resistance of digital prints against filtered sunlight

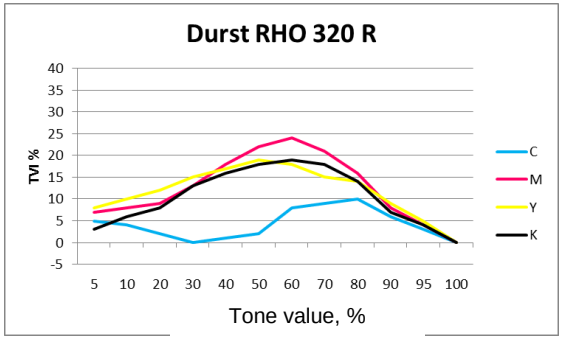
Test parameters:

Equipment: Suntest XLS+
Standard: ISO 4892-2 method B6
Filter: window glass
Irradiance range: 300-400 nm
Temperature: 24 - 65 °C

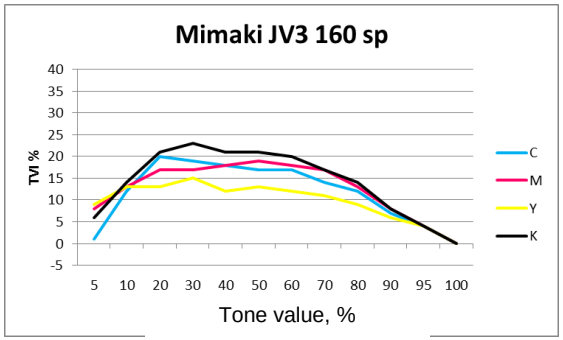
Irradiance in 48 hours: 7533 kJ/m^2
Time: 144 hours

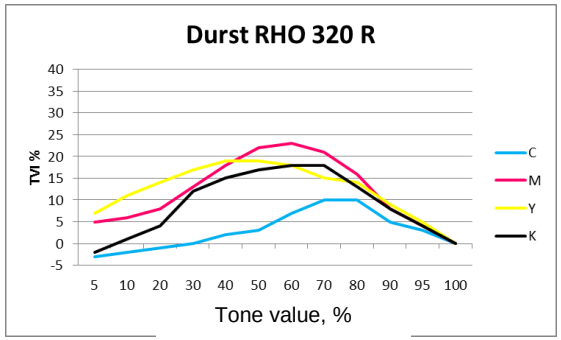
Results – TVI





← 0 hour





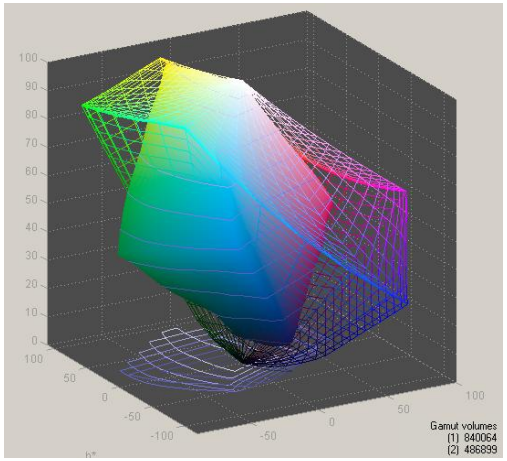
← after144 hours

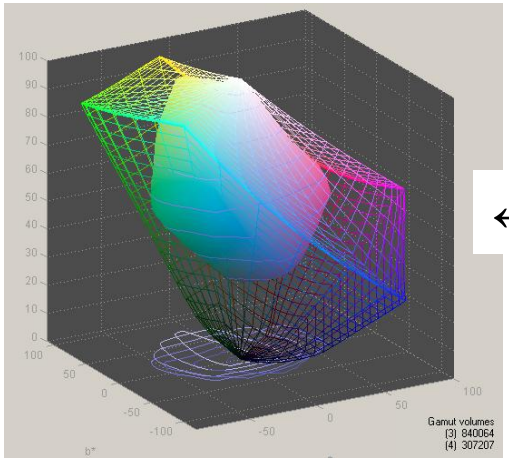
TVI curves in Avery MPI 3001 self-adhesive foil prints

Results – ΔE^*_{ab}

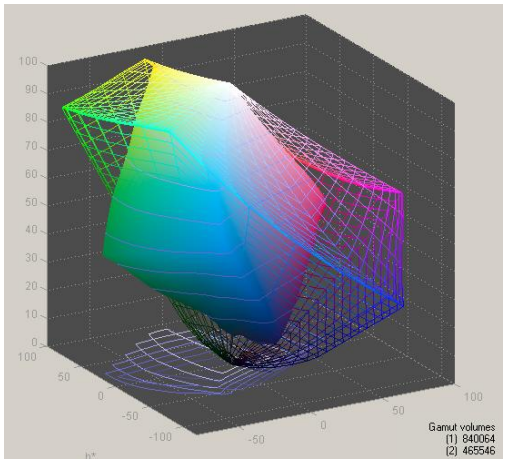
Substrate	ΔE^*_{ab144}							
	Mimaki JV3 160 sp							
	C	M	Y	K	R	G	B	CMY
1	0.25	1.63	1.25	1.16	1.35	1.14	1.64	0.87
2	2.69	3.15	1.84	1.74	3.07	2.98	3.45	3.78
3	1.85	1.61	1.29	0.36	1.93	1.17	1.57	0.66
Substrate	Durst RHO 320 R							
	C	M	Y	K	R	G	B	CMY
1	1.09	2.52	1.69	2.15	3.54	1.43	2.46	1.55
2	0.62	2.28	2.08	0.82	2.62	1.62	2.05	1.22
3	0.62	1.64	2.86	0.74	0.52	1.72	0.55	0.57

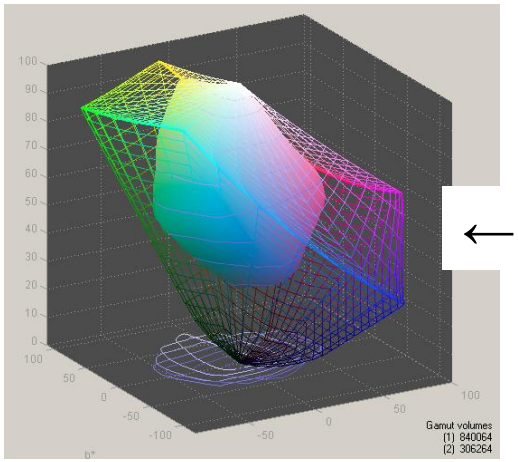
Results – Colour gamut





← 0 hour





← after144 hours

Gamut solids of test prints on Emblem Poster paper substrate (left: Mimaki JV3 160 sp, right: Durst RHO 320 R)

Results – Colour gamut

Substrates	Relative gamut (%)			
	Mimaki JV3 160 sp		Durst RHO 320 R	
	0 h	144 h	0 h	144 h
Avery MPI 3001	1	0.97	1	0.94
Ferrari Decolit 251	1	0.92	1	0.94
Emblem Poster Paper 200	1	0.95	1	0.99

Relative changes of printable gamut

Conclusions

- In our study we investigated the resistance of digital prints against filtered sunlight on three types of substrates, printed with solvent and UV inks on inkjet printers.

- We experienced visible changes of the test prints caused by the irradiation. The magnitude of the changes depended on the substrate and the printer used.

Conclusions

- We found that in case of primary and secondary colors the irradiation caused 1 – 4 ΔE^*_{ab} color differences, while printable color gamut decreased ~ 5%.

- Our findings may contribute to developments aimed at the improvement of the accelerated aging of digital prints.

Thank you for your kind attention