Xenon Light Stabilty Testing
MetalPrints™ vs. Long Lasting Photo Papers

Introduction

Xenon light stability testing was performed to compare Fade Resistance of current MetalPrints™ with 6 Color SubliJet IQ ink versus chromagenic (silver halide/dye) long lasting photo paper prints.

Procedure

The test procedure utilized essentially parallels that established by the Image Permanence Institute at the Rochester Institute of Technology (RIT). Testing was performed using a Q-Sun Xenon Test Chamber equipped with Window Glass Filters to simulate daytime sunlight through a window. No additional glass filters were utilized in front of the samples. Appendix A illustrates the UV light filtering effect of 1/8" window glass. Light intensity in the chamber was set to 0.6 W/Sq. m. at 420 nm which, (according to Q-Lab Corp.), is equivalent to 50,000 lux. Chamber temperature was controlled at 25° C. Standard test targets consisted of cyan, magenta, yellow, red, green, blue, and neutral (black) patches at ten levels of color intensity for each sample type. Targets were measured for cyan, magenta, yellow, and visual color density as defined by ISO Status A utilizing an X-Rite 528 Densitometer. Results were recorded as % loss of color density versus time for the 0.5 initial density and 1.0 initial density patches. Since target patches did not usually correspond exactly to 0.5 or 1.0 initial densities, the closest density patches were used to estimate the time densities by interpolation. End points for image lifetime for cyan, magenta, and yellow are defined similar to the Rochester protocol as:

Parameter	End Point
Cyan Fade	30% Loss (Pure Cyan or Neutral)
Magenta Fade	30% Loss (Pure Magenta or Neutral)
Yellow Fade	30% Loss (Pure Yellow or Neutral)
Cyan-Magenta Balance	15 % Change (Neutral)
Magenta-Yellow Balance	15 % Change (Neutral)
Yellow-Cyan Balance	15 % Change (Neutral)

These end points are estimated to be the color change level at which the average person will detect the change. The lifetime for the image is defined (in kilolux-hours) when the first of these parameters reaches its end point.

Results

Sample	End Point	Time (Hrs)	Time (Kilolux-Hours)
Photo Paper A	0.5 Cyan	460	23,000
Photo Paper B	1.0 Cyan	820	41,000
Photo Paper C	0.5 Yellow	630	31,500
MetalPrints™	0.5 Magenta	1810	90,500

The Cyan, Magenta, and Yellow % fade versus time results for the four samples are charted in Appendix B. None of the samples were shifted out of color balance (as defined by 15% change) at the end point times as listed above.

Discussion

The endpoints stated above are experimental values determined under the defined test conditions and do not involve any assumptions. Converting this data into actual image lifetimes would involve numerous assumptions. The key assumption for lifetime estimations is that of reciprocity, i.e. that test light intensity and time are linearly interchangeable (50 kilolux for 1 year will produce the same results as 1 kilolux for 50 years). This assumption can be debated, but it is widely accepted in the photo imaging industry. It has been tested somewhat by the Wilhelm Institute in Germany, but only over a narrow time/intensity range for obvious reasons. The most common assumption used to estimate lifetimes is an intensity of 450 lux for 12 hours per day (this is used by RIT). Some publications have used 250 lux or as low as 150 lux. RIT also performs testing using cool white fluorescent lighting at 50 kilolux at 21° C. Other test facilities, such as the Wilhelm Institute, utilize cool white fluorescent lighting at 35 kilolux at 24° C.

Any attempt to estimate actual image lifetimes in years would require knowledge of light intensity for display area averaged over the average hours of illumination. Comparisons of relative image lifetimes among the four samples would not involve any assumptions of illumination intensity or duration.

Any estimations involving the results from above should only be done for situations involving daylight illumination. Results for fluorescent lighting would be different and lifetimes would be expected to be longer due to much reduced levels of the more damaging UV light.

Conclusions

White MetalPrints™ panels imaged with 6 color SubliJet IQ inks were tested for color fade and color balance by an industry accepted, accelerated test protocol which utilizes a Xenon Arc Test Chamber to simulate interior daylight conditions. Three different long lasting silver halide/dye photo papers were concurrently tested for comparison. Image lifetime for the MetalPrints™ panels, as defined by the test protocol, was 2 to 4 times that of the long lasting photo papers.

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Appendix A

FILTERING EFFECT OF GLASS ON SUNLIGHT

Common Window Glass. Glass of any type acts as a filter on the sunlight spectrum. The shorter, more damaging wavelengths are the most greatly affected. Figure 14 shows direct summer sunlight compared to sunlight filtered through ordinary, single strength, untinted, 0.125 inch thick window glass. As the figure shows, ordinary glass is essentially transparent to light above about 370 nm. However, the filtering effect becomes more pronounced with decreasing wavelength. The most damaging wavelengths below about 310 nm are completely filtered out.

Automotive Glass. Automotive glass is thicker than window glass. The thicker glass acts as a more efficient filter. In addition, auto glass windshields are often tinted and usually contain a layer of plastic for safety enhancement. Each of these factors adds to the filtering efficiency. Figure 15 shows direct summer sunlight compared to sunlight filtered through tinted automotive windshield glass. Almost all of the most damaging ultraviolet light has been filtered out. Figure 16 shows that various other types of auto window glass filter sunlight less than windshield glass but more than ordinary window glass. Further data on sunlight through automotive glass compared to laboratory light sources has been reported elsewhere.[5]

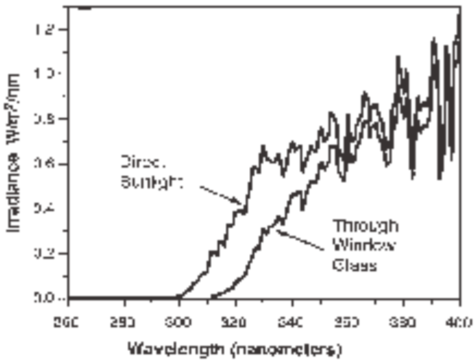

Figure 14 — Sunlight Through Window Glass

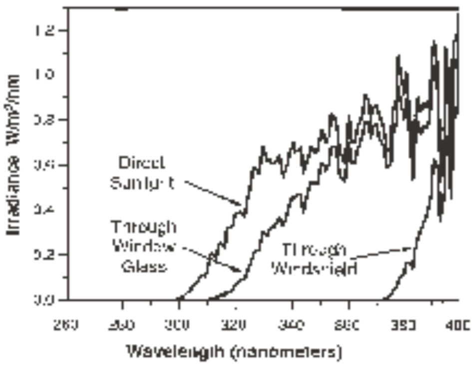

Figure 15 — Sunlight Through Windshield Glass

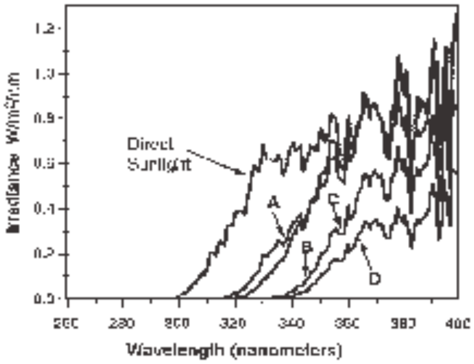

Figure 16 — Sunlight Through Auto Glasses

Figure 16, Sunlight Through Various Types of Auto Window Glass

A = 0.128 inch thick, Clear
B = 0.228 inch thick, Clear
C = 0.159 inch thick, Lightly Tinted
D = 0.194 inch thick, Tinted

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[5] [illegible] and Sunlight Through Auto Glass," [illegible] 1987

Appendix B

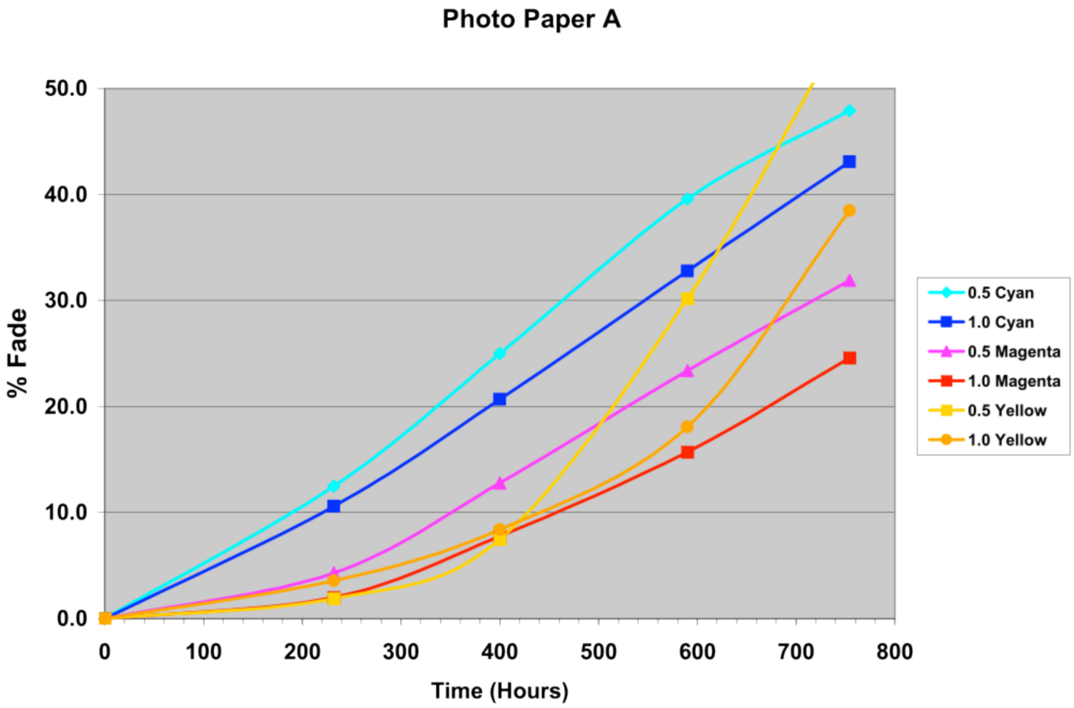

Photo Paper A

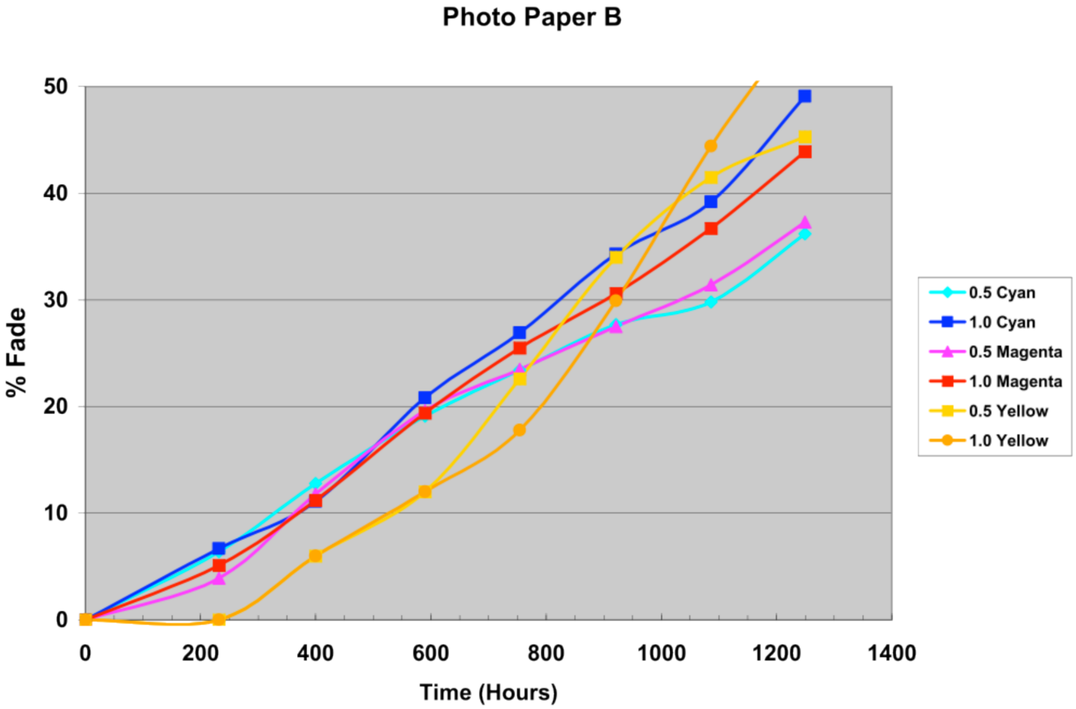

Photo Paper B

Appendix B (cont'd)