

# Accelerated Light-Fading of Some Historic Office Copy Documents

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## ABSTRACT

The responsivity to light of the images and paper substrates comprising documents produced by a range of mostly twentieth century office copy processes has been investigated under accelerated exposure conditions using microfade testing. The results confirm that dye-based copies as a group tend to be fugitive, in some cases alarmingly so, but beyond this it is difficult to generalise. As might be expected, the responses of coated and chemically impregnated papers, many designed to be light and/or heat sensitive, is highly unpredictable and the microfade test results strongly reinforce the value of object-specific lightfastness evaluation rather than generalisations based on published data and assumed identity.

**Keywords** light, fading, display, office copying, documents, microfade testing, Thermo fax, facsimile

## INTRODUCTION

For more than two centuries snowballing technological, industrial and social changes and the concomitant growth of commerce and public administration have fuelled the need to efficiently create and copy documents for communication, record keeping and archiving. Mundane as it may be, document copying is a cornerstone technology and this is reflected by the rapidity and ingenuity with which new technologies – optical, mechanical, chemical and electronic – have continually been adapted for the purpose (Batterham 2008). While most copies only see the light of day once or twice in their lifetime, a tiny tip of the vast iceberg of archived and accidentally preserved material acquires sufficient historic, social or personal significance to warrant display. Artists, including David Hockney and Warhol collaborator Gerard Malanga, have also created or reproduced images using mid-twentieth century copy processes like Thermofax and fax machines (Birmingham 2002, Norville-Day 1994). The relatively minor relevance of lightfastness to the documents' original purpose and the nature of the copying technologies have left us with records stretching back to the late nineteenth century that are potentially highly vulnerable to display lighting.

This paper describes observations from an opportunistic microfade testing survey of the lightfastness of a small number of documents held by the National Archives of Australia. It was thought to be interesting primarily because there is so little published information of its kind and because the documents are firmly attributed to particular copy technologies, if not necessarily representative of them or their class. A number of the processes are based on the heat or light sensitivity of chemically coated and impregnated papers, which years later still contain the same thermally and photochemically active components and/or their degradation products. The potential problems therefore not only include the light sensitivity of text and images but also the substrates that carry the images and provide contrast. These same chemicals may also be involved in photo-redox reactions that lead to cellulose oxidation, for example the catalytic role of iron compounds in photo-Fenton reactions (Thomas et al 2010).

In many of these cases loss of legibility and substrate deterioration is probably inevitable whether or not they are exposed to light, therefore the decision to display and if so for how long boils down to working out what is likely to destroy the documents first and how much additional harm a given amount of light exposure might cause. Unfortunately the relative rates of the different deterioration processes involved are essentially unknowable in practice without very long-term observation and measurement under ambient storage and display conditions. In this environment accelerated exposure is a useful tool, and perhaps the only one we have, but as this study clearly shows its results cannot be applied uncritically. Paul Whitmore, who invented the microfade technique wrote, "[t]he accurate prediction of the fading of different colorant systems is an elusive, perhaps unachievable goal" (Whitmore et al 2000), and for very complex systems in particular, like many of those described here, microfade testing's value is as an early warning system, identifying colourants at most risk of light-fading, and providing information about the probable nature of the colour change – whether the image or substrate is likely to become lighter or darker or more or less yellow with exposure. Combined with other information, accelerated exposure studies can also yield clues as to the photochemical mechanisms involved and assist with the evaluation of conservation treatments designed to mitigate light-fading.

## METHOD

### MICROFADE TESTING

Microfade testing is an accelerated light-fading technique in which the visible reflectance spectrum of a small area of a colourant (c.a. 0.3mm) illuminated by high intensity UV-free visible light is recorded as it changes. Colour change ( $\Delta E_{00}$ ), a perceptual measurement, is calculated from spectral change using standard equations, in this case CIEDE2000 (CIE 2001). The advantages of microfade testing are that the test area is small enough to fit comfortably within most typed and graphic lines, the method is rapid, and because it is essentially non-destructive real objects intended for display rather than surrogates may be tested. The Oriel Microfade Tester (Newport) employed in this study is substantially described by