applied sciences

MDPI

Article Supplementary materials

Degradation of paints and SOPs under VIS-light: Raman and FTIR investigation

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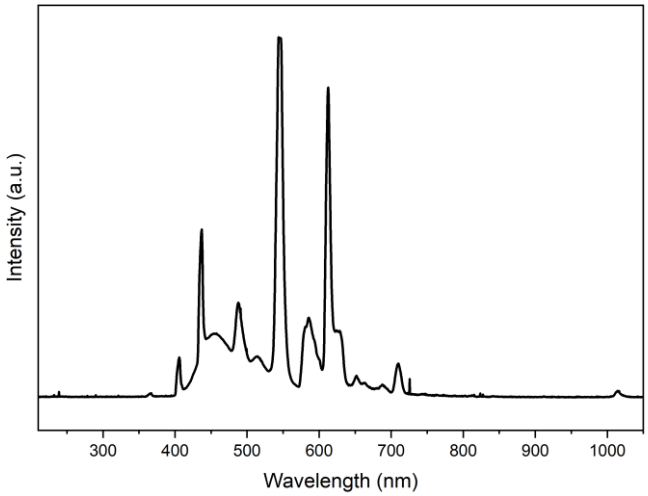
Supplementary materials



Supplementary Figure S1. Emission spectrum of the light employed in light ageing.

Methodology for color differences comparison and validation

Colorimetric data were collected using two distinct methods to evaluate color fading in pigment and paint samples.

1. ΔE_1 (calibrated image method): color coordinates (L*, a*, b*) were extracted from calibrated photographic images using Adobe Photoshop. Calibration was performed with a ColorChecker Passport under controlled lighting conditions and using (Calbrite PROFILER software, v.2.0). Color values were extracted over a 30×30-pixel area to minimize local variability. ΔE values were calculated using the CIELAB formula.

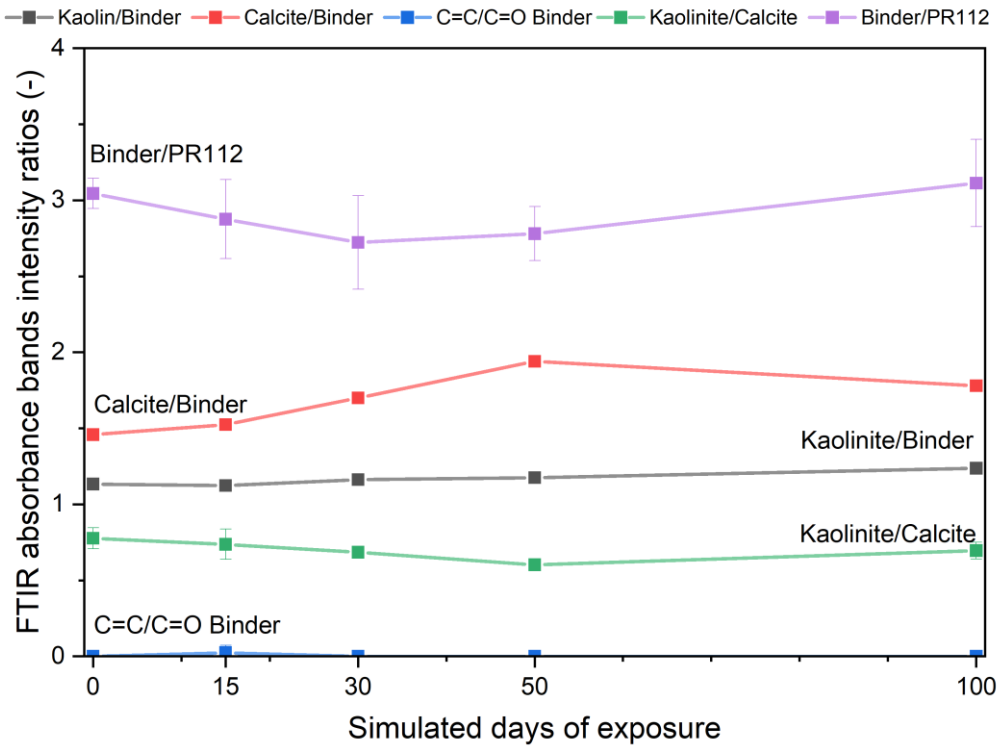
2. ΔE_2 (VIS reflectance spectroscopy method): measurements were performed using a Konica Minolta CM-2600d spectro-colorimeter (D65 illuminant, 10° observer angle, 8 mm aperture). Six replicate measurements were taken per sample, and average L*, a*, b* values were used to compute ΔE.

To validate the reliability of ΔE measurements obtained from calibrated photographic images, a subset of representative samples was selected for comparison with spectro-colorimetric data. This validation was conducted on a dedicated set of paint mock-ups applied on glass slides, where both methods could be applied reliably. The selected samples included: two red faded samples, two red reference samples, one yellow sample (high chromatic contrast with the red reference) and one orange sample (intermediate chromatic contrast). The comparison revealed a strong agreement between the two methods. The Pearson correlation coefficient is R=0.998, confirming a nearly perfect linear relationship between image-based and instrument-based ΔE values. This result validates the use of calibrated image analysis as a reliable and

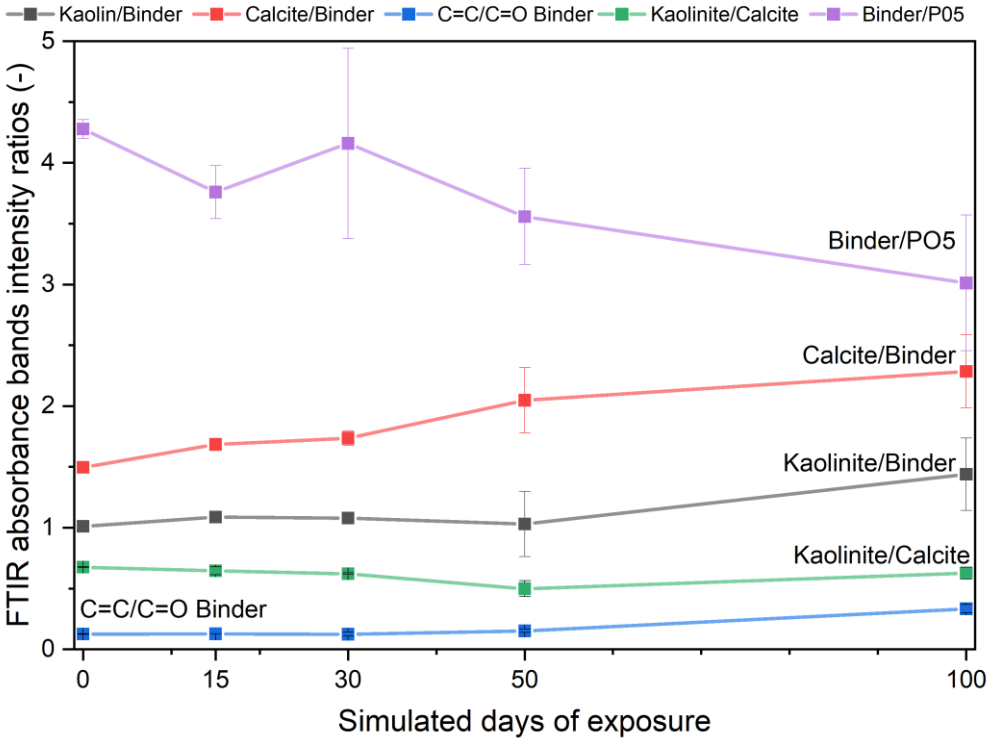
non-invasive method for assessing color differences, particularly in contexts where not feasible due to conservation requirements or the physical dimensions of the object.

Supplementary Table S1. Comparison of color difference values (ΔE) obtained from calibrated photographic images (ΔE_1) and VIS reflectance spectroscopy (ΔE_2) for various pigment and paint samples. The strong agreement between the two methods, confirmed by a Pearson correlation coefficient of 0.998, validates the use of calibrated image analysis as a reliable alternative for colorimetric evaluation in conservation studies.

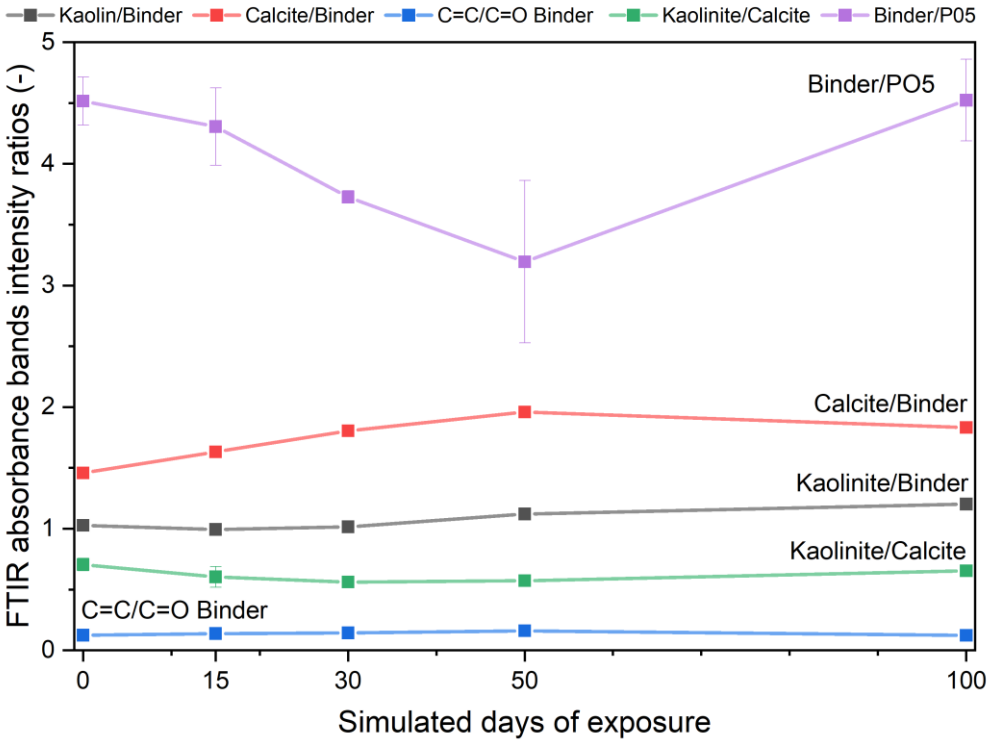
Color 1	Color 2	ΔE_1	ΔE_2	Difference
Yellow	Red Ref	87.42	87.64	-0.22
Orange	Red Ref	20.32	15.90	4.42
Faded Red	Red Ref	9.49	7.87	1.62
Red Ref	Red Ref	0	0	0
Faded Red 2	Red ref 2	11.58	10.34	1.24
Faded Red 2	Red Ref	9.27	7.98	1.29
		R=0.998		



Supplementary Figure S2. Evolution of ATR-FTIR bands' intensity ratios for red paint in uncontrolled relative humidity (DRY) aging environment at 0, 15, 30, 50, and 100 days of simulated days of exposure.



Supplementary Figure S3. Evolution of ATR-FTIR bands' intensity ratios for orange paint in high relative humidity (RH) aging environment at 0, 15, 30, 50, and 100 days of simulated days of exposure.



Supplementary Figure S4. Evolution of ATR-FTIR bands' intensity ratios for orange paint in in uncontrolled relative humidity (DRY) aging environment at 0, 15, 30, 50, and 100 days of simulated days of exposure.