

The Effect Of Cyclododecane on Aged Acrylic Paint Films

Abstract

This project studies the use of cyclododecane (CDD) as a tool for the treatment of acrylic paint films. Cyclododecane ($C_{12}H_{24}$) is a stable molecule that sublimates and does not leave residues. Cyclododecane has not been extensively used by painting conservators. CDD could be used as a temporary consolidant or a protection layer. The use of cyclododecane would allow conservators to perform treatments such as tear repairs, flattening and mechanical removal more safely by holding unstable layers in plane.

Experiment

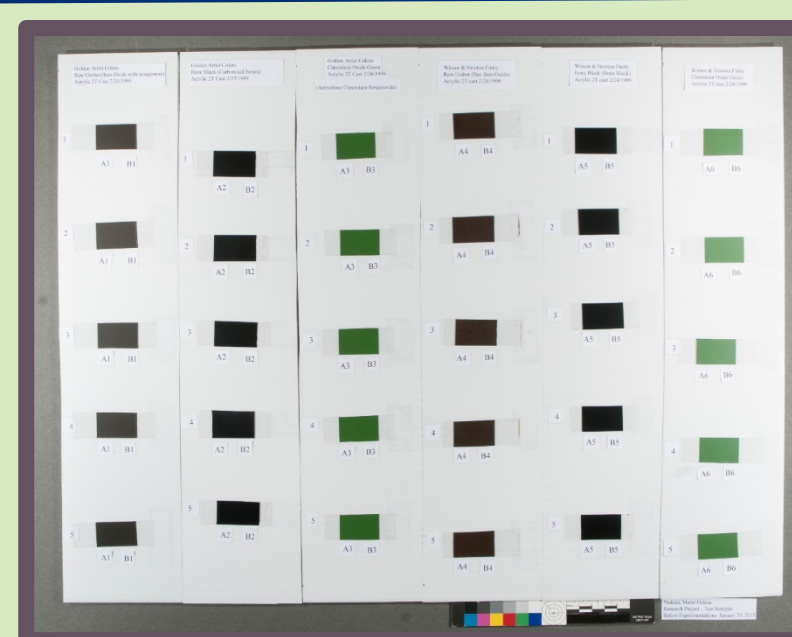
Cyclododecane was tested on two brands of acrylic paints: Golden Artists Colors Inc. and Winsor & Newton™ as they are readily available in art supplies stores for artists to use. Three pigments for each brand were tested: Iron Oxide (Umber), Bone Black and Chromium Oxide Green. The samples used have been naturally aged to evaluate how CDD affects an aged paint-film.

For each pigment from each manufacturer, five strips of samples were divided into two series: a cyclododecane-coated series (A series) and non cyclododecane-coated series (B series)

Gloss and colour measurements were performed on cyclododecane-coated and uncoated samples. In addition, Fourier transform-infrared spectroscopy (FT-IR) was performed in order to evaluate possible migrating products and the presence of residues.

Hypothesis

Using cyclododecane on acrylic paint films will be a safe tool for conservators, will not leave residues, will not alter the surface of acrylic paint films and will not induce surfactant migration.



Test Sample- before CDD Exposure

For each brand, three of the same pigments were selected. Acrylic paint samples naturally were aged for 15 years. Series B was protected from the cyclododecane spray application using a Coroplast (corrugated plastic).

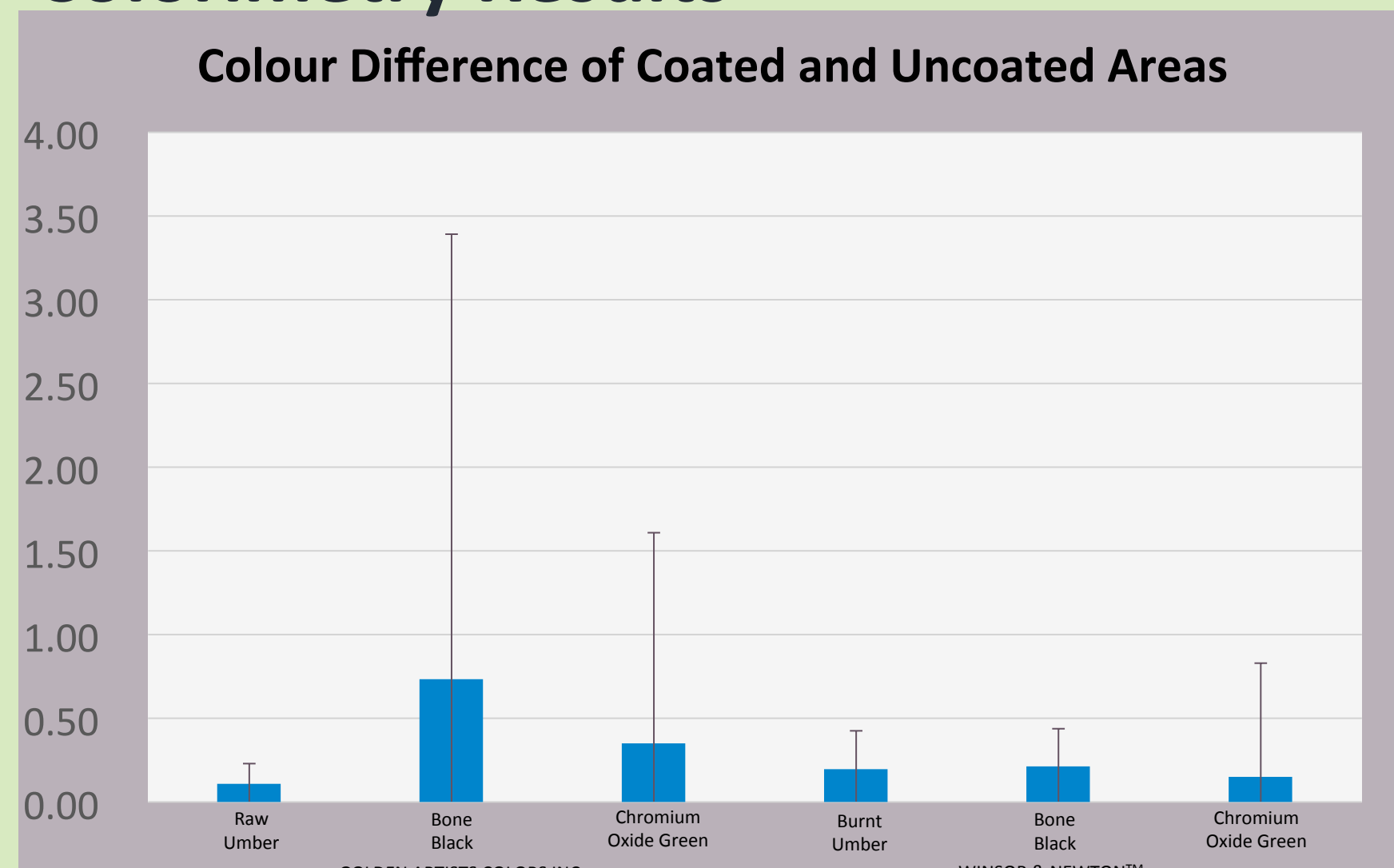


Cyclododecane Spray by Kremer Pigmente Inc.

Cyclododecane spray by Kremer Pigmente Inc. was chosen for this research. The method of application of CDD should be guided by the nature of the work. Application by spray of CDD was chosen for this research project because it is likely to be safer than other types of application (i.e.: application by melt of in mixture with solvents).

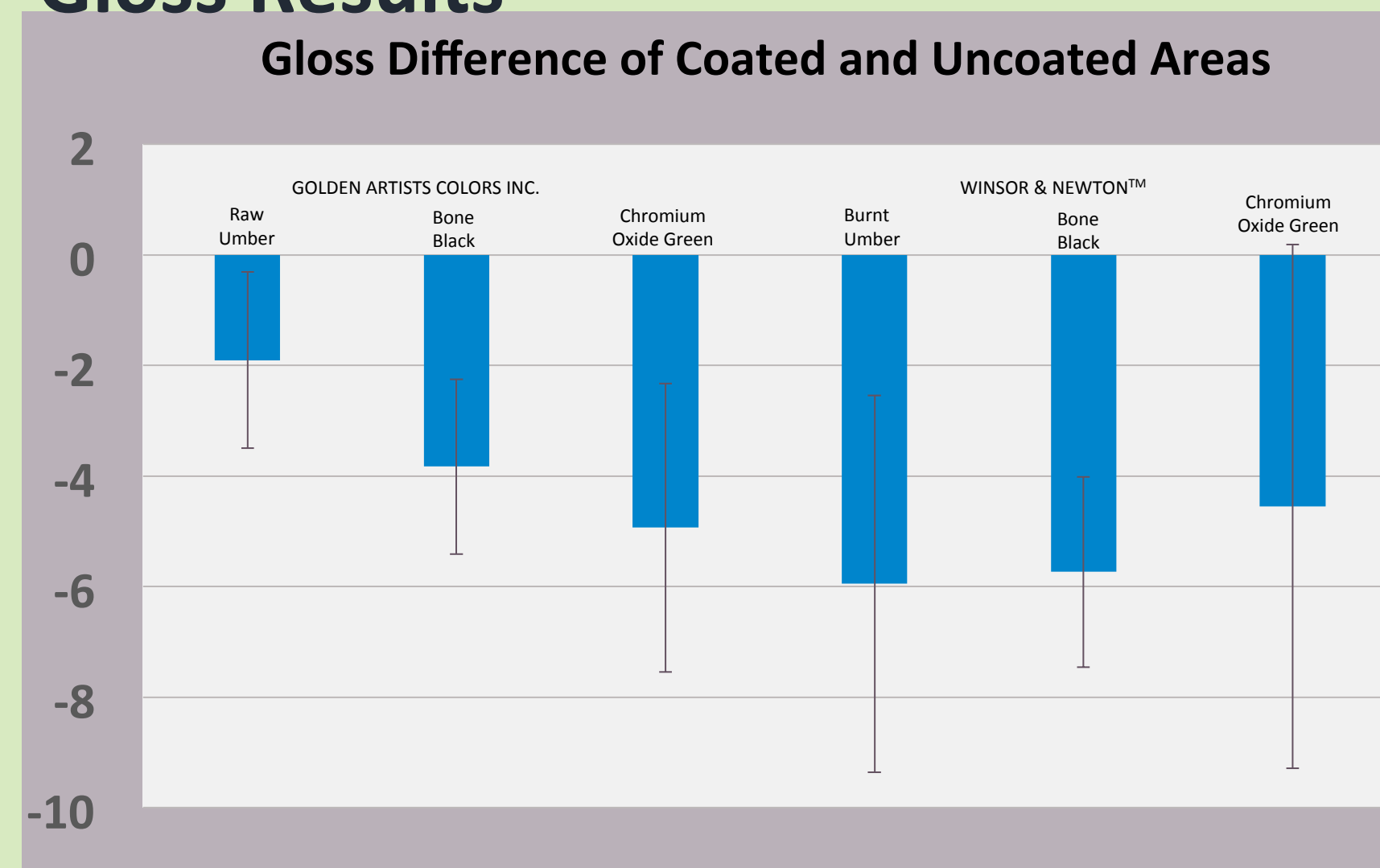
Results and Discussion

Colorimetry Results



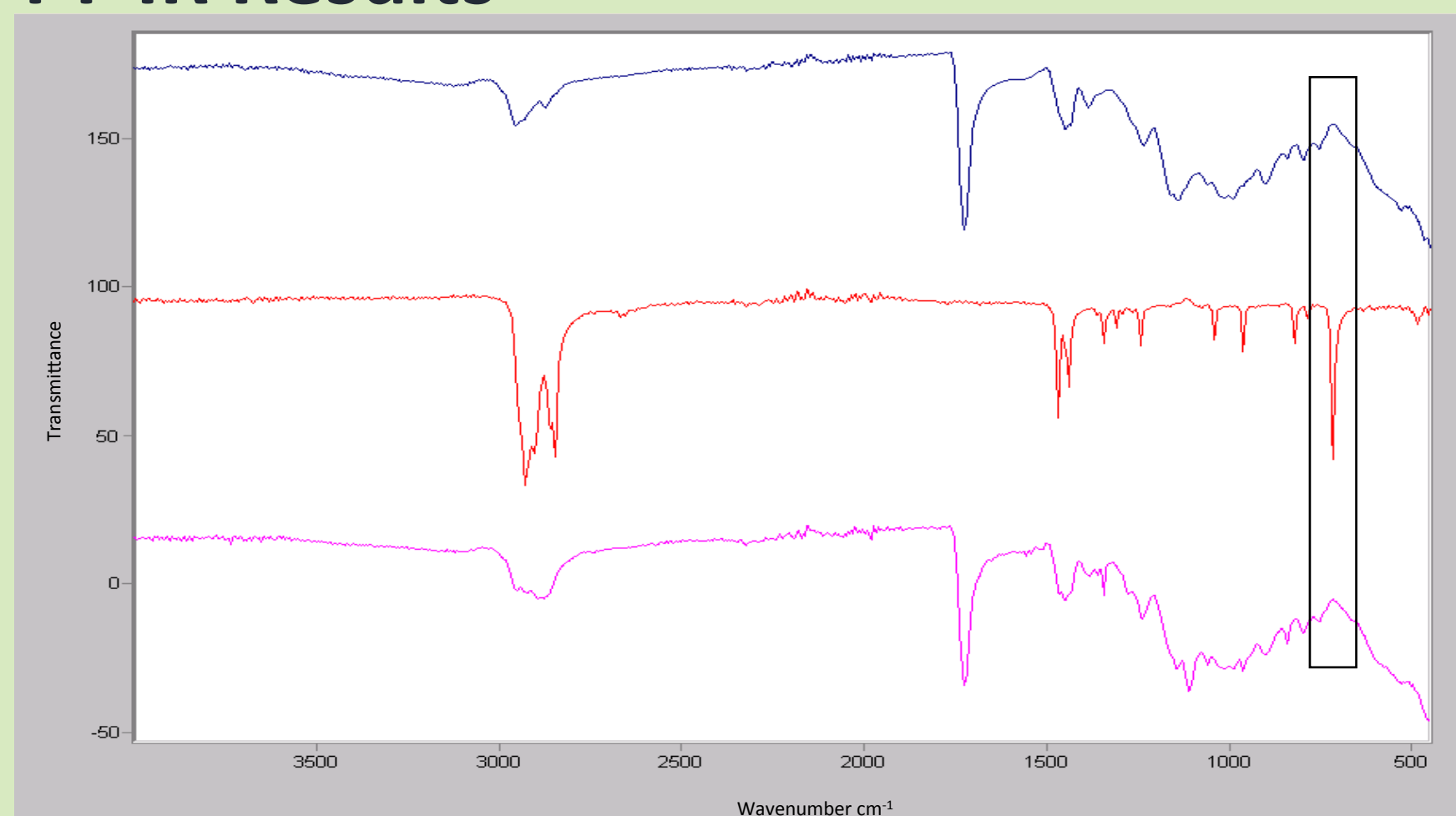
The graph above presents the results for series A and B. The color difference unit ΔE^* was calculated in accordance with CIE 2000 $L^*a^*b^*$ color difference equation. ΔE^* was less than one and no change in colour was perceptible in all cases but for Golden Artists Colors Inc. Bone Black (Carbonized Bone) and Chromium Oxide Green.

Gloss Results



The graph above presents the results for the average gloss units calculated for series A and B. The results showed that for each series there were a perceptible change in surface gloss. In each case, the change in gloss was negative indicating a decrease in gloss. The surface is therefore matter after CDD was sprayed and sublimated from the surface.

FT-IR Results



The acrylic samples were analysed for CDD residues by examining the CH_2-CH_2 bond absorption ($c.717\text{ cm}^{-1}$) where the coated sample showed strong absorption. The uncoated sample and the sample after sublimation showed no absorption in the 717 cm^{-1} position confirming there was no perceptible residues left in the sample after CDD sublimated.

Golden Artists Colors Inc. - Chromium Oxide Green

- Uncoated sample
- Coated sample
- Sample after sublimation

Preliminary Conclusions

This study showed that the commercial cyclododecane spray used affected the acrylic samples analysed. Changes in gloss were perceptible consistently throughout the population. Residues and changes in colour were not perceptible by the methods of analyses used. This research opens up other avenues for further research on cyclododecane used in painting conservation and acrylic emulsion paint.

Acknowledgements

Thank you to all the following people for their generous contributions to the success of this research project: Dr. Alison Murray, Professor Barbara Kemplan and Michael O'Malley, Michael Doutre, Scott Williams and Dr. H.F (Gus) Shurvell.

Special thanks to the Canada Graduate Scholarships-Master's Program (CGS M) and the Joseph-Armand Bombardier Canada Graduate Scholarships (SSHRC)

Contact: nadeau.m@queensu.ca © March 2015