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Outdoor Public Murals: Materials, Advocacy and Conservation

Abstract:

Mural artists in the Philadelphia Mural Art Program and students and faculty of the Winterthur/University of Delaware Program in Art Conservation are collaborating to assess the stability of materials and explore the use of protective surface coatings for outdoor murals. Public murals are subject to deterioration by natural elements, atmospheric pollutants, mechanical damage or disfigurement, and problems caused by the particular materials and methods used by the artist. Identifying methods for preserving and protecting outdoor murals is a challenge not only due to the physical size and constraints of the artworks, but also to the political, social, and aesthetic challenges that are intrinsic to public works of art. Ownership, stewardship, and consensus regarding the treatment of the artwork can present roadblocks, while funding for the care and treatment of these large scale works can seem unattainable. Despite these challenges, these collaborative efforts are developing affordable, safe, and efficient methods for the preventive conservation of outdoor murals.

This paper will outline the collaborative work among artists, students, and conservators in the Philadelphia area. It will also explore the greater scope of challenges with outdoor public murals, their significance, and their future preservation and conservation through initiatives such as Rescue Public Murals. This paper will summarize a preliminary study testing an ultraviolet-light absorbing coating that could provide protection from light exposure and weathering while providing a surface barrier to shield the paint from dirt, grime, and graffiti. Other design goals for the UV protective coating were that it be aqueous based for safe application over large areas, that it could be evenly applied and would remain clear without discoloring, and that it would be reversible using an aqueous-based system relying on a targeted pH level rather than organic solvents for safe, effective removal.

I. Introduction:

The social significance of outdoor murals

In the 1960s, social realism in art appeared in a new venue through public murals. The 1967 creation of the *Wall of Respect* is often cited as the moment when the patterns of public art changed.¹ Located on a building slated for demolition in Chicago's South Side, the *Wall of Respect* was a work created by a group of more than twenty community-minded black artists. The mural was a representation of the ethnic and political issues of the time.² Many of these early murals inspired social change through what is considered "the people's art."³ The contemporary mural movement reached out to create art for people who were unlikely to venture to museums. Muralists used their work to speak out on social issues, record history, and generate solidarity in communities. The mural movement quickly spread to other cities throughout the United States, including Boston, Los Angeles, and New York. The mural programs gained community support and enlivened neighborhoods. They have been viewed as a democratic public art form, highly visible and community focused.

In the early 1970s, mural programs such as the Social and Public Art Resource Center (SPARC) in Venice, California became models for community-building and anti-graffiti campaigns for inner-cities.⁴ Mural projects such as the Great Wall of Los Angeles⁵ enticed troubled youths off the streets and converted graffiti artists into muralists. Now after over 30 years, the Great Wall is the focus of a massive fundraising campaign for mural preservation.⁶

SPARC's initial success influenced the formation of the Philadelphia Anti-Graffiti Network (PAGN), a city-wide initiative to eradicate destructive graffiti and address neighborhood problems.⁷ PAGN evolved into the Mural Arts Program (MAP), and since its inception in the 1980s, the program has produced over 2,500 murals⁸ throughout Philadelphia. These murals have become a cherished part of the civic landscape and a

great source of inspiration to the millions of residents and visitors who encounter them each year, though public events, publications, and tours. Employing over 300 artists each year,⁹ MAP is also one of the largest employers in the Philadelphia arts community. Mural programs, such as MAP, are now in cities throughout the United States. These programs have achieved great success in their efforts to generate community support for the public murals they have created over the years; however, through lack of funding, building reconstruction, and exposure to the elements or time itself, many murals are lost each year.

The preservation of outdoor murals

In 2003, a two-day symposium, *Mural Painting and Conservation in the Americas*, was held at the Getty Center in Los Angeles to address mural painting and conservation. The event pulled together a cross-disciplinary roster of art historians, conservators, community leaders, and artists to discuss the social, artistic, and conservation challenges relating to public murals.¹⁰ In April of 2004, a follow-up meeting was held once again under the sponsorship of the Getty Conservation Institute to address the needs for a national mural preservation effort. The initial panel is identified in Figure 1 and consisted of three conservators, three muralists, Heritage Preservation President, Larry Reger, and four art historians and administrators.¹¹

The group agreed to explore a new initiative called Rescue Public Murals.¹² RPM set out to inventory outdoor murals in the United States, assess their condition, and work to preserve murals in need. One of the important issues discussed was the need for research into materials used by muralists. There have been few if any research projects in the field of conservation investigating the most resistant paints to be used for outdoor murals or examining deterioration due to light-sensitive materials or weather. As the Winterthur/University of Delaware Program in Art Conservation (WUDPAC) is only about a 45-minute drive from Philadelphia, a small group of conservation scientists, professors and several students from the WUDPAC program arranged a meeting with local muralists to discuss such issues.¹³



Fig. 1- Top Row (left to right): Leslie Rainer, Getty Conservation Institute; Meg Saligman, Muralist; Larry Reger, Heritage Preservation; Debra Lehane, Administrator; Holly Barnett-Sanchez, Administrator; Barbara Wolanin, Curator to the Architect of the Capitol in Wash., D.C.; John Weber, Muralist; Joyce Hill Stoner, Professor/Conservator of Easel Paintings WUDPAC; Paul Botello, Muralist; Front Row: Tim Drescher, Independent Scholar, Will Shank, Painting Conservator. Photo provided by Joyce Hill Stoner

In April of 2005, the WUDPAC group visited the studio of Meg Saligman, a noted muralist and advocate for the preservation and care of murals. After a brief tour of her studio, the team met with Meg and fellow muralist Josh Sarantitis to discuss materials, techniques, and other issues relating to the creation and care of murals. Meg then led the group on a tour of area murals which exemplified the various materials and issues they had discussed.

One of their first stops was at a mural known as *Dr. J* [Fig. 2]. In 1990, MAP hired California artist Kent Twitchell to paint a portrait of the basketball hero Julius Erving.¹⁴ The mural was universally applauded and helped generate grants for future mural projects. In the twenty-seven years since its completion, this mural has shown signs of deterioration. As an attempt at restoration, other artists were hired to repaint sections of the mural which were flaking; this resulted in mismatched colors and matte surfaces and obscured the once articulate shadowy outline of the figure.¹⁵

The team went on to see other murals which exemplified the various paint materials used by the artists. As an example, the untitled mural pictured in Figure 3 was painted by muralist Richard Haas using Keim paints.¹⁶ These are silicate-based paints especially formatted for masonry supports and are considered some of the most lightfast paints available.¹⁷ This mural is now 25 years old and has exhibited little fading. However, these paints have limited appeal to artists because the Keim palette is restricted to muted colors; with no deep red, orange, yellow, or violets. Artists have mentioned that Keim paints are also difficult to apply and somewhat expensive.¹⁸



Fig. 2 - *Dr. J (Julius Irving)*, Kent Twitchell, 1990. Photo by Joyce Hill Stoner.

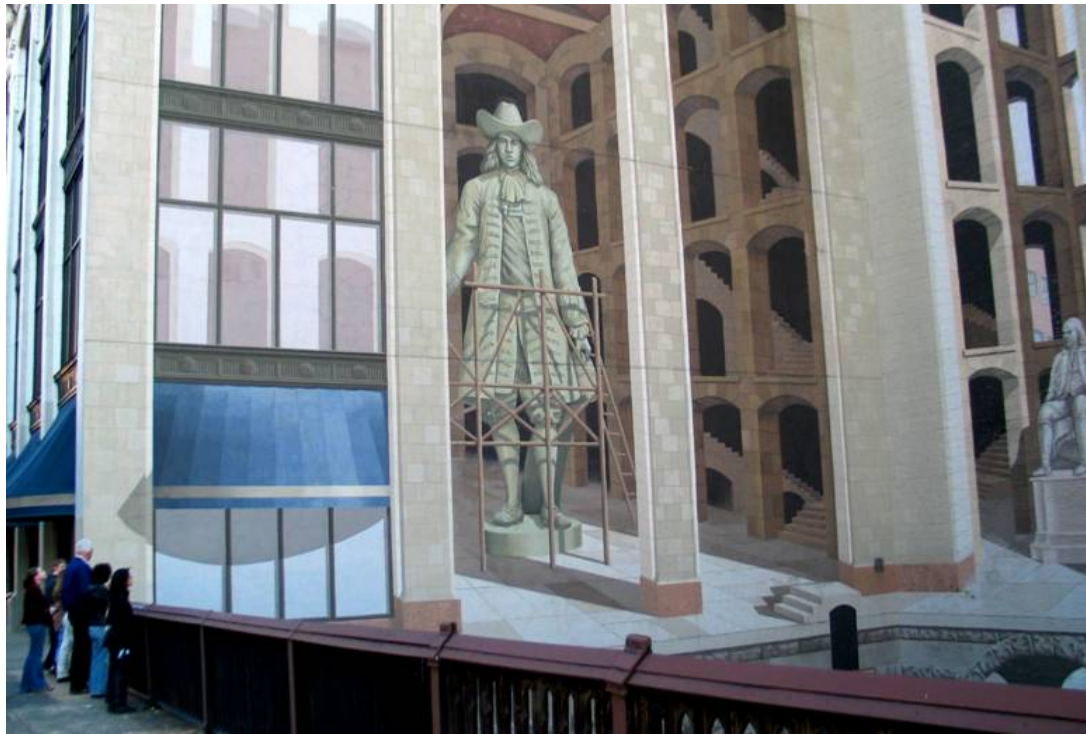


Fig. 3 - *Untitled*, Richard Haas, 1984. Photo by Joyce Hill Stoner



Fig. 4 - *Tribute to the Flag*, Meg Saligman, 2001 and cover of Sherman Williams Annual Report. Photograph and image provided by the Philadelphia Mural Arts Program and Sherman Williams Paints.

The mural in Figure 4 was created using a high performance acrylic paint known as Sher-cryl created by Sherwin-Williams. Meg Saligman was commissioned to paint this tribute to the flag as a memorial to the 9/11 terrorist attacks.¹⁹ Sherwin-Williams sponsored the mural and donated the Sher-cryl paint used to create it. The company was so proud of this mural that they featured it on the cover of their annual report.

Though these paints have high quality and lightfastness, muralists have stated that Sher-cryl paints are somewhat challenging to work with due to color change when drying and are cost prohibitive when bidding for work on public mural projects.²⁰

The group went on to see other murals in the area, including a second mural by Meg Saligman *Philadelphia Muses*. This mural was rendered in Nova Color artist's acrylic paints, a favored paint used by mural artists.²¹ Not only does Nova Color come in an expanded palette of varying colors, but the artists like the way the paint mixes and handles during use. It is cost effective, and the colors are listed as having the highest level of lightfastness.²² However, despite the company's claims, artists have noted that Nova Color murals are prematurely fading and chalking [Fig 5]. Fading is considered by Meg to be a greater detriment to her artwork than flaking. Muralists recognize the extreme conditions under which their



Fig 5 – Detail of Richard Wolbers pointing out chalking and fading on paint surface to the artist, Meg Saligman. Photo of *Philadelphia Muses*, Meg Saligman, 1998 by Joyce Hill Stoner, 2005



Fig. 6 – *Common Threads*, Meg Saligman, 1998. Comparison of photographs to show fading of paint colors between the image taken for publication (Photograph by David Graham and Jack Ramsdale) shortly after completion in 1998 with an image taken in 2005 (photo by Jovce Hill Stoner).

works exist and are apparently more understanding of physical damage to their work than the material fading of their images.

Meg Saligman escorted the group to one of her most popular murals, in fact, the largest and most prominent mural created for MAP. Completed in 1998, *Common Threads* unites allegory and portraiture [Fig. 6]. The students featured in the mural are from the Philadelphia High School for the Creative and Performing Arts.²³ They are depicted imitating the postures of historical figurines. From the selection of the wall to the inception and implementation of Meg's design, *Common Threads* is a wonderful example of the collaboration between a community, the artist, and the mural program in the creation of an inspiring work of art. Of great concern however, is the degree of fading that has occurred in the image since its completion in 1998.

In Figure 6, a more recent photograph is shown in comparison to one taken for publication shortly after its completion. Though the publication photo is more saturated,

one can still perceive how much fading has occurred in the image over the years since its completion, especially in the magenta, blue, and yellow colors, with the most significant fading visible in those colors mixed with titanium white.

Muralists are aware of alternative methods of applying paints which could reduce fading, such as applying paint using a sort of watercolor technique, which was the method used to create a commemorative mural for the Wills Eye Hospital in Philadelphia.²⁴ The mural was painted in 1991 using Nova Color paints. The paints were applied in translucent glazes over a white ground leaving the whites in reserve rather than mixing the colors with titanium white. This mural has exhibited minimal fading over the fifteen years since it was first painted.

Muralists have also considered other techniques, such as using mosaic tiles to create images instead of using paints. Some artists, including Meg Saligman, dismiss such alternatives, for as Saligman stated “painters love the process of painting.”²⁵ These artists need a greater understanding of the limitations of the materials available, to enable them to make educated decisions regarding the materials they use and helping them to preserve their murals longer than the current 15- to 20-year expectancy.

The visit served as a catalyst for a collaborative project between the Philadelphia artists and the WUDPAC program. The project began as a summer research project for University of Delaware undergraduate student, Jessica Keister. Ms Keister worked with professors and scientists in the program to investigate the fading of outdoor mural paints. The experiment was set up to investigate the photo-reactive effect of titanium dioxide and the possible use of ultraviolet inhibitors to prevent or reduce fading. Four common brands of mural paints used by local muralists were selected and exposed to the elements for a period of over nine months. The tests were conducted on the grounds of the Winterthur Museum and involved over 900 samples. The results collected in Mrs. Keister’s report confirmed that the addition of titanium dioxide accelerated paint film fading. The results also indicated that the addition of a UV inhibiting coating was effective for reducing fading.²⁶ The project has been extended beyond this initial testing and continues to be

monitored by Dr. Joseph Weber, University of Delaware Professor and Scientist at Winterthur's Science Research and Analysis Laboratory (SRAL).

The testing of the UV absorber within the protective coating of the samples was promising but limited to solvent-based coatings. The use of solvent-based coatings is of concern on large-scale projects, not only due to the surface area and drying times, but also due to the health hazards for the individuals applying it and for the environment. My project was developed as a second-year research project in preventive conservation to test an aqueous-based UV-inhibiting coating specifically designed for outdoor murals. Of specific interest was the creation of an aqueous-based coating which could be removed using an aqueous solution buffered to an appropriate pH, rather than using solvent-based solutions.

II. Developing a protective coating:

This project evolved in part from two previous research papers by WUDPAC students. The first was the previously mentioned research, "*The Investigation of Fading in Outdoor Murals: The Photo-Reactive Effect of Titanium Dioxide and Possible Use of Ultraviolet Inhibitors*" by Jessica E. Keister. As part of her research, Ms. Keister devised preparatory experiments to monitor the performance of protective coatings on select Nova Color acrylic mural paints. Two of the coatings she tested were Golden MSA with UVLS (Ultra Violet Light Stabilizers) and Paraloid B-72 with Ciba 777 UVA (Ultra Violet Absorber), both of which were effective at preventing fading in the exposed painted samples. The second was Christina Ritschel's independent study project in preventive conservation titled: "*Ultraviolet-light absorbing coating for Historic Windows.*" Her project investigated the effectiveness of an aqueous-based, brush-applied, UV-absorbing coating developed specifically for application on historic window panes with a reversibility based on pH levels in aqueous solutions instead of organic solvents. In this study, the coating samples were subjected to a multi-step aging process and the transmission of UV light was measured along with any changes in optical properties.

The formula for this project was adapted from the one developed by Richard Wolbers for UV protection in historic glass window panes. Avalure 315 was selected as the polymer to create a coating that could be reversed using an aqueous-based solution facilitated by a slightly alkaline pH of about 9. Maintaining a pH around this level was critical not only for the reversal of the coating, but also to reduce swelling of the painted surface.²⁷

In order to ascertain the benefits and concerns that a protective coating could provide for outdoor murals, I met with the head of the Philadelphia Mural Arts Program, Jane Golden, Meg Saligman and Heritage Preservation's co-chair of the Rescue Public Murals (RPM) program, Kristin Overbeck Laise. The group expressed concern for ease of application, safety of materials, effectiveness as a protective barrier against ultraviolet-light and weather, protection from tagging by graffiti artists, low maintenance, minimal cost, reversibility, and clarity to minimize color shifts and yellowing.

Ideally the coating would be one which not only protected the mural but also could be applied and maintained without great cost. Funding is limited and so the potential of an aqueous-based coating which meets all of these essential elements would benefit mural programs greatly. Many of the coating options currently available fail to meet all of these specifications. Anti-graffiti coatings can protect against tagging, but they often yellow quickly and can cause delamination of the paint film as the coating deteriorates. Other coatings work temporarily, but often yellow, peel, or become irreversible as they age. Research into effective, lightfast protective coatings for outdoor murals is being carried out by manufacturers such as Golden Paints and through institutions such as the Getty Conservation Research Center in Los Angeles,²⁸ but the studies are generally limited to solvent-based coatings. The primary goal of this research is to investigate an alternative coating which is both ecologically sympathetic and uniformly protective of the mural surface.

UV absorbers for protective coatings

Light stabilizers are classified according to their mode of action: ultraviolet light absorbers (UVAs) act by shielding the paint from ultraviolet light, while hindered amine (or amide) light stabilizers (HALS) act by scavenging the radical intermediates formed in the photo-oxidation process.²⁹ This experiment was limited to the use of UVAs only in order to provide a baseline of research into their effectiveness at blocking ultraviolet light. By excluding other ingredients, such as HALS, testing could be made at a base level, enabling future research to be built on the results of the simplest formulation of the coating.

In commercial industries, clear top-coats are often applied for the protection of underlying paints and surfaces from abrasion, scratches, moisture, atmospheric gases, and ultraviolet light. UV absorbers (UVAs) convert the energy absorbed from UV light into heat via a mechanism called keto-enol tautomerism. The heat then dissipates through the coating without affecting the paint layer beneath.³⁰ As an example, the cyclic mechanism diagrammed in Figure 7³¹ below indicates how a particular UVA absorbs UV light causing heat to be dissipated through vibrational energy. It is based on this mechanism that UVAs remain active during the life-time of the coating.

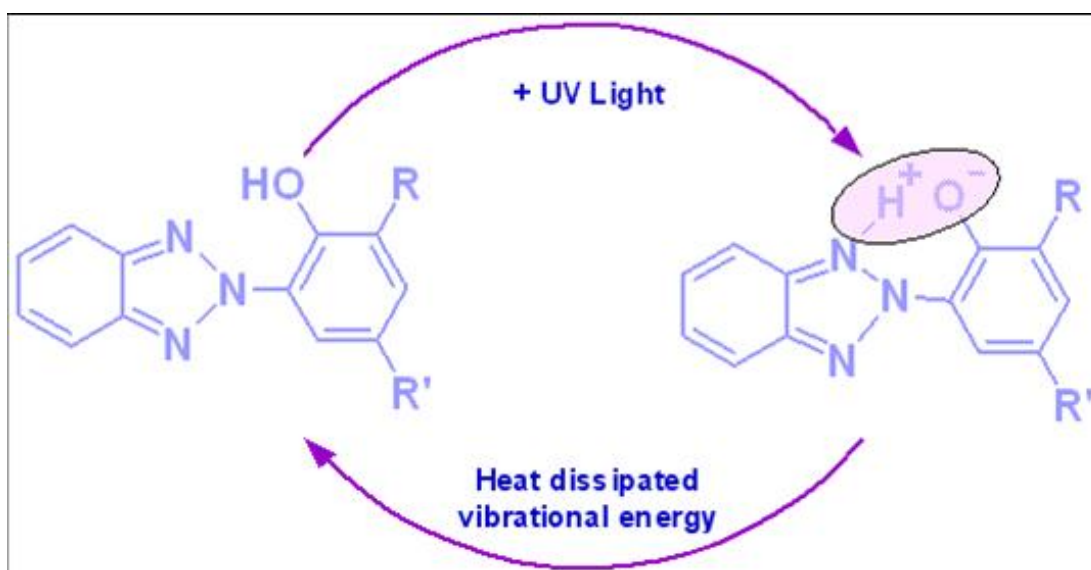


Fig. 7 - Energy dissipation in hydroxyphenyl-benzotriazol UV Absorbers

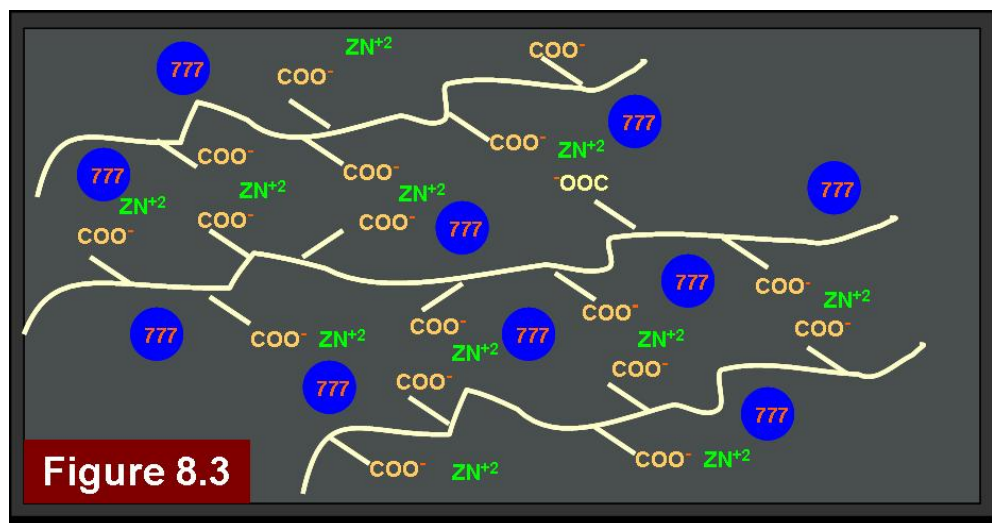
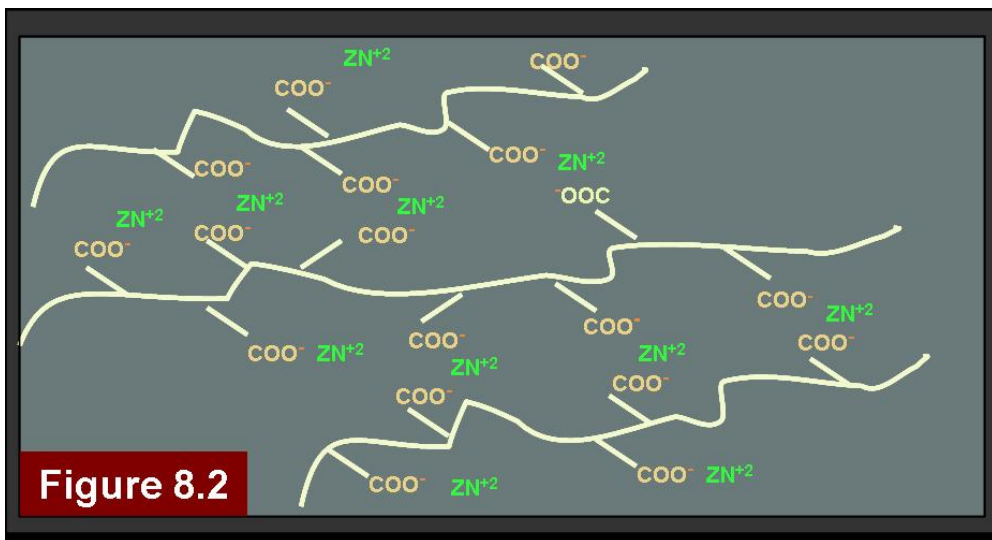
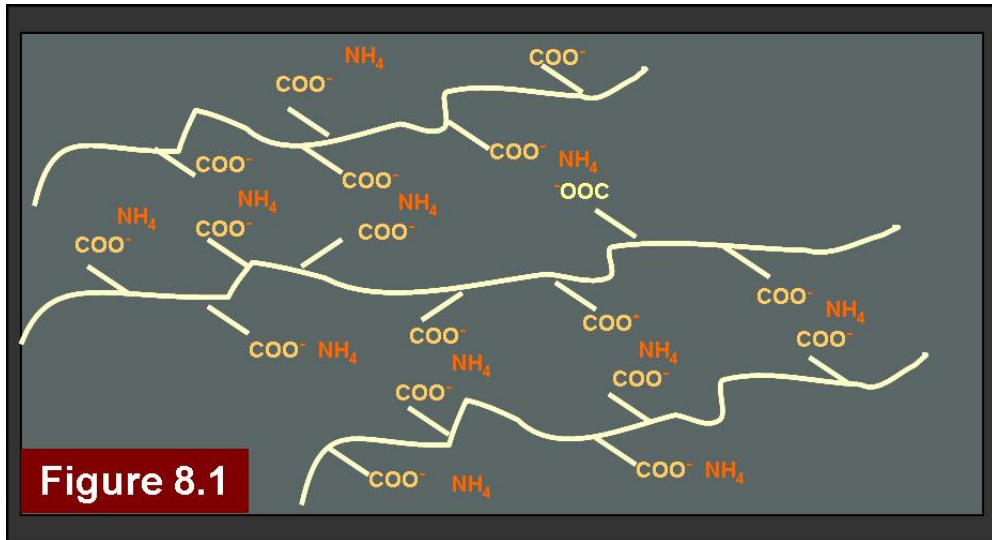
Preparation of the coating

The carboxylic acid groups of the Avalure 315 polymer were first ionized by the addition of a base, ammonium hydroxide [Fig. 8.1]. Zinc carbonate was then added to cross-link the polymer, creating a tougher film which would stand up to exposure to the elements while facilitating reversibility using a chelating solution [Fig 8.2]. The zinc carbonate acts as a lynch-pin within the polymer film, linking the strands of the polymer together at random sites. Finally the UV absorber was added to protect the paint film from photo-degradation [Fig. 8.3]. Together, these ingredients created a film which could be reversed using an aqueous chelating solution buffered to a relative pH of 9, utilizing both the slightly alkaline pH levels to ionize the acid groups in the polymer in conjunction with the chelating agent's formation with the zinc to remove the coating. The reversibility of the coating at this alkaline level of pH means the coating is unaffected by acid rain and that it is within a safe working zone for the paint film beneath.

The UV absorber used is manufactured by Ciba Specialty Chemicals. It is a Triazine, one of the more durable UV absorbers for use in protecting pigments. The experimental coating was tested using transmitted ultraviolet-visible spectroscopy and determined to effectively absorb UV light between 290-350nm.³²

III. Experimental Design

Nova Color mural paints were selected for the experiment due to their popularity among artists and due to the number of the murals rendered in this paint in the Philadelphia area. The substrate selected was Lutrador,[®] a non-woven polyester fabric that some muralists use as a support.³³ The fabric gives them the flexibility of rendering the initial image off site and then applying it to the wall prior to final painting. Forty-five colors were



selected from the Nova Color palette. The paint colors were first rolled onto the polyester non-woven fabric and given time to dry before a second coat was brush applied to create a textured surface.

The paint colors were first rolled onto 16 x 38" pre-cut sheets of the polyester Lutrador fabric, let to dry, and then a second coat was applied using a two-inch foam brush to create a textured surface. Due to time restraints, the initial aging tests performed in this study were done on only seven colors and the remaining paint-outs were placed in dark storage for use in future research experiments.

To test the coating in outdoor weathering conditions, we met with Meg Saligman in late October 2006 to revisit some of the previously mentioned murals and apply test areas of the coating. The first mural selected was one painted by Philadelphia artist, Josh Sarantetis, entitled, *Metamorphosis*. Completed in 2001, the mural is located on the walls of the Ridge Avenue Shelter for homeless men.³⁴ The mural is particularly symbolic to the residents of the shelter; the gigantic butterflies attached to its surface were crafted by men living there. They participated in the creative process of the mural and feel a sense of ownership due to their involvement.³⁵ A discrete area of the mural was selected to receive the protective coating, indicated by the red box in Figure 9. The section was taped off and the coating rolled onto the surface. Next we selected the mural of *Dr. J*, painted by Kent Twitchell. The area that received the coating is highlighted in red, illustrated in Figure 10 before and after the coating was applied.

Light aging equipment

An Atlas SunCheck weathering oven with a xenon arc lamp was used to simulate ultraviolet light exposure for the painted samples. An Atlas Multimonitor was connected to the oven and used to measure the UV transmittance in the 295-400nm range. The electrical current of the weathering oven was measured in amperes which were displayed on the oven and an internal timing device was used to control exposure times.

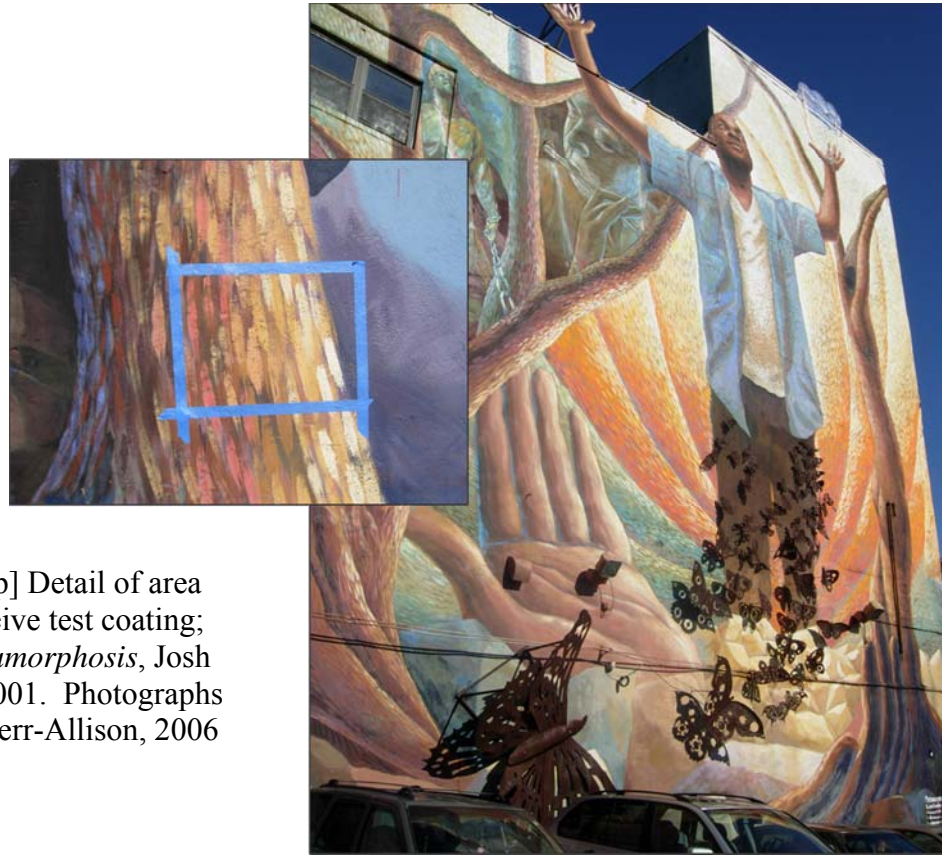


Fig. 9 – [Top] Detail of area taped to receive test coating; [Right] *Metamorphosis*, Josh Sarantitis, 2001. Photographs by Amber Kerr-Allison, 2006



Fig. 10 – [Top] Detail of area where test coating was applied ; [left] *Dr. J (Julius Irving)*, Kent Twitchell, 1990. Photographs by Amber Kerr-Allison, 2006

Each sample square was then light aged to replicate approximately ten years of outdoor light exposure. The samples were positioned face up in the Atlas SunCheck weathering oven with the Multimonitor positioned in an area which was not being monitored for color or gloss changes [Fig. 11]. The timer was set to 72 hours of irradiance, amperes at 6.3, maintained at 3.7w/m^2 and monitored twice daily.

Color measurement

A Minolta Chroma Meter CR400 colorimeter using the CIE*Lab76 color system, with a D65 standard illuminant and 10° standard observer was used to obtain values for luminance (L^*), a^* , and b^* before and after exposure. The portable unit could be transported on-site to test the surface coatings applied to the outdoor murals. The colorimeter was calibrated prior to each use and measurements automatically converted to a CIE $L^*a^*b^*$ color system for comparison to designated standards. These values are derived from the tristimulus values and give a visualized idea of the color change in the sample. The overall color difference (ΔE) between the initial measurements and those taken after exposure were calculated using the equation.³⁶



Fig. 11 - Atlas SunChex weathering oven with a xenon arc lamp.

$$\Delta E = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2}$$

The human eye can usually detect a color difference of around 1-1.5 ΔE units.

A template was designed to secure each of the control-aged samples in place. The template had twelve circular openings through which the colorimeter could take its readings, six uncoated sites and six coated sites [Fig. 12]. The samples were positioned in place with key markers which lined up and guided the placement of the template on the

surface of the sample. This provided more precise, repetitive measurements across the surface prior to and after exposure. No initial readings were taken at the on-site mural locations as the colorimeter failed to operate without a battery. Readings were taken at these locations at the end of the experiment to provide a baseline for future color difference measurements.

Gloss measurement

A Horiba Gloss Checker IG-320 was used to measure change in gloss to the coated and uncoated surfaces before and after exposure. This unit has a measurement range of 0.0 to 100.0, with a 3 ½" digit LCD display and an elliptical measurement area of 12 x 6 mm. The optical system has an incidence angle to viewing angle of 60° to 60° with an LED light source. The photodetector is a silicon photodiode with a measurement precision reproducibility of ± 1 digit. The power source is a nine-volt battery.



Fig. 12 – Template was used to measure designated areas of the coated and uncoated surface.

The gloss meter was calibrated prior to each measurement. Each sample color was measured sixteen times, eight times on the coated areas and eight times on the uncoated areas. An average reading for both the coated and uncoated areas was calculated before and after exposure to light aging, and the difference between the two values was calculated.

Reversibility of coating

The reversibility of the coating was tested using 0.5% aqueous chelating solutions of both citrate and EDTA at a relative pH of 9. This was to confirm the effectiveness of using the combination of a slightly alkaline pH level to ionize the carboxylic acid groups in the polymer with the interaction of the chelating agent and zinc for removing the coating

from the paint film. The solutions were applied to the surface using a rolled-cotton swab. Fourier Transform Infrared Spectroscopy (FTIR) was used in to detect whether there was a reduction in peaks associated with the coating during the reversibility testing.

IV. Results and discussion

The initial findings collected for the naturally exposed samples are promising. The coating has lasted through the freeze/thaw cycles of nearly one year. There are no indications of delamination, yellowing, or crazing, and the coating saturated areas of color that had previously appeared faded.

The initial findings collected from the artificially aged samples showed that neither the coated nor the uncoated painted samples exhibited any signs of significant fading after the equivalent of 10 years of light exposure. The calculated ΔE for the sampled areas remained below the 1 to 1.5 ΔE noticeable by the human eye, with 0.67 as the average ΔE calculated for the all the coated samples, and 0.56 as the overall ΔE calculated for the uncoated samples.³⁷

Gloss measurements were also taken to determine whether there had been any change in the surface of the coated and uncoated samples. On average the coated measurements showed little if any significant changes in gloss with an averaged gloss measurement change of $+0.3$. Some of the uncoated samples did show a slight change in gloss after light exposure, but the average gloss change measured for uncoated samples was only $+1.3$.

The lack of fading in the paint samples after light exposure led to speculations that the sample had not been aged long enough or under the right conditions to trigger the fading, or that there may be other factors contributing to the mechanism and/or appearance of the faded murals. It is known that exposure to outside elements, sun and pollution, causes the surface of the paints to become irregular and pitted. This would cause light to scatter

giving the appearance of fading due to the scattering effect [Fig. 13.1]. When the coating was applied to the faded surfaces of the outdoor murals it provided a saturated even appearance to the irregular paint surface, enabling rays of light to pass uninterrupted through the coating and reflect off the painted surface without scattering [Fig. 13.2]. To test this possibility samples were taken from an uncoated area of the *Metamorphosis* mural by Josh Sarantitis.

SEM/EDS was used to image the painted surface of the sample [Fig.14] and crystalline structures were found forming on the surface, pictured at 1000X magnification. The images also confirmed the irregular and pitted surface of the weathered paint. EDS spectra on the weathered paint and crystalline particles were compared. The spectra showed that chlorine, magnesium, and an increased amount of calcium were found only in the particles. These elements suggest the presence of salts on the paint surface. This is a common occurrence on outdoor painted surfaces; salts form due to moisture causing deterioration and a hazy, faded look to the paint.³⁸

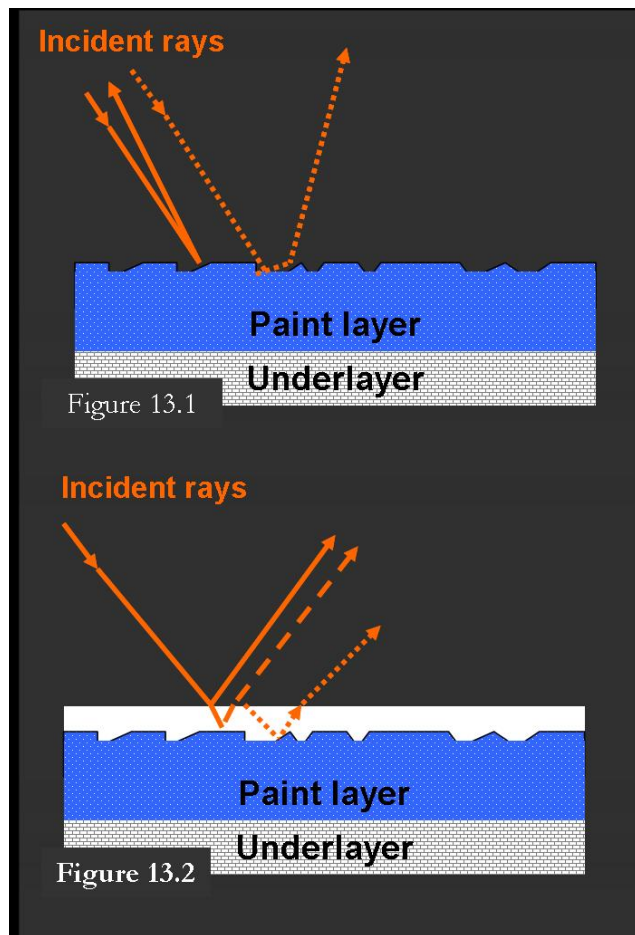


Fig. 13 – [13.1] Weathered surface showing light scattering off pitted surface of paint. [13.2] Coated surface indicating light reflecting through coating, giving a more saturated appearance to the paint.

The reversibility of the coating was tested using 0.5% aqueous chelating solutions of both citrate and EDTA at an approximate pH of 9. This was to confirm the effectiveness of using the combination of a slightly alkaline pH level to ionize the carboxylic acid groups in the polymer with the interaction of the chelating agent, and zinc for removing the coating from the paint film.

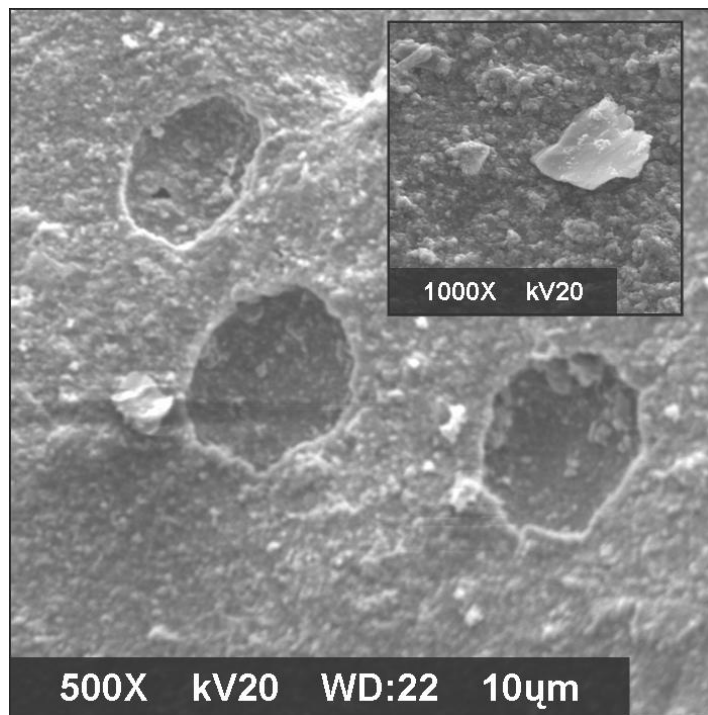


Fig. 14 – SEM image of surface at 500X of sample taken from uncoated surface area of *Metamorphosis*, Josh Sarantitis, 2001. Insert detail of crystalline material found on surface at 1000x.

FTIR was used to determine the effectiveness of the aqueous solution. Comparing spectra between uncoated and coated paint samples shows a reduction in two specific peaks that are attributed to the carboxylate ions within the coating [Fig. 15]. These peaks were greatly reduced by the EDTA solution buffered to a pH of 9. These results indicate the effectiveness of an aqueous chelating solution for reversing the coating.

V. Future Research

The preliminary results of the coating are encouraging and have prompted many ideas for future avenues of research such as the addition of hindered amine light stabilizers which act as scavengers of free radicals in the coating due to UV exposure. They do not absorb UV radiation, but act to inhibit degradation of the coating, thus extending its durability. They also protect the coating from thermal degradation and can be used as a thermal stabilizer. Additional consideration has been given to the inclusion of carbon nanotubes in the coating to reduce static electrical charges and decrease the amount of dirt and

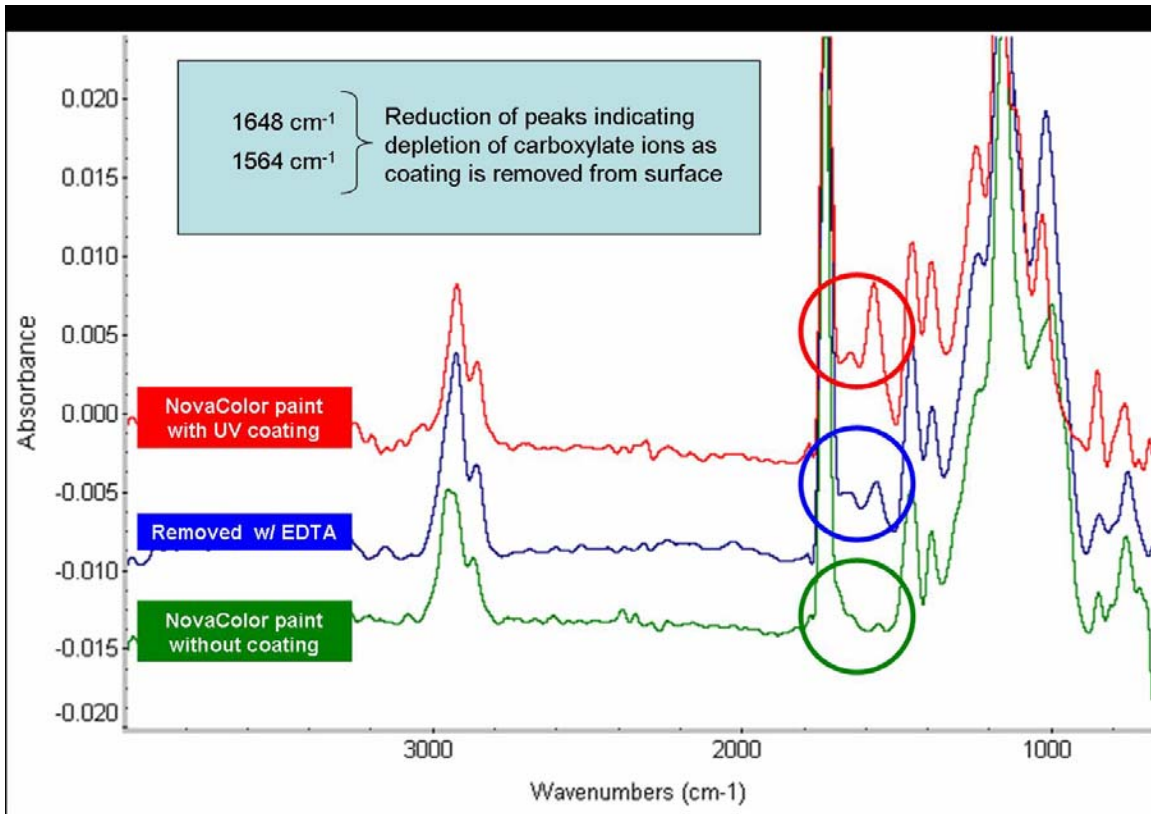


Fig. 15 – Comparative FTIR spectra taken as coating was removed from surface with EDTA buffered to a pH of approximately 9.

grime attracted to the surface, as well as continued research into the reversibility of the coating using pyrolysis GCMS and targeted research to determine the coating's effectiveness as an anti-graffiti coating. What is most clear is that studies into identifying new materials for the protection and maintenance of outdoor murals must continue to be pursued.

Advocacy and public outreach

In December of 2006, RPM announced its formation under the auspices of Heritage Preservation in Washington, DC. Individuals and communities are invited to submit information about public murals, particularly those that appear to be in poor condition. Anyone interested in participating in the documentation or nomination of a mural can contact RPM by visiting the website at RescuePublicMurals@heritagepreservation.org.

RPM's first official committee meeting was hosted by the Getty Conservation Institute (GCI) in April of 2007 to identify the crucial steps to be taken to preserve and protect outdoor murals. As part of the initial effort, a subcommittee has been created to research materials used in the construction of outdoor murals. Within days of this meeting the GCI sponsored a two-day symposium which brought together conservators, scientists, muralists, and manufacturers to visit murals in the Los Angeles area and discuss materials for future research and conservation issues for outdoor murals.³⁹ Research into materials and their effectiveness at sustaining and protecting murals is keenly needed.

Many of the hundreds of mural art masterpieces from the 1970s and 1980s are in serious disrepair; without prompt attention they will vanish. Efforts to identify new materials for the protection and maintenance of outdoor murals will be essential to their preservation, and it is hoped that research such as this will serve as a catalyst for additional studies into the potential benefits of protective coatings that will help preserve these cultural treasures.

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