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Anti-Graffiti Protection Systems

Prepared By
Yasser A. Khodair, Ph.D., P.E.
Muddassir M. Ahmed
Vinay S. Perala
Mohammed S. Shareef
Bradley University

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Yasser A. Khodair (https://orcid.org/0000-0001-9233-0071), Muddassir M. Ahmed, Vinay S. Perala, Mohammed S. Shareef	ICT-24-022 UILU-2024-2022

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16. Abstract

Anti-graffiti coatings provide a shielding layer that facilitates the removal of graffiti by providing a water-and oil-resistant surface that precludes the penetration of paint through the substrate. The main objective of this research is to provide the Illinois Department of Transportation (IDOT) with recommendations on the re-evaluation of the existing moratorium on anti-graffiti protection systems and the best practices of their usage. A survey of the state of the practice on anti-graffiti protection systems that targeted the North Central States Consortium for Midwest state departments of transportation was conducted. The responses of six states were summarized and fully analyzed, highlighting the pros and cons of each product. A comprehensive market survey of the best anti-graffiti coatings available in the market, their characteristics, advantages and disadvantages, and best practices adopted in using them was performed. Moreover, the anti-graffiti protection coatings applied in Illinois construction projects during the past 14 years were summarized. The research comprised a study of graffiti-removal techniques, such as physical, chemical, and biological techniques. Furthermore, the researchers classified all studied products based on their type (sacrificial vs. non-sacrificial) and ranked them based on the combined effect of their surface applicability, volatile organic compound content, and cost. Flowcharts that categorize anti-graffiti protection systems based on their types, porosity of the substrate, volatile organic compound content, removal techniques, and cost were developed to guide IDOT in selecting the most appropriate anti-graffiti coating for a certain project. The research concluded that the existing moratorium placed by IDOT on the usage of anti-graffiti protection systems should be lifted and recommended a set of anti-graffiti coatings that can be used with multiple surface applications as well as identified their characteristics and optimal procedures for their usage.

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Members of the Technical Review Panel (TRP) were the following:

- Mark Shaffer, TRP Chair, Illinois Department of Transportation
- Dan Gancarz, Illinois Department of Transportation
- Derrick Lopez, Illinois Department of Transportation
- Steve Mastny, Illinois Department of Transportation
- Kelly Senger, Illinois Department of Transportation
- Frank Sharpe, Federal Highway Administration
- Anthony Wagner, Illinois Department of Transportation
- Dan Zerrusen, Illinois Department of Transportation

EXECUTIVE SUMMARY

Anti-graffiti coatings provide a protective layer that makes the removal of graffiti an easier process by providing a hydrophobic (water repellent) and oleophobic (oil repellent) surface that prevents the penetration of paint through the underlying surface. There are three types of anti-graffiti protection systems: sacrificial (removed during the graffiti-removal process and reapplied after each cleaning cycle), semipermanent (two-layer systems built with a permanent coat followed by a second self-sacrificing coat), and permanent (can withstand repeated cleaning cycles without damaging the substrate surface).

The primary goals of this research were to provide the Illinois Department of Transportation (IDOT) with detailed information related to the usage of anti-graffiti protection coatings in other states as well as best techniques for their usage and best products available in the market. The researchers conducted a survey of current practices adopted by state DOTs; a synthesis of current anti-graffiti protection systems by performing a market survey of current anti-graffiti coatings, their specifications, cost, application requirements, and pros and cons; and a study of anti-graffiti coatings used in Illinois construction projects during the past 14 years. Based on this information, recommendations on the re-evaluation of the existing moratorium placed by IDOT on the use of anti-graffiti protection systems were provided.

The survey of the state of the practice on the usage of anti-graffiti protection systems included 47 questions related to the type of anti-graffiti coatings used, their chemical composition, method of application and removal, advantages and disadvantages, and best practices of their usage. The survey was disseminated to the North Central States Consortium for state DOTs in the Midwest, where six states (Minnesota, Kansas, Michigan, Wisconsin, Iowa, and Indiana) responded. The results from the survey were summarized and fully analyzed. The survey responses identified eight non-sacrificial anti-graffiti products that have been used by the six states. The data collected from the survey included the type of product, chemical composition, surface compatibility, state(s) using it, cost, volatile organic compound (VOC) content, cleaning agents, whether a primer is needed, drying time, application temperature, and advantages and disadvantages. Some of these properties were used in ranking these products.

Additionally, the market survey included the properties of the best 10 anti-graffiti products in the market, which were summarized, ranked, and fully analyzed. The properties of the studied products were collected, including the type of product (sacrificial versus non-sacrificial), surface compatibility, VOC content, advantages and disadvantages, and technical specifications, which include application temperature, water vapor transmission, color of the product, and cost. The anti-graffiti protection coatings that were applied in Illinois construction projects during the past 14 years were gathered from contract drawings available on IDOT's website. The properties of these coatings were obtained from the suppliers. The data collected from the projects' contract drawings were used to identify seven products, which were summarized and fully analyzed by collecting their properties from the suppliers' product sheets.

Moreover, three major graffiti-removal techniques were identified: physical, chemical, and biological cleaning methods. Physical techniques include traditional methods such as pressurized water jets, sandblasting, and soda blasting, while chemical techniques include the use of detergents, paint removers, organic solvents, alkaline products, paint strippers, and degreasers. Biological cleaning includes bioremediation, which is the use of microorganisms to consume and break down toxic waste.

Anti-graffiti protection coatings collected from the state DOT survey, market survey, and IDOT projects database were classified based on type (sacrificial versus non-sacrificial) and ranked based on a weighted score that assumes different weights for three parameters (25% VOC, 35% cost, and 40% surface compatibility). In this process, each product was assigned a normalized score based on the value of the parameter compared to other products on a scale from 1 to 10 and then a weighted score was computed that takes into account the combined effect of the three parameters.

The products were classified using flowcharts based on their type, porosity of the underlying surface, VOC content, removal techniques, and cost. The flowcharts were developed to provide guidance in selecting the product that would best fit a certain project. A cost analysis was performed to identify the different direct and indirect costs accrued during the application of anti-graffiti coatings in a certain project.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1: INTRODUCTION

Graffiti is a form of artistic expression that often is thought of as vandalism. Although graffiti started in the 1960s in New York, it has continued to be a persistent problem, especially in urbanized areas (Carmona-Quiroga et al., 2016). This phenomenon has significant social and economic impacts and needs to be addressed more diligently. Anti-graffiti coatings can mitigate or eliminate this issue by providing an effective way to get rid of graffiti without affecting the surface to which it has been applied and by making the adhesion of graffiti to the surfaces of structures more difficult, making graffiti faster and easier to remove. However, the durability of anti-graffiti coatings can be an issue. There are many factors that can influence their integrity and functionality, such as thickness, gloss, adhesion, water repellency, roughness, and microstructure (Carmona-Quiroga et al., 2016). These factors can affect the coatings' efficiency in protecting the surfaces to which they are applied, including cleaning procedures such as pressure water and solvents and environmental conditions such as weather conditions (Kramer, 2010). Nevertheless, new types of anti-graffiti coatings are more resilient and long lasting.

The main objectives of this research are as follows:

- Provide IDOT with a synthesis of current anti-graffiti protection systems.
- Summarize information related to the usage of anti-graffiti protection systems in other states and local jurisdictions as well as the best practices followed.
- Survey different types of anti-graffiti coatings available in the market and provide recommendations about their effective use.
- Determine the viability of applying anti-graffiti protection systems on IDOT structures.
- Provide recommendations on the re-evaluation of the existing moratorium on anti-graffiti protections systems.

These goals were accomplished by conducting a state-of-the-art literature review on anti-graffiti protection systems. Additionally, detailed information related to the usage of anti-graffiti protection coatings in other states and the best practices associated with their usage—including information about their characteristics, type, chemical composition, method and ease of application, cleaning methods, and advantages and disadvantages—were obtained by conducting a survey of the state of the practice of current anti-graffiti protection systems used by state DOTs. A market survey of current anti-graffiti coatings, including their specifications, cost, application requirements, and pros and cons was implemented. A full analysis was conducted of the anti-graffiti protection systems used in Illinois in the past 14 years.

Overall, this report serves as a comprehensive guide to IDOT in selecting the most suitable anti-graffiti coating for a specific application. It also provides information about whether surface preparation is needed, method of application, drying time, cleaning method, and cost of each product.

CHAPTER 2: LITERATURE REVIEW

Graffiti is a growing problem in most cities worldwide. Graffiti removal requires a substantial budget by local governments and agencies every year. Undesired graffiti is a serious problem because it has negative social and economic impacts. Affected communities are usually considered poor socioeconomic localities. Therefore, governments and municipalities are striving to get rid of graffiti in a timely manner (Sanmartín et al., 2014).

Graffiti removal may involve abrasive chemicals that may result in permanent damage to the underlying surface and environmental hazards. Additionally, full graffiti removal from porous substrates is very challenging (Sanmartín et al., 2014). Therefore, introducing anti-graffiti coatings plays an important role in graffiti removal and protecting the underlying substrate. Anti-graffiti coatings provide a surface that is hydrophobic and oleophobic, which repels the paint or ink of the graffiti, facilitating its removal (Amrutkar et al., 2022). Anti-graffiti coatings also cover the substrate with a coating that has low surface energy, which results in weak molecular attraction between the substrate and the graffiti paint, expediting the cleaning process.

There are three types of anti-graffiti coatings—sacrificial, semipermanent, and non-sacrificial—presented in Figure 1. Sacrificial coatings are removed during the cleaning process and must be reapplied after each cycle. These coatings are usually based on waxes, micro-wax, acrylates, and polysaccharides (Lubelli et al., 2008; Moura et al., 2014). These products are the least expensive among the three types of anti-graffiti coatings. Another advantage of sacrificial products is they are usually transparent and easy to clean. Semipermanent coatings are usually based on polymers, acrylics, or epoxies. They are typically a two-layer system, where the first layer is non-sacrificial followed by a sacrificial layer. These types of coatings can withstand a limited number of cleaning cycles (two or three). Permanent coatings are based on acrylic-siloxane copolymers, polyurethanes, and silicones, as presented in Figure 2. These coatings are not removed during the cleaning process, can withstand numerous cycles, and have a longer service life (Moura et al., 2014). Although permanent coatings are the most expensive type, they offer greater durability and protection to the surface to which it is applied (Lubelli et al., 2008).

Historically, the most common anti-graffiti types were waxes (sacrificial) and polyurethane (non-sacrificial). However, polyurethanes caused color change in the substrate layer and formed an isolation layer, preventing water vapor from passing through and causing water accumulation. This accumulation of water can lead to degradation and deterioration of the underlying substrate. These effects can be exacerbated when polyurethane-based anti-graffiti products are used with porous substrates, which is why they are not suitable for porous materials (Whitford, 1992). Another drawback is that these coatings have low ultraviolet (UV) resistance, and when exposed to the sun for long periods, yellowing of the product may occur (Teng et al., 2012; Scheerder et al., 2005). Although the products that are based on waxes or silicones in an aqueous base have better water permeability than polyurethanes, they have low UV resistance (Weaver, 1995).

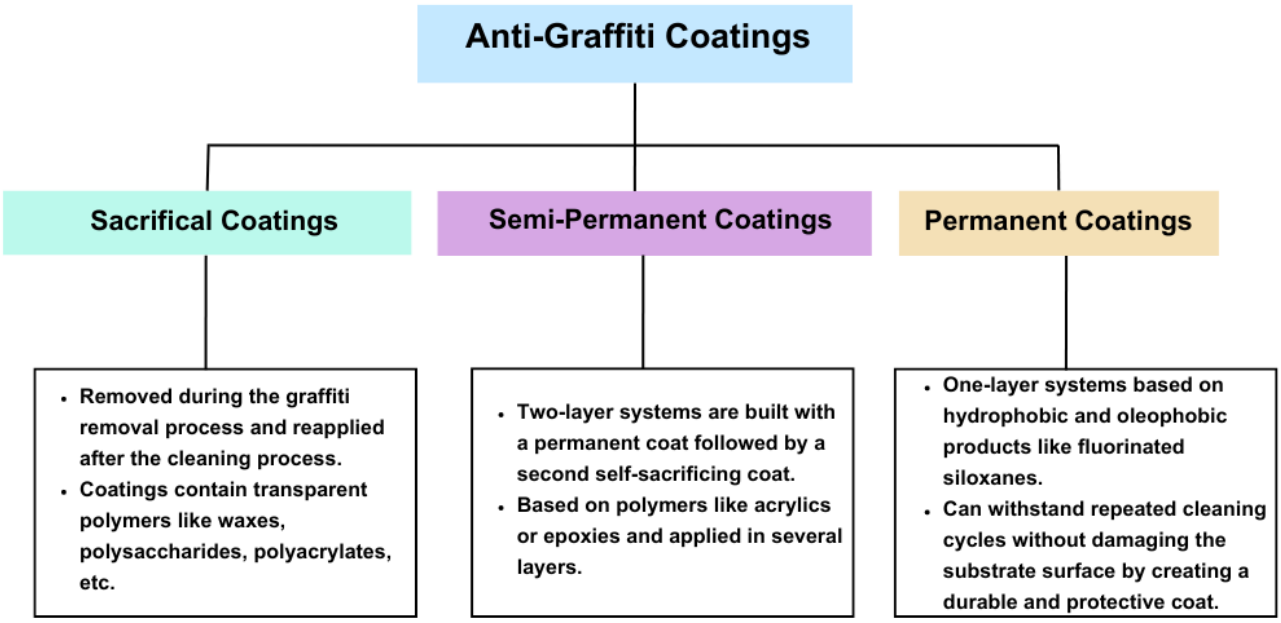


Figure 1. Flowchart. Types of anti-graffiti coatings.

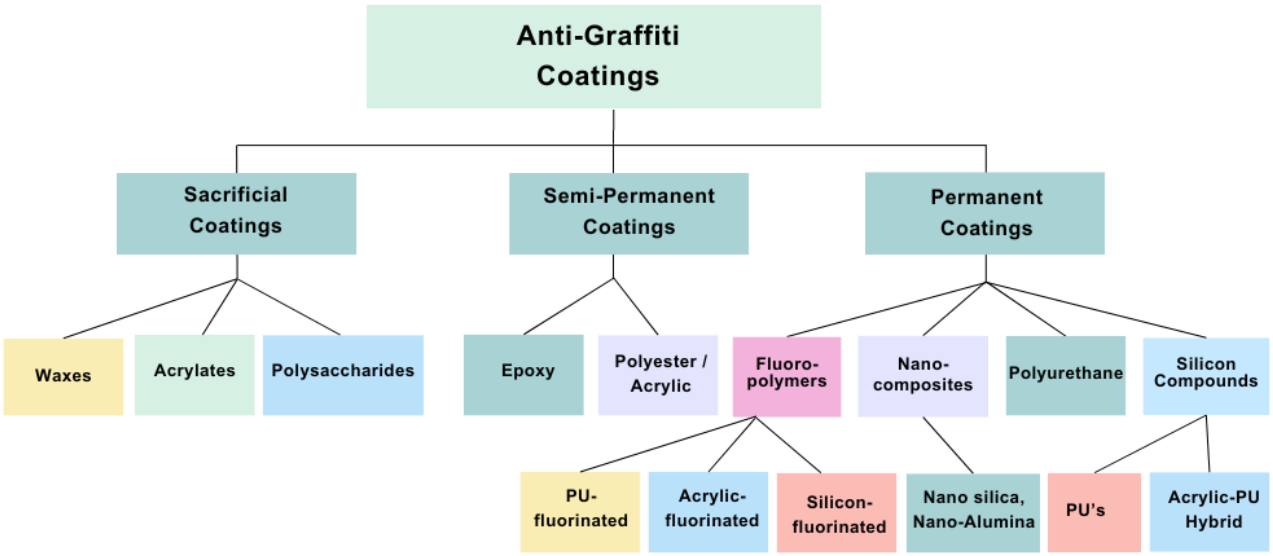


Figure 2. Flowchart. Compositions of anti-graffiti coatings.

Source: Amrutkar et al. (2022)

Because of the limitations of using waxes and polyurethanes such as limited durability and low water vapor permeability, other anti-graffiti coatings based on fluoroalkylsiloxane and organic–inorganic hybrid products have been researched in the literature (Scheerder, 2005; Carmona-Quiroga et al., 2010; Rabea et al., 2012). These products work well with porous materials because of their low

surface energy and high-water vapor permeability, which precludes water accumulation and surface deterioration (Carmona-Quiroga et al., 2010). Fluorinated polymers have appealing properties stemming from the fluorine atom and the carbon-fluorine (C-F) bond. The existence of fluorine atoms in these polymers provide them with low surface energy, which makes them water and oil repellent (Scheerder et al., 2005). Therefore, fluorinated polymers are considered superior anti-graffiti protection coatings. Additionally, fluorinated polymer–based products have high UV resistance and enhanced durability because of their increased chemical and thermal stability (Licchelli et al., 2011). Recent advancements in nanotechnology have resulted in the development of anti-graffiti products that include nanoparticles such as the inclusion of nanosilica in products based on organic polymers. These products have proved to have better properties such as hardness, chemical and thermal stability, and UV resistance (Rabea et al., 2012; Ganesh, 2012).

Nanotechnology in anti-graffiti products leverages the unique properties of nanoparticles to create surfaces that are not only resistant to graffiti, but also enhance longevity and durability. Polymeric nanocomposites, which integrate nano-scale inorganic particles such as aluminum oxide, clay, calcium carbonate, silica, and titanium dioxide into the polymer matrix, are increasingly being recognized as preferable substitutes for traditional polymeric coatings. Nanocomposites exhibit superior characteristics in comparison to pure polymers and conventional micro-composites—namely in terms of their barrier efficiency, temperature resilience, durability in challenging conditions, and resistance to fire and flame (Frigione et al., 2018). Nanosilica particles are commonly preferred over other nanocomposites such as nano-alumina due to their non-interference with the transparency of the coating. The coating remains clear because of its low refractive index. In addition, nanosilica particles possess a high modulus and hardness, improving the mechanical characteristics of the coatings (Adapala et al., 2015). A key advantage of anti-graffiti coatings enhanced with nanoparticles is their higher resilience against UV radiation. Long-term exposure to UV radiation can cause the deterioration of certain materials, resulting in color fading and loss of structural integrity. Nanosilica-infused coatings efficiently reduce these effects, thereby maintaining the visual appeal and structural integrity of the treated surfaces for extended durations (Rabea et al., 2012).

Moreover, there are various types of graffiti removal such as physical, chemical, and biological methods, as illustrated in Figure 3. Each method is chosen based on the type of graffiti and the surface to which it may be applied. Physical removal methods include pressurized hot- or cold-water jets, sandblasting, soda blasting (baking soda), scalpel work, dolomite powder, alumina oxide, and ground-walnut shells. Pressurized water may be successful in removing graffiti on many occasions; however, it can cause damage to historic materials even at low or moderate pressures (100–400 psi). A micro-abrasive technique may be appropriate for removing graffiti from sensitive masonry surfaces, provided low pressure and fine abrasives are used (35–40 psi) (Weaver, 1995). Pressurized hot water can be used effectively in removing graffiti from concrete and masonry surfaces with pressures from 2000–3000 psi and 700 psi, respectively, to avoid surface damage. Additionally, the use of sandblasting and soda blasting has been a common practice in removing graffiti. Soda blasting is less abrasive than sandblasting. Another advantage of soda blasting is that it leaves a protective film over the surface, preventing paint and other coatings from adhering to the treated surface. Physical removal methods also include novel techniques such as ultrasonic and megasonic agitation, plasma spray, vacuum arc, dry ice blasting, and laser. Plasma technology is where a rotary nozzle is used to

apply plasma at atmospheric pressure, hitting the surface of the graffiti at almost ultrasonic speed and causing the applied paint to evaporate (Plasmatreat, 2024). Dry ice in small pellets of carbon dioxide (CO_2), pressure blasted into graffiti-affected walls, are transformed into gas that is released into the atmosphere with no residue behind. Laser technology has been used recently because it could be less aggressive compared to chemical and mechanical techniques (Sanjeevan et al., 2007; Li et al., 1996). The main advantages of laser removal include selectivity, control over the operational area, gradual and precise graffiti removal, noise reduction, elimination of chemical cleaning agents, and being environmentally friendly (Weaver, 1995). Nonetheless, laser beams, depending on their intensity and wavelength, can raise the temperature of the surface of the substrate and eventually cause it to crack.

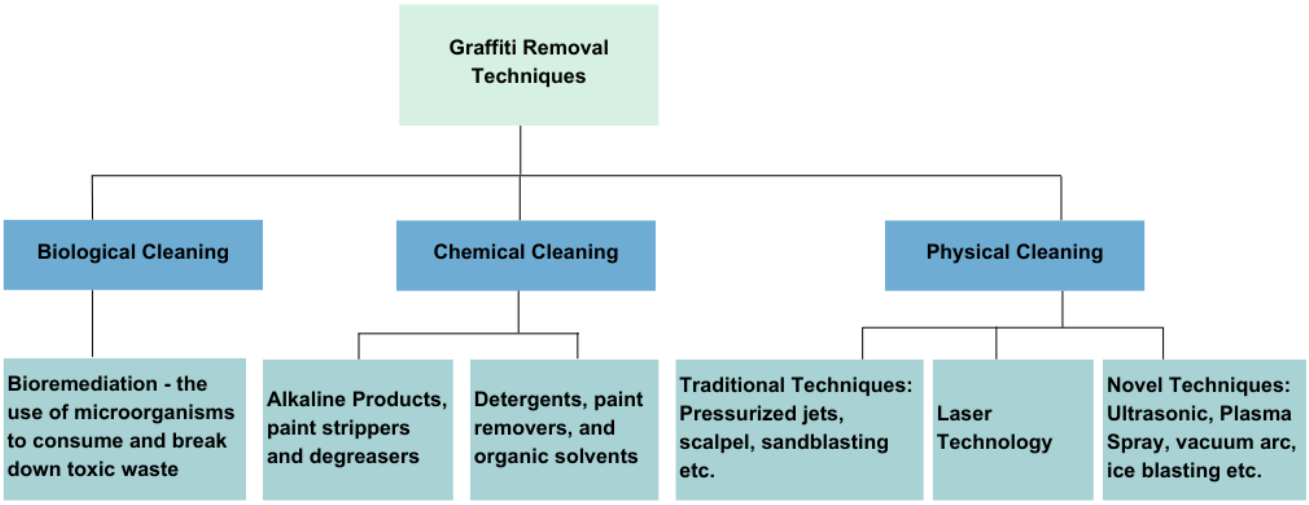


Figure 3. Flowchart. Types of graffiti removal.

Source: Amrutkar et al. (2022)

Chemical methods include detergents, paint removers based on methylene dichloride, organic solvents, alkaline products, and paint strippers. Some chemical methods can cause damage to the surface as well. Chemical cleaning methods are used widely as cleaning agents because pressurized water may not be very effective in some situations since many graffiti materials are not soluble in water. Chemical cleaning combined with high pressurized water can become a very effective cleaning method. For instance, pressurized water combined with neutral or nonionic detergent can be effective in removing recently applied graffiti (Weaver, 1995). Non-alkali delicate masonry can be treated using alkaline compounds to remove oils, greases, and waxes. Nevertheless, utilizing alkaline compounds should always be followed by neutralizing the surface by using weak acid wash and water. The use of strong alkalis (pH 13 or 14) may result in efflorescence and staining on masonry surfaces.

Bioremediation is a biological cleaning method that uses living organisms to get rid of environmental pollutants. Microorganisms are used to consume and break down the toxic waste through

biodegradation (Whitford, 1992). This method has several advantages compared to chemical and physical cleaning as it targets xenobiotic (i.e., not produced naturally) compounds and is cheaper, simpler to use than other methods, and environmentally friendly (Sanmartín, 2014). All methods have benefits and drawbacks, though. For example, if frequencies and amplitudes of ultrasonic and megasonic agitation are not carefully managed, they may unintentionally damage substrates; similarly, plasma spraying may present difficulties because it requires a reduction in operating pressure. Dry ice and soda blasting offer promise for residue-free removal but may cause thermal shock to substrates (Sanmartín et al., 2014). Some historic masonry materials can be damaged with the application of low or moderate pressurized water (Weaver, 1995).

CHAPTER 3: ANTI-GRAFFITI PROTECTION SYSTEMS SURVEY

INTRODUCTION

A survey of the state of the practice on the use of anti-graffiti protection systems was distributed to the North Central States Consortium for state DOTs in the Midwest. The survey included an introduction explaining the purpose of the survey and defining the three types of anti-graffiti protection systems (sacrificial, semipermanent, and permanent). The survey is composed of 47 questions, shown in Appendix A, related to the type of anti-graffiti coatings used, their chemical composition, method of application and removal, advantages and disadvantages, and best practices of their usage. Six states (Minnesota, Kansas, Michigan, Wisconsin, Iowa, and Indiana) responded to the survey (Appendix B). The results from the survey have been summarized and fully analyzed.

PRODUCTS

SIL-GUARD WB is a one-component, permanent anti-graffiti coating appropriate for metal, fiberglass, concrete, brick, stone, and pre-existing coatings. It provides instant protection from future graffiti and can be applied immediately to most existing graffiti. Superior durability and an extended service life are guaranteed when room-temperature vulcanizing silicone is paired with moisture-cure polysiloxane. SIL-GUARD WB directly creates chemical connections with the host surface to enhance adhesion without requiring extensive site preparation, priming, or abrasive blasting. Most graffiti may be removed easily with water at a lesser pressure (1,200 psi) because of its hydrophobic nature. This type of silicone-based waterproofing material offers a variety of benefits. It is eco-friendly with low emissions and does not harm the environment while delivering top-notch performance. Whether preferred in custom colors or clear, its strong waterproofing properties shield against long-term moisture damage. It is easy to clean off graffiti and maintains its appearance over time without turning yellow or fading. At $75.00 a gallon and a non-sacrificial formula, SIL-GUARD WB offers a solution against graffiti vandalism. With a coverage of 150 square feet per gallon, the cost per square foot comes to $0.50 (Advanced Chemical Technologies, Inc., 2021). Table 1 presents the product data of SIL-GUARD WB.

Table 1. Product Data of SIL-GUARD WB Anti-Graffiti Coating

Physical Properties	Description/Values
Color	Clear/custom colors
Composition	Siliconized polymer
Appearance	Thick paint
Drying Time	2–3 hours
Recommended Coats	2
Water Vapor Permeability	20 US perm
Application Temperature	40°F–100°F
VOC Content	< 25 g/L
Method of Application	Use airless spray

Si-COAT 532 is a single-component, permanent, room-temperature-vulcanizing (RTV), moisture-cure, polysiloxane coating that gives excellent color and durability and long service life. This coating protects surfaces like metal, fiberglass, concrete, brick, stone, and existing coatings. It defends against graffiti and can be applied seamlessly over existing marks for long-lasting performance. By combining RTV silicone with moisture-cure polysiloxane, it forms chemical bonds with the surface without requiring much preparation or harsh treatments. Its water-repellent properties easily remove graffiti with low-pressure water (1,200 psi). Si-COAT 532 offers effective results and easy maintenance solutions. Graffiti markings should be removed from the Si-COAT 532 coating as soon as possible using a standard cold water pressure washer for optimal results. A warm water pressure wash can be required if the graffiti has been there for more than 10 days and is difficult to remove with cold water. At $130.00 per gallon or $0.69 per square foot, the non-sacrificial polysiloxane coating covers 188 square feet per gallon and comes in packing sizes of 1, 5, and 50 gallons (CSL Silicones Inc., 2013). Table 2 presents the product data of Si-COAT 532.

Table 2. Product Data of Si-COAT 532 Anti-Graffiti Coating Manufactured by CSL Silicones Inc.

Physical Properties	Description/Values
Color	Clear
Composition	Polysiloxane
Gloss Level	Semi-gloss
Drying Time	60–90 minutes
Application Temperature	41°F–266°F
VOC Content	45.55 g/L
Method of Application	Airless spray, brush, or roller

TK-PERMACLEAN VOC is a one-component, non-yellowing, permanent anti-graffiti coating. It is made of blends of aliphatic urethane resins that are designed to prevent graffiti vandalism from occurring on delicate surfaces. On surfaces shielded by TK-PERMACLEAN VOC, spray paint, lipstick, markers, nail polish, and multi-component paint products will not stick. This protective layer offers durability to withstand multiple cleanings with strong solvents, high-pressure washing, and graffiti-removal products without requiring a fresh coat afterward. It has a strong ability to resist damage from cleansing agents. Additionally, this coating is easy to apply and maintain because it is a single-component solution. It maintains its clarity without yellowing when exposed to prolonged UV rays and adverse weather conditions. It can be tinted using TK-1166 Urethane Colorants, ensuring both protection and visual appeal. At $260.00 per gallon or $0.58 per square foot, this coating covers 450 square feet per gallon, comes in packing sizes of 1-gallon cans and 5-gallon pails, and protects numerous surfaces such as steel, all forms of wood, stucco, brick, block, and masonry, as well as previously painted surfaces. The protection provided by TK-PERMACLEAN VOC would be extremely beneficial for locations that are prone to recurrent graffiti, such as barrier walls, bridges, signs, parking ramps, and transportation facilities (TK Products Construction Coatings, 2018). Table 3 presents the product data of TK-PERMACLEAN VOC.

Table 3. Product Data of TK-PERMACLEAN VOC Anti-Graffiti Coating Manufactured by TK Products

Physical Properties	Description/Values
Color	Clear
Composition	Blends of aliphatic urethane resins
VOC Content	< 350 g/L
Application Temperature	35°F to 95°F
Drying Time	25 minutes
Coverage Rate	450 sq. ft/gallon
Shell Life	6 months
Method of Application	Brush, roller, or spray

GRAFFITI GARD IV is a two-component, permanent, low-luster aliphatic urethane coating. This water-based coating is available in a pigmented or clear color and is resistant to graffiti from a range of sources, including spray paint and marking pens. Wet spray paint or ink that has recently been sprayed frequently crawls back over itself, annoying would-be taggers into moving on to another target. Using GRAFFITI GARD IV biodegradable cleaner and power washing makes cleaning the glossy surface simple. This anti-graffiti coating comes with a range of user-friendly features that can make it a favored option for protecting surfaces. Its easy-to-use application process ensures a seamless experience, while its water-based formula simplifies cleanup. With resistance to graffiti and UV rays, surfaces remain in good condition even in tough environments. Additionally, its breathable properties support the health of materials. A notable feature is its low VOC content, allowing for use in states and regions without issue. At $85.00 per gallon or $0.24 per square foot, this coating covers 350 square feet per gallon and comes in packing sizes of 1 and 5 gallons. Moreover, it may be applied to a wide range of interior and external vertical surfaces, such as bare concrete, sound, clean previously coated concrete, brick, properly prepared previously coated metal, split face block, and additional surfaces specified by the manufacturer (TEX-COTE LLC, 2024-a). Table 4 presents the product data of GRAFFITI GARD IV.

Table 4. Product Data of GRAFFITI GARD IV Low Luster or Pigmented Anti-Graffiti Coating Manufactured by TEX-COTE

Physical Properties	Description/Values
Gloss	Low gloss
Color	Clear/pigmented
Composition	Aliphatic urethane
VOC Content	< 50 g/L
Application Temperature	50°F to 90°F
Coverage Rate	350 sq. ft/gallon
Shell Life	6 months
Moisture Vapor Transmission	6 perms
Method of Application	Brush, roller, or airless sprayer

Sherwin-Williams 2K Waterbased Anti-Graffiti Coating is a non-sacrificial solution that is composed of a two-part hydrophobic polyurethane with a VOC content of more than 100 g/L. This formula not only provides resistance to graffiti, but also maintains color and shine well over time. Its low odor makes it eco-friendly and compliant with standards while creating a shield against unwanted marks. This versatile coating can be applied easily on surfaces using brushing, rolling, or spraying techniques. Moreover, it has clear tint bases—gloss (B65T194) and satin (B65T195)—which can act as a coat, enhancing its adaptability for diverse applications. This water-based anti-graffiti coating is crafted to protect outdoor surfaces that have been prepared against graffiti vandalism. It can be applied to a range of surfaces such as bridge abutments, commercial buildings, schools, transit stations, overpasses, railcars, and new construction sites. Acting as a lasting sacrificial anti-graffiti solution, it provides enduring protection against unauthorized markings. Moreover, it meets the criteria for performance uses, making it suitable for various industries and settings. At $337.00 per gallon or $0.41 per square foot, this coating covers 816 square feet per gallon and comes in a packing size of 2.71 gallons (Sherwin-Williams, Nov. 2022). Table 5 presents the product data of the 2K Waterbased Anti-Graffiti Coating.

Table 5. Product Data of 2K Waterbased Anti-Graffiti Coating Manufactured by Sherwin-Williams

Physical Properties	**Description/Values**
Color	Clear, white, or a wide variety of colors
Composition	Hydrophobic polyurethane
VOC Content	< 100 g/L
Application Temperature	50°F to 120°F
Drying Time	34 minutes to 6 hours
Coverage Rate	816 sq. ft/gallon
Shell Life	12 months
Method of Application	Brush, roller, or airless sprayer

Sherwin-Williams Invisi-Shield Anti-Graffiti Clear is a two-component, graffiti-resistant, VOC-compliant acrylic polyurethane that is easy to apply over concrete and masonry surfaces. It can be used with other suitable substrates and existing high-performance products as well as part of a waterproofing masonry sealer system. The UV block in this coating prolongs the gloss and color retention of recently applied aliphatic polyurethane coatings. Applying Invisi-Shield by brush, roller, or spray is simple, and it becomes nearly transparent or invisible when applied over appropriate surfaces. This coating is specially crafted for use on prepared surfaces in various settings. It can be applied to a variety of surfaces such as steel tanks, structural steel, power plants, and concrete bridges, among others. The coating protects against graffiti damage, making it a great choice for areas where maintaining surface integrity is crucial. Whether used on barrier walls, railings, or other structures, this coating offers lasting defense against markings, ensuring the durability and appearance of infrastructure. At $174.00 per gallon or $0.44 per square foot, this coating covers 400 square feet per gallon and comes in a packing size of a 1- and 4-gallon kit (Sherwin-Williams, Aug. 2017). Table 6 presents the product data of Invisi-Shield Anti-Graffiti Clear.

Table 6. Product Data of Invisi-Shield Anti-Graffiti Clear Manufactured by Sherwin-Williams

Physical Properties	Description/Values
Color	Clear
Composition	Acrylic polyurethane
VOC Content	< 420 g/L
Application Temperature	50°F to 100°F
Drying Time	45 minutes
Coverage Rate	400 sq. ft/gallon
Shell Life	36 months
Method of Application	Brush, roller, or airless sprayer

Sherwin-Williams Anti-Graffiti Coating 1K Siloxane is easy to use right out of the box. It bonds with moisture in the air, making it simple to apply on prepared surfaces. This coating comes with benefits, such as resistance against graffiti, making it a great option for preventing unwanted marks. It is easy to clean using water or solvent wipes, ensuring easy maintenance. Its durability against UV rays and ability to stick well offer lasting protection from the elements. Additionally, its quick drying time and excellent spray properties make application efficient. It is a single-component solution, so it is suitable for various uses. This special coating is perfect for protecting outdoor surfaces from graffiti damage. It can be used in places such as bridges, buildings, schools, transport hubs, and new construction sites. Its simple application process ensures protection, making it a popular option for areas where graffiti is a problem. At $200.00 per gallon or $0.17 per square foot, this coating covers 1,155 square feet per gallon and comes in a packing size of 5 gallons (Sherwin-Williams, Sep. 2019). Table 7 presents the product data of Anti-Graffiti Coating 1K Siloxane.

Table 7. Product Data of Anti-Graffiti Coating 1K Siloxane Manufactured by Sherwin-Williams

Physical Properties	Description/Values
Color	Clear
Composition	Siloxane
VOC Content	< 250 g/L
Application Temperature	40°F to 120°F
Drying Time	30 minutes to 9 hours
Coverage Rate	1155 sq. ft/gallon
Shell Life	12 months
Method of Application	Brush, roller, or airless sprayer

Duraguard 310 CRU is a two-part polyurethane coating designed to enhance the durability of surfaces, particularly concrete. It is mainly used as a topcoat, applied over the ChemMasters Safe Cure & Seal EPX epoxy primer, improving resistance to chemicals and UV light. This coating is commonly used in DOT environments like municipal bridge parapets, bridge columns, precast spans, bridge substructures and superstructures because of its versatility. Its benefits include its ability to

withstand chemicals indoors and outdoors. Duraguard 310 CRU offers abrasion resistance, making it an excellent option for applications that require durability, such as high build, trowel-applied, or self-leveling toppings. Additionally, its ability to resist staining and degradation from substances like food items, acids, alkalis, and hydrocarbons further cements its reputation as a quality coating. Noteworthy features include its color retention and stability, along with a finish that ensures a visually appealing and long-lasting outcome. At $129.00 per gallon or $0.43 per square foot, this coating covers 300 square feet per gallon and comes in packing sizes of 1 and 5 gallons. (ChemMasters Inc., 2021). Table 8 presents the product data of Duraguard 310 CRU.

Table 8. Product Data of Duraguard 310 CRU Anti-Graffiti Coating Manufactured by ChemMasters

Physical Properties	**Description/Values**
Color	Clear/pigmented
Composition	Aliphatic polyurethane
VOC Content	< 350 g/L
Drying Time	5 hours
Coverage Rate	300 sq. ft/gallon
Shell Life	12 months
Method of Application	Brush, roller, or airless sprayer

LISTING OF PRODUCTS

A product's visibility and ability to influence a customer's decision based on its presentation are among a few of the many benefits of listing. How information is presented can have a significant impact on the meaning we extract from it and how we act on it in today's fast-paced, information-saturated society. Ranking factors consider visibility, reliability, competition, user experience with navigation, distribution of resources, and the process of making decisions. The research team compiled a list of anti-graffiti products according to several criteria, including VOC content, cost, and the number of surfaces on which the product is compatible. The contribution of each component to the listing is broken up as follows:

- **VOC Content**: Lower VOC content is generally preferable because of environmental and health concerns, so products with low VOC content were given higher priority.

- **Cost**: Products with lower costs were listed higher, assuming that a higher cost does not always guarantee better performance.

- **Surface Compatibility**: Coatings that can be applied to more surfaces were given higher priority in the list.

Lists are presented in Table 9, Table 10, and Table 11 by VOC content, cost, and surface compatibility, respectively. Table 12 presents some advantages and disadvantages of products found from the survey.

Table 9. List of Products Based on VOC Content

Product/Manufacturer	VOC Content	Composition	Cost ($/Sq. ft)	Surface Compatibility
SIL-GUARD WB Clear/Pigmented *(Advanced Chemical Technology Inc.)*	< 25	Siliconized polymer	0.50	• Concrete • Brick • Stone • Metal • Wood
Si-COAT 532 *(CSL Silicones Inc.)*	45.55	Polysiloxane	0.69	• Concrete • Brick • Stone • Metal • Wood
GRAFFITI GARD IV Low Luster Clear/Pigmented *(TEX-COTE)*	< 50	Aliphatic urethane	0.24	• Concrete • Brick • Previously painted metal
2K Waterbased Anti-Graffiti Coating *(Sherwin-Williams)*	< 100	2 Component, Hydrophobic polyurethane	0.41	• Concrete • Masonry • Steel
Anti-Graffiti Coating 1K Siloxane *(Sherwin-Williams)*	< 250	Siloxane	0.17	Concrete
TK-PERMACLEAN VOC *(TK Products)*	< 350	Blends aliphatic urethane resins	0.58	• Concrete • Masonry • Brick • Wood • Steel
Duraguard 310 CRU *(ChemMasters)*	< 350	2 components, aliphatic polyurethane	0.43	Concrete
Invisi-Shield *(Sherwin-Williams)*	< 420	Amorphous precipitated silica & trimethylbenzene	0.44	• Concrete • Masonry • Steel

Table 10. List of Products Based on Cost

Product/Manufacturer	Cost ($/Sq. ft)	VOC Content (g/L)	Composition	Surface Compatibility
Anti-Graffiti Coating 1K Siloxane *(Sherwin-Williams)*	0.17	< 250	Siloxane	Concrete
GRAFFITI GARD IV Low Luster Clear/Pigmented *(TEX-COTE)*	0.24	< 50	Aliphatic urethane	• Concrete • Brick • Previously painted metal
2K Waterbased Anti-Graffiti Coating *(Sherwin-Williams)*	0.41	< 100	2 Component, Hydrophobic polyurethane	• Concrete • Masonry • Steel
Duraguard 310 CRU *(ChemMasters)*	0.43	< 350	2 components, aliphatic polyurethane	Concrete
Invisi-Shield *(Sherwin-Williams)*	0.44	< 420	Amorphous precipitated silica & trimethylbenzene	• Concrete • Masonry • Steel
SIL-GUARD WB Clear/Pigmented *(Advanced Chemical Technology Inc.)*	0.50	< 25	Siliconized polymer	• Concrete • Brick • Stone • Metal • Wood
TK-PERMACLEAN VOC *(TK Products)*	0.58	< 350	Blends aliphatic urethane resins	• Concrete • Masonry • Brick • Wood • Steel
Si-COAT 532 *(CSL Silicones Inc.)*	0.69	45.55	Polysiloxane	• Concrete • Brick • Stone • Metal • Wood

Table 11. List of Products Based on Surface Compatibility

Product/Manufacturer	Surface Compatibility	Cost ($/Sq. ft)	VOC Content (g/L)	Composition
SIL-GUARD WB Clear/Pigmented *(Advanced Chemical Technology Inc.)*	• Concrete • Brick • Stone • Metal • Wood	0.50	< 25	Siliconized polymer
Si-COAT 532 *(CSL Silicones Inc.)*	• Concrete • Brick • Stone • Metal • Wood	0.69	45.55	Polysiloxane
TK-PERMACLEAN VOC *(TK Products)*	• Concrete • Masonry • Brick • Wood • Steel	0.58	< 350	Blends aliphatic urethane resins
GRAFFITI GARD IV Low Luster Clear/Pigmented *(TEX-COTE)*	• Concrete • Brick • Previously painted metal	0.24	< 50	Aliphatic urethane
2K Waterbased Anti-Graffiti Coating *(Sherwin-Williams)*	• Concrete • Masonry • Steel	0.41	< 100	2 Component, Hydrophobic polyurethane
Invisi-Shield *(Sherwin-Williams)*	• Concrete • Masonry • Steel	0.44	< 420	Amorphous precipitated silica & trimethylbenzene
Anti-Graffiti Coating 1K Siloxane *(Sherwin-Williams)*	Concrete	0.17	< 250	Siloxane
Duraguard 310 CRU *(ChemMasters)*	Concrete	0.43	< 350	2 components, aliphatic polyurethane

Table 12. Advantages and Disadvantages of Anti-Graffiti Products

Product/Manufacturer	Advantages	Disadvantages	Primer	Surface Compatibility
SIL-GUARD WB Clear/Pigmented *(Advanced Chemical Technology Inc.)*	• Doesn't yellow • Low VOC content • Easy removal	Requires two coats for maximum protection	Not needed	• Concrete • Brick • Stone • Metal • Wood
Si-COAT 532 *(CSL Silicones Inc.)*	• Hydrophobic and waterproof • Breathable coating • UV resistant • Easy to clean • One-coat application	• Cannot apply to substrate temperatures below 41°F (5°C) •Recommended to do a field adhesion test before application	Not needed	• Concrete • Brick • Stone • Metal • Wood
TK-PERMACLEAN VOC *(TK Products)*	• Non-yellowing • UV resistant • Weather resistant	Requires prior application of TK-Anti-Graffiti Primer	TK-Anti-Graffiti Primer	• Concrete • Masonry • Brick • Wood • Steel
GRAFFITI GARD IV Low Luster Clear/Pigmented *(TEX-COTE)*	• Low VOC content • Low luster • UV resistant	• Do not over-apply film build as excessive thickness may create a milky appearance through air entrapment • Graffiti should be removed with GRAFFITI GARD IV Biodegradable Cleaner	• TEX-COTE RAINSTOPPER 1750W Clear Sealer for porous substrates • Previously painted substrates do not need priming	• Concrete • Brick • Previously painted metal

Product/Manufacturer	Advantages	Disadvantages	Primer	Surface Compatibility
2k Waterbased Anti-Graffiti Coating *(Sherwin-Williams)*	• Low odor • Excellent gloss retention • Excellent anti-graffiti resistance	High cost	• Pro Industrial Pro-Cryl Universal Primer (for Steel) • Pro Industrial Water Based Catalyzed Epoxy (for concrete)	• Concrete • Masonry • Steel
Invisi-Shield *(Sherwin-Williams)*	• UV resistant • Easy application	If applied directly to concrete or masonry surfaces, nonuniform gloss level, white stain, or darkening may occur.	Not needed	• Concrete • Masonry • Steel
Anti-Graffiti Coating 1K Siloxane *(Sherwin-Williams)*	• Excellent UV resistance • Excellent adhesion • Fast drying • Countless graffiti removals without reapplication	Limited to concrete surfaces	Not needed	Concrete
Duraguard 310 CRU *(ChemMasters)*	• Excellent abrasion resistance • Color retention	• Requires primer • High VOC content • Excellent color retention	Safe-Cure & Seal EPX epoxy primer	Concrete

RESULTS

The survey investigated how anti-graffiti protection systems are used within the North Central States Consortium for state DOTs in the Midwest, gathering feedback from six states: Minnesota, Kansas, Michigan, Wisconsin, Iowa, and Indiana. The survey described three types of anti-graffiti protection systems—sacrificial, semipermanent, and permanent. Despite the higher cost, permanent coatings offer protection and durability for surfaces. SIL-GUARD WB Clear/Pigmented and Si-COAT 532 are notable choices for their lasting defense against various environmental elements. These coatings can be applied to surfaces with ease and are more cost-effective compared to other permanent options. After examination, the findings were summarized, offering perspectives on the current practices related to anti-graffiti strategies in the area. Table 13 provides a summary of all products found from the survey.

Table 13. Summary of Anti-Graffiti Products Found from the Survey

Product/Manufacturer	Type	Composition	Cleaning Agent	Cost ($/Sq. ft)
SIL-GUARD WB Clear/Pigmented *(Advanced Chemical Technology Inc.)*	Non-sacrificial	Siliconized polymer	Lower water pressure (1,200 psi)	0.50
Si-COAT 532 *(CSL Silicones Inc.)*	Non-sacrificial	Polysiloxane	Cold water pressure (1,200 psi)	0.69
GRAFFITI GARD IV Low Luster Clear/Pigmented *(TEX-COTE)*	Non-sacrificial	Aliphatic urethane	GRAFFITI GARD IV Biodegradable Cleaner followed by power washing	0.24
TK-PERMACLEAN VOC *(TK Products)*	Non-sacrificial	Blends aliphatic urethane resins	TK-KWIK KLEAN to soften and remove graffiti without damaging the protective membrane	0.58
2k Waterbased Anti-Graffiti Coating *(Sherwin-Williams)*	Non-sacrificial	2 Component, hydrophobic polyurethane	Pressure wash utilizing a maximum of 3,000 psi clean water	0.41
Anti-Graffiti Coating 1K Siloxane *(Sherwin-Williams)*	Non-sacrificial	Siloxane	Power wash with a 3000-psi pressure washer	0.17

Product/Manufacturer	Type	Composition	Cleaning Agent	Cost ($/Sq. ft)
Invisi-Shield *(Sherwin-Williams)*	Non-sacrificial	Amorphous precipitated silica & trimethylbenzene	• Plasti-Master, • TSW-2 Multi-Master All Purpose Stain & Graffiti Remove	0.44
Duraguard 310 CRU *(ChemMasters)*	Non-sacrificial	2 components, aliphatic polyurethane	Do not use strong caustic or solvent-based cleaner	0.43

CONCLUSION

The type of surface, surrounding conditions, and financial constraints are some elements that influence the choice of anti-graffiti coating. Non-sacrificial coatings offer longer-lasting protection and greater compatibility for a wider range of surfaces, but their prospective cost may be higher. Interested parties must consider their particular needs and the features of the surface when selecting the appropriate anti-graffiti coating, because each coating has specific benefits and drawbacks. All products listed in this chapter are readily available in more than 200-gallon quantities.

CHAPTER 4: MARKET SURVEY

This chapter presents findings from a market survey of anti-graffiti coatings. The purpose of the chapter is to examine different coating types based on various characteristics. Key findings highlight a diverse range of options available, each with unique properties and applications. This chapter goes over alternatives for choosing suitable coatings according to certain requirements. Graffiti vandalism poses significant challenges in maintaining the aesthetics and the quality of urban landscapes. To overcome this problem, anti-graffiti coatings have been developed as a preventive measure. Anti-graffiti coatings available in the market are categorized into two main types: non-sacrificial and sacrificial. Non-sacrificial coatings are one-layer systems based on hydrophobic and oleophobic products. These coatings can withstand repeated cleaning cycles (i.e., up to 10 cycles without damaging the substrate surface). Sacrificial coatings are removed during the graffiti-removal process and reapplied after the cleaning process. This chapter explores the effectiveness of diverse types of coatings in protecting surfaces from graffiti damage.

METHODOLOGY

A market survey was conducted as part of the research methodology to collect information on available anti-graffiti coatings. The research team reached out to both manufacturers and local distributors to obtain the cost per gallon and additional characteristics not available online. In addition, information was obtained through a review of relevant literature from previous research papers. The information collected was analyzed to identify trends, patterns, and common characteristics among different anti-graffiti coatings.

PRODUCTS

VandlGuard Ten Anti-Graffiti Coating is Rainguard Pro's top-of-the-line graffiti protection system against the permanent damage of building surfaces caused by graffiti tagging. Backed by a 10-year warranty protection, it can be applied to a wide variety of both unpainted and painted surfaces. VandlGuard Ten is approved by the City of Los Angeles for use on all city-owned buildings and approved by the Toronto Transit Commission, North America's largest public transportation system, for use on all owned properties. It is also specified on all new Walmart retail stores requiring graffiti protection. VandlGuard Ten is available in ready-to-use 1- and 5-gallon containers and requires a final application of VandlGuard Finish Coat to complete the anti-graffiti protection system. At $149.00 a gallon and with a non-sacrificial formula, VandlGuard Ten offers a premium solution against graffiti vandalism. With a coverage of 250 square feet per gallon, the cost per square foot comes to $0.60. It works well on a variety of surfaces, such as concrete, brick, wood, and more because of its cross-linked copolymer composition. Its notable feature is that it keeps a low gloss for minimal appearance change while preventing the growth of germs, fungus, mildew, and mold. VandlGuard Ten is utilized in a range of projects and settings, serving both construction and renovation purposes. It provides protection for building structures, screens, retaining walls, fences, and highway sound barriers. In environments like school hallways and public facility restrooms, it ensures lasting defense against graffiti damage. Additionally, it is a choice for preserving signs, bridge abutments, and playground park areas. Its versatility extends to uses such as protecting vinyl banners and stickers on flower

planters on busy streets (RainguardPro, 2024). Table 14 presents the product data of VandlGuard Ten Anti-Graffiti Coating.

Table 14. Product Data of VandlGuard Ten Anti-Graffiti Coating Manufactured by RainguardPro

Physical Properties	Description/Values
Color	Clear, minimal change in appearance or surface texture
Composition	Cross-linked co-polymer
Gloss Level	Low gloss
Drying Time	1–2 hours
Recommended Coats	2
Water Vapor Permeability	100% permeable
Application Temperature	40°F–90°F
VOC Content	< 20 g/L
Method of Application	Use low-pressure hand pump garden sprayer, roller, or brush to apply

Permashield Premium is a two-part aliphatic polyurethane anti-graffiti coating. Backed by a 10-year warranty, Permashield Premium can withstand multiple tagging, and cleaning caused by spray paints, markers, and other chemicals/contaminations. It offers a transparent protective layer for painted or unpainted surfaces, such as concrete, masonry, stucco, tile, metal, artistic murals, and signs. Additionally, Permashield Premium has been approved by state and city authorities. It comes in pigmented options, with matte and high-gloss finishes. This non-sacrificial clear coating protects against UV radiation, stains, chemicals, and hot tires for $0.76 per square foot. It provides long-lasting protection because of its low VOC content and low odor composition that is breathable, non-yellowing, and non-chalking. It is recommended to apply a minimum of two coats when the surrounding temperature is around 50°F to 90°F (Monopole Inc., 2020). Table 15 provides the product data of Permashield Premium.

Table 15. Product Data of Permashield Premium Manufactured by Monopole Inc.

Physical Properties	Description/Values
Color	Clear
Composition	Two-part aliphatic polyurethane
Drying Time	2–8 hours
Recommended Coats	2–3
Water Vapor Permeability	5.99% permeable
Application Temperature	50°F–90°F
VOC Content	0 g/L
Method of Removal	Spray citrus clean super cleaning agent and use a brush or nylon scour pad

Brickform's UreMax WB is a two-component, matte-finish polyurethane that creates a high-solids coating. The water-based product works with any type of brick and stone surface and preserves and protects any above-grade stone, masonry, or concrete. It is ideal for high-traffic areas like interior lobbies and food service areas as well as use on concrete countertops. It is not advised for dense or pre-sealed surfaces like terrazzo, dense brick, dense slate, marble, or granite. UreMax WB is the most resilient and chemical-resistant barrier coating; it also lacks a solvent-borne sealer's typical odor. It is made to seal and protect masonry and concrete exposed to the harshest use circumstances. UreMax WB is incredibly durable and chemically resistant, and it prevents the growth of mold and mildew as well as tire markings. Priced at $189.99 per gallon, this coating covers an area of 500 square feet per gallon, resulting in a cost of $0.38 per square foot. It is recommended to apply two coats of UreMax WB. Material usage is around 350–600 square feet per gallon/coat. The concrete's texture, age, and condition, as well as the application technique and other local factors, can all affect coverage rates. With a VOC content of less than 50 g/L, it offers moderate environmental friendliness and is available in ready-to-use 1- and 4-gallon units (Brickform, 2014). Table 16 presents the product data of UreMax WB.

Table 16. Product Data of Brickform UreMax WB Manufactured by Brickform

Physical Properties	Description/Values
Color	Liquid, clear
Composition	Two-part water-based polyurethane
Odor	Mild
VOC Content	< 50 g/L
Drying Time	4–8 hours
Recommended Coats	2
Shell Life	2.5 years
Density	8.9 pounds per gallon when mixed
Application Temperature	45°F to 95°F
Method of Removal	Brickform E-Etch Cleaning Agent

NanoSlic NS 240 is a hydrophobic and oleophobic coating specifically designed to protect surfaces from graffiti. NS 240 is a permanent ceramic clear coat that offers physical and chemical properties. This coating provides resistance to water- and solvent-based paints, so all water- and solvent-based paints, markers, and varnishes are repelled by its nonstick surface after curing. This thin transparent coating does not change when exposed to UV light, ensuring durability without deterioration. It has adhesion and can withstand abrasion. The coating can be cured at room temperature or in an oven, offering flexibility in how to apply it while keeping its qualities intact. At $790.00 per liter or $9.99 per square foot, the non-sacrificial coat covers 300 square feet each gallon and comes in packing sizes of 1 oz, 4 oz, and 1 liter, making it the most expensive product compared to other products (NanoSlic Smart Coatings, 2019). Table 17 presents the product data of NanoSlic NS 240.

Table 17. Product Data of NS 240 Manufactured by NanoSlic

Physical Properties	Description/Values
Color	Clear gloss
Composition	Nano silica
Odor	Odourless
Drying Time	30 minutes
Non-Volatile Content	28%
Potential Applications	Railroads, subways, public spaces, infrastructure
Method of Application	Spray or dip-coated

GRAFFITI GARD S is a one-component coating made of polysiloxane that is easy to use and non-sacrificial. It repels graffiti from various materials, such as spray paint and marking pens. It causes recently applied wet spray paint or ink to crawl back onto itself, annoying would-be taggers into moving onto another target. Graffiti-removal cleaners like TEX-COTE Graffiti Paste Cleaner or power washing are uncomplicated ways to clear the surface, offering hassle-free graffiti removal. This product comes with a ready-to-use formula: simply mix and apply. The high-solids formula ensures a coating that resists graffiti because of its siloxane technology. Moreover, it provides UV protection, keeping surfaces looking fresh and colorful for a longer period. Its low VOC content meets environmental standards while delivering top-quality performance. The product not only shields surfaces from graffiti, but also maintains their water-repellent properties for appearance. At $90.00 per gallon or $0.72 per square foot, this coating covers 125 square feet per gallon and comes in packing sizes of 1 quart, 1 gallon, and 5 gallons. It is applicable to a wide range of external vertical surfaces, such as bare concrete, sound, clean previously coated concrete, brick, appropriately prepared previously coated metal, and additional surfaces specified by the manufacturer (TEX-COTE LLC, 2024-b). Table 18 presents the product data of GRAFFITI GARD S anti-graffiti coating.

Table 18. Product Data of GRAFFITI GARD S Anti-Graffiti Coating Manufactured by TEX-COTE

Physical Properties	Description/Values
Gloss	Satin to semi-gloss
Color	Transparent
Composition	Polysiloxane
VOC Content	< 250 g/L
Application Temperature	50°F to 90°F
Coverage Rate	75–125 sq. ft/gallon
Shell Life	6 months
Method of Application	Brush, roller, or airless sprayer

Graffiti Stopper 1K is a solvent-borne, moisture-curing polysiloxane coating intended to prevent surface graffiti. It is a non-sacrificial, single-component product. Graffiti Stopper 1K will help most coatings, paints, and inks stick to fewer surfaces after application. Paintings usually tend to bead on

the surface, making inscriptions, patterns, and graffiti artwork less noticeable and serving as a warning. Paints and inks, once dried on the surface, can be removed without the use of harsh chemicals. Soap and water work well in this regard, and neither the surface nor the underlying coating are harmed. Applying a special coating can effectively deal with graffiti-related issues. By preventing artwork creation, it acts as a deterrent to further graffiti. Moreover, it's easy cleaning process, which does not require chemicals, makes it a practical solution. Once applied, there is no need for reapplication, offering lasting protection. Additionally, its strong adhesion to surfaces regardless of textures ensures thorough coverage. Its low gloss or satin/matte finish enhances aesthetics while simplifying maintenance. The UV stability of the coating prevents color fading over time, ensuring effectiveness. With application methods and minimal odor, this coating provides an efficient way to address graffiti problems. It may be applied to a wide range of surfaces, such as exterior concrete, masonry, and painted, primed, or galvanized metals. It can also be applied on traffic signs, rail cars, sound barriers, bridges, bathroom stalls, schools, or other areas subjected to graffiti. At $370.71 per gallon or $1.14 per square foot, this coating covers 325 square feet per gallon and comes in a packing size of 7.92-gallon pails (ChemMasters Inc., 2024). Table 19 presents the product data for Graffiti Stopper 1K.

Table 19. Product Data of Graffiti Stopper 1K Manufactured by ChemMasters

Physical Properties	Description/Values
Color	Clear
Composition	Polysiloxane
VOC Content	< 250 g/L
Application Temperature	>50°F
Drying Time	4 hours
Coverage Rate	275–325 sq. ft/gallon
Shell Life	12 months
Method of Application	Brush, roller, or airless sprayer

TK-BLOCK AND GRAFFITI GUARD 5220 VOC is a clear silicone elastomer coating that is water and graffiti resistant. It can shield concrete blocks and other porous masonry surfaces. It also offers protection from weather and water damage as well as from compounds that cause graffiti and vandalism. This coating acts as a shield against exterior factors such as rain, sunlight, and extreme temperatures. Its formula helps to prevent stains caused by moisture and mildew, ensuring surfaces remain clean for longer periods. It not only resists graffiti, but also makes cleaning easier, reducing maintenance efforts. Additionally, it allows surfaces to breathe, preventing moisture buildup and protecting their integrity. Perfect for use on buildings or existing concrete structures and porous materials, it offers durable protection while keeping the look attractive. Nevertheless, there are limits to its use. It should not be used on extremely dense, polished, or painted surfaces or asphalt. Glass or non-masonry surfaces need special protection, or they might be damaged. Furthermore, it is not suitable for horizontal surfaces or below-grade applications. If used for spray application, stainless steel or brass fittings and gaskets are preferred because the solvent may disintegrate other equipment. At $114.00 per gallon or $0.91 per square foot, this silicone elastomer coating covers 125

square feet each gallon and comes in packing sizes of 1-gallon cans and 5-gallon pails (TK Products Construction Coatings, 2018-b). Table 20 presents the product data of TK-BLOCK AND GRAFFITI GUARD 5220 VOC.

Table 20. Product Data of TK-BLOCK AND GRAFFITI GUARD 5220 VOC Manufactured by TK Products

Physical Properties	Description/Values
Color	Clear
Composition	Silicone elastomer
VOC Content	< 420 g/L
Application Temperature	40°F to 90°F
Drying Time	25 minutes
Coverage Rate	125 sq. ft/gallon
Recommended Coats	Two (extremely porous surfaces)
Method of Application	Brush or roller

Sacrificial GRAFFITI GARD is a water-based resin that serves as a protective layer over new or previously painted substrates. The formulation includes a blend of waxes and resins. Its role is to protect the substrate beneath. Another advantage is that graffiti can be removed easily. The wax enables individuals to remove graffiti with minimum effort without altering the substrate. Additionally, it allows for easy reapplication and protection whenever the need arises. It is applicable on various surfaces such as concrete stain, concrete, metal, cement, plaster, wood, block, brick, and other manufacturer-approved surfaces. It is recommended that materials such as masonry, including mortar, concrete, and cement plaster, be cured for a minimum of 28 days prior to applying the Sacrificial GRAFFITI GARD. To remove the Sacrificial GRAFFITI GARD, it is advised to use a hot water blaster, with water pressure and temperature between 900 psi and 1200 psi and 170°F to 180°F, respectively. At $35.00 per gallon or $0.14 per square foot, this coating covers 250 square feet per gallon and comes in packing sizes of 1, 5, 30, and 55 gallons, making it the top sacrificial anti-graffiti product among other sacrificial products (TEX-COTE, 2024-c). Table 21 presents the product data of Sacrificial GRAFFITI GARD.

Table 21. Product Data of Sacrificial GRAFFITI GARD Manufactured by TEX-COTE

Physical Properties	Description/Values
Color	Clear
Composition	Blends of waxes and resins
VOC Content	< 50 g/L
Application Temperature	50°F to 100°F
Coverage Rate	250 sq. ft/gallon
Shell Life	12 months
Method of Application	Roller or commercial-grade airless

MuralShield is an anti-vandalism and preservation coating system that creates durable and highly maintainable murals. It is a two-part system that consolidates and provides UV protection as well as vandalism protection when used with **World's Best Graffiti Coating** (WBGC). It protects, restores, and maintains aerosol and acrylic murals. Vandalism can be readily removed after the MuralShield System is installed with just a hot water pressure washer or removers sold by the manufacturer. WBGC is then reapplied to the affected area before completion. WBGC is not only effective for graffiti removal, but also suitable for delicate historic building surfaces like stucco, brick, and concrete with prior damage. Its flexibility with ambient temperature and UV stability ensures durability. The resulting protective barrier is invisible, behaving like a "living" skin that adapts to environmental changes. This feature allows walls to breathe normally, preventing water vapor from being trapped. Moreover, it contains zero VOCs and is biodegradable, nontoxic, and odorless. Coverage extends to approximately 300 square feet per gallon on porous surfaces (with two coats) or 400 square feet per gallon on hard, impervious surfaces (with two coats). In conjunction with MuralShield, WBGC offers enduring protection for murals and artworks. The sacrificial clear coating utilizes a water-carried paraffin wax dispersion, and it costs only $65.00 per gallon or $0.11 per square foot. The sacrificial water-carried paraffin wax coating comes in packing sizes of 1 quart, 1 gallon and 5 gallons (Urban Restoration Group, September 2023). Table 22 presents the product data of the World's Best Graffiti Coating.

Table 22. Product Data of World's Best Graffiti Coating Manufactured by Urban Restoration Group

Physical Properties	**Description/Values**
Color	Clear
Composition	Water-carried paraffin wax dispersion
Odor	Odorless
Drying Time	4 hours
Recommended Coats	2
Shell Life	Approximately 3 years
Application Temperature	45°F to 95°F
PH	8
Method of Application	Rollers, paintbrush, low-pressure sprayers, or airless sprayers

3M Anti-Graffiti Film is a transparent polyester film with a scratch-resistant surface and excellent anti-staining properties. These are optically clear window films. The films will help shield glass from abrasion, scratches, graffiti, etching, and vandalism when they are placed on the surface. A one-year warranty is included with these films, which are meant to be a sacrificial (removable) layer. When replacing them, these films are simple to remove and do not form a chemical contact with glass. Protecting glass from vandalism, graffiti, scratches, etching, or abrasion is essential for maintaining its integrity and appearance. For internal or external use, this protective film acts as a sacrificial layer, protecting the underlying glass from damage. Additionally, it combats the cause of solar fading primarily by blocking about 99% of the sun's harmful UV rays and reducing glare from intense sunlight. Not only does this enhance visibility, but it also provides safe driving conditions. This film

costs around $8.00 per square foot and comes in sheets of sizes of 4 mil (72 in. × 100 ft), 6 mil (72 in. × 100 ft), and 4 mil (36 in. × 25 ft). It is suitable for glass surfaces and provides a cost-effective alternative to replacing glass (3M, 2019). Table 23 presents the product data of 3M Anti-Graffiti Film.

Table 23. Product Data of 3M Anti-Graffiti Film Manufactured by 3M

Physical Properties	Description/Values
Material Base	Transparent polyesters
Visible Light Transmission	89.5%
UV Block	> 98%
Application Temperature	39°F to 113°F
Drying Time	Final adhesion is reached after approximately 8–10 days in dry conditions
Shell Life	5 years
Method of Application	Suitable for wet application or dry, semiautomatic lamination

LISTING OF PRODUCTS

Listing is vital to many areas including making the product more visible and influencing the consumer to make decisions based on how the items are listed. In today's fast-paced, information-saturated environment, the order in which information is presented can profoundly affect the meaning we derive from this data and the way we act upon such information. The rationale for ranking matters encompasses visibility, credibility, competition, navigation, user experience, resource allocation, and the decision-making process. The research team listed the anti-graffiti products based on factors such as VOC content, product cost, and number of surfaces to which it can be applied (surface compatibility). A breakdown of how each factor contributed to the listing is listed as follows:

- **VOC Content:** Lower VOC content is generally preferable because of environmental and health concerns, so products with low VOC content were given higher priority.
- **Cost:** Products with lower costs were listed higher, assuming that a higher cost does not always guarantee better performance.
- **Surface Compatibility:** Coatings that can be applied to more surfaces were given higher priority in the list.

Tables 24 and 25 list non-sacrificial and sacrificial products by VOC content, respectively. Tables 26 and 27 list non-sacrificial and sacrificial products by cost, while Tables 28 and 29 list non-sacrificial and sacrificial products by surface compatibility. Table 30 presents advantages and disadvantages of the products found from the market survey.

Table 24. List of Non-Sacrificial Market Survey Products Based on VOC Content

Product/Manufacturer	VOC Content (g/L)	Composition	Cost ($/Sq. ft)	Surface Compatibility
Permashield Premium *(Monopole Inc.)*	Zero	2-part aliphatic polyurethane	0.76	• Unpainted or painted concrete, stucco, plaster, and masonry • Prepared metal
NanoSlic 240 *(NanoSlic)*	Zero	NanoSilica	9.99	Railroads, subways, and infrastructure
VandlGuard Ten Premium *(RainGuardPro)*	< 20	Cross-linked copolymer	0.60	• Concrete, brick or stucco • Block, natural stone • Wood • Metal • Plastic
UreMax WB *(Brickform)*	< 50	2-part water-based polyurethane	0.38	• Concrete • Masonry • Stone
GRAFFITI GARD S *(TEX-COTE)*	< 250	Polysiloxane	0.72	• Concrete • Brick • Previously coated metal
TK-BLOCK AND GRAFFITI GUARD VOC *(TK Products)*	< 350	Silicone Elastomer	0.91	• Concrete • Masonry
Graffiti Stopper 1K *(ChemMasters)*	Not mentioned	Polysiloxane	1.14	• Concrete • Masonry • Painted, primed, or galvanized metal

Table 25. List of Sacrificial Market Survey Products Based on VOC Content

Product/Manufacturer	VOC Content (g/L)	Composition	Cost ($/Sq. ft)	Surface Compatibility
World's Best Graffiti Coating *(Urban Restoration Group US Inc.)*	Zero	Water-carried paraffin wax	0.11	• Concrete • Brick • Stucco
Sacrificial Graffiti Gard System *(TEX-COTE)*	< 50	Water-based formulation, a blend of waxes and resins	0.14	• Concrete • Cement, plaster • Block, • Brick • Metal • Wood
3M Anti-Graffiti Film *(3M)*	N/A	Polyester	8.00	Glass

Table 26. List of Non-Sacrificial Market Survey Products Based on Cost

Product/Manufacturer	Cost ($/Sq. ft)	VOC Content (g/L)	Composition	Surface Compatibility
UreMax WB *(Brickform)*	0.38	< 50	2-part water-based polyurethane	• Concrete • Masonry • Stone
VandlGuard Ten Premium *(RainGuardPro)*	0.60	< 20	Cross-linked co-polymer	• Concrete, brick or stucco • Block, natural stone • Wood • Metal • Plastic
GRAFFITI GARD S *(TEX-COTE)*	0.72	< 250	Polysiloxane	• Concrete • Brick • Previously coated metal
Permashield Premium *(Monopole Inc.)*	0.76	Zero	2-part aliphatic polyurethane	• Unpainted or painted concrete, stucco, plaster, and masonry • Prepared metal
TK-BLOCK AND GRAFFITI GUARD VOC *(TK Products)*	0.91	< 350	Silicone Elastomer	• Concrete • Masonry

Product/Manufacturer	Cost ($/Sq. ft)	VOC Content (g/L)	Composition	Surface Compatibility
Graffiti Stopper 1K *(ChemMaster)*	1.14	Not mentioned	Polysiloxane	• Concrete • Masonry • Painted, primed, or galvanized metal
NanoSlic 240 *(NanoSlic)*	9.99	Zero	NanoSilica	Railroads, subways, and infrastructure

Table 27. List of Sacrificial Market Survey Products Based on Cost

Product/Manufacturer	Cost ($/Sq. ft)	VOC Content (g/L)	Composition	Surface Compatibility
World's Best Graffiti Coating *(Urban Restoration Group US Inc.)*	0.11	Zero	Water-carried paraffin wax	• Concrete • Brick • Stucco
Sacrificial GRAFFITI GARD System *(TEX-COTE)*	0.14	< 50	Water-based formulation, a blend of waxes and resins	• Concrete • Cement, plaster • Block, • Brick • Metal • Wood
3M Anti-Graffiti Film *(3M)*	8.00	N/A	Polyester	Glass

Table 28. List of Non-Sacrificial Market Survey Products Based on Surface Compatibility

Product/Manufacturer	Surface Compatibility	Cost ($/Sq. ft)	VOC Content (g/L)	Composition
VandlGuard Ten Premium *(RainGuardPro)*	• Concrete, brick or stucco • Block, natural stone • Wood • Metal • Plastic	0.60	< 20	Cross-linked co-polymer
Permashield Premium *(Monopole Inc.)*	• Unpainted or painted concrete, stucco, plaster, and masonry • Prepared metal	0.76	Zero	2-part aliphatic polyurethane

Product/Manufacturer	Surface Compatibility	Cost ($/Sq. ft)	VOC Content (g/L)	Composition
UreMax WB *(Brickform)*	• Concrete • Masonry • Stone	0.38	< 50	2-part water-based polyurethane
NanoSlic 240 *(NanoSlic)*	Railroads, subways, and infrastructure	9.99	Zero	NanoSilica
GRAFFITI GARD S *(TEX-COTE)*	• Concrete • Brick • Previously coated metal	0.72	< 250	Polysiloxane
Graffiti Stopper 1K *(ChemMasters)*	• Concrete • Masonry • Painted, primed, or galvanized metal	1.14	Not mentioned	Polysiloxane
TK-BLOCK AND GRAFFITI GUARD VOC *(TK Products)*	• Concrete • Masonry	0.91	< 350	Silicone Elastomer

Table 29. List of Sacrificial Market Survey Products Based on Surface Compatibility

Product/Manufacturer	Surface Compatibility	Cost ($/Sq. ft)	VOC Content (g/L)	Composition
Sacrificial GRAFFITI GARD System *(TEX-COTE)*	• Concrete • Cement, plaster • Block, • Brick • Metal • Wood	0.14	< 50	Water-based formulation, a blend of waxes and resins
World's Best Graffiti Coating *(Urban Restoration Group US Inc.)*	• Concrete • Brick • Stucco	0.11	Zero	Water-carried paraffin wax
3M Anti-Graffiti Film *(3M)*	Glass	8.00	N/A	Polyester

Table 30. Advantages and Disadvantages of Anti-Graffiti Products

Product/Manufacturer	Advantages	Disadvantages	Primer	Surface Compatibility
VandlGuard Ten Premium *(RainGuardPro)*	• Low gloss • Retards mildew • Easy to apply • Low-cost application • Low VOC content • Low odor	Requires micro-seal & finish coat	Not needed	• Concrete, brick or stucco • Block, natural stone • Wood • Metal • Plastic
Permashield Premium *(Monopole Inc.)*	• UV, stain, chemical resistant • Zero VOC • Eco-friendly • Non-yellowing, non-chalking • Breathable	• Can't be applied in windy conditions • Cannot be applied to surfaces containing 15% or higher moisture content	Monobond RI primer (for metal or steel)	• Unpainted or painted concrete, stucco, plaster, and masonry • Prepared metal
UreMax WB *(Brickform)*	Resists mold and mildew growth	Not recommended for pre-sealed or dense surfaces	Not needed	• Concrete • Masonry • Stone
NanoSlic 240 *(NanoSlic)*	• Low VOC content • UV degradation • High degree of adhesion and abrasion resistance • Easy to clean	High initial cost	Not needed	Railroads, subways, and infrastructure
GRAFFITI GARD S *(TEX-COTE)*	• Ready to use • Excellent graffiti resistance & UV resistance • Easy removal	High VOC content	Not needed	• Concrete • Brick • Previously coated metal
Graffiti Stopper 1K *(ChemMasters)*	• Easy to clean • Low-gloss finish • UV stable	High initial cost	Not needed	• Concrete • Masonry • Painted, primed, or galvanized metal

Product/Manufacturer	Advantages	Disadvantages	Primer	Surface Compatibility
TK-BLOCK AND GRAFFITI GUARD VOC *(TK Products)*	Resists efflorescence and stains	Cannot be applied to extremely dense surfaces	Not needed	• Concrete • Masonry
Sacrificial GRAFFITI GARD System *(TEX-COTE)*	• Protects underlying surface • Easy to remove graffiti • Immediate protection	• Requires reapplication • Do not use on below-grade or horizontal surfaces exposed to ponding water	Not needed	• Concrete • Cement, plaster • Block, • Brick • Metal • Wood
World's Best Graffiti Coating *(Urban Restoration Group US Inc.)*	• Safe, quick, and easy to apply by spray, brush, or roller • Fast drying time • Invisible / matte finish • Nontoxic and odorless	• Sacrificial nature • Not suitable for nonporous surfaces	Not needed	• Concrete • Brick • Stucco
3M Anti-Graffiti Film *(3M)*	•Scratch-resistant surface • Easy to remove and replace •Cost-effective alternative to replacing glass • UV rejection	Sacrificial nature requires replacement after graffiti removal	Not needed	Glass

RESULTS

The results show there is a large variety of anti-graffiti products with different compositions, prices, and performance characteristics. There are mainly two types of coatings available in the market. Permanent coatings, also known as non-sacrificial coatings, are based on acrylic-siloxane copolymers, polyurethanes, and silicones. These coatings can endure multiple cycles (i.e., 10 cycles), have a longer service life, and are not eliminated during the cleaning process. Even though permanent coatings are the most expensive type, the substrate is more protected and has longer durability. Coatings such as VandlGuardTen Premium and Permashield Premium are the top two permanent coatings that offer long-lasting protection and resistance to various environmental factors. Additionally, they can be

applied to a greater number of surfaces and are less expensive compared to other permanent coatings. A summary of non-sacrificial anti-graffiti products is presented in Table 31.

Table 31. Summary of Non-Sacrificial Anti-Graffiti Products

Product/Manufacturer	Type	Composition	Cleaning Agent	Cost ($/Sq. ft)
Permashield Premium *(Monopole Inc.)*	Non-sacrificial	2-part aliphatic polyurethane	Citrus Clean Super, spray directly on graffiti, followed by brushing or nylon scour pad	0.76
VandlGuard Ten Premium *(RainGuardPro)*	Non-sacrificial	Cross-linked copolymer	Mild detergent or soap, warm to hot water while power washing less than 500 psi (no harsh chemical cleaners required)	0.60
UreMax WB *(Brickform)*	Non-sacrificial	2-part water-based polyurethane	Brickform E-Etch	0.38
Graffiti Stopper 1K *(ChemMasters)*	Non-sacrificial	Polysiloxane	Common soap and stiff, natural bristle brush followed by high-pressure water	1.14
TK-BLOCK AND GRAFFITI GUARD VOC *(TK Products)*	Non-sacrificial	Silicone Elastomer	TK-Chemical cleaner	0.91
GRAFFITI GARD S *(TEX-COTE)*	Non-sacrificial	Polysiloxane	Power-washing or use of graffiti-removing cleansers such as TEX-COTE Graffiti Gard Biodegradable Cleaner	0.72
NanoSlic 240 *(NanoSlic)*	Non-sacrificial	NanoSilica	Not specified	9.99

The other common type is sacrificial coatings, which are removed during the cleaning process and must be reapplied after each cycle. These are usually based on waxes, micro-wax, acrylates, and polysaccharides. Moreover, graffiti removal is made easier by these sacrificial coatings. Coatings such as the Sacrificial GRAFFITI GARD System and World's Best Graffiti Coating, although listed eighth and ninth respectively on the overall listing, are the top two coatings in the sacrificial coating category as they are clear, easy to apply, and easy to clean without any use of harsh chemicals. Table 32 presents a summary of sacrificial anti-graffiti products.

Table 32. Summary of Sacrificial Anti-Graffiti Products

Product/Manufacturer	Type	Composition	Cleaning Agent	Cost ($/Sq. ft)
Sacrificial GRAFFITI GARD System *(TEX-COTE)*	Sacrificial	Water-based formulation, a blend of waxes and resins	Hot water blaster with a water temperature of 170°F–180°F, the water pressure should be approx. 900 to 1200 psi	0.14
World's Best Graffiti Coating *(Urban Restoration Group US Inc.)*	Sacrificial	Water-carried paraffin wax	Hot water and high pressure (~90°C / 200ºF / 1300–2175 psi)	0.11
3M Anti-Graffiti Film *(3M)*	Sacrificial	Polyester	Use a cleaning agent designed for high-quality glass surfaces and must be wet and nonabrasive with a pH value between 6 and 8	8.00

To ensure the longevity of these coatings and maintain the cleanliness of the surfaces, effective graffiti-removal methods are essential. Various techniques, such as sandblasting, soda blasting, and pressure washing, are commonly employed for this purpose. While sandblasting is great at removing graffiti from surfaces, it can be harsh and might cause damage if not done carefully. It is excellent for tougher materials like steel, aircraft parts, and concrete. Moreover, it is applied using a much greater pressure of around 80–150 psi. Soda blasting, which uses sodium bicarbonate particles, provides a better option for delicate surfaces. This process involves propelling fine sodium bicarbonate particles onto a surface using compressed air or water. This method is ideal for wood and masonry and uses a pressure of only 20 psi. On the other hand, pressure washing, which is one of the most common techniques, uses high-pressure water jets without abrasive materials to get rid of graffiti and is often paired with chemical cleaners for better results. Generally, hot water is used for pressure washing

with varying pressures of around 2000–3000 psi. High-pressure water can cause minimal damage to the surface and is safe for most materials. Additionally, it is environmentally friendly, as it does not use abrasive or toxic materials, and it is more affordable compared to other removal techniques. These removal methods, combined with the appropriate anti-graffiti coatings, ensure surfaces remain clean and protected over time.

CONCLUSION

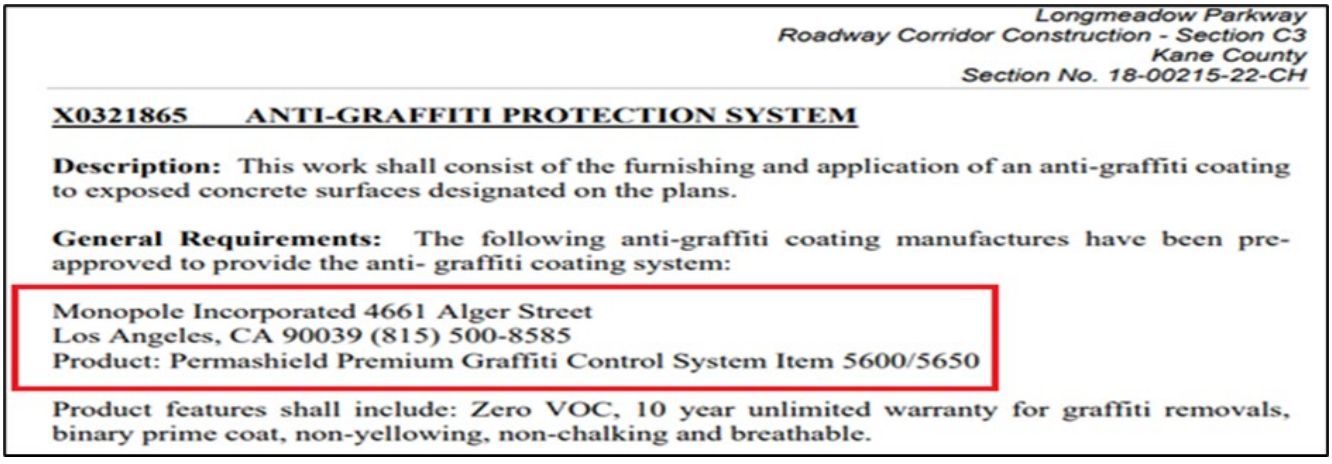
Several factors determine the choice of anti-graffiti coating, including the type of surface, the surrounding environment, and budget. Sacrificial coatings require frequent reapplication even though they provide quick protection and make graffiti removal easy. Non-sacrificial coatings provide greater suitability for a variety of surfaces and long-lasting protection, but they may come with a higher potential cost. While choosing the best anti-graffiti coating, consumers must consider their specific needs and surface characteristics as each coating has unique advantages and limitations. All products listed in this chapter are readily available in more than 200-gallon quantities.

CHAPTER 5: ANTI-GRAFFITI PRODUCTS USED IN THE STATE OF ILLINOIS

Graffiti removal and prevention have posed significant challenges over the years. To address this issue, anti-graffiti protection coatings have been used in construction projects in the state of Illinois. This chapter analyzes projects involving these systems undertaken by the Illinois Department of Transportation (IDOT) over the past 14 years. The objective is to identify the specific products used in these projects and the types of surfaces on which they were applied. By understanding these patterns, the researchers aim to provide recommendations for the best anti-graffiti coating(s) that can be adopted by IDOT in the future. Graffiti defacement affects transportation infrastructure, leading to maintenance costs and aesthetic degradation. Anti-graffiti coatings offer a potential solution by minimizing the effort required for graffiti removal. This chapter delves into the State of Illinois' historical use of anti-graffiti protection systems and analyzes the projects done in past years that used anti-graffiti protection systems.

ANALYSIS

This study examined projects within the IDOT database that utilized anti-graffiti protection systems. By accessing project documents, the researchers identified preapproved suppliers and their specified products, an example of which is presented in Figure 4. They then contacted these suppliers to gather essential details of the products, including volatile organic compound (VOC) content, unit costs, and technical specifications. They conducted a thorough examination of the project plans to determine the type of surface onto which the anti-graffiti coating was applied. The focus was to distinguish between porous surfaces, such as concrete or wood, and nonporous surfaces, like glass or metal. This distinction was essential, as it allowed the researchers to understand the compatibility of different anti-graffiti coatings with specific surface types. By categorizing surfaces in this manner, they aimed to identify coatings that would adhere effectively and provide long-lasting protection based on the unique properties of each surface.



Longmeadow Parkway
Roadway Corridor Construction - Section C3
Kane County
Section No. 18-00215-22-CH

X0321865 ANTI-GRAFFITI PROTECTION SYSTEM

Description: This work shall consist of the furnishing and application of an anti-graffiti coating to exposed concrete surfaces designated on the plans.

General Requirements: The following anti-graffiti coating manufactures have been pre-approved to provide the anti- graffiti coating system:

Monopole Incorporated 4661 Alger Street
Los Angeles, CA 90039 (815) 500-8585
Product: Permashield Premium Graffiti Control System Item 5600/5650

Product features shall include: Zero VOC, 10 year unlimited warranty for graffiti removals, binary prime coat, non-yellowing, non-chalking and breathable.

Figure 4. Photo. Details of preapproved supplier and preapproved product.

For example, Figure 4 illustrates the specifications for project 61F04. The preapproved supplier is Monopole Incorporated, 4661 Alger Street, Los Angeles, California 90039, phone number (815) 500-8585, and the preapproved product is Permashield Premium Graffiti Control System Item 5600/5650. The plans showed the anti-graffiti system was used for a concrete surface (porous) of soldier piles.

The data from all projects were grouped in an Excel spreadsheet, and the different products collected from the data are presented in Table 33.

Table 33. Projects That Utilized Anti-Graffiti Protection Systems Found from IDOT Website

Sl. No.	Project Number	State/Local	County	Letting Date	Quantity (Sq. ft)
1	61F04	Local	89 Stephenson	9-Nov-18	2,888
2	93704	Local	167	04-Aug-17	2,099
3	87599	Local	37 Henry	28-Apr-17	217
4	63598	Local	89 Stephenson	20-Sep-13	1,405
5	62K74	State	31 Greene	20-Jan-23	33,338

PRODUCTS

The projects listed in Table 33 were categorized as local jurisdiction or state jurisdiction projects. If it is categorized as a state project, then it is a state job, and the product is on Illinois property. If it is categorized as a local project, then a local authority used the product, and it is not on state property. Properties of the anti-graffiti products mentioned in Table 34 include:

1. **Permashield Premium Graffiti Control System Item 5600/5650** is a non-sacrificial anti-graffiti coating made with a two-part aliphatic polyurethane. It was applied to porous surfaces such as concrete soldier piles, abutments, MSE (mechanically stabilized earth) retaining walls, tunnel end walls, and wing walls. The product offers several benefits, including UV resistance and resistance to stains, chemicals, and hot tires. It is non-yellowing, non-chalking, breathable, has very low VOC content, and emits low odor. This breathable coating allows moisture vapor to escape, preventing damage from trapped moisture. Notably, its very low VOC content and low odor make it environmentally friendly and user-friendly. However, when applying it to metal surfaces, thorough surface preparation is required to ensure proper adhesion.

2. **Brickform UreMax WB** is a non-sacrificial anti-graffiti coating composed of a two-part water-based polyurethane. It was applied to porous surfaces, including concrete abutments, pier caps, crash walls, curbs, and retaining walls. The product offers several advantages, such as inhibiting the growth of mold and mildew and resisting tire markings. However, it is not recommended for presealed or dense surfaces like glazed tile, marble, granite, dense brick, dense slate, or terrazzo. Additionally, it should not be applied if the temperature is below freezing (32°F) within the 24-hour curing cycle.

3. **Sherwin-Williams Anti-Graffiti Coating Clear B97C00150 (1K Siloxane)**, also used by the Wisconsin and Michigan Departments of Transportation, is a non-sacrificial anti-graffiti coating made with siloxane. This coating is designed for application on porous surfaces and was applied to concrete retaining walls, concrete pedestals, concrete caps, and facings. The product has several advantages: it can endure multiple graffiti removals without needing reapplication, requires only one coat for application, dries quickly, and offers excellent adhesion properties. Additionally, it is highly resistant to chalking, fading, and peeling. However, its use is primarily limited to concrete surfaces.

4. **Sherwin-Williams Pro-Industrial Anti-Graffiti Coating (2K Waterbased)**, also used by the Michigan Department of Transportation, is a non-sacrificial anti-graffiti coating composed of a two-component hydrophobic polyurethane. It is designed for application on porous surfaces and was applied on concrete retaining walls. The product offers several advantages, including low odor, excellent resistance to graffiti, and superior gloss retention, ensuring that treated surfaces maintain their aesthetic appeal. However, the product is relatively expensive, costing $337.79 per gallon, which may be a consideration for budget-conscious projects.

5. **Si-COAT 530 by CSL Silicones Inc.**, also utilized by the Kansas Department of Transportation, is a non-sacrificial anti-graffiti coating composed of polysiloxane. It is specifically designed for porous surfaces and was applied to concrete retaining walls. This product offers several advantages, including a one-coat application that simplifies the process and requires minimal surface preparation. It has a long service life, is hydrophobic and waterproof, and features a breathable coating that allows the surface to release trapped moisture. Additionally, it is easy to clean with cold, low-pressure water and provides UV resistance to protect against sun damage. However, it has limited durability and may require reapplication over time to maintain its protective qualities.

6. **VandlGuard by Rainguard Pro** is a non-sacrificial anti-graffiti coating with a chemical composition of cross-linked copolymer. It was applied to porous surfaces such as concrete retaining walls. Its advantages include approval by various organizations, low gloss for minimal appearance change, and retarding the growth of mildew, mold, fungus, and bacteria. However, it requires application of micro-seal beforehand and VandlGuard finish coat. It is an effective and durable option for protecting porous surfaces like concrete from graffiti. Its low-gloss finish and microbial growth prevention are significant benefits, though it does require a multi-step application process and is not suitable for glass surfaces.

7. **Organic Zinc Rich Primer / Epoxy / Urethane Paint system** is a sacrificial anti-graffiti coating composition. It was applied to nonporous surfaces such as steel columns.

Table 34. Findings of Anti-Graffiti Products from the Projects

Sl. No.	Project	Preapproved Suppliers	Preapproved Products	Observation	Type of Product
1	61F04	Monopole Incorporated	Permashield Premium Graffiti Control System Item 5600/5650	AGPS* used for the concrete surface of soldier piles.	Non-Sacrificial
2	93704	Not Specified	Brickform UreMax WB	AGPS* used for concrete surface of abutments, superstructure, and retaining walls.	Non-Sacrificial
3	87599	Not Specified	Composition: Organic Zinc Rich Primer / Epoxy / Urethane Paint System	AGPS* used for steel columns.	Sacrificial
4	63598	Sherwin-Williams	Sherwin-Williams Anti-Graffiti Coating Clear B97C00150 (1K Siloxane) *(Used by Wisconsin and Michigan DOTs)*	AGPS* used for the concrete surface of retaining walls.	Non-Sacrificial
5	62K74	Sherwin-Williams	Pro-Industrial Anti-Graffiti Coating (2K Waterbased) *(Used by Michigan DOT)*	Usage details not found in the plans.	Non-Sacrificial
6	62K74	CSL Silicones Inc.	Si-COAT 530 *(Used by Kansas DOT)*	Usage details not found in the plans.	Non-Sacrificial
7	62K74	RainguardPro	VandlGuard Non-Sacrificial Anti-Graffiti Coating	Usage details not found in the plans.	Non-Sacrificial

AGPS- Anti-Graffiti Protection System

RESULTS

A total of 34 projects were studied and fully analyzed. Not all projects specified the preapproved suppliers or products. Among the studied projects, seven different preapproved products/compositions were obtained, as some of the projects had products and suppliers in common. Figure 5 summarizes the results:

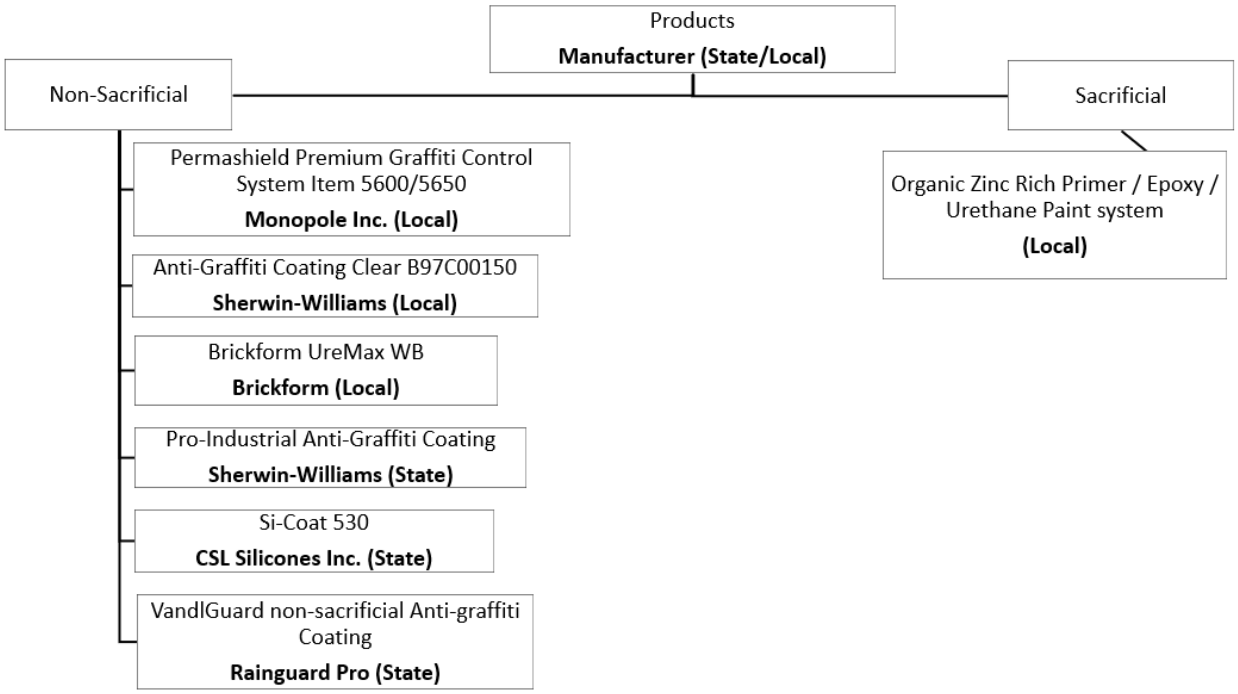


Figure 5. Flowchart. Illustration of the anti-graffiti products.

LISTING OF PRODUCTS

The products identified through analysis were evaluated and listed based on several criteria: cost, compatibility with various surfaces, and VOC content. The rankings were determined by assessing each product's performance in these areas.

- **Cost**: Products were evaluated to determine which provided the best overall value. This step involved comparing the costs of each product to assess their affordability. Lower-cost options were considered more economical and received higher rankings. The focus was on identifying products that offered effective performance at a reduced price, ensuring cost-efficiency without compromising quality. By prioritizing affordability, the rankings highlighted products that provide maximum benefit for the least expense, making them more accessible and appealing for users looking to optimize their budget.

- **Surface Compatibility**: The versatility of each product was assessed by the number of different surfaces on which it could effectively be applied. Products that worked on a wider range of surfaces were ranked higher.

- **VOC Content**: The environmental impact and safety of the products were assessed by examining their VOC content. VOCs are chemicals that can easily become vapors or gases, contributing to air pollution and posing health risks to humans. Products with lower VOC levels emit fewer harmful chemicals into the environment, making them safer for both users and the surrounding ecosystem. Therefore, products with minimal VOC content were rated

higher in the rankings due to their reduced environmental footprint and lower potential for causing health issues.

Tables 35, 36, and 37 provide detailed rankings, highlighting each product's performance in terms of cost, surface compatibility, and VOC content, respectively, and showing how the rankings change when these factors are considered separately.

Table 35. Listing of IDOT Products Based on Cost

Sl. No.	Product	Type	Cost ($/Sq. ft)	Surface Compatibility	VOC (g/L)	Comments
1	Sherwin-Williams 1K Siloxane	Non-sacrificial	0.17	1 (Porous only)	< 250.00	• Concrete
2	Brickform UreMax WB	Non-sacrificial	0.38	2 (Porous only)	< 50.00	• Compatible with all stone and masonry surfaces
3	Sherwin-Williams 2K Waterbased	Non-sacrificial	0.41	5 (Porous & nonporous)	< 100.00	• Iron • Steel • Masonry • Block • Concrete
4	VandlGuard Ten Premium	Non-sacrificial	0.60	10 (Porous & nonporous)	< 20.00	• Aggregate panels • Concrete, brick, stucco, EIFS and cement plaster • Metal • Plastic • Stone • Wood
5	Si-COAT 532	Non-sacrificial	0.69	6 (Porous & nonporous)	< 45.50	• Metal • Concrete • Brick • Stone • Wood • Fiberglass
6	Permashield Premium	Non-sacrificial	0.76	5 (Porous & nonporous)	0.00	• Concrete • Masonry • Stucco • Tile • Metal

Table 36. Listing of IDOT Products Based on VOC Content

Sl. No.	Product	Type	VOC (g/L)	Cost ($/Gal.)	Surface Compatibility	Comments
1	Permashield Premium	Non-sacrificial	0.00	170.00	5 (Porous & nonporous)	• Concrete • Masonry • Stucco • Tile • Metal
2	VandlGuard Ten Premium	Non-sacrificial	< 20.00	149.00	10 (Porous & nonporous)	• Aggregate panels • Concrete, brick, stucco, EIFS and cement plaster • Metal • Plastic • Stone • Wood
3	Si-COAT 532	Non-sacrificial	< 45.50	130.00	6 (Porous & nonporous)	• Metal • Concrete • Brick • Stone • Wood • Fiberglass
4	Brickform UreMax WB	Non-sacrificial	< 50.00	189.00	2 (Porous only)	• Compatible with all stone and masonry surfaces
5	Sherwin-Williams 2K Waterbased	Non-sacrificial	< 100.00	337.00	5 (Porous & nonporous)	• Iron • Steel • Masonry • Block • Concrete
6	Sherwin-Williams 1K Siloxane	Non-sacrificial	< 250.00	200.00	1 (Porous only)	• Concrete

Table 37. Listing of IDOT Products Based on Surface Compatibility

Sl. No.	Product	Type	Surface Compatibility	VOC (g/L)	Cost ($/Gal.)	Comments
1	VandlGuard Ten Premium	Non-sacrificial	10 (Porous & nonporous)	< 20.00	149.00	• Aggregate panels • Concrete, brick, stucco, EIFS and cement plaster • Metal • Plastic •Stone • Wood
2	Permashield Premium	Non-sacrificial	5 (Porous & nonporous)	0.00	170.00	• Concrete • Masonry • Stucco • Tile • Metal
3	Si-COAT 532	Non-sacrificial	6 (Porous & nonporous)	< 45.50	130.00	• Metal • Concrete • Brick • Stone • Wood • Fiberglass
4	Sherwin-Williams 2K Waterbased	Non-sacrificial	5 (Porous & nonporous)	< 100.00	337.00	• Iron • Steel • Masonry • Block • Concrete
5	Brickform UreMax WB	Non-sacrificial	2 (Porous only)	< 50.00	189.00	• Compatible with all stone and masonry surfaces
6	Sherwin-Williams 1K Siloxane	Non-sacrificial	1 (Porous only)	< 250.00	200.00	• Concrete

CONCLUSIONS

This chapter provides valuable insights into the State of Illinois' anti-graffiti practices in the past 14 years. By understanding the historical context and product usage, we can better recommend an ideal anti-graffiti coating strategy for transportation infrastructure. Among the projects, most projects used anti-graffiti protection systems on bridges and MSE retaining walls with mainly a porous surface (concrete), and only one project used the anti-graffiti system for a nonporous surface (steel). In addition, the results of a survey that was disseminated to different states DOTs indicated there were some products in common that have been used by multiple states. The responses indicated they had satisfactory performance with them as anti-graffiti protection systems. All products listed in this chapter are readily available in more than 200-gallon quantities.

CHAPTER 6: GRAFFITI-REMOVAL TECHNIQUES

Graffiti removal is difficult and expensive, frequently proving only partially effective. The selection of cleaning procedures is crucial because improper methods might cause harm to surface coatings and materials. Implementing preventive measures such as erecting physical barriers like fences, trees, and shrubs can discourage graffiti; however, they are not completely foolproof in preventing it. Anti-graffiti coatings provide a proactive solution by forming surfaces that repel water and oil, facilitating the removal of graffiti and preserving the durability and aesthetic of building materials.

Timely removal of graffiti is crucial to prevent the paint from undergoing chemical bonding with air contaminants, making the cleaning process more difficult. Impermeable materials such as steel, glass, and glazed tiles can be cleaned effectively using chemical solutions. In contrast, porous materials typically require repeated cleaning cycles because of the complexity involved in removing graffiti from such surfaces. Commonly employed methods for removal include mechanical and chemical approaches. Mechanical methods encompass techniques such as abrasion and high-pressure cleaning, while chemical procedures involve the use of solvents and other chemicals. Nevertheless, these techniques have the potential to harm specific substances. Laser removal is now being researched because of its less invasive nature, providing a potential option for maintaining the integrity of the surface while efficiently eliminating graffiti. Biological cleaning is another removal method, which involves using microorganisms, such as bacteria and fungi, to break down and remove graffiti paint from surfaces. This method, known as bio-cleaning or bioremediation, provides an effective, safe, and eco-friendly alternative to conventional graffiti-removal methods. Choosing the correct removal technique is essential for achieving successful and nondestructive outcomes, taking into account the type of graffiti and the surface material (Moura et al., 2014).

PHYSICAL CLEANING METHODS

Physical techniques for graffiti removal employ mechanical processes to scrub, blast, or apply heat to eliminate undesired paint and markings. Commonly used techniques include abrasion, pressure washing, novel techniques, and laser technology. Abrasions use substances such as sand or baking soda to erode graffiti mechanically, whereas pressure washing employs powerful water jets to remove paint forcefully from surfaces. These methods are efficient on various types of surfaces, providing a practical alternative for removing graffiti. Nevertheless, careful implementation is necessary to prevent any harm to the underlying material.

Pressurized water cleaning is a commonly employed physical technique for eliminating graffiti. It involves using water jets at different pressures to displace paint from surfaces. To prevent the introduction of toxic substances or chemicals that could cause harm, it is necessary to use clean water during the operation. Hot water, usually ranging from 104°F to 140°F, is more efficient than cold water, particularly for removing chemically softened residue during rinsing. Water with a low pressure, less than or equal to 250 psi, is appropriate for cleaning in general. It can be useful when used in combination with brushing, especially on new graffiti that has not yet dried. Water at high pressure, ranging from 250 to 1000 psi, is stronger and frequently required to remove more resistant

graffiti. Nevertheless, it is crucial to exercise caution in order to regulate the pressure and select suitable nozzles to avoid any potential harm to the surface (Historic England, 2021).

Sand blasting is a highly efficient and rapid technique used to eliminate graffiti from buildings, especially in difficult situations. This method involves blasting sand at a high velocity onto a painted surface by utilizing a power washer that is equipped with a sandblaster. The sand's abrasive nature causes the paint to be stripped away, resulting in the successful removal of graffiti. Although sand is the predominant medium in sandblasting, alternative materials including steel grit, steel shots, copper slag, and powdered abrasives can be employed based on the particular surface and intensity of the graffiti. Sandblasting is applicable to a wide range of surfaces, such as metal, concrete, masonry, brick, and wood. However, it is important to exercise caution when applying this approach to porous surfaces such as brick, wood, or old stone, as its erosive properties might expedite degradation. When used appropriately, sandblasting is an extremely successful method for removing graffiti, despite its roughness. With its ability to return surfaces to their initial condition, this cleaning method is extremely valuable (Rachel, 2020).

Soda blasting provides a gentler alternative to conventional abrasive blasting techniques by using sodium bicarbonate (baking soda) as the abrasive material. This procedure involves propelling micro sodium bicarbonate particles onto a surface by means of pressurized air or water. In contrast to harsh techniques such as sandblasting, soda blasting is comparatively mild and is especially appropriate for surfaces that require caution against potential harm. Soda blasting is particularly suitable for materials like wood and stone (Historic England, 2021). It creates a protective film on the surface, which hinders the adhesion of paints and other coatings. Additionally, it offers a certain degree of surface protection. Soda blasting utilizes a notably reduced pressure, typically as low as 20 psi, which renders it a safer and more ecologically sound alternative. Soda blasting generates a certain amount of dust, but it poses less risk to respiratory health, is not poisonous, and is more environmentally friendly than conventional abrasive blasting substances. Nevertheless, the cost of the product may be slightly more because of its environmentally friendly characteristics and the additional time needed for thorough removal. Although sodium bicarbonate can serve as a milder abrasive agent, it has certain restrictions, especially when used on porous surfaces such as wood. The granules possess a low density and are capable of dispersing over long distances, but this can be alleviated by incorporating water into the air/soda combination. Moreover, sodium bicarbonate possesses partial solubility and can be assimilated into permeable materials, which may result in the creation of salts when subjected to alternating wet and dry conditions. Although there are some restrictions, soda blasting is nevertheless a highly effective and eco-friendly technique for eradicating graffiti, particularly in cases where it is important to minimize surface damage.

Novel techniques, such as dry ice blasting and plasma arc spraying, may be used to remove graffiti. Dry ice blasting is an innovative and environmentally friendly technique to remove graffiti. It involves propelling tiny pellets of dry ice, which is the solid state of carbon dioxide, onto surfaces with high pressure. When the dry ice hits, it sublimates, going straight from solid to gas without leaving any residue. This technique is gentle and does not cause any damage, making it appropriate for fragile surfaces while ensuring that the underlying material remains unharmed. In addition, the tiny carbon dioxide emission during the process rapidly dissipates into the environment. Nevertheless, a

drawback of dry ice blasting is the possibility of causing heat shock to delicate surfaces, which requires cautious implementation to prevent harm. Plasma arc spraying is an effective technique for removing graffiti. It employs a specialized pistol to spray liquid metal onto the surface. The plasma, propelled at almost supersonic velocities by a rotating nozzle, induces the sprayed paint to vaporize. This process is highly efficient and does not leave behind any chemical residue, making it a highly effective alternative for removing graffiti on a big scale. Nevertheless, it is crucial to address technical factors, such as the risk of substrate damage caused by inappropriate frequency and amplitude configurations. In addition, plasma spraying requires lower operating pressures, which could provide difficulties during deployment. Although there are some limits, plasma arc spraying offers a potent and economical method for eliminating graffiti from many types of surfaces (Sanmartín et al., 2014).

Laser technology has become a sophisticated and efficient means of eliminating graffiti, providing numerous benefits compared to conventional methods. Laser systems are being used more and more for different cleaning purposes, such as removing graffiti. A significant advantage of laser cleaning is its noncontact characteristic. It allows for precise and targeted removal of graffiti without causing any damage to the underlying surface. This makes lasers an ideal choice for delicate materials like historic buildings and structures. In addition, laser cleaning provides accurate control of the treated area, guaranteeing a slow and controlled elimination of graffiti. Various laser types, including CO_2, Nd:YAG, and Nd:YVO4, have been used to remove graffiti. Each kind has its own distinct advantages. Nd lasers are utilized extensively for their high efficiency and adaptability. They function at varying wavelengths, enabling customized treatment based on the specific graffiti and substrate. For example, Nd lasers operating at a wavelength of 1064 nm are employed frequently to remove paint in a general sense. However, shorter wavelengths like 355 nm are more efficient in cleaning paintings. The laser cleaning is efficient for removing graffiti from different surfaces and forms of graffiti. The efficiency of cleaning and the prevention of substrate damage are heavily influenced by laser parameters, including fluence, pulse repetition frequency, and pulse duration. Water-assisted laser irradiation is used commonly to improve the efficiency of laser treatment without raising the fluence. Although laser cleaning has many benefits, such as progressive and repeatable removal of contaminants with minimal harm to the environment, it can also pose issues if not carefully managed, such as the risk of color alteration or damage to the underlying material. Nevertheless, continuous study and developments in laser technology persistently enhance the effectiveness and safety of laser-based graffiti removal, rendering it a progressively favored option for restoration specialists and conservationists (Sanmartín et al., 2014).

CHEMICAL CLEANING METHODS

Chemical cleaning is a widely used technique for removing graffiti, known for its ability to specifically target and eliminate undesired paint and markings from different surfaces. Chemical treatments can enter the subsurface of the substrate, unlike mechanical procedures, allowing them to break down the chemicals that hold the graffiti onto the surface. This technique enables a more accurate and comprehensive cleaning procedure, particularly advantageous for sensitive or absorbent materials. Solvent-based paint softeners are highly efficient in eliminating paints that are bonded to organic materials as well as inks from felt-tip markers and ballpoint pens. This is achieved by dissolving the

adhesive substance and releasing the pigments. However, it is important to ensure that the surface is completely dry before applying the paint softener.

The versatility of chemical cleaning is attributed to the variety of reagents, including dilute bleach, alkali, or acid, that can be used in subsequent treatments to eliminate any residual pigment or "ghosting." Typically, these substances are used in either a gel or liquid state, which enables convenient observation of the development and guarantees comprehensive cleansing. Proprietary materials can be thickened to form pastes or poultices, which can be applied to vertical or overhanging surfaces. This allows for longer periods of application without the need for regular observation (English Heritage, 1999).

Detergents are a frequently used chemical cleaning technique for removing graffiti, especially when dealing with fresh graffiti made using markers that dissolve in water. Utilizing low-pressure water washing, occasionally with the help of neutral or nonionic detergents, is frequently the most delicate method, particularly for preserving old masonry. Nonionic detergents are favored due to their lack of ionization in solution, which prevents the formation of solid, visible residues that could damage the surface being cleaned. Nevertheless, it is important to exercise caution while using any detergent, as some commercial laundry detergents are not pH-neutral and may contain compounds that result in unpleasant residues on masonry materials. To achieve the best outcomes, it is recommended to mix the water and detergent and then combine it with an absorbent substance. This mixture should be applied as a poultice. This technique enhances the precision of graffiti targeting and prevents the solution from dripping down the wall, avoiding the risk of staining surfaces or redistributing colors. While water washing with detergents is typically gentle, it may not be particularly helpful for removing graffiti, as many graffiti materials are not soluble in water. If faced with such situations, it may be required to employ a more resilient cleaning technique, such as the utilization of organic solvents or specialized paint removers. However, detergents continue to be a beneficial first step, especially for recently placed graffiti, reducing the necessity for more severe treatments that may harm the historical masonry (Weaver, 1995).

Alkaline paint strippers are highly efficient in breaking down oil-based films by means of saponification, which makes them well-suited for cleaning oils, greases, and waxes from brickwork that is not sensitive to alkalis (English Heritage, 1999). They are commonly employed alongside a poultice to regulate their usage and hinder further infiltration into the underlying material. Nevertheless, it is important to use caution when handling potent alkaline substances, such as sodium hydroxide (also known as caustic soda or lye) and potassium hydroxide. If these compounds are not properly neutralized, they can lead to the formation of efflorescence and discoloration on masonry surfaces. Moreover, they can chemically interact with iron compounds found in specific types of masonry, such Indiana limestone, causing the formation of stubborn ferric hydroxide stains that are challenging to remove. Following the application, it is imperative to proceed with a weak acid wash and a comprehensive water rinse in order to neutralize any remaining alkaline residues (Sanmartín et al., 2014).

Bleaches and acidic cleaning may be used to remove graffiti. Hypochlorite-based bleaches are highly effective in breaking out residual pigments, commonly known as ghosting, that are left behind by

graffiti. Bleaches are more easily rinsed off compared to powerful alkalis and typically have fewer harsh side effects. Nevertheless, they necessitate meticulous treatment to prevent any possible harm to the underlying material. Calcium hypochlorite, a type of bleach, may effectively decolorize pigments in paints and inks that are stubborn and resistant to removal. It is commonly used in poultices for this purpose. Although bleaches are efficient, it is crucial to rinse them off completely to avoid any lasting damage to the masonry caused by leftover chemicals (Weaver, 1995). Acidic cleaning solutions pose substantial dangers when used for graffiti removal, especially on limestone and sandstone surfaces. Acids can dissolve calcium carbonate, which can result in the removal of the polished appearance from marble and polished lime stones. Furthermore, the utilization of acids might result in the deposition of detrimental soluble salts within the pores of the substrate, causing surface disintegration and efflorescence. Consequently, it is necessary to neutralize acids and thoroughly rinse them off the surface once they have been used. Although acidic cleaners are effective, their propensity for causing damage necessitates their limited and selective usage. Chemical graffiti removers should ideally have a neutral pH of 7 to limit the potential for substrate damage (English Heritage, 1999).

Organic solvent-based cleaning agents are highly effective at dissolving various types of paints and inks. Throughout history, methylene chloride (also known as dichloromethane, or DCM) has been utilized widely as a solvent for this specific objective. Due to its volatility and rapid action, it is capable of dissolving nearly all resinous coatings, including epoxy. Nevertheless, the potential of DCM to cause cancer and its substantial health hazards have resulted in its restriction or prohibition in numerous nations. Consequently, substances including acetone, benzyl and isopropyl alcohols, glycols, and dibasic esters have gained popularity as substitutes. These alternatives achieve a more optimal equilibrium between efficiency and safety; however, they still require careful handling due to their flammability and health risks (English Heritage, 1999). Organic solvents are employed commonly in a poultice form in practical situations to hinder the excessive absorption into the brickwork, averting potential issues such as discoloration or damage. Several commercial paint removers are available in the form of viscous gels or pastes that effectively stick to vertical surfaces, enabling precise application and effortless removal. Several of these products feature fiber-reinforced backings that effectively reduce evaporation and facilitate the clean removal of the softened paint. An advantage of utilizing organic solvents is their ability to fully evaporate, ensuring no residue remains on the substrate. Nevertheless, the elevated volatility of these substances necessitates adequate ventilation and the utilization of personal protection equipment to minimize health hazards during application (Weaver, 1995). Although commercially available aerosol graffiti removers can be effective, they are generally not advisable for use on brick surfaces. These products have the potential to induce liquid paint to flow down walls, resulting in the discoloration of previously clean surfaces and the redistribution of pigments when rinsed. Toluene and N-methyl-2-pyrrolidone (NMP) are solvents that are highly effective but also carry substantial environmental and health hazards. These hazards include causing harm to development and contributing to dangerous air pollution. Linear dicarboxylic acid diesters combined with nonionic surfactants are a more eco-friendly alternative that effectively removes graffiti from porous materials while causing less harm to the environment. These solvents offer a safer option that maintains high effectiveness, allowing them to be used in a broader range of applications for removing graffiti (Sanmartín et al., 2014).

BIOLOGICAL CLEANING METHOD

Initial academic research exploring the employment of microorganisms in cleaning processes emerged during the late 1980s to early 1990s. Removing graffiti using microorganisms, such as bacteria and fungi, presents significant challenges due to the diverse composition of graffiti paint and its interactions with the underlying surface. The microorganism strains employed in the cleaning process need to exhibit strong resistance to graffiti and should effectively degrade the paint, preferably in aerobic environments. When considering various methods for cleaning surfaces, bio-cleaning stands out for its perceived consistency compared to other techniques such as physical and chemical cleaning. These alternative methods, while effective in removing graffiti, often pose the risk of damaging the surface due to their abrasive nature or intense energy application. In contrast, bio-cleaning offers a gentler approach, utilizing the natural action of microorganisms to break down and remove contaminants. This method not only effectively cleans the surface, but also has the advantage of preserving the original appearance and shine, making it a preferred choice for delicate or sensitive materials.

Bioremediation involves using living organisms to eliminate environmental pollutants through biodegradation or to prevent pollutants from entering the environment by treating waste and producing biodegradable substances. Microorganisms are well-suited for bioremediation due to their extensive metabolic diversity, which allows them to utilize a wide range of organic and inorganic compounds for growth. Microorganisms have been proposed for the removal of natural organic matter and synthetic polymers from cultural heritage surfaces. Microorganisms utilized for bioremediation are typically chosen through a series of growing experiments on a culture medium, often enriched with the specific target substance. During these trials, the concentration of the target substance may be adjusted, allowing for the assessment of the microorganisms' adaptation and survival capabilities. Bioremediation offers several advantages over chemical and physical cleaning methods: it cleans selectively, keeps surfaces intact, is easy to use without needing skilled workers, is safe for people and the environment, and is widely accepted by the public for its safety and sustainability. Bio-cleaning costs are similar to solvent-based chemicals and sometimes cheaper than new methods like laser removal and ultrasound.

CHAPTER 7: RANKING OF PRODUCTS

The ranking of anti-graffiti products involves a systematic evaluation based on multiple criteria to ensure the most suitable products are selected for different surfaces and performance standards. Figure 6 presents the criterion used for ranking. This chapter explains the approach used to determine the rankings.

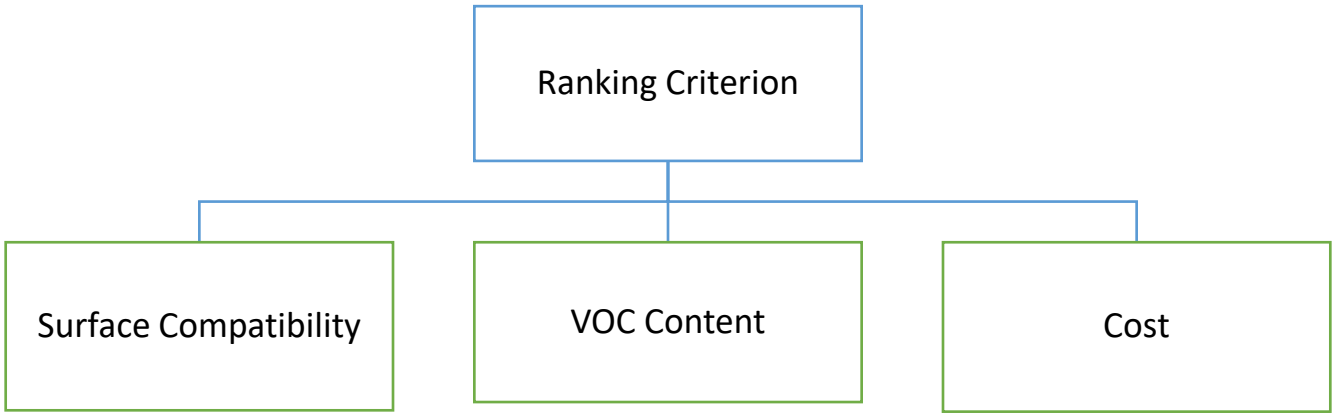


Figure 6. Flowchart. Ranking criterion for anti-graffiti products.

STEP 1: EVALUATION CRITERIA

The three evaluation criteria are outlined below:

- **Number of Compatible Surfaces:** Products were evaluated based on how many different types of surfaces they can effectively protect, including both porous and nonporous surfaces. Products with higher versatility received better rankings. Tables 38 and 39 present surface compatibility of non-sacrificial and sacrificial products, respectively.

- **VOC Content:** The VOC content of each product was assessed to determine its environmental and health impact. Products with lower VOC content were ranked higher because of their reduced environmental footprint and health risks. Tables 40 and 41 present the VOC content for non-sacrificial and sacrificial products, respectively.

- **Cost:** The cost of each product was taken into consideration to balance performance with budget constraints. Products offering low cost were ranked higher. Tables 42 and 43 present the cost per square foot of non-sacrificial and sacrificial products, respectively.

Table 38. Surface Compatibility of Non-Sacrificial Products

Sl. No	Product	Cement	Brick	Stone	Metal	Wood	Glass	Plastic	Fiberglass	No. of Compatible Surfaces
1.	SIL-GUARD WB Clear/Pigmented *(Advanced Chemical Technology Inc.)*	Yes	Yes	Yes	Yes	Yes	No	No	Yes	6
2.	Si-COAT 532 *(CSL Silicones Inc.)*	Yes	Yes	Yes	Yes	Yes	No	No	Yes	6
3.	TK-PERMACLEAN VOC *(TK Products)*	Yes	Yes	No	Yes	Yes	No	No	No	4
4.	GRAFFITI GARD IV Low Luster Clear/Pigmented *(TEX-COTE)*	Yes	Yes	No	Yes	No	No	No	No	3
5.	2K Waterbased Anti-Graffiti Coating *(Sherwin-Williams)*	Yes	No	No	Yes	No	No	No	No	2
6.	Invisi-Shield *(Sherwin-Williams)*	Yes	No	No	Yes	No	No	No	No	2
7.	Anti-Graffiti Coating 1K Siloxane *(Sherwin-Williams)*	Yes	No	No	No	No	No	No	No	1
8.	Duraguard 310 CRU *(ChemMasters)*	Yes	No	No	No	No	No	No	No	1
9.	VandlGuard Ten Premium *(VandlGuard)*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	7

Sl. No	Product	Cement	Brick	Stone	Metal	Wood	Glass	Plastic	Fiberglass	No. of Compatible Surfaces
10.	Permashield Premium *(Monopole Inc.)*	Yes	Yes	Yes	Yes	Yes	Yes	No	No	6
11.	Brickform UreMax WB *(Brickform)*	Yes	Yes	Yes	Yes	Yes	No	No	No	5
12.	NanoSlic 240 *(NanoSlic)*	Yes	No	No	Yes	Yes	Yes	No	No	4
13.	GRAFFITI GARD S *(TEX-COTE)*	Yes	Yes	No	Yes	No	No	No	No	3
14.	Graffiti Stopper 1K *(ChemMasters)*	Yes	Yes	Yes	Yes	Yes	No	No	No	5
15.	TK-BLOCK AND GRAFFITI GUARD VOC *(TK Products)*	Yes	Yes	Yes	Yes	Yes	No	No	No	5

Table 39. Surface Compatibility of Sacrificial Products

Sl. No	Product	Cement	Brick	Stone	Metal	Wood	Glass	Plastic	Fiberglass	No. of Compatible Surfaces
1.	Sacrificial GRAFFITI GARD System *(TEX-COTE)*	Yes	Yes	Yes	Yes	Yes	No	No	No	5
2.	World's Best Graffiti Coating *(MURALSHIELD)*	Yes	Yes	No	No	No	No	No	No	2
3.	3M Anti-Graffiti Film *(3M)*	No	No	No	No	No	Yes	No	No	1

Table 40. VOC Content of Non-Sacrificial Products

Sl. No.	Product	VOC (g/L)
1.	SIL-GUARD WB Clear/Pigmented *(Advanced Chemical Technology Inc.)*	25
2.	Si-COAT 532 *(CSL Silicones Inc.)*	45.55
3.	TK-PERMACLEAN VOC *(TK Products)*	350
4.	GRAFFITI GARD IV Low Luster Clear/Pigmented *(TEX-COTE)*	50
5.	2K Waterbased Anti-Graffiti Coating *(Sherwin-Williams)*	100
6.	Invisi-Shield *(Sherwin-Williams)*	420
7.	Anti-Graffiti Coating 1K Siloxane *(Sherwin-Williams)*	250
8.	Duraguard 310 CRU *(ChemMasters)*	350
9.	VandlGuard Ten Premium *(VandlGuard)*	20
10.	Permashield Premium *(Monopole Inc.)*	0
11.	Brickform UreMax WB *(Brickform)*	50
12.	NanoSlic 240 *(NanoSlic)*	0
13.	GRAFFITI GARD S *(TEX-COTE)*	250
14.	Graffiti Stopper 1K *(ChemMasters)*	100
15.	TK-Block and Graffiti Guard VOC *(TK Products)*	350

Table 41. VOC Content of Sacrificial Products

Sl. No.	Product	VOC (g/L)
1.	Sacrificial GRAFFITI GARD System *(TEX-COTE)*	50
2.	World's Best Graffiti Coating *(MURALSHIELD)*	0
3.	3M Anti-Graffiti Film *(3M)*	100

Table 42. Cost per Square Foot of Non-Sacrificial Products

Sl. No.	Product	Cost ($/Sq. ft)
1.	SIL-GUARD WB Clear/Pigmented *(Advanced Chemical Technology Inc.)*	0.5
2.	Si-COAT 532 *(CSL Silicones Inc.)*	0.69
3.	TK-PERMACLEAN VOC *(TK Products)*	0.58
4.	GRAFFITI GARD IV Low Luster Clear/Pigmented *(TEX-COTE)*	0.24
5.	2K Waterbased Anti-Graffiti Coating *(Sherwin-Williams)*	0.41
6.	Invisi-Shield *(Sherwin-Williams)*	0.44
7.	Anti-Graffiti Coating 1K Siloxane *(Sherwin-Williams)*	0.17
8.	Duraguard 310 CRU *(ChemMasters)*	0.43
9.	VandlGuard Ten Premium *(VandlGuard)*	0.6
10.	Permashield Premium *(Monopole Inc.)*	0.76

Sl. No.	Product	Cost ($/Sq. ft)
11.	Brickform UreMax WB *(Brickform)*	0.38
12.	NanoSlic 240 *(NanoSlic)*	9.99
13.	GRAFFITI GARD S *(TEX-COTE)*	0.72
14.	Graffiti Stopper 1K *(ChemMasters)*	1.14
15.	TK-BLOCK AND GRAFFITI GUARD VOC *(TK Products)*	0.91

Table 43. Cost per Square Foot of Sacrificial Products

Sl. No.	Product	Cost ($/Sq. ft)
1.	Sacrificial GRAFFITI GARD System *(TEX-COTE)*	0.14
2.	World's Best Graffiti Coating *(MURALSHIELD)*	0.11
3.	3M Anti-Graffiti Film *(3M)*	8

STEP 2: SCORING

Normalization: Each criterion was normalized to a scale of 1–10 to ensure comparability across different factors. This involved using a normalization formula to standardize the scores. The lower values of cost and VOC content are assigned a scale of 10, while the greater score is assigned a scale of 1. Figure 7 is the formula to calculate the normalized score.

$$Normalized\ \ Score_{(i)} = 1 + 9 \times \frac{Value - Max\ Value}{Min\ Value - Max\ Value}$$

Figure 7. Equation. Equation for calculating normalized score of 1–10 for VOC content and cost.

Source: Chakraborty & Yeh (2007)

Products with a greater number of compatible surfaces will receive a higher scale, while those with fewer compatible surfaces will receive a lower scale. The formula presented in Figure 8 can be used to compute the normalized scale for the number of compatible surfaces requirement.

$$Normalized\ \ Score_{(i)} = 1 + 9 \times \frac{Value - Min\ Value}{Max\ Value - Min\ Value}$$

Figure 8. Equation. Equation for calculating normalized score of 1–10 for number of compatible surfaces.

Source: Chakraborty & Yeh (2007)

Weighted Average: Following normalization, each score was multiplied by a certain weight determined by the importance of each criterion. The weights indicate the relative significance of each criterion in the overall assessment. The weightage given to the number of compatible surfaces is higher, specifically 40%, compared to the weightage given to cost (35%) and VOC content (25%).

Total Weighted Score: The total score for each product was calculated by summing up the weighted scores from each criterion. The formula to calculate the total weighted score is presented in Figure 9.

$$Total\ Weighted\ Score_{(i)} = \sum_{j=1}^{n} (Normalized\ Score_{(j)} \times Weight_{(j)})$$

Figure 9. Equation. Equation for calculating total weighted score.

Source: Hashim et al. (2007)

In this formula, *j* represents each criterion and *n* is the total number of criteria. The sum of the products of the normalized scores and their corresponding weights gives the total weighted score. Table 44 and Table 45 present the calculated weighted scores of non-sacrificial and sacrificial products, respectively.

Table 44. Evaluation of Weighted Scores of Non-Sacrificial Products

Sl. No.	Product	VOC	No. of Compatible Surfaces	Cost	Total
	Weights (%)	**25%**	**40%**	**35%**	**100%**
1.	SIL-GUARD WB Clear/Pigmented *(Advanced Chemical Technology Inc.)*	9.46	8.5	9.7	9.27
2.	Si-COAT 532 *(CSL Silicones Inc.)*	9.02	8.5	9.52	9.1
3.	TK-PERMACLEAN VOC *(TK Products)*	2.5	5.5	9.62	6.12
4.	GRAFFITI GARD IV Low Luster Clear/Pigmented *(TEX-COTE)*	8.93	4	9.94	7.32
5.	2K Waterbased Anti-Graffiti Coating *(Sherwin-Williams)*	7.86	2.5	9.78	6.18
6.	Invisi-Shield *(Sherwin-Williams)*	1	2.5	9.75	4.64
7.	Anti-Graffiti Coating 1K Siloxane *(Sherwin-Williams)*	4.64	1	10	4.93
8.	Duraguard 310 CRU *(ChemMasters)*	2.5	1	9.76	4.47
9.	VandlGuard Ten Premium *(VandlGuard)*	9.57	10	9.61	9.81
10.	PermasShield Premium *(Monopole Inc.)*	10	8.5	9.46	9.3
11.	Brickform UreMax WB *(Brickform)*	8.93	7	9.81	8.41
12.	NanoSlic 240 *(NanoSlic)*	10	5.5	1	5.05
13.	GRAFFITI GARD S *(TEX-COTE)*	4.64	4	9.5	6.24
14.	Graffiti Stopper 1K *(ChemMasters)*	7.86	7	9.11	7.95
15.	TK-BLOCK AND GRAFFITI GUARD VOC *(TK Products)*	2.5	7	9.32	6.88

Table 45. Evaluation of Weighted Scores of Sacrificial Products

Sl. No.	Product	VOC	No. of Compatible Surfaces	Cost	Total
	Weights (%)	**25%**	**40%**	**35%**	**100%**
1.	Sacrificial GRAFFITI GARD System *(TEX-COTE)*	5.5	10	9.97	8.88
2.	World's Best Graffiti Coating *(MURALSHIELD)*	10	3.25	10	7.04
3.	3M Anti-Graffiti Film *(3M)*	1	1	1	1

STEP 3: RANK ASSIGNMENT

Products were then ranked from highest to lowest based on their total weighted scores. Separate rankings were done for sacrificial and non-sacrificial products to ensure clear differentiation and easier selection based on the type of protection needed. Tables 46 and 47 present the rankings.

Table 46. Ranking of Non-Sacrificial Products Based on Evaluated Weighted Scores

Rank	Product
1.	VandlGuard Ten Premium *(VandlGuard)*
2.	Permashield Premium *(Monopole Inc.)*
3.	SIL-GUARD WB Clear/Pigmented *(Advanced Chemical Technology Inc.)*
4.	Si-COAT 532 *(CSL Silicones Inc.)*
5.	Brickform UreMax WB *(Brickform)*
6.	Graffiti Stopper 1K *(ChemMasters)*
7.	GRAFFITI GARD IV Low Luster Clear/Pigmented *(TEX-COTE)*
8.	TK-BLOCK AND GRAFFITI GUARD VOC *(TK Products)*
9.	GRAFFITI GARD S *(TEX-COTE)*
10.	TK-PERMACLEAN VOC *(TK Products)*
11.	2K Waterbased Anti-Graffiti Coating *(Sherwin-Williams)*
12.	Anti-Graffiti Coating 1K Siloxane *(Sherwin-Williams)*
13.	NanoSlic 240 *(NanoSlic)*
14.	Invisi-Shield *(Sherwin-Williams)*
15.	Duraguard 310 CRU *(ChemMasters)*

Table 47. Ranking of Sacrificial Products Based on Evaluated Weighted Scores

Rank	Product
1.	Sacrificial GRAFFITI GARD System *(TEX-COTE)*
2.	World's Best Graffiti Coating *(MURALSHIELD)*
3.	3M Anti-Graffiti Film *(3M)*

CHAPTER 8: FLOWCHARTS

The provided flowcharts aim to simplify the process of choosing the appropriate anti-graffiti products by considering three primary considerations: substrate surface type, the nature of the anti-graffiti material, and product-specific attributes. The selection process is structured as follows:

- Evaluate the Substrate Surface:
    - Porous Surfaces: These surfaces include materials such as cement, brick, and stone.
    - Non-porous Surfaces: These surfaces include materials such as metal and glass.
- Determine the Type of Anti-Graffiti Material Needed:
    - Sacrificial Coatings: These coatings are removed along with the graffiti, requiring reapplication after each cleaning.
    - Non-Sacrificial Coatings: These coatings provide a permanent protective barrier that withstands multiple cleanings without the need for reapplication.
- Select Products Based on Three Key Factors:
    - Number of Compatible Surfaces: Ensure the product is suitable for the specific type of substrate surface.
    - VOC Content: Products are classified based on their volatile organic compound content, impacting environmental and health safety. Options range from 0 VOC to those with higher VOC content.
    - Cost: Consider the financial aspect to find a product that fits within your budget while meeting necessary performance and environmental criteria.

The flowcharts in Figures 10, 11, 12, 13, and 14 offer a concise and organized method for determining the most suitable anti-graffiti solution. They simplify the decision-making process and ensure an effective balance of effectiveness, safety, and cost-effectiveness.

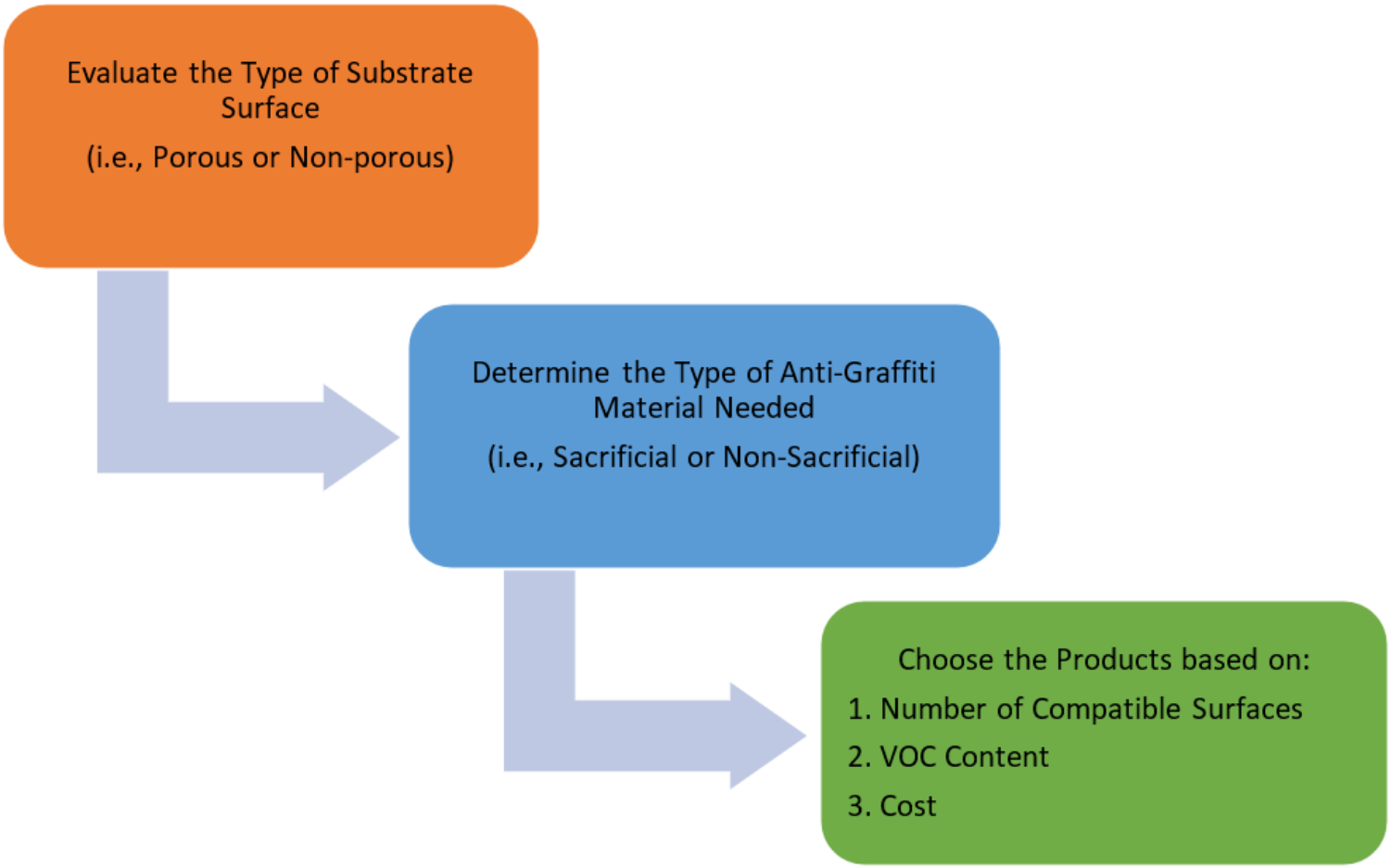


Figure 10. Flowchart. Process for selecting the anti-graffiti products.

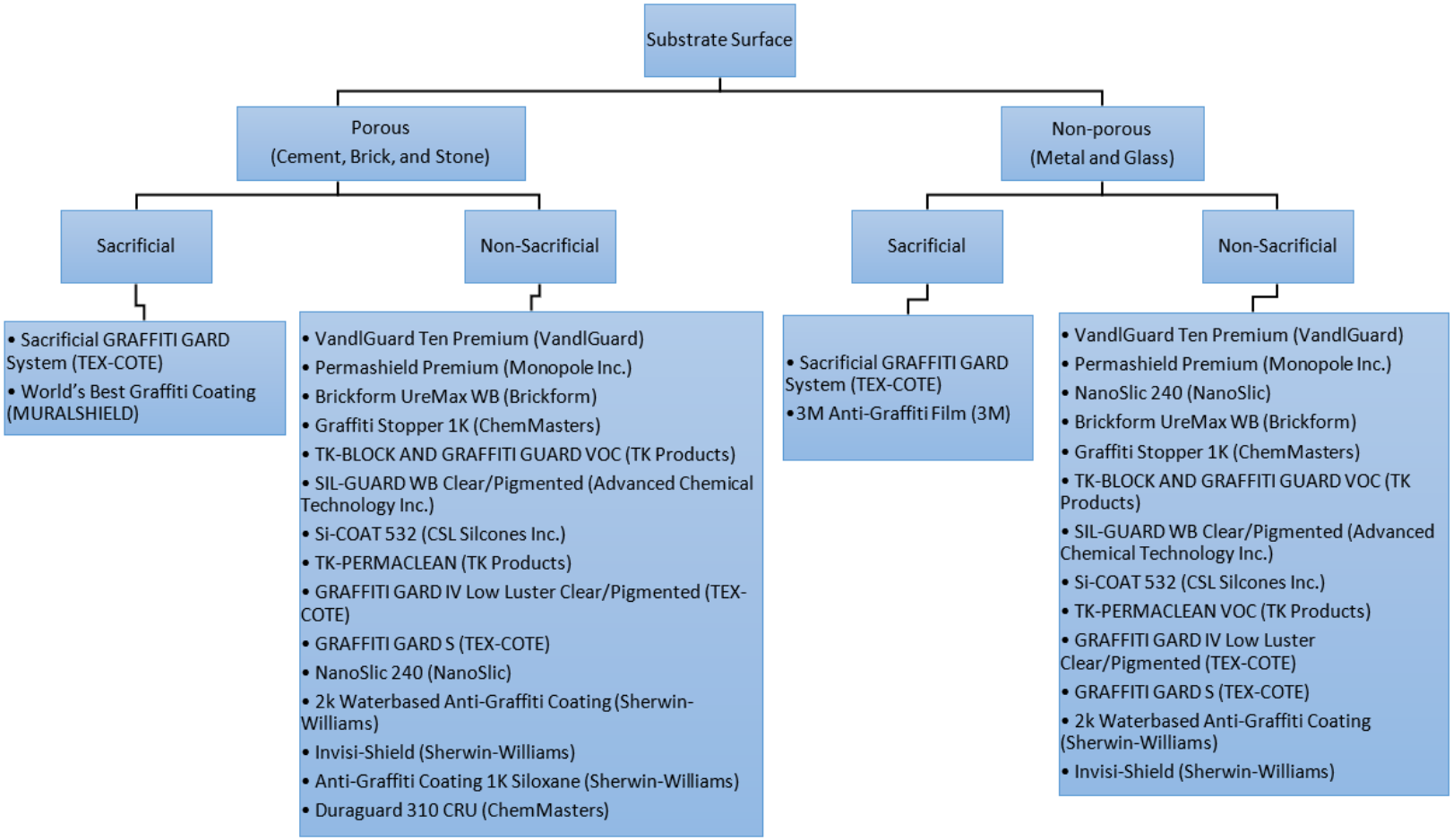


Figure 11. Flowchart. Classification of anti-graffiti products based on surface compatibility.

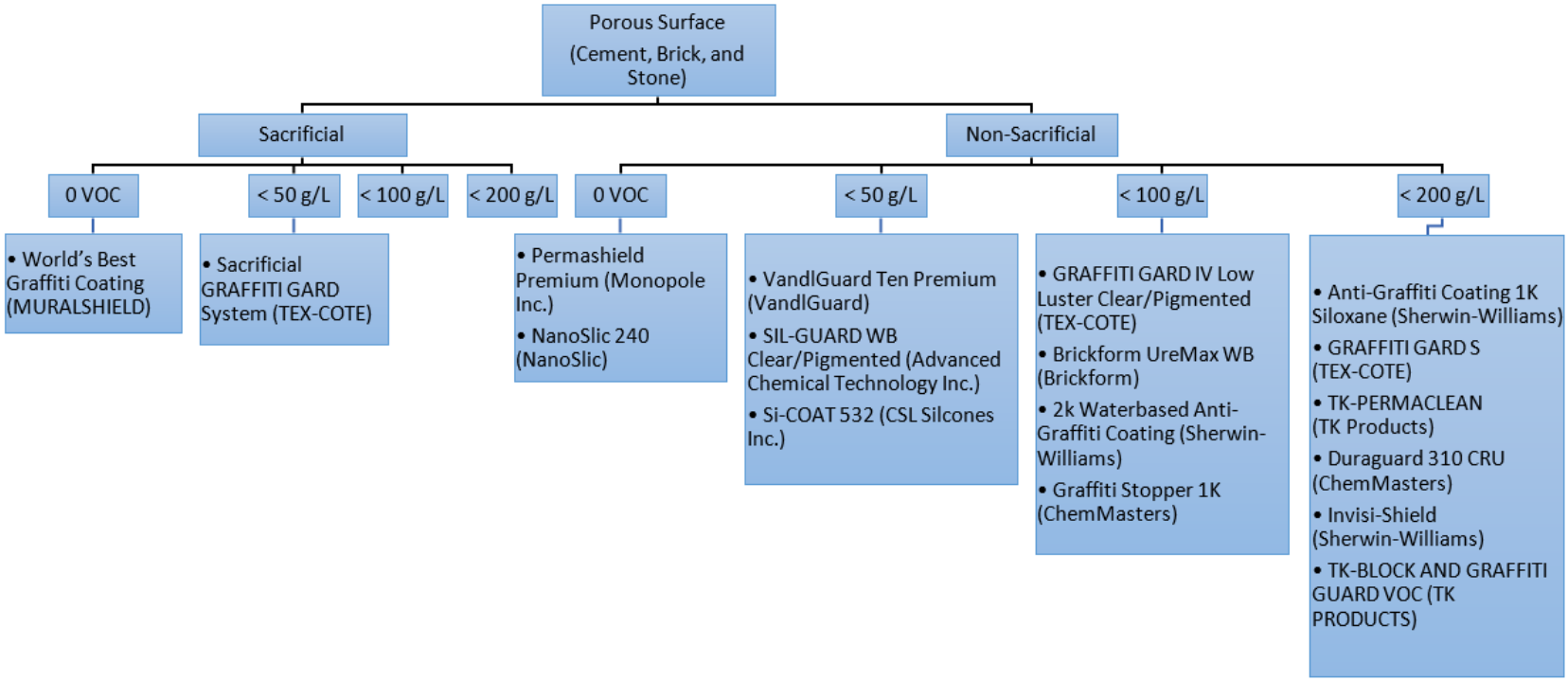


Figure 12. Flowchart. Classification of anti-graffiti products with porous surface compatibility based on VOC content.

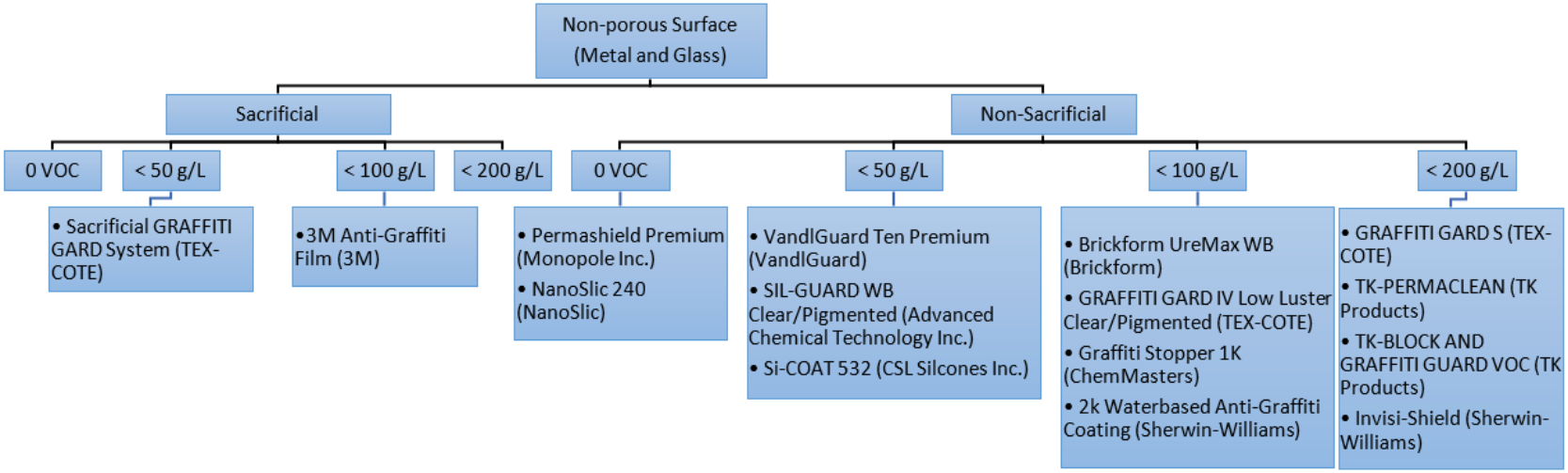


Figure 13. Flowchart. Classification of anti-graffiti products with nonporous surface compatibility based on VOC content.

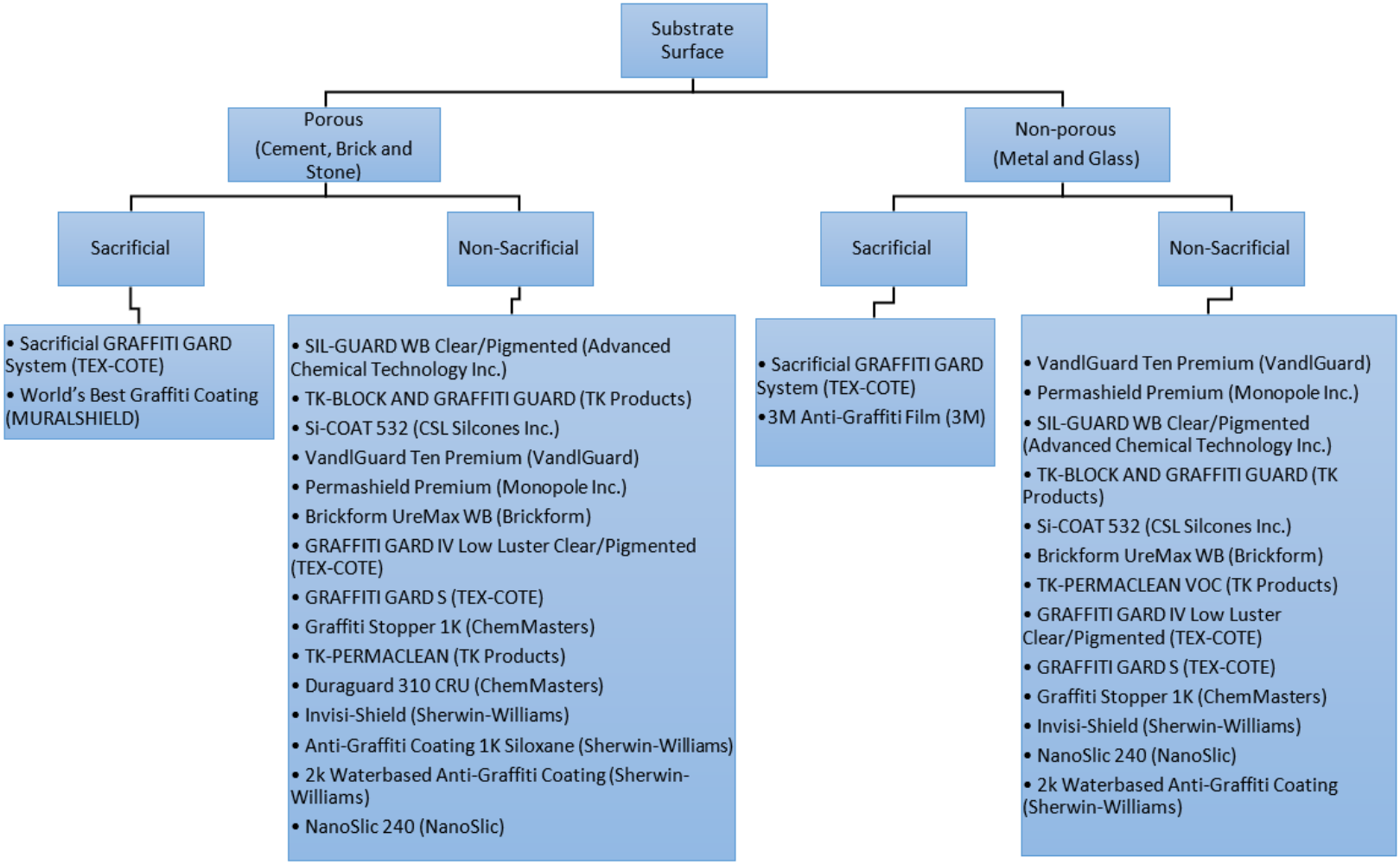


Figure 14. Flowchart. Classification of anti-graffiti products based on the cost per square foot.

CHAPTER 9: COST ANALYSIS FOR ANTI-GRAFFITI PRODUCTS

In this chapter, we conduct a comprehensive cost analysis of anti-graffiti coatings, focusing on various types of costs associated with their application and maintenance. By examining the cost components, including initial material costs, application costs, maintenance costs, and life-cycle costs, we aim to offer a comprehensive financial overview, helping stakeholders understand the economic commitment and potential savings associated with using anti-graffiti coatings. This analysis is intended to aid in making informed decisions about investing in and managing these protective coatings.

TYPES OF COSTS INVOLVED

There are five cost components: initial material costs, application costs, maintenance costs, life-cycle costs, and labor cost outlined in further detail below.

Initial Material Costs

Initial material costs refer to the price of purchasing the anti-graffiti coatings. These costs can vary significantly based on the product's composition, brand, and performance characteristics. The formula for calculating initial material costs is presented in Figure 15:

$$\textit{Total Material Cost} = \textit{Cost per Gallon} \times \textit{Gallons Required}$$

Figure 15. Equation. Calculation of total material cost.

Application Costs

Application costs encompass expenses related to labor, equipment, and time needed to apply the coating. These costs are calculated by considering the hourly wage of the workers, the number of hours required, and any additional equipment costs. The formula for application costs is presented in Figure 16:

$$\textit{Total Application Cost} = (\textit{Hourly Wage} \times \textit{Hours Required}) + \textit{Equipment Cost}$$

Figure 16. Equation. Calculation of total application cost.

Maintenance Costs

Maintenance costs include expenses for cleaning the surfaces and reapplying the coating as needed. These costs depend on the frequency of graffiti incidents and the durability of the coating. The formula for annual maintenance costs is presented in Figure 17:

$$\textit{Annual Maintenance Cost} = (\textit{Cost per Cleaning} \times \textit{Number of Cleanings per Year}) + (\textit{Reapplication Cost} \times \textit{Frequency of Reapplication})$$

Figure 17. Equation. Calculation of annual maintenance cost.

Life-Cycle Costs

Life-cycle costs represent the total cost of ownership over the expected life of the coating. This includes initial material costs, application costs, and ongoing maintenance costs. The formula for life-cycle costs is presented in Figure 18:

$$Total\ Lifecycle\ Cost = Initial\ Material\ Cost + Application\ Cost + (Annual\ Maintenance\ Cost \times Expected\ Lifespan)$$

Figure 18. Equation. Calculation of total life-cycle cost.

Labor Cost

As per the 2024 RSMeans Heavy Construction Cost Data (Hale, 2024), the hourly rate for a laborer, inclusive of overhead and profit, is $55. To determine the total fees, use the formula presented in Figure 19:

$$Total\ Fees = (Hourly\ Rate) \times (City\ Cost\ Index)$$

Figure 19. Equation. Calculation of total fees of labor.

The city cost indices found from RSMeans (n.d.) Heavy Construction 2020 quarter 4 cost data book for some cities in Illinois are given in Table 48.

Table 48. Cost Indices for Application of Wall Finishes and Painting/Coating in the State of Illinois

Cities	Wall Finishes and Painting/Coating Cost Indices
Carbondale	103.6
Champaign	103.5
Chicago	139.9
Decatur	108.3
Peoria	122.7
Rockford	125.2
Springfield	111.7

ANTI-GRAFFITI PRODUCT COSTS

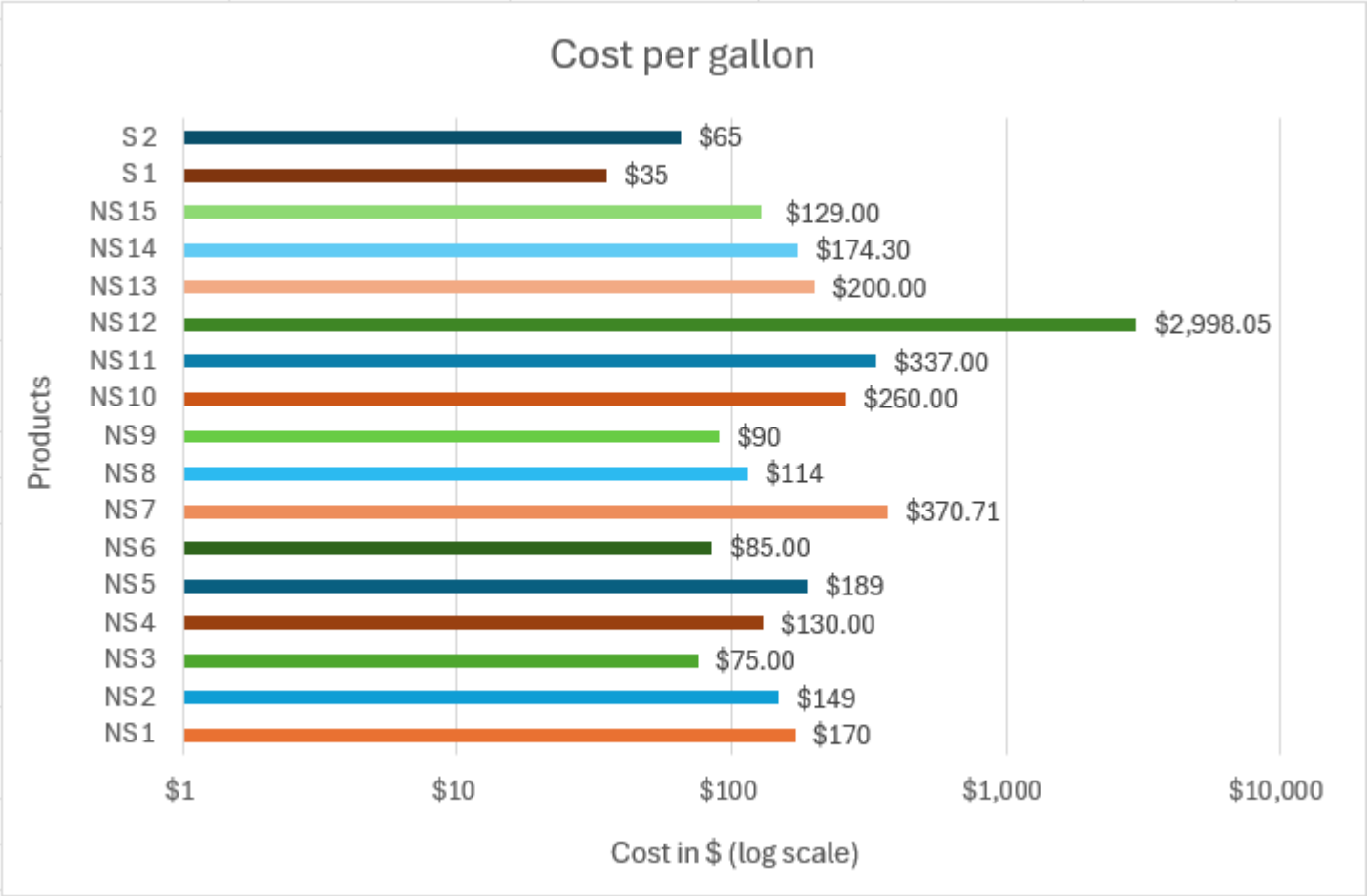
Figures 20 and 21 illustrate the price differences among various anti-graffiti products. Table 49 presents the abbreviations for each product. NanoSlic 240 is the most expensive at approximately $2,998.05 per gallon, followed by Graffiti Stopper 1K priced at $371.71, while other products like Invisi Shield, Sherwin-Williams 1K Siloxane, and Brickform UreMax WB range around $150–$200 per gallon. More economical options include Sacrificial GRAFFITI GARD, GRAFFITI GARD S, World's Best Graffiti Coating and SIL-GUARD WB, each priced around $50 per gallon. Mid-range products such as VandlGuard Ten Premium, Si-COAT 532, and TK-BLOCK AND GRAFFITI GUARD VOC are priced at about

$100–$150 per gallon. The chart highlights the significant price variations, offering a clear comparison for decision-makers to select the most cost-effective anti-graffiti coating for their needs.

Table 49. Anti-Graffiti Products

Abbreviation	Product Name
NS 1	Permashield Premium
NS 2	VandlGuard Ten Premium
NS 3	SIL-GUARD WB
NS 4	Si-COAT 532
NS 5	Brickform UreMax WB
NS 6	GRAFFITI GARD IV Low Luster
NS 7	Graffiti Stopper 1K
NS 8	TK BLOCK AND GRAFFITI GUARD VOC
NS 9	GRAFFITI GARD S
NS 10	TK-PERMACLEAN VOC
NS 11	Sherwin-Williams 2K Waterbased Anti-Graffiti Coating
NS 12	NanoSlic 240
NS 13	Sherwin-Williams Anti-Graffiti Coating 1K Siloxane
NS 14	Invisi Shield
NS 15	Duraguard 310 CRU
S 1	Sacrificial GRAFFITI GARD
S 2	World’s Best Graffiti Coating
S 3	3M Anti-Graffiti Film

NS: Non-sacrificial anti-graffiti coating; S: Sacrificial anti-graffiti coating



Note: S3 is an anti-graffiti film and only available per square foot.

Figure 20. Bar chart. Distribution of product costs per gallon based on the type of anti-graffiti coating.

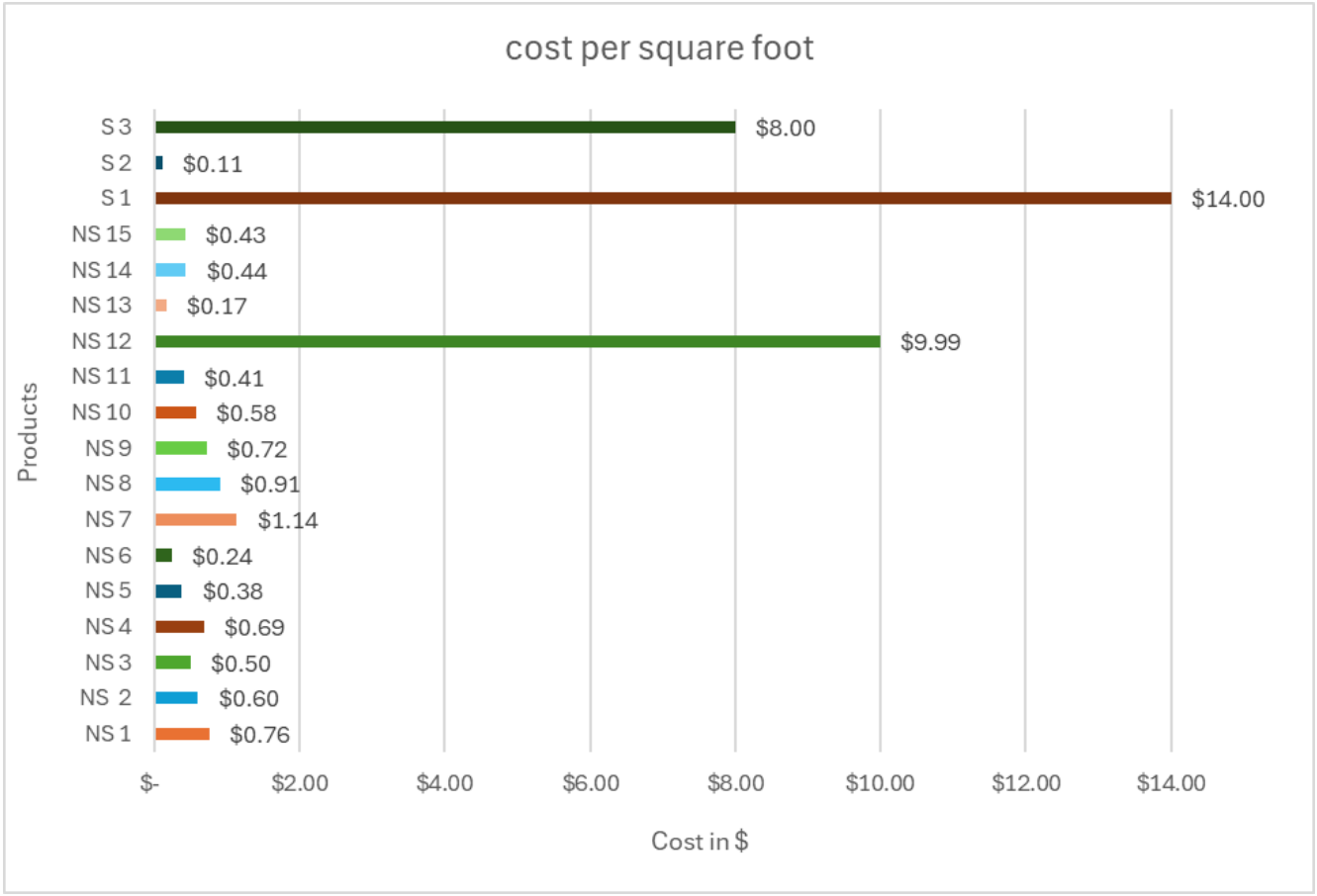


Figure 21. Bar chart. Distribution of product costs per square foot based on the type of anti-graffiti coatings.

CONCLUSIONS

Cost analysis underlines the necessity of evaluating multiple factors when choosing an anti-graffiti coating. Initial material costs are undoubtedly significant, but they are just one part of the equation. Application costs, including labor and preparation, can vary widely and impact the overall budget. Furthermore, maintenance costs over the lifespan of the coating are crucial. For instance, high upfront costs might be justified if the coating offers lower maintenance expenses and longer durability, thereby reducing the frequency and cost of reapplications. On the other hand, while cheaper coatings may seem appealing initially, they might lead to higher overall costs because of more frequent maintenance and reapplication requirements. Therefore, decision-makers should conduct a comprehensive evaluation that includes initial costs, application costs, maintenance frequency, and overall durability to determine the most cost-effective and efficient anti-graffiti coating for their specific needs. This holistic approach ensures that the selected coating not only meets budgetary constraints, but also provides long-term protection and value.

CHAPTER 10: SUMMARY AND CONCLUSIONS

Despite the recent enhancements in the development of anti-graffiti protection systems, graffiti remains a persistent problem that needs to be counteracted. There are three types of anti-graffiti protection systems: (1) sacrificial anti-graffiti coatings, which are eliminated during the graffiti removal process, (2) semipermanent coatings, which are usually composed of a two-layer system—a permanent coat followed by a sacrificial one, and (3) permanent coatings, which can withstand several cleaning cycles without having to be replaced.

This research conducted a literature review on anti-graffiti protection systems as well as a survey of the state of the practice on anti-graffiti protection systems in other states and best practices, including their characteristics, type, chemical composition, method and ease of application, cleaning methods, and advantages and disadvantages. The survey included 47 questions related to the type of anti-graffiti coatings used, chemical composition, method of application and removal, advantages and disadvantages, and best practices of their usage. It was disseminated to the North Central States Consortium for state DOTs in the Midwest. Six states (Minnesota, Kansas, Michigan, Wisconsin, Iowa, and Indiana) responded to the survey, and their responses were summarized and fully analyzed, indicating information about products used, level of satisfaction, and challenges encountered in their use. Minnesota had the most positive responses among the six states. The survey identified eight anti-graffiti products that were used in the six states. The properties of these anti-graffiti coatings were collected from their suppliers and were fully studied and summarized. The data collected from the survey included the product type, chemical composition, surface compatibility, state(s) using it, cost, VOC content, cleaning agent, whether a primer is needed, drying time, application temperature, and advantages and disadvantages.

Additionally, a market survey was performed, where the best 10 anti-graffiti products available in the market were summarized, ranked, and fully analyzed. The product characteristics examined in the market survey included product type (sacrificial vs. non-sacrificial), surface compatibility, VOC content, advantages and disadvantages, technical specifications (application temperature, water vapor transmission, color of the product), and cost. The products were ranked based on their type, surface compatibility, VOC content, and cost.

The anti-graffiti protection coatings applied in Illinois construction projects during the past 14 years were collected from contract drawings available on IDOT's website. The data collected from the contract drawings identified seven products that were summarized and fully analyzed by collecting their properties from their suppliers. Six of the identified products were used on porous surfaces and only one was applied on nonporous surfaces. The specifications of these products were used in ranking them as well. The analysis also included if these products have been used by any states that responded to the survey.

Moreover, graffiti-removal techniques can be categorized into physical, chemical, and biological cleaning methods. Physical cleaning methods can be further classified into traditional and novel cleaning methods. Traditional methods include pressurized hot- or cold-water jets, sandblasting, soda blasting (baking soda), scalpel work, dolomite powder, alumina oxide, and ground-walnut shells,

while novel techniques include ultrasonic and megasonic agitation, plasma spray, vacuum arc, dry ice blasting, and laser cleaning. Chemical cleaning techniques comprise the use of detergents, paint removers, organic solvents, alkaline products, paint strippers, and degreasers. Biological cleaning is based on bioremediation, which is the use of microorganisms to consume and break down toxic waste through biodegradation.

Furthermore, anti-graffiti protection coatings collected from the state DOT survey, market survey, and IDOT database projects were divided into sacrificial versus non-sacrificial categories and ranked based on the combined effect of three parameters: surface compatibility, VOC content, and cost. Each product was assigned a normalized score from 1 to 10 for each parameter, and a total weighted score was assigned for each product based on assuming different scaled weights (25%, 35%, and 40%) for VOC content, cost, and surface compatibility, respectively.

All products were categorized using flowcharts. This categorization included the types of anti-graffiti coatings (sacrificial versus non-sacrificial), porosity of the underlying surface, VOC content, removal techniques, and cost. The flowcharts were developed to provide guidance to IDOT personnel and practitioners in the State of Illinois in selecting the appropriate product(s) for a certain surface and conditions. A cost analysis was performed to identify the different direct and indirect costs associated with the application of each product to provide a brief comparative analysis between the total number of products analyzed in this study.

The research recommended that the existing moratorium on the use of anti-graffiti protection systems since 2004 be lifted because of the development of new techniques in the production of anti-graffiti protection systems. It also included a set of anti-graffiti coatings that can be used with multiple surface applications and determined their full specifications, cost, and best practices for use.

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APPENDIX A: ANTI-GRAFFITI PROTECTION SYSTEMS SURVEY

Thank you for participating in our survey regarding the use of Anti-Graffiti Protection Systems in your state. The objectives of the survey are to determine the different types of anti-graffiti protection systems, the pros and cons of each type, and the best practices associated with their usage: Anti-graffiti coatings can be classified into three categories: sacrificial, semipermanent, and permanent (non-sacrificial). A brief description of each of these types is provided below:

Sacrificial anti-graffiti coatings: Sacrificial coatings are removed after each instance of graffiti cleaning along with the graffiti paint and must be reapplied. These products are based on waxes, micro-wax, acrylates, and polysaccharides. These coatings are most commonly transparent and easy to remove. Sacrificial coatings are relatively inexpensive; however, they might result in erosion or damage to the underlying surface with repeated cleaning cycles.

Semipermanent anti-graffiti coatings: Semipermanent coatings can be applied in several layers and are also removed after a few cleaning cycles (2 to 3). These products are based on polymers, acrylics, or epoxies. They are also known as 2-layer systems or 1-layer systems, the 2-layer systems are built up with a permanent coat followed by a second self-sacrificing coat, while the 1-layer systems are based on hydrophobic and oleophobic products.

Permanent anti-graffiti coatings: Permanent anti-graffiti coatings, also known as non-sacrificial coatings, provide long-term protection against graffiti. They remain intact during graffiti removal as they provide a protective layer that prevents the adhesion of the graffiti to the underlying surface and hence, make it easier to remove. Permanent anti-graffiti coatings can withstand repeated cleaning cycles (up to 10 cycles) without damaging the underlying surface. These include fluorinated polymers, nanoparticles-based coating, acrylic-siloxane copolymers, polyurethanes, and silicones.

Survey Questions:

1. Personal Information:
    a. Name ……
    b. Position/Role: ……
    c. Organization: ……..
    d. State: ……..
    e. Email: ……

2. How often do you encounter graffiti vandalism in your area?
    a. Frequently
    b. Occasionally
    c. Rarely
    d. Never

3. In your experience, what sizes of graffiti vandalism are most commonly encountered?

a. Small tags or signatures
b. Medium-sized artworks or messages
c. Large-scale murals or paintings
d. Varied sizes, depending on location
e. Not encountered graffiti vandalism
f. Other (please specify): ……

4. Are Anti-Graffiti Protection Systems currently used in your state?

a. Yes
b. No

5. If yes, specify the type(s) of the anti-graffiti protection system(s) used?

a. Sacrificial
b. Non-sacrificial
c. Semi- Permanent
d. N/A

6. What type of surfaces are typically protected with anti-graffiti coatings in your state?

……

7. If a sacrificial system is used, what type of material is used?

a. Polysiloxane
b. Polysaccharide
c. Waxes
d. Micro-waxes
e. N/A
f. Other, please specify .....

8. If a non-sacrificial system is used, what type of material is used?

a. Nanoparticles (i.e. nanosilica) coatings
b. Polymer blends coatings
c. Silicone-based coatings
d. Epoxy-based coatings
e. Fluorinated coatings

f. Organic-inorganic hybrid products

g. N/A

h. Other, please specify.....

9. What type of surface was the anti-graffiti protection system applied to? List the name(s) of the anti-graffiti protection system(s) product(s) used in each case between the brackets.

a. Concrete (……)

b. Bricks (……..)

c. Stucco (.....)

d. Stone (……)

e. Metals (……)

f. Glass (……)

g. Glazed tile (.....)

h. Other, please specify .....

10. How satisfied are you with the effectiveness of your anti-graffiti coating in facilitating the cleaning process after graffiti vandalism?

a. Very satisfied

b. Somewhat satisfied

c. Neutral

d. Somewhat dissatisfied

e. Very dissatisfied

11. How familiar are you with the types of anti-graffiti products available in the market?

a. Very familiar

b. Somewhat familiar

c. Not familiar at all

12. Which sacrificial and non-sacrificial anti-graffiti protection brands or manufacturers do you recommend?

……

13. What are the reasons for choosing such anti-graffiti products?

……

……..

14. What was the last anti-graffiti protection system project applied in your state, and when? What anti-graffiti protection product was used?

……..

15. What is the life expectancy of sacrificial anti-graffiti coatings in your state (if applicable)?

……

16. What is the life expectancy of non-sacrificial anti-graffiti coatings in your state (if applicable)?

……..

17. Are there any surface-specific preparations or treatments you undertake before applying anti-graffiti coating to concrete surfaces? If yes, please describe.

……..

18. Are there any surface-specific considerations, such as texture, porosity, or color of concrete surface that influence your choice between sacrificial and non-sacrificial anti-graffiti coatings?

……..

19. Does the climate affect your choice of the anti-graffiti protection system in your state? If so, how?

……

……

20. Does the climate affect the performance of the anti-graffiti protection system in your state? If so, how?

……

21. Does the climate affect the durability of the anti-graffiti protection system and the surface that is applied to in your state? If so, how?

……

22. Have the anti-graffiti protection systems ever been removed and reapplied in your state? If yes, what method was used to remove the system? What type of coating was used in the reapplication process?

……..

23. In your opinion, what techniques do you recommend for the removal of graffiti? Select all that apply.

a. Physical methods such as Pressure washing

b. Chemical cleaners

c. Sandblasting

d. Soda blasting

e. Heat application (e.g., steam or hot water)

f. Manual scrubbing

g. Ultrasonic

h. megasonic agitation

i. Plasma spray

j. Dry ice blasting

k. Laser

l. Bioremediation

m. Other (please specify): _____

24. Was there any damage to the surface during the removal process? Please list all types of surface damages that may have occurred.

……

25. What is the method of application of the anti-graffiti protection system used?

a. Roll

b. Brush

c. Spray

d. Other, please specify .....

26. What is the main reason for using the anti-graffiti protection system adopted in your state?

a. Climate

b. Cost

c. Surface applied to

d. Method of application

e. Effectiveness

f. Durability

g. Maintenance

h. Other, please specify .....

27. What are the key advantages of the anti-graffiti protection systems used in your state?

    a. Effectiveness in removing graffiti
    b. Ease of application
    c. Compatibility with the applied surface
    d. Resilience to environmental impacts
    e. Low initial Cost
    f. Low re-application cost
    g. Easy to apply
    h. Easy to clean
    i. Transparent
    j. Durability
    k. Other, please specify .....

28. What are the main disadvantages of the anti-graffiti protection systems used in your state?

    a. Damage to the substrate
    b. Durability issues
    c. High Cost
    d. Ineffectiveness in removing graffiti
    e. Toxic material and hard to remove
    f. Limited protection time
    g. Color changes to the substrate
    h. High maintenance expense
    i. Limited water vapor permeability
    j. Other, please specify .....

29. What factors affect your choice between sacrificial and non-sacrificial protection systems?

……..

……..

30. What is the cost of the material used as an anti-graffiti protection system in your state?

……..

……..

31. What is the cost of applying and removing the anti-graffiti protection system used in your state?

……..

……..

32. What are the challenges associated with applying the anti-graffiti protection system used in your state?

……...

……..

33. What are the challenges associated with removing graffiti in your state?

a. Difficulty in completely removing graffiti

b. Damage to the underlying surface during removal

c. Color changes to the substrate

d. Time-consuming process

e. Use of abrasive chemicals or methods impacting the environment

f. The material is toxic and hard to remove

g. Other (please specify): ……

34. What are the challenges associated with maintaining the anti-graffiti protection system used in your state?

……...

……..

……..

35. What is the anti-graffiti protection system adopted in your state best used for?

a. Historic buildings

b. High volume traffic zones

c. Residential zones

d. Bridge piers and abutments

e. Retaining wall and wing walls

f. Culvert headwalls

g. Other, please specify .....

36. In your opinion, what factors most influence the durability of the sacrificial protection system?

a. Climate Conditions

b. Porosity of surface (porous vs. non-porous)

c. Surface compatibility (i.e. Concrete, Brick, Stone, wood, steel, etc...)

d. Preparation of surface

e. Number of coats applied

f. Application technique

g. Not sure

h. Other, please specify.....

37. In your opinion, what factors most influence the durability of Permanent (non-sacrificial) protection systems?

a. Climate Conditions

b. Porosity of surface (porous vs. non-porous)

c. Surface compatibility (i.e. Concrete, Brick, Stone, wood, steel, etc...)

d. Preparation of surface

e. Number of coats applied

f. Application technique

g. Not sure

h. Other, please specify.....

38. How concerned are you about potential color changes to the original surface after the application and removal of anti-graffiti coating?

a. Very concerned

b. Somewhat concerned

c. Not concerned

d. Not sure

39. How many washing cycles does your current permanent anti-graffiti coating withstand before requiring reapplication?

a. Less than 10 washing cycles

b. 10-20 washing cycles

c. 21-30 washing cycles

d. More than 30 washing cycles

e. Not sure

40. In your opinion, which type of anti-graffiti coating is more cost effective?

a. Sacrificial is more cost-effective compared to semi-permanent and non-sacrificial

b. Semi-permanent is more cost effective compared to sacrificial and non-sacrificial

c. Non-sacrificial is more cost-effective compared to sacrificial and semi-sacrificial

d. They all have the same cost

e. Not sure

41. What techniques were used for surface preparation before applying anti-graffiti protection in your state?

a. Power washing (hot)

b. Power washing (cold)

c. Sandblasting

d. Soda blasting

e. Chemical agents

f. Manual scrubbing

g. Other, please specify .....

42. How satisfied are you with the effectiveness of your current anti-graffiti coating?

a. Very Satisfied

b. Satisfied

c. Somehow satisfied

d. Not satisfied

43. What are the factors that most influence your satisfaction with your current anti-graffiti coating?

a. Easy of application

b. Ease of graffiti removal

c. Effectiveness in graffiti removal

d. Multi-surface compatibility

e. Environmental friendly

f. Cost

g. High water vapor permeability

h. Minimal color changes to the substrate

i. Other, please specify .....

44. Are the hydrophobic and oleophobic products you've used in your state successful in repelling both water and oil-based substances?

a. Yes, they repel both water and oil-based substances

b. No, they primarily repel water but not oil-based substances

c. No, they primarily repel oil-based substances but not water

d. Not sure

45. Does the porosity of the surface affect your choice of the anti-graffiti protection system? If so, how?

……..

……..

46. How do you assess the long-term effectiveness and performance of anti-graffiti protection products?

……..

……..

47. What improvements or features would you like to see in future anti-graffiti protection systems in comparison to current products you are using?

……..

……..

Additional Comments:

……

……..

……..

……..

……..

……..

APPENDIX B: SURVEY RESPONSES

INDIANA DOT

Survey Question No. 2. How often do you encounter graffiti vandalism in your area?

a. Frequently

b. **Occasionally**

c. Rarely

d. Never

Survey Question No. 3. In your experience, what sizes of graffiti vandalism are most commonly encountered?

a. Small tags or signatures

b. Medium-sized artworks or messages

c. Large-scale murals or paintings

d. **Varied sizes, depending on location**

e. Not encountered graffiti vandalism

f. Other (please specify): ……

Survey Question No. 4. Are Anti-Graffiti Protection Systems currently used in your state?

a. Yes

b. **No**

Survey Question No. 11. How familiar are you with the types of anti-graffiti products available in the market?

a. Very familiar

b. **Somewhat familiar**

c. Not familiar at all

Additional Comments: INDOT stopped using any coating last year. We found that our maintenance department didn't know what coatings had been used where and ended up painting over all the graffiti anyway, so we stopped using it.

WISCONSIN DOT

Survey Question No. 2. How often do you encounter graffiti vandalism in your area?

a. Frequently

b. **Occasionally**

c. Rarely

d. Never

Survey Question No. 3. In your experience, what sizes of graffiti vandalism are most commonly encountered?

a. Small tags or signatures

b. Medium-sized artworks or messages

c. Large-scale murals or paintings

d. **Varied sizes, depending on location**

e. Not encountered graffiti vandalism

f. Other (please specify): ……

Survey Question No. 4. Are Anti-Graffiti Protection Systems currently used in your state?

a. Yes

b. **No**

Survey Question No. 7. If a sacrificial system is used, what type of material is used?

a. Polysiloxane

b. Polysaccharide

c. Waxes

d. Micro-waxes

e. **N/A**

f. Other, please specify .....

Survey Question No. 8. If a non-sacrificial system is used, what type of material is used?

a. Nanoparticles (i.e. nanosilica) coatings
b. Polymer blends coatings
c. Silicone-based coatings
d. Epoxy-based coatings
e. Fluorinated coatings
f. Organic-inorganic hybrid products
g. **N/A**
h. Other, please specify.....

Survey Question No. 10. How satisfied are you with the effectiveness of your anti-graffiti coating in facilitating the cleaning process after graffiti vandalism?

a. Very satisfied
b. Somewhat satisfied
c. Neutral
d. **Somewhat dissatisfied**
e. Very dissatisfied

Survey Question No. 11. How familiar are you with the types of anti-graffiti products available in the market?

a. Very familiar
b. Somewhat familiar
c. **Not familiar at all**

Survey Question No. 33. What are the challenges associated with removing graffiti in your state?

a. **Difficulty in completely removing graffiti**
b. Damage to the underlying surface during removal
c. Color changes to the substrate
d. Time-consuming process
e. **Use of abrasive chemicals or methods impacting the environment**
f. The material is toxic and hard to remove
g. Other (please specify): ……

Additional Comments:

WisDOT has used anti-graffiti products on a very limited basis over the years. In the early 2010's, there were a few projects where we specified anti-graffiti coatings, specifically on retaining walls.

In the past, the products we had implemented were permanent anti-graffiti coatings (non-sacrificial). A few select past projects in Wisconsin utilized the following list of acceptable products for use on unpainted, painted, or stained concrete surfaces. Some projects also required a 3-step process with an acrylic bonding admixture, an anti-graffiti shield primer, and finally the anti-graffiti coating.

Anti-Graffiti Coating by Sherwin-Williams.

Permaclean 1495 Gloss Finish and 1496 Matte Finish, by TK Products.

Duraguard 310 CRU by Chem Masters.

However, we eventually felt that they didn't seem to be working well and so we went away from using anti-graffiti products. We found they weren't very affective in keeping the graffiti off of the structures, and it was still difficult to remove graffiti when the coating was used. We discovered there is still a lot of effort needed to remove the graffiti, even with the anti-graffiti coating; this includes consideration for when graffiti happened, the material was toxic to remove, and it created some danger for the workers trying to remove it as a part of removing the graffiti.

Again, we have gone away from using these types of products on a widespread basis.

From a maintenance perspective, most of the local municipalities prefer to handle the graffiti as it comes up by simply painting over it, and this is usually the DOT's maintenance practice as well. Graffiti is typically painted over whenever it is found in areas where it can be seen by the general public or if a specific complaint is received.

You may consider sending the survey or an inquiry to TxDOT, if you have not already. In discussing with some of our counterparts there, it sounds like they have had mixed success with anti-graffiti products. For graffiti removal, their specs call for one of either a solvent based graffiti removal product, or a product that uses water (at low pressure). See link below for additional information:

https://ftp.dot.state.tx.us/pub/txdot-info/cst/DMS/8000_series/pdfs/8111.pdf

MINNESOTA DOT

Survey Question No. 2. How often do you encounter graffiti vandalism in your area?

a. **Frequently**
b. Occasionally
c. Rarely
d. Never

Survey Question No. 3. In your experience, what sizes of graffiti vandalism are most commonly encountered?

a. Small tags or signatures
b. Medium-sized artworks or messages
c. Large-scale murals or paintings
d. **Varied sizes, depending on location**
e. Not encountered graffiti vandalism
f. Other (please specify): ……

Survey Question No. 4. Are Anti-Graffiti Protection Systems currently used in your state?

a. **Yes**
b. No

Survey Question No. 5. If yes, specify the type(s) of the anti-graffiti protection system(s) used?

a. Sacrificial
b. **Non-sacrificial**
c. Semi- Permanent
d. N/A

Survey Question No. 6. What type of surfaces are typically protected with anti-graffiti coatings in your state?

Multi color Architectural form liner finishes

Survey Question No. 7. If a sacrificial system is used, what type of material is used?

a. Polysiloxane
b. Polysaccharide
c. Waxes
d. Micro-waxes

d. **N/A**

e. Other, please specify .....

Survey Question No. 8. If a non-sacrificial system is used, what type of material is used?

a. Nanoparticles (i.e. nanosilica) coatings

b. **Polymer blends coatings**

c. Silicone-based coatings

d. **Epoxy-based coatings**

e. Fluorinated coatings

f. Organic-inorganic hybrid products

g. N/A

h. Other, please specify.....

Survey Question No. 9. What type of surface was the anti-graffiti protection system applied to? List the name(s) of the anti-graffiti protection system(s) product(s) used in each case between the brackets.

a. Concrete (.....)

b. Bricks (.....)

c. Stucco (.....)

d. Stone (.....)

e. Metals (.....)

f. Glass (.....)

g. Glazed tile (.....)

h. Other, please specify: **Painted Surfaces (Walls, Brick, Stone, Concrete)**

Survey Question No. 10. How satisfied are you with the effectiveness of your anti-graffiti coating in facilitating the cleaning process after graffiti vandalism?

a. Very satisfied

b. **Somewhat satisfied**

c. Neutral

d. Somewhat dissatisfied

e. Very dissatisfied

Survey Question No. 11. How familiar are you with the types of anti-graffiti products available in the market?

a. Very familiar

b. **Somewhat familiar**

c. Not familiar at all

Survey Question No. 12. Which sacrificial and non-sacrificial anti-graffiti protection brands or manufacturers do you recommend?

https://www.dot.state.mn.us/products/paint/antigraffiti.html

Survey Question No. 13. What are the reasons for choosing such anti-graffiti products?

MnDOT had defacing concerns for our assets in the metro areas. We worked with already approved concrete coatings companies to define an Anti-graffiti qualification process. Over the years we switched from sacrificial to more permanent.

Survey Question No. 14. What was the last anti-graffiti protection system project applied in your state, and when? What anti-graffiti protection product was used?

Annually on multiple projects maybe 12/year.

Survey Question No. 15. What is the life expectancy of sacrificial anti-graffiti coatings in your state (if applicable)?

N/A

Survey Question No. 16. What is the life expectancy of non-sacrificial anti-graffiti coatings in your state (if applicable)?

MnDOT is experiencing multiples years of success.

Survey Question No. 17. Are there any surface-specific preparations or treatments you undertake before applying anti-graffiti coating to concrete surfaces? If yes, please describe.

Immediately after the color was added to the concrete, following manufacturer's rec.

Survey Question No. 18. Are there any surface-specific considerations, such as texture, porosity, or color of concrete surface that influence your choice between sacrificial and non-sacrificial anti-graffiti coatings?

No, we only use non-sacrificial.

Survey Question No. 19. Does the climate affect your choice of the anti-graffiti protection system in your state? If so, how?

No

Survey Question No. 20. Does the climate affect the performance of the anti-graffiti protection system in your state? If so, how?

No

Survey Question No. 21. Does the climate affect the durability of the anti-graffiti protection system and the surface that is applied to in your state? If so, how?

Not to our knowledge

Survey Question No. 22. Have the anti-graffiti protection systems ever been removed and reapplied in your state? If yes, what method was used to remove the system? What type of coating was used in the reapplication process?

Yes, back in the day when we used sacrificial coatings but not recently.

Survey Question No. 23. In your opinion, what techniques do you recommend for the removal of graffiti? Select all that apply.

a. **Physical methods such as Pressure washing**

b. **Chemical cleaners**

c. Sandblasting

d. Soda blasting

e. **Heat application (e.g., steam or hot water)**

f. **Manual scrubbing**

g. Ultrasonic

h. megasonic agitation

i. Plasma spray

j. Dry ice blasting

k. Laser

l. Bioremediation

m. Other (please specify): **Elephant Snot to remove. Paint over surfaces that do not have anti-graffiti coatings and are single color.**

Survey Question No. 24. Was there any damage to the surface during the removal process? Please list all types of surface damages that may have occurred.

Not that we are aware of.

Survey Question No. 25. What is the method of application of the anti-graffiti protection system used?

a. Roll
b. Brush
c. **Spray**
d. Other, please specify .....

Survey Question No. 26. What is the main reason for using the anti-graffiti protection system adopted in your state?

a. Climate
b. Cost
c. Surface applied to
d. Method of application
e. Effectiveness
f. **Durability**
g. **Maintenance**
h. Other, please specify .....

Survey Question No. 27. What are the key advantages of the anti-graffiti protection systems used in your state?

a. **Effectiveness in removing graffiti**
b. Ease of application
c. Compatibility with the applied surface
d. Resilience to environmental impacts
e. Low initial Cost
f. Low re-application cost
g. Easy to apply
h. Easy to clean
i. Transparent
j. Durability
k. Other, please specify .....

Survey Question No. 28. What are the main disadvantages of the anti-graffiti protection systems used in your state?

a. Damage to the substrate

b. Durability issues

c. High Cost

d. Ineffectiveness in removing graffiti

e. Toxic material and hard to remove

f. Limited protection time

g. Color changes to the substrate

h. High maintenance expense

i. Limited water vapor permeability

j. Other, please specify: **That our Department Maintenance forces may not know where the anti-graffiti coatings are applied which is why we switched to only putting it on multi-colored surfaces.**

Survey Question No. 29. What factors affect your choice between sacrificial and non-sacrificial protection systems?

MnDOT only uses non-sacrificial

Survey Question No. 30. What is the cost of the material used as an anti-graffiti protection system in your state?

That is a contract item that is incidental to the surface coating (approx. $1.80 SF)

Survey Question No. 31. What is the cost of applying and removing the anti-graffiti protection system used in your state?

$1.80 SF includes labor and material to apply by contract only

Survey Question No. 32. What are the challenges associated with applying the anti-graffiti protection system used in your state?

Inconsistent tracking and notification to our Maintenance Staff

Survey Question No. 33. What are the challenges associated with removing graffiti in your state?

a. Difficulty in completely removing graffiti

b. Damage to the underlying surface during removal

c. Color changes to the substrate

d. Time-consuming process

e. Use of abrasive chemicals or methods impacting the environment

f. The material is toxic and hard to remove

g. Other (please specify): **To-date we don't remove them**

Survey Question No. 34. What are the challenges associated with maintaining the anti-graffiti protection system used in your state?

We don't maintain aesthetics

Survey Question No. 35. What is the anti-graffiti protection system adopted in your state best used for?

a. Historic buildings

b. High volume traffic zones

c. Residential zones

d. Bridge piers and abutments

e. Retaining wall and wing walls

f. Culvert headwalls

g. Other, please specify: **Multi-colored surfaces as stated above**

Survey Question No. 36. In your opinion, what factors most influence the durability of the sacrificial protection system?

a. Climate Conditions

b. Porosity of surface (porous vs. non-porous)

c. Surface compatibility (i.e. Concrete, Brick, Stone, wood, steel, etc...)

d. Preparation of surface

e. Number of coats applied

f. Application technique

g. Not sure

h. Other, please specify: **N/A**

Survey Question No. 37. In your opinion, what factors most influence the durability of Permanent (non-sacrificial) protection systems?

a. **Climate Conditions**

b. Porosity of surface (porous vs. non-porous)

c. Surface compatibility (i.e. Concrete, Brick, Stone, wood, steel, etc...)

d. **Preparation of surface**

e. Number of coats applied

f. Application technique

g. Not sure

h. Other, please specify.....

Survey Question No. 38. How concerned are you about potential color changes to the original surface after the application and removal of anti-graffiti coating?

a. Very concerned

b. Somewhat concerned

c. **Not concerned**

d. Not sure

Survey Question No. 39. How many washing cycles does your current permanent anti-graffiti coating withstand before requiring reapplication?

a. **Less than 10 washing cycles**

b. 10-20 washing cycles

c. 21-30 washing cycles

d. More than 30 washing cycles

e. Not sure

Survey Question No. 40. In your opinion, which type of anti-graffiti coating is more cost effective?

a. Sacrificial is more cost-effective compared to semi-permanent and non-sacrificial

b. Semi-permanent is more cost effective compared to sacrificial and non-sacrificial

c. **Non-sacrificial is more cost-effective compared to sacrificial and semi-sacrificial**

d. They all have the same cost

e. Not sure

Survey Question No. 41. What techniques were used for surface preparation before applying anti-graffiti protection in your state?

a. Power washing (hot)

b. Power washing (cold)

c. Sandblasting

d. Soda blasting

e. Chemical agents

f. Manual scrubbing

g. Other, please specify: **Follow Manufacturer's Recommendations**

Survey Question No. 42. How satisfied are you with the effectiveness of your current anti-graffiti coating?

a. Very Satisfied

b. **Satisfied**

c. Somehow satisfied

d. Not satisfied

Survey Question No. 43. What are the factors that most influence your satisfaction with your current anti-graffiti coating?

a. Easy of application

b. **Ease of graffiti removal**

c. Effectiveness in graffiti removal

d. Multi-surface compatibility

e. Environmental friendly

f. Cost

g. High water vapor permeability

h. Minimal color changes to the substrate

i. Other, please specify .....

Survey Question No. 44. Are the hydrophobic and oleophobic products you've used in your state successful in repelling both water and oil-based substances?

a. **Yes, they repel both water and oil-based substances**

b. No, they primarily repel water but not oil-based substances

c. No, they primarily repel oil-based substances but not water

d. Not sure

Survey Question No. 45. Does the porosity of the surface affect your choice of the anti-graffiti protection system? If so, how?

No

Survey Question No. 46. How do you assess the long-term effectiveness and performance of anti-graffiti protection products?

We don't

Survey Question No. 47. What improvements or features would you like to see in future anti-graffiti protection systems in comparison to current products you are using?

Current Products are working well.

MICHIGAN DOT

Survey Question No. 2. How often do you encounter graffiti vandalism in your area?

a. Frequently

b. **Occasionally**

c. Rarely

d. Never

Survey Question No. 3. In your experience, what sizes of graffiti vandalism are most commonly encountered?

a. Small tags or signatures

b. Medium-sized artworks or messages

c. Large-scale murals or paintings

d. **Varied sizes, depending on location**

e. Not encountered graffiti vandalism

f. Other (please specify): ……

Survey Question No. 4. Are Anti-Graffiti Protection Systems currently used in your state?

a. **Yes -Seldom used**

b. No

Special Provision (from previous 2012 Standard Specifications for Construction):

https://mdotjboss.state.mi.us/SpecProv/getDocumentById.htm?projNum=1929761&fileName=Anti-Graffiti%20Coating%20System-12DS800(O075).docx

Survey Question No. 5. If yes, specify the type(s) of the anti-graffiti protection system(s) used?

a. Sacrificial

b. **Non-sacrificial**

c. Semi- Permanent

d. N/A

Survey Question No. 6. What type of surfaces are typically protected with anti-graffiti coatings in your state?

Bridge Superstructure Surfaces – Concrete deck slab fascias and bridge railing concrete parapet surfaces

Bridge Substructure Surfaces – Abutment Walls, Wingwalls, pier column and cap surfaces.

Ancillary Structures – Retaining Walls, Sound Walls

Survey Question No. 7. If a sacrificial system is used, what type of material is used?

a. Polysiloxane

b. Polysaccharide

c. Waxes

d. Micro-waxes

e. **N/A**

f. Other, please specify .....

Survey Question No. 8. If a non-sacrificial system is used, what type of material is used?

a. Nanoparticles (i.e. nanosilica) coatings

b. Polymer blends coatings

c. **Silicone-based coatings**

d. Epoxy-based coatings

e. Fluorinated coatings

f. Organic-inorganic hybrid products

g. N/A

h. Other, please specify.....

Survey Question No. 9. What type of surface was the anti-graffiti protection system applied to? List the name(s) of the anti-graffiti protection system(s) product(s) used in each case between the brackets.

a. **Concrete (Used Sherwin-Williams: Anti-Graffiti Coating or 2K Waterbased Anti-Graffiti Coating)**

b. Bricks (.....)

c. Stucco (.....)

d. Stone (.....)

e. Metals (.....)

f. Glass (.....)

g. Glazed tile (.....)

h. Other, please specify .....

Survey Question No. 10. How satisfied are you with the effectiveness of your anti-graffiti coating in facilitating the cleaning process after graffiti vandalism?

a. Very satisfied

b. Somewhat satisfied

c. **Neutral**

d. Somewhat dissatisfied

e. Very dissatisfied

Survey Question No. 11. How familiar are you with the types of anti-graffiti products available in the market?

a. Very familiar

b. **Somewhat familiar**

c. Not familiar at all

Survey Question No. 12. Which sacrificial and non-sacrificial anti-graffiti protection brands or manufacturers do you recommend?

Sherwin-Williams: Anti-Graffiti Coating or 2K Waterbased Anti-Graffiti Coating

Survey Question No. 13. What are the reasons for choosing such anti-graffiti products?

Ease of removal and reduce maintenance

Survey Question No. 14. What was the last anti-graffiti protection system project applied in your state, and when? What anti-graffiti protection product was used?

No specific project; Product used was Sherwin-Williams: Anti-Graffiti Coating or 2K Waterbased Anti-Graffiti Coating

Survey Question No. 16. What is the life expectancy of non-sacrificial anti-graffiti coatings in your state (if applicable)?

Special provision lists a 10 year warranty - https://mdotjboss.state.mi.us/SpecProv/getDocumentById.htm?projNum=1929761&fileName=Anti-Graffiti%20Coating%20System-12DS800(O075).docx

Survey Question No. 18. Are there any surface-specific considerations, such as texture, porosity, or color of concrete surface that influence your choice between sacrificial and non-sacrificial anti-graffiti coatings?

If concrete is textured (rough surface), no anti-graffiti coating is used.

Survey Question No. 19. Does the climate affect your choice of the anti-graffiti protection system in your state? If so, how?

Per Manufacturer's specifications

Survey Question No. 23. In your opinion, what techniques do you recommend for the removal of graffiti? Select all that apply.

a. **Physical methods such as Pressure washing**

b. Chemical cleaners

c. Sandblasting

d. Soda blasting

e. Heat application (e.g., steam or hot water)

f. **Manual scrubbing**

g. Ultrasonic

h. megasonic agitation

i. Plasma spray

j. Dry ice blasting

k. Laser

l. Bioremediation

m. Other (please specify): _____

Survey Question No. 25. What is the method of application of the anti-graffiti protection system used?

a. Roll

b. Brush

c. **Spray**

d. Other, please specify .....

Survey Question No. 26. What is the main reason for using the anti-graffiti protection system adopted in your state?

a. Climate
b. Cost
c. Surface applied to
d. Method of application
e. Effectiveness
f. Durability
g. **Maintenance**
h. Other, please specify .....

Survey Question No. 27. What are the key advantages of the anti-graffiti protection systems used in your state?

a. Effectiveness in removing graffiti
b. Ease of application
c. Compatibility with the applied surface
d. Resilience to environmental impacts
e. Low initial Cost
f. Low re-application cost
g. Easy to apply
h. **Easy to clean**
i. Transparent
j. Durability
k. Other, please specify .....

Survey Question No. 28. What are the main disadvantages of the anti-graffiti protection systems used in your state?

a. Damage to the substrate
b. Durability issues
c. High Cost
d. Ineffectiveness in removing graffiti
e. Toxic material and hard to remove
f. Limited protection time
g. Color changes to the substrate

h. **High maintenance expense**

i. Limited water vapor permeability

j. Other, please specify .....

Survey Question No. 33. What are the challenges associated with removing graffiti in your state?

a. Difficulty in completely removing graffiti

b. Damage to the underlying surface during removal

c. Color changes to the substrate

d. **Time-consuming process**

e. Use of abrasive chemicals or methods impacting the environment

f. The material is toxic and hard to remove

g. Other (please specify): ……

Survey Question No. 35. What is the anti-graffiti protection system adopted in your state best used for?

a. Historic buildings

b. High volume traffic zones

c. Residential zones

d. Bridge piers and abutments

e. Retaining wall and wing walls

f. Culvert headwalls

g. Other, please specify: **Bridge Components**

Survey Question No. 38. How concerned are you about potential color changes to the original surface after the application and removal of anti-graffiti coating?

a. Very concerned

b. Somewhat concerned

c. Not concerned

d. **Not sure**

Survey Question No. 39. How many washing cycles does your current permanent anti-graffiti coating withstand before requiring reapplication?

a. Less than 10 washing cycles

b. 10-20 washing cycles

c. 21-30 washing cycles

d. More than 30 washing cycles

e**. Not sure**

Survey Question No. 40. In your opinion, which type of anti-graffiti coating is more cost effective?

a. Sacrificial is more cost-effective compared to semi-permanent and non-sacrificial

b. Semi-permanent is more cost effective compared to sacrificial and non-sacrificial

c. Non-sacrificial is more cost-effective compared to sacrificial and semi-sacrificial

d. They all have the same cost

e. **Not sure**

Survey Question No. 44. Are the hydrophobic and oleophobic products you've used in your state successful in repelling both water and oil-based substances?

a. Yes, they repel both water and oil-based substances

b. No, they primarily repel water but not oil-based substances

c. No, they primarily repel oil-based substances but not water

d. **Not sure**

Survey Question No. 46. How do you assess the long-term effectiveness and performance of anti-graffiti protection products?

Color and durability to provide graffiti removal near end of anticipated service life

Survey Question No. 47. What improvements or features would you like to see in future anti-graffiti protection systems in comparison to current products you are using?

Applicable to multiple surface roughness characteristics (not just flat and smooth) and Ease of (re-application).

Additional Comments:

The option to use an aesthetic-textured concrete on exposed surfaces, such as along bridge fascias or on abutment walls or on retaining walls, may discourage graffiti due to the uneven surface.

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Survey Question No. 2. How often do you encounter graffiti vandalism in your area?

a. Frequently

b. **Occasionally**

c. Rarely

d. Never

Survey Question No. 3. In your experience, what sizes of graffiti vandalism are most commonly encountered?

a. Small tags or signatures

b. Medium-sized artworks or messages

c. Large-scale murals or paintings

d. **Varied sizes, depending on location**

e. Not encountered graffiti vandalism

f. Other (please specify): ……

Survey Question No. 4. Are Anti-Graffiti Protection Systems currently used in your state?

a. **Yes -rarely**

b. No

Survey Question No. 5. If yes, specify the type(s) of the anti-graffiti protection system(s) used?

a. Sacrificial

b. **Non-sacrificial**

c. Semi- Permanent

d. N/A

Survey Question No. 6. What type of surfaces are typically protected with anti-graffiti coatings in your state?

Bridge piers and abutments, culvert headwalls and wings

Survey Question No. 7. If a sacrificial system is used, what type of material is used?

a. Polysiloxane

b. Polysaccharide

c. Waxes

d. Micro-waxes

e. **N/A**

f. Other, please specify .....

Survey Question No. 8. If a non-sacrificial system is used, what type of material is used?

a. Nanoparticles (i.e. nanosilica) coatings
b. Polymer blends coatings
c. Silicone-based coatings
d. Epoxy-based coatings
e. Fluorinated coatings
f. Organic-inorganic hybrid products
g. **N/A**
h. Other, please specify .....

Survey Question No. 9 What type of surface was the anti-graffiti protection system applied to? List the name(s) of the anti-graffiti protection system(s) product(s) used in each case between the brackets.

a. **Concrete (Bridge piers and abutments, culvert headwalls and wings)**
b. Bricks (.....)
c. Stucco (.....)
d. Stone (.....)
e. Metals (.....)
f. Glass (.....)
g. Glazed tile (.....)
h. Other, please specify .....

Survey Question No. 10. How satisfied are you with the effectiveness of your anti-graffiti coating in facilitating the cleaning process after graffiti vandalism?

a. Very satisfied
b. Somewhat satisfied
c. **Neutral**
d. Somewhat dissatisfied
e. Very dissatisfied

Survey Question No. 11. How familiar are you with the types of anti-graffiti products available in the market?

a. Very familiar
b. Somewhat familiar
c. **Not familiar at all**

Survey Question No. 12. Which sacrificial and non-sacrificial anti-graffiti protection brands or manufacturers do you recommend?

Preapproved for CSL Silcones Inc and Sherwin-Williams

Survey Question No. 13. What are the reasons for choosing such anti-graffiti products?

Met Specification requirements and requested to be on prequalification list

Survey Question No. 14. What was the last anti-graffiti protection system project applied in your state, and when? What anti-graffiti protection product was used?

No information on the last system used. Known year is 2020. Can be a bid item or subsidiary to other bid items. Contractors may use any product on the Prequal list: Si-Coat 532AG Remarkable Low VOC (Clear or Pigmented), 1K Siloxane B97C00150

Survey Question No. 15. What is the life expectancy of sacrificial anti-graffiti coatings in your state (if applicable)?

N/A

Survey Question No. 16. What is the life expectancy of non-sacrificial anti-graffiti coatings in your state (if applicable)?

Unknown

Survey Question No. 17. Are there any surface-specific preparations or treatments you undertake before applying anti-graffiti coating to concrete surfaces? If yes, please describe.

Manufacturer's recommendations

Survey Question No. 18. Are there any surface-specific considerations, such as texture, porosity, or color of concrete surface that influence your choice between sacrificial and non-sacrificial anti-graffiti coatings?

None

Survey Question No. 19. Does the climate affect your choice of the anti-graffiti protection system in your state? If so, how?

Manufacturer's recommendations

Survey Question No. 20. Does the climate affect the performance of the anti-graffiti protection system in your state? If so, how?

Not Known

Survey Question No. 21. Does the climate affect the durability of the anti-graffiti protection system and the surface that is applied to in your state? If so, how?

Not Known

Survey Question No. 22. Have the anti-graffiti protection systems ever been removed and reapplied in your state? If yes, what method was used to remove the system? What type of coating was used in the reapplication process?

No

Survey Question No. 23. In your opinion, what techniques do you recommend for the removal of graffiti? Select all that apply.

a. **Physical methods such as Pressure washing**

b. Chemical cleaners

c. Sandblasting

d. Soda blasting

e. Heat application (e.g., steam or hot water)

f. **Manual scrubbing**

g. Ultrasonic

h. megasonic agitation

i. Plasma spray

j. Dry ice blasting

k. Laser

l. Bioremediation

m. **Other (please specify): Painting**

Survey Question No. 24. Was there any damage to the surface during the removal process? Please list all types of surface damages that may have occurred.

Not applicable

Survey Question No. 25. What is the method of application of the anti-graffiti protection system used?

a. **Roll**

b. **Brush**

c. **Spray**

d. Other, please specify .....

Survey Question No. 26. What is the main reason for using the anti-graffiti protection system adopted in your state?

a. Climate
b. Cost
c. Surface applied to
d. Method of application
e. Effectiveness
f. Durability
g. Maintenance
h. Other, please specify: **Not used regularly**

Survey Question No. 27. What are the key advantages of the anti-graffiti protection systems used in your state?

a. Effectiveness in removing graffiti
b. **Ease of application**
c. Compatibility with the applied surface
d. Resilience to environmental impacts
e. Low initial Cost
f. Low re-application cost
g. Easy to apply
h. Easy to clean
i. Transparent
j. Durability
k. Other, please specify .....

Survey Question No. 28. What are the main disadvantages of the anti-graffiti protection systems used in your state?

a. Damage to the substrate
b. Durability issues
c. High Cost
d. Ineffectiveness in removing graffiti
e. Toxic material and hard to remove
f. Limited protection time

g. Color changes to the substrate

h. High maintenance expense

i. Limited water vapor permeability

j. Other, please specify **Not used regularly to know disadvantages**

Survey Question No. 29. What factors affect your choice between sacrificial and non-sacrificial protection systems?

N/A

Survey Question No. 30. What is the cost of the material used as an anti-graffiti protection system in your state?

See next question

Survey Question No. 31. What is the cost of applying and removing the anti-graffiti protection system used in your state?

Application: material and application cost was $26.95/sq yd in 2020

Removal – not known

Survey Question No. 32. What are the challenges associated with applying the anti-graffiti protection system used in your state?

Not known

Survey Question No. 33. What are the challenges associated with removing graffiti in your state?

a. Difficulty in completely removing graffiti

b. Damage to the underlying surface during removal

c. Color changes to the substrate

d. Time-consuming process

e. Use of abrasive chemicals or methods impacting the environment

f. The material is toxic and hard to remove

g. Other (please specify): **Not known**

Survey Question No. 34. What are the challenges associated with maintaining the anti-graffiti protection system used in your state?

Not known

Survey Question No. 35. What is the anti-graffiti protection system adopted in your state best used for?

a. Historic buildings

b. High volume traffic zones

c. Residential zones

d. Bridge piers and abutments

e. Retaining wall and wing walls

f. Culvert headwalls

g. **Other, please specify: Bridge Piers and abutments**

Survey Question No. 36. In your opinion, what factors most influence the durability of the sacrificial protection system?

a. Climate Conditions

b. Porosity of surface (porous vs. non-porous)

c. Surface compatibility (i.e. Concrete, Brick, Stone, wood, steel, etc...)

d. Preparation of surface

e. Number of coats applied

f. Application technique

g. Not sure

h. Other, please specify: **N/A**

Survey Question No. 37. In your opinion, what factors most influence the durability of Permanent (non-sacrificial) protection systems?

a. Climate Conditions

b. Porosity of surface (porous vs. non-porous)

c. Surface compatibility (i.e. Concrete, Brick, Stone, wood, steel, etc...)

d. Preparation of surface

e. Number of coats applied

f. Application technique

g. **Not sure**

h. Other, please specify.....

Survey Question No. 38. How concerned are you about potential color changes to the original surface after the application and removal of anti-graffiti coating?

a. Very concerned

b. Somewhat concerned

c. **Not concerned**

d. Not sure

Survey Question No. 39. How many washing cycles does your current permanent anti-graffiti coating withstand before requiring reapplication?

a. Less than 10 washing cycles

b. 10-20 washing cycles

c. 21-30 washing cycles

d. More than 30 washing cycles

e. **Not sure**

Survey Question No. 40. In your opinion, which type of anti-graffiti coating is more cost effective?

a. Sacrificial is more cost-effective compared to semi-permanent and non-sacrificial

b. Semi-permanent is more cost effective compared to sacrificial and non-sacrificial

c. Non-sacrificial is more cost-effective compared to sacrificial and semi-sacrificial

d. They all have the same cost

e. **Not sure**

Survey Question No. 41. What techniques were used for surface preparation before applying anti-graffiti protection in your state?

a. Power washing (hot)

b. Power washing (cold)

c. Sandblasting

d. Soda blasting

e. Chemical agents

f. Manual scrubbing

g. Other, please specify: **Manufacturer's Recommendations**

Survey Question No. 42. How satisfied are you with the effectiveness of your current anti-graffiti coating?

a. Very Satisfied
b. Satisfied
c. Somehow satisfied
d. Not satisfied
e. **Other - Has not tried to remove from treated bridge piers**

Survey Question No. 43. What are the factors that most influence your satisfaction with your current anti-graffiti coating?

a. Easy of application
b. Ease of graffiti removal
c. Effectiveness in graffiti removal
d. Multi-surface compatibility
e. Environmental friendly
f. Cost
g. High water vapor permeability
h. Minimal color changes to the substrate
i. Other, please specify: **No history to answer**

Survey Question No. 44. Are the hydrophobic and oleophobic products you've used in your state successful in repelling both water and oil-based substances?

a. Yes, they repel both water and oil-based substances
b. No, they primarily repel water but not oil-based substances
c. No, they primarily repel oil-based substances but not water
d. **Not sure**

Survey Question No. 45. Does the porosity of the surface affect your choice of the anti-graffiti protection system? If so, how?

No

Survey Question No. 46. How do you assess the long-term effectiveness and performance of anti-graffiti protection products?

Have not been in use long enough

Survey Question No. 47. What improvements or features would you like to see in future anti-graffiti protection systems in comparison to current products you are using?

None

Additional Comments:

None

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Survey Question No. 4. Are Anti-Graffiti Protection Systems currently used in your state?

a. **Yes**

b. No

Survey Question No. 5. If yes, specify the type(s) of the anti-graffiti protection system(s) used?

a. Sacrificial

b. **Non-sacrificial**

c. Semi- Permanent

d. N/A

Survey Question No. 6. What type of surfaces are typically protected with anti-graffiti coatings in your state?

Structures such as bridges (raw and painted concrete piers, abutments, and concrete beams, painted steel girders), unpainted concrete noise walls and retaining walls, painted concrete pedestrian tunnels

Survey Question No. 8. If a non-sacrificial system is used, what type of material is used?

a. Nanoparticles (i.e. nanosilica) coatings

b. **Polymer blends coatings**

c. **Silicone-based coatings**

d. Epoxy-based coatings

e. Fluorinated coatings

f. Organic-inorganic hybrid products

g. N/A

h. Other, please specify .....

Survey Question No. 17. Are there any surface-specific preparations or treatments you undertake before applying anti-graffiti coating to concrete surfaces? If yes, please describe.

Concrete surfaces that are painted and also receive anti-graffiti coating are blasted with a combined sand- and water-blast as surface preparation.

Survey Question No. 30. What is the cost of the material used as an anti-graffiti protection system in your state?

See next question 3-year average cost in Iowa is roughly $52/square yard installed

Survey Question No. 35. What is the anti-graffiti protection system adopted in your state best used for?

a. Historic buildings

b. **High volume traffic zones**

c. **Residential zones**

d. Bridge piers and abutments

e. Retaining wall and wing walls

f. Culvert headwalls

g. Other, please specify: Bridge Piers and abutments

Survey Question No. 38. How concerned are you about potential color changes to the original surface after the application and removal of anti-graffiti coating?

a. Very concerned

b. **Somewhat concerned**

c. Not concerned

d. Not sure

Survey Question No. 41. What techniques were used for surface preparation before applying anti-graffiti protection in your state?

a. **Power washing (hot)**

b. **Power washing (cold)**

c. Sandblasting

d. Soda blasting

e. Chemical agents

f. Manual scrubbing

g. Other, please specify .....

Survey Question No. 47. What improvements or features would you like to see in future anti-graffiti protection systems in comparison to current products you are using?

One issue is vapor permeability for applications on concrete, both painted and unpainted. It would be ideal if this type of coating allowed vapor transmission similar to acrylic paint or mineral silicate. Concrete coatings perform best in temperate climatic conditions when they allow the concrete to breathe, but top-coating permeable paints with anti-graffiti product removes that permeability from the entire coating system.


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