



Review

Conservation strategies against graffiti vandalism on Cultural Heritage stones: Protective coatings and cleaning methods



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ABSTRACT

Graffiti paintings, as an act of vandalism, are one of the most severe threats to stone applied in Cultural Heritage. Their cleaning is expensive and in most of the cases, also induce stone damage, such as chemical contamination, by-products and physical changes. In the recent years, the application of anti-graffiti products has been carried out in order to preserve the valuable substrate. Despite the research lines have been focused on the evaluation of cleaning procedures and anti-graffiti products, it is necessary to lead a critical study of the recently reported results, considering the type of stone and the composition of the other key stakeholders, namely the anti-graffiti protective coatings, the paints and the cleaning agents. A brief description of the composition of the most common spray paints used by graffiti-writers in Cultural Heritage stones is also presented.

The protective effectiveness of anti-graffiti coatings and the most remarkable findings on stone graffiti cleaning methods are listed and discussed. Anti-graffiti coatings may facilitate the removal of graffiti compared to untreated surfaces, however this efficacy may be compromised on more porous substrates. Moreover, in almost all of the analysed scientific papers, it was possible to remove graffiti without inducing any damage to the substrate.

This review paper will allow to help conservator-restores to achieve the optimization of the graffiti cleaning procedures on stones in Cultural Heritage. Finally, some futures research lines are pointed out.

1. Introduction

The term graffiti is derived from the Italian word *graffiare* (to scratch) and can be defined as writing or drawings scribbled, scratched, drawn or painted, on a wide range of materials and substrates, mainly located in public accessible places, as result of a vandalism act [1]. Around 3,500,000 protected monuments in European cities are affected by this threat and many cities worldwide spend huge amounts of money in cleaning campaigns to tackle graffiti vandalism [2]. The European Commission (EC) has financed projects to develop sustainable anti-graffiti products that ensure the satisfactory graffiti extraction without induce damages on the substrate (GRAFFITAGE, 2005–2008) [2] and on support urban environment policies to prevent and eliminate graffiti (GRAFFOLUTION, 2014–2016) [3]. During the last decade, some research centres and universities worldwide have been testing commercial anti-graffiti coatings and developing new formulations that intend to avoid/reduce the interaction of the cleaning procedure with the valuable substrate [2]. As a matter of fact, the EC established the main

characteristics of the protective coatings to be applied in materials of historical monuments: Low surface energy; Permanent under outdoor conditions; Reversible to specially designed mild cleaning systems; Permeable to water vapour; Impermeable to liquid water and; Transparent [2].

However, in many cases, graffiti is done in historic surfaces (Fig. 1) without anti-graffiti protection and in real practice, they are not shortly removed after their execution, i.e., most of the times they are cleaned after long environmental exposure. This leads the graffiti to interact with the environmental agents (e.g. rain and atmospheric pollutants) and also with the stone substrate. Thus, the graffiti paint may suffer physical and chemical alterations and subsequently the stone may be affected not only by the application of graffiti but also by its alteration process. Along with the previously mentioned consequences it must be added the damages associated to cleaning, such as surface abrasion, chemical contamination, mineralogical alterations [4,5], which are related with the intrinsic properties of the stone, the composition of the paint and the cleaning agents used [4].

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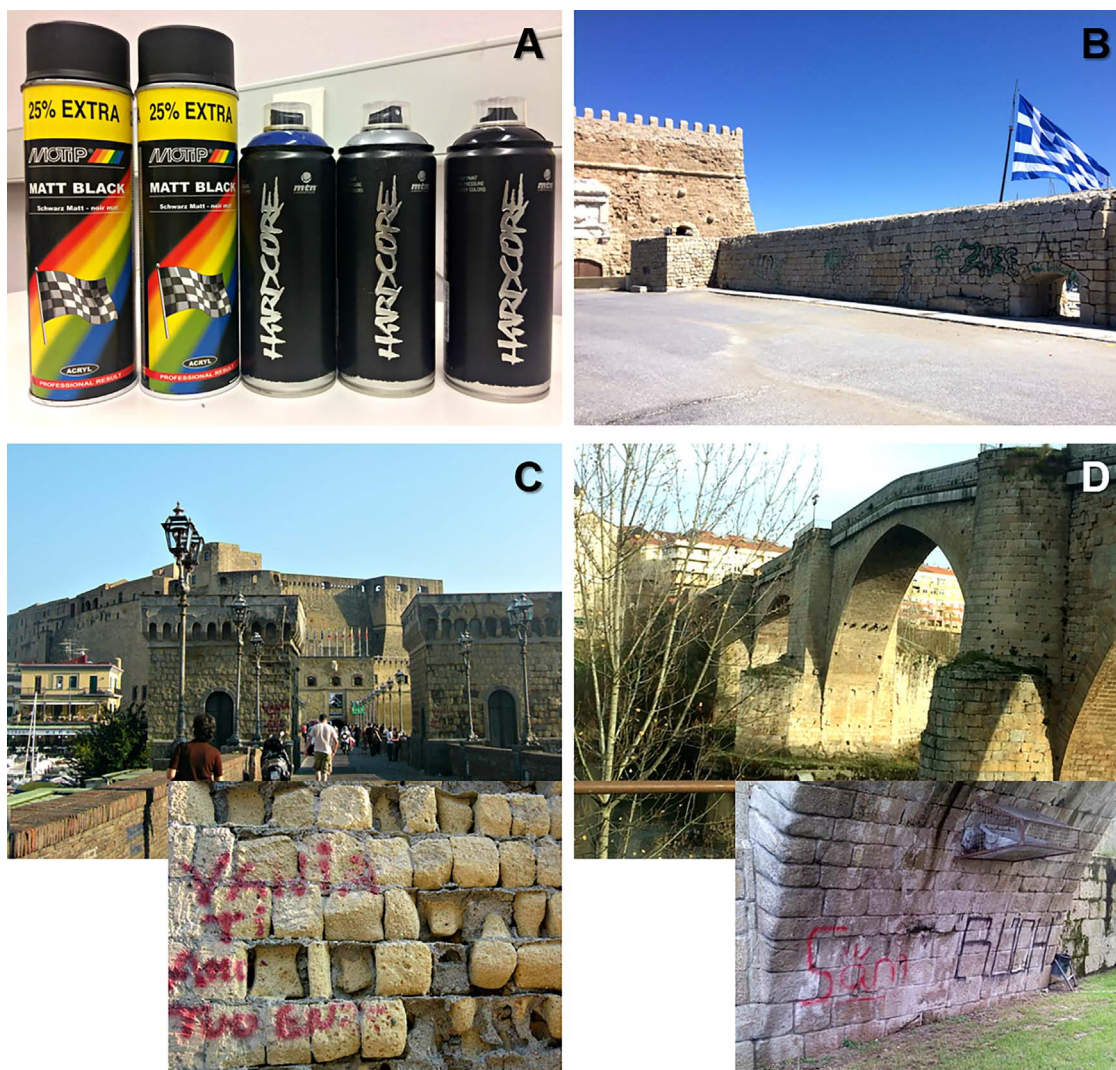


Fig. 1. A: Graffiti cans MOTIP® and Montana Colours®. B-D: Graffiti vandalism paintings in stone monuments: B: Venetian fortress in Heraklion (Crete, Greece); C: Castel dell'Ovo (Naples, Italy); D: Roman bridge in Ourense (Spain). Sources: A and B: the authors; C: Cristina Montojo and D: Alberto Pereira.

Therefore, in order to optimize the strategies to minimize the dangerous effect of graffiti on Cultural Heritage stones, an evaluation of the more recent researches on the graffiti cleaning and anti-graffiti coatings is imperious. So this review presents a state-of-the-art over the composition of the most common graffiti paints, anti-graffiti protective coatings and their cleaning procedures (chemical, mechanical, laser and biological methods). The cleaning performances are critically evaluated considering the stone type, the binder composition of the paints and the cleaning agent. This review concludes with a discussion of emerging issues and new research directions.

2. Graffiti materials

The range of materials used by graffiti-writers to scribble monuments and historic facades is fairly extent and they can be found in multiple layers superimposed requiring a sequence of methods/products to be removed [6,7].

Spray paint outlines as the main material used by graffiti-writers due to its visual impact and quick and easy application [5,8]. They are composed of pigments that provide colour and opacity, additives that improve certain properties (e.g. plasticity, fluidity, thickness, etc.), a binder that holds all the ingredients together and a solvent that allows this mixture to flow [9]. Paints may harden by evaporation of the solvent or through polymerization. The polymerization can occur by

chemical reaction with oxygen, a hardener, moisture and coalescence of an emulsion [1]. While the ones that harden by evaporation of the solvent can be dissolved thru re-application of the solvent [1], the ones that harden by polymerization cannot be easily returned to the previously liquid state [6]. Moreover, the paint may penetrate to various depths on the substrate depending on factors like a high solvent content (that implies a higher flow rate) and the interfacial tension solid surface/liquid [9].

From the universe of graffiti materials like spray paints, markers and inks covered by the literature, it is important to highlight some brands that were specially developed for the graffiter's market. Montana Colors® (Fig. 1) introduced in the market the first spray paint made specifically for graffiters and it is now spread worldwide across 60 countries. It was founded in Barcelona in 1994 by Jordi Rubio [10] who started at Felton®, which is a paint production company also in Barcelona [11]. The international Krink® started with handmade paints for personal use by KR (founder) in Brooklyn in 1993 [12]. Nero D'inferno® was originally developed for use as a leather dye, however later it became established as one of the common choices of ink for artists. Brands with a larger market, not only focused on graffiti materials are also reported in the literature e.g. MOTIP HOME & HOBBYLACQUER® group (Fig. 1), Trans-color®, Herpe, Hammerite, Trimetal Nobel, Akzo Nobel Coatings AG, European Aerosols, De Keyn Paint, Intergamma, Auto-K.

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