

Evaluation of the Effectiveness of a Previous Paint Layer to Slow Down Deterioration of Urban art Murals

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Abstract. *The art created in public spaces is part of the cultural richness of modern society being nowadays contemporary muralism one of the most common painted manifestations of urban art. Unfortunately, these urban creations suffer serious deterioration in a very short space of time due, in some cases, to the lack of prior conditioning of the surface. In this study, the effectiveness of a previous paint layer in slowing down the deterioration of urban art paints was evaluated in two situations: a real mural (monitoring changes during 1 year) and in laboratory – by means of a UV aging test. The presence of the previous layer can modify the colour appearance of the paints, but its application had not meant a better durability after exposure.*

Keywords. Urban art, spray paint, alkyd paint, previous paint layer, painting conservation, contemporary muralism

1 Introduction

Nowadays, contemporary murals are one of the artistic expressions commonly found in public spaces [1]. The artistic value of these artworks could be compromised due to the deterioration processes affecting the paints and derived from the action of the environment factors [2]. Many of the deterioration forms that affect the materials used in urban art (loss of pictorial layer, scaling, etc.) are due to the fact that the substrate has not been properly prepared before applying the paints [2,3]. One possible solution could be to apply a previous layer of paint to the substrate to prepare it to receive the final paint coating.

To create the artworks, artists commonly use modern commercial paints, applied in different formats, the most common being aerosol and brush. Most of these pictorial materials are composed of an organic base of one or several polymers or resins of different natures (acrylic, alkyd, vinyl, styrene, phenolic, polyurethane polyester, epoxy, etc.), pigments of organic and inorganic nature, which confer colour, solvents, fillers and additives. Artists apply these paints to a wide range of substrates (concrete, brick, stone, glass, metal, wood, plastic, etc.) with or without a previous paint layer.

The aim of this study is to evaluate the effect of the application of a previous paint layer in the context of urban art and to study the impact on colour fading. For this, a real mural -in which a previous paint layer was applied- was selected and monitoring 1 year. For comparative purposes, laboratory mock-ups of the same paints with and without the presence of the previous paint layer were made and subjected to an UV ageing test. After the exposures, physical changes were studied in order to evaluate the paint durability by means of stereomicroscopy and spectrophotometry.

2 Materials and Methods

2.1 Contemporary urban art mural and paints

The mural selected is *A Guarda Escrita Nas Estrelas* (Fig. 1A), which was painted in August 2018 by the artists Nuvi and Éxfico on the harbour wall in the port of A Guarda (NW Spain). The structure is made by reinforced concrete.

The wall was first spray gun-painted with a styrene-acryl blue paint from Montó Pinturas (Montokril Liso S 5540r90b), which corresponded to the previous paint layer (PL). The rest of the mural was painted using Montana Colors MTN 94 alkyd spray paints in orange-OR (RV 2004), pink-PI (RV 151), green-GR (RV 6018) and yellow-YE (RV 1021).

In order to evaluate physical changes produced by the mural exposure, colour monitoring in the CIELab space was carried out for 1 year [4], using a Minolta CM-700d spectrophotometer. The measurements (10 random shots per area) were made in specular component excluded (SCE mode), with a spot diameter of 3 mm, illuminant D65 and observer angle of 10°. Colour parameters were recorded: lightness L^* , a^* (colour position between red -positive values- and green -negative values-), b^* (colour position between yellow -positive values- and blue -negative values-) and chroma C^* . The changes in colour were evaluated by calculating the ΔL^* , Δa^* , Δb^* and ΔC^*_{ab} colour differences and the total colour difference (ΔE^*_{ab}).

2.2 UV ageing test

Mock-ups of the same paints used in the mural were prepared. For this, concrete specimens of 7 x 7 x 2 cm were used. Two types of mock-ups were made: with and without the previous blue paint layer (Fig. 1B and 1C). The spray paints were applied following manufacturer's recommendation and held for 30 days in laboratory conditions (15 ± 5 °C; $60 \pm 10\%$ RH).

The painted mock-ups were exposed to UV radiation, using OSRAM Ultra Vitalux 300 W UV lamps (16.3 W of UV-A and 1.3 W of UV-B radiation power), positioned at a vertical distance of 50 cm from the surfaces of the mock-ups, ensuring equal irradiation. The mock-ups were exposed to 210 cycles of 22 h of irradiation (and 2 h of darkening), resulting a total of 4620 h of irradiation. The colour monitoring was performed following the same procedure described above but registering 6 random shots per area. The mock-ups were visualized by a stereomicroscope before and after the ageing test using a Nikon SMZ800.

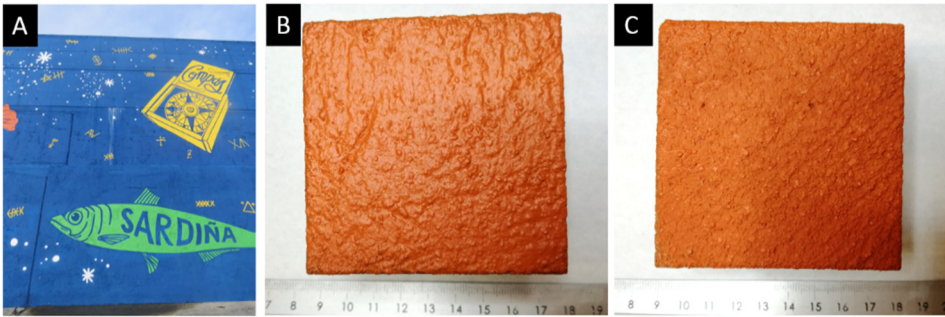


Figure 1. A: detail of *A Guarda Escrita Nas Estrelas mural*, where the previous blue paint layer and the features painted with green, yellow and orange paints are observed. B and C: mock-ups before the UV exposure with (B) and without the previous blue layer (C).

3 Results and Discussion

3.1 Impact of the previous layer on the original colour of the paints

In order to evaluate the impact of the application of the previous layer of blue paint on the original colour of the paints, the ΔE^*_{ab} values were calculated after the application of the paints to the blue paint, taking the surface of the mock-ups without the previous layer as reference (Fig. 2A).

Considering a ΔE^*_{ab} value of 3 CIELab units as the threshold after which the colour change is perceptible to the human eye [5], the application of the previous layer produced a visible change in orange (5.20 ± 0.45 CIELab units) and green (3.59 ± 0.44 CIELab units) paints. In both paints, the application of the previous layer produced an increase in the lightness, whereas, in the orange paint, a statistically significant increase in C^* was detected. Therefore, the green paint became paler and the orange paint lighter (compare Fig. 1B and C).

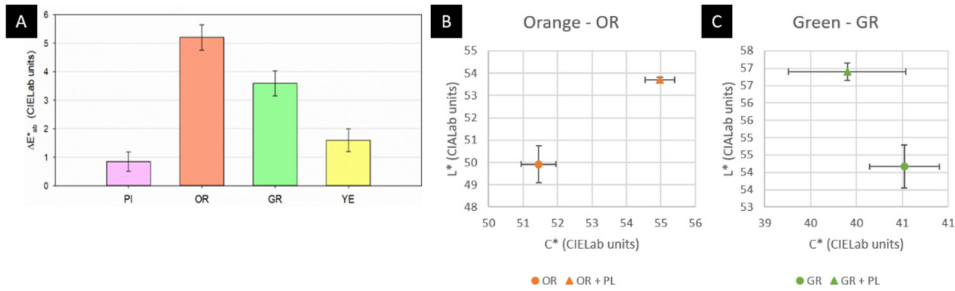


Figure 2. A: Plots of colour parameters in painted surfaces. A: mean values and error bars of ΔE^*_{ab} caused by the application of the previous blue layer on the paints in the mock-ups. B and C: mean values and error bars for L^* and C^* parameters in the paints without and with the previous layer: orange-OR (B) and green (C).

3.2 Evaluation of the paint durability after the mural exposure and UV aging test

The values of ΔE^*_{ab} of the paints exposed to real environment and UV test are graphically represented in Fig. 3A. The values of the colour parameters are included in Table 1.

Regarding the mock-ups, those in which the paint was applied over a previous paint layer suffered a higher colour change after exposure than mock-ups in which the paint was applied directly to the concrete, although the differences were statistically significant only in the pink-PI paint (Fig. 3A). Comparison of the surfaces of the pink-PI mock-ups with and without the previous paint layer and before and after the UV test are shown in Fig. 3B and C.

In the mural, ΔE^*_{ab} suffered by the paintings after the exposure was, in all the cases, higher than the ΔE^*_{ab} suffered for the mock-ups made with the same paints applied over the previous paint layer (Fig. 3A). The paints suffering the highest colour change were orange-OR and pink-PI. The greater colour deterioration in real outdoor conditions can be attributed to the fact that more factors of deterioration besides solar radiation converge in the mural, which contribute to a greater degradation of the colour [2].

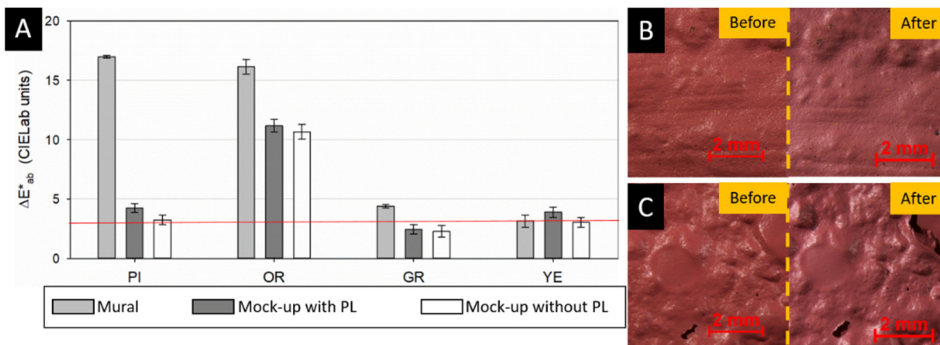


Figure 3. A: mean values and error bars of ΔE^*_{ab} after the mural exposition and the mock-ups after the UV test (with and without previous layer PL). B and C: stereomicrographs of mock-ups surfaces of pink paint with (B) and without (C) the previous layer, before and after the UV test.

The colour deterioration of the paints is mainly due to a change in two colour parameters (Table 1): in general, C^* decreased and L^* increased (except for GR, where L^* decreased). Therefore, the colour of the paints OR, PI and YE became paler after exposures and darker in the case of GR.

Table 1. L^* , a^* , b^* and C^* colour variations and the total colour difference (ΔE^*_{ab}) in paints of the mural after 1 year of outdoor exposition and in the mock-ups with previous blue paint layer (MK-PL) and in the mock-ups without previous blue paint layer (MK) after the UV test.

Paint	Condition	ΔL^*	Δa^*	Δb^*	ΔC^*_{ab}	ΔE^*_{ab}
PI	Mural	8.06 ± 0.05	-13.95 ± 0.10	5.38 ± 0.05	-9.51 ± 0.08	16.98 ± 0.12
	MK-PL	0.53 ± 0.33	-3.92 ± 0.18	-1.53 ± 0.08	-4.17 ± 0.18	4.24 ± 0.39
	MK	-0.13 ± 0.36	-2.79 ± 0.08	-1.62 ± 0.05	-3.08 ± 0.08	3.23 ± 0.37
OR	Mural	6.98 ± 0.18	-14.52 ± 0.48	-1.00 ± 0.35	-9.53 ± 0.56	16.14 ± 0.62
	MK-PL	1.76 ± 0.32	-7.41 ± 0.34	-8.15 ± 0.28	-10.99 ± 0.39	11.16 ± 0.53
	MK	1.87 ± 0.41	-6.14 ± 0.30	-7.81 ± 0.29	-9.79 ± 0.40	10.11 ± 0.59
GR	Mural	0.02 ± 0.07	0.61 ± 0.08	-4.36 ± 0.11	-3.44 ± 0.13	4.40 ± 0.15
	MK-PL	-0.41 ± 0.18	0.52 ± 0.18	-2.36 ± 0.29	-2.03 ± 0.33	2.45 ± 0.39
	MK	-1.03 ± 0.45	0.78 ± 0.18	-1.82 ± 0.25	-1.88 ± 0.24	2.23 ± 0.55
YE	Mural	1.81 ± 0.29	-2.56 ± 0.28	0.00 ± 0.32	-0.29 ± 0.34	3.14 ± 0.51
	MK-PL	0.53 ± 0.23	-3.70 ± 0.27	-1.05 ± 0.22	-1.64 ± 0.26	3.89 ± 0.42
	MK	0.58 ± 0.30	-2.73 ± 0.07	0.14 ± 0.36	-0.38 ± 0.36	2.79 ± 0.47

4 Conclusions

The presence of previous layers of paints visually modifies the original colour of the paints applied on it. In this study, this modification was unpredictable, affecting two of the four paints. Artists should consider this fact if the final appearance of the paints is important to them.

The application of a previous paint layer did not increase the final durability of the paints to UV radiation test, so if the objective is to slow down fading of the paintings due to photo-degradation, the application of the previous layer would not be necessary. In the case of exposure to the real environment, as occurs in the mural, it would have been necessary to compare the durability of the paint in areas where the previous paint layer was not applied, in order to be able to conclude about its effectiveness in slowing down deterioration.

Acknowledgements

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