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Chromatic reintegration in contemporary monochromatic unvarnished paintings: a case study based on artwork from Jorge Martins

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Abstract: The choice of chromatic reintegration materials for contemporary monochromatic oil and acrylic emulsion unvarnished paints is usually a problem before treatment. This kind of paintings maybe subject to abrasions, especially on the edges, fingerprints and smudges, mainly caused during handling. Being unvarnished works, chromatic reintegration becomes a more complex process as no protective layer exist over the paint. The aim of this work was to assess the materials that over performed in the reintegration of paintings from the Portuguese painter Jorge Martins. Representative mock-ups made with the artist and using his materials and techniques were artificially aged. Different types of materials, aqueous and non-aqueous, were then tested to assess the best ones. It was found that the best results were obtained with Ferrario® pigment dispersed in the Tri-Funori® binding medium and with Winsor & Newton® Designers Gouache, both aqueous and non-toxic.

Keywords: chromatic Reintegration, Tri-Funori®, Gouaches, Monochromatic, Non-varnished, Acrylics, Oils

La reintegración cromática en pintura contemporánea monocromática sin barnizar: un caso de estudio basado en la obra de Jorge Martins

Resumen: La selección de los materiales de reintegración cromática para las pinturas contemporáneas monocromas no barnizadas al óleo y al emulsión acrílica son un problema antes del tratamiento de conservación y restauración. Este tipo de pinturas tiene abrasiones, especialmente en los lados, huelas digitales y manchas, principalmente causadas durante el manejo. Porque son pinturas sin barnizar, la reintegración cromática se convierte en un proceso más complejo ya que la capa protectora no existe sobre la pintura. El objetivo de este trabajo fue evaluar los materiales que tuvieron un rendimiento superior en la reintegración de las pinturas del pintor portugués Jorge Martins. Las maquetas representativas hechas directamente con el artista y usando sus materiales y técnicas fueron artificialmente envejecidas. Luego se probaron diferentes tipos de materiales, acuosos y no acuosos, para evaluar los mejores. Se descubrió que los mejores resultados se obtuvieron con materiales acuosos y no tóxicos como los pigmentos en polvo de Ferrario® disperso en el medio Tri-Funori® y con las gouaches de Winsor y Newton®.

Palabras clave: reintegración Cromática, Tri-Funori®, Guaches, Monocromo, No-Barnizadas, Acrílicos, Óleos

Reintegração cromática em pinturas contemporâneas monocromáticas sem verniz: um estudo de caso a partir da obra de Jorge Martins

Resumo: A escolha dos materiais de reintegração cromática para pinturas contemporâneas a óleo e emulsão acrílica não envernizadas, constituem um problema antes do tratamento de conservação e restauro. Este tipo de pinturas contém abrasões, impressões digitais e manchas de sujidade, que aparecem em particular nas laterais, maioritariamente causadas pelo manuseamento. Por serem pinturas não envernizadas o processo de reintegração cromática torna-se complexo, uma vez que não existe qualquer camada de proteção na pintura. O objetivo deste trabalho foi avaliar os materiais que tiveram um desempenho superior durante as reintegrações cromáticas das pinturas do pintor português Jorge Martins. Construíram-se com o artista, maquetas representativas da sua técnica pictórica recorrendo aos seus materiais. As mesmas maquetas foram artificialmente envelhecidas. Para uma avaliação do mais indicado, diferentes tipos de materiais aquosos e não aquosos, foram testados. Verificou-se que os melhores resultados, foram obtidos com os pigmentos da marca Ferrario® disperso em Tri-Funori® e com os guaches da marca Winsor & Newton®, ambos aquosos e não tóxicos.

Palavras-chave: reintegração Cromática, Tri-Funori®, Guaches, Monocromáticos, Não-envernizadas, Acrílicos, Óleos

Introduction

The choice of materials for contemporary monochrome, unvarnished, oil and acrylic paintings determine complex decision-making processes before and during chromatic reintegration. The particular characteristics of these unprotected paintings make them susceptible to abrasions, fingerprints and smudges, taking place mainly along the edges of the painting during handling and transport due to the absence of frames. This problem is mentioned in literature by Althöfer (2003: 46-47) and by Scicolone (2002: 128) or more recently by Pacheco (2014: 158-175). Being recent and unvarnished works, questions are raised related to the criteria and methodology of intervention, regarding the solubility of the pictorial layer, choice of materials, compatibility and colour matching.

This article presents a case study by analysing the technic and the materials in use in two paintings by the Portuguese artist Jorge Martins (Molina 2018) from 1960 to 1980. The oil and acrylic works by Jorge Martins combine some particularities that represents one of the major concerns for chromatic reintegration into contemporary monochrome painting. Being unvarnished, these paintings are prone to damage or overall weathering from abrasions and stains, resulting from improper handling. Since the artist's paintings are based on chromatic effects, damages greatly interfer with the reading, the plastic qualities and the paintings' artistic intent. The main purpose of this work is to assess and propose the use of reintegration materials for chromatic reintegration of paintings from Jorge Martins. These materials will be applied using the mimetic method and constrained to the time frame from 1960 to 1980, being non-toxic and removable. Three mock-ups (two oils and one acrylic) were specifically created for the process by Jorge Martins, representative of his pictorial technique. Rembrandt® and Winsor & Newton® artist's paints were used in the mock-ups.

Major damages such as abrasions and dirt stains were inflicted into these models, to simulate real usage damages based on the most common damages found in some of the artist's paintings. The damages inflicted into the paintings were done manually on specific areas of the chromatic surface by using sandpaper and other materials such as hand cream and dirt.

Subsequently, all mock-ups were submitted to technical photography by using visible raking transmitted light, ultraviolet light and infrared light. Spectral data was also acquired by hyperspectral imaging (HIS) and converted into the correspondent chromatic perception. All photos and spectral data was obtained before and after artificial and accelerated aging by 500 hours according to ASTM D 40303-03 Standard Test Methods for Lightness of Colours used in Artist's Materials (ASTM, 2003). Of the tree mock-ups only two were aged, while the remaining one was used as a comparative example for colour and as a support for chromatic reintegration tests.

During the chromatic reintegration tests, a variety of dry, aqueous and non-aqueous materials were tested on different substrates, such as: linen canvas fabric with and without primer.

- The ready-made dry materials tested:
  - Winsor & Newton® Watercolour Stick;
  - Pan Pastel® Artist' Pastel powder pigments;

- The ready-made aqueous materials tested:
  - Winsor & Newton® Professional Watercolours;
  - QoR® Watercolor;
  - Mr. Graham® Artists Watercolour;
  - Schmincke Horodam® Aquarell;
  - Winsor & Newton® Designers Gouache;
  - Royal Talens® Extra Fine Quality;
  - Liquitex® Acrylics Markers Water Based;
  - Winsor & Newton® Professional Acrylic;
  - Interactive® Atelier Artists' Acrylic;
  - LeFranc & Bourgeois® Acrylic FLASHE;
  - Vallejo® Model Air Acryl Water Based.

- The ready-made non-aqueous materials tested:
  - Paraloid® B-72 Chips;
  - Kremer® Laropal® A-81.

An handmade palette was also produced mixing the following binders with four different brands of pigments: Ferrario®, Winsor & Newton®, Sennelier® and Kremer® pigments. The four different brands of powdered pigments were tested to see what kind of influence pigments (colour quality) and binders would have, as their refractive index, on a chromatic reintegration.

- The hand-made aqueous binders tested:
  - Methylcellulose;
  - Tri-Funori®;

- The hand-made non-aqueous binders tested:
  - MS2A®;
  - Regalrez® 1094;
  - Gustav Berger® O.F. PVA Medium;
  - Aquazol® 200.

The selection of materials for chromatic reintegration focused on the toxicity and quality of the visual properties that each one presented during chromatic reintegration. We also considered the original materials of the mock-ups, such as oil and acrylic emulsion and the compatibility of the new materials introduced during the process.

Materials and methods

The methodology used can be divided into four different work phases. Firstly, the mock-up paintings were created; secondly, the paintings were aged; thirdly, the paintings were reintegrated; fourthly, the paintings before and after the process were analysed and compared.

—Creation of the mock-ups and damage simulation

Mock-up paintings were created based on two oil and one acrylic original painting, represented in Figure 1. Selected specific areas were from each painting were selected and reproduced into the mock-ups the artist's atelier, using the artist's materials and having is supervision. After studying the artist's technique and materials, through in-person interviews and regular visits to his atelier, it was possible to understand his working methodology. The pictorial technique is characterised by thin lays of transparent paint over an opaque layer. Three linen canvases were used. The oil mock-ups were painted on a Royal Talens® preparation of titanium dioxide acrylic resin dispersion – Talens Gesso Primer 100, while the acrylic one was painted directly on linen.

Figure 1.- Jorge Martins. *O Jogo da História Trágico*…, 1970; Oil on linen canvas. 176,5 cm x 93 cm. 2: Jorge Martins. Light Out, 1975; Acrylic on linen canvas. 171 cm x 100 cm. Particular collection. Marta Aleixo©.

For the two oil models [represented in Figure 2 A], different colour mixtures were used. The light blue was painted with Sèvres Blue [PB15:4, PW4] from Rembrandt®, Royal Talens® and the deep blue was painted with a mixture composed by Idanthrene Blue, from Winsor & Newton® [PB69] plus Indigo [PB15:6, PB29, PBk9] and Titanium White [PW6], from Rembrandt®. The white line was painted with Titanium White [PW6], from Rembrandt®. In a second phase, a mixture of vernis à retoucher (composed by Medium Siccative Flemish, turpentine essence, raw and cooked linseed oils) and Cobalt Blue pigment [PB74] from Rembrandt® were applied on the light blue to create a layer of transparency different from the dark blue matte layer, not to protect the painting.

The acrylic mock-up [Figure 2 B] was painted with Cadmium Red Light [PR108] and Titanium White [PW6] from Winsor & Newton®, and painted directly on linen.

The next step was the simulation of abrasions with different dimensions and smudges, by using sandpaper and dirty, respectively.

— Artificial aging

The artificial aging was achieved by using a SunTest XXL + Atlas equipment using the ASTM D 4303-03 (ASTM, 2003) standard, as described in Table 1. The used settings were a radiation between 300nm-400nm, with an energy of 60,5W/m^2, an exposure time of 500 hours at constant 60º Celsius. Artificial and accelerated aging made possible the understanding of the changes the paintings go through over a certain period of time [as represented in Figure 3] allowing the comparison with the original works of the artist.

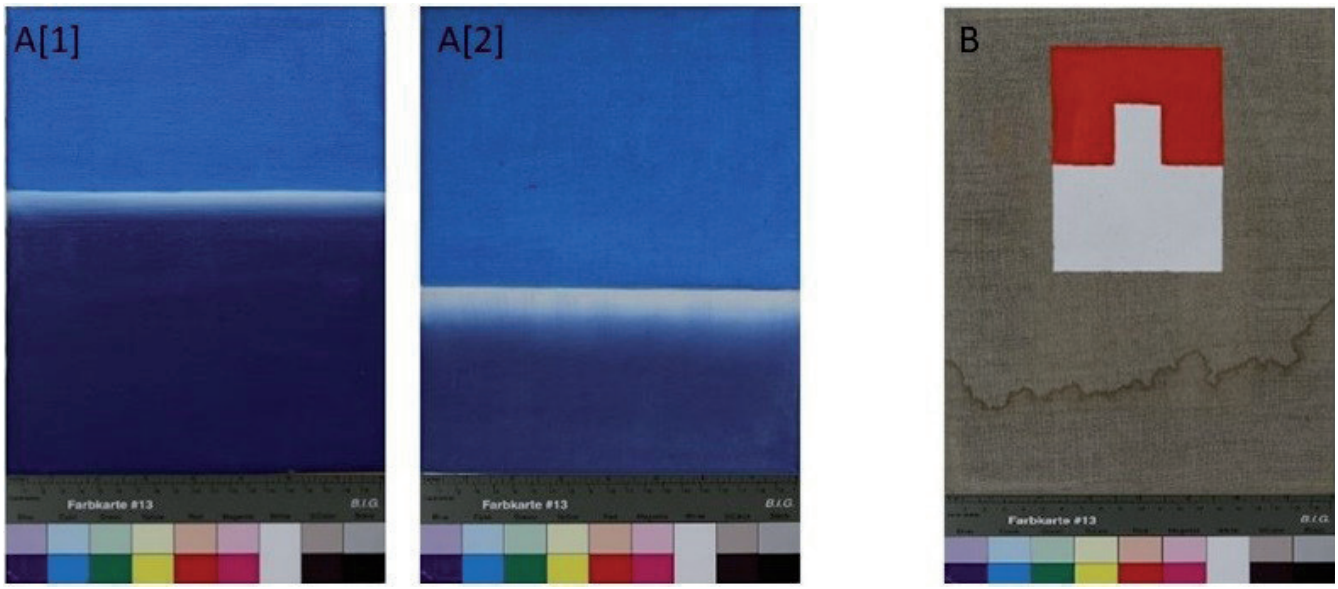

Figure 2.- A [1] and A [2] oil mock-ups; B acrylic mock-up. Marta Aleixo©.

Table 1.- Accelerated aging data.

Radiation	Energy	Exposition time	Temperature
300nm to 400nm	60, 5W/m^2	500 hours	60ºC

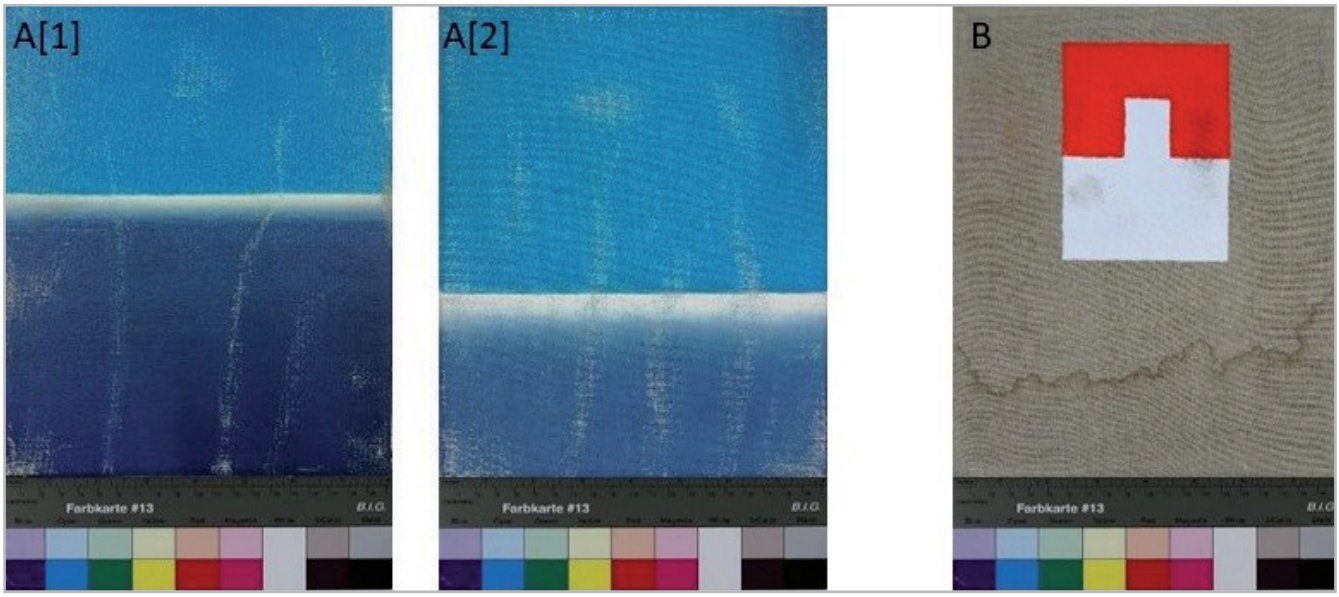

Figure 3.- A [1] and A [2] oil and B acrylic mock-ups, after damages and artificial aging. Marta Aleixo®.

— *Chromatic reintegration tests*

During this process, small samples with different materials were prepared. These chromatic reintegration tests were made in similar linen, prepared with primer and non-prepared [Figure 4]. The purpose was to understand which materials and colours could be used to reintegrate the common damages simulated and which ones were compatible and similar with the original chromatic layer of Jorge Martins' paintings and his pictorial technique.

Dry, aqueous and non-aqueous materials were tested [Figure 4, Table 2]. In the case of dry materials, PanPastel® *Artist' Pastels*, they can be applied by brush

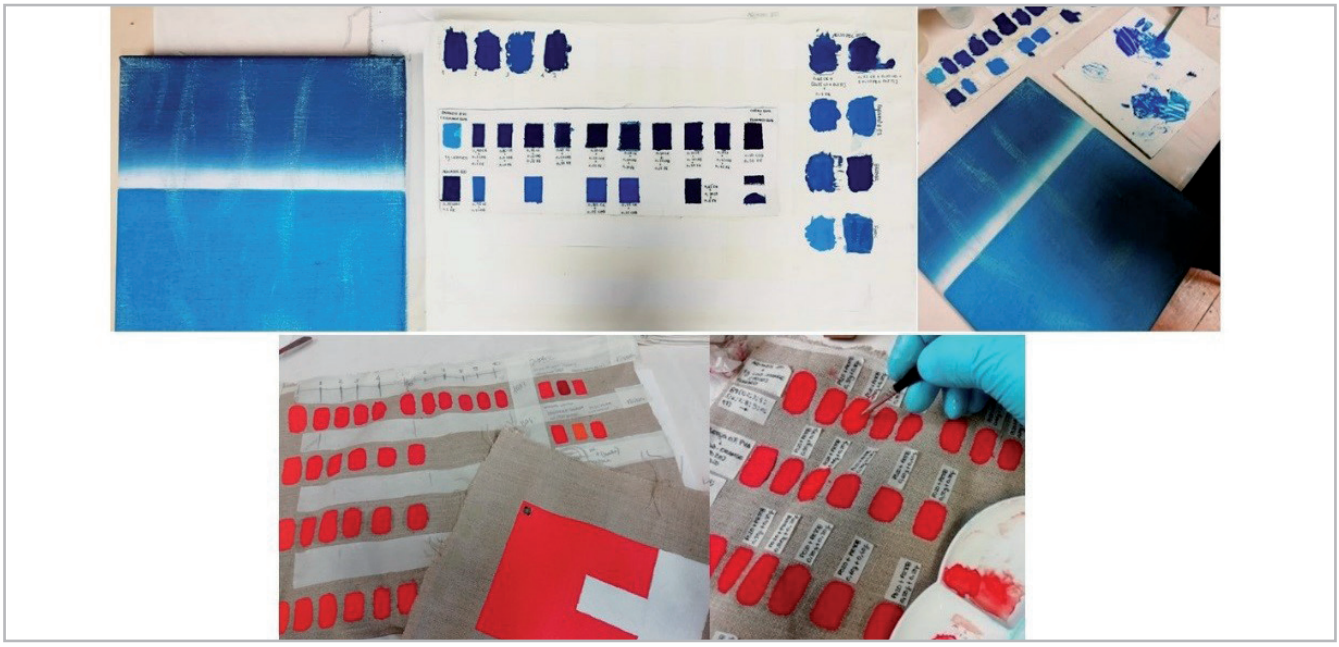

Figure 4.- Different samples made for A and B oil and acrylic mock-ups, respectively. Marta Aleixo©.

Table 2.- Chromatic reintegration materials tested.

DRY	AQUEOUS				NON-AQUEOUS	
	Watercolours	Gouaches	Acrylics	Binders	Readymade paints	Binders
Winsor & Newton® Watercolour Sticks	QoR® Watercolour	Winsor & Newton® Designers Gouache and Royal Talens®	Liquitex® Acrylic Markers Water Based	Methylcellulose	Kremer® Laropal® A-81	MS2A®
PanPastel® Artist' Pastels	Mr. Graham® Artists Watercolour	Guache Extra Fine Quality	Winsor & Newton® Professional Acrylic	Tri-Funori®	Paraloid® B-72 Chips	Regalrez®1094
	Schmincke Horodam® Aquarell		Lefranc & Bougeois® Acrylic FLASHE			Paraloid® B-72
	Winsor & Newton® Artists' Watercolours		Vallejo® Model Air Acryl Water Based			Gustav Berger® O.F. PVA Medium
			Interactive® Atelier Artists' Acrylic			Aquazol® 200

or with sponges, very was useful for matte surfaces and for pictorial techniques in which the artist uses the canvas as a compositional element. They can be used directly on the linen without damaging it and can be easily removable. The *Watercolors Sticks* presented some disadvantages because on the linen surfaces created non-uniform areas with some brighter than others.

About the ready-made aqueous materials [Table 2] the best results were obtained with watercolours and gouaches. They can be dissolved in water, which in comparison to the other solvents used in other materials tested minimises the risk of the solubility of the chromatic layer of the non-varnished paints and the risk of the toxicity. Examples of other solvents described in Table 2 are the non-aqueous handmade paints Kremer® Laropal A-8; the Paraloid® B-72 Chips, the binders MS2A®, Regalrez®, among others.

The opacity of the gouaches from Winsor & Newton® is a positive point compared to watercolours, which are more transparent and brilliant paints. Even considering the possibility of obtaining different degrees of paint dilution. Tests results showed that gouaches are very useful, in particular for bases during chromatic reintegration. They also require less overlapping colour layers, compared to hand-made binders Methylcellulose and Tri-Funori®. The quality of the paint resulting from these aqueous binders also depends on the quality and characteristics of the pigments and their preparation. However, Tri-Funori® presented better visual results when applied as a reintegration material on the representative mock-ups of the Martins' pictorial technique.

Both test and final chromatic reintegration of the mock-ups were made using the mimetic method. The chromatic reintegration was completed using small dots limited to the areas of abrasion (minimal intervention criteria) where the chromatic layer was absent. We executed the process with a fine brush *Winsor & Newton*® Finest Sable number 1. Before applying the final colour, white bases were reintegrated with PW6 *Titanium White* gouache paint. The sandpaper used to simulate the damage removed part of the chromatic layer and created a dark stain on the pictorial surface. Titanium White pigment allowed to tone the stains between the warp and weft threads.

The following criteria was also considered: material compatibility and reversibility.

The reintegration was performed in a laboratory environment under a light source with a CCT of 5500K (Kaiser Kit Studiolight E70) and with a 2,5× magnifying glasses (Optivisor®). Greys cards with 18% reflectivity were also used to reduce simultaneous contrast effect and better perceive the colours of the surrounding area to match (Bailão and Sustic, 2012).

The colour palette was chosen based on pigments originally used in the mock-ups build together with the artist. Observable colour properties were considered: brightness, opacity and lightness of the paint. The viscosity and the adhesion of the material to the substrate were also considered.

The solubility and the sensitivity of the surface to polar and non-polar solvents, both oils and acrylics, are always a problem. Due to the toxicity of the solvents, the aqueous materials were chosen.

The oil mock-ups shown on Figure 6 A [1] were first reintegrated with handmade paints using Tri-Funori® binder and Ferrario® pigments. Precise quantities of pigment were also used to create a colour similar to the original.

• Dark blue colour quantities:
  - 0,95g Cerulean Blue [PB35] + 0,5g Ferrario Blue [PB15] plus 0,5g Ultramarine [PB29] + 0,3g Organic Orange [PO13]

• Light blue colour quantities:
  - 0,95g Cerulean Blue and 0,5g Ferrario Blue [PB15]

However, the use of both mixtures, light and darker blue, was not always linear. Depending on the areas to be reintegrated, the colour adjustment was made with the addition of one of the pigments that make up the mixture. After a few days, the chromatic reintegration was removed by swabbing with cotton and water and reintegrated again with Winsor & Newton® Designers Gouaches, just like in mock-up A [2] [Figure 5]. The reason for this procedure was because of the behaviour of the pigment, which over time became powdery.

Considering the artist's pictorial technique and due to the dimension of the damages, the preparation layer was removed and a white base using the Winsor & Newton® Titanium White [PW6] pigment was applied. After a few moments of drying colour was applied.

To create the deep blue in mock-ups A [1 and 2], a mixture of Ultramarine [PB29] and Cerulean Blue [PB35] was used. During the chromatic reintegration, the matching of the colours in the darker areas of the chromatic layers of both mock-ups (A [1] and A [2]) was achieved by adding to the initial mixture the Ultramarine [PB29], the Cerulean Blue [PB35] and the Marigold Orange [PO73] pigments. The blue pigment Phthalocyanine [PB15] conferred the tinting power to the colour. The orange pigment Marigold Orange [PO73] decrease the saturation and darkened the blue tone obtained in the first mixture. The light blue was reintegrated with the initial mixture referred.

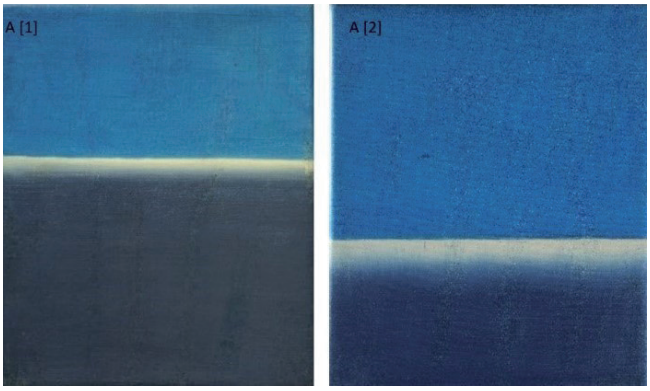

Figure 5.- Mock-ups A [1] and A [2], after chromatic reintegration. Marta Aleixo©.

The acrylic mock-up was reintegrated with the aqueous binder Tri-Funori® and Ferrario® pigments (Fig. 6), using the same methodology as the oils mock-ups. The red handmade paint, prepared at the laboratory was applied under a white Winsor & Newton® Designers Gouaches Titanium White [PW6] base. Titanium White [PW6] is an inert pigment with a high refractive index (between 2.3 to 2.65, depending on the purity of the pigment). It is the opaquest white pigment, with excellent coating and whiteness and therefore luminous (Mayer, 1993). The use of this pigment based, allowed to tone the darkest spots left by abrasions in the intervals of the linen.

Red paint was created with a specific mixture of Cadmium Yellow Orange [PO20] and Cadmium Red Light [PR108]. The quantity of the mixture was:

• Red colour quantity:
  - 0,80g Cadmium Yellow Orange [PO20] + 0,20g Cadmium Red Light [PR108]

After testing different mixtures, the one achieved was similar to the original, but light in colour [Figure 6 [1 and 2]]. This process was taken into account due to the very specific colour used by the artist Jorge Martins in his original acrylic canvas painting which was a mixture of Winsor and Newton® Artist's Acrylic with Cadmium Red Light [PR108]. This pigment colour will tend towards orange. The approximation to the tone and luminosity of the opaque inorganic pigment was achieved by a mixture of two colours. The adjustment could be made with either red or orange, depending on the pictorial area. Red was the basis of the original pigment, while orange, in greater quantities, added luminosity and brightness to the tone, allowing it to give a lighter colour during reintegration.

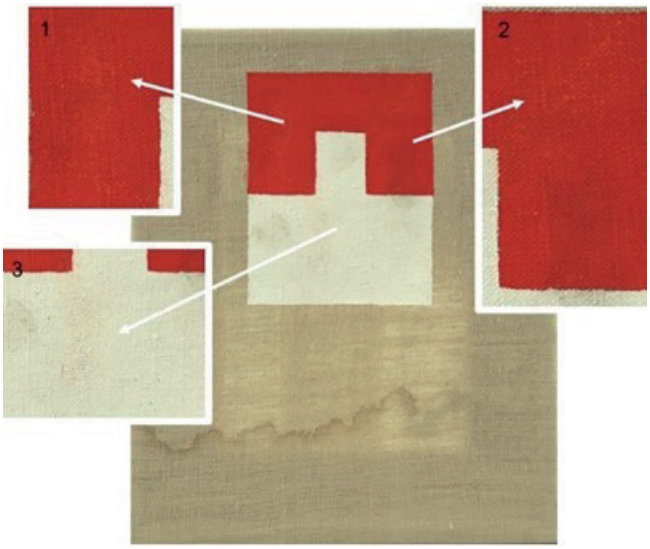

Figure 6.- Mock-up B after chromatic reintegration with hand-made aqueous binder Tri-Funori®. Mock-up B [1 and 2] representing the red area reintegrated with the mixture of Cadmium Yellow Orange [PO20] and Cadmium Red Light [PR108]. Mock-up B [3] represents the white area reintegrated with Titanium White [PW6] pigment. Marta Aleixo©.

Contrary to the chromatic reintegration's carried out primarily on the oil model A [1], those executed on the acrylic mock-ups didn't present any problem.

— *Hyperspectral Imaging System*

To better assess the chromatic changes that occurred the entire process, between the mock-ups creation, damage and aging simulation and posterior reintegration, the paintings were imaged using a hyperspectral imaging system. Hyperspectral images (Linhares and Nascimento, 2008) with spectral data from 400nm to 720nm in 10nm steps and 1024(V) × 1344(H) pixels were acquired and used to simulate the perceived colour of the mock-ups before and after damages, aging and reintegration. A white light source under 1850 lux was used to illuminate the paintings. The spectral channel was adjusted for the best exposure time in each acquisition. Illumination spatial non uniformities were compensated by imaging a uniform reference in the same position of the painting. Straylight and dark noise were also corrected during the retrieval of the reflectance. The acquired radiance was converted into reflectance by using a Munsell N7 reference with known reflectance, presented in the field of view of the HIS during the painting acquisition. CIELAB colour coordinates were estimated in each case assuming the CIEDE65 illuminant and the CIE 1931 Standard Observer. The colour differences between the mock-ups before and after reintegration was estimated assuming the CIEDE Euclidean distance in the CIELAB colour space between correspondent image pixels for correspondent colours, after image registration to account for different acquisition setups and different final images resulting from different times of acquisition. The frequency of the colour difference CIEDE was then estimated and assumed as the metric of chromatic similarity. The higher the frequency for lower CIEDE values, the higher the degree of similarity. Nevertheless, colour differences lower than 2.2 CIEDE were assumed to be undiscernible as described elsewhere for complex images (Aldaba, 2006).

Experimental results and discussion

The results of the tested materials showed that of all materials analysed and observed [Table 2], it was the readymade paints Winsor & Newton® Designers Gouaches and the handmade paints created using Tri-Funori® and the Ferrario® pigments that presented the best visual results. They were the ones that best suited the artist's pictorial technique, based on chromatic effects.

These results were directly reflected in the quality of the colour achieved by comparison to the original colour of the pictorial layer in the mock-ups already aged. Even though the chromatic layer became less saturated and the abrasions and stains became more visible.

During the making of the oil paints mock-ups, its monochromatic surfaces and colour transitions were explored and a semi-glossy surface was observed overall. The reintegration of the abrasions on this surface with Winsor & Newton® Designers Gouaches was done by executing small dots of paint with a fine brush. The final result enabled the viewing of the paintings close to the original reading of the works [Figure 7]. Only mock-up A [1] was submitted to artificial aging (see Figure 7, painting A [1]), but then it was possible to adapt the colour mixtures used in the aged A [2] mock-up. However, it is easily possible to identify some of the reintegrated areas [Figure 8].

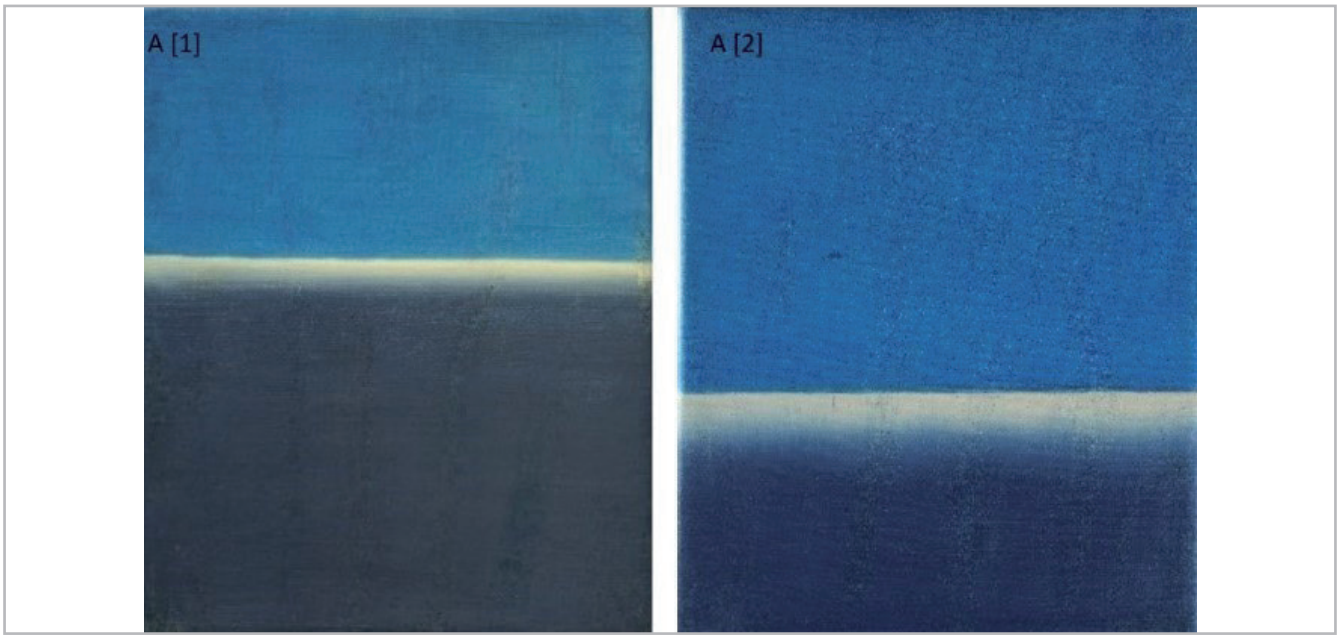

Figure 7.- Mock-ups A [1] and A [2], respectively, after chromatic reintegration with Winsor & Newton®.

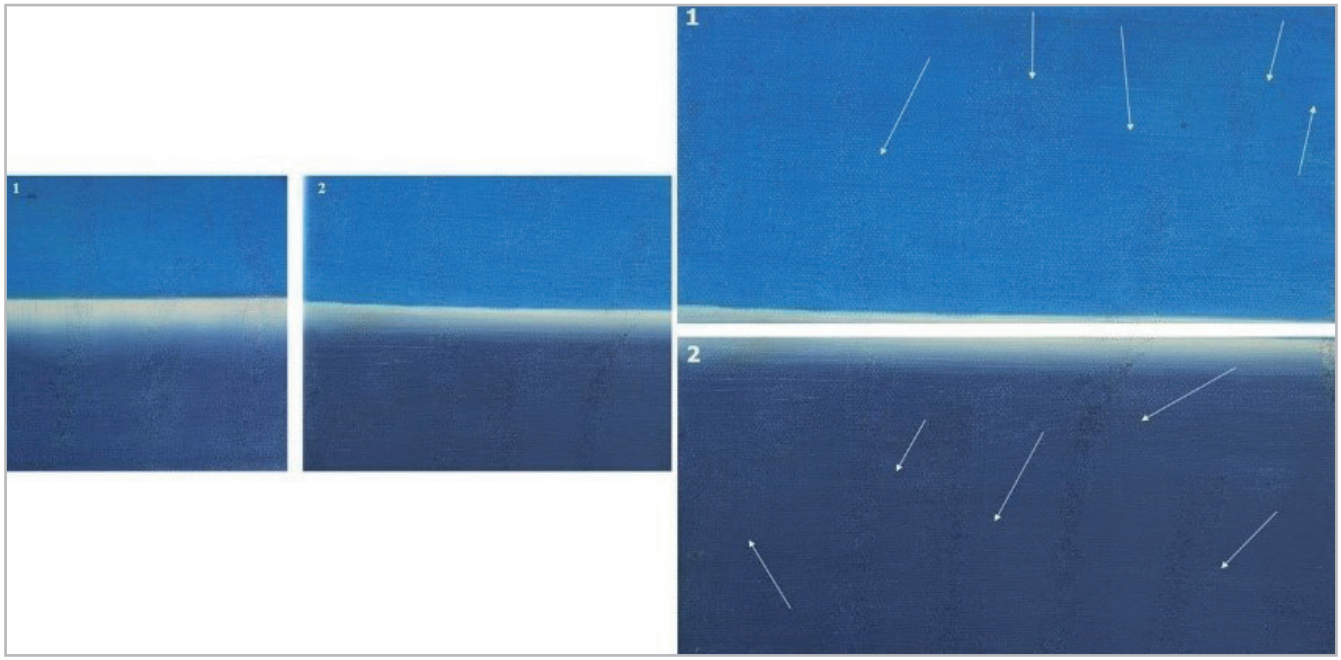

Figure 8.- Detailed areas of mock-ups A [1 and 2]. 1: Mock-up A [1] after chromatic reintegration. 2: Mock-up A [2] after chromatic reintegration. The arrows identify the reintegrated areas. Marta Aleixo©.

For the reintegration of the colour to achieve the final result, the paint couldn't be applied too diluted. For a correct adjustment of the application of this paint, two or three layers of colour were applied, depending on the area and on the slightly diluted white base previously applied.

When analysing the distribution of the frequency of the CIEDE chromatic differences before and after the interventions, it was considered that a CIEDE higher than 2.2 indicated differences perceived by the human eye.

When using the mimetic method, it was found that most interventions are detectable, as the CIEDE was more frequent around 7 on mock-up A [1] and around 12 on mock-up A [2] (see Figure 7 and Figure 9). However, they don't cause discomfort when observing the work since the colour errors obtained by hyperspectral imaging in total painting.

In the case of the acrylic model, the damage result was different. The chromatic layer formed by this material is less glossy than the one formed by oil and the original paint was directly applied to the support. Thus, the handmade aqueous binder Tri-Funori® was the choice that offered the best visual results. Similar to gouaches, two or three layers were needed to cover the totality of the damages, using the pigments Cadmium Yellow Orange [PO20], Cadmium

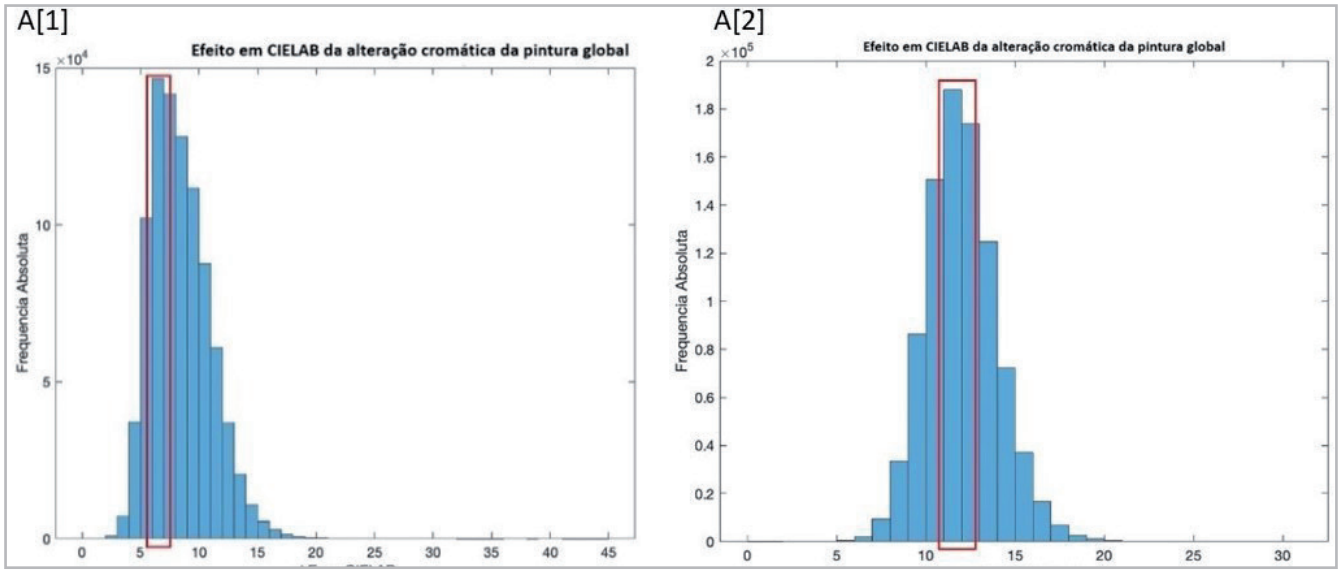

Figure 9.- A [1] and A [2] frequency of CIEDE in CIELAB estimated for paintings before and after damages, aging and interventions.

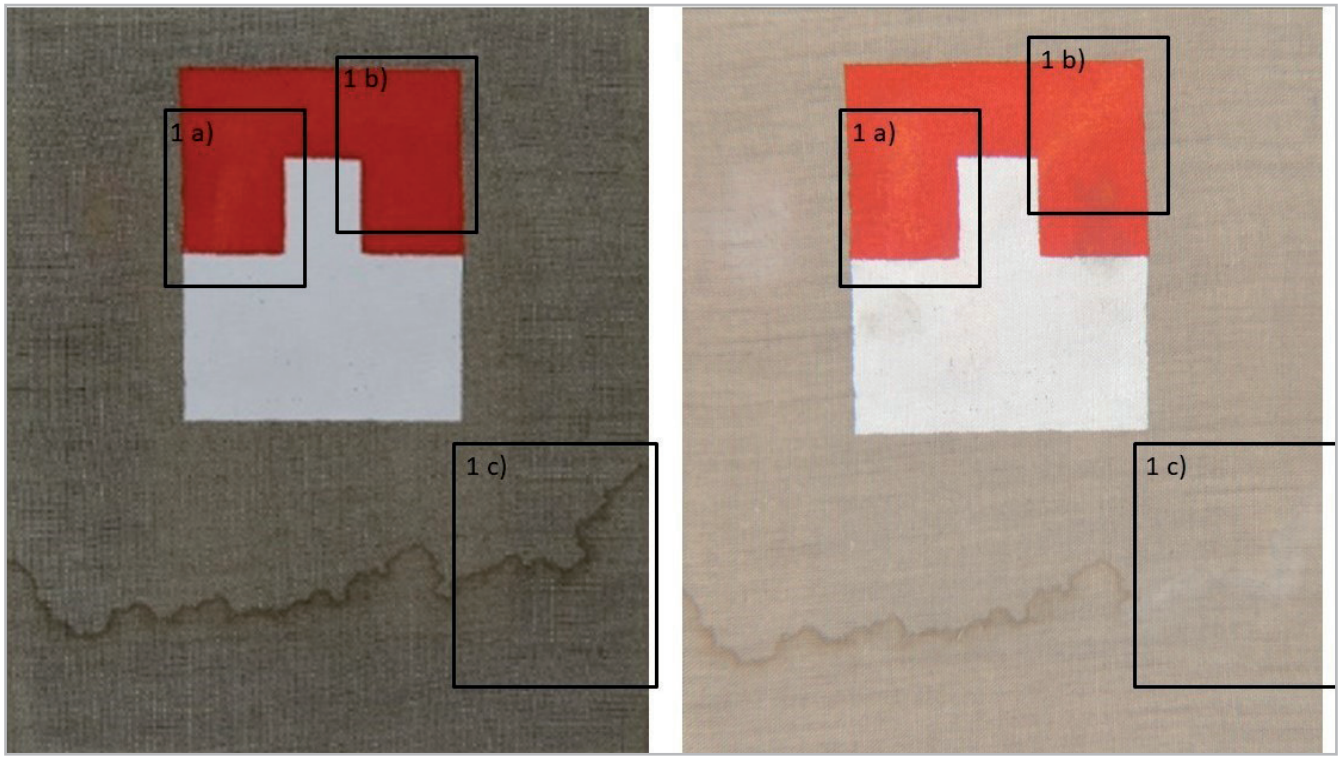

Figure 10.- Mock-up B with areas signalled before (left) and after (right) aging and chromatic reintegration. Marta Aleixo©.

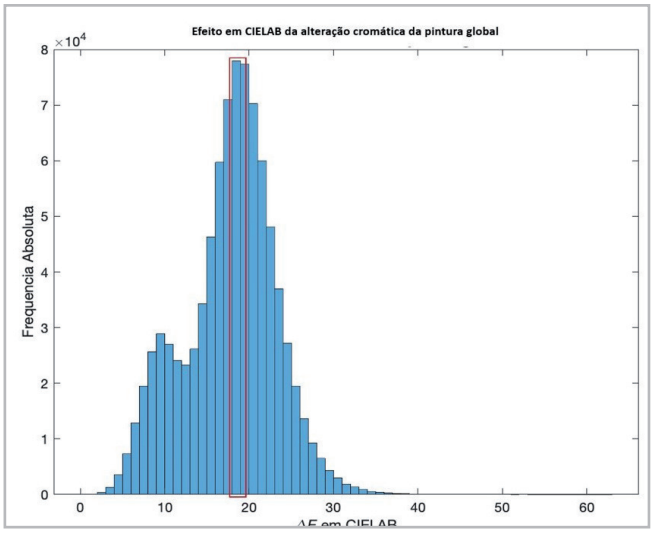

Figure 11.- Frequency of CIEDE in CIELAB estimated for paintings before and after damages, aging and intervention for mock-up B.

Red Light [PR108] and Titanium White [PW6]. These pigments had a good coating/hiding power – contrary to the situation observed in the first phase of chromatic reintegration with the same binder in mock-up A [1]. On mock-up B only synthetic Ferrario® pigments were used. During the paint preparation process, the dispersion was good and the results was a matte layer. For this reason, the areas where the paint was applied were observed in the mock-ups. Mock-up B [Figure 10] identifies the areas with the visible differences between before and after the colour intervention.

In mock-up A [1], organic pigments and synthetic pigments were used. The mixture of both and the weak dispersion of organic pigments in the water used in the preparation of Tri-Funori® influenced not only the paint itself but also the final results of the chromatic reintegration.

The results of estimating the chromatic differences for mock-up B, showed a distribution of the frequency of the chromatic errors different from mock-up A, but also indicating that the indifferences were distinguishable. In the case of the acrylic model B, the distribution of the frequency of the CIEDE, when comparing the paintings before and after the interventions, was more frequent around 18, as represented in Figure11.

Conclusions

The materials studied and analysed are quite different from each other. They enable differentiated solutions and visual results according to the problem presented by the damage and the specific characteristics of the chromatic layer.

Considering the pictorial technique of the painter Jorge Martins, studied during the construction of the mock-ups, the most suitable chromatic reintegration method to apply to the paintings was assumed to be the mimetic through small dots. Nevertheless, no other techniques of colour reintegration were tested. It was found that the best chromatic reintegration materials were the aqueous ones, in particular the ready-made watercolours Winsor and Newton® Designers Gouaches and the hand-made aqueous binder Tri-Funori® using Ferrario® pigments.

Jorge Martins does not varnish his paintings with a final protective layer of varnish. In these situations, changes to the chromatic layer become one of the biggest concerns. As they are affected by damages such as abrasions or dirt stains, the coloured areas become more complex to reintegrate and the selection of materials and their compatibility becomes more difficult.

Of the materials presented, the aqueous ones, specifically the watercolours and the Tri-Funori binder, were the ones that showed visual results closer to the desired ones. They are also materials that needs water-like solvents to be removable, which causes less damages to the painting, the conservator-restorer and the environment.

Acquiring the spectral information of a painting before and after the intervention enables precise chromatic comparisons and quantifications of the colour differences associated with human chromatic perceptual differences. This quantification of the CIEDE colour differences associated with a visual perception suggests the use of hyperspectral imaging as a useful tool that allow you to monitor the colour change process of a chromatic layer during certain treatment phases.

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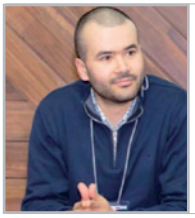

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