Damages caused by pressure sensitive tapes on paper artwork from the early 20th century

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ABSTRACT: The use of pressure sensitive tapes (PST) on paper documents and artworks represents one of the most complex issues for the conservation and restoration fields. This paper presents and discusses some examples of damages caused by the PST presence on a 20th century drawing collection from Fábrica Constância, nowadays belonging to the National Museum of Azulejo (MNAz). This work constitutes a first step towards a systematic identification and classification of damage caused by PST use on Fábrica Constância drawing's collection.

1. INTRODUCTION

Pressure sensitive tapes (PST) appeared by the end of the 19th century and their potential use in a multitude of applications soon turn them into a convenience for conservators. Unfortunately, for that reason, PST were too often employed on artworks as a primary solution for fixation of loose parts, tear mends and picture framing, among others. Despite their ephemeral nature, only by the end of the 20th century PST lack of long-term stability started to raise conservation concerns on their removability and long-term negative effects, especially on cultural heritage items (O'Loughlin 2001).

PST consist, in general, of an adhesive layer of natural or synthetic rubber or an acrylic polymer, and a carrier. This last element can include a variety of materials, namely foil crepe paper, cellophane, cellulose acetate and plasticized polyvinyl chloride. Apart from polymers, the plastic backings may also contain softeners, antioxidants, plasticizers and curing agents (Smith, et al. 1984, Blaxland 1994).

1.1. PST and Cultural Heritage

Despite the wide range and variety of damage caused by PST on cultural heritage, graphic documents, and particularly books and paper materials, are among those more prone to physical and chemical alterations by PST's aging due to their fragile nature. Several factors, intrinsic to the materials themselves, can contribute to this damage. The nature and quality of paper supports, which widely vary from excellent, on early hand-made papers, made solely from rags of worn linen and cotton clothing or rope and nets, to highly unstable groundwood papers, on modern times, are one of them. Moreover, other components added to improve their mechanical and aesthetic properties, like sizing, which decreases the absorbency of paper, coatings and fillers to increase strength and pliability, or even dyestuff, to alter the aesthetic appearance, worsen the situation by adding complexity to the interaction of paper supports with PST (O'Loughlin 2001, Gorassini, et al. 2016).

The practice of climate control is a relatively recent issue in museums, libraries and archives; being so, PST used in paper supports have aged naturally under unknown, and surely not controlled conditions. The damage patterns observed nowadays include colour alteration to darker and yellowish hues, shrinkage and tension creases. Moreover, when PST loses adhesion and the carrier comes loose, disfiguring dark stains can frequently be observed.

PST removal is considered one of the most demanding processes in conservation work. It can be complex or eventually precluded when the application of PST occurred over media such as ballpoint pen or typewriter inks, which can become solvated by the tackifiers and/or the plasticizer present in the tapes; or over pastel or graphite media,

composed of small particles that can be absorbed by tapes prone to cold flow (O'Loughlin 2001). Therefore, to determine the most suitable tape and stain removal methodologies, or to improve the existing ones, the first step should always consist on an accurate identification of the aged PST through a systematic assessment of the object and PST condition and their morphologic characteristics. This can be achieved by visual examination, along with photographic registration under different types of illumination schemes.

1.2. The Preparatory Drawings

According to Kurlansky (2016), drawing only achieved the status of a standard art form when paper became easily available. This happened during the Renaissance period, when the European population became increasingly interested in paper. Parchment was previously used for drawing, but in a scarce and non-systematic way because it was too expensive and too difficult to erase. At first, paper was also too expensive to be used to dash off a quick sketch but, simultaneously, it had a too low standing for serious art. By the late 15th century, a strong increase was felt in the cultivation of flax and hemp, used to produce linen and ropes, and consequently more rags were available for papermaking. The widespread availability of paper allowed the artists to freely sketch and play with the ideas before the final production of the artistic object. The use of preparatory drawings and studies as a structural factor for the final work is one of the main methodologies followed since the classical period and consequently, for the past six centuries, studying art has meant to work on paper and to learn how to draw (Kurlansky 2016, Arruda 2005).

A countless number of drawings of a wide variety of categories can nowadays be found in the collections housed in museums and other cultural institutions. Despite some relevant works of art from a specific author or epoch, the majority are preparatory drawings and sketches, frequently unfinished, and not always appreciated on their artistic value or considered as heritage. This is probably one of the reasons why it is recurrent to find them in poorly preserved state, damaged or rudimentary restored, and presenting PST to fix the support, especially when oversized.

2. EXPERIMENTAL

Six technical drawings (sample 5, 13, 14, 15, S4 and S5) from the early 20th century, belonging to Fábrica Constância and nowadays in the National Museum of Azulejo (MNAz) collection, were selected for this study. These drawings were made in different paper supports and media. Sample 5 is a fragmented corner of a pencil drawing, made from a white, machine–made, vellum paper; samples 13 and 14 are small sized preparatory drawings, drawn with graphite pencil and blue and red inks on white, machine-made, tracing papers; sample 15 is a piece from a black ink drawing on a very thin, white, machine-made paper; sample S4 is part of an oversized preparatory painted drawing, on a brown, rough, textured, machine-made Kraft paper; sample S5 is a piece from a graphite drawing, drawn in two, lighter brown, thinner and smooth textured Kraft paper leaves, attached by PST to a second support of white, thick, machine-made paper.

From this initial group of six samples, two (14 and S4) were selected for exemplifying the most frequent damages caused by PST's use while the other four underwent a more complete characterization scheme.

Visual examination of the samples was first conducted by the naked eye under normal daylight conditions to establish the physical description of the items and their pathologies. A detailed inspection with macro-photographic imaging, using a Nikon D3100 digital camera SWM ED IF Aspherical Micro 1:1 Ø 62 was carried out. Detailed inspection of the items was also carried out with optical microscopy (OM), with the help of a portable digital microscope Dino-Lite®, model AM413T-FVW, using visible light and UV radiation [four white and four UV (400 nm) light-emitting diode lights]. Colorimetric studies (L*, a* and, b* - CIE Lab space defined by *Commission International de l'Éclairage* in 1976) were performed on both the unstained paper supports and stained areas with a *Datacolor International Mercury* portable spectrophotometer. The spectrometer was equipped with a Xenon lamp and a photodiode sensitive to the 360 to 750 nm spectral range. Black and white standards were used for calibration. Illuminated CIE D65; 10º of observation angle and specular component excluded. Analyses were performed on three different points of each sample, with the average value used for data interpretation.

3. RESULTS

The main types of PST's damages observed in this collection are presented in Figure 1. They include darkening of PST's carriers with consequent visual in-terference with the drawing (a - d); tension creases, due to PST's physical shrinking of the carriers (b, d); loose carriers, that lead to drawing detachment from the second support or passe-partout (c); and a solvated effect on the drawing/writing mediums (b, d) due to PST adhesive and its components, such as plasticizers, stabilizers etc.

In cases such as that exemplified on sample S4 (Fig.1a), where PST with a good grasp was placed over a layer of gouache pigments, the attempt to remove the PST would most certainly result in further damage to the drawing, since it will lead to medium loss and superficial abrasion of the paper support.

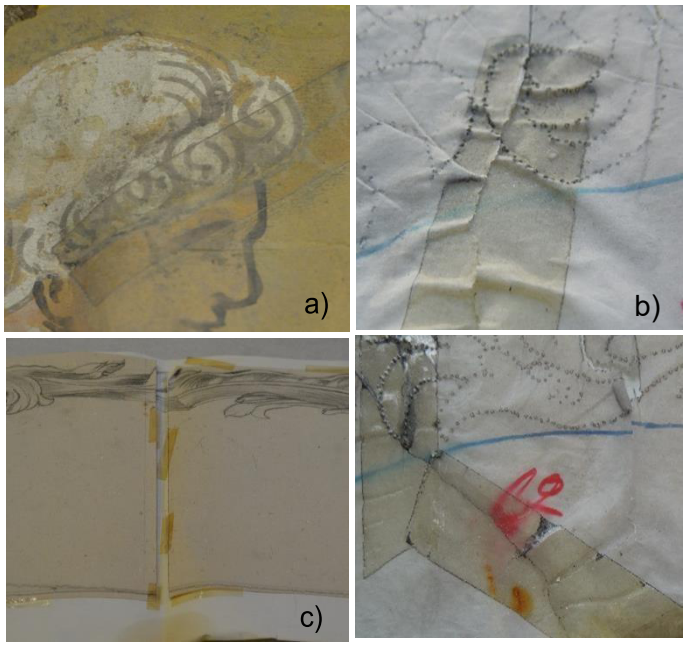


Figure 1. Examples of PST damages on paper drawings: a) sample S4 - tape disfigurement b) sample 14 - tension creases c) sample S5 - aged tapes, with loose carriers and dark obstructing stains d) sample 13 - tape yellowing and medium solvated.

Macro-photographic images under racking and transmitted light, and digital imaging under visible and UV radiation at ×48 are presented in Table 1 and Table 2, respectively. Reflected light imaging showed a heavy layer of PST adhesive's residue on the surface of samples 5, 15 and S5 and dirt adhered to the limits of those areas. Comparing to the imaging with transmitted light, the main physical alteration was an accentuated variation on papers translucency. As expected for the cellulose supports, in most of the cases, the PST stained areas presented a higher translucency, not always homogenous, but directly dependent on the amount of residue present (sample 15 and the stained area on the secondary, white paper of sample S5). In contrast, the adhesive stains on thicker, mechanical-made, heavier sized, vellum papers, showed a decrease of the paper's translucency (represented on sample 5 and on the first support of sample S5).

Digital imaging with reflected light showed the smoothness of the surface texture of the stained area and despite the apparent loss of tackiness, it was still possible to observe some spots with a glowing aspect on both papers supports on sample S5.

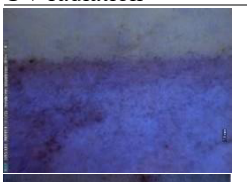
Fluorescence under UV radiation (Table 2) allowed visualizing differentiation between the stained and unstained areas. The bright yellowish colour observed on the stains can be associated to an organic origin, probably a gum, while the unstained paper supports present no fluorescence and reflect the blue hues.

Fluorescence was brighter on sample 5 and 15. The PST adhesive stains presented a brighter yellow tone on the first, while fluorescence appeared darker yellow on the latter. This can be explained due to a heavier amount of adhesive residue layer of a different origin. In sample S5 the same adhesive residue is present on both supports. On the upper support, a brown, thicker vellum paper, the adhesive stained areas showed no fluorescence unlike the stained areas on the support beneath this one that showed a bright yellow fluorescence.

Table 1. Macro-photography under racking and transmitted light.

SAMPLES	Racking light	Transmitted light
5		
13		
15		
S5		

Table 2. Digital imaging with a Dino-Lite®, under visible reflected light and UV radiation.

SAMPLES	Visible light	UV radiation
5		
13		
15		
S5		

The colorimetric studies confirmed that in overall, independently of the type of support or amount of PST adhesive residue, the stained areas registered an accentuated loss of luminosity when compared with the unstained paper support (Fig. 2). These variations were particularly notorious on the vellum papers

where the darkening caused by the adhesive can be easily observed (Table 3).

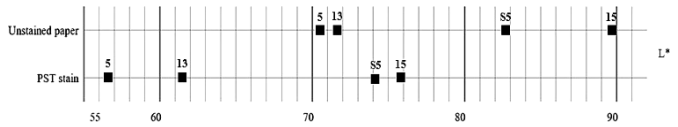


Figure 2. Schematic representation of L* parameter variation on the colorimetric study of unstained paper and PST stain areas of samples 5, 13, 15, S5.

Table 3. Colorimetrical value variation of parameter L*.

Samples	Unstained paper	PST stains	Δ L*
5	70,12	56,41	13,71
13	71,12	61,33	9,79
15	89,97	75,36	14,61
S5	82,73	74,33	8,4

4. CONCLUSIONS

Four samples of a group of six drawings from Fábrica Constância and nowadays belonging to the National Museum of Azulejo collection were studied. The aim was to evaluate the damage caused by PST use, based on morphological and colorimetric aspects.

PST stained areas presented a dark aspect, common to all the drawings studied. Other observed feature was the general increase of translucency on the stained areas. The exceptions were detected on thicker, mechanical-made, heaver sized, vellum paper supports, where translucency decreased, even when there was a high amount of adhesive residue.

Digital imaging under UV radiation allowed demarcating more consistently the adhesive stained areas due to fluorescence colour and hue degrees. Brighter colours were observed in those cases where the adhesive has not completely lost its tack properties.

5. REFERENCES

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