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Cleaning techniques: presentation of a case study of capillary washing at the Universidade Federal de Pelotas, Brazil

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Submitted: February 19, 2021
Accepted: May 17, 2021

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Abstract
The article presents a case study of an aqueous capillary washing procedure applied to an engraving, based on the materials and techniques presented in the International Course on Paper Conservation in Latin America: Meeting East. These contents, included in the Paper conservation subject of the Advanced course on cultural property conservation and restoration at the Universidade Federal de Pelotas, located in Brazil, were carried out by students, under guidance, in an experimentation and learning process. After a brief discussion on the principles of capillary washing and on the non-woven fabric Sontara® PrintMaster, the steps to create the capillary washing system and the results achieved are shown in the conclusions, highlighting some issues related to the modifications made to the system to achieve better results, the validity of the use of Sontara® PrintMaster non-woven fabric and deionized water in works on paper conservation procedures in Brazil.

Keywords
Conservation; aqueous cleaning; capillary system; works on paper; Sontara® PrintMaster.

This article develops the case study of a cleaning procedure applied to an engraving using a material called Sontara® PrintMaster, both seen at the International Course on Paper Conservation in Latin America: Meeting East, in which the author assisted in 2012. Some of the contents of the course were integrated into the Paper conservation subject of the Advanced course on cultural property conservation and restoration at the Universidade Federal de Pelotas (UFPel), Brazil.[1]

[1] In the last decade, progress has been made in the implementation of the training of Brazilian conservators in public institutions of higher education. In the course at the UFPel, which began its activities in 2008, students are trained to conserve and restore paintings and works on wood as well as on paper. Works on paper are addressed in two-semester courses, one more focused on conservation and the second on restoration practices. All activities and projects related to the subjects are carried out in the Paper conservation laboratory.

In fact, the International Course on Paper Conservation in Latin America: Meeting East allowed a different vision on cultural heritage conservation, especially the search and application of alternative materials and a closer look at the Japanese papers used by paper conservators in Brazil. In addition, a discussion on the preparation and application of wheat starch paste was incorporated into the course contents since this traditional adhesive is still little used by Brazilian professionals.

From the perspective of the use of new materials, the case study presents an experimentation and learning process with the participation of students who carried out, under guidance, an aqueous cleaning to an engraving by using Sontara® PrintMaster non-woven fabric, and applying the capillary system.

Sontara® Print Master is a non-woven fabric manufactured by the Dupont™ company, it was created to be a cleaning cloth for equipment in the printing industry. Its production is done through a hydroentanglement process, in which polyester, viscose, or cellulose fibers are consolidated by high-pressure water jets without the use of chemical additives or adhesives to keep the fibers together. According to the manufacturer, the result is a fabric with purity, softness, strength, high capacity, and speed of liquid absorption (Metalgamica, 2021). These characteristics make it an interesting material for use in some document conservation procedures, such as aqueous cleaning.

Immersion in a bath with the use of water or combined with other solvents, enzymes, surfactants, etc., is a common procedure in the works on paper conservation and can be applied independently or before other treatments, such as, for example, deacidification. In general, it is an important procedure that can be beneficial for documents, especially with the removal of degradation products resulting from aging processes in some papers. However, there are also risks in the process, such as the possibility of solubilization of inks and beneficial substances present in the paper, such as calcium and magnesium salts, alterations in the microstructure of the paper, tearing and modification of the dimensions and the texture (Book and Paper Group Wiki and American Institute for Conservation, 2021). Therefore, the decision to apply aqueous cleanings should be carefully evaluated, always seeking to apply less invasive and less risky treatments.

Among the available methods, aqueous cleaning that uses a capillary system presented in the case study is recommended for works and documents that are sensitive to water or that are too fragile to be subjected to the usual bath immersions.

Analyzing different aqueous cleaning processes on water-sensitive paper based objects, Schalky *et al.* (2011) discuss the treatment employing the capillary system with the non-woven fabric Paraprint OL60,[2] which had been previously developed and reported by Susanne Kirchner. This system uses the force of water capillarity, a natural phenomenon that causes water to rise through a capillary tube or by contact with other absorbent materials. The work under treatment is moistened and placed on an absorbent material soaked in water, which has its corners submerged in two water containers placed at different heights. That way, a system of communicating vessels is created where the water moves continuously from one end of the absorbent material to the other and the solutes that migrate from the paper to the absorbent material are actively transported out

[2] Paraprint OL60 is a non-woven fabric manufactured by Lohman Vliesstoffe GmbH & Co. KG for medical and filtration purposes. Its composition is 100% viscose consolidated with resin. Characteristics such as strong capillary action, high diffusion rate, high wet strength, and physical stability make this material very interesting for use in conservation (Huhsmann and Hähner, 2007).

of the system. That is, in what has been called capillary washing, the transfer of the material is also by diffusion and convection, in which, initially, the degradation products move from the interior to the surface of the cellulose fiber, then towards the surface of the paper and finally into the water in the container.

When the capillary system is applied in the conservation of documents and works on paper makes it possible, for example, to extract unwanted elements through dissolution, filtration, and the introduction of beneficial compounds for the paper.

The case study describes its application in the aqueous cleaning of an engraving. The following data shows the description of the work that received the treatment, as well as the stages of capillary washing, and the adaptations made to achieve better results. In the end, a reflection is made on the results and on aspects that can be further investigated.

Presentation of the case study

Data and characteristics of the work

The work in question is a heliographic printing with the reproduction of a painting by Carlo Dolci titled *Mater Dolorosa*. The print was made on modern paper, dating nearly to the 1930s. It is a medium-sized engraving, measuring 64.5 cm X 47.5 cm, and has a grammage of 240 gr/m2.

Figure 1. Image of the work before cleaning. Heliographic printing titled *Mater Dolorosa*. *Image: ©Isis Fófano Gama, 2019.*

Before the cleaning treatment, the work went through the usual stages carried out in the Paper conservation laboratory, such as solubility tests, water absorption, pH measurement, and examinations with direct, raking, transmitted, and ultraviolet light. Cleaning with rubber powder and brushes preceded the aqueous cleaning. Subsequently, the deacidification, resizing, infills, inpating, and, finally, conditioning were carried out.

The work was considered in good condition, although with some damage, such as dirt, water stains, folds, creases, adhesives, among others. The test result indicated that the pH was close to 5.

The decision to apply an aqueous treatment was justified by the possibility of raising the pH of the work, reducing water stains, and attenuating the darkening of the image. It was decided to do the cleaning by the capillary system to apply a more passive technique with less risk to the work.

Execution of the cleaning treatment

The cleaning was done using the capillary system that uses the principle of communicating vessels, in which an absorbent material is placed between two containers with water, positioned at different heights. A stream of water is then formed, which moves from one container to the other, slowly and gradually, allowing a safe cleaning process for the work. Figure 2 shows the usual system scheme for this type of cleaning.

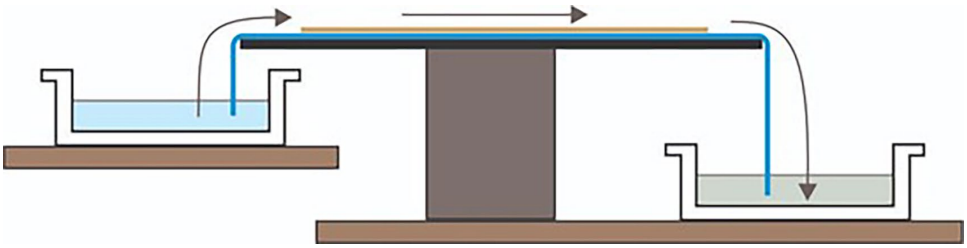

Figure 2. Drawing of the usual scheme of the capillary washing system. *Made by: ©Otavio Oliveira Boszczovski, 2019.*

Before carrying out the cleaning in the work, a similar engraving was tested with the system shown in figure 2, however, the results were not very effective, especially concerning the water flow. It was then decided to make some modifications, which were applied in the treatment of the work presented in this case study.

Figure 3 shows the system used with the defined adaptations, i.e., with the first water container in a much higher position. This created a much more inclined plane, which probably resulted in a greater action of gravity, facilitating the passage of water.

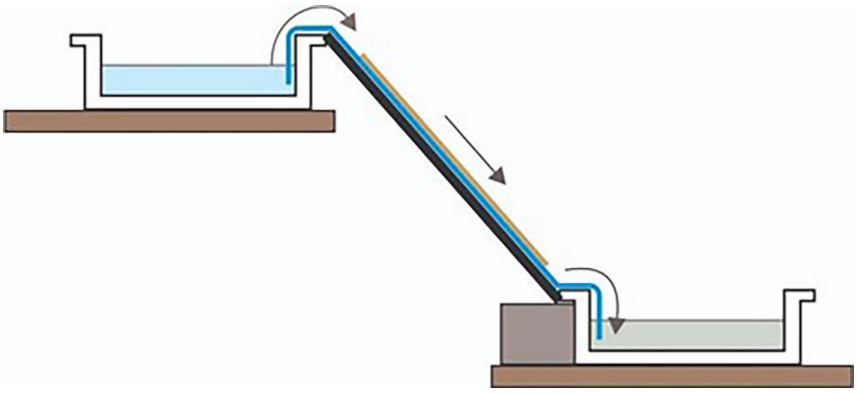

Figure 3. Drawing of the scheme of the alteration made in the capillary washing system.
Made by: ©Otavio Oliveira Boszczovski, 2019.

The Sontara® PrintMaster, used as the absorbent and conductive material, was placed on a rigid, wetted support. The work was then also spray-dampened and placed on the Sontara® PrintMaster on the inclined plane. It should be noted that the size of the work, the type of paper, and its grammage allowed the work to remain stabilized on the most inclined plane.

The Sontara® PrintMaster was positioned with both ends up in the water containers. This formed the system that allows the water to move slowly through the absorbent material and the work, carrying away the paper degradation products.

Deionized water was used in this procedure, which is generally used in conservation laboratories in Brazil since tap water often contains chlorine and possible impurities.

Figure 4. The work *Mater Dolorosa* in aqueous capillary washing treatment.
Image: ©Isis Fófano Gama, 2019.

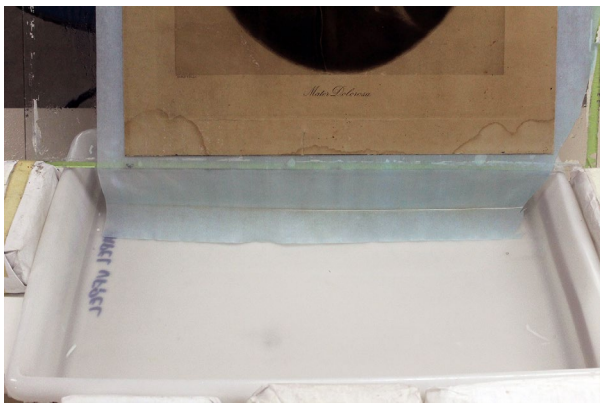

Figure 5. Details of the water stains are quite evident at the beginning of treatment.
Image: ©Isis Fófano Gama, 2019.

The cleaning lasted about three hours, keeping the item continuously wet through the application of water by spraying. In the end, deacidification was done with the application of calcium hydroxide solution. After drying, plane correction along with support and image reintegration procedures were carried out.

Results

A significant decrease in the yellowish tones of the engraving and a consistent reduction of water stains were observed. Therefore, it was verified that the application of capillary washing was efficient in removing or reducing harmful components that were in the work. The alteration of the pH was achieved, which was initially at 5 and, at the end of the treatment, was measured at around 7, which is the result of the cleaning process, as well as the deacidification applied at the end. Compared to other cleaning techniques used in the treatment of works on paper, it was considered that greater control of the process was achieved with a reduction of risks for the work.

Figura 6. Image of the work after capillary washing in the *Mater Dolorosa*.
Image: ©Isis Fófano Gama, 2019.

Conclusions

Based on the practical activity of an academic subject, the case study fulfilled the objective of favoring a significant experience for the training of students through the execution of an important procedure for the conservation of works on paper.

Some aspects should be pointed out regarding the modifications made to the capillary system treatment, the use of Sontara® PrintMaster, and deionized water.

As shown above, a first attempt of the procedure was made keeping the work on the absorbent support in a horizontal plane, because the results were not satisfactory, then a modification was made by significantly increasing the inclination of the system and, in this way, a good water flow was obtained, which accelerated the cleaning process. Since none of the other components of the capillary system of the process were altered, it is understood that this factor was fundamental for the optimal results obtained. Schalky *et al.* (2011) report that, in the study by Kirchner, the inclination of the capillary system was considered an important factor and, after investigating the effects of angle variations, she recommended an inclination of 2°. However, Schalky *et al.* (2011), in further analysis of the transport mechanisms occurring in the capillary system, argue that inclination is not a factor that should be considered. This is an interesting discussion that deserves to be better evaluated through other experiments.

Sontara® PrintMaster was considered an important material for the results achieved, especially for its capacity and speed of absorption of liquids. In addition, it is a relatively accessible material in Brazil, especially in comparison with Paraprint OL60, which needs to be imported, implying higher costs. This does not exclude other non-woven fabrics that can and should be tested and evaluated for use in these cleaning systems.

It is also deemed necessary to evaluate the use of deionized water. As already mentioned, in general, deionized water is used in Brazil due to the quality problems of tap water. It is recognized that its high capacity to carry away free ions present in water may have been an important factor for the results obtained in this case study, however, the fact that deionized water can carry away also other beneficial substances from the paper should be considered. Thus, the quality and characteristics of the water used in conservation procedures should be better evaluated by experts in the field in Brazil.

Finally, it is recognized that the case study has limitations since other factors may interfere with aqueous cleaning that was not addressed. However, it is believed that research plays an important role in opening some reflections. Thus, the proposal for disseminating knowledge from the International Course on Paper Conservation in Latin America: Meeting East is sustained.

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