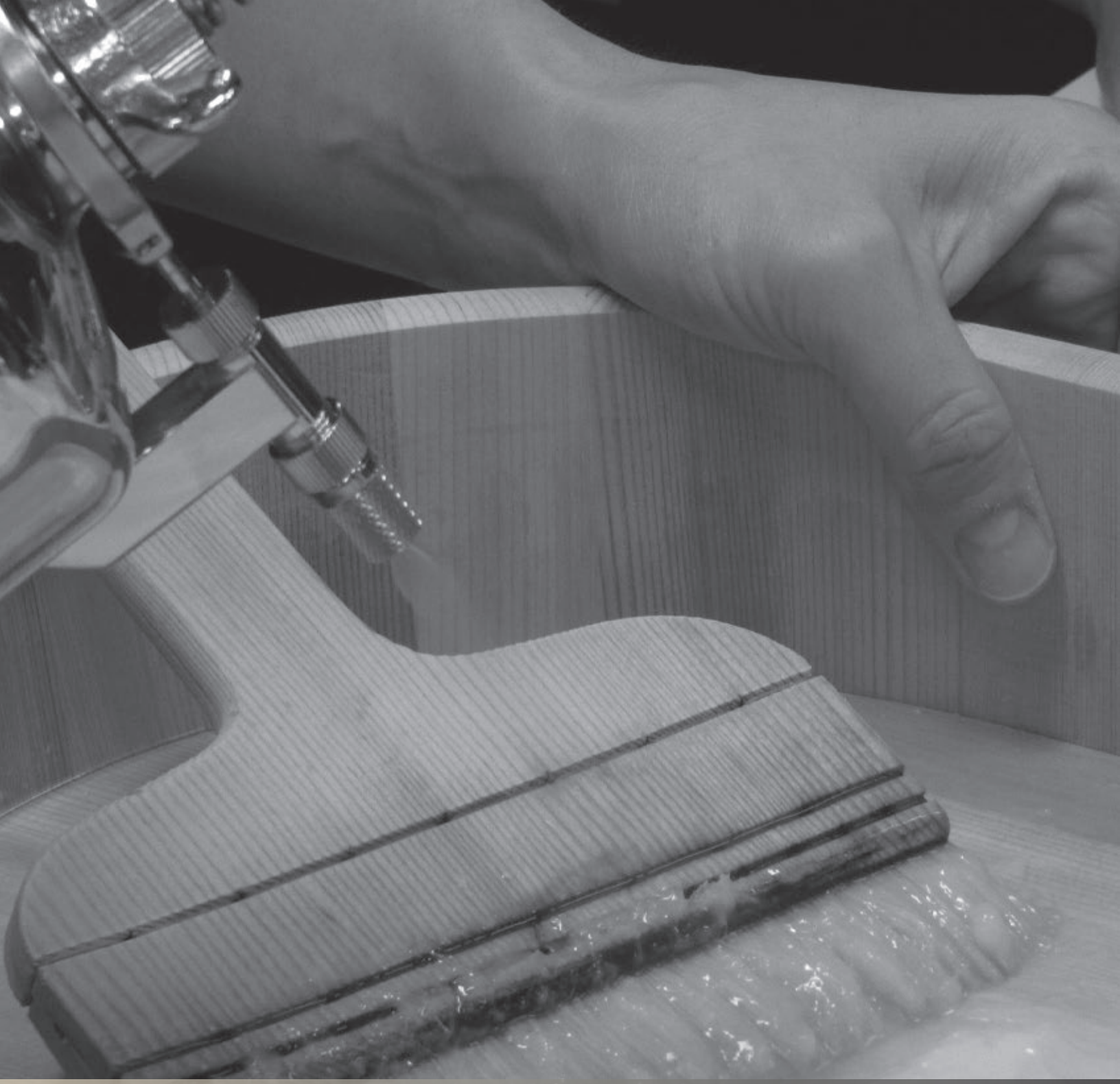

Versión en **INGLÉS**

A before and after in the preparation and use of adhesives

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Abstract
This paper describes the experiences of panelists and attendees of the online seminar entitled Experiences and reflections of the International Course Paper Conservation in Latin America. Meeting East 2012-2019. The experiences of the five members of the thematic session on adhesives and participants from the 2012 to 2019 courses are integrated. The appropriation and application of the use of adhesives implemented for the conservation and restoration of heritage paper-based assets in local, regional and heritage realities are discussed. Being members of different editions allows us to expose the knowledge we had and complement it, this dynamic occurred both when participating in the course and at the discussion of the thematic table. The experience of participating in both events led us to have different views on the subject, which is reflected in a before and after in the preparation and use and possibilities of adhesives.

Keywords
Adhesives; wheat starch; methyl cellulose; hydroxypropyl cellulose; gelatin B; paper conservation.

Background

The International Course on Paper Conservation in Latin America. Meeting East, in which several generations of Latin American professionals dedicated to the conservation of graphic and documentary material have participated, aimed to provide basic concepts on Japanese materials and techniques used for paper conservation, as well as the possibility of adapting these materials and techniques to apply them to non-Japanese heritage and, particularly to Latin American heritage.

Due to the pandemic situation that is affecting the world, the eighth edition of the course, planned for 2020, was not held. Instead, an online seminar was planned, organized by the Coordinación Nacional de Conservación del Patrimonio Cultural[1] (CNCPC) of the Instituto Nacional de Antropología e Historia (INAH)[2] of Mexico, in collaboration with the Tokyo National Research Institute for Cultural Properties (TNRICP) and ICCROM. Its purpose was to share experiences and to generate a space for reflection on the topics taught in the course, in its seven editions carried out from 2012 to 2016, as well as in 2018 and 2019.

[1] National Agency for Cultural Heritage conservation (note from the translator).

[2] National Institute of Anthropology and History (note from the translator).

The seminar was developed in two stages: the first one was dedicated to share the participants experiences through online presentations divided in thematic groups; the second one focused on updating some of the topics covered in the course.

Experiences from group 5: adhesives

The seminar's organizing committee divided the participants into thematic groups, based on the preferences they expressed through a survey undertaken beforehand. In group 5, the central theme was adhesives. Experiences were shared on the use of adhesives before and after participating in the course. The group was composed by María Alejandra Garavito Posada from the Biblioteca Pública Piloto of Medellín,[3] Colombia (participant from the 2019 course), Laura Inés Milán Barros, then, from the Instituto de Investigaciones Dr. José María Luis Mora,[4] Mexico (2018), Claudia Pradenas Farías from the Centro Nacional de Conservación y Restauración of the Servicio Nacional del Patrimonio Cultural of Chile[5] (2012) and Cynthia Solís Denis from the Laboratorio de conservación of the Archivo Nacional de Asunción,[6] Paraguay (2018).

Prior to the course, participants had different levels of knowledge about the preparation and use of adhesives in conservation and restoration treatnents, due to the diversity of our academic backgrounds. Some of us recognized the lack of experience that resulted in a series of errors caused by the scarce access to tools, to adequate equipment and to quality raw materials for use in conservation, for example, the use of bain-marie to cook wheat starch or the prohibition of installing stoves in our workplaces. This meant that in some cases we had to take the utensils home to prepare the adhesives there; the use of food-grade wheat starch or mineral water[7] instead of distilled or double-distilled water to prepare the adhesives was also predominant. Although some of us have access to the appropriate equipment, tools and raw materials, we did not find it easy to prepare the adhesives, control the proliferation of microorganisms in their preparations or calculate the right amount for a specific treatment.

This knowledge was modified once we took the International Course on Paper Conservation in Latin America. Meeting East, which, among other topics, gave us the tools to improve the preparation processes of wheat starch and other adhesives such as gelatin, methyl cellulose and hydroxypropyl cellulose (Klucel® G). However, once we tried to apply the knowledge acquired in the course in our respective countries, and taking into account the diverse conditions that characterize the climate of Latin America, we also had to adapt the processes learned, which resulted in new experiences.

In general terms, adhesives are substances that are used, in different proportions and preparations, to attach one surface to another. They have been used for millennia, extracted from vegetable resins, starches, sugars and concentrated proteins (Thornton, 2005: 22).

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[3] Pilot Public Library (note from the translator).

[4] Dr. José María Luis Mora Research Institute (note from the translator).

[5] National Center of Conservation and Restoration of the National Service of Cultural Heritage of Chile (note from the translator).

[6] Conservation Laboratory of the National Archive of Asunción (note from the translator).

[7] The term "mineral water" does not have the same meaning in all Spanish-speaking countries. For example, in Paraguay it refers to a type of bottled water, without gas and suitable for human consumption and that is also used in restoration processes, as opposed to drinking tap water that contains chlorine or double-distilled water for medical use. In the case of Chile, mineral water is water with or without gas suitable for human consumption; the water used in the Centro Nacional de Conservación y Restauración of the Servicio Nacional del Patrimonio Cultural of Chile is distilled in the laboratory or tap water filtered through an activated carbon filter to remove heavy metals. In Colombia, mineral water is a commercial brand of bottled water with or without gas; at the Biblioteca Pública Piloto in Medellín they use distilled water, purchased from chemical suppliers. Finally, in Mexico, mineral water refers to a type of carbonated bottled water; as in Colombia, the water used for restoration is distilled water, and purchased from suppliers outside the institutions.

In conservation and restoration intervention treatments carried out on books, documents and graphic works with paper support, adhesives are an indispensable material. Their application is conditioned by the treatment to be applied; the material characteristics of the object, its use and function; the type of alteration or deterioration present in the documentary object. As regards deterioration, adhesives are used to solve problems such as tears, lacunae, loose parts, detached parts, lack of sizing, among others; in most cases, cellulose ethers and starches are used.

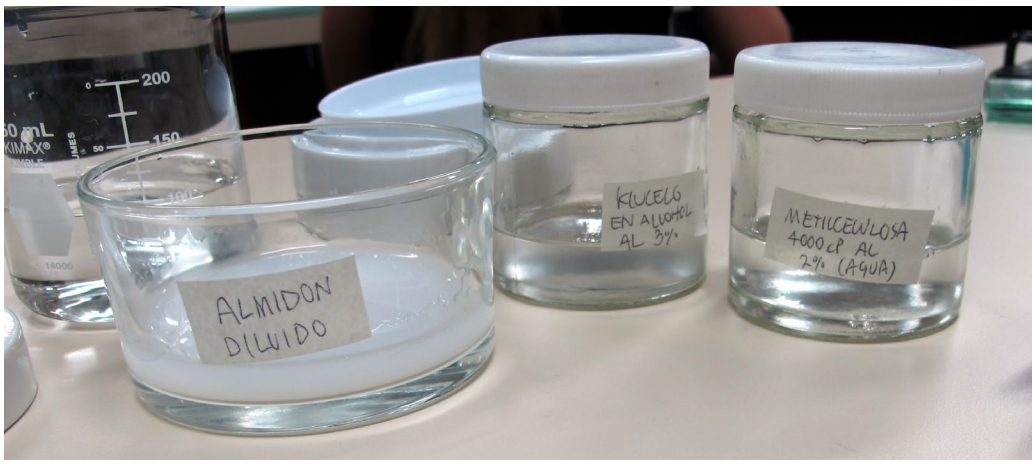


Figure 1. Adhesives. *Image: ©Laura Milán, 2018.*

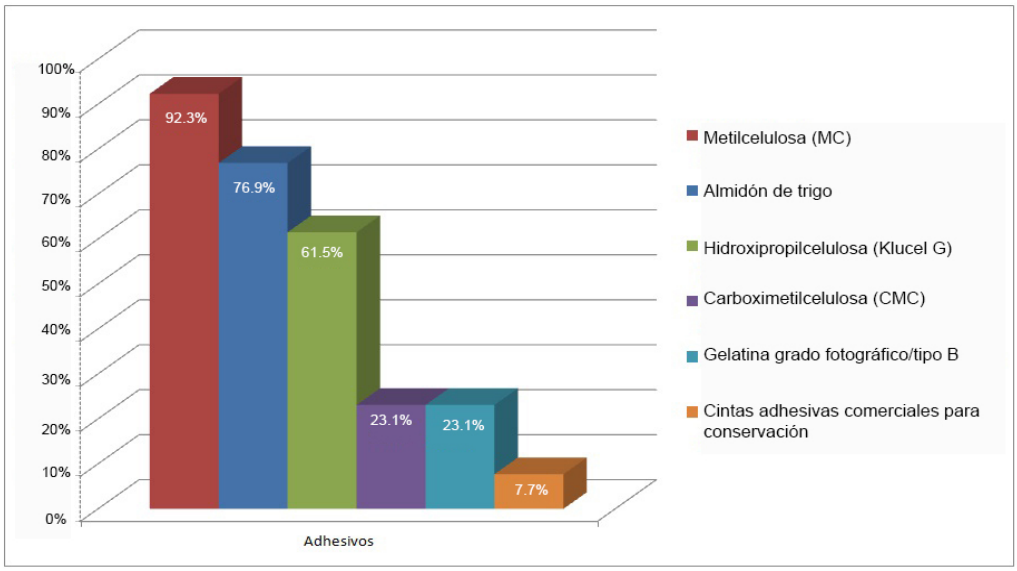
During the course, we reinforced the notion that desirable adhesives should have the following characteristics:

- provide sufficient strength to hold together indefinitely two surfaces, whether of the same or different materials
- not produce stains on the original support, either by contact or when drying
- not generate color changes
- be reversible or, in its absence, allow a new treatment.
- be resistant to attack by insects and microorganisms
- have a stable pH, which should preferably tend to be alkaline (pH 8)
- not chemically alter the original support
- be non-toxic
- be easy to prepare
- be easy to apply
- minimize deformations during the drying process

Preparing adhesives for conservation and restoration treatments was always a long and complicated task, so among the aspects mentioned above it was very new to understand that, if done properly, the preparation can be an easy and much more expeditious process than what we were used to.

As a complement to the presentation made during the webinar, we decided to launch a survey[8] aimed at the participants of the different iterations of the International Course on Paper Conservation in Latin America. Meeting East, which resulted in responses from at least one participant from each course, who shared their experiences with adhesives in different Latin American countries. The survey was answered by 14 participants who work in public institutions in Argentina, Colombia, Mexico, Peru, Spain, Uruguay and Venezuela.

According to the responses, when considering the experiences of the participants of the session, we can conclude that the most commonly used adhesives for paper restoration in Argentina, Chile, Colombia, Mexico, Peru, Spain, Uruguay and Venezuela are methyl cellulose (MC) (92. 3%), followed by wheat starch (76.9%), hydroxypropyl cellulose (Klucel® G) (61.5 %), carboxymethyl cellulose (CMC) (23.1%), photographic grade gelatin, or type B (23.1%), and, finally, commercial adhesive tapes for conservation (7.7 %); as well as combinations of adhesives. A constant among the responses is the change in adhesive preparation methods after participating in the course.



Graphic 1. Answers to the online survey. *Image: ©Alejandra Garavito, 2021.*[9]

Specificities of the adhesives used

It is a fact that all of us, given our training as conservator-restorers, had knowledge about the preparation and use of adhesives; however, the course offered new possibilities on the subject and on application methods, which we tried to replicate once we were back in our institutions, adapting them to the conditions and collections we work with. During our preparatory meetings for the virtual seminar, we also agreed on the use of the aforementioned adhesives, but we realized that the differences were in the way of preparation and, of course, in the commercial supplies to which we have access in our respective countries.

[8] The survey was sent via email to the 68 participants of all course sessions, and consisted of 15 questions focusing on the use, preparation, storage and application of adhesives.

[9] Percentage data on the use of combined adhesives is not available, so it is not included in the graph.

In this section we will present the adhesives we use, their generalities and the different ways of preparation in order to find advantages and disadvantages, and thus select the most appropriate preparation and application methodologies when faced with an intervention problem in different conditions.

Methyl cellulose

Methyl cellulose is part of the group of cellulose ethers.[10] It is one of the products usually used in the restoration of works with paper support, in addition to being used as an adhesive for repairs in breaks and tears and for the infills of missing parts. It is also used as a sizing agent, as a fixative for inks, or as a consolidant in the preparation of pulp, and even as a surfactant in some washing techniques or as a gel for surface cleaning. One of its main characteristics is that it is considered a stable product (Barberá, 2004: 44). Concentrations and viscosities depend on the process to be carried out, but in general, it is used between 1% and 4% and viscosity about 400 or 4000 cP.

The geographical location, the brand and quality of the product purchased are part of the determining variables; it is not the same to prepare the adhesive in a dry environment, with a relative humidity of 30 % and an ambient temperature of approximately 20 °C, as it is to prepare it in an area where the relative humidity reaches 90 % and with temperatures exceeding 30 °C. In the second case it will be necessary to be cautious in the preparations, due to the proliferation of microorganisms. At the same time, the place of manufacture of the brand of the product is decisive for the quality of the preparation, since in some cases the product, for example, could contain a fungicide added since its manufacture to promote its conservation for a longer period, limiting the growth of fungi and other microorganisms. We also noted that in the first edition of the course, in 2012, the topic was only treated in a theoretical manner, while in subsequent iterations, some preparation practices were carried out, such as dispersing the powder in hot water and then dissolving and forming the gel, with the application of cold water.

In Santiago, Chile, it is used the commercial brand Metylan® and the method by which methyl cellulose is prepared at the Centro Nacional de Conservación y Restauración is by dissolving the powder in cold water (5 °C) and letting it stand for 30 minutes for complete dissolution. Given that Santiago is a city that generally presents environmental conditions with low relative humidity and warm temperatures, the preparation is covered with a film and stored at room temperature. This method was not learned in the course, but also in my generation (2012) there were no practices of methyl cellulose preparation, so the information provided by the theoretical part was that the powder was soluble at 5 °C.

At the Archivo Nacional of Asunción, due to the variations in adverse weather conditions where the temperature can sometimes exceed 35 °C, and the relative humidity can reach 90 % in some seasons, the preparation consists of dispersing the powder in hot water at 80 °C and then adding 96 % ethyl alcohol. This method of preparation ensures that the adhesive is kept free of microorganisms; it is stored with a cover, and refrigerated. In this case, the brand used comes from City Chemical Corporation® laboratories. Although the formula was not the one presented in the course, the adaptation of the mixture with ethyl alcohol has provided good results.

[10] Cellulose ethers are semi-synthetic polymers derived from cellulose coming from wood or cotton. They are white powders, have no odor, no taste and no ionic charge, and therefore the viscosity of their solutions is little affected by pH (Feller, 1990: 173).

Figure 2. Sizing with methyl cellulose. *Image: ©Alejandra Garavito 2019.*

Figure 3. Infills made with Japanese paper, adhered with methyl celulose. *Image: ©Laura Milán, 2020.*

Both at the Biblioteca Pública Piloto in Medellín, Colombia, and at the restoration workshop of the Instituto de Investigaciones Dr. José María Luis Mora in Mexico City, the raw material is purchased in shops specializing in conservation products. The method of preparation is similar to that learned in the course, consisting of dispersing and completely hydrating the powder in one third of the total volume (hot water at 80 °C), then adding the remaining two thirds of very cold water and stirring, covering and leaving it stored at room temperature[11] (26-28 °C in Medellín; 18-26 °C in Mexico City) or in commercial refrigerators at between 5 and 7 °C.

The responses in the survey also showed other ways of preparing and storing methyl cellulose, such as dilution only in warm water and leaving the mixture to stand for a couple of hours, and storage in furniture made of metal or in spaces with climate-controlled or temperature-controlled systems. Some of the preparation methods described by the participants are different from the one presented; it is important to emphasize that what was taught serve us as a guide to facilitate the preparation methods, but these have been adapted to the raw material available in each country, the climatic variables and the type of concentration and viscosity of the type of treatmentr to be undertaken.

In the method taught in the course, we could observe that is best to dilute the methyl cellulose in warm water and then add cold water; this speeds the preparation time, with the method that was practiced we realized that the time was a matter of hours and in some cases days.

The advantages and disadvantages of using methyl cellulose that we were able to observe from our experience of treatments are as follows:

Table 1. Advantages and disadvantages of using methyl cellulose

ADVANTAGES	DISADVANTAGES
Easy preparation	Brightening
Easy storage in all climates	Not recommended for use with soluble inks or iron gall inks.
Easy to prepare large quantities and different concentrations	Limited adhesive power
Compatibility with cellulose supports	
Colorless	
Reversible	
Insoluble in hot water	

In conclusion, this adhesive is easy to prepare and store, independently of the climatic region. It can be prepared in large quantities, in different concentrations and viscosities, which makes it very ductile. It is colorless but once dry it produces a shiny surface, so care must be taken in which part or for what type of treatments it is applied. As it becomes a gel that transmits humidity, it is useful for superficial cleaning without leaving a toxic residue as it has a chemical composition similar to paper cellulose. However, due to the humidity transmitted, it is not advisable to use it on documents with iron gall inks.

[11] The average temperatures of the cities were taken from www.theweatherchannel.com

Hydroxypropyl cellulose

Another of the cellulose ethers reviewed in the course and also referred to in the survey answers is hydroxypropyl cellulose or Klucel® G; during the course was shown not only its advantages in different ratios but also its use and application in various cases.

The method of preparation is the same in all countries, although Klucel® G is soluble in water below 38 °C, and in most organic solvents (ethyl alcohol, acetone, toluene) (Barberá, 2004: 48) , we all agree that the advantages of its use are when using ethyl alcohol, because its evaporation time is slower compared to acetone or toluene and because it can be used in water-sensitive works, such as transparent papers, couches, media such as watercolor or iron gall inks that cannot be treated with calcium phytate.

Its preparation consists of adding the powder[12] to the total volume of ethyl alcohol, then leaving it to stand for 24 hours for complete dissolution. It is stored at room temperature, except in Asunción, where, as a precaution, it should be refrigerated, as the solvent may evaporate under ambient conditions and microorganisms may proliferate. The commercial brands with which we have experimented are Krammer® and the one offered by Talas®.

According to the survey, the main uses of Klucel® dissolved in ethyl alcohol are the protection of water-sensitive colors, consolidation of iron or metalloacidic inks, as an adhesive for reinforcements and linings on transparent papers, and for hemerographic or mechanical pulp material as it dries quickly and hardly stains the material, as a cleaning gel, and as an additive to other adhesives such as starch.

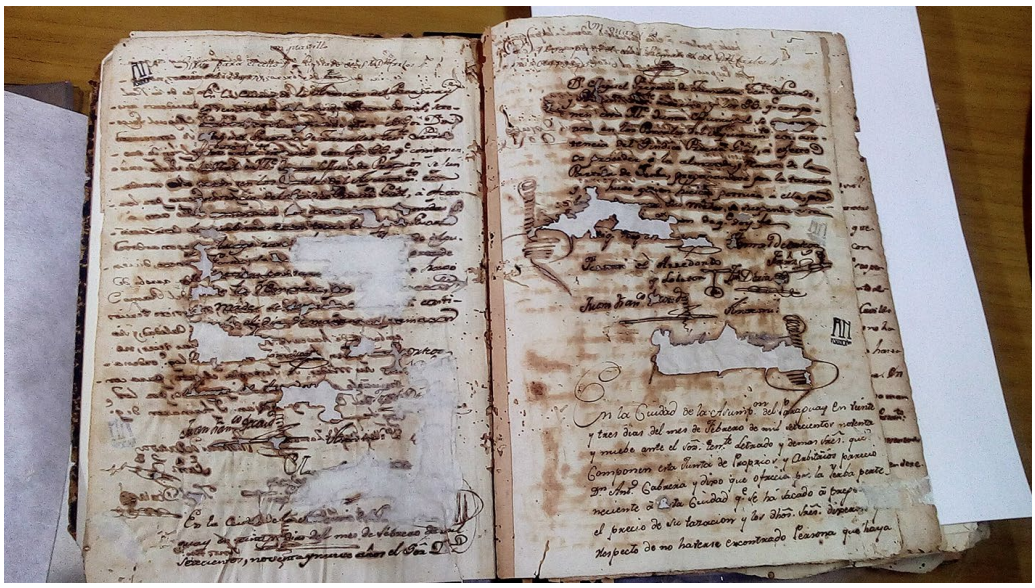


Figure 4. Fixing of iron or metalloacidic inks with Klucel® G. *Image: ©Cynthia Solís, 2017.*

Another Klucel® G application process learned during the course is the use of remoistable Japanese tissue, which will be mentioned later on.

[12] The concentration of the preparation of Klucel® G is determined by the given use, as adhesive is suggested 4-6 %, as glue 1-2%, and as fixative and consolidant 0.05-1 % (Barberá, 2004: 49).

The advantages and disadvantages we observed in the use of hydroxypropyl cellulose are as follows:

Table 2. Advantages and disadvantages of the use of Klucel® G.

ADVANTAGES	DISADVANTAGES
Facilitates the use of remoistable linings, in works that cannot receive humidity	In dry climates, the evaporation of ethanol is very fast, which makes the application more difficult
Fast drying	A lot of weight needs to be placed on the document in order to secure the adhesion
Low paper wetting	Low adhesive power
Compatibility with cellulose supports	
Colorless	
Reversible	

We can conclude that in preparations with ethyl alcohol it is possible to use it in water-sensitive works, as it does not wet the paper very much and dries quickly. It is also colorless and reversible. The main disadvantage we found is that it has little adhesive power, so it needs a lot of weight in the treatment to ensure adhesion.

Type B gelatin or of photographic grade

It is a protein adhesive, formed by collagen, soluble in water and polar solvents. It is often used as an ink consolidant or fixative, and to carry out treatments on documents with metal or iron gall inks, as well as laminates.

Figure 5. Gluing with type B gelatine *Image: ©Claudia Pradenas, 2016.*

Figure 6. Ink fixing with type B gelatine.
Image: ©Laura Milán, 2020.

We all agree on the same method of preparation, which consists of hydrating the gelatin in water at room temperature and then allowing it to dissolve in a water bath; the temperature of the water should not exceed 60 °C (Kolbe, 2001: 53), so that the gelatin does not lose its adherent properties, and then allowing it to cool. However, there is a peculiarity in the preparation: in Santiago de Chile, the gelatin is allowed to cool and then sieved several times so that it remains liquid or has a consistency similar to cellulose ethers, which allows it to be applied to the surface without having to be heated beforehand.

The advantages and disadvantages we observed in the use of Gelatin B are as follows:

Table 3. Advantages and disadvantages of the use of type B gelatin.

ADVANTAGES	DISADVANTAGES
It facilitates the use of remoistable linings, in works where humidity cannot be applied	It must be used hot
It dries fast	It may generate a shine on the surface
Low paper wetting	The speed of drying/evaporation depends on the climate
Compatibility with cellulose substrates and ink binders	Water temperature control at the time of preparation
Colorless	It can change color as it ages
Reversible	It may be susceptible to insect attack under certain conditions
Good emulsifying power	Weight must be placed on the work/document to ensure full adhesion
High adhesive power	
Depending on the concentration it can form very stiff layers, useful for forming contact cleaning gels	
Binder or fixative for soluble inks	
Sizing agent for iron galling inks due to its ability to form bonds with iron ions	

As a conclusion: type B gelatin is a good choice as a replacement for cellulose ethers; the emulsifying power of type B gelatin represents an advantage for use in restoration because it has been shown to have the ability to bind certain elements, such as iron ions in the case of iron gall inks, where it provides a protective barrier under certain conditions, and can be used as a sizing agent and for making repairs. The major disadvantage is that it must be used warm and is very susceptible to attack by microorganisms.

Wheat starch

Wheat starch is a natural polysaccharide of vegetable origin, similar to cellulose. It is insoluble in cold water but, when heated, it solubilizes well and on cooling produces starch paste (Calvo, 1997: 22). It is marketed as a white powder.

One of the problems we face in its preparation is the type of starch we can access. We noticed significant differences in quality between starch of Japanese origin and starch available in the different countries of Latin America, the Caribbean and the Iberian Peninsula. Among the commercial brands most commonly used by thematic session 5, it was found that most of the starches used were those marketed by preservation shops in the United States.

In order to solve some of the problems regarding the acquisition of the product, some of us have tried the extraction of starch from commercial flours sold in our countries of origin, as we learned in the course. However, we must make several tests and compare the results, especially because many of these flours have additives such as vitamins or minerals, which we do not know for certain if they leave any residue on the paper.

Although most of us had used wheat starch paste for our conservation and restoration treatments, after participating in the course, we understood better the preparation process and the importance of each of its phases in order to obtain an optimal adhesive. These phases are: prior hydration of the powder, adequate and correct cooking, sieving and kneading.

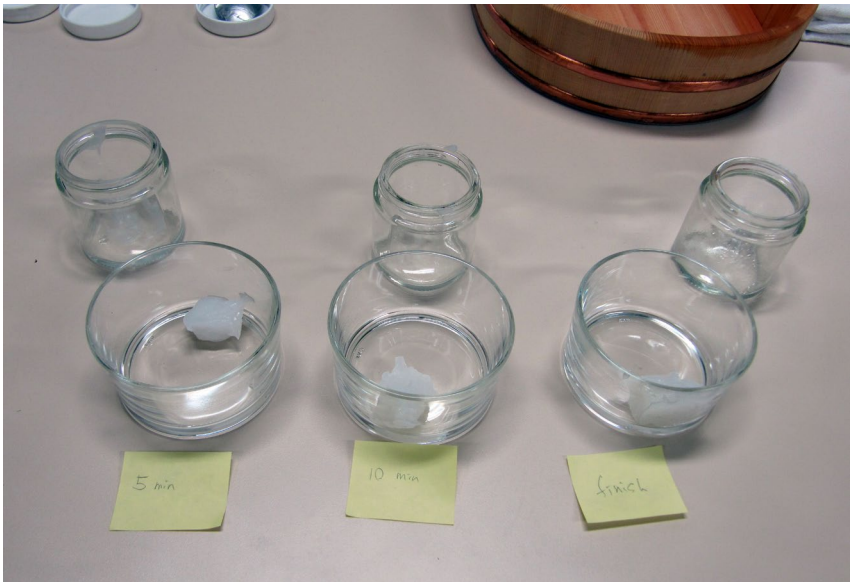


Figure 7. Starch transformation during cooking times. *Image: ©Claudia Pradenas, 2012.*

Figure 8. Starch sieving and kneading. *Image: ©Cynthia Solís, 2020.*

While we all understand the importance of each phase, it has been necessary to make adjustments and have some differences in the preparation method:

- The first point concerns the prior hydration of the starch in distilled water. Before the course, none of us used to do this, and now it is incorporated into the process. However, not all of us let the starch rest for the same length of time, i.e. some of us hydrated for some hours and others did the hydration process in days. Prior to the course, no one of us was aware of the need to change the hydration water during the process.
- As for cooking, it can be done on a cooker or microwave, and it is important to note that in some places, such as Spain, it is forbidden to have gas cookers inside conservation workshops.
- The sieving and kneading process is also common to all, but, due to the needs of each work space, some tools have been adapted to the process, such as the use of plastic sieves, due to the difficulty of acquiring those of Japanese origin.

Figure 9. Adaptation of tools. *Images: ©Claudia Pradenas and Cynthia Solis, 2017 and 2020.*

In the course, we learned that preparation using an industrial microwave oven works well and that, similar to what happens when cooking on the cooker, the physical process of the starch molecule occurs. This is when the granules swell and burst, thus reducing the molecular crystallinity, resulting in a disorganized and gelatinized structure. The cooked starch mass becomes sticky or viscous and becomes adhesive. On cooling, the solubilized starch chains immediately tend to reassociate. This reassociation is called retrogradation and is the process that prevents or delays the proliferation of microorganisms (Belard, 2009: 37; AIC-BPG, 1989: 92). We consider this to be a great contribution to the treatments carried out in each of our laboratories, as it reduces the preparation time from approximately 45 minutes to only 5 minutes.

It is also important to comment that, regarding the storage of starch, after the course we made modifications when we understood that the starch molecule deteriorates with cold, since this causes the starch to become granular and therefore lose its adhesive power. So it is not advisable to store it in a refrigerator (AIC-BPG, 1989: 10). The ideal is to calculate the amount needed and prepare the starch for the moment, especially in locations with dry relative humidity conditions (20 %) and high temperature (over 30 °C) where microorganisms proliferate in the adhesive. However, we learned that it is possible to remove the attacked part and use sections of the starch that have not been affected by microorganisms.

The advantages and disadvantages that we observed in the use of starch are the following:

Table 4. Advantages and disadvantages of starch use.

ADVANTAGES	DISADVANTAGES
Increased adhesion	Low flexibility at high concentrations
Increased compatibility with the support	Opacity
Fast drying without press	
Moisture applied to the substrate can be better controlled	
It does not crystallize	
No color change	

In conclusion, we can add that wheat starch paste is an adhesive that, after the course, can be considered as one of the noblest materials, since it has a good adhesive power, it is very malleable, it can be used in almost all processes and it does not create a shiny surface. However, being opaque, it can visually affect some treatments. As it is a paste, humidity can be controlled by increasing or decreasing the amount of water at the time of dilution according to the process to be carried out.

Another advantage is that the interventions made with starch can be reversible or, failing that, a new treatment can be possible. As for drying, the shrinkage it generates allows drying in the open air without the need to use presses.

A disadvantage is that it cannot be prepared in large quantities due to its rapid decomposition process.

Pre-coatings

The pre-coatings are made by placing several layers of adhesive, either starch, methyl cellulose or type B gelatin on Japanese paper, on a polyester film or Mylar®, or on an X-ray plate as we did in the course, and let it dry; in this way we obtain an adhesive-embedded paper, similar to an adhesive tape, but with the conservation characteristics we have already mentioned. To use it in the heritage item, it is only necessary to remove it from the polyester film and apply again the solvent with which it was prepared or with similar solvents, which gives an advantage depending on the needs.

Although in the course we learned how to carry out pre-coatings, in our experience trying to replicate the technique has not always had good results. Some of us have tried to prepare reactivation with hydroxypropyl cellulose, however, we have found it difficult to separate the

Japanese paper from the polyester film, it breaks or it curls in such a way that it is impossible to use it; in addition, the defibration of the edges is lost due to the straight cuts that are made, in cases where it is necessary to use the remoistable Japanese tissue with adhesive as reinforcement strips. We agree that it is a good solution for laminating works or documents whose support is fragile or the type of paper is not compatible with humidity or very sensitive to moisture, as in the case of transparent paper or coated paper.

We have also experimented with commercial products such as Crompton® paper (made of a 9 g/m2 tissue of abaca hemp fibers with neutral pH) or Archibond® tissue (made of a Japanese paper of 100% Manila fiber, and with a thickness of 8.5 g/m^2). The adhesive layer is based on Paraloid® (Marcopolo, 2021; Productos de Conservación, 2021).

Preparing pre-coated materials can be a good option to replace commercial products that lose their adhesive power over time, thus reducing costs, since Cromptom® or Filmoplast® R paper from Neschen® are not cheap, and in our experience, the latter do not always comply with the reversibility or re-treatability premise.

The advantages and disadvantages that we observed in the use of pre-coated materials are as follows:

Table 5. Advantages and disadvantages of using pre-coated materials.

ADVANTAGES	DISADVANTAGES
Use on very sensitive papers such as coated paper, tracing paper or transparent papers	It is not so easy to control the temperature used to adhere the paper to the support, which may cause a degradation process
Iron gall inks or metalloacid inks	Significant weight use is required to achieve adhesion

We can conclude that: pre-coated materials are very useful in archives, especially on materials with ink acidity problems, since to be used they need some solvent such as ethyl alcohol to be adhered, which implies less moisture. However, there is a problem of preparing it at a high concentration, since it is difficult to detach it from the polyester film. Another observation about commercial products is that many times we do not know the types of adhesives used, which is often a problem when doing a treatment.

Mixtures of adhesives

Regarding the advantages and disadvantages of methyl cellulose and wheat starch paste, some of us have found that their use as a mixture results in better adhesion and greater flexibility, as well as slower drying time.

Another common mixture is the use of methyl cellulose with synthetic adhesives such as polyvinyl acetate (PVA), where methyl cellulose functions as an additive, depending on the concentration (1:1, 1:2), which can increase or decrease the drying time of either methyl cellulose or PVA and confer certain reversibility to the mixture.

Figure 10. Consolidation of a heritage item. *Image: ©Claudia Pradenas, 2007.*

Final considerations

The thematic session in which we worked during the month of November, and which allowed us to participate in the online seminar, was a very valuable experience because it was recognized that even though the topics discussed in the different iterations of the course were the same, each professional, in each country and with their own heritage, appropriates and applies it in a very different way. Sharing these points of view has been very constructive, since it has allowed very important feedback regarding the conservation and restoration of heritage on paper. Therefore, we affirm that the course made reflect about everything we knew about adhesives, before and after the course.

Talking about adhesives and consolidants is a common topic for all participants, as they are fundamental elements in almost all the treatment, but the choice of the ideal adhesive can always be a point of discussion.

One of the things we can conclude from our meetings, it is that while we may have recipes for preparing the different adhesives, the application and timing depend entirely on the specific case. There is no adhesive that is the best or the worst; its function is determined by the problem we want to solve.

The course allowed us to have a broad knowledge of the adhesives used in Japan and the rest of Latin America, from a practical and theoretical point of view, which makes it easier for us to choose the most convenient ones for the works we deal with in our institutions. This exchange of knowledge has allowed us to make important changes in the intervention of works with paper support; in addition, the same working group generated very positive experiences, besides

knowing how interventions are approached in other institutions, it also promoted to know a new method of preparation of methyl cellulose in the Centro Nacional de Conservación y Restauración of the Servicio Nacional del Patrimonio Cultural de Chile or the addition of ethyl alcohol to the preparation of methyl cellulose in the Restoration Studio of the Instituto de Investigaciones Dr. José María Luis Mora.

Taking into account the limitations within the restoration workshops, such as not always having access to imported adhesives for economic reasons, or the difficulty in obtaining them, or not having the necessary facilities, or the most suitable tools, or the environmental conditions of the countries, among many other factors, this makes us constantly evaluate the need for further research on the process of extraction of starch from commercial wheat flour and its possible uses in the treatment of work on paper as a substitute for Japanese starch.

The course also contributed to the need to initiate research processes, by carrying out tests with different types of papers found in the collections, to determine which types of adhesives are more convenient to use, as well as the drying method, preparation, dilution and the most appropriate application method.

Finally, we believe that this type of reflection exercise not only makes it possible to meet colleagues from other countries and institutions, but is also an important starting point for the exchange of knowledge and experiences focused on better conservation of cultural heritage.

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References

American Institute for Conservation of Historic and Artistic Works Book and Paper Group (1989) "Adhesives", *Paper Conservation Catalog*, available at: <https://www.conservation-wiki.com/w/images/5/53/46_adhesives.pdf> [accessed on 25 January 2021].

Barberá Durón, Natalia Valeria (2004) *Metil celulosa e hidroxipropil celulosa, estudio comparativo de su estabilidad y características de envejecimiento*, degree thesis on Restauración de Bienes Muebles, Ciudad de México, Escuela Nacional de Conservación, Restauración y Museografía-Instituto Nacional de Antropología e Historia.

Belard, Regina, Higuchi, Hisashi, y Perry, Jennifer (2009) "Furunori (aged wheat starch paste): challenges of production in non-traditional settings", *Journal of the Institute of Conservation*, 32: 31-51.

Calvo Manuel, Ana (1997) *Conservación y restauración: materiales, técnicas y procedimientos: de la A a la Z*, Madrid, Ediciones del Serbal.

Feller, R.L y Wilt, M. (1990) *Evaluation of Cellulose Ethers for Use in Conservation*, Los Angeles, The Getty Conservation Institute (Research in Conservation, 3), available at: <https://www.getty.edu/conservation/publications_resources/pdf_publications/pdf/ethers.pdf> [accessed on 25 January 2021].

Kolbe, G. (2001) "Gelatine, Eigenschaften und Auswahlkriterien in der Papierrestaurierung", *Papierrestaurierung. Mitteilungen der IADA*, 2 (suplement): 41-56.

Marco Polo (2021) *Papeles libres de ácido* [online], available at: <https://www.edmarcopolo.com/papeles-libres-de-acido-53.php> [accessed on 23 January 2021].

Muñoz-Viñas, Salvador (2010) *La restauración del papel*, Madrid, Tecnos.

Productos de conservación (2021) *Archivond Tissue* [online], available at: <https://www.productosdeconservacion.com/eshop/papel/448-archibond-tissue.html> [accessed on 23 January 2021].

Tacón, Javier (2009*) La restauración en libros y documentos. Técnicas de intervención*, Madrid, Ollero y Ramos.

Thornton, Jonathan (2005) *Adhesive and adhesion*, Buffalo State College.