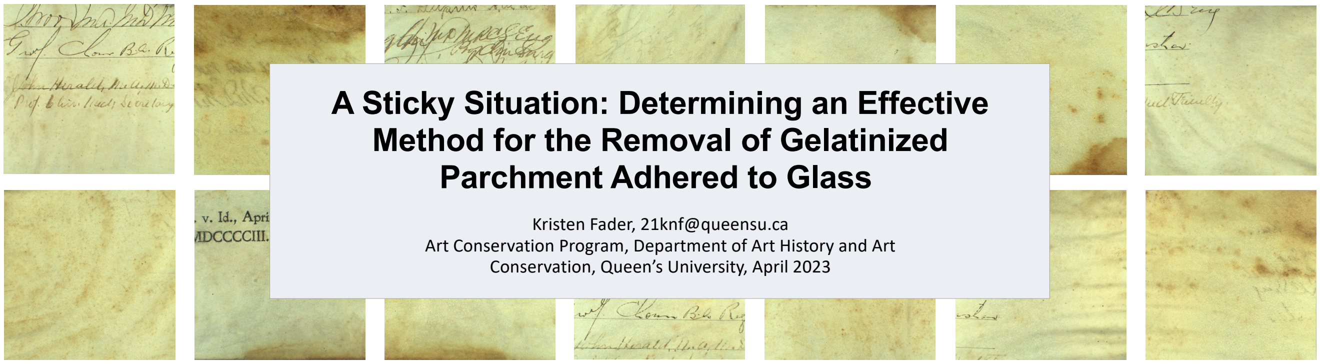

A Sticky Situation: Determining an Effective Method for the Removal of Gelatinized Parchment Adhered to Glass

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Introduction

Parchment can become extremely distorted when exposed to water due to it being highly hygroscopic. However, of primary concern here, is that the partial hydrolysis of collagen results in gelatinization due to a loss of internal hydrogen bonds and a fundamental restructuring of the triple helical structure to a coil structure (see Fig. 1). Beyond the chemical changes experienced at a microscopic level, the parchment becomes stiff and translucent, and tidelines lines or other unwanted mechanisms can occur. When the wet parchment which has gelatinized comes into contact for an extended period of time with glass, adherence can occur between the two materials, with the parchment essentially creating its own gelatin "adhesive." This project has researched the treatment methods which may allow for the safe removal of gelatinized parchment adhered to glass without causing any further damage to the parchment matrix, as there are no recommendations or case studies of this phenomenon in the literature. Treatment methods were selected from a literature review of similar case studies, such as gelatin photographs adhered together and parchment adhered to strip linings, however the most effective methods involve the use of ethanol, rather than water which is commonly used in photograph conservation, which does not result in further gelatinization of the parchment.
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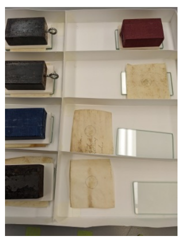
Experimental

Sample Preparation:
- Eight samples were prepared from a 20th century parchment donated from the teaching collection of the Queen's Archives
- Samples were wetted to create gelatinization and held down to the glass with weights
- Gelatinization and translucency were observed

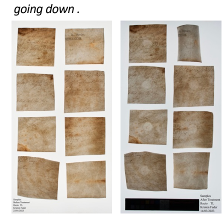


Samples being prepared and held to glass under weight.

Treatment Methods:
1. Aqueous solvent chamber
2. Ethanol solvent chamber
3. Localized application of water
4. Localized application of ethanol
5. Aqueous immersion
6. Ethanol immersion
7. Gore-tex humidification
8. Humidification chamber

Characterization of parchment:
- Colour spectrophotometer
- Multi-spectral imaging
- Weight
- Fourier-transform Infrared (FTIR) Spectroscopy

Samples before (left) and after (right) treatment under transmitted light in order from 1 starting in the top left corner going down, to 5 starting in the top right corner going down .



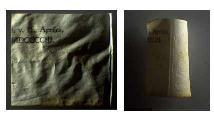
Results and Discussion

Samples exhibited colour change which show the ΔE for the recto and verso of each sample taken from measurements with the CIELAB *a*b* System. Any colour change of ΔE 1 or 2 is perceptible to the eye, with ΔE>5 being a substantial colour change.

Sample	ΔE Recto	ΔE Verso
1	1.02	3.93
2	2.31	2.68
3	1.24	3.76
4	2.20	1.64
5	1.39	1.99
6	3.79	2.74
7	2.13	1.97
8	2.42	2.74

***Table 1**. Samples after treatment colour change.*

It can be difficult to discern the level of colour change acceptable as some samples experienced more on the verso than on the recto, for example with the localized application of water (which was applied only to the verso). The full immersion of the sample in ethanol resulted in no further gelatinization, but the greatest colour change on the recto of the samples at a ΔE 3.79, though still not considered a substantial colour change, while the aqueous immersion had the lowest colour change holistically of all the treatments.



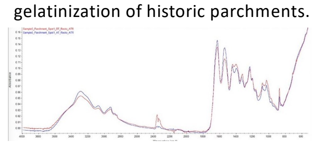
Sample 5 before (left) and after (right) treatment

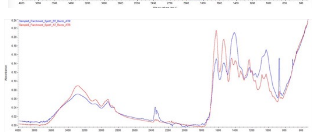
Though the aqueous immersion resulted in the lowest colour change, this resulted in the most planar deformations, even after drying under weight. In terms of the weight gained by each sample, sample 5 also had the best result, with only 1.67% of weight gained (see table below), compared to the ethanol immersion, and two humidification methods used which had the greatest weight increase.

Sample	Weight BT (grams)	Weight AT (grams)	% of weight gained
1	0.63488	0.6458	1.72%
2	0.61954	0.63153	1.94%
3	0.58209	0.59271	1.82
4	0.63498	0.64378	1.39%
5	0.59661	0.60656	1.67%
6	0.59582	0.61032	2.43%
7	0.78574	0.80445	2.38%
8	0.74979	0.77012	2.71%

***Table 2.** Samples before and after treatment weights.*

To truly understand what the effects of each treatment are on the samples, we can look to the changes in absorptions of the amide I, II, A, and B which have been previously used by Gonzalez and Wess (2008) to characterize the extent of gelatinization of historic parchments.





Hydrated collagen structures sees an upshift of the amide II, located in the ≈ 1540 cm^{-1} as well as the amide I at ≈ 1650 cm^{-1}. This can be seen in sample 5 (above) before and after treatment. The parchment was historic and already degraded, however, the immersion into an aqueous bath led to an increase in absorbance at these points. The use of ethanol appears to have created far greater changes in absorbency at these wavelengths, however, when used as a local application only the area in contact with the ethanol is effected and no visible translucency or gelatinization was noted. More research is needed to determine if gelatinization is occurring due to the introduction of ethanol into the parchment matrix. The use of slow, controlled humidification had the lowest perceivable uptake in absorbency.

Conclusion

Parchment can be a tricky material to treat in a conservation setting as the conservator must consider the proteinaceous matrix such as its hygroscopicity and ability to transform from collagen into gelatin. Though the treatment of the samples with ethanol resulted in the least amount of time and manipulation of the samples, along with resulting in the least amount of planar deformations after drying, it resulted in large colour changes and significant uptakes in absorbencies for the amide I and amide II, indicating collagen degradation into gelatin. However, no visual gelatinization nor translucency was observed and so further research is needed on the effects of ethanol on the parchment matrix. The most successful treatments were those using slow, controlled humidification, as these has low colour changes as well as very minimal uptake in absorbency with FTIR, with little to no gelatinization or translucency observed.

Selected References

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