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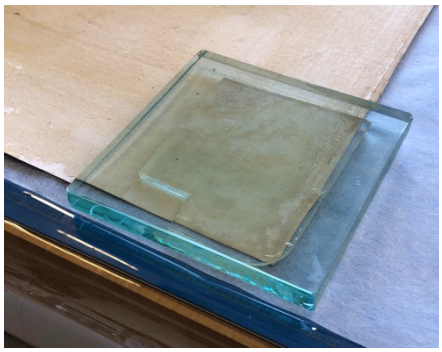
Warmed Gellan Gum and Enzymes for Adhesive Reduction

INTRODUCTION

In early spring of 2019 Madison Brockman, graduate fellow in the Winterthur/University of Delaware program and third year intern at the Los Angeles County Museum of Art spent her research days at the J. Paul Getty Museum, working on a special project with Michelle Sullivan, Associate Conservator of Drawings. During the course of this treatment, the two devised a technique for adhesive reduction using warmed gellan gum and enzymes, which safely and effectively delivers the aqueous solution to water-sensitive objects.



The object treated was a chine collé photogravure by Sir Lawrence Alma-Tadema entitled "Spring," a print reproduction of his oil painting from 1894. When the painting was acquired in 1972, the print came with it but was never accessioned. As a chine collé, this object has inherent moisture sensitivities between the primary and secondary layers. Works with such limitations are excellent candidates for gel treatments, which restrict moisture release to a greater extent than traditional blotter washing or float washing. In this treatment, rigid polysaccharide gels were used for a wide array of treatment steps, including adhesive reduction as well as overall and local stain reduction.

First, the print's canvas lining was mechanically removed, leaving behind a thick layer of starch-based adhesive on the verso of the soft secondary support. In this case, using gels and enzymes facilitated a quicker and safer adhesive reduction versus mechanical scraping and/or abrasive swabbing. In this treatment, alpha-amylase was used to digest the residual adhesive layer. This enzyme exhibits greater activity at elevated temperatures, but water is required for the enzymatic reaction to proceed, so one must be careful to not drive off all moisture if elevated temperatures are used.

PRELIMINARY TESTING

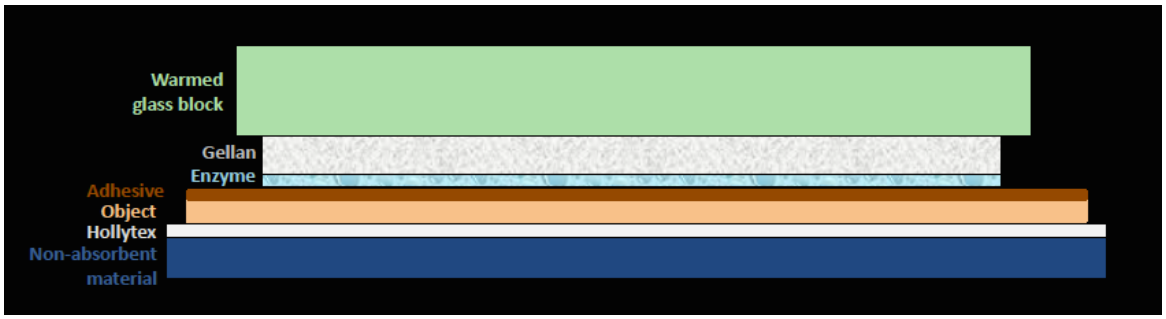
It is a common assumption that enzymes interact unfavorably with the polyanionic molecular structure of gellan gum, leading many conservators to use agarose for enzyme-based treatments. However, agarose is significantly more expensive than gellan gum, and at the scale of this object, choosing agarose would be cost prohibitive. With this in mind, the authors set out to ensure they could use the buffered enzyme solution with pre-cast gellan sheets, and would not have to rely on agarose.

To test this theory, swatches of gellan gum and agarose, both prepared with the enzyme trypsin, were applied to an expendable sample of aged animal glue. The adhesive appeared to be removed equally as well with the gellan as with the agarose samples when viewing them in normal and raking illumination. Some of the adhesive was drawn up into the gel via capillary force, and the rest was sufficiently softened and could be mechanically removed from the object. Examination under ultraviolet radiation further confirmed that the adhesive was successfully solubilized and removed, as there was no more fluorescence of the adhesive after application of the enzymatic solution and gellan gum.

In light of the successful test results, the enzyme-gellan gum treatment protocol was further refined and applied to the Alma-Tadema chine collé print. The final protocol is outlined stepwise below.

TREATMENT PROTOCOL

1. Place object with the adhesive facing up on a nonabsorbent surface with a polyester interleaving material like Hollytex between.
2. Use a brush to apply a uniform layer of the enzyme to the adhesive area only where the gel and glass block will be applied. Take care that the enzyme solution is not stirred or applied vigorously to avoid incorporation of air that may oxidize the enzyme.
3. Cook and cast a 3% (w/v) sheet of gellan gum. Once set, cut the gellan into manageable sizes based on the glass blocks available (the authors used 4" by 4" squares).
4. Gently heat one or two half-inch thick glass block weights on the hot plate until they are sufficiently warm but not too hot to the touch, around 75° C.
5. Place a gellan gel square on top of the area with enzyme solution, then cover with the warm glass block. Let the gel sit for about 15 to 20 minutes, checking periodically to assess adhesive softening. The glass should sufficiently maintain its temperature during this time.
6. After 15 to 20 minutes, or when the adhesive becomes softened, gently roll up the adhesive with a flat-tipped tool (e.g. Delrin *hera*). When the adhesive is sufficiently softened, it should come up smoothly – if it is not responding well, repeat the previous steps.
7. Clearance protocols—to remove residual enzyme—will depend upon the remaining treatment steps. In the case of the chine collé, treated areas were cleared using water-dampened blotters as the print was subjected to several rounds of overall bathing. Similarly, a barrier layer was not used between the gellan gum and the object for this reason.



RESULTS

The gellan gum-enzyme protocol described above proved highly successful in reducing a thick, starch-based adhesive layer from the Alma-Tadema print in a safe and timely manner. Using warmed glass blocks was much more effective in digesting the adhesive than without: in areas where the same enzyme and gel set-up was employed but the glass block was not warmed, more of the adhesive layer remained. Owing to the localized enzyme application and controlled moisture delivery from the gellan gum, the adhesive between the primary and secondary supports was not compromised during treatment. Upon completion of all treatment steps, which included overall bathing and local stain reduction using gellan gum, the verso of the object was free of the thick adhesive layer and significantly less discolored.

This combination of warmed gellan gum and enzymes can be customized to other treatments as well, and the authors hope other conservators will have the opportunity to experiment with it.

ACKNOWLEDGEMENTS

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FURTHER READING

Iannuccelli, S., S. Sotgiu. 2010. “Wet treatments of works of art on paper with rigid Gellan gels,” The Book and Paper Group Annual 29:25-39.

Van Dyke, Y. 2017. “Agarose-enzyme gels in paper conservation,” Gels in the Conservation of Art. pp. 101-6.

SOURCES OF MATERIALS

Kelcogel LA Gellan Gum
CP Kelco U.S., Inc.
3100 Cumberland Boulevard, Suite 600 Atlanta, GA 30339
(800) 535-2687 http://cpkelco.com/products/gellan-gum/

Calcium acetate, monohydrate
Sigma-Aldrich
PO Box 14508, St. Louis, MO 63178
(800) 325-3010 https://www.sigmaaldrich.com/catalog/product/sigald/402850?lang=en&region=US

a-Amylase type II-A
Sigma-Aldrich
PO Box 14508, St. Louis, MO 63178
(800) 325-3010 https://www.sigmaaldrich.com/catalog/product/sigma/a6380?lang=en&region=US

Trizma(R) pre-set crystals
Sigma-Aldrich
PO Box 14508, St. Louis, MO 63178
(800) 325-3010 https://www.sigmaaldrich.com/catalog/product/sigma/t7193?lang=en&region=US

Calcium chloride, dihydrate
Sigma-Aldrich
PO Box 14508, St. Louis, MO 63178
(800) 325-3010 https://www.sigmaaldrich.com/catalog/product/sigma/c3306?lang=en&region=US

Delrin *hera*
Peachey Tools
37 Nagle Ave, New York, NY 10040
(212) 387-7860 https://www.peacheytools.com/shop/delrin-hera

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