

Assaying Klucel-G recipes, application methods in the surface consolidation of tanned bookbinding leathers

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Thanks to: The Proprietors of the Boston Athenæum, Dawn Walus, Stanley Cushing, Jeff Peachey, Olivia Primanis, Dr. Nealia House

For deteriorated leathers, Klucel-G is the most common consolidant in book conservation. However, there are few published notes on its practical use. Instead, anecdotal experiences have shaped everyday practices, resulting in a wide variety of commonly used solvents, concentrations, and application methods. A frequent preparation includes making a stock solution of 2-4% (w/v) Klucel-G in ethanol for use over a span of a few months, applied to leathers as needed multiple times by brush. This research presents a very qualitative attempt, modest in scope and sample size, examining current practices. The visual differences between a small selection of Klucel-G recipes, varied by four solvent mixtures (acetone, 1:1 acetone/isopropanol, isopropanol, and ethanol) and four concentrations (0.5%, 1.0%, 2.0%, and 3.0%, w/v), was tested on small areas of historical leathers from the circulating collection of the Athenæum that did not appear to have been previously treated. Additionally, visual differences were contrasted between two methods of application (brush and spray) of Klucel-G/isopropanol solutions (at 0.5% and 1.0%, w/v) on historical leathers from the circulating collection that did not appear to have been previously treated.

VISUAL RESULTS OF KLUCEL-G RECIPES. Solutions prepared at 21°C and left covered for 4 hours. Solutions applied as evenly as possible, once by brush.

Solvent Key
a = acetone
1:1 acetone: isopropanol
i = isopropanol
e = ethanol

	Klucel-G % (w/v)			
	0.5 %	1.0 %	2.0 %	3.0 %
Sheep skin at fore edges of <i>Obras de Luis de Leon...</i> , Tomo 3. Madrid: La Hija de Ibarra, 1805. Fibers coherent, slightly powdery. Before and after testing.				
Goat skin at fore edges of <i>Elements of Jurisprudence</i> by Richard Wooddeson. Dublin: J. Moore, 1792. Fibers moderately coherent, powdery. Before and after testing.				
Desiccated, powdery sheep skin rebacks (ca. 1900) at spines of <i>Irish Statues, Volume 4, 1703-1719</i> (0.5%, 1.0%), and <i>Volume 7, 1749-1761</i> (2.0% and 3.0%). Dublin: Boulter Grierson, 1765. Fibers slightly coherent, very powdery.				
	a 1:1 i e	a 1:1 i e	a 1:1 i e	a 1:1 i e

Notes

- "Coherence" and "powder" are two criteria used to classify leather degradation. See 'Fibre assessment' by Larsen, Rene, et al., in *ENVIRONMENT Leather Project*. ed. R. Larsen. Copenhagen: Royal Danish Academy of Fine Arts, School of Conservation, 1996. 113-121.
- Why does ethanol cause more significant color changes in these tests? A hypothesis can be found in "Binding Repairs for Special Collections at the Harry Ransom Humanities Research Center" by Olivia Primanis in *Book and Paper Group Annual*, Volume 19, 2000 (footnote 6): "In an email dating to June 4, 1997, Chris Calnan explained that 'Ethanol is a stronger polar solvent than isopropanol and will exert a greater effect on soluble tannin fractions. With highly deteriorated leather the use of ethanol may bring about staining as soluble tan material is leached out and deposited at the surface as the ethanol evaporates off'"

VISUAL RESULTS OF KLUCEL-G (IN ISOPROPRANOL) APPLICATION METHODS. Solutions prepared at 21°C and left covered for 16 hours. Solutions applied as evenly as possible, 2 times for each area. 7.5x magnification.

	0.5 %		1.0 %		
Calf skin of <i>Journal of the General Convention of Virginia</i> . Richmond, Virginia: Wyatt M. Elliott, 1861. Fibers coherent, slightly powdery.					After testing.
	1	2	4	3	
	Spray	Brush	Spray	Brush	
Sheep skin of <i>The Treaty Power Under the Constitution of the United States</i> by Robert T. Devlin. San Francisco: Bancroft-Whitney Company, 1908. Fibers moderately coherent, very powdery.					After testing.
	7	5	8	6	
	Spray	Brush	Spray	Brush	

Potential implications for conservation practice:

- Acetone, ethanol solvents may cause significant color shifts in leather consolidation. If that may be an issue, for example with light colored leathers, it might be best to consider other solvents.
- Lower percentage (<2.0%) Klucel-G solutions in isopropanol may cause less color shifts than higher concentrations. If that is important for your treatment, **consider moving away from solutions >2.0%, and be wary of stock solutions** that may have dried out over time. Consider that each application of Klucel-G solution will result in further darkening.
- **Spray application** of low % Klucel-G/isopropanol may be preferred for suede or reverse leather bindings, and for leathers where flesh layers are exposed.

Observations:

- Acetone, ethanol solvents caused significant color shifts (darkening) even in low concentrations. Increased concentrations of these two solvents *did not* seem to affect the degree of color shifts.
- Isopropanol and 1:1 acetone/isopropanol solvents caused far less significant color shifts. Increased concentrations of these solvents, and increased degrees of application, resulted in increased degrees of color shifts (darkening) in leather.
- Tests of application method resulted in only negligible differences in color shifts (slight darkening, visible only with magnification) for grain layers of calf and sheep skin. However, with brush application, exposed flesh layers of those same skins darkened more significantly (visible without magnification) than spray. More applications, regardless of method, resulted in darkening.
- There were no visible, qualitative differences in surface gloss between brush and spray applications.
- Klucel-G/Isopropanol solutions at higher concentrations than 1% were too viscous for spraying. They could clog the nozzle.
- Klucel-G did not completely solubilize in acetone or 1:1 acetone/isopropanol and remained slightly lumpy after four hours, even in low concentrations.

Thoughts for further research:

- This research is focused on the visual effects of Klucel-G consolidants on historical leathers. It does not attempt to determine its efficacy, or the efficacy of other (well) known consolidants.
- It is difficult to consistently apply even amounts of Klucel-G solutions on a single volume, let alone in testing across many volumes, whether by brush or spray. It would be extremely worthwhile to find consistent and standard methods of application to enable better quantitative testing of consolidants.
- How can we quantitatively compare historical leathers? In order to perform meaningful tests, it must be determined how to characterize historical leathers quantitatively, including assays on how they may have been previously treated.