

Preliminary Notes on Use of Modified Polysulfide Resin as Filler-Adhesive for Losses in Aged Leather

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In recent years, the SPNEA Furniture Conservation Laboratory has viewed and treated several leather upholstered chairs of early 18th century American origin. These were all of a type called "Boston" chairs, made in large quantities in the 1720.s, both for local use and export. Made of maple or birch, and stained to imitate walnut, they were upholstered in traditional manner: narrow linen webbing nailed to the tops of seat rails, covered with a stout hand-woven linen "sacking" to support the stuffing, stuffed with coarse marsh grass, and covered with a thick cowhide. This was apparently wet first, stretched over the rails and nailed with iron tacks. An additional band of leather was applied over the first layer around all 4 seat rails, and secured with brass nails and "white" nails (polished iron rose-head nails, intended to be visible). Seat backs were first covered with coarse linen sacking, equivalent cowhide, and attached with brass nails in a double row around the perimeter. The seats often were stitched through the entire thickness of leather and foundation underupholstery in a decorative pattern, typically trapezoidal or elliptical, with heavy linen cording. This kept the stuffing from shifting away from the center of the seat through use, and provided a decorative touch. Actual seat stitching is usually missing in the condition they have survived, though remnants may be found.

The leather covers themselves were full thickness hide, 3/32" being an average. They were usually walnut brown, evidently to harmonize with the walnut stain on the frame. Most often, the leather has split through aging in irregular cracks. Further shrinkage after splitting may leave gaps of 3/8" or more.

Recent research into the physical and organic chemistry of leather deterioration has shown that long-term maintenance of flexibility and original dimension requires a critical balance between moisture, fat and oil content.

Oxidation or hydrolysis of collagen bonds, accelerated in cases of high sulfur content and acid formation, prevents the fibers from slipping past each other during cyclical expansion and contraction. If moisture content also falls too low, shrinkage and rupture is likely. Over-application of leather dressings, which saturates fibers and crowds out moisture, may further accelerate this process. Old coatings, such as shellac, may also have set up uneven surface stresses and prevented transpiration of atmospheric moisture, and a series of surface cracks may be present.

Traditional treatments for such cracks usually involve removal of the leather from the chair, and skiving in repair leather to match, or stitching across the break with heavy linen thread. Sometimes backing leather was applied with hide glue, but these typically broke loose, or the acidic content of the glue may have further embrittled the leather. More recent fill materials used by leather conservators have included wax-resin mixtures, various flexible casting resins, and shredded leather in a 8-72 Acryloid binder.

Our preliminary research on modified polysulfide filler-adhesive was intended to overcome problems with the above methods relating to reversibility, adhesion, strength, and flexibility.

Though widely used as synthetic rubbers, industrial sealants, leather impregnants, flexible adhesives, corrosion resistant coatings, and epoxy flexibilizers, polysulfides are relatively unknown among conservation materials. They have inherently extremely high resistance to oxidation, low transmission of vapors, extremely high flexibility, and may be formulated to provide variable adhesion. While the presence of sulfur in aged leather may lead to formation of sulfuric acid and advanced leather deterioration, the sulfur in polysulfide polymers is highly bonded, and not subject to reduction except under extreme conditions. Considerable research in industry has focused on polysulfide-epoxy formulations for various applications where strength and flexibility are desired.

For use as a filler-adhesive for deteriorated leather, the properties sought in this study were:

1. resistance to long-term deterioration
2. lack of reactivity with the leather
3. high flexibility, to accommodate further shrinkage
4. easy reversibility without removing the leather from the chair, or other object
5. adequate adhesion on further leather shrinkage, but just enough so the repair-fill would release from the leather under severe shrinkage
6. a long-working time, so it could be molded, shaped, worked before setting
7. correct viscosity, so it would not flow away from the fill area before setting
8. moldability, so it would take the impression of leather grain
9. carveability, so excess material could be cleanly removed after setting
10. ability to be pigmented or colored

Numerous polysulfide resin-epoxy-colorant mixtures were formulated in the lab from among available industrial resins, attempting to balance these requirements. Sample leathers were cut or torn, a backing fabric of coarse linen or non-woven polyester was applied behind the leather, and the filler-adhesive was used to fill the gap, and to adhere 3/811 of the back of the torn leather to the backing fabric. After full curing, each sample was mechanically pulled, stretched, and manipulated to test for flexibility, adhesion, elongation, and deformation. This testing was not done with calibrated instruments. It is hoped that future research may provide funding for more controlled testing.

General observations from preliminary testing

1. Polysulfide resins themselves were too thixotropic for this application. They flowed away from the repair area before setting.
2. Polysulfide resins themselves did not have adequate adhesion to the leather to prevent release when severely stretched.
3. 3-5% epoxy greatly improved adhesion to the aged leather, while maintaining superior flexibility.
4. Sizing the leather first with B-72 where polysulfide filler would contact it was necessary. This prevented penetration of the resin filler deep into leather pores, made leather fibers stand on end to provide a grip for the resin, and allowed the filler to be merely pulled off to release it. The original goal of a formulation which does not require removal of leather from chairs for conservation was thus accomplished.
5. A silicone rubber mold can be made first to take a textured impression of adjoining leather, pressed into the uncured resin, and will give the fill a matching texture.
6. Bulking the filler resin with glass beads and/or powdered pigments increases the viscosity, im-

proves carveability after setting, and reduces adhesion to the leather, thus providing an additional safety margin.

Our final formulation included

97 parts Morton-Thiokol LP-3 Liquid Polysulfide Polymer 3 parts D.E.R. 331 Epoxy resin (Allid Resin Corp./Weymouth Industrial Park/E. Weymouth, MA 02189) Lansco Dry Cement Pigments to match leather color Glass beads as necessary to adjust viscosity

Actual treatment procedure

Edges of the torn leather and the back of the leather about 1/2" away from tears was sized with B-72 in alcohol, 2 coats, and allowed to dry. Non-woven polyester fiber cloth (Pelon) of coarse weave was fished behind each crack, extending 2'1 on either side of crack. On the chair back, coarse-weave linen was substituted for Pelon to match the original linen on the chair, now missing. The linen was adhered to the back of the leather with B-72 in alcohol around its perimeter only. The polysulfide-epoxy mixture was applied in each crack, enough to fill the crack and extend behind the crack about 3/8'1. A sandbag was custom made, to support the underside and backside of the leather and to act as a semi-rigid form to mold the warped leather, isolated from the leather with Saran Wrap, and clamped to the chair frame. The warped edges of the cracked leather were then weighted from the front with a variety of weights so that all leather edges were in proper alignment. A silicone rubber mold, previously taken from adjoining leather areas, was then pressed into the surface of the unset filler resin. When cured, the molds and weights were removed, and excess filler squeezeout was carved and tooled flush with adjoining leather surfaces. Slightly hollow areas of fill were further filled with colored beeswax. All fills were then further patinated with various colored beeswaxes to adjust the appearance in harmony with the original surrounding leather.

Need for further research

Accelerated aging tests should be conducted to determine final characteristics of the polysulfide-epoxy filler material. Long-term reversibility, flexibility, adhesion, and chemical stability should be measured. Instrumental methods of strength and flexibility should be employed to give standard measurements of these factors.

Sources of supply

Polysulfide Resin

Thiokol, Chemical Division, 930 Lower Ferry Road, P.O. Box 1296, Trenton, NJ 08607

Epoxy Resin:

Allide Resin corp., Weymouth Industrial Park, East Weymouth, MA 02189

Non-woven polyester fabrics (Pelon)

Fabric stores have some grades

Talas

Cement Pigments:

Masonry suppliers locally

Silicone rubber mold materials:
Conservation Materials, Ltd., Sparks, NV 89431
240 Freeport Blvd.

Bibliography:

Thiokol technical publications and materials data sheets

Liquid Polymer/Epoxy Compounds --TD# 451 J

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Polysulfide Polymer: 575 L

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