The Use of Aquazol-Based Gilding Preparations

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Abstract: The polymer poly(2-ethyl-2-oxazoline), sold under the trade name Aquazol, is gaining appeal for many conservators due to its excellent adhesive qualities and wide-ranging solubility in polar organic solvents including water. This chemically stable polymer is being used as an adhesive, clear coating, and consolidant. During the last year, substitutions of Aquazol-solvent solutions for hide glue in traditional gilding preparations have been highly successful in compensating conserved gilded objects at the Museum of Fine Arts, Houston. For the compensation of traditional water gilding, these preparations have three major advantages. First, the solvent vehicle can be tailored to avoid disturbing original water or solvent-sensitive surfaces. Second, the use of fast evaporating organic solvents can speed the build up of new surfaces. Finally, unlike water-based hide glues that are often difficult to remove safely, the broad solubility of Aquazol provides a high degree of safety and reversibility to both fills and gilding. As a tool for compensating gilding, Aquazol-based gesso, gesso putty, and bole provide a significant alternative for reproducing the difficult sheen of burnished water gilding.

Introduction

GILDING ON FURNITURE, FRAMES, AND other wood surfaces is one of the most demanding types of decoration to conserve since its multi-layer structure is inherently complex and quite fragile. Gilders prepare wood with many coats of gesso, a mixture of hide glue and chalk. Once the gesso is tooled or polished, it is toned with a colored bole or clay also bound in hide glue. They adhere the whisper thin leaves of gold in one of two manners: by reactivating the clay bole's glue binder with water; or by utilizing an oil-resin adhesive size to adhere the leaf onto the surface. Gilders can burnish water gilded surfaces to a glass-like reflectance that produces dramatic contrasts. Alternately, gilders often further modify their work by applying thin matte layers of glue, glossy layers of varnish or other colorful resins such as dragon's blood.

The traditional approach taken by both gilders and other craftspeople restoring these surfaces has been the wholesale application of a new gilded surface by removing or simply covering over damaged gilding. This approach offers more control than local mending and assures a high degree of uniformity. Unfortunately for the interpretation of many sophisticated gilded surfaces, this wholesale approach also lends itself to the use of more accessible and less demanding techniques that are inconsistent with the original surface's aesthetics. Typically, conservators find this treatment as the substitution of a matte oil gilding or metal powder paints applied over a more labor-intensive, highly burnished water gilded surface.

Today, the conservation of gilded surfaces and objects is removed from this arena less by materials or techniques than by our attempts to respect the integrity and aesthetics of the original surfaces. Most conservators still employ the same traditional hide glue-based gilding materials to insure compatible, consistent results for their compensations. In truth, few treatment options exist that purely satisfy a necessary respect for original surfaces and the aesthetic desires of owners and institutions.

Alternatives to Traditional Gilding

Many conservators have advanced alternative gilding strategies designed to be more controllable and reversible than traditional gilding (*Thornton 1991*). Conservators have developed a wide variety of simple and effective techniques for compensating

oil gilding and other low sheen gilt surfaces. An example of a such a technique would be the use of synthetic adhesives, such as an acrylic emulsion, as a size for adhering gold leaf. This substitution of a soft synthetic adhesive for the reactive drying oil-resin size can insure both ease of application and a degree of reversibility. Interference paints and mica powders are also becoming popular for compensating oil gilded, stenciled, and distressed surfaces. Unlike metal powders that can oxidize and discolor, these materials are inert. Unfortunately, conservators have very few techniques for compensating burnished water gilded surfaces with as much ease or reversibility. Most easily soluble adhesives are not hard enough to withstand the action of burnishing. Those that are, such as Acryloid B-72, epoxy, and polyester are not very sympathetic with the movement of hide glue-based gilding preparations and can delaminate as the surrounding surfaces respond to changes in humidity.

Most alternative water gilding materials are themselves water borne. A common substitute for local water gilding repair is the proprietary product "Kölner's burnishing clay." These clays come in several pre-mixed colors suspended in a water borne adhesive, usually cellulose ether, that can be removed later in acetone. (*Thornton 1991, 225-226*) The adhesion of the these clays however, is only moderately good and flaking often occurs with burnishing.

Several conservators have achieved good results using water borne polyvinyl alcohol as a substitute for hide glue in both gesso and bole preparations. Polyvinyl alcohol is a hygroscopic polymer produced by reactive conversion of polyvinyl acetate. The varying degree of substitution and molecular weight of the final product affects the solubility of the polymer in both water and alcohol. (*Hebrard and Small 1991, 279-282*) Gilding executed with polyvinyl alcohol is both sympathetic with water gilding and can be burnished to a highly specular sheen like its hide glue counterpart. These gessos and boles are both largely reversible in alcohol without disturbing extant gilding. Unfortunately, polyvinyl alcohol is not a flawless substitute for hide glue. Some settling of the inert fillers occurs in a water-borne layer of gesso and bole as they dry that makes them difficult to sand or recut. Disconcerting questions also exist regarding the decreasing solubility of polyvinyl alcohol as it cross links with several common salts. (*Hebrard and Small 1991, 281*)

The paucity of alternatives for compensations of burnished water gilding still exists since most conservators rely on local re-gilding with traditional hide glue-based gesso and bole. This is particularly true when compensating complex surfaces where the gesso is re-cut after application. Ultimately, we must confront the major shortcomings of this traditional compensation. First, even in the most conservative approach, the use of water brings a potential to stain and remove gilding. The smoothing and polishing of fills and bole layers with water often result in further loss of original surface. While adequate isolating barriers mitigate wholesale loss of the gilded surface, some loss is unavoidable. Second, the lack of real retreatability of gesso fills and blended layers of bole and gold leaf poses serious concerns for the future care and preservation of these objects.

Aquazol-Based Gilding

The lack of a reliable alternative for compensating water gilding has driven the exploration of a solvent-borne gilding technique for conservation efforts at the Bayou Bend Collection of the Museum of Fine Arts, Houston. The resulting preparations and techniques have proven efficient and durable in compensating water gilding as well as a variety of other types of gilded decoration.

This gilding system substitutes solvent-borne solutions of poly(2-ethyl-2-oxazoline) for water borne hide glue binders used in traditional gilding preparations. The polymer, sold under the trade name Aquazol, is widely soluble in polar organic solvents such as acetone, alcohols, or methylene chloride, as well as directly in water. The long polymer chains of $-(C_5H_9NO)-$ units have unusually high molecular weights with low viscosity. Aquazol polymers are presently produced in three molecular weights of approximately 50,000, 200,000 and 500,000. (*Polymer Chemistry Innovations 1994*)

Aquazol has already achieved some popularity in conservation circles because of this wide-ranging solubility and a high, glass-like refractive index of 1.52. Conservators have exploited its broad

adhesive and wetting qualities for consolidating paint and laying down reverse painted decoration on glass. Aquazol's hygroscopic character, which makes it compatible with the movement of traditional gliding, and solubility in solvents that would not disrupt existing passages of decoration, made it initially desirable for consideration.

The stability and aging characteristics of Aquazol polymers have been tested on a limited basis. (*Wolbers et al. 1994*) The results of this accelerated aging study, representing approximately 50 years of aging, support that Aquazol polymers are light stable and maintain both their neutral pH and their broad solubility with aging. The molecular weight of the polymers did decrease after accelerated aging due to scission of the long polymer chains. This was most notable with Aquazol 500. Its molecular weight decreased from an initial level of 300,000 to 210,000. This suggests that the solubility of these polymers might actually increase with aging although this may result in some loss of strength. Wolbers also noted that unlike hide glue this polymer maintains a plastic deformation with little embrittlement at low relative humidity.

Aquazol-Based Preparations

The highest molecular weight polymer, Aquazol 500, dissolved in ethanol, has been substituted at comparable concentrations for the stock hide glue in several different recipes of both traditional gesso and bole. The high molecular weight solution of Aquazol in a fast evaporating solvent to some degree mimics the thermoplastic gelling of hide glue. This allows a minimum "open time" during which settling of the inert filler can occur, resulting in layers that act more uniformly. The successful results achieved with each recipe indicate a relatively forgiving material.

Use a stock 10% weight by volume solution of Aquazol 500 dissolved in ethanol in formulating the gesso, gesso putty and bole preparations below.

Gesso (liquid):
One part 10% (w/v) solution of Aquazol 500 dissolved in ethanol
One part inert filler consisting of gilder's whiting (chalk) and kaolin

The exact proportions of the inert filler are in most ways a matter of personal taste. In general, the gesso layers should be matte but not friable to the touch. Pigment to volume concentrations of 80-90% are common in traditional gesso formulations. (*Mecklenburg 1994*) The inclusion of kaolin as one-quarter to one-half of the volume of the inert filler adds two important qualities to this preparation. First, it helps provide a more velvety texture to the gesso that allows you to brush it out more smoothly. Second, the clay particles help prevent the settling and compacting of the chalk in the liquid gesso between uses. Along with chalk and kaolin, you can add barium sulfate (at approximately 15-20% of the filler) to render fills opaque for purposes of identification using x-radiography. (*Thornton 1991, 219-220*)

Gesso (putty):
Liquid gesso (see above)
small amount of additional inert filler

Incorporate a little chalk into a puddle of liquid gesso and work the mass with a pallet knife until it forms a uniform putty that still adheres to the glass. Work this putty into a ball and use it to fill deeper losses.

Bole:
One part of gilder's clay (pre-moistened to a buttery consistency in the solvent)
Four parts stock 10% (w/v) solution of Aquazol 500 dissolved in ethanol.

You can use pre-moistened clays that have been dried and re-wetted with solvent to the same consistency for this purpose. It is crucial that the clay be pre-moistened in the solvent since small lumps are almost impossible to disperse later. The above concentrations are variable depending on the porosity of the gesso surface as well as the number of coats you apply.

Application

Since all of these preparations have a fast evaporating vehicle, they should be stored in tightly sealed containers such as small (125 ml) wide mouth jars with tightly fitting plastic screw tops. If necessary, thin solutions with more alcohol if they have been open for an extended period. Maintain the gesso putty for extended periods in a sealed jar with a solvent soaked rag or paper towel.

Apply thin layers of gesso and bole using a soft brush. Generally you can apply another layer as

Figure 1. Test blank with Aquazol gesso and bole layers and test blank comparing burnished and unburnished gilded surfaces.

soon as the surface looses its shine and most of the solvent has evaporated. Remove any excess or overruns with solvent on a swab. Fills can be shaped with tools or balsa wood forms, and feathered using abrasive papers or solvent-saturated linen or silk cloth.

Gilding Using Aquazol Preparations

The technique of adhering gold leaf to a surface with these preparations is essentially the same as water gilding. Flood the surface with a soft brush charged with pure solvent such as ethanol (or solvent with less than 0.25% (w/v) of Aquazol, in place of the traditional gilders liquor). Take care not to work the brush against the surface since this will disturb the bole. The surface must be equally wet with solvent just before setting the leaf down and allowing it to be drawn down onto the bole surface by the absorption of the solvent. The rate of evaporation of ethanol is dramatically greater than that of water, so it is beneficial to work with smaller areas to reduce the amount of potential faulting. Staining caused by solvent and bole bleeding through a tear or running onto a freshly gilded surface does still occur. Over-gild the stain as you would with water gilding.

The gilded surface must be almost completely dry (within a few hours after application) before burnishing with either an agate or bone burnishing tool. Like traditional water gilding, there is a window of opportunity to achieve maximum shine. If you leave a surface to dry completely, you can only achieve a mild sheen to the surface with these materials. *(fig. 1)*

Coating

The solubility of Aquazol in both water and alcohol limits the use of traditional gums, glue, and shellacs for clear coating and toning. The application of coatings with polar solvents will, at the least, disrupt a burnished surface and has the potential to dissolve and remove the gilding entirely. However, you can use clear coatings such as B-72, B-67, dammar, and Soluvar that have aromatic or other non-polar solvents.

Case Study

To date, the most in depth use of these preparations has been the treatment of a water gilded and white painted arm chair

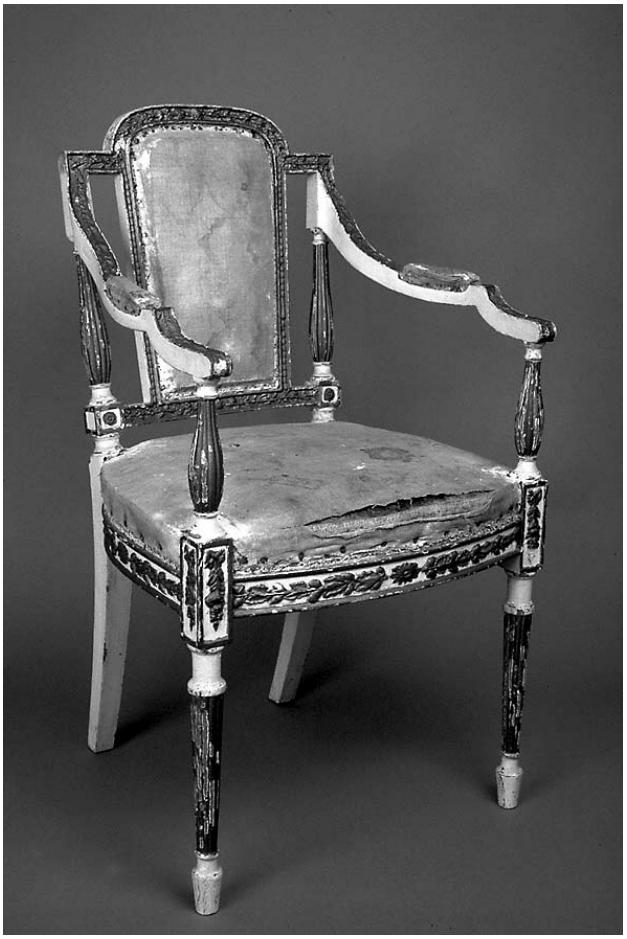

Figure 2. Cabriole Chair, 1785-1805, Philadelphia. Bayou Bend Collection, museum purchase with funds provided the Theta Charity Antiques Show. Before Treatment.

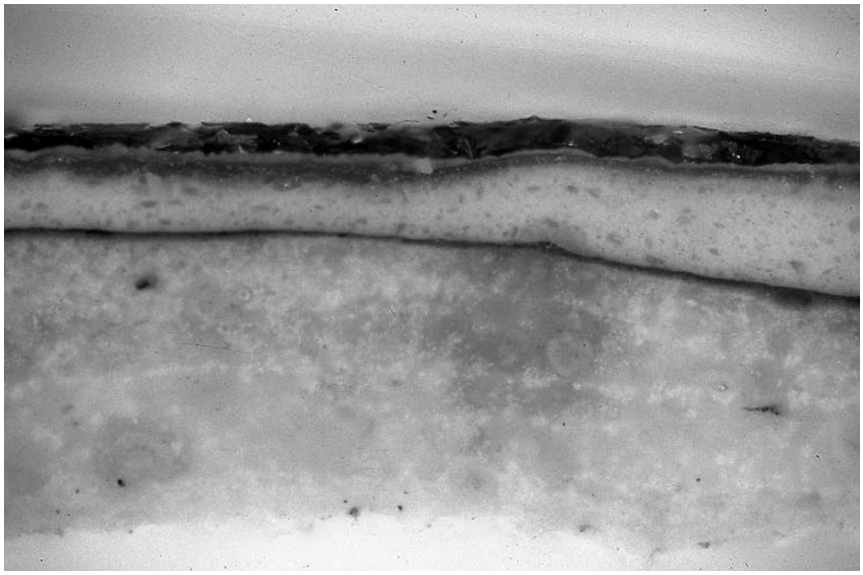

Figure 3. Cross-section of gilded decoration from chair, 250x. Above the thin line of original water gilding, layers of paint, oil gilding and bronze powder paint can be seen.

made during the late eighteenth century in Philadelphia. The Museum's Bayou Bend Collection purchased this chair in 1991. It is one of a set of eight such armchairs owned privately and in public institutions that document a brief popularity of continental white-painted and gilded decoration in Philadelphia.

The condition of each of these chairs has been a testament to the slippery slope of wholesale restoration. *(fig. 2)* Originally, the ash chair frames and applied composition ornaments were gessoed and broadly water gilded before the backgrounds were painted with a lead white distemper paint (*Shelton 1994*). Microscopy revealed two major campaigns of restoration. *(fig 3)* In the first campaign, the restorer sanded any losses and flaking surfaces before painting the surface overall with a white oil paint and oil gilding approximately the same design. During the second campaign, a restorer covered this surface with a white emulsion paint and bronze powders which have discolored extensively.

After considerable consolidation of the flaking surfaces with gelatin, the thick layers of restorations were easily removed using polar organic solvents. The true condition of the chair's decoration was clearly evident: in addition to losses due to the inherent fragility of the gilding, the restorers had left a highly variable surface with full survival adjacent to sanded, exposed wood. *(fig. 4)* Since both the burnished gilding and lead white distemper decoration were water soluble, the merits of an alternative solvent-based gilding compensation technique were immediately obvious.

The goal of the treatment was to produce a consistent appearance that would allow the remaining original gilding to represent itself well. Missing composition ornaments were replicated using new composition molded in casts taken from existing elements. The process of gilding began by applying an isolating barrier of B-72 dissolved in xylene to protect the existing gilding from possible abrasions. The losses were filled with several brushed applications of Aquazol-based liquid gesso and shaped with solvent using a brush and tightly woven linen pads. On the convex reeds of the legs and arm supports, a balsa wood form cut with gouges to the proper curved shape was used to aid shaping and contouring the fills. A smooth final surface was achieved using abrasive papers where it was safe on large fills (600 or higher grit) or by polishing with a linen pad. Two brush coats of bole cover both the fills and areas where the gilding and bole had been worn away. *(fig.5)*

After the surfaces had dried thoroughly, the bole was wet with pure alcohol and a piece of 23K gold leaf was applied to allow the absorption of the solvent to draw the leaf down. Very exact application was possible because the leaf was isolated from the existing passages and could be easily removed with solvent.

The gilding was burnished to a matching degree of shine within a few hours of application. Later, the localized protective coating was removed and a clean coating of B-72 dissolved in xylene was applied over the entire surface. This coating isolates the surface from further color work and provides an added degree of protection. *(fig. 6)*

Figure 4. Detail after cleaning. Remnants of the original gilding and white-painted distemper paint are visible.

Figure 5. Detail after replacement of missing ornament and application of Aquazol gesso and bole.

Conclusions

While this system has proven very effective, conservators must consider the use of alcohol or other organic solvents in each case. *(fig. 7)* Period toned lacquer and varnishes would be an unfortunate casualty if they were not identified prior to treatment. Also, there is potential for disruption of an adjacent surface gilded with varnish or an oil size, often found on a frame or molding. In practice, using alcohol or other solvents instead of water in gilding has both benefits and drawbacks. The speed at which alcohol evaporates can increase the speed at which you can build a surface. However, you must adjust your technique to limit the amount of surface wet at any one time, as well as work swiftly and with certainty.

Although the results of treatments with this system are good, more testing of both Aquazol polymers and these gilding preparations is required to better understand their properties and potential liabilities. Gilding will always remain a difficult decoration to conserve. By utilizing the broadly soluble Aquazol polymers instead of hide glue, it is possible to compensate even delicate burnished water gilded surfaces with a great deal of control. The benefits of this system are numerous. The polymer appears stable and maintains its solubility in accelerated aging tests. Aquazol-based gesso and bole preparations can be delivered in a range of organic solvents tailored to the needs of the object. These preparations have also proven to be surprisingly forgiving. Most important, these preparations can provide a range of reversible treatment options for conservators.

Acknowledgments

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Figure 6. Detail after gilding and burnishing.

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Materials List

Aquazol polymers available from Polymer Chemistry Innovations, Inc. 4231 Fremont Ave., Tucson, Arizona 85714; phone (520)746-8446.

Gilders whiting, pre-moistened clays, gold leaf, etc. available from Sepp Leaf Products, Inc. 381 Park Avenue South, New York, New York 10016; phone (212)683-2840, fax (212)725-0308.

Figure 7. Overall view of cabriole chair after completed treatment.