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2-2-2004

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THE EFFECTS OF LIGHT AND AGEING ON SELECTED QUILTING PRODUCTS CONTAINING ADHESIVES

by

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Introduction

A quiltmaker's choice of materials, including fabric, batting, thread and other materials influences the lifespan of a quilt. It is disappointing, and sometimes devastating, when components prematurely yellow, stiffen or weaken with age. Although conservators and conservation scientists have evaluated archival-quality adhesive products and determined which ones are acceptable for use in conservation treatments, there were no published results concerning the long-term performance of adhesive-containing products available to quiltmakers and home sewers. Consequently, they could not make informed choices. Therefore, the purpose of this study was to determine whether or not selected adhesive-containing products for quilters, specifically quilt basting sprays, fusible webs, and fusible battings, contribute to discoloration or promote degradation of fabrics over time.

Quilt basting sprays have been available for some time and are used to temporarily bond a quilt top and backing to the batting in lieu of pin or hand basting with a needle and thread. They use solvent-based adhesives, but the chemical constitution of the products is proprietary. Most brands proclaim their adhesives to be colorless, nontoxic, non-staining, acid free and to have little or no odor. Sulky® brand label claims "bonding disappears in 2-5 days". Sullivans' labeling information asserts the bond of their adhesive spray is temporary, repositionable, and can be reactivated with steam. The Spray and Fix® label claims that their adhesive spray will not discolor fabric and that the bond dissipates after 6 months or when laundered. While it is likely the adhesive bond may dissipate over time, the adhesive compound will not disappear. Therefore, it seems highly unlikely that adhesive sprays will not eventually cause fabrics to discolor.

Battings and webs coated with a resin or heat-activated adhesive "baste" the fabric to the batting when ironed in place and thereby eliminate traditional basting. Fusible battings have been around for less than two years and include products from June Tailor, Stearns and Hobbs. The adhesives used in fusible battings remain proprietary.

Fusible webs have been available for more than thirty years and are used for appliqué techniques, as well as for "basting" fabric to batting. Stitch Witchery®, developed and

trademarked in1969, is a polyamide polymer, which patent records describe as a "thermally activatable adhesive in net form." Pellon®'s Wonder-Under® is also a polyamide-based adhesive product, which became available commercially in 1986 according to U.S. trademark records.

Polyamide polymers are known to be particularly susceptible to photo-oxidation from ultraviolet light and heat. HeatnBond™, available since 1989, is a mixture of polyvinyl alcohol (PVAL) polymers, resin and a tackifier according to the company. PVAL in its pure form has been used for conservations treatments for many years. However, it is known to stiffen over time. In addition, it has not proven as stable to light and heat as conservators initially thought.

Textile scientists and conservators aware of these adhesive-containing products for quiltmaking purposes have expressed concerns about them because the conservation science literature is filled with reports about the deleterious effects of adhesives on textiles. Most notably, Jane Down and her colleagues at the Canadian Conservation Institute have investigated the effects of adhesives since the early 1980s because of observations of stiffening and discoloration caused by adhesives used in the repair of paper and textiles. The adhesives in these quilting products may be water-soluble as claimed during the first few months after application, but it is unlikely that any adhesive-containing product will remain water-soluble indefinitely. Furthermore, it is impossible for any adhesive to simply "disappear."

Materials and Experimental Methods

The resistance of fusible webs, temporary-bond adhesive sprays, and fusible battings to light and heat were evaluated in this study. Fabric assemblies were created using the three categories of adhesive-containing products. The adhesive in fusible webs and battings activate when an iron applies heat, thereby bonding fabric to the batting. Adhesive sprays are not heat activated; rather they are pressure sensitive adhesives. The adhesive spray products were sprayed on the backside of fabrics, left to dry until tacky and then attached to the batting.

Fabric assemblies were constructed using a mercerized and bleached 100% cotton muslin (Testfabrics) as the top layer and Hobbs Heirloom® bleached 100% cotton batting as the bottom layer. The two layers were bonded together with an adhesive spray or a fusible web. Adhesive sprays included in this study were Sullivans, Sulky® KK2000™ , and Spray & Fix® 505. The fusible webs included Stitch Witchery® (Bostik, Inc.), Pellon® Wonder-Under® (Freudenberg Nonwovens Ltd.) and HeatnBond™ (Therm O Web, Inc.).

Fusible battings included June Tailor™ 100% polyester Low Loft Fusible Batting ™, Stearns Mountain Mist® WHITE GOLD 100% cotton Fusible Batting, and Hobbs Heirloom®

80% cotton/20% polyester blend Fusible Batting. Fusible batting fabric assemblies differed from the others in that the fusible batting was sandwiched between two layers of cotton fabric because the adhesive was applied to both surfaces of the batting.

Two sets of controls were prepared without adhesive products. One set contained a top layer of 100% cotton fabric stitched to Hobbs Heirloom® bleached 100% cotton batting. This control was used for the adhesive sprays and the fusible webs. The other set of controls contained two layers of cotton fabric with a non-fusible batting sandwiched between and stitched together to provide controls for the fusible battings. Three replicate specimens were prepared for each product for evaluation under both light and heat ageing conditions.

University of Nebraska's Department of Chemistry Research Instrumentation Facility was enlisted to identify the chemical classification of the adhesive spray and fusible batting products. Fourier transformed infrared (FTIR) spectroscopy was employed to determine the chemical classification of the adhesive sprays. The three adhesive sprays were identified as polyvinyl acetate (PVAC) products. Archival-quality PVAC is known to be a stable adhesive and has been used in conservation treatments for more than sixty years.

Fusible batting adhesives were examined by proton nuclear magnetic resonance (NMR),. Findings suggested that all three fusible battings incorporated similar adhesive compounds; all contained ether and/or epoxy groups, but a host of compounds contain such groups. Therefore, it proved impossible to identify the chemical class of the adhesive compounds without employing additional, expensive analyses, which funding did not permit.

To determine whether or not quilting materials containing adhesives would yellow, weaken or stiffen over time, specimens cut from the fabric assemblies were exposed to accelerated ageing in an oven or to light in a machine that allowed continuous light exposure for 24 hours a day. The specimens were exposed to 6 and 36 hours of accelerated ageing at 135◦C because this temperature did not exceed the recommended application temperature of the fusible webs. In addition, conservation scientists have equated 7 hours of ageing at 140° C to a lifespan of approximately 20 years and 36 hours of ageing at 140° C to a 100-year minimum lifespan, which might be an expected life of an heirloom. Specimens were exposed to 40 and 80 hours of artificial light because selected household textiles (e.g. draperies) are expected to withstand 40 hours of accelerated xenon light exposure according to voluntary industry guidelines. Household textiles capable of withstanding 80 hours of artificial light without fading or yellowing are regarded as superior. Following light exposure and ageing, changes in color, breaking strength and stiffness were measured.

Results and Discussion

Results showed that some adhesive sprays yellowed more than others. Specimens containing Sullivans' adhesive spray yellowed significantly more than the control or specimens containing any other adhesive spray following both 40 and 80 hours of light exposure, as well as following 36 hours of accelerated ageing. On the other hand, Sulky® adhesive spray specimens exhibited significantly greater strength losses (~35% loss) compared to the control (~5% loss) or other adhesive spray specimens following 40 and 80 hours of light exposure and following 6 and 36 hours of ageing. Despite significant discoloration associated with Sullivans' spray adhesive, it exhibited no more strength loss than the control. Spray and Fix® was the only adhesive spray product for which there were no significant differences from the control in terms of yellowing or strength loss.

The differences observed between adhesive sprays were probably due to differences in additives incorporated in the product formulations. Since all three adhesive sprays were polyvinyl acetate adhesive products and yet they performed quite differently, it is apparent that knowing the basic chemical classification of an adhesive spray product provided on the product label is not enough information to make an informed decision. Quiltmakers who wish to use an adhesive spray in a quilt they intend to become an heirloom should select Spray and Fix. The makers of Sulky® and Sullivans' may wish to reevaluate and modify their product formulations.

None of the fusible webs exhibited significant yellowing, stiffening, or strength losses following 6 hours of ageing or 40 hours of light exposure. This suggests that fusible webs would perform acceptably in quilts and household textiles intended for a lifespan of less than one hundred years.

On the other hand, following 36 hours of accelerated ageing all of the fusible webs exhibited undesirable yellowing and bleed through. However, HeatnBond™ – the polyvinal alcohol-based adhesive formulation – yellowed significantly more than the others. Additionally, HeatnBond™ exhibited significantly greater strength losses after 36 hours of ageing than the control or any other fusible web. On the other hand, Wonder-Under® (a polyamide-based web) exhibited significantly greater amounts of color change than the control following 80 hours of light exposure. However, this color change was not yellowing. Instead, Wonder-Under® exhibited significant product bleed through, making the appearance unacceptable. In addition, Wonder-Under® exhibited significantly greater stiffening than the control following 36 hours of ageing. These findings suggest that fusible webs should not be incorporated in quilts that makers hope will become heirlooms. It is also clear that knowing the general chemical classification of an adhesive provided on a product label is not enough information to make an

informed decision, since the two polyamide products (Stitch Witchery® and Wonder-Under®) behaved very differently from each other.

All fusible batting products exhibited more yellowing following accelerated ageing than they did following light exposure. However, none of them exhibited more yellowing than the controls. In terms of strength loss and stiffness, none of the fusible batting fabric assemblies were significantly different from controls. This was true following both light exposure and accelerated ageing. When incorporated into fabric assemblies, fusible battings exhibited less color change than fabric assemblies containing adhesive sprays or fusible webs. The adhesives used in the fusible battings proved to be the most stable to heat and light of any of the adhesive-containing products evaluated in this study.

Conclusions

In conclusion, the fusible battings evaluated in this study were the only adhesive-containing products that appear acceptable for quilts intended as heirlooms, as well as ones made for shorter term enjoyment during one's lifetime. The fusible webs evaluated proved acceptable for quilts intended to last for less than 100 years. However, they can not be recommended for quilts intended to be handed down from generation to generation or for studio art quilts intended for sale to serious collectors or museums. Most museum curators or knowledgeable collectors will not want to pay thousands of dollars for a quilt that has a projected lifespan of less than one hundred years, and possibly only twenty to fifty years.

Finally, all of the adhesive sprays tested, except Spray and Fix®, were associated with significant yellowing or strength losses following both shorter and longer periods of ageing and light exposure. Because additives vary so much from product to product and negatively influence product performance, it is impossible to make recommendations concerning adhesives by chemical class. Therefore, quiltmakers should carefully consider their long term expectations for each quilt they make and select adhesive-containing products accordingly.

Acknowledgements

We gratefully acknowledge the financial support provided for this research by the International Quilt Association and *Quilter's Newsletter Magazine*.