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Author(s): Chris McGlinchey and Bing Yuan
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INVESTIGATION OF ADHESIVES FOR RC PRINTS

Chris McGlinchey and Bing Yuan

Presented at the 2003 PMG Winter Meeting, San Juan, Puerto Rico

Abstract

This research project, conducted jointly between The Museum of Modern Art and the Polymer Research Institute at Polytechnic University Brooklyn, is investigating adhesives for polyethylene resin-coated (RC) photographs. The research group is investigating Amorphous Polyolefins for use as the main component to a conservation adhesive. Our present findings indicate that an adhesive formulation with properties between a typical pressure sensitive adhesive and a heat-seal formulation appears promising and is best described as an 'ultra-cool' melt adhesive.

Introduction

Adhesives rely upon interactive forces between the adhesive and the substrate to draw the two materials together. The adhesive 'sets' in three possible ways: an increase in molecular weight (cross-linking), solvent loss, and / or cooling. Adhesives that fall into the latter two categories are thermoplastic and describe most of the adhesives used in conservation processes and are the class of materials this research is limited to. With thermoplastics, the interactive forces are based on reversible secondary bond interactions. These secondary forces range from weak van der waals forces exhibited in aliphatic hydrocarbons to stronger forces including hydrogen bonding found in more polar compounds. Barring significant molecular degradation, thermoplastic type adhesives are reversed through some combination of solvent and or heat. The reversal via secondary forces is what makes these materials reversible under conservation guidelines.

One adhesive to be developed for a conservation application is the ethylene-polyvinyl acetate (EVAc) copolymer based heat-seal adhesive, Beva 371. This material was developed as a lining adhesive for paintings though paper and photograph conservators have also used it successfully for some applications. However, EVAc based adhesives are not ideal for non-polar surfaces like the polyethylene cladding of RC prints. When the substrate is polar, the high cohesive energy density from the vinyl acetate domains is an asset: the internal forces that account for the high cohesive strength are balanced out by the attraction the adhesive has for the polar substrate. This is an example of an adhesive that has both good adhesive and cohesive strength. When the substrate is non polar, which is the case with RC prints, the high cohesive strength of vinyl acetate does not have the same affinity for the substrate and, over time, the adhesive can pull away. In developing an adhesive specifically for non-polar substrates one must focus on weak van der Waal's forces to produce an adhesive bond.

Hydrocarbon rubbers, both natural and synthetic, lack the high cohesive energy density of PVAc and will more permanently bond to a non-polar surface. Unfortunately, they are chemically unstable and posses a fraction that is both low molecular weight and low Tg which will eventually separate out from the formulation and risk staining the print. In addition, they may increase their cohesive energy through oxidative degradation that would give rise to the same cohesive forces that could lead to delamination.

Research is focusing on a class of copolymer resins known as Amorphous Polyolefins as that chief component in an adhesive formulation for RC prints.
Amorphous polyolefins (APOs) are a class of hydrocarbon copolymer resins that contain a crystalline polyethylene phase (similarly to EVAc copolymers) but have amorphous polypropylene segments. The amorphous component of these resins is the origin for the resin's ability to wet a surface. Since the APO is a copolymer, the 'sticky' component is chemically bound to the polymer and will not migrate out. The degree to which this covalently bonded wettability is limited and commercial formulations of PSA tapes contain low molecular weight liquid additives are used to improve 'quick-tack'.

It was found that in developing an adhesive with reduced 'quick-tack' that slightly elevated temperatures were necessary to activate the bond. A series of APO test adhesives have been made and applied to a tape carrier support. It was found that 40^{o}C (104^{o}F) is a safe activation temperature to use for a brief time and that some of the test formulations are capable of supporting the weight of a large RC print. To apply an even pressure to the entire area of the tape join, steel blocks were submerged in a 40^{o}C water bath. The blocks were machined to cover the entire face of the tape join and are 2.5 cm thick. This thickness yielded what is approximately light finger pressure, about 20 g/cm^{2}.

The present trait of all adhesives under examination is that they require a slight elevation in heat. Thus, we are considering this a development of a new type of adhesive, an 'ultra-cool' melt to distinguish it from cool melt adhesives that are activated at about 65^{o}C. Further testing will help determine the optimal adhesive formulation and will be the subject of forthcoming publications.

Chris McGlinchey
The Museum of Modern Art
11 West 53rd Street
NY, NY 10019

Bing Yuan
Polytechnic University
6 Metrotech Center
Brooklyn, NY, 11201

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