Evaluation of Archival Tapes : A Preliminary Report

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I. Introduction

A great variety of tapes of both the pressure sensitive and gummed type are currently available from manufacturers. They are very easy to use but little information is currently available concerning their stability and reversibility. A project in the Conservation Processes Research Division of CCI was initiated in order that the tapes could be evaluated and recommendations made regarding their archival and conservation use.

After initial screening (on the basis of pH) eight tapes were subjected to testing. They include: Filmoplast P, P90 and SH tapes; 3M #415 double-sided tape and #924 transfer tape; Archival Aids Document Repair Tape and Framing Tape; and an Holland gum tape.

The basis for a chemical evaluation was provided by the Tappi hot and cold extraction methods of pH determination as well as measurement of brightness change, carried out before and after accelerated thermal ageing (21 days at 70°C and 35% RH). The experimental procedure included assessment of 1. the tape alone, and 2. the tape applied to five different paper supports. The papers used were a buffered Permalife, an unbuffered all-rag bond, an unbuffered processed wood pulp, a wood pulp book paper dated 1926 and a ledger paper dated 1917. Information concerning the extent of ageing was provided by viscometric DP performed on paper before and after ageing.

A second set of samples in which tape was applied to paper was similarly prepared and aged so that a subjective assessment of the ease of removal of the various tapes could be reached. Five papers which offered a variety of problems in tape removal were chosen: Minokichi Japanese paper (Mulberry, Aiko #211), machine made wood pulp, handmade European paper (Barcham Green, Dover), watercolour art paper (Sanderson), a wood pulp book paper dated 1926 and a ledger paper dated 1917. The solvents tested include water, ethyl alcohol, acetone, ethyl acetate, petroleum ether, trichloroethylene, hexane, toluene, methylene chloride, tetrahydrofuran (THF), dimethylformamide (DMF), and dimethylsulfoxide (DMSO).

II. Summary of Results

1. Reversibility

All solvents worked to some extent with the Archival Aids Document Repair Tape although there was increased chance of fibre damage with solvents which swell the paper. Similar results were obtained with the Filmoplast SH tape. Adhesive residues could not be removed safely with water or alcohol. The Filmoplast P and P90 varied from the first two in that they gave some variable results with less polar solvents and skinning was a problem with water, ethanol or DMSO. The carriers of these tapes tended to separate easily from the paper leaving the adhesive behind. Use of water first to remove the carrier alone, seemed to make adhesive removal more difficult. The 3M #924 and 415 gave similar results with ethylacetate, acetone and THF working best. Success was poor with the other solvents. As would be expected, the Holland Gum

Tape did not respond well to organic solvents. However, water should work with some soaking. Reversal was a real problem with the Archival Aids Framing Tape. DMF was probably the best solvent.

Since observations of this type are rather subjective, it is not possible to draw definitive conclusions. The degree of calendering, sizing, absorbancy and degradation of the paper, as well as the permeability and thickness of the tape carrier can be as important as the chemical characteristics of a given adhesive. Volatility and surface tension of the solvents can also be critical. However, an overall evaluation for all the tapes suggests that acetone, ethylacetate, THF and DMSO are among the best solvents for tape removal. Health and safety indicates that acetone and ethyl acetate should be tried before the more toxic THF or DMSO are used.

2. Chemical Evaluation

2.1 pH Analysis

Both the hot and cold extraction methods of analysis gave very similar results with the individual tapes not changing more than one half a pH unit as a result of ageing. In general, the samples of paper plus tape changed no more and in some cases less than the tapes alone. When the results for all five papers were averaged, three tapes (Archival Aids Framing Tape, 3M #924 and 415) showed no statistically significant change. Only barely detectable changes were observed with the Holland Gummed Tape. The remaining four tapes (Archival Aids Document Repair Tape, Filmoplast P, P90 & SH Tapes) showed an average decrease in pH of 0.5 units.

2.2 Estimation of Yellowing by Reflectance Measurement

Similar favorable results were obtained with the reflectance analysis. When observing the paper side without tape, only one tape (Holland Gum Tape) caused the paper to yellow very significantly more than a paper blank without any tape. The other seven tapes did cause some yellowing but at a level which was detectable by instrument, not by eye.

Rather different results were observed when looking at the tape side of the paper. The changes observed with all the tapes were significant and could be detected by visual inspection. The tape that yellowed the most was the Archival Aids Framing Tape. Its change was around 8% R or 0.040 absorbance units. The four tapes Holland Gum and Filmoplast P, P90 & SH, yellowed about 20% less. The tape that yellowed the least was the Archival Aids Document Repair Tape. It showed a change which was less than half the framing tape. However, this favorable result may be due more to the fact that the tape is very thin than to a very significant superiority.

III. Conclusions and Future Work

The conclusion from the reflectance results is that with the possible exception of the Holland Gum Tape, the tapes do not greatly affect the colour of the paper artifact they are adhered to. However, the tape itself will probably yellow at a rate faster than the paper artifact. The observations we have made from our data leads us to consider that the use of these tapes

may be objected to as much on aesthetic grounds as on chemical reasons. However, we do not believe our results to date to be definitive and are particularily concerned that tapes which may be used in direct contact with artifacts be tested further.

Therefore, this project has now entered into a second phase where we plan to more extensively age those tapes which remained above pH 6.0 during Phase I. Since our first experiments did not show much variation as a function of paper type, these later tests will be done on only a naturally aged rag paper. They will be evaluated relative to a control of a good quality bast fibre Japanese paper adhered to the rag substrate with a traditional starch paste. We are also subjecting samples of all eight tapes adhered to all five paper types to natural ageing in the dark. The full results and data of the first phase of this project will be published along with those of Phase II.

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