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The Use of A-D Strips for Screening Conservation and Exhibit Materials

INTRODUCTION

Recently the Image Permanence Institute introduced a product for monitoring the outgassing of acetic acid in acetate film collections. A-D strips are paper-based indicators which use bromcresol green, as a sodium salt, to show the presence of acids. Although developed for detection of acetic acid, A-D strips can be used to detect other acids such as those released by adhesives, paper, textiles, wood products, and plastic. When placed in a closed container with the sample material, the strips change from blue at pH 5.4 to green and then to yellow at pH 3.8, if acid gasses are released. The color changes within a few days. The strips come with a color keyed pencil to assist in identifying results. The method described below can be used to give a simple, quick indication of the effect of a proposed material on acid-sensitive materials such as paper. It can be performed without special equipment such as aging ovens. Results are generally seen within a week. The commercial availability of the indicator strips allows a recognized standard indicator strip to be used and compared.

TEST METHOD

Testing of materials is done by placing a test strip with the sample in a tightly closed container. Prevent direct contact between strip and sample, so as to indicate offgassing rather than contact acidity. As bromcresol green dye is light fugitive, store test containers in the dark. Ideally, test materials should be preconditioned to 50% relative humidity before being placed in a glass stoppered jar. Results showing differences between materials will still be obtained, however, using test materials conditioned to ambient conditions and sealed in resealable polyethylene bags. Bags should be previously unused, as polyethylene can absorb and retain acidity. Because plastic films of different gauges will vary in permeability to gasses, a consistent film gauge should be used. Heavy weight freezer bags appear to retain acidic gasses longer and give more indicative results. The A-D strips are preconditioned to 50% relative humidity and prior to use should be stored closed in the resealable bag in which they are supplied. Strips should not be reused. When using resealable bags as a test chamber, it is advised to run two controls, with an indicator strip in a glass stoppered jar and another strip in a resealable bag, to be sure that the bag itself is not interacting with the indicator strip. Read the directions provided with the A-D strips for further information.

SAMPLE SELECTION AND PREPARATION

This test indicates the presence of volatile acidic gasses inside the test chamber. The release of volatiles is influenced by sample mass, exposed area, freshly cut edges, interaction of materials present in composites, and incomplete or thorough airing of freshly coated films or adhesives.

The A-D strips are sensitive to the quantity of sample present. Samples of related materials should be prepared to compare the relative performance of an equivalent volume or area of the material in a manner which would replicate actual proposed use. If comparing a variety of board materials which might be used in making a display panel, an equivalent area, such as 100 cm^2, of each material could be tested, as use will dictate a size of board. Similarly, in comparing pressure sensitive adhesive tapes, an equivalent area can be used as sample. If a composite structure is to be made, a replica of the composite layers and adhesives can be made to determine if alkaline components will counteract acidic offgassing of the whole structure. Pure adhesive offgassing can be tested by using a glass rod to pull smooth coatings onto inert polyester film. Note that thorough airing of adhesive films for 96 hours will markedly reduce offgassing. After airing, equivalent areas of coated films can be cut as samples.

SUPPLIES AND PROCEDURE

- A-D strips, stored in sealed bag in dark until use, and reference pencil
- tweezers for handling strips to avoid contamination
- glass stoppered jar for control strip
- resealable heavy weight bags (we used Dow Ziploc Freezer bags) or glass stoppered jars
- samples
- glass rods for coating liquid adhesives onto polyester film
- polyester film

1. Select and prepare samples to be compared, choosing a standard weight, size or area as appropriate to intended use.
2. Insert sample into glass stoppered jar or resealable bag. Use tweezers to insert indicator strip. When using resealable bags, insert hand into bag to introduce a volume of air and seal to retain air.
3. Store sample bags or glass jars in dark.
4. Examine strips daily for a week and note changes in color, comparing to reference pencil supplied with A-D strips.

GENERAL RESULTS

More than a hundred samples of materials present in a conservation lab were tested, including both generally accepted materials and adhesives, new and old materials considered unacceptable, and materials of unknown stability. Groups of related materials were tested to give a relative indication of which might be preferred over others, such as a variety of board products, films, solvent based and dispersion type adhesives. Composite structures were made that replicate the components present in storage and book boxes.

In the first testing of adhesives coated on polyester, adhesives were allowed to dry 48 hours before samples were cut and inserted into resealable bags. The test was later repeated, allowing the films to air for 96 hours after coating, before samples were cut and inserted. This change in the length of airing had a dramatic effect on the acidic offgassing from polyvinyl acetate dispersion adhesives. Conservators who work with these adhesives should consider how much airing of a finished housing is necessary before an artwork, artifact or book is inserted. A variety of pressure sensitive adhesive tapes were also examined. Surface pH is not a very useful concept for these nonaqueous systems, but acidic offgassing was seen to vary between different tapes. Testing results may encourage the substitution of newer tapes for others in general use.

In another group of samples, composites were made up using a variety of boards and dispersion adhesives, and the same book cloth and alkaline endsheet, and aired for 96 hours. Composites made with poorer quality boards had more acidic offgassing, as did those made with older dispersion adhesive. Composites made with alkaline buffered matboard had less acidic offgassing, presumably because the alkaline mat board had less internal acidity to be mobilized by the aqueous adhesive dispersion and its alkaline reserve appeared to neutralize acidity. Layers of the same components, but without adhesive, were also tested. Comparing results showed that the dispersion adhesives are a significant source of acidic offgassing within such composite structures and that dried adhesive films do not appear to act as a significant barrier to offgassing. Older, presumably more degraded, dispersion adhesives appear to be worse sources of acidic offgassing. A recently introduced dispersion adhesive with an alkaline agent added to make its pH neutral showed less acidic offgassing. In addition, an indicator strip inserted in a ten-year old book with a acidic odor also changed in color. This result shows that some sources of acidity can continue to offgas for long periods of time.

Some samples of older materials known to be of poor quality were tested to see if acidic offgassing continues after considerable natural aging. Acidic offgassing was seen with old samples of pressed wood, pressure sensitive adhesive tapes and groundwood core matboard.

DISCUSSION

This method of testing with bromcresol green indicator strips has not been rigorously correlated with other methods such as the Oddy test. Until such a correlation can be undertaken, when a material gives suspicious results with the A-D strips, a prudent person should run a follow-up test by another method such as the Oddy test or headspace gas chromatography (ASTM 4526-85). A-D strips appear to be sensitive to acidic offgassing which results in lead corrosion in the Oddy test. Some samples which have been tested by both methods have shown lead corrosion in the Oddy test and color change in the indicator strip. In some cases the strips may be more sensitive and begin to show initial color change in the range between 0 (no change) and 1 (first step change) with materials which do not show corrosion of the lead. A few materials known to be of poor quality, acidic brown Kraft paper (surface pH 4.5 with Merck indicator strip) and brown corrugated board, were not found to release acidic gasses. It must be stressed that this indicator strip test method does not show if materials are suitable for direct contact, but only if acidic gasses are being released.

LIMITATIONS

The bromcresol green indicator strips are sensitive to acidic pH between 5.4 and 3.8. They will not indicate an environment that is above pH 5.4 or below pH 3.8, for example a weakly acidic environment, neutral, or a corrosive alkaline environment such as from ammonia offgassing. The strips will interact with carbon dioxide in the atmosphere and must be used in a closed container and over a limited time period. Because the bromcresol green dye is water soluble, indicator strips should not be used in close proximity to original materials, as dye could cause staining if wetted.

USES OF THE TESTS AND CONCLUSIONS

Bromcresol green indicator strips can be used as a fast and easy method to detect acidic offgassing from a large number of materials. They can be used as a quick preliminary screening method before undertaking more time-consuming tests such as the Oddy test. They also can be used by conservators without access to more sophisticated laboratory facilities to get an indication as to whether proposed materials will contribute acidic gasses to the enclosed environment in a housing or display structure. Further research is needed to attempt to correlate the results of offgassing detected with bromcresol green indicator strips to those obtained by the Oddy test or other tests.

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