

Acetic Off Gassing in Clamshell Enclosures

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Introduction

BACKGROUND

Rare book conservators construct specialized, custom-fit, cloth-covered containers for special collections material. These “clamshell boxes”, are typically constructed with binders board and covered with a linen or cotton cloth using polyvinyl acetate (PVA) adhesive. This adhesive off-gasses acetic acid as it cures. Acetic acid is known to cause deterioration of paper and leather, common materials placed in these boxes. To reduce the effect of the gas and to decrease the concentration of the chemical, most conservators are trained to air out newly made boxes. While conservators possess substantial “folk wisdom” and anecdotal evidence on the value of airing clamshell boxes, to date there are no published studies on the necessity of this step.



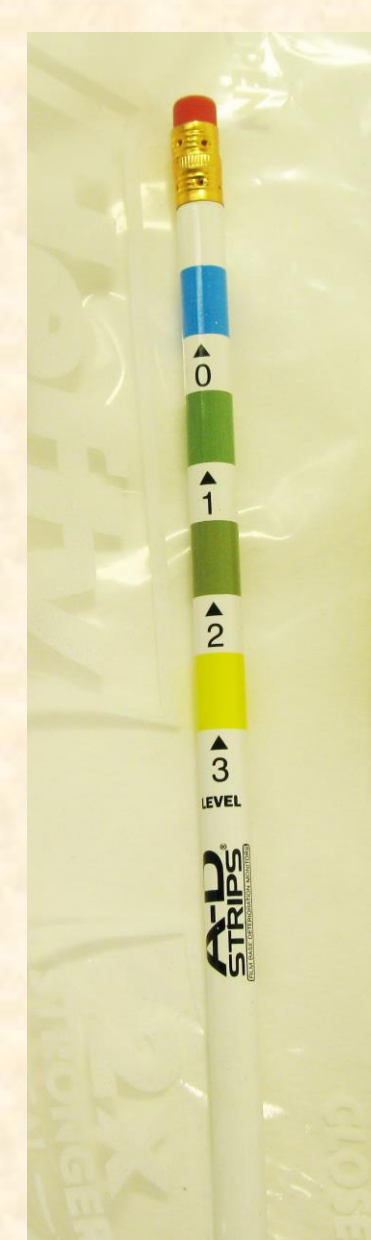
Examples of Clamshell boxes (opened and closed)

CURRENT SOLUTIONS TO REDUCE THE IMPACT OF THE GAS INCLUDE:

- Airing out the boxes by standing them upright with the trays opened for a period of days
- Replacing the PVA with potentially more benign adhesives such as methylcellulose, acrylic adhesives (Lascaux 498HV), and wheat starch paste

THIS STUDY

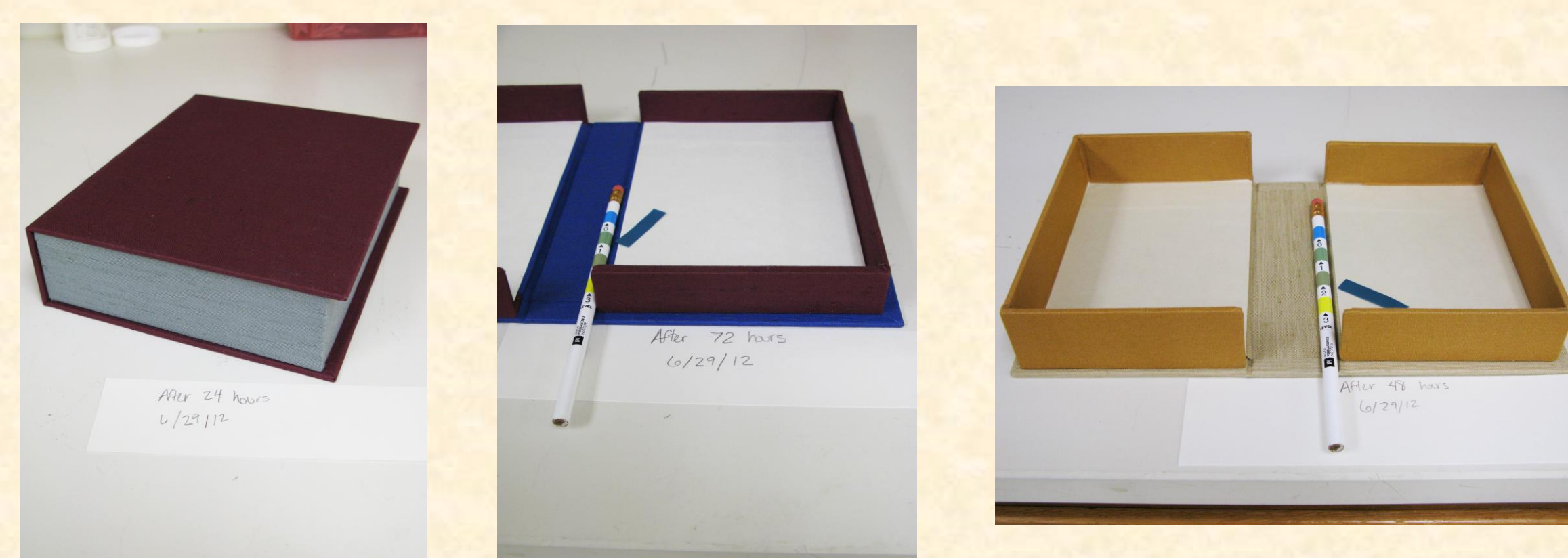
- This presentation will investigate the use of acid detection strips to study acetic acid off-gassing occurring in custom-made, cloth-covered book boxes constructed and used by conservators in research libraries.
- To answer the off-gassing question, A-D strips (Acid-Detection strips), originally designed by the Image Permanence Institute for acetate film were used. A colored strip with a pH indicator changes color from blue to green, and finally to yellow as the levels of acetic acid gas increase



Reference pencil showing scale of 0 to 3, with 3 meaning extensive off-gassing. A-D strips were removed from storage bag with tweezers.

RESEARCH QUESTIONS:

1. Does PVA off gassing of acetic acid linger inside clamshell enclosures?
2. Are other box materials contributing to the off-gassing effect?



Examples of clamshell boxes made for books at the KU Spencer Research Library. A-D strips were placed inside to test for acetic off-gassing.

Stage One

STEP 1: MATERIAL ACQUISITION

Binders Board:

- Davey Red Board
- Archival Products' Davey Acidthree board
- Conservation by Design's Superior millboard (green)

Cloth:

- Cialux
- Archival Products' Conservation Buckram
- Canapetta

PVA Adhesives:

- Talas Jade 403
- Wisdom adhesive R896-A
- Talas Elvace

Additional Adhesives:

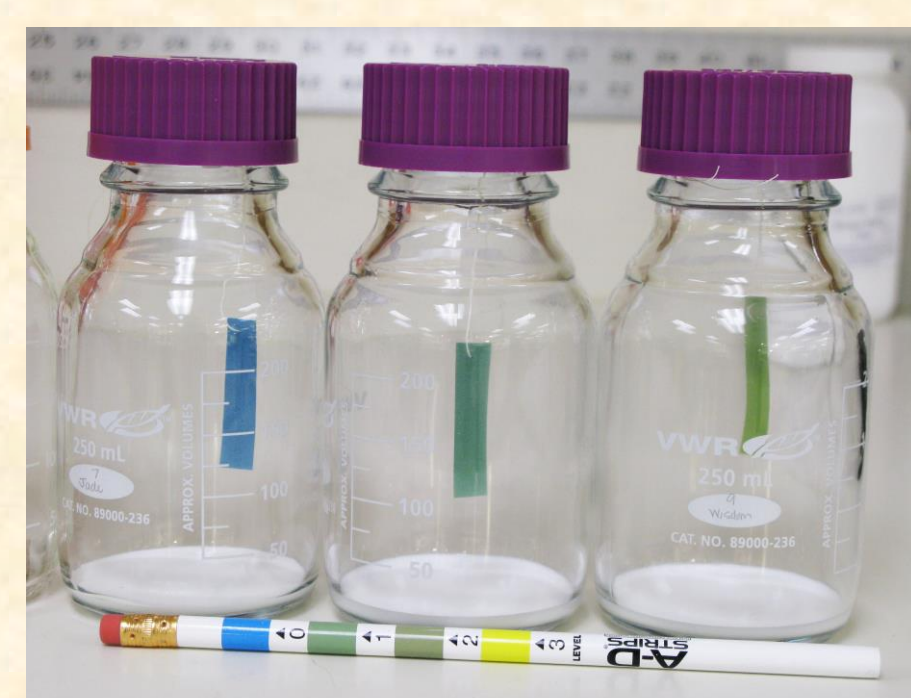
- Methylcellulose A4M (2% Solution)
- Talas Lascaux acrylic adhesive

Additional Supplies:

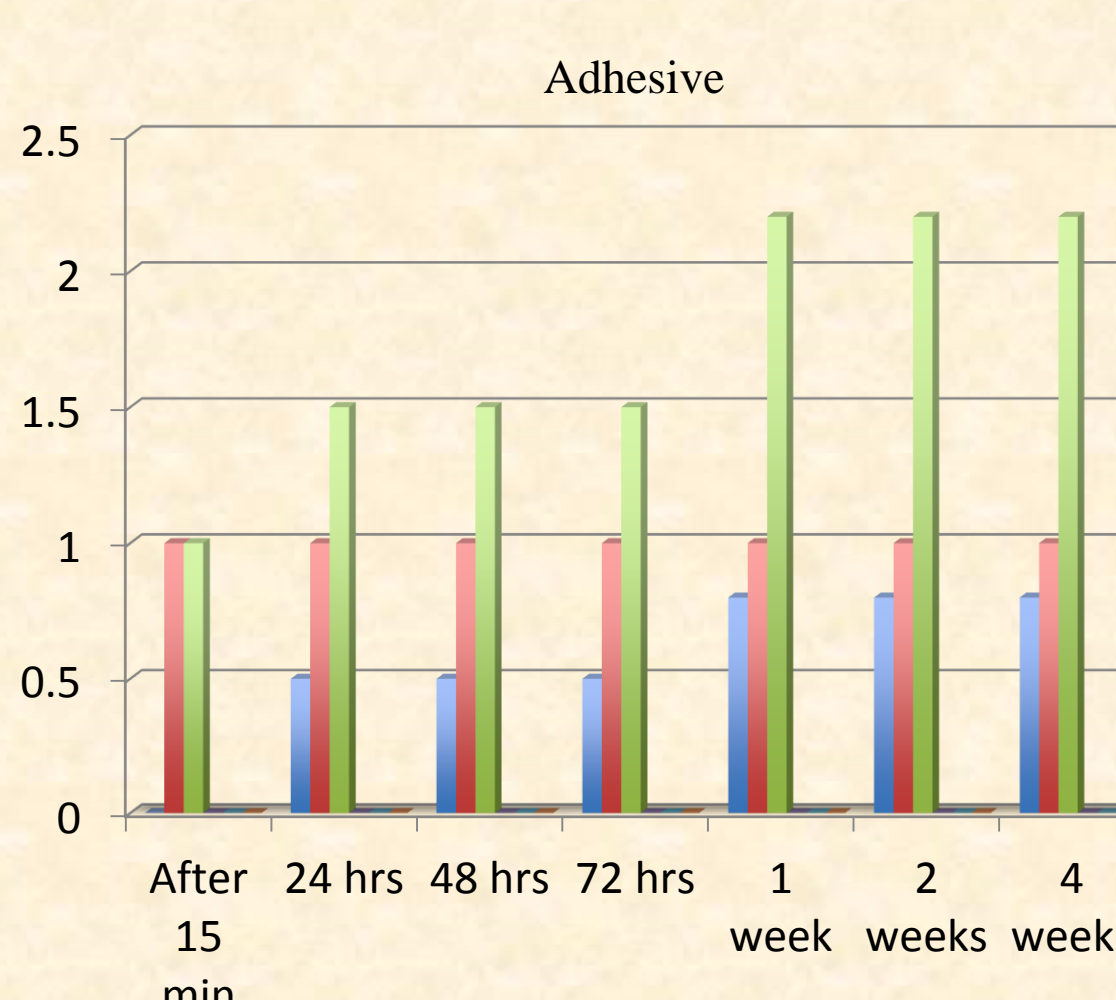
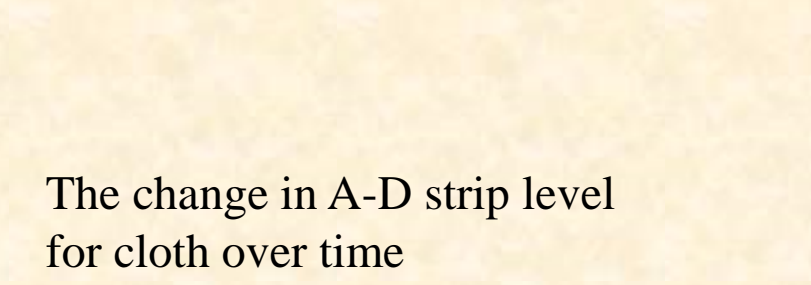
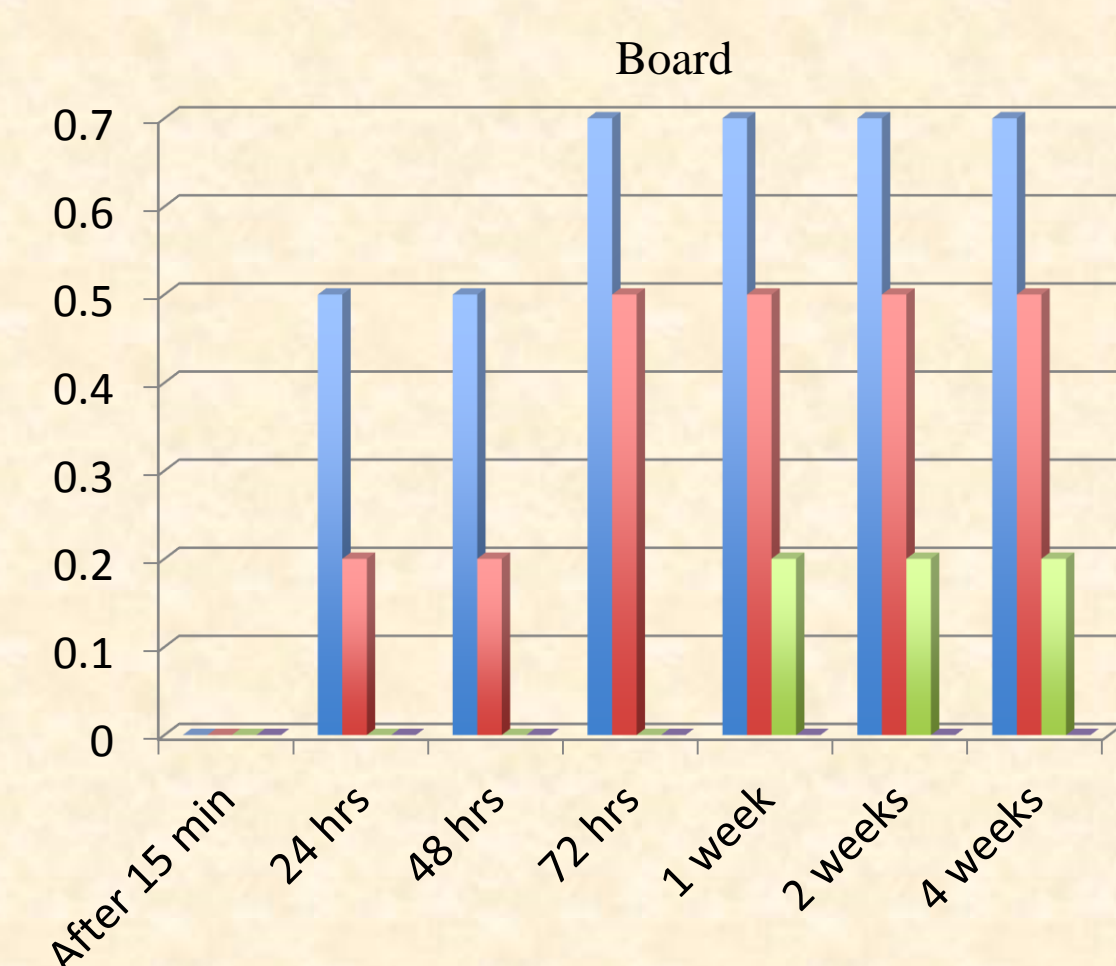
- A-D detection strips
- Glass stoppered jars
- Ziploc Bags
- Linen Thread

STEP 2: TESTING SAMPLES OF MATERIALS THAT COMPRISE BOXES

To test off-gassing potential, sample size components of the clamshell boxes were placed in glass stoppered jars along with an A-D strip. A control jar consisting solely of an A-D strip was prepared for comparison purposes. Some adhesives showed an immediate change in acidity, which was recorded. The jars were then left alone but periodically checked at 24, 48, and 72 hours, as well as 1, 2, and 4 weeks.



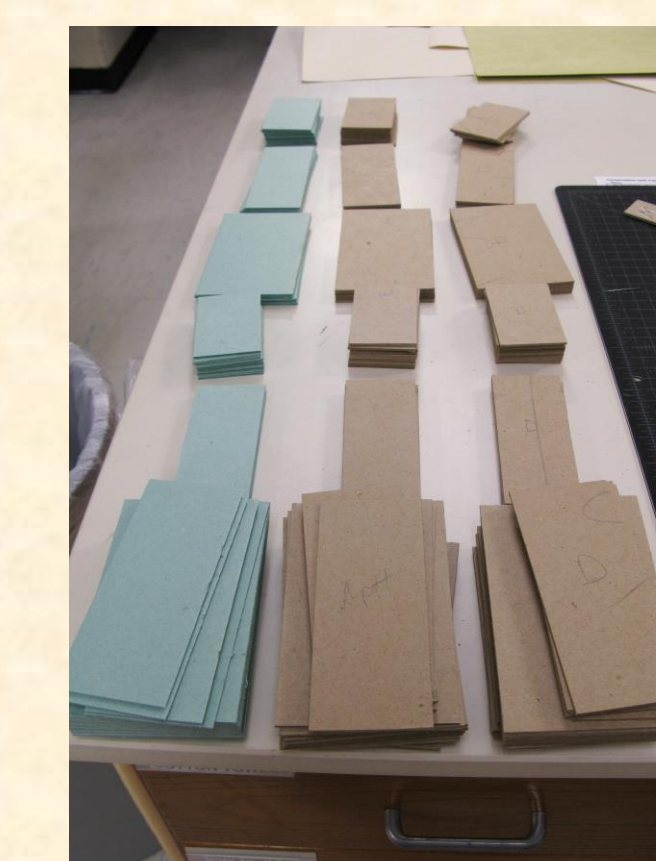
Components were tested individually in glass jars. Adhesives were measured out for consistency in each jar, A-D strip suspended by linen thread over adhesive, A-D strips checked at periodic intervals in order to track changes.



Stage Two

STEP 3: CONSTRUCT AND TEST BOXES

Fifteen partially made clamshell boxes were made with differing combinations of the board, cloth, and adhesive materials, and aired out for 24 hours prior to being sealed in an inert bag with an A-D strip placed inside each tray. The A-D strips were checked without opening the sealed bags at 24, 48, and 72 hours, and 1, 2, and 4 weeks.



Clamshell halves were constructed, and placed in Ziploc bags with A-D strip for review.



CLAMSHELL COMBINATIONS WITH LITTLE OR NO ACETIC ACID DETECTION

- Board: superior millboard (green),
- Cloth: LBS buckram
- Adhesive: Lascaux
- After 4 weeks this tray showed no traces of acidity.

CLAMSHELL COMBINATIONS WITH SIGNIFICANT ACETIC ACID DETECTION

- 1st Combination
- Board: Davey
 - Cloth: Canapetta
 - Adhesive: Wisdom
- 2nd Combination
- Acidphree board
 - LBS buckram
 - Adhesive: Wisdom

ACID DETECTION

• The Acid-Detection strips proved effective in detecting acetic acid off-gassing in the enclosures and sample materials.

• Results from monitoring reveal both the clamshell trays and their materials show an A-D strip change anywhere from a minimal 0.2 to a substantial 2.2 change on a scale of 0 to 3.

RECOMMENDATIONS

• Airing out Clamshell boxes for at least one week before placing item inside: After one week acid levels remained fairly stable for the remainder of the experiment

• Using less acidic materials like Davey board and LBS buckram in combination with an adhesive that may off-gas more: Although Lascaux and Methylcellulose did have lower levels of acetic acid as superior adhesives they worked poorly and did not bond the box components together sufficiently

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