ACCELERATED AGING STUDY OF PAPERS TREATED WITH CITRATE SOLUTIONS

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BACKGROUND

A SAMPLE AQUEOUS TREATMENT WITH 1% SODIUM CITRATE

BEFORE TREATMENT

AFTER TREATMENT

DISCOLORATION
CITRATES IN PAPER CONSERVATION:

- CITRIC ACID
- AMMONIUM CITRATE (DIBASIC, TRIBASIC)
- SODIUM CITRATE (TRIBASIC DIHYDRATE)

CITRIC ACID

[Image of citric acid structure]

IONIZATION

CITRATE ANION

[Image of citrate anion structure]

HTTP://WWW.SOFTSCHOOLS.COM/FORMULAS/CHEMISTRY/CITRIC ACID FORMULA/480/

KIDNEYSTONES.UCHICAGO.EDU
EXPERIMENTAL DESIGN

TWO PAPER SAMPLES:
1. WHATMAN FILTER NO. 1 (W)
2. ANTIQUE RAG (A)

1% W/V SODIUM CITRATE,
ADJUSTED TO PH 7 WITH CITRIC ACID
EXPERIMENTAL DESIGN

TWO PAPER SAMPLES:
1. WHATMAN FILTER NO. 1 (W)
2. ANTIQUE RAG (A)

FOUR COUPONS PER PAPER:
1. CONTROL (C)
2. OVERALL BATHING, NO RINSING (O)
3. OVERALL BATHING AND RINSING (R)
4. LOCAL SWAB WITH SWAB RINSING (L)
EXPERIMENTAL DESIGN

TWO PAPER SAMPLES:
1. WHATMAN FILTER NO. 1 (W)
2. ANTIQUE RAG (A)

FOUR COUPONS PER PAPER:
1. CONTROL (C)
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3. OVERALL BATHING AND RINSING (R)
4. LOCAL SWAB WITH SWAB RINSING (L)

LIGHT EXPOSURE:
1. COVERED (CV)
2. EXPOSED (EX)

<table>
<thead>
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<th>PAPER TYPE AND TREATMENT</th>
<th>COVERED</th>
<th>EXPOSED</th>
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<tbody>
<tr>
<td>BLUE WOOL (BW)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BW1CV</td>
<td>BW1EX</td>
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EXPERIMENTAL DESIGN

BEFORE TESTING

NORMAL LIGHT

RAKING LIGHT

UV LIGHT
EXPERIMENTAL DESIGN

COVERED AREAS

NORMAL LIGHT

RAKING LIGHT

UV LIGHT
EXPERIMENTAL DESIGN

EXPOSED AREAS

NORMAL LIGHT

RAKING LIGHT

UV LIGHT
PRELIMINARY ANALYSIS

MICROFADE TESTING

SPECTROPHOTOMETRY
### UV FLUORESCENCE ANALYSIS CABINET

UVA/B range, 400-280 nm  
“Spectroline” Model CL-150, Spectronics Corp.

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### SPECTROPHOTOMETER & SOFTWARE

Konica Minolta 2600D  
OnColor Software, v.5.5.5.3 QC  
Color Sensor Version: 1.0 Demo, CyberChrome, Inc.
RESULTS

AT, NORMAL

AT, UV

COLOR CHANGE HAPPENS, BUT AT A SIMILAR RATE TO THE CONTROL SAMPLES. ALL SAMPLES ARE LESS UV LIGHT SENSITIVE THAN BLUE WOOL 4 (ΔE 18.65).
FURTHER RESEARCH

**TWO MORE TYPES OF AGING:**

1. **GALLERY LIGHTING**
2. **THERMAL AGING OVEN**

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**GALLERY LIGHT SAMPLES**

**THERMAL AGING OVEN**
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LACMA

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UNIVERSITY OF DELAWARE
PROGRAM IN ART CONSERVATION

ANAGPIC 2019
UCLA/GETTY PROGRAM
IN CONSERVATION OF
ARCHAEOLOGICAL AND
ETHNOGRAPHIC MATERIALS

THE NATIONAL ENDOWMENT
FOR HUMANITIES

Madison Brockman | Accelerated Aging Study of Papers treated with Citrate Solutions