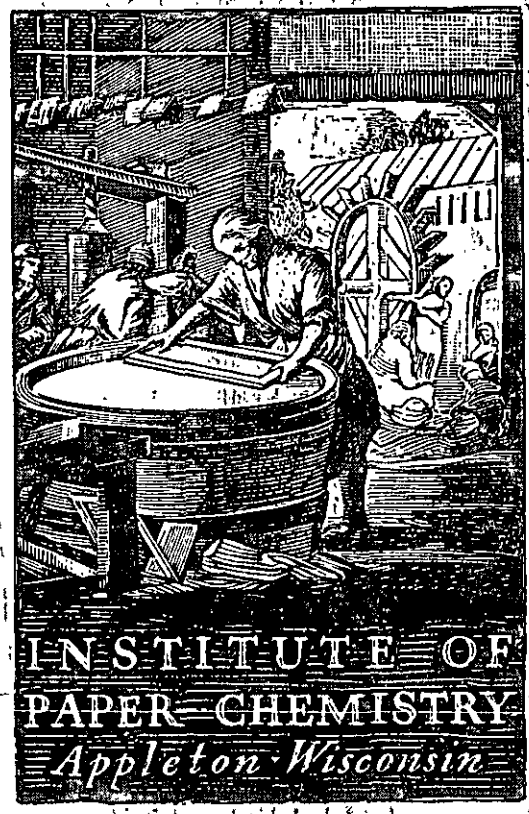

EVALUATION OF B-FLUTE V_2c CORRUGATED BOARD BOXES FOR WET-PACK POULTRY

Project 1108-18

Progress Report Six

to

FOURDRINIER KRAFT BOARD INSTITUTE, INC.

June 30, 1958

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

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ABSTRACT

Progress Report Five discussed the results obtained in a study to comparatively evaluate several combinations of wax-treated corrugated board for wet-pack poultry boxes. In addition to the combinations tested therein, a B-flute V_3c combination was also to have been included. This was tested at a later date following the same procedures as in Progress Report 5 and this report summarizes the results obtained.

The results may be summarized as follows:

PART I. COMPRESSION RESULTS

The B-flute V_3c boxes sustained considerably lower loads than either the wax-treated boxes or the Ice-O-box evaluated in the previous study. This was true for the top and center box positions as well as for the bottom box position (boxes resting in water for 48 hours prior to test).

PART II. STACK TESTS

In the stack tests the B-flute V_3c stacks appeared to exhibit a performance nearly equal to the Ice-O-box or the wax-treated 69-33-42 and 69-26-42 combinations.

INTRODUCTION

Progress Report Five discussed the results obtained in a study to comparatively evaluate several combinations of wax-treated corrugated board for wet-pack poultry boxes. Six combinations of wax-treated A-flute board were evaluated. They were

1. 69-33-42
2. 69-26-42
3. 47-33-47
4. 47-26-47
5. 42-33-42
6. 42-26-42

As noted in that report, a B-flute V_3c combination was to have been included in the above program; however, delivery of the V_3c was delayed. Because of the delay, the Institute was requested to proceed without the V_3c combination and to evaluate it separately at a later date. This report discusses the compression and stacking results obtained with the V_3c board.

MATERIALS

The B-flute V_3c board used in these tests was submitted by the Union Bag-Camp Paper Corp. Samples of the board were checked for compliance with the V_3c adhesion specification. Examination of the board after 24 hours' immersion indicated that the adhesion was borderline with respect to the V_3c specification.

BOX CONSTRUCTION AND TEST PROCEDURES

The construction of the boxes and the test procedures employed were identical to those described in Progress Report Five. The following briefly summarizes the test procedure:

A. Compression tests--Pre-test treatment

Four stacks of three boxes each were set up with the bottom box in each stack resting in a tray filled with about 1/2 inch of water. Each box was filled with 10 lb. crushed ice. The stacks were held for 48 hours at 40°F. and 90% R.H. prior to compression testing.

B. Stack tests

1. Number of boxes per stack: 6
2. Number of stacks: 2
3. Contents: 24 dummy packages (2.20 lb.) plus 15 lb. ice
4. Truck journey: 100 miles
5. Storage conditions: 40°F. and 90% R.H.

DISCUSSION OF RESULTS

PART I. COMPRESSION RESULTS

The compression results on the individual boxes are tabulated in Table I and summarized in Table II where the results are compared to those obtained in the previous study (see Progress Report Five).

TABLE I

INDIVIDUAL BOX COMPRESSION RESULTS FOR POULTRY-TYPE B-FLUTE V_3c BOXES

Stack	Maximum Load (0-1.0 inch), lb. Top Box	Center Box	Bottom Box	Deflection, inches Top Box	Center Box	Bottom Box
A	1780	1750	730	0.52	0.58	1.00
B	1590	1790	810	0.42	0.48	0.30
C	1670	1680	710	0.53	0.35	1.00
D	1700	1780	830	0.64	0.37	0.26
Average	1685	1750	770	0.53	0.44	0.64

TABLE II

SUMMARY OF COMPRESSION RESULTS

Combination	Box Compression (0 to 1.0 in.), lb. Top Box	Difference, %[a]	Center Box	Difference, %[a]	Bottom Box	Difference, %[a]
Ice-0-box	3100	--	2990	--	1605	--
69-33-42	4140	+33.5	4020	+34.4	1660	+3.4
69-26-42	3870	+24.8	3830	+28.1	1400	-12.8
47-33-47	4095	+32.1	4125	+38.0	1240	-22.7
47-26-47	3315	+6.9	3295	+10.2	1000	-37.7
42-33-42	3690	+19.0	3490	+16.7	1055	-34.3
42-26-42	2970	-4.2	2865	-4.2	980	-38.9
V_3c	1685	-45.6	1750	-41.5	770	-52.0

[a] Based on Ice-0-box results as reference.

As may be noted in Table I, the V_3c boxes behaved in much the same manner as the combinations tested previously--that is, the top and center boxes gave approximately equal test results whereas much lower results were exhibited by the bottom boxes (in contact with tray water). It may be remarked that all four bottom box covers exhibited complete separation of liner and medium after test in that portion of the cover which was watersoaked. This behavior is illustrated in Figure 1.

In Table II where the compression results in the V_3c are compared to the previous results, it may be noted that on the top and center box positions, the V_3c boxes sustained considerably smaller loads than the Ice-0-box-- or wax-treated combinations. On a percentage basis, the V_3c boxes in the top and center box positions were from 41.5 to 45.6 lower than the Ice-0-box. For the more stringent conditions associated with the bottom box position, the V_3c boxes were about 52% lower than the Ice-0-box. Under these wet conditions, the V_3c boxes also exhibited lower compression strength than the wax-treated boxes although the differences were not as great--particularly for the wax-treated combinations fabricated with 42-lb. kraft liners.

PART II. STACK TEST RESULTS

The inclination and height measurements taken on the V_3c box stacks are summarized in Tables III, IVA and IVB. In each table the test data for the Ice-0-box and the wax-treated combinations (see Progress Report Five) have also been tabulated for reference.

TABLE III

INCLINATION OF STACKS

Exposure, days	Stack Inclination, inches							
	Ice-O-box[a]	69-33-42[b]	69-26-42[b]	47-33-47[b]	47-26-47[b]	42-33-42[b]	42-26-42[b]	V_3[c]
				Stack A				
1	0.15	0.25	0.95	0.75	0.30	0.25	0.75	0.25
2	0.20	0.35	1.10	0.75	0.40	0.45	1.10	0.30
3	0.20	0.40	1.10	0.75	0.50	0.65	1.65	0.40
4	0.20	0.60	1.15	0.75	0.80	0.80	2.20	0.40
5	0.35	0.65	1.30	0.75	1.00	0.90	3.20	0.40
6	0.35	0.70	1.35	0.80	1.30	1.00	3.75	0.45
7	0.35	0.75	1.45	0.80	1.50	1.15	4.00	0.45
8	--	0.75	1.55	0.80	1.75	1.25	4.25	0.45
9	--	0.85	1.60	0.80	1.85	1.35	4.50	0.45
11	--	0.90	1.70	0.85	2.00	1.50	5.00	0.50
				Stack B				
1	0	0.20	0.50	0.25	0.95	1.10	0.55	0.50
2	0	0.25	0.60	0.55	1.00	1.90	1.40	0.80
3	0.05	0.25	0.75	0.95	1.00	2.55	2.15	1.00
4	0.05	0.35	0.80	1.20	1.10	3.45	2.75	1.15
5	0.10	0.35	0.80	1.45	1.30	4.50	3.30	1.25
6	0.10	0.40	0.80	1.65	1.40	5.30	3.60	1.35
7	0.15	0.40	0.80	1.85	1.60	6.00	3.90	1.40
8	--	0.40	0.80	2.00	1.80	6.50	3.95	1.40
9	--	0.40	0.80	2.20	2.00	7.00	4.20	1.45
11	0.20	0.40	0.90	2.50	2.35	8.05	4.40	1.50
				Average of Both Stacks				
4	0.12	0.48	0.98	0.98	0.95	2.12	2.48	0.78
7	0.20	0.58	1.12	1.32	1.55	3.58	3.95	0.92
11	--	0.65	1.30	1.68	2.18	4.78	4.70	1.00

[a] Results taken from Project 1108-18, Progress Report Two, to the Fourdrinier Kraft Board Institute, Inc., Sept. 25, 1957--Set 1, corrugated top and solid fiber bottom.

[b] Results taken from Project 1108-18, Progress Report Five, to the Fourdrinier Kraft Board Institute, Inc. April 9, 1958.

TABLE IV-A

CHANGE IN HEIGHT OF STACKS

Exposure, days	Change in Height at Top Box, inches							
	Ice-0-box[a]	69-33-42[b]	69-26-42[b]	47-33-47[b]	47-26-47[b]	42-33-42[b]	42-26-42[b]	V_3[c]
				Stack A				
1	0	0.20	0.10	0.05	0.15	0.20	0.20	0.10
2	0.05	0.20	0.10	0.10	0.25	0.35	0.45	0.15
3	0.05	0.20	0.10	0.10	0.35	0.40	0.65	0.15
4	0.05	0.20	0.10	0.10	0.40	0.45	0.80	0.20
5	0.10	0.25	0.20	0.10	0.50	0.50	1.15	0.20
6	0.10	0.25	0.20	0.15	0.55	0.50	1.30	0.25
7	0.10	0.25	0.25	0.15	0.75	0.70	1.50	0.30
8	--	0.30	0.25	0.15	0.80	0.75	1.60	0.30
9	--	0.35	0.30	0.20	0.85	0.80	1.75	0.30
11	--	0.35	0.35	0.20	0.95	0.85	1.90	0.35
				Stack B				
1	0.05	0.10	0.05	0.10	0.20	0.25	0.25	0.10
2	0.05	0.15	0.10	0.15	0.30	0.45	0.50	0.15
3	0.05	0.15	0.10	0.25	0.35	0.65	0.75	0.15
4	0.05	0.20	0.20	0.25	0.35	0.75	0.85	0.20
5	0.10	0.20	0.20	0.25	0.45	1.00	0.95	0.20
6	0.10	0.25	0.20	0.35	0.45	1.15	1.15	0.25
7	0.10	0.30	0.25	0.45	0.55	1.40	1.25	0.25
8	--	0.30	0.30	0.45	0.55	1.55	1.35	0.25
9	--	0.35	0.30	0.55	0.65	1.60	1.45	0.25
11	0.10	0.35	0.30	0.60	0.75	1.80	1.55	0.30
				Average of Both Stacks				
4	0.05	0.20	0.15	0.18	0.38	0.60	0.82	0.20
7	0.10	0.28	0.25	0.30	0.65	1.05	1.38	0.28
11	--	0.35	0.32	0.40	0.85	1.32	1.72	0.32

[a] Results taken from Project 1108-18, Progress Report Two, to the Fourdrinier Kraft Board Institute, Inc., Sept. 25, 1957--Set 1, corrugated top and solid fiber bottom.

[b] Results taken from Project 1108-18, Progress Report Five, to the Fourdrinier Kraft Board Institute, Inc., April 9, 1958.

TABLE IV-B

CHANGE IN HEIGHT OF STACKS

Exposure, days	Change in Height at Top of Bottom Box, inches						
	Ice-0-box[a]	69-33-42[b]	69-26-42[b]	47-33-47[b]	47-26-47[b]	42-33-42[b]	42-26-42[b]	V_3c
				Stack A				
1	0.05	0.05	0	0.10	0.15	0.05	0.20	0.05
2	0.05	0.10	0.05	0.10	0.25	0.10	0.30	0.10
3	0.05	0.10	0.05	0.15	0.30	0.15	0.50	0.15
4	0.05	0.10	0.10	0.15	0.35	0.20	0.70	0.15
5	0.05	0.10	0.10	0.15	0.35	0.20	0.90	0.15
6	0.10	0.10	0.15	0.15	0.40	0.20	1.00	0.20
7	0.10	0.10	0.15	0.15	0.50	0.25	1.10	0.20
8	--	0.10	0.15	0.15	0.55	0.25	1.10	0.20
9	--	0.10	0.15	0.20	0.55	0.30	1.15	0.20
11	--	0.10	0.15	0.25	0.60	0.30	1.20	0.20
				Stack B				
1	0.05	0.05	0	0.05	0.10	0.20	0.10	0.10
2	0.05	0.10	0.05	0.15	0.15	0.35	0.25	0.10
3	0.05	0.10	0.10	0.20	0.20	0.50	0.40	0.15
4	0.05	0.10	0.15	0.25	0.30	0.50	0.50	0.15
5	0.05	0.15	0.15	0.30	0.30	0.60	0.55	0.20
6	0.05	0.15	0.20	0.35	0.35	0.65	0.65	0.20
7	0.05	0.15	0.20	0.40	0.35	0.70	0.65	0.25
8	--	0.20	0.20	0.45	0.35	0.85	0.65	0.25
9	--	0.20	0.25	0.45	0.40	0.90	0.70	0.25
11	0.05	0.20	0.25	0.50	0.45	1.00	0.75	0.25
				Average of Both Stacks				
4	0.05	0.10	0.12	0.20	0.32	0.35	0.60	0.15
7	0.08	0.12	0.18	0.28	0.42	0.48	0.88	0.22
11	--	0.15	0.20	0.38	0.52	0.65	0.98	0.22

[a] Results taken from Project 1108-18, Progress Report Two, to the Fourdrinier Kraft Board Institute, Inc., Sept. 25, 1957--Set 1, corrugated top and solid fiber bottom.

[b] Results taken from Project 1108-18, Progress Report Five to the Fourdrinier Kraft Board Institute, Inc., April 9, 1958.

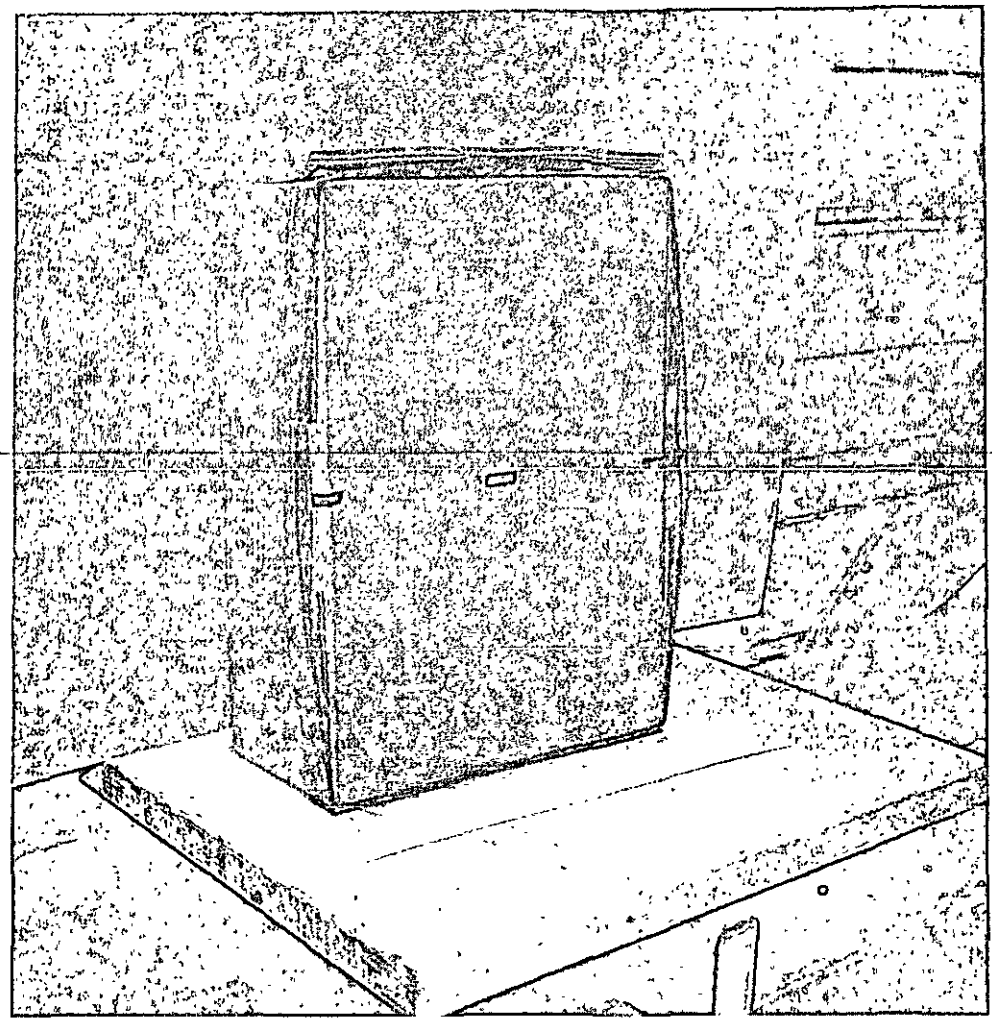


Figure 1. Appearance of a Typical Bottom Box After Compression Testing.

Photographs were taken of the stacks after various storage periods. Figures 2 through 4 illustrate stack appearance after 1, 5 and 7 days, respectively. Figure 5 illustrates the cover delamination encountered when the stacks were disassembled.

Referring to Table III, it may be noted that the V_3c box stacks tended to exhibit inclinations that were equal to or greater than those found for the Ice-O-box, 69-33-42 or 69-26-42 wax-treated combinations. Inclinations for the remaining combinations tended to be greater than those exhibited by the V_3c stacks. In Tables IV-A and IV-B, it may be noted that the change in height measurements tended to rank the V_3c boxes in much the same order as the inclination measurements.

The measurements of the loss of ice and the change in box weight are summarized in Table V. With respect to the loss in ice it may be noted that there was almost a total loss over the 11-day period. Some ice remained in a few of the boxes in contrast to the results reported in Progress Report Five where almost complete melting was encountered. This may be attributed to the slightly greater amounts of ice initially packed in these V_3c boxes. On the other hand, the quantity of unmelted ice was far smaller than that encountered in a previous study (see Progress Report Two). It is now believed that this may be attributed to the slightly higher cold room temperatures used in this study and in Progress Report Five.

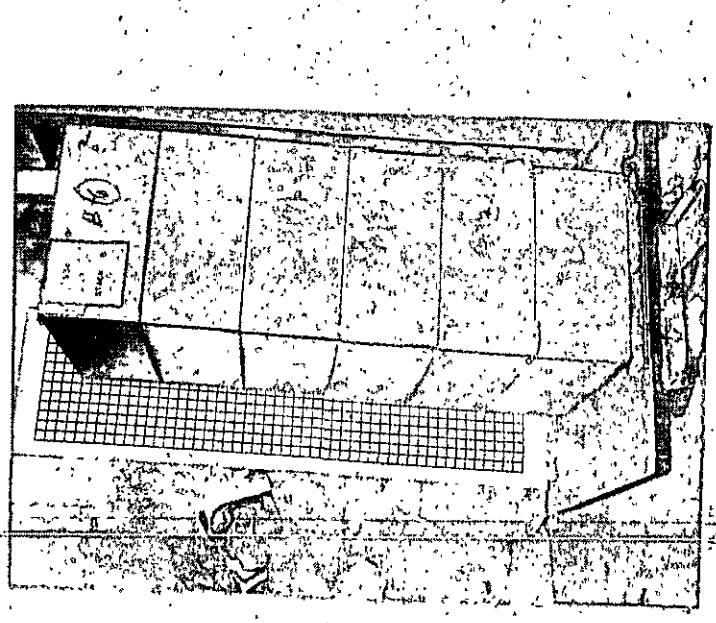
With respect to the change in box weight, it may be observed that there was a substantial pick-up in water amounting to from 37 to 39% on the basis of the initial box weights. This was considerably greater than results

TABLE V

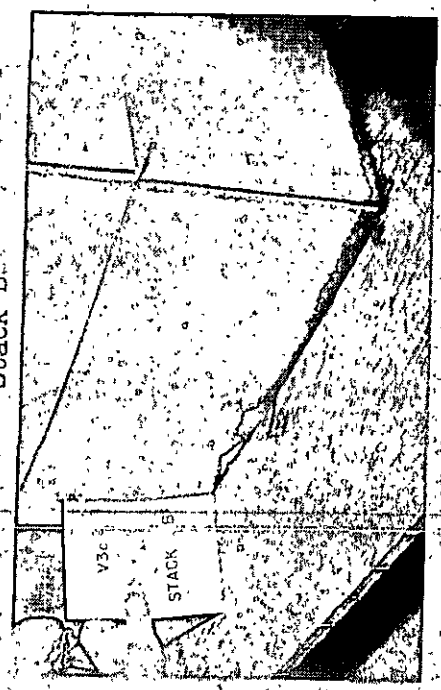
LOSS OF ICE AND CHANGE IN BOX WEIGHT AFTER 11 DAYS' STORAGE

Box No.	Weight of Ice, lb. Start	Weight of Ice, lb. End	Empty Box Weight, lb. Start	Empty Box Weight, lb. End
		Stack A		
1	15.2	0.03	4.05	5.50
2	15.1	0.79	4.08	6.00
3	15.1	0.80	4.07	6.00
4	15.1	0.98	4.08	6.25
5	15.1	0.03	4.07	5.25
6	15.1	0.02	4.06	5.00
Av.	15.1	0.44	4.07	5.67
Change %[a]	--	-97	--	+39
		Stack B		
1	15.1	0.00	4.08	5.50
2	15.1	0.52	4.06	5.75
3	15.1	0.90	4.10	6.00
4	15.1	0.55	4.09	5.75
5	15.1	0.30	4.08	5.50
6	15.2	0.06	4.05	5.00
Av.	14.1	0.39	4.08	5.58
Change, %[a]	--	-97	--	+37

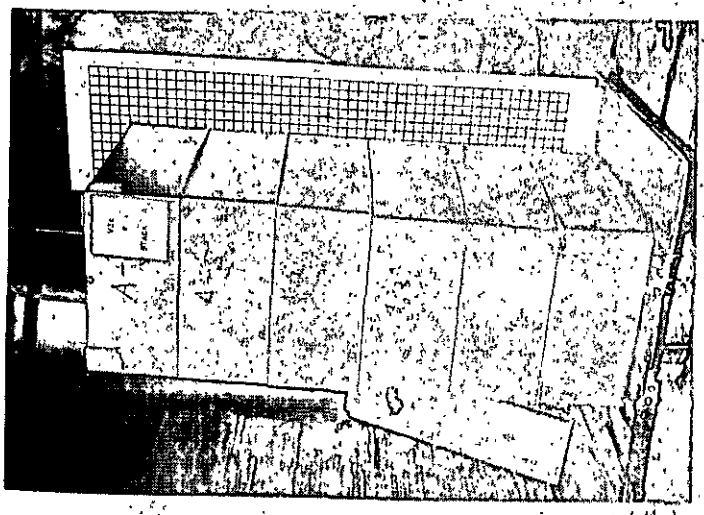
[a] Based on "start" results as reference.



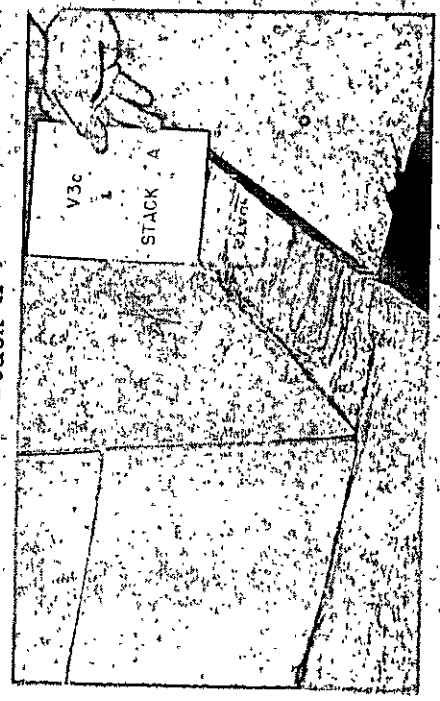
Stack B



Lower Box
Stack B

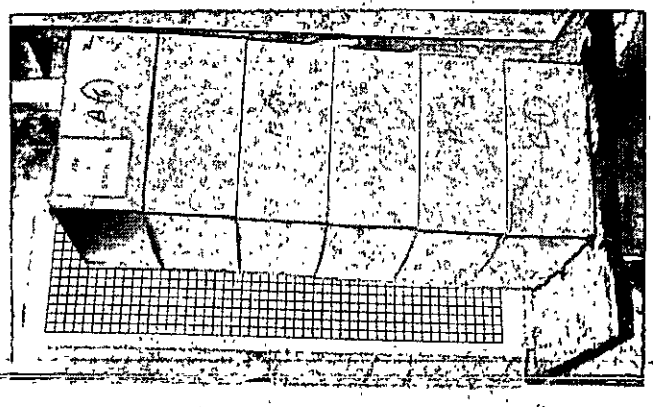


Stack A

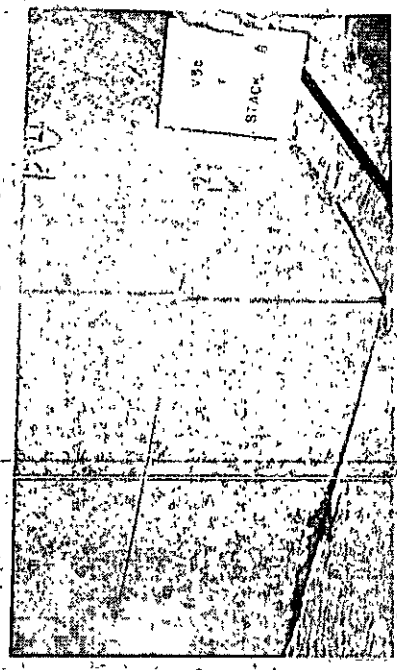


Lower Box
Stack A

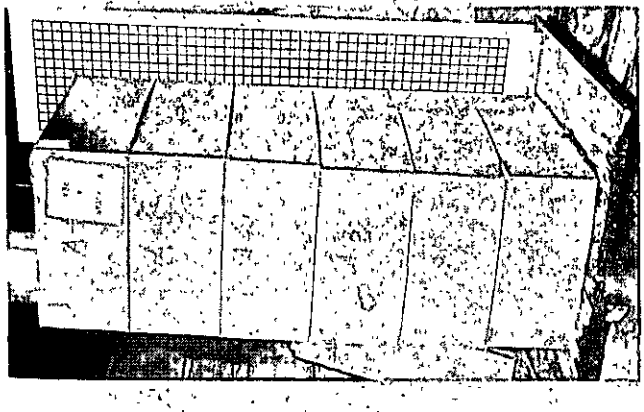
Figure 2. Appearance of Stacks After 1 Day Storage.



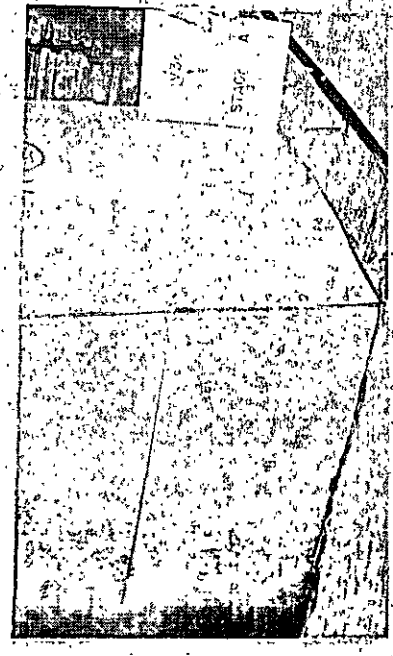
Stack B



Lower Box
Stack B



Stack A



Lower Box
Stack A

Figure 3. Appearance of Stacks After 5 Days' Storage.

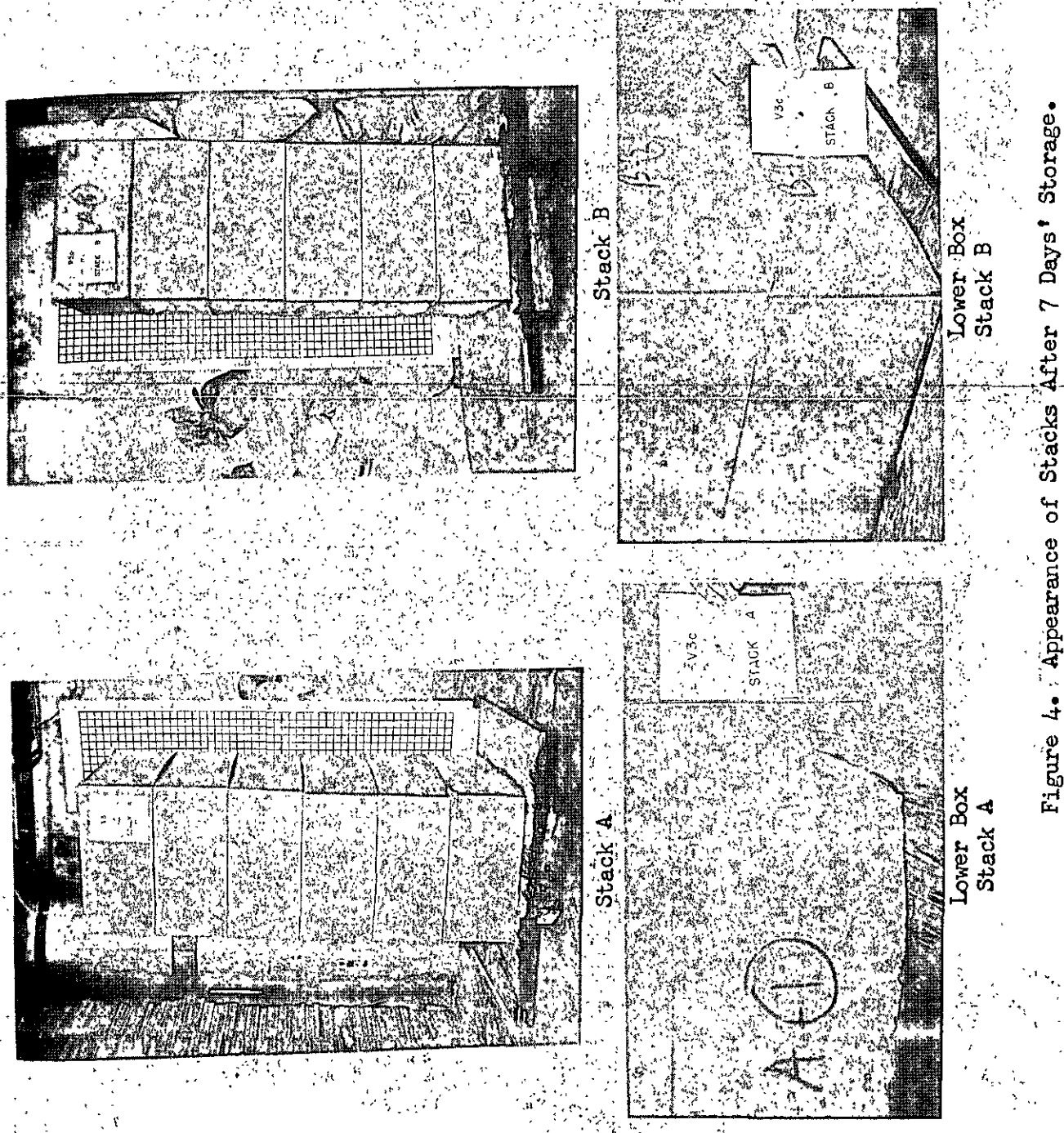


Figure 4. Appearance of Stacks After 7 Days' Storage.

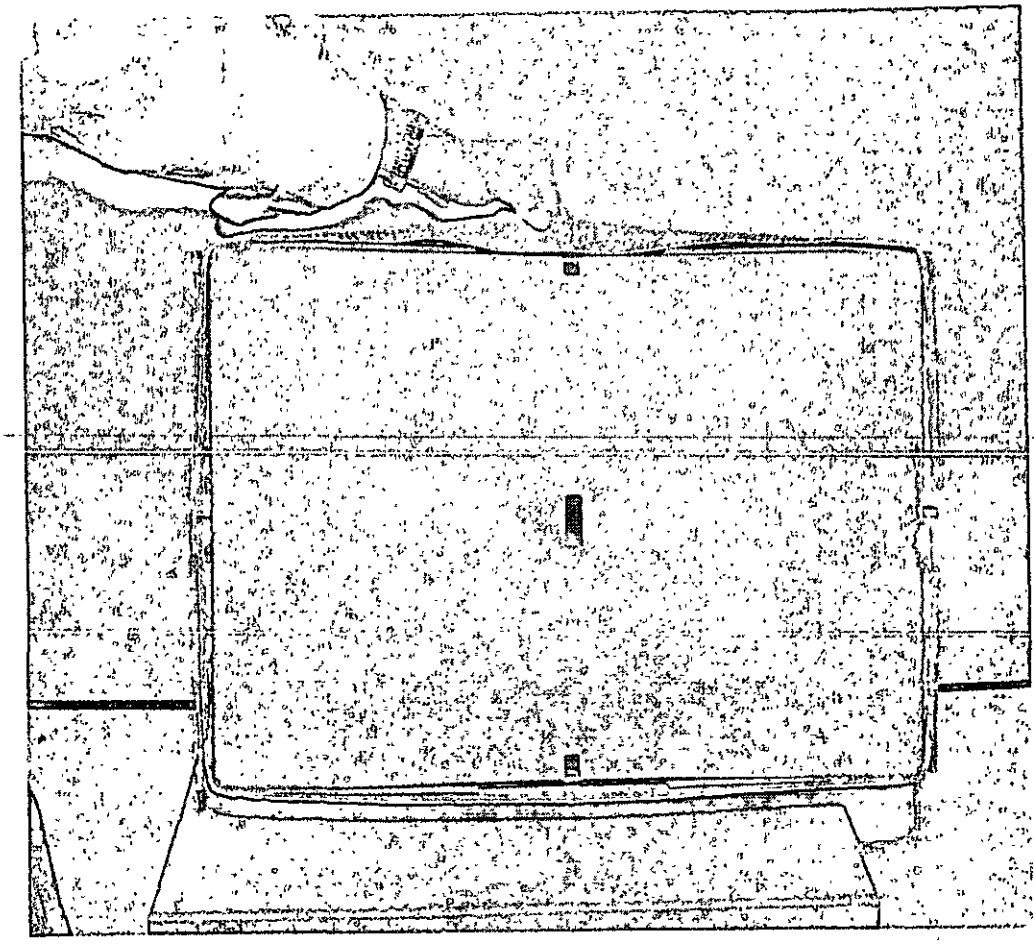


Figure 5. Appearance of a Bottom Box After 11 Days' Showing Cover Delamination.

obtained for the wax-treated boxes tested in Progress Report Five or the various experimental boxes tested in Progress Report Two. No particular reason for the greater pick-up is known.

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