Institute of Paper Science and Technology

FINAL REPORT

Single-facer Green Bond Strength

Project 2696-25

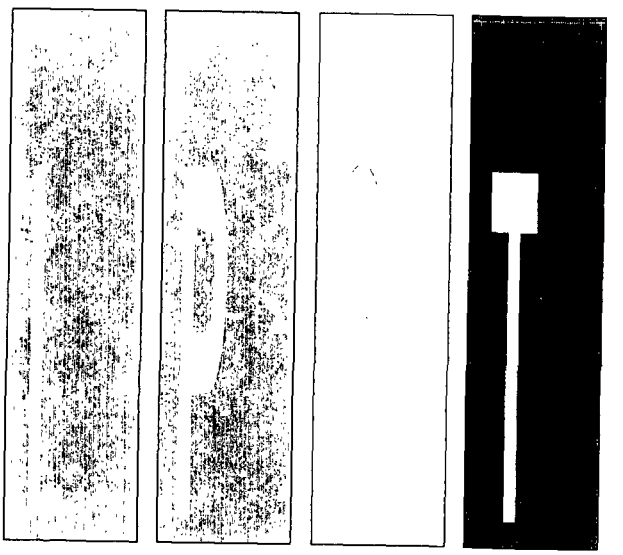
Submitted to

CONTAINERBOARD AND KRAFT PAPER GROUP

of the

AMERICAN PAPER INSTITUTE

December 15, 1991



Atlanta, Georgia

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1. Summary and Conclusions.

The formation of the single-facer bond was studied by measuring the strength development of the green bond as a function of the single-facer speed, the level of preconditioning, and the physical properties of the linerboard and medium. A low green bond strength could produce blisters and loose edges in the single-face web. Such defects adversely affect the functional performance of the finished box and the box plant waste costs.

The experimental results show that the development of the green bond can be modeled using the concept of a finite induction time before any bonding occurs followed by a linear rate of bond development until 100% green bond strength is achieved. The data analysis, based on this model, supports the following conclusions:

1. Time is a critical factor since the green bond strength increases with time. Steps to minimize mechanical stresses to the green bond, such as vibration, tension variation, and flexing and flutter of the single-faced web for as long as possible, should minimize the probability of forming blisters and loose edges.

2. The degree of preconditioning of both the linerboard and the medium influence the development of green bond strength. More preconditioning increases the bond development by reducing the induction time and by increasing the bonding rate. This observation indicates that the preconditioning equipment at the single-facer should be kept in a proper operating state. It also indicates that care should be taken to increase the preconditioning level simultaneously with increasing single-facer speed. Preconditioning levels are usually reduced when the corrugator is slowed in order to minimize warp. Failure to readjust the preconditioning when the corrugator speed is again increased could increase the probability of single-facer bond defects.

3. Under normal speed and preconditioning levels, the green bond development was improved by having a more porous and less wettable medium. A minimum time to 100% green bond barrier was observed at 30 milliseconds for the experimental process used. Materials having a 30 millisecond 100% bonding time with less preconditioning did not improve when more preconditioning was used.

4. Under subnormal preconditioning levels, the green bond development was improved by having a smoother wire side linerboard and by having a less porous medium.

5. The Edge Crush test and the cured Pin Adhesion strength was improved when more medium preconditioning was used. The cured Pin Adhesion was also improved when more linerboard preconditioning was used.

2. Introduction.

The objective of this project was to determine the critical linerboard and corrugating medium properties and the corrugator operating conditions that affect the strength of the green bond at the single-facer.

The bond between the linerboard and the fluted medium on a corrugator is achieved with an aqueous base starch adhesive that is applied to the tips of the fluted medium. The linerboard material is brought into contact with the adhesive coated flute tip, and pressure, heat, and time are used to set the starch adhesive and to form the bond. The bonding is achieved by the gelatinization of the starch adhesive and the subsequent removal of water from the bonding site.

There are two types of bonds formed on the corrugator, the single-face bond and the double-face bond. The double-face bond is formed by sandwiching the corrugated structure between a steam heated hot plate and a moving belt that is held down by steel rollers or air pressure. This provides continuous heat and pressure until the doublebacker bond has developed sufficient strength to hold the plies together. The single-facer bond, on the other hand, is formed by applying heat and pressure to the bonding site at a nip between the lower corrugating roll and the pressure roll in the single-facer. The bond exiting this nip must be of sufficient strength to hold the web together until the final cured bond is achieved. This initial bond at the single-facer is called the "green bond."

The single-face bond can not be reformed in subsequent stages on the corrugator if the green bond separates due to mechanical stresses. Such a separation produces defects known as "blisters," "loose edges," or "fluff-out," and these defects have a severely adverse effect on the performance of the finished package. Such defects also have an adverse effect on the box plant waste costs.

3. Experimental Design.

All of the single-facer green bond experiments were done on the IPST pilot single-facer. The IPST pilot doublebacker was used to fabricate the double-faced combined board from the experimental single-faced webs. The linerboard and medium materials used in the study were supplied by CKPG member companies and represented a range of commercial container board. A constant linerboard material was used for the medium experiments, and a constant medium material

was used for the linerboard study. The corrugating adhesive was the standard formulation used by IPST for high-speed corrugating trials.

The strength of the single-face green bond was determined by the use of a wedge device which was located on the exit side of the nip formed by the lower corrugating roll and the pressure roll, Figure 1. The medium used in the study was two inches wider than the linerboard. The space between the edges of the wedge was 10.5 inches, which allowed the 10-inch wide linerboard web to pass between the wedge edges with no mechanical force being applied. The edges of the 12-inch wide medium, however, were contacted by the edges of the wedge and experienced an upward force due to the contour of the wedge edges. This upward force provided a stress on the green bond and could result in a separation of the fluted medium from the linerboard if the green bond was weak. The strength of the green bond determined the extent of the bond separation. A strong green bond resulted in no separation of the gluelines, while a weaker green bond resulted in varying degrees of debonding extending toward the center of the single-faced web up to complete delamination of the linerboard from the medium. The degree of delamination was measured and used as a gage of the green bond strength.

The wedge tip was located three inches from the centerline of the nip between the lower corrugating roll and the pressure roll. Each of the trial materials were run at corrugator speeds ranging from 100 fpm to 800 fpm in 100 fpm intervals or to the fastest speed at which 100% delamination occurred. Since the wedge position was fixed, the corrugator speed determined the bonding time allowed before the wedge debonding force was applied. This bonding time varied from 150 milliseconds at 100 fpm to 18.75 milliseconds at 800 fpm. The green bond strength as measured by the degree of delamination could then be related to the bonding time.

The effect of preconditioning of the medium and linerboard was evaluated by using two levels of steaming and heating, Table A. The change in preconditioning of the medium involved changes in presteaming, and the change in preconditioning of the linerboard involved changes in both presteaming and preheating. The more preheat condition represents the normal operating mode for the IPST pilot single-facer. The less preheat condition represents a subnormal operating mode.

Since the variation in corrugator speed would affect both the bonding time before stressing the bond and the preconditioning as influenced by contact time, this specific screening experiment does not completely separate the effects of moisture, temperature, and time on the green bond strength. However, it does allow analysis to separate the time from the qualitative preconditioning effects.

FIGURE 1
GREEN BOND STRENGTH MEASUREMENT

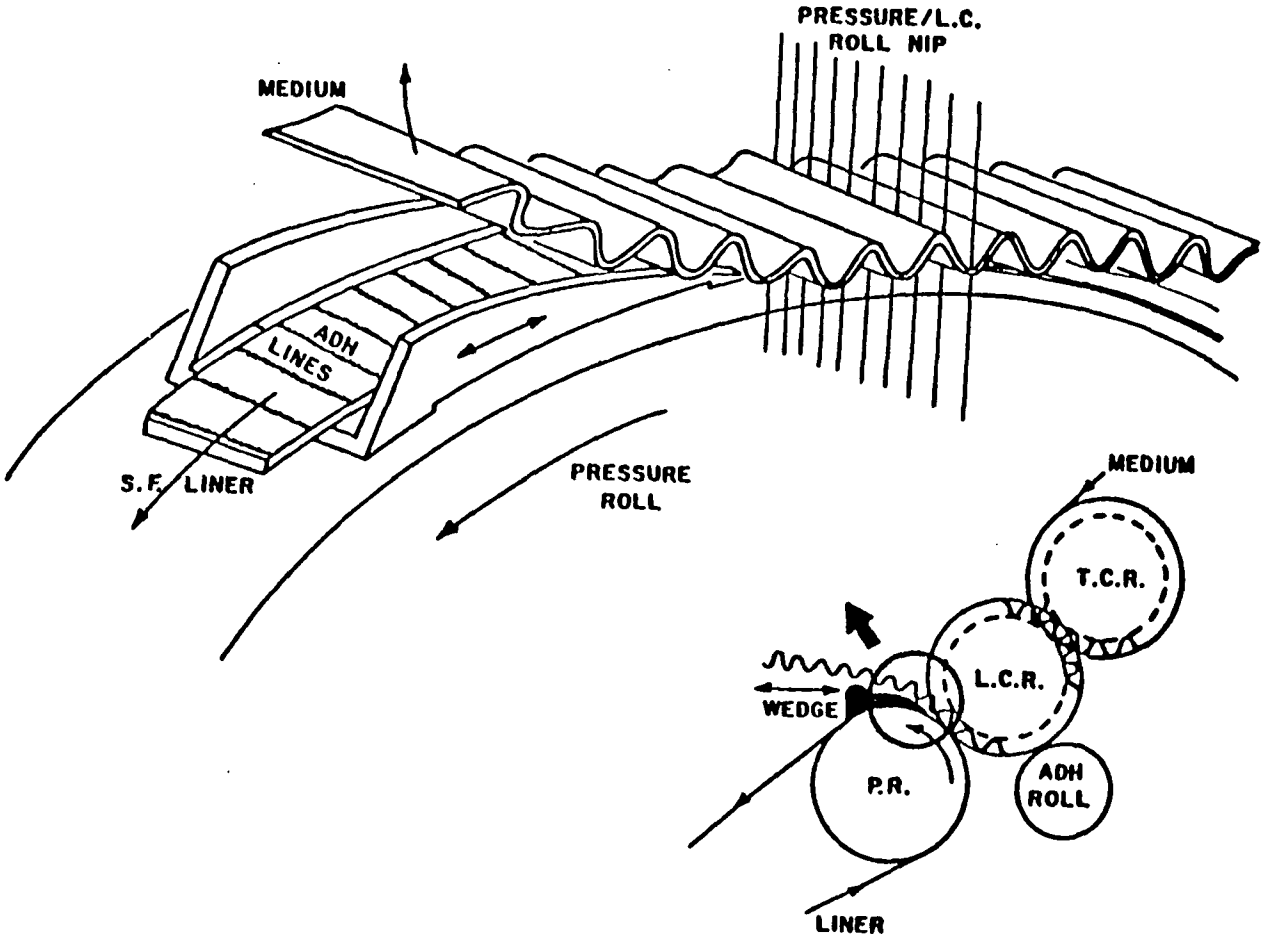


TABLE A
PREHEATING CONDITIONS

CONDITIONING STAGE	(NORMAL) MORE PREHEAT	LESS PREHEAT
MEDIUM STUDY		
PREHEATER SHOWER	ON	ON
PREHEATER	ON	ON
GAYLORD SHOWER	ON	OFF
MAIN SHOWER	ON	OFF
CORRUGATING ROLLS	ON	ON
PRESSURE ROLL	ON	ON
LINERBOARD STUDY		
PREHEATER SHOWER	ON	OFF
PREHEATER	ON	ON
SPRAY SHOWER	ON	OFF
SMALL PREHEATER	ON	OFF
SMALL PREHEATER	ON	OFF
PRESSURE ROLL	ON	ON

4. Material Properties.

The physical tests that were done on the medium and linerboard and on the combined corrugated board are shown in Table B. Selected test properties for the 15 commercial medium materials used in the study are summarized in Table C, and the detailed data are given in Appendix I. The medium types included 100% recycled, caustic carbonate, green liquor, and NSSC. The corresponding data for the 24 commercial linerboard materials are shown in Table D and Appendix II and for the combined corrugated board in Table E and Appendices III, IV, and V. The summarized data in Tables C, D, and E are shown in terms of the average for all of the samples, the highest and lowest single sample, the total range, and the coefficient of variation expressed as the range divided by the average.

As shown in Tables C and D, and as might be expected, the least variable property measured was the basis weight for both the linerboard and the medium, with a coefficient of variation of 8% and 5%, respectively. The cross direction Ring Crush and STFI Crush strength of the medium exhibited a 30% range and a 38% range for the linerboard.

The properties which might be expected to influence the green bond strength, such as porosity, liquid absorption, and smoothness, exhibited a wide range across the commercial materials. The medium smoothness had a 170% range; the water absorption had a 290% range; and the porosity had a 114% range. While the percent range for medium porosity was large, the least porous medium had a porosity of only 29 seconds.

The corresponding range values for the linerboard samples were 1% caustic drop, 104% range; wire side smoothness, 72% range; and porosity, 160% range. Similar to the medium, the least porous linerboard had a porosity of only 44 seconds.

It should be noted that these materials were not selected by IPST based on the physical properties but were random samples submitted by CKPG member companies. As such, they should represent a reasonable cross-section of current commercial materials. It would also be expected that the wide ranges observed for the properties would be adequate to detect a level of statistical correlation to the green bond strength if the property has a major impact.

The summary of the combined-board physical properties is given in Table E for both the medium and linerboard experiments and for both the more preheat and less preheat conditions. The statistical analysis of the difference in strength between the more preheat and less preheat conditions showed the medium experiment Flat Crush, Pin Adhesion, and Edge Crush Test properties and the linerboard experiment Pin Adhesion property to be statistically significant at the 95% or greater probability level. In all cases the strength was

TABLE B

PHYSICAL PROPERTIES MEASURED

1. FOR LINERBOARD AND MEDIUM.

CONDITIONED BASIS WEIGHT
TAPPI CALIPER (STEEL PLATEN)
IPC CALIPER (SOFT PLATEN)
TAPPI DENSITY
IPC DENSITY
COEFFICIENT OF FRICTION, HOT, WIRE & FELT SIDES
BENDSTEN SMOOTHNESS, WIRE & FELT SIDES
GURLEY POROSITY
Z-DIRECTION TENSILE
TENSILE, MD & CD
TENSILE STRETCH, MC & CD
TENSILE ENERGY ABSORPTION, MD & CD
TENSILE STIFFNESS, Et, MD & CD
STFI CRUSH, MD & CD
RING CRUSH, MD & CD
SONIC MODULUS, Ext, Eyt, Ezt, Gxyt
WATER ABSORPTION, T-819
ALCOHOL/WATER ABSORPTION, 6 SURFACE TENSION LEVELS

2. FOR LINERBOARD ONLY.

CAUSTIC AND LACTIC ACID ABSORPTION, T-492
POLAR ANGLE

3. FOR MEDIUM ONLY.

CONCORA

4. COMBINED BOARD, LINERBOARD EVALUATION.

SINGLE-FACE BOND PIN ADHESION
EDGE CRUSH TEST

5. COMBINED BOARD, MEDIUM EVALUATION.

FLAT CRUSH
SINGLE-FACE PIN ADHESION
EDGE CRUSH TEST

TABLE C

MEDIUM PROPERTIES
15 COMMERCIAL MEDIUMS

PROPERTY	AVER.	MIN.	MAX.	RANGE	CofV%
GENERAL PROPERTIES					
BASIS WEIGHT, LB./MSF	26.33	25.8	27.1	1.3	5%
TAPPI CALIPER, MILS	9.48	8.70	11.12	2.42	26%
TAPPI DENSITY, LB./MSF/MIL	2.78	2.36	3.03	0.67	24%
IPC CALIPER, MILS	7.87	7.1	8.6	1.5	19%
IPC DENSITY, LB./MSF/MIL	3.35	3.05	3.68	0.63	19%
ROLL MOISTURE CONTENT, %	6.15	4.8	7.4	2.6	42%
STRENGTH PROPERTIES					
MD TENSILE, LB./IN.	40.7	31.8	48.4	16.6	41%
MD STRETCH, %	1.30	1.02	1.61	0.59	45%
MD TEA, Ft.Lb./Sq.Ft.	4.19	2.17	6.49	4.47	107%
MD Et, LB./IN.	5198	4313	6314	2001	38%
CD TENSILE, LB./IN.	16.0	13.8	18.8	5.0	31%
CD STRETCH, %	2.25	1.26	3.24	1.98	88%
CD TEA, Ft.Lb./Sq.Ft.	3.32	1.50	5.64	4.14	125%
CD Et, LB./IN.	2113	1707	4853	3146	149%
MD RING CRUSH, LB./6 IN.	51.92	46.5	64.1	17.6	33%
MD STFI CRUSH, LB./IN.	22.80	19.8	27.1	7.3	32%
CD RING CRUSH, LB./6 IN.	38.8	34.4	45.0	10.6	27%
CD STFI CRUSH, LB./IN.	13.04	11.0	15.0	4.0	31%
CONCORA, LB.	61.0	50.5	73.7	23.2	38%
ZDT, LB./Sq.In.	77.2	71	84	13	17%

CONTINUED

TABLE C CONTINUED

MEDIUM PROPERTIES
15 COMMERCIAL MEDIUMS

PROPERTY		AVER.	MIN.	MAX.	RANGE	CofV%
OTHER PROPERTIES						
HOT FRICTION, FELT SIDE		0.207	0.12	0.33	0.21	102%
HOT FRICTION, WIRE SIDE		0.217	0.12	0.33	0.21	102%
SMOOTHNESS(BEND.) FELT, mL/MIN		1262	578	2799	2221	176%
SMOOTHNESS(BEND.) WIRE, mL/MIN		1319	561	2846	2285	173%
WATER ABSORBTION, T819, SEC.		32.4	3.6	97.2	93.6	289%
ALCOHOL/WATER DROP 72d/cm,SEC.		40.9	10.2	129.0	118.0	290%
POROSITY, SEC.		18.3	7.8	28.6	20.8	114%
SINGLE-FACER GREEN BOND STRENGTH, % AREA BONDED						
WITH MINIMAL	200 FPM, 75mS	71.1	52	81	29	41%
PREHEAT OR	400 FPM, 38mS	10.6	0	40	40	377%
PRECONDITIONING	600 FPM, 25mS	2.1	0	23	23	1095%
WITH ADDED	200 FPM, 75mS	75.8	63	83	20	26%
PREHEAT AND	400 FPM, 38mS	44.6	0	63	63	141%
PRECONDITIONING	600 FPM, 25mS	39.9	0	60	60	150%

TABLE D

LINERBOARD PROPERTIES
24 COMMERCIAL LINERBOARDS

PROPERTY	AVER.	MIN.	MAX.	RANGE	CofV%
GENERAL PROPERTIES					
BASIS WEIGHT, LB./MSF	42.19	39.98	43.14	3.16	8%
TAPPI CALIPER, MILS	12.13	11.06	13.97	2.91	24%
TAPPI DENSITY, LB./MSF/MIL	3.49	2.96	4.06	1.10	32%
IPC CALIPER, MILS	10.92	9.58	12.91	3.33	30%
IPC DENSITY, LB./MSF/MIL	3.88	3.21	4.40	1.19	31%
STRENGTH PROPERTIES					
MD TENSILE, LB./IN.	89.32	68.21	101.5	33.29	37%
MD STRETCH, %	1.408	1.18	1.72	0.54	38%
MD TEA, Ft.Lb./Sq.Ft.	9.74	7.1	13.2	6.1	63%
MD Et, LB./IN.	10525	8227	11730	3503	33%
CD TENSILE, LB./IN.	35.85	29.28	43.20	13.92	39%
CD STRETCH, %	3.620	2.20	4.48	2.28	63%
CD TEA, Ft.Lb./Sq.Ft.	11.60	7.4	16.6	9.2	79%
CD Et, LB./IN.	3442	2576	4338	1762	51%
MD RING CRUSH, LB./6 IN.	103.6	87.5	126.5	39.0	38%
MD STFI CRUSH, LB./IN.	38.2	31.1	45.4	14.3	37%
CD RING CRUSH, LB./6 IN.	80.6	63.0	91.7	28.7	36%
CD STFI, LB./IN.	21.2	18.3	26.6	8.3	39%
ZDT, LB./Sq.In.	48.0	20	66	46	96%

CONTINUED

TABLE D CONTINUED

LINERBOARD PROPERTIES
24 COMMERCIAL LINERBOARDS

PROPERTY		AVER.	MIN.	MAX.	RANGE	CofV%
OTHER PROPERTIES						
HOT FRICTION, FELT SIDE		0.228	0.183	0.300	0.117	51%
HOT FRICTION, WIRE SIDE		0.239	0.165	0.330	0.165	69%
SMOOTHNESS(BEND.) FELT, mL/MIN		1419	788	2138	1350	95%
SMOOTHNESS(BEND) WIRE, mL/MIN		1780	1158	2444	1286	72%
WATER ABSORBTION, T819, SEC.		600+	600+	600+	N/A	N/A
ALCOHOL/WATER DROP,72d/cm,SEC.		600+	600+	600+	N/A	N/A
1% CAUSTIC DROP, SEC.		436+	148	600+	452+	+104%
POROSITY, SEC.		21.68	9.2	43.8	34.6	160%
POLAR ANGLE		3.23	0.83	11.22	10.39	322%
SINGLE-FACER GREEN BOND STRENGTH, % AREA BONDED						
WITH MINIMAL	200 FPM, 75mS	84.9	62.8	100	37.2	44%
PREHEAT	400 FPM, 38mS	55.9	0	80.8	80.8	145%
PRECONDITIONING	600 FPM, 25mS	15.5	0	61.2	61.2	396%
WITH ADDED	200 FPM, 75mS	83.3	63.8	98.5	34.8	42%
PREHEAT AND	400 FPM, 38mS	84.2	61.5	95.0	33.5	40%
PRECONDITIONING	600 FPM, 25mS	49.6	0	71.5	71.5	144%

TABLE E

COMBINED BOARD PROPERTIES

PROPERTY	AVERAGE	MINIMUM	MAXIMUM	RANGE	C OF V
MEDIUM STUDY WITH MORE (NORMAL) PREHEAT					
FLAT CRUSH, PSI	35.9	43.3	28.8	14.5	40%
PIN ADHESION, LB	103.3	117.5	87.5	30.0	29%
EDGE CRUSH, LB/IN	42.74	46.88	40.22	6.66	16%
MEDIUM STUDY WITH LESS PREHEAT					
FLAT CRUSH, PSI	35.0	41.7	29.6	12.1	35%
PIN ADHESION, LB	100.0	118.0	76.5	41.5	42%
EDGE CRUSH, LB/IN	41.68	44.61	37.87	7.54	18%

STATISTICAL ANALYSIS OF DIFFERENCE WITH PREHEAT

PROPERTY	DIFF.(M-L)	t-VALUE	PROB. %
FLAT CRUSH	+0.89	2.393	97.5%
PIN ADHESION	+3.30	2.895	98.0%
EDGE CRUSH	+1.06	2.681	99.0%

PROPERTY	AVERAGE	MINIMUM	MAXIMUM	RANGE	C OF V
LINERBOARD STUDY WITH MORE (NORMAL) PREHEAT					
PIN ADHESION, LB	110.3	123.2	94.6	28.6	26%
EDGE CRUSH, LB/IN	43.82	51.15	37.97	13.18	30%
LINERBOARD STUDY WITH LESS PREHEAT					
PIN ADHESION, LB	101.6	116.9	75.9	41.0	40%
EDGE CRUSH, LB/IN	43.91	48.07	37.41	10.66	24%

STATISTICAL ANALYSIS OF DIFFERENCE WITH PREHEAT

PROPERTY	DIFF.(M-L)	t-VALUE	PROB. %
PIN ADHESION	+8.64	3.776	99.9%
EDGE CRUSH	-0.09	0.123	NOT SIG.

NOTE: MEDIUM VALUES ARE THE AVERAGE OF 37.5 AND 50.0 m-s DATA.
LINERBOARD VALUES ARE THE AVERAGE OF 30 & 37.5 m-s DATA.

greater when more preheat was used. However, the improvement was relatively small in magnitude, being between 2.5% and 8.5% of the average value with less preheat.

5. Green Bond Strength Analysis.

Single variable and multiple linear regression analysis were done using the measured percent bonded area as the dependent variable and the medium and linerboard properties as the independent variables. No statistically significant correlations were found for the medium experiment. The only statistically significant correlation found for the linerboard, Table F, was the Hot Friction Test when more preheat was used. While the F-Ratio value was significant, the correlation coefficient was only 0.228 which indicates considerable data scatter.

Part of the difficulty in detecting correlations from this data was the dependency of both the preconditioning effects and the bonding time on the speed of corrugating and the fact that the degree of bonding was not linear with speed over the entire speed range studied. Since these effects could not be separated based on the experimental design, the bonding data which could be used for each correlation calculation had to be restricted to a single speed. This greatly limited the database available for the calculations.

A different approach was therefore taken which would allow the pooling of the data over the entire speed range. The model that was hypothesized is shown in Figure 2 and is based on the model used to describe liquid absorption phenomena. The model hypothesizes a finite induction time required before any bonding occurs and a linear rate of bond development with time once bonding starts until 100% bonding is achieved. Once 100% bonding occurs, longer times cannot produce further improvement. Because of the nature of this experiment, it was also hypothesized that 100% bonding would not necessarily be achieved due to the mechanical action of the wedge, the need to operate in a bond sensitive range, and the possibility that there could be a reduction in bond strength at longer bonding times. This reduction could occur because time was increased by slowing the corrugator speed, and slower speeds could overheat the paper and result in a crystallized starch bond that would be prone to separation due to brittleness. It was also hypothesized that the use of more preheat could improve the green bond strength at a given bonding time by decreasing the induction time and by increasing the rate of bond formation. This offset, shown in Figure 2, could be considered as a trade-off of corrugator speed for energy input.

The experimental data were analyzed in the format of the hypothesis and is shown in Figure 3. The linerboard experimental data show good agreement with the hypothesis, including an induction time, a reasonably linear rate of bond development, a maximum bonding

TABLE F

LINERBOARD STUDY
CORRELATION OF BONDED AREA TO LINERBOARD PROPERTIES

LINERBOARD PROPERTY	PREHEAT CONDITION	R-SQUARED VALUE	F-RATIO PROBABILITY %
POROSITY, SEC.	LESS	0.004	23
	MORE	0.000	4
CAUSTIC DROP, SEC.	LESS	0.226	86
	MORE	0.168	79
LACTIC ACID DROP, SEC.	LESS	0.002	24
	MORE	0.000	1
SMOOTHNESS, ml/MIN.	LESS	0.077	79
	MORE	0.000	0
HOT FRICTION	LESS	0.000	6
	MORE	0.228	98
CAUSTIC DROP AND HOT FRICTION	MORE	0.225	85

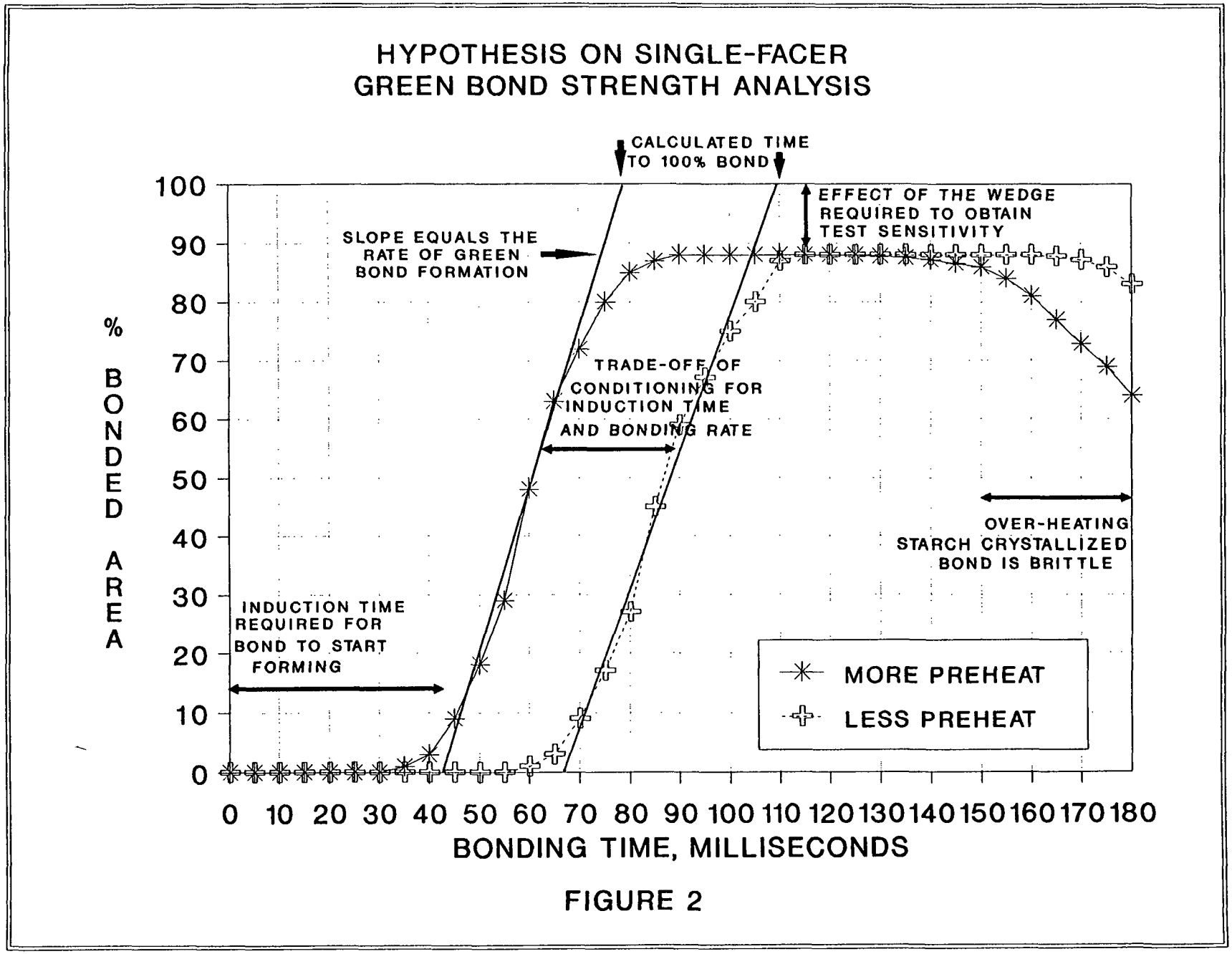
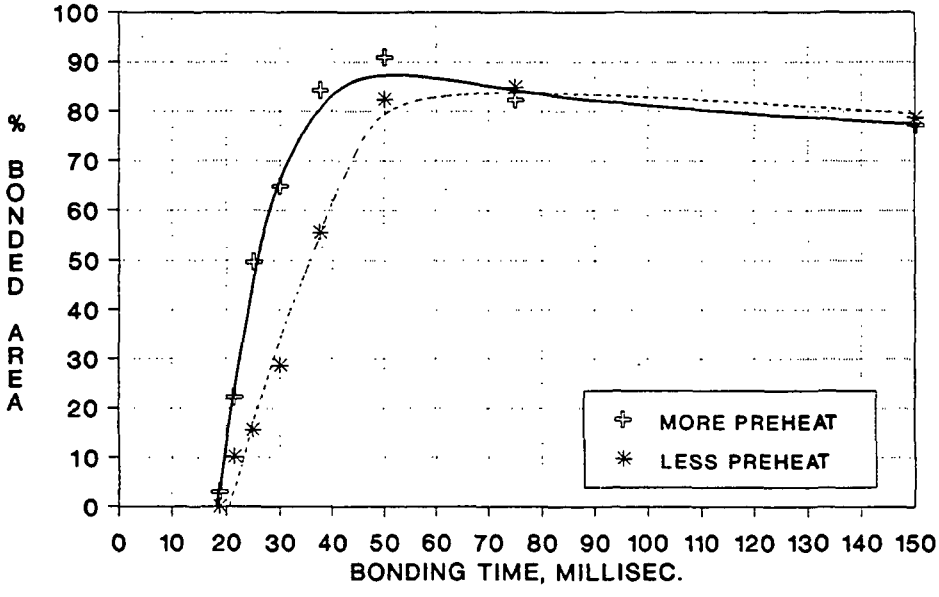

HYPOTHESIS ON SINGLE-FACER
GREEN BOND STRENGTH ANALYSIS
CALCULATED TIME
TO 100% BOND
EFFECT OF THE WEDGE
REQUIRED TO OBTAIN
TEST SENSITIVITY
SLOPE EQUALS THE
RATE OF GREEN
BOND FORMATION
TRADE-OFF OF
CONDITIONING FOR
INDUCTION TIME
AND BONDING RATE
OVER-HEATING
STARCH CRYSTALLIZED
BOND IS BRITTLE
INDUCTION TIME
REQUIRED FOR
BOND TO START
FORMING
MORE PREHEAT
LESS PREHEAT
% BONDED AREA
100
90
80
70
60
50
40
30
20
10
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
BONDING TIME, MILLISECONDS

FIGURE 2

SINGLE-FACE GREEN BOND STRENGTH
AVERAGE OF ALL 22 COMMERCIAL
LINERBOARD SAMPLES



SINGLE-FACE GREEN BOND STRENGTH
AVERAGE OF ALL 15 COMMERCIAL
MEDIUM SAMPLES

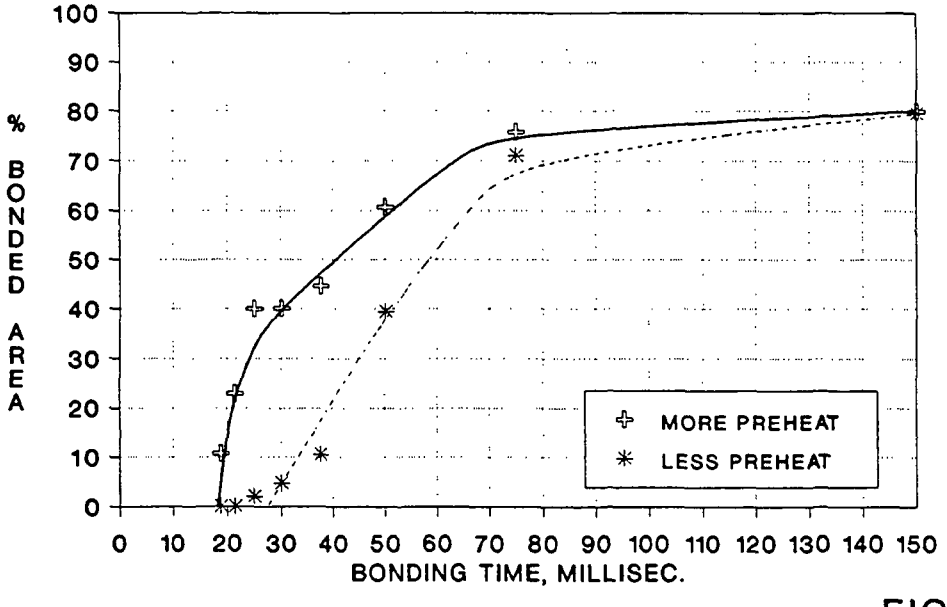


FIGURE 3

slightly below 100%, and a slight reduction in bonding levels at extended bonding time. The medium study data also follow the hypothesis except for a flattened portion of the bond development rate between 30 and 70 milliseconds for the more preheat condition. The medium curves did not exhibit the drop in bond strength at the longer bonding time within the 150-millisecond maximum time used in the experiment.

The bonding curves for each of the experimental materials were analyzed and the induction time, rate of bond formation, and calculated time to 100% bond determined. The data for each of the linerboard samples are given in Table G, and the data for each of the medium samples are given in Table H. The data are shown summarized in Table I. The use of more preheat for the linerboard reduced the calculated time to 100% bond by an average of 12.0 milliseconds or 25.6%. The induction time decreased by 3.7 milli-seconds which is 31% of the 12.0-millisecond total. The effect of preheat on the rate of bond formation accounted for 69% of the total. The data indicate that preheating of linerboard improves the green bond strength primarily by increasing the bonding rate and secondarily by reducing the induction time.

The corresponding data for the medium study were a 30.5-millisecond total bonding time improvement, or 41%, of which 14.5 milli-seconds was reduced induction time, or 48% of the total time reduction; and of which 52% of the total was due to a faster rate of bond development. This indicates that the effect of medium preheating on the green bond strength is equally related to a reduction in the induction time and an increase in the rate of bond formation. The data also suggest that the preheating conditions for the medium have more of an effect on the green bond strength than does the preheating of the linerboard. However, both are important.

The change in induction time and the rate of bond formation going from less preheating to more preheating for the individual samples are shown in Figure 4 for the 22 linerboard samples and in Figure 5 for the 15 medium samples. Lines connect the two corresponding data points for each sample. The data show a range of behavior for the different sample materials. The variability shown may be due to random experimental error or to real material effects. The calculated time to 100% bond is shown in Figure 6 for linerboard and Figure 7 for medium. The data show that more preheating acts to reduce the variation in the green bond strength of the various materials. The data also show that no material achieved a time to 100% bond less than 30 milliseconds. This apparent time barrier at 30 milliseconds is demonstrated best by the linerboard data in Figure 6. Linerboard samples LN and LC had calculated time to 100% bond values of 30 to 35 milli-seconds with less preheat. When more preheat was used, virtually no improvement in bonding time occurred. In comparison, linerboard samples LF, LG, LJ, and LE had bonding times ranging from 40 to 60 milliseconds when less preheat was used. The bonding time of these samples improved to 30-

TABLE G

BONDING CURVE VALUES FOR LINERBOARD SAMPLES

LINERBOARD SUPPLIER CODE	INDUCTION TIME (MILLISEC.)		BONDING RATE %BOND/MILLISEC.		CALCULATED TIME TO 100% BOND	
	LESS PREHEAT	MORE PREHEAT	LESS PREHEAT	MORE PREHEAT	LESS PREHEAT	MORE PREHEAT
LG	25.0	21.0	5.00	10.00	45.0	31.0
LK	19.0	19.0	4.73	7.84	40.1	31.8
LB	19.0	21.0	3.50	7.00	47.6	35.3
LF	19.0	19.0	4.50	8.30	41.2	31.0
LN	25.0	19.0	9.76	9.26	35.2	29.8
LT	30.0	19.0	6.00	7.95	46.7	31.6
LD	25.0	25.0	3.40	5.45	54.4	43.3
LM	38.0	21.0	6.50	7.00	53.4	35.3
LV	30.0	21.0	6.08	7.40	46.4	34.5
LJ	19.0	18.5	3.10	7.84	51.3	31.3
LE	19.0	19.0	2.45	8.00	59.8	31.5
LC	19.0	15.0	7.75	6.40	31.9	30.6
LY	25.0	21.0	4.60	8.25	46.7	33.1
LX	19.0	17.5	3.80	6.50	45.3	32.9
LQ	19.0	19.0	6.20	8.00	35.1	31.5
LA	19.0	21.0	5.80	7.50	36.2	32.3
LL	25.0	21.0	5.80	8.30	42.2	33.0
LU	19.0	21.0	3.40	7.40	48.4	34.5
LI	30.0	21.0	3.95	4.15	55.3	45.1
LH	21.0	19.0	2.17	4.81	67.1	39.8
LO	25.0	19.0	4.80	6.10	45.8	35.4
LP	25.0	19.0	3.50	3.21	53.6	50.2

TABLE H

BONDING CURVE VALUES FOR MEDIUM SAMPLES

MEDIUM SUPPLIER CODE	INDUCTION TIME (MILLISEC.)		BONDING RATE %BOND/MILLISEC.		CALCULATED TIME TO 100% BOND	
	LESS PREHEAT	MORE PREHEAT	LESS PREHEAT	MORE PREHEAT	LESS PREHEAT	MORE PREHEAT
A	38.0	21.0	3.20	3.75	69.3	47.7
Z	30.0	19.0	1.83	5.33	84.6	37.8
N	38.0	18.3	3.50	4.44	66.6	40.8
O	38.0	21.0	2.72	2.61	74.8	59.3
G	21.0	14.0	2.50	5.71	61.0	31.5
M	38.0	21.0	2.40	4.00	79.7	46.0
D	50.0	38.0	2.10	2.22	97.6	83.0
X	38.2	19.0	3.39	7.00	67.7	33.3
S	38.2	21.0	2.44	3.89	79.2	46.7
Q	38.0	21.0	3.33	4.00	68.0	46.0
P1	30.0	19.0	2.22	4.76	75.0	40.0
AH	38.0	19.0	1.91	6.32	90.4	34.8
Y	21.0	14.0	1.88	6.06	74.2	30.5
AC	30.0	18.0	3.00	4.00	63.3	43.0
P2	25.0	10.0	2.72	4.00	61.8	35.0

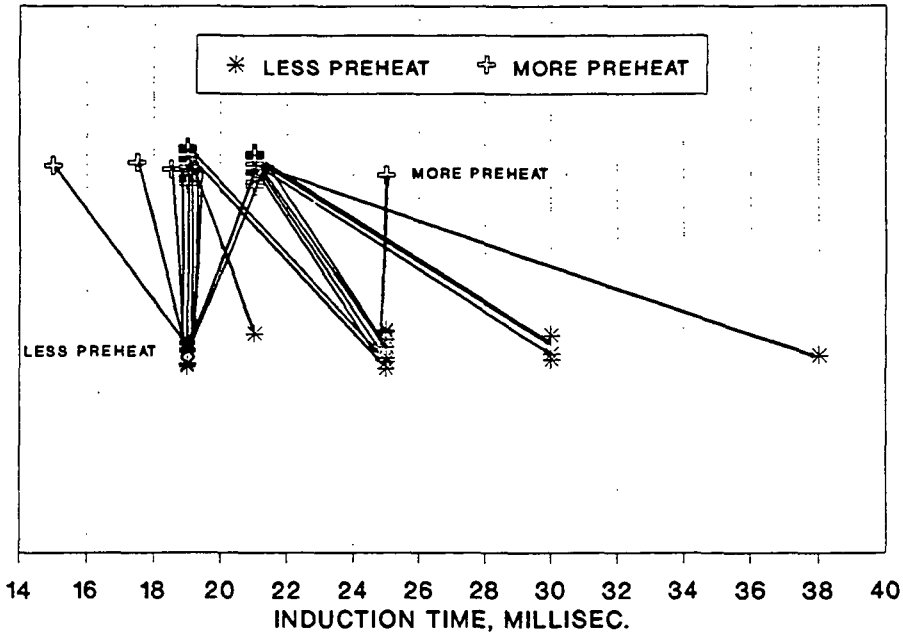
TABLE I

CHANGES IN INDUCTION TIME, BONDING RATE, AND CALCULATED TIME TO 100% BOND FOR LINERBOARD AND MEDIUM SAMPLES

BONDING PARAMETER	STATISTIC VARIABLE	LESS PREHEAT	MORE PREHEAT	DIFFERENCE (1)
LINERBOARD				
INDUCTION TIME (MILLISEC.)	AVERAGE	23.4	19.7	+ 15.8%
	SIGMA	5.17	1.89	+ 63.4%
	RANGE	19.0	10.0	+ 47.4%
BONDING RATE (% BOND PER MILLISEC.)	AVERAGE	4.85	7.12	+ 46.8%
	SIGMA	1.795	1.614	+ 10.1%
	RANGE	7.59	6.79	+ 10.5%
CALCULATED TIME TO 100% BOND (MILLISEC.)	AVERAGE	46.8	34.8	+ 25.6
	SIGMA	8.55	5.27	+ 38.4
	RANGE	35.2	20.4	+ 42.0
MEDIUM				
INDUCTION TIME (MILLISEC.)	AVERAGE	34.1	19.6	+ 42.5
	SIGMA	7.81	6.03	+ 22.8
	RANGE	29.0	24.0	+ 17.2
BONDING RATE (% BOND PER MILLISEC.)	AVERAGE	2.61	4.54	+ 73.9
	SIGMA	0.571	1.334	- 133.6
	RANGE	1.67	4.39	- 162.9
CALCULATED TIME TO 100% BOND (MILLISEC.)	AVERAGE	74.2	43.7	+ 41.1
	SIGMA	10.64	13.27	- 24.7
	RANGE	36.6	52.5	- 43.4

(1) DIFFERENCE IS EXPRESSED AS A % OF THE LESS PREHEAT VALUE. THE "+" SIGN INDICATES AN IMPROVEMENT IN BOND RATE OR A REDUCTION IN VARIABILITY WITH MORE PREHEAT. THE "-" SIGN INDICATES AN UNFAVORABLE CHANGE WITH ADDED PREHEAT.

LINERBOARD INDUCTION TIME
CHANGE WITH MORE PREHEAT



LINERBOARD BOND RATE
CHANGE WITH MORE PREHEAT

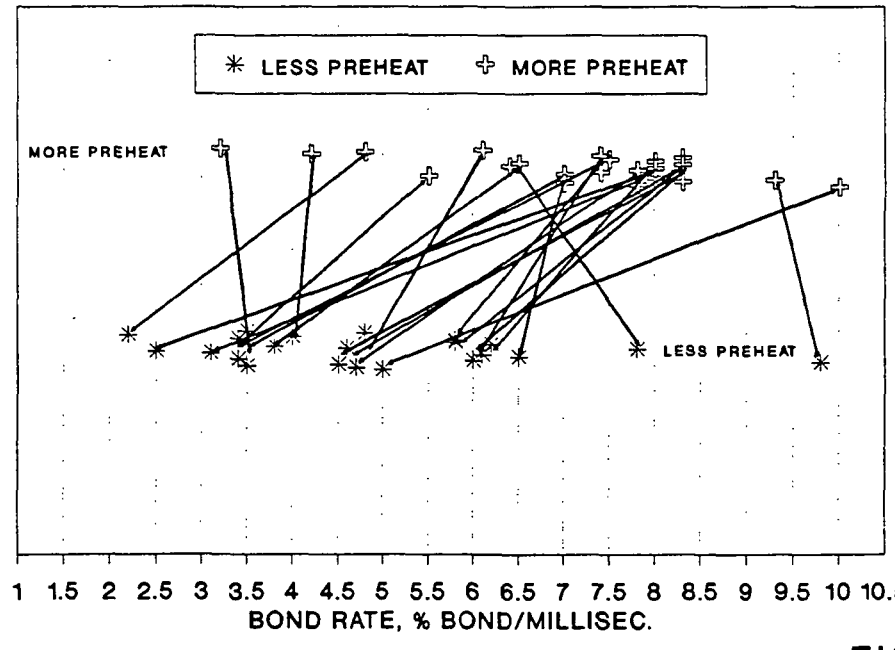
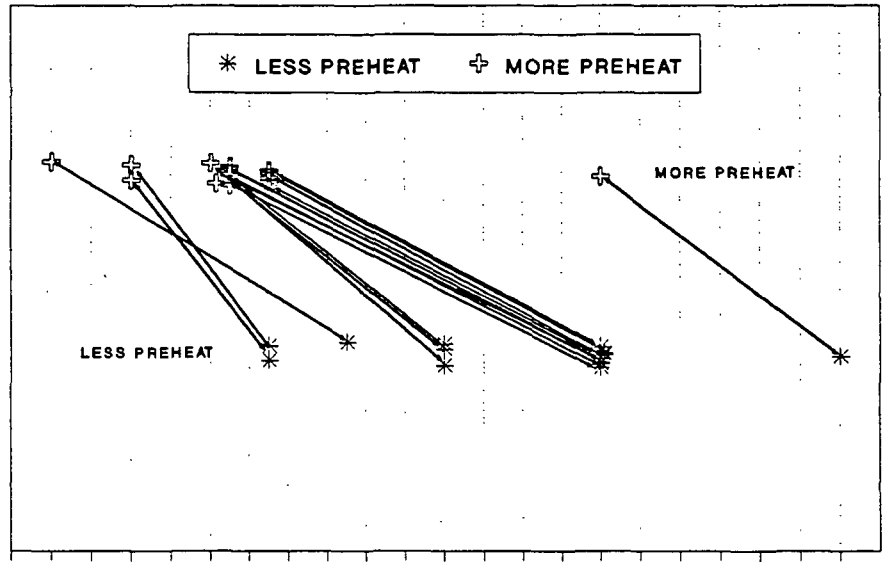


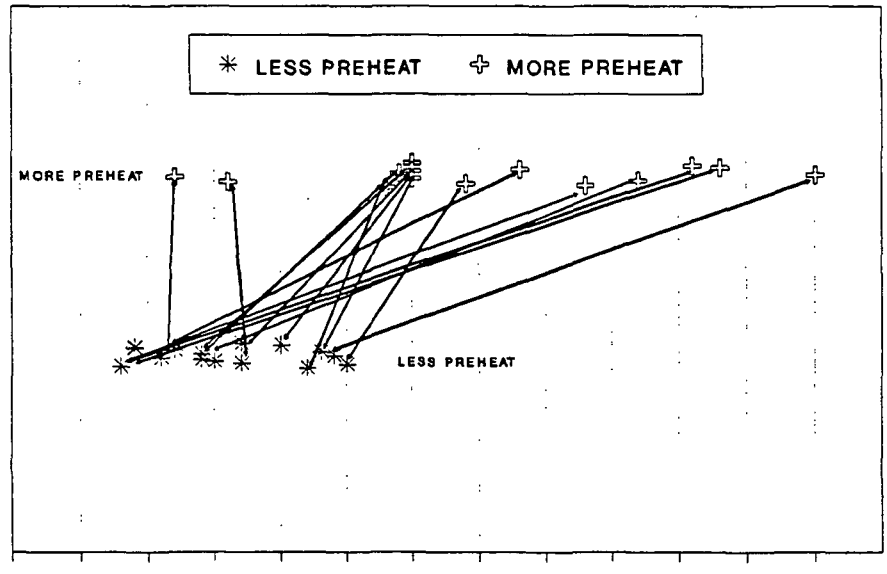
FIGURE 4

MEDIUM INDUCTION TIME
CHANGE WITH MORE PREHEAT



8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52
INDUCTION TIME, MILLISEC.

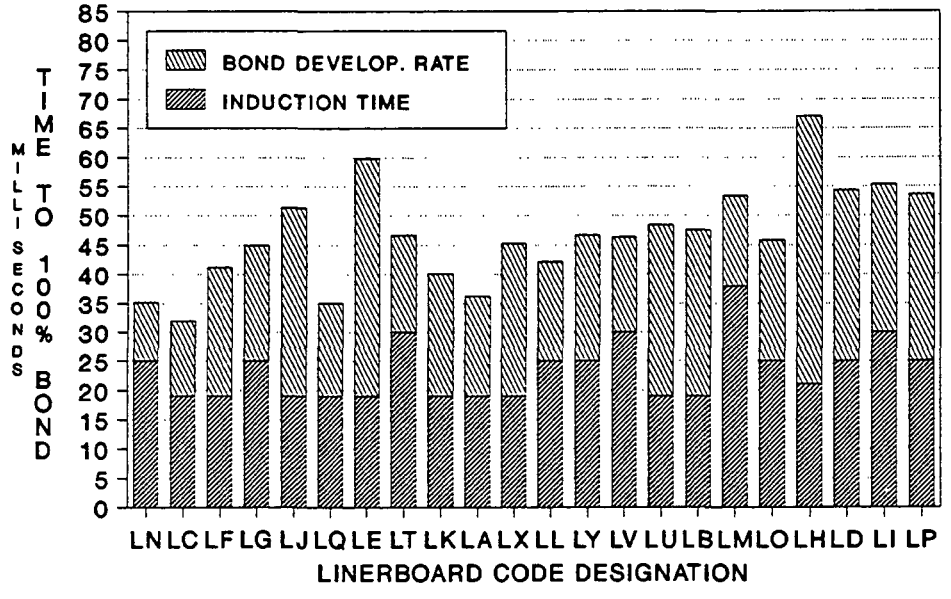
MEDIUM BOND RATE
CHANGE WITH MORE PREHEAT



1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 7.5
BOND RATE, % BOND/MILLISEC.

FIGURE 5

LINERBOARD SAMPLES
CALCULATED TIME TO 100% BONDING
REDUCED PREHEAT CONDITION



LINERBOARD SAMPLES
CALCULATED TIME TO 100% BONDING
NORMAL (MORE) PREHEAT CONDITION

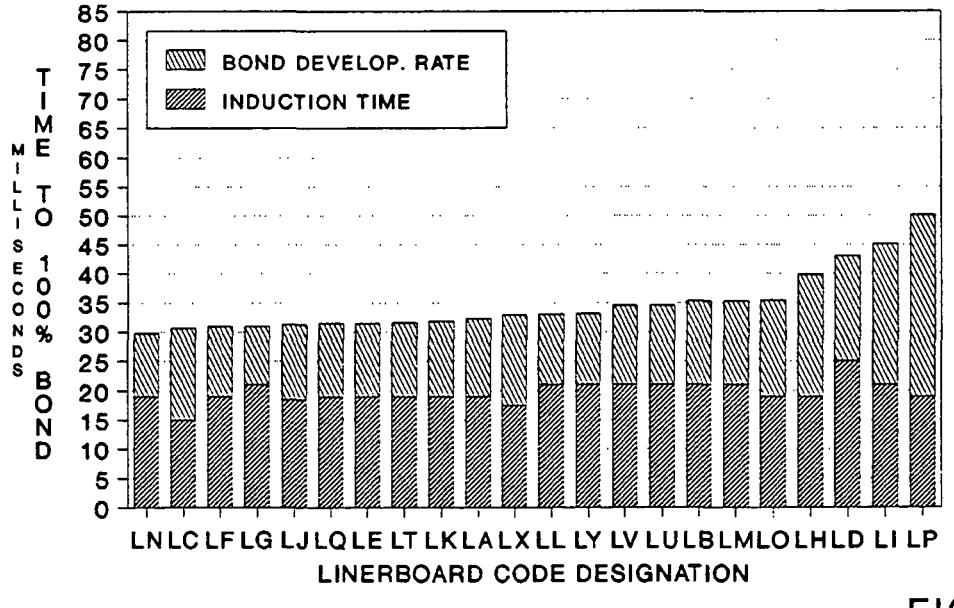
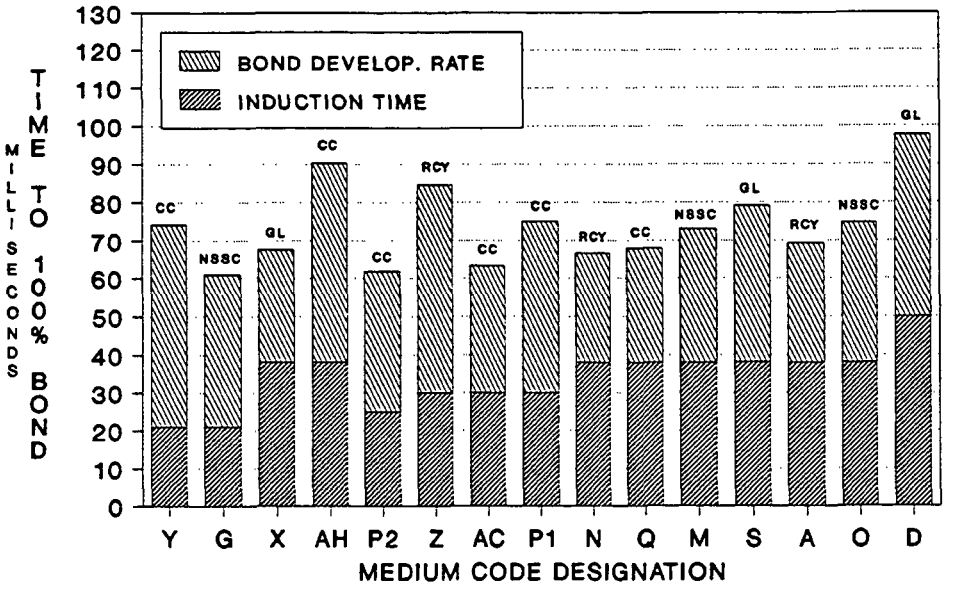


FIGURE 6

MEDIUM SAMPLES
CALCULATED TIME TO 100% BONDING
REDUCED PREHEAT CONDITION



MEDIUM SAMPLES
CALCULATED TIME TO 100% BONDING
NORMAL (MORE) PREHEAT CONDITION

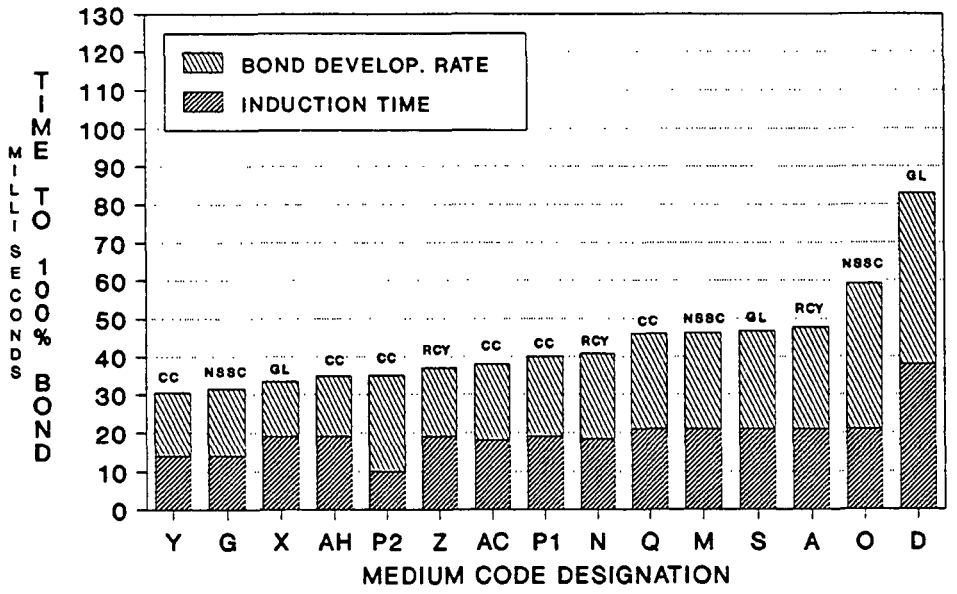


FIGURE 7

milliseconds when more preheat was used. It is hypothesized that this 30 milli-second barrier is a result of the total process, that is, the adhesive, the preheating capacity, and the materials. Additional work would be needed to determine whether this barrier could be overcome and to determine which of the process variables have the most impact.

Regression analysis was performed to determine whether the various bonding parameters were correlated to physical properties of the materials. Those correlations that had a F-Ratio probability greater than 75% are shown in Table J for the medium and Table K for the linerboard. The R-Squared correlation coefficients show that only weak correlations were found. The correlations that were found were related to the change in the rate of bond formation. The correlations that are observed for the calculated time to 100% bond are believed to be due to the bonding rate component of this value rather than being an independent correlation.

The best correlation for medium was between the rate of bond formation and the medium water absorption and the medium porosity for the more preheat condition, Equation 1. The rate of bond formation was correlated to the medium porosity for the less preheat condition, Equation 2. The rate of the green bond strength development improves with a more porous and less wettable medium when more preheat is used and with a less porous medium when less preheat is used. An explanation is not available at this time as to why the effect of medium porosity differs depending on the level of preheat used.

$$\text{RATE OF BOND} = 0.0276(\text{WATER ABS.}) - 0.0866(\text{POR.}) + 5.22 \qquad (1)$$

$$\text{R-SQUARED} = 0.490$$

$$\text{RATE OF BOND} = 0.134(\text{POR.}) + 0.171 \qquad (2)$$

$$\text{R-SQUARED} = 0.410$$

No statistically significant correlations were found between the rate of green bond strength development and the linerboard properties when more preheat was used. The wire side smoothness did show a statistical significant correlation to the green bond development rate under the reduced preheat condition, Equation 3. A smoother linerboard wire side improved the rate of green bond formation.

TABLE J

CORRELATION ANALYSIS OF BONDING PARAMETERS
TO MEDIUM TEST PROPERTIES

DEPENDENT VARIABLE	INDEPENDENT VARIABLE	R-SQUARED VALUE	F-RATIO PROB. %	SLOPE	INTER.
EXPERIMENTS WITH MORE (NORMAL) PREHEAT					
RATE OF BONDING	SMOOTHNESS,WIRE	0.110	77	-.00579	11.46
RATE OF BONDING	WATER ABSORP.	0.375	98	0.0760	2.074
TIME TO 100% BD	WATER ABSORP.	0.152	85	-1.195	82.13
RATE OF BONDING	WATER DROP	0.352	98	0.0752	1.464
TIME TO 100% BD	WATER DROP	0.196	90	-1.009	84.61
RATE OF BONDING	POROSITY	0.212	92	-0.433	12.41
EXPERIMENTS WITH LESS PREHEAT					
RATE OF BONDING	POROSITY	0.410	99	0.134	0.171
TIME TO 100% BD	POROSITY	0.189	90	-3.623	139.71

MULTIPLE LINEAR REGRESSION ANALYSIS
FOR MEDIUM WITH MORE (NORMAL) PREHEAT

RATE OF BD. = 0.0276(WATER ABSORP.) - 0.0866(POROSITY) + 5.22

R-SQUARED = 0.490 F-RATIO PROB. = 99.3%

LINEAR REGRESSION ANALYSIS FOR MEDIUM
WITH LESS PREHEAT USED

RATE OF BOND = 0.134(POROSITY) + 0.171

R-SQUARED = 0.410 F-RATIO PROB. = 99%

TABLE K

CORRELATION ANALYSIS OF BONDING PARAMETERS
TO LINERBOARD TEST PROPERTIES

DEPENDENT VARIABLE	INDEPENDENT VARIABLE	R-SQUARED VALUE	F-RATIO PROB. %	SLOPE	INTER.
EXPERIMENTS WITH LESS PREHEAT					
RATE OF BONDING	HOT FRICT.,WIRE	0.104	86	-128.53	35.86
RATE OF BONDING	SMOOTHNESS,WIRE	0.209	97	-.00212	8.59
TIME TO 100% BD	SMOOTHNESS,WIRE	0.303	99	0.0403	-23.88
RATE OF BONDING	CAUSTIC DROP	0.129	90	0.00335	3.434
TIME TO 100% BD	CAUSTIC DROP	0.271	78	-0.012	51.89
INDUCTION TIME	CAUSTIC DROP	0.106	86	0.00874	19.64

RATE OF BD. = 8.59 - 0.00212(WIRE SIDE SMOOTHNESS)

R-SQUARED = 0.209 F-RATIO PROB. = 97%

MULTIPLE LINEAR REGRESSION OF SMOOTHNESS AND CAUSTIC DROP TO THE RATE OF BOND FORMATION DID NOT IMPROVE THE STATISTICAL PARAMETERS OVER THOSE OBTAINED USING ONLY THE SMOOTHNESS AS THE INDEPENDENT VARIABLE.

RATE OF BOND = 8.59 - 0.00212(WIRE SIDE SMOOTH.) (3)

R-SQUARED = 0.209

The calculated rate of bond formation, using the correlation equations discussed above, are shown plotted versus the measured rate of bond formation in Figure 8. As expected from the correlation coefficients, a closer agreement is observed for the medium material than for the linerboard.

In summary, the green bond strength is influenced by three process variables. The first factor is the time between the exit from the nip and when the debonding force is applied. A longer time produces a stronger bond. The second factor is the use of preheat. More preheat produces a stronger bond in a given time. The third factor is the physical properties of the medium and the linerboard.

The implication of the results is that the single-face web should be protected from mechanical forces for as long a time as possible. This would include minimizing vibration, variation in tensile force, flexing, and web flutter. The proper preheating conditions are important to maintaining a good green bond strength. The various steaming and heating units on the single-facer need to be kept in proper working condition and with the proper temperatures and steam quality. The container board properties of porosity, water absorption, and smoothness can influence the green bond, especially at reduced preheat conditions.

Many corrugators still operate with wide fluctuations in speed. It is a normal practice to reduce the preheater wraps when the corrugator is slowed in order to minimize warp. This work indicates that care should be taken to increase the wrap when the corrugator speed is increased so as to maintain the green bond strength and thereby minimize the probability of generating blisters and other bonding defects.

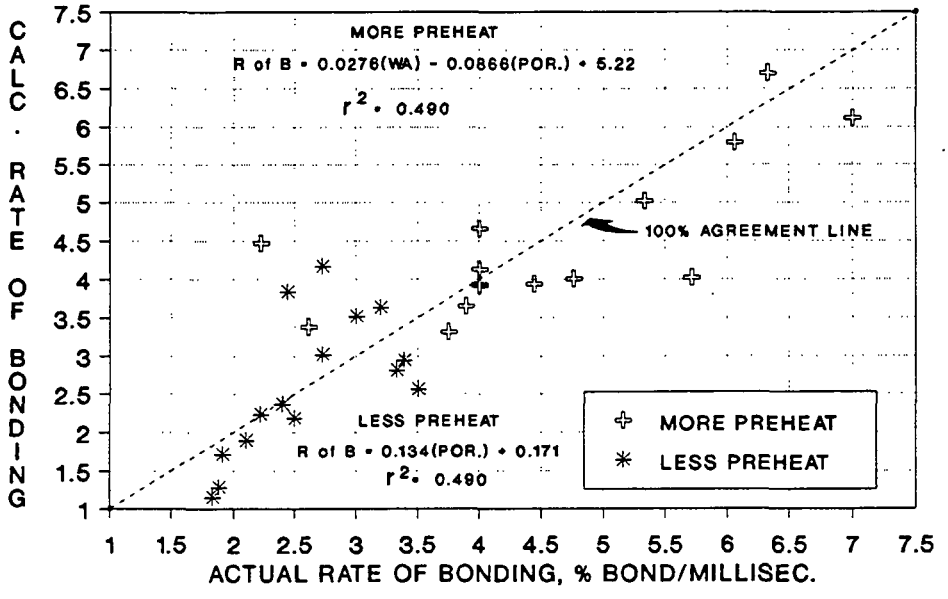
6. Combined Board Test Properties.

The single-faced webs from the bonding experiment had the double-face linerboard applied on the IPST pilot doublebacker. The resultant combined board was tested for Edge Crush Test, cured Pin Adhesion, and for the medium experiment samples, Flat Crush.

Figure 9 shows the relationship of the combined board Flat Crush to the Concora for the 15 medium materials. The medium materials are grouped according to the pulp type. While there is a wide variation in the ratio between samples, there is not a consistent difference between the types of pulp.

Figure 10 shows the relationship between the Ring Crush and STFI

COMPARISON OF ACTUAL TO CALCULATED
RATE OF BOND FORMATION FOR
15 COMMERCIAL MEDIUM MATERIALS



COMPARISON OF ACTUAL TO CALCULATED
RATE OF BOND FORMATION FOR
22 COMMERCIAL LINERBOARD MATERIALS
LESS PREHEAT CONDITION

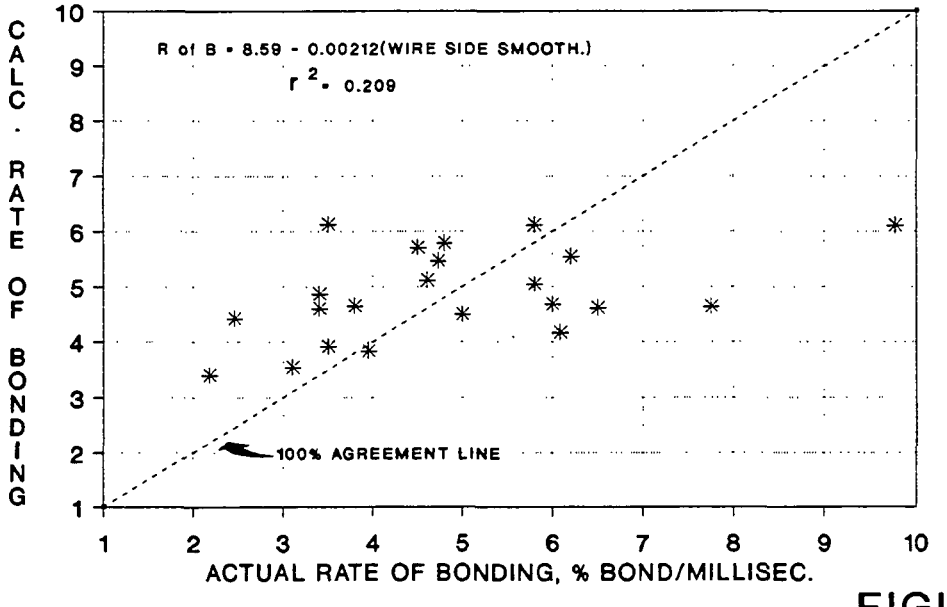
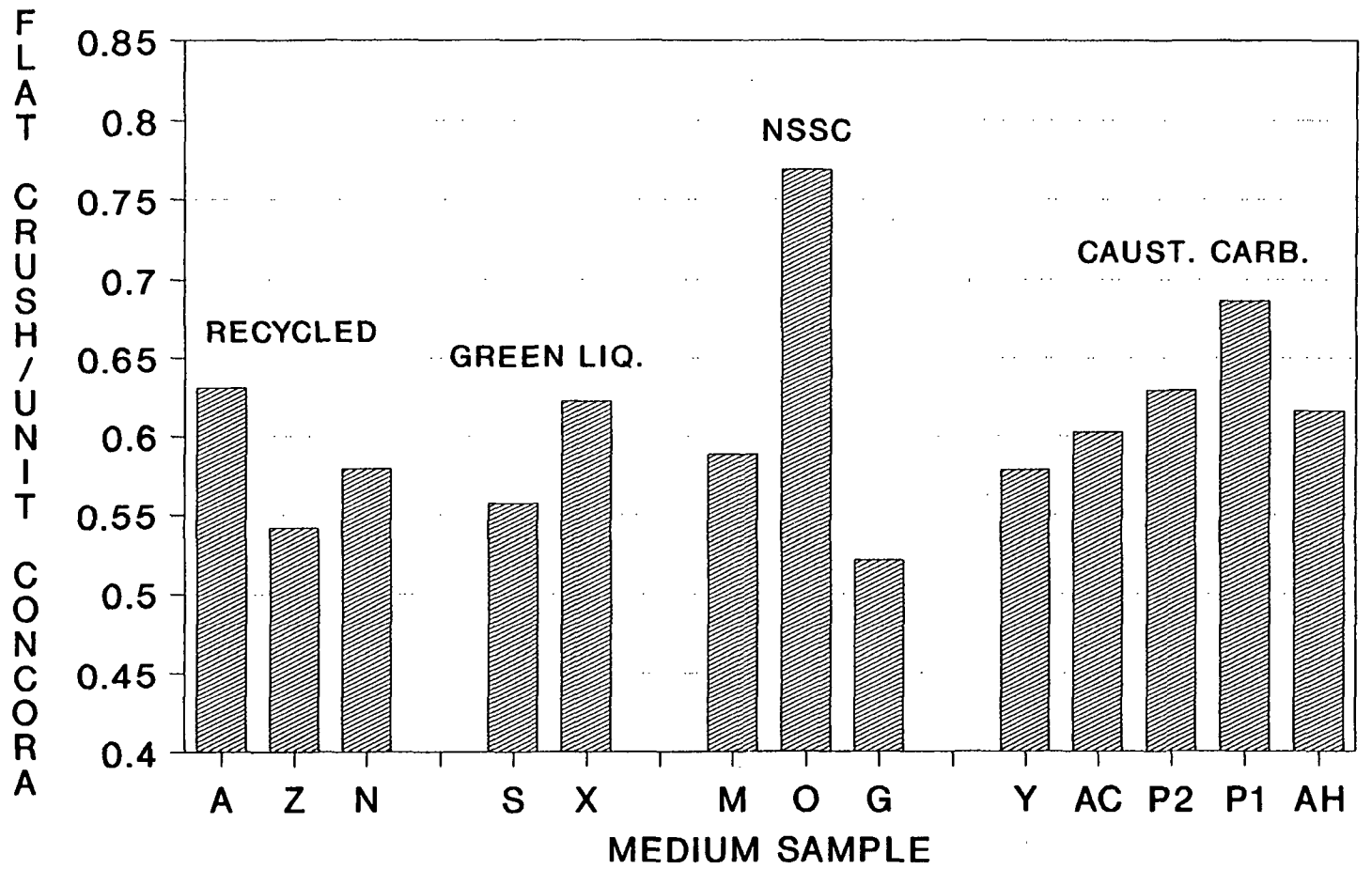


FIGURE 8

FIGURE 9

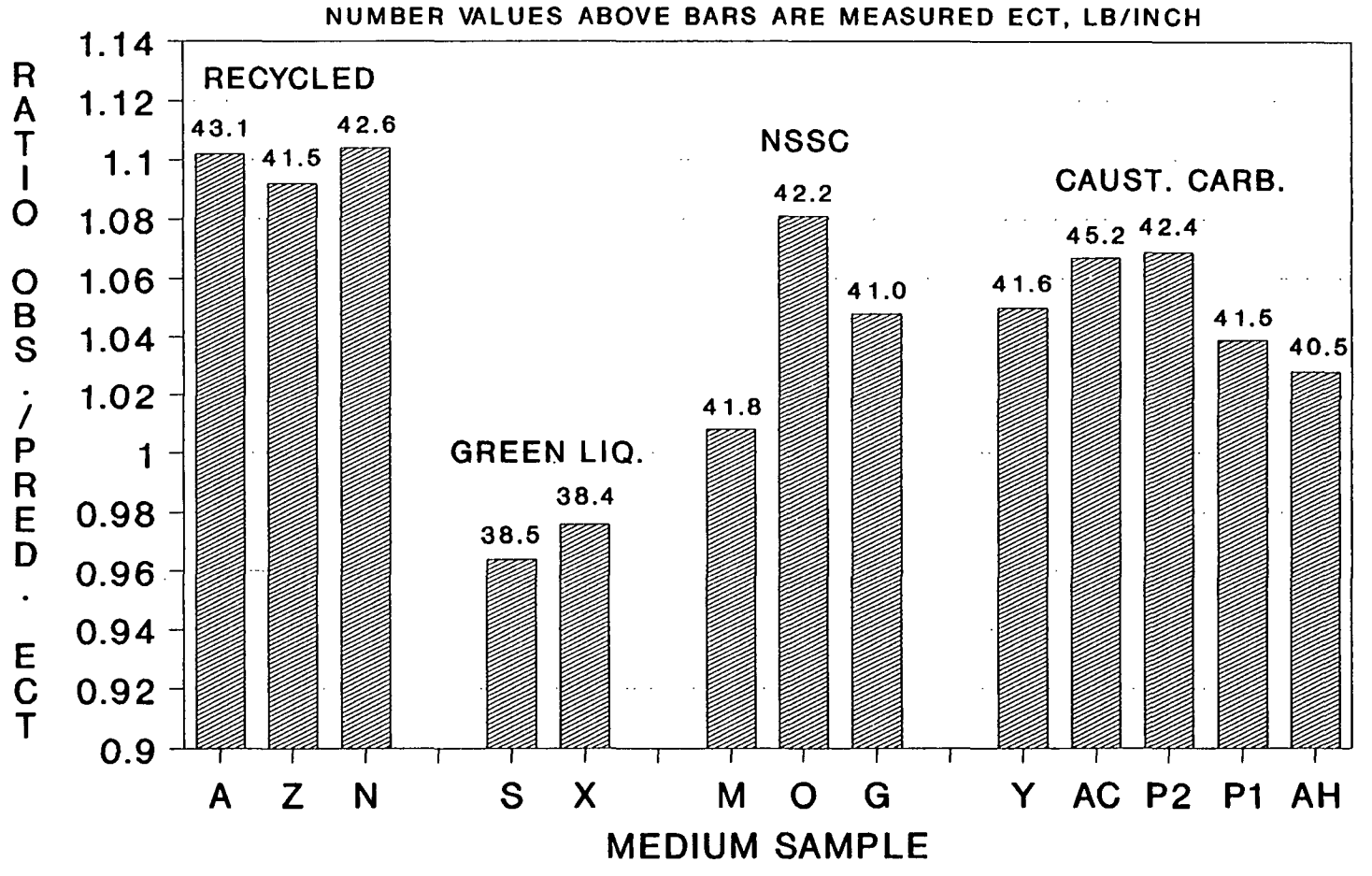
EFFECT OF MEDIUM CONCORA ON FLAT CRUSH



CONSTANT LINERBOARD AND CONVERTING CONDITIONS @ 500 FPM

FIGURE 10

EFFECT OF MEDIUM CRUSH STRENGTH ON ECT



CONSTANT LINERBOARD AND CONVERTING CONDITIONS @ 500 FPM

Crush and the combined board Edge Crush Test for the 15 medium samples. The data is expressed as the ratio of the observed ECT to the ECT calculated from the component crush strength using the published API equation. The data show that the recycled mediums had a consistently higher ratio than that for the other types of medium. The higher ratio indicates that the recycled medium lost less of its compression strength during corrugating.

Statistical analysis showed that the ECT for the medium study samples was 1.1 lb/in, or 2.6%, higher when more preheat was used. The difference was significant at the 99% probability level. The effect of preheating on ECT was not observed for the samples from the linerboard study. The statistical probability of a difference was much less than 50%.

The correlation between the component crush strength and the resultant combined board ECT for both the medium study and the linerboard study is shown in Figure 11. In both instances, the correlation coefficient was higher for the Ring Crush Test than for the STFI Crush Test.

Figures 12 and 13 show that there was only a poor correlation between the green bond strength and the cured Pin Adhesion. However, the effect of preheating on the green bond strength and the cured Pin Adhesion was statistically significant, Figures 14 and 15. The cured Pin Adhesion strength of the singleface bond was 3.3% higher when more preheat was used for the medium material study and 8.5% higher for the linerboard material study.

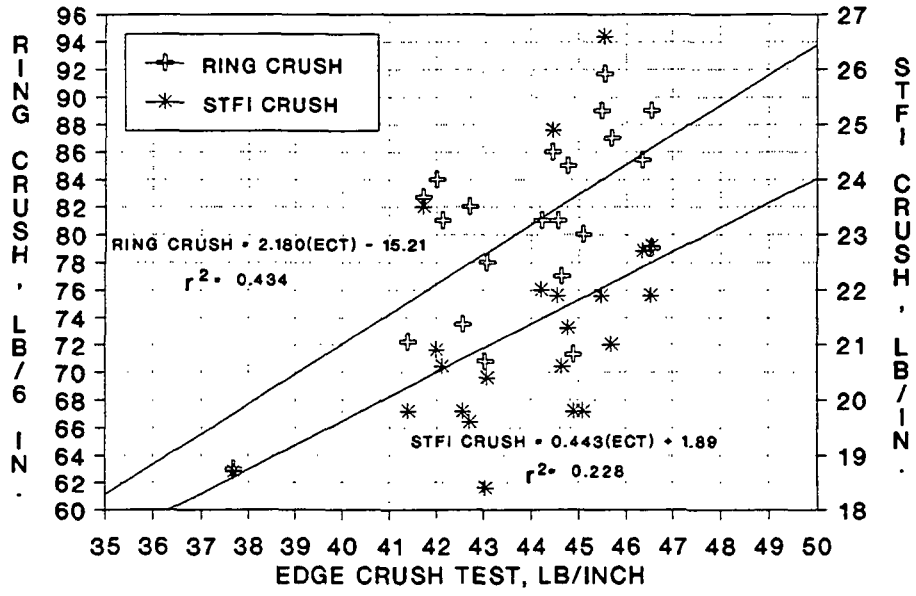
7. Acknowledgements.

The assistance given in this project by the following organizations is greatly appreciated:

Grain Processing Company, Muscatine, Iowa
Moisture Systems Corporation, Hopkinton, MA
CKPG Member Companies

CORRELATION OF RING CRUSH AND STFI CRUSH
TO ECT FOR LINERBOARD SAMPLES

22 COMMERCIAL LINERBOARD SAMPLES



CORRELATION OF RING CRUSH AND STFI CRUSH
TO ECT FOR MEDIUM SAMPLES

15 COMMERCIAL MEDIUM SAMPLES

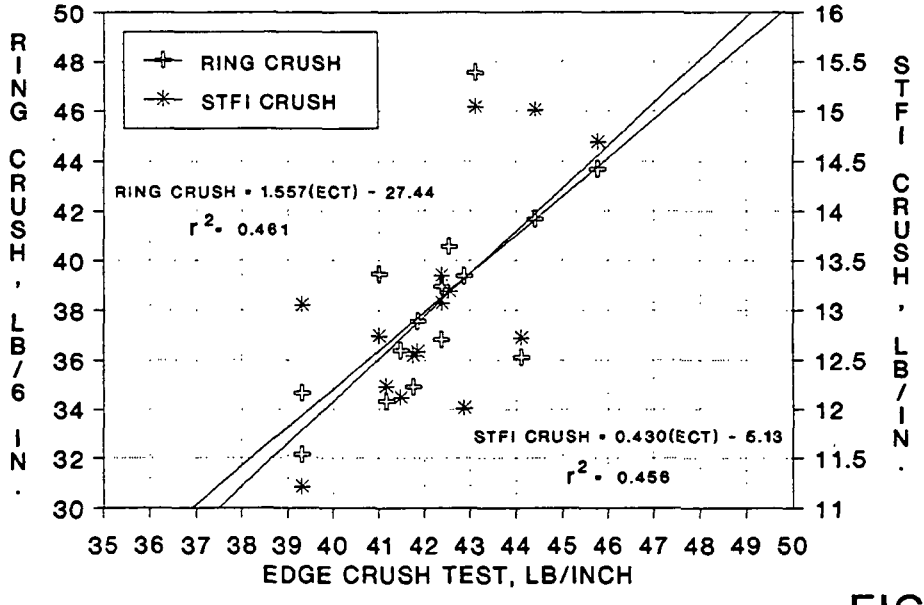


FIGURE 11

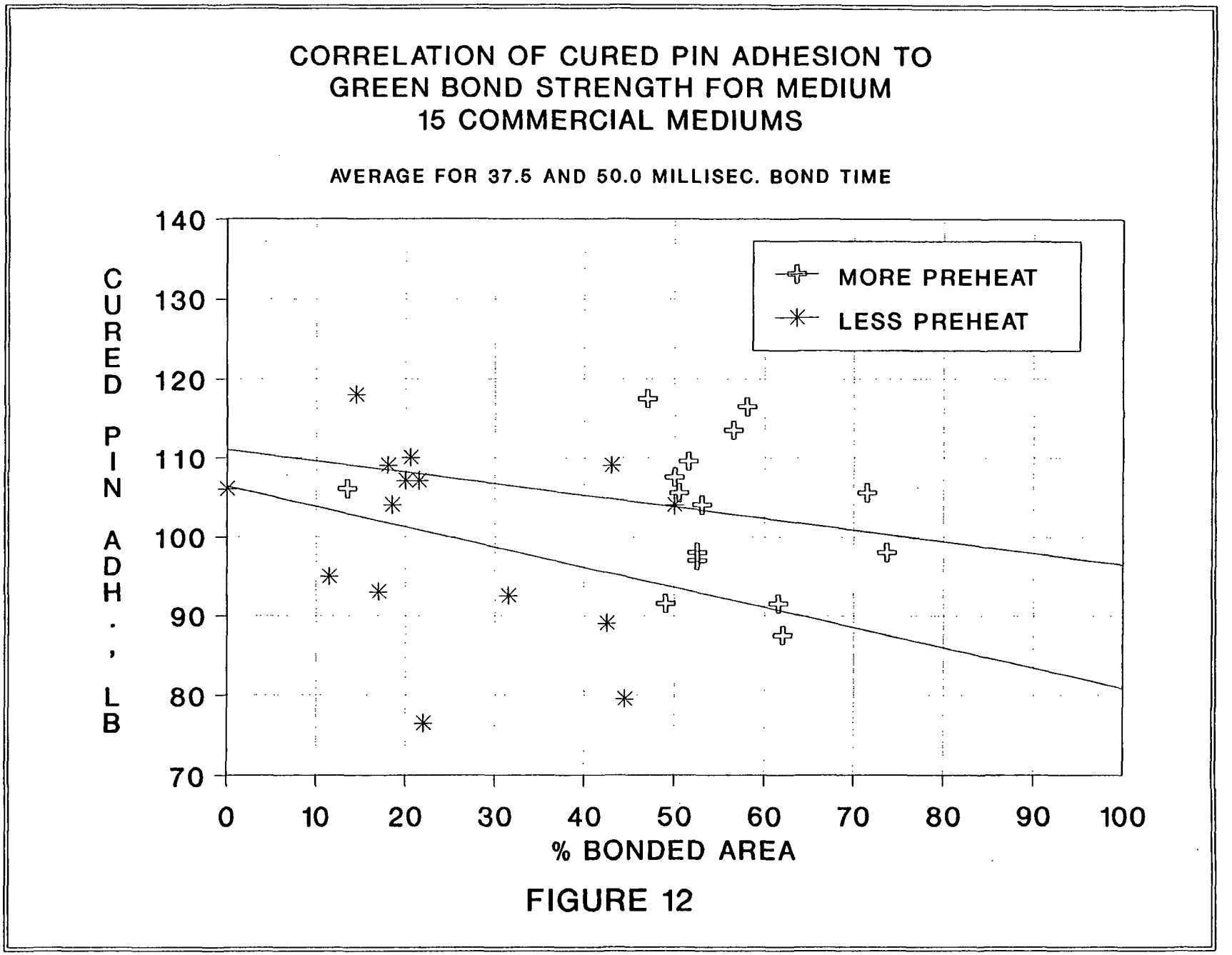

CORRELATION OF CURED PIN ADHESION TO
GREEN BOND STRENGTH FOR MEDIUM
15 COMMERCIAL MEDIUMS
AVERAGE FOR 37.5 AND 50.0 MILLISEC. BOND TIME
CURED PIN ADH., LB
140
130
120
110
100
90
80
70
0
10
20
30
40
50
60
70
80
90
100
% BONDED AREA
MORE PREHEAT
LESS PREHEAT

FIGURE 12

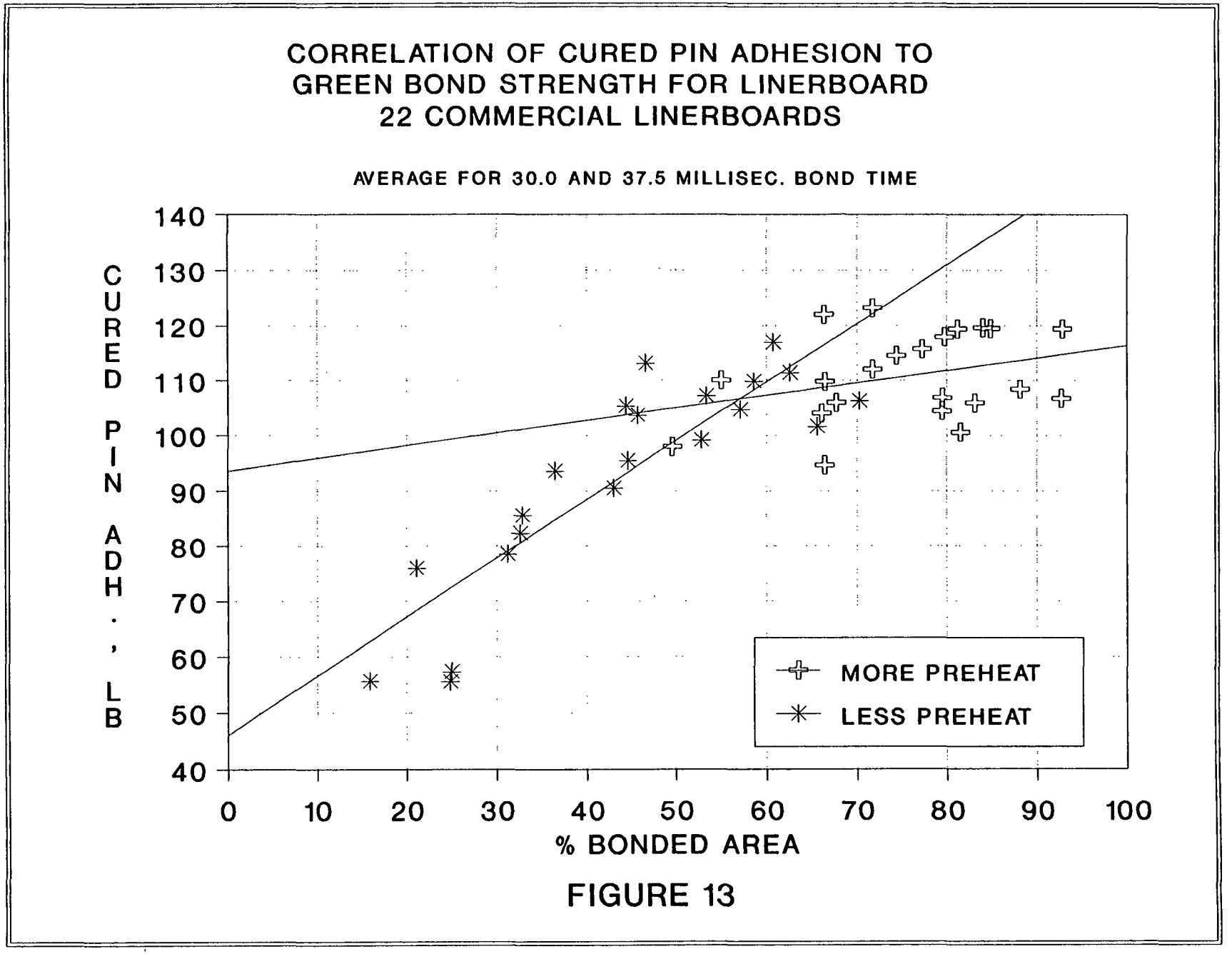

CORRELATION OF CURED PIN ADHESION TO
GREEN BOND STRENGTH FOR LINERBOARD
22 COMMERCIAL LINERBOARDS
AVERAGE FOR 30.0 AND 37.5 MILLISEC. BOND TIME
CURED PIN ADH., LB
140
130
120
110
100
90
80
70
60
50
40
0
10
20
30
40
50
60
70
80
90
100
% BONDED AREA
MORE PREHEAT
LESS PREHEAT

FIGURE 13

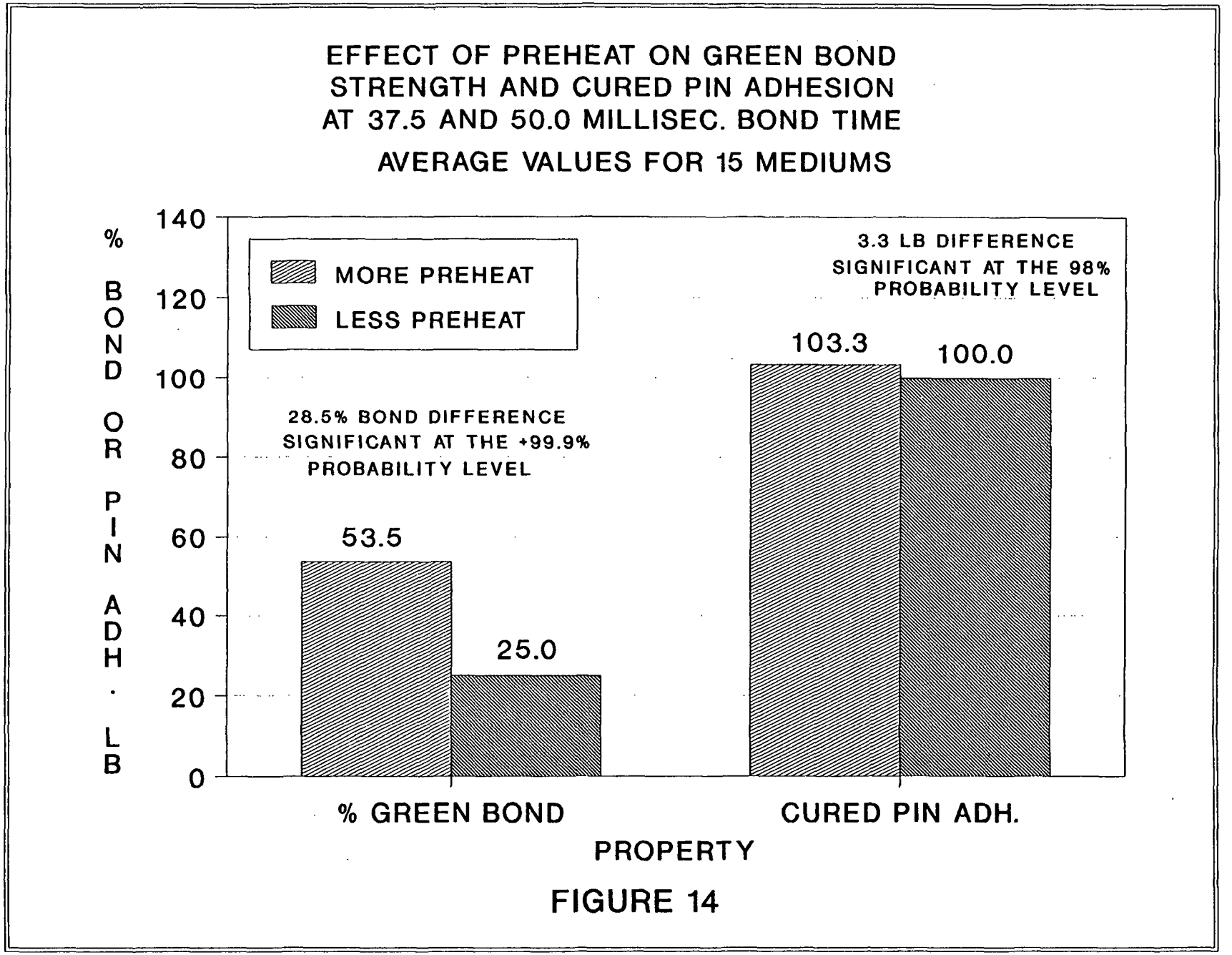

EFFECT OF PREHEAT ON GREEN BOND STRENGTH AND CURED PIN ADHESION AT 37.5 AND 50.0 MILLISEC. BOND TIME
AVERAGE VALUES FOR 15 MEDIUMS
% BOND OR PIN ADH. LB
140
120
100
80
60
40
20
0
MORE PREHEAT
LESS PREHEAT
28.5% BOND DIFFERENCE SIGNIFICANT AT THE +99.9% PROBABILITY LEVEL
3.3 LB DIFFERENCE SIGNIFICANT AT THE 98% PROBABILITY LEVEL
53.5
25.0
103.3
100.0
% GREEN BOND
CURED PIN ADH.
PROPERTY

FIGURE 14

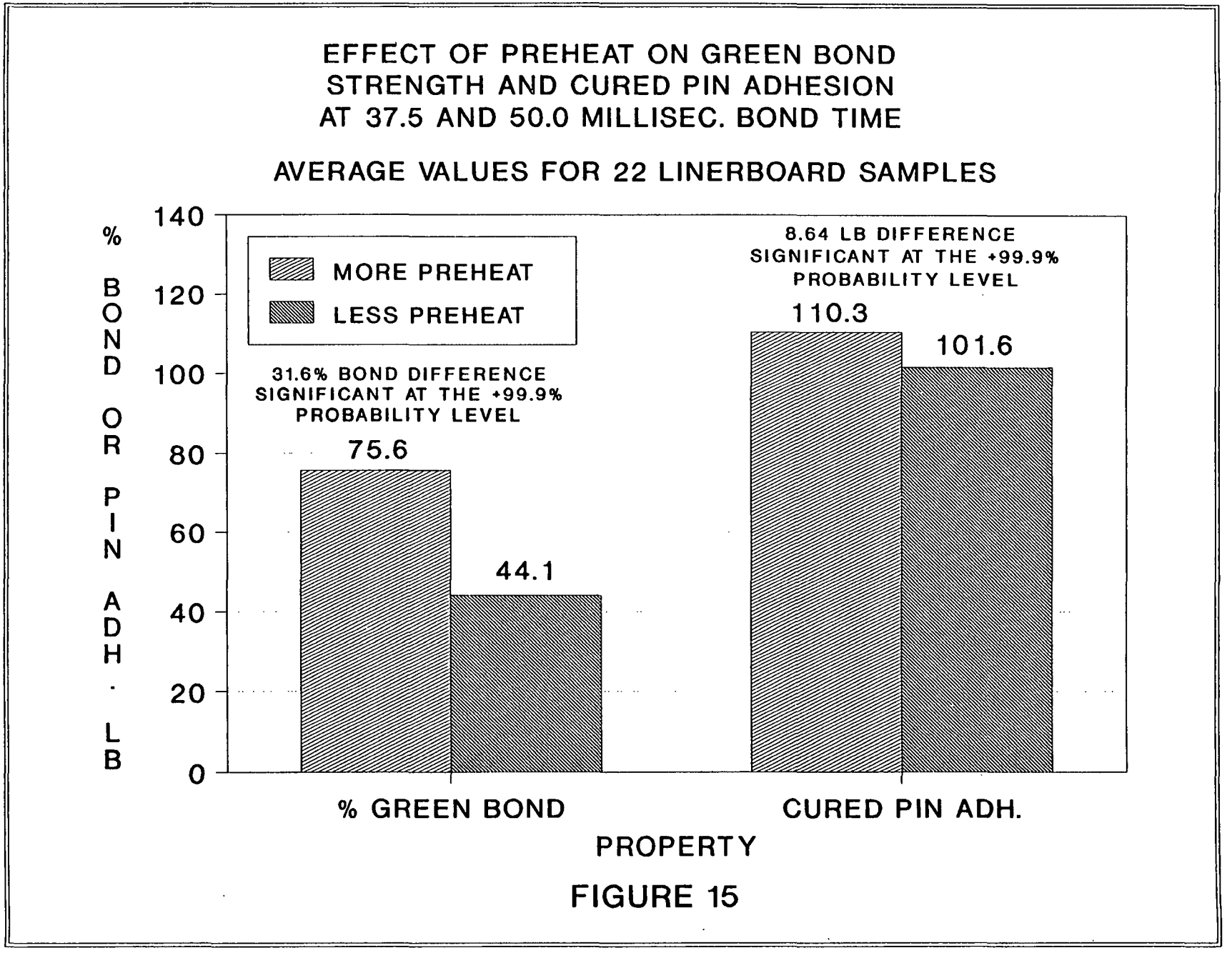

EFFECT OF PREHEAT ON GREEN BOND STRENGTH AND CURED PIN ADHESION AT 37.5 AND 50.0 MILLISEC. BOND TIME
AVERAGE VALUES FOR 22 LINERBOARD SAMPLES
% BOND OR PIN ADH. LB
140
120
100
80
60
40
20
0
MORE PREHEAT
LESS PREHEAT
31.6% BOND DIFFERENCE SIGNIFICANT AT THE +99.9% PROBABILITY LEVEL
75.6
44.1
8.64 LB DIFFERENCE SIGNIFICANT AT THE +99.9% PROBABILITY LEVEL
110.3
101.6
% GREEN BOND
CURED PIN ADH.
PROPERTY

FIGURE 15

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APPENDICES

Appendix I Summary of Physical Characteristics Caustic Carbonate

Mill Code:		AH	AC	Q	Y	P–2	P–1	Averages
Basis Weight, lb/Msqft		26.10	26.7	26.1	26.1	25.9	25.8	26.12
Caliper (TAPPI), mil	Ave	9.92	9.79	11.53	10.24	8.79	9.15	9.90
	SD	0.35	0.14	0.66	0.42	0.33	0.16	0.34
Caliper (IPC), micron	Ave	201.71	192.39	214.15	218.71	197.31	197.93	203.70
	SD	7.32	11.65	12.46	8.29	10.14	4.20	9.01
Inches	Ave	7.94	7.57	8.43	8.61	7.77	7.79	8.02
	SD	0.29	0.46	0.49	0.33	0.40	0.17	0.35
Density (TAPPI), lb/rm–mil		2.63	2.73	2.16	2.55	2.95	2.82	2.64
Density (IPC), lb/rm–mil		3.29	3.31	3.10	2.94	3.35	3.31	3.22
MD Tensile, lb/in	Ave	34.67	35.21	36.9	38.72	33.28	32.122	35.15
	SD	0.51	0.51		0.58	0.49	0.47	0.51
CD Tensile, lb/in	Ave	13.83	16.57	14.3	15.47	16.83	16.54	15.59
	SD	0.22	0.26		0.24	0.26	0.26	0.25
MD Stretch, %	Ave	1.09	1.21	1.23	1.28	1.27	1.29	1.23
	SD	0.01	0.02		0.02	0.02	0.02	0.02
CD Stretch, %	Ave	1.27	2.16	2.09	2.44	2.21	1.80	2.00
	SD	0.02	0.04		0.04	0.04	0.03	0.03
MD ET, lb/in	Ave	4907	4646	4820	5055	4525	4208	4693.37
	SD	79.34	74.68		81.26	72.73	67.98	75.20
CD ET, lb/in	Ave	1920	1982	1744	1719	2014	1960	1889.97
	SD	29.67	30.67		26.33	31.22	30.62	29.70
MD TEA, ftlb/sqft	Ave	2.87	3.23	3.68	3.84	3.33	3.22	3.36
	SD	0.43	0.44		0.36	0.45	0.44	0.42
CD TEA, ftlb/sqft	Ave	1.43	3.25	2.77	3.44	3.31	2.51	2.78
	SD	0.02	0.05		0.05	0.05	0.04	0.04
MD STFI, lb/in	Ave	21.32	22.84	21.72	22.55	19.63	20.25	21.38
	SD	1.98	1.21	1.77	1.37	1.32	1.05	1.45
CD STFI, lb/in	Ave	12.74	15.01	12.54	12.58	13.07	13.35	13.21
	SD	1.52	0.87	1.04	1.13	1.24	1.10	1.15
MD Ring Crush, lb/6in	Ave	47.82	53.62	50.47	58.10	46.13	47.15	50.55
	SD	3.21	0.87	4.35	2.71	2.07	2.31	2.59
CD Ring Crush, lb/6in	Ave	39.45	41.67	34.90	37.55	36.80	38.93	38.22
	SD	1.84	3.15	1.73	1.77	1.93	2.10	2.09
Concora, lb	Ave	49.17	64.17	57.40	60.50	54.17	55.00	56.73
	SD	2.88	1.67	3.78	1.52	3.49	1.58	2.49
Friction (HOT), Felt	Ave	0.13	0.28	0.19	0.32	0.19	0.18	0.22
	SD	0.01	0.02		0.03	0.00	0.02	0.02
Friction (HOT), Wire	Ave	0.18	0.29	0.20	0.35	0.19	0.22	0.24
	SD	0.01	0.03		0.03	0.01	0.01	0.02
Porosity (Gurley), sec/100ml	Ave	11.50	25.00	19.7	8.30	21.17	15.33	16.83
	SD	1.05	3.16	1.70	0.52	1.47	0.82	1.45
Smooth. (Bendtsen), F, ml/min	Ave	968	524	2666	1212	590	770	1121.67
	SD	90.40	25.10	297.88	70.10	29.15	52.44	94.18
Smooth. (Bendtsen), W, ml/min	Ave	916	516	2578	1242	532	768	1092.00
	SD	132.80	13.42	61.40	53.60	38.99	25.88	54.35

Appendix I — Summary of Physical Characteristics — Caustic Carbonate

Mill Code:		AH	AC	Q	Y	P–2	P–1	Averages
ZDT, psi	Ave	74.00	80.2	71.00	76.2	81.6	81.00	77.33
	SD	2.24	5.07	2.35	1.48	2.88	2.55	2.76
Ext, kN/m		1053	1058	1151	1139	1089	990	1080.00
Eyt, kN/m		508	525	499	455	550	499	506.00
Gxyt, kN/m		284	296	285	278	300	279	287.00
Ezt, kN/m		15.73	26.17	25.48	17.71	17.36	15.63	19.68
Water Absorbtion, T819								
Wire up, sec		89.8	39.1	14.2	46.7	45.7	38.8	45.72
(A2), wire, sec.		28.6	8.8	3.9	18.4	13.2	12.5	14.23
(A2), felt, sec.		22.4	8.8	3.6	15.4	14.8	12.9	12.98
(A3), wire up, sec		53.2	25	12.2	29.4	34.1	30.4	30.72
Alcohol/Water sol.								

Surface Tensions		F	W	F	W	F	W	F	W	F	W	F	W	F	W
dyne/cm.	72.2	92.8	69.2	71.2	49.8	27.2	21.7	50.5	47.0	62.0	58.8	56.8	52.2	60.08	49.65
	47.7	12.0	11.5	9.0	7.8	4.2	2.8	2.0	2.0	15.0	11.8	10.2	7.8	8.73	7.28
	37.7	2.6	4.0	4.3	3.2	2.2	2.0	1.5	1.5	3.5	2.5	2.5	1.8	2.77	2.5
	33.3			3.2	3.0					3.2	2.2			3.20	2.6
	28.7														
	25.4														
	24.2														

Roll Moisture, %	6	6	6.8	7.2	7.3	6.6	6.65

Appendix I Summary of Physical Characteristics Recycled

Mill Code:		A	N	Z	Averages
Basis Weight, lb/Msqft		26.00	26.6	26.6	26.40
Caliper (TAPPI), mil	Ave	8.61	8.75	10.24	9.20
	SD	0.32	0.43	0.58	0.44
Caliper (IPC), micron	Ave	182.93	197.05	213.95	197.98
	SD	2.31	14.96	10.35	9.21
Inches	Ave	7.20	7.76	8.42	7.79
	SD	0.09	0.59	0.41	0.36
Density (TAPPI), lb/rm−mil		2.89	3.04	2.60	2.84
Density (IPC), lb/rm−mil		3.66	3.46	3.03	3.39
MD Tensile, lb/in	Ave	48.3	46.67	42.04	45.67
	SD		0.70	0.63	0.66
CD Tensile, lb/in	Ave	18.84	15.36	15.45	16.55
	SD		0.24	0.24	0.24
MD Stretch, %	Ave	1.274	1.56	1.46	1.43
	SD		0.02	0.02	0.02
CD Stretch, %	Ave	3.24	3.03	2.31	2.86
	SD		0.05	0.04	0.04
MD ET, lb/in	Ave	5051	5635	5211	5299.13
	SD		90.68	83.77	87.22
CD ET, lb/in	Ave	1913	1791	1822	1842.00
	SD		27.38	27.98	27.68
MD TEA, ftlb/sqft	Ave	6.939	5.76	4.77	5.82
	SD		0.35	0.37	0.36
CD TEA, ftlb/sqft	Ave	5.635	4.45	3.18	4.42
	SD		0.07	0.05	0.06
MD STFI, lb/in	Ave	21.54	22.59	20.62	21.58
	SD	1.71	2.68	1.40	1.93
CD STFI, lb/in	Ave	12.72	12.23	11.21	12.05
	SD	1.25	1.49	1.08	1.28
MD Ring Crush, lb/6in	Ave	50.08	50.77	46.12	48.99
	SD	2.73	2.39	2.87	2.66
CD Ring Crush, lb/6in	Ave	36.10	34.32	32.12	34.18
	SD	1.01	3.25	3.46	2.57
Concora, lb	Ave	64.40	66.50	56.67	62.52
	SD	2.97	4.45	3.05	3.49
Friction (HOT), Felt	Ave	0.116	0.22	0.11	0.15
	SD		0.01	0.01	0.01
Friction (HOT), Wire	Ave	0.127	0.21	0.13	0.16
	SD		0.01	0.02	0.02
Porosity (Gurley), sec/100ml					
	Ave	25.8	17.83	7.33	16.99
	SD	2.35	2.32	0.52	1.73
Smooth. (Bendtsen), F, ml/min					
	Ave	1578	616	1390	1194.67
	SD	108.50	73.35	50.50	77.45
Smooth. (Bendtsen), W, ml/min					
	Ave	2378	604	1384	1455.33
	SD	165.10	67.68	36.47	89.75

Appendix I Summary of Physical Characteristics Recycled

Mill Code:		A	N	Z	Averages
ZDT, psi	Ave	81	76.8	70.4	76.07
	SD	2.00	2.17	3.65	2.60
Ext, kN/m		1344	1352	1290	1328.67
Eyt, kN/m		577	503	535	538.33
Gxyt, kN/m		329	309	321	319.67
Ezt, kN/m		22.43	19.51	17.54	19.83
Water Absorbtion, T819					
Wire up, sec		11.8	9.7	15.7	12.40
(A2), wire, sec.		5	3	4.7	4.23
(A2), felt, sec.		4.2	2.7	4	3.63
(A3), wire up, sec		11.1	9.4	13.4	11.30

Alcohol/Water sol. Surface Tensions		F	W	F	W	F	W	F	W
dyne/cm.	72.2	34.6	19.7	15.0	13.2	25.2	16.8	24.9	16.5
	47.7	12.0	14.3	4.0	3.0	6.5	3.8	7.5	7.03
	37.7	14.0	12.5	3.2	3.0	4.2	3.5	7.13	6.43
	33.3	10.0	10.5	3.2	3.8	3.5	3.0	5.57	5.77
	28.7	6.8	8.5					6.8	8.5
	25.4	7.8	5.2					7.8	5.2
	24.2	6.0	4.6					6	4.6

Roll Moisture, %		6.6	5.2	7.4	6.40

Appendix I Summary of Physical Characteristics Green Liquor

Mill Code:		X	S	D	Averages
Basis Weight, lb/Msqft		26.4	27.06	26.3	26.59
Caliper (TAPPI), mil	Ave	11.27	8.93	8.88	9.69
	SD	1.45	0.15	0.15	0.58
Caliper (IPC), micron	Ave	197.93	192.73	195.35	195.34
	SD	17.68	3.03	6.05	8.92
Inches	Ave	7.79	7.59	7.69	7.69
	SD	0.70	0.12	0.24	0.35
Density (TAPPI), lb/rm−mil		2.34	2.99	2.96	2.76
Density (IPC), lb/rm−mil		3.23	3.58	3.37	3.39
MD Tensile, lb/in	Ave	41.85	48.39	39.66	43.30
	SD	0.63		0.59	0.61
CD Tensile, lb/in	Ave	15.85	14.79	19.21	16.62
	SD	0.25		0.28	0.26
MD Stretch, %	Ave	1.32	1.262	1.19	1.26
	SD	0.02		0.02	0.02
CD Stretch, %	Ave	2.54	1.954	2.08	2.19
	SD	0.04		0.04	0.04
MD ET, lb/in	Ave	5622	6314	5251	5728.93
	SD	90.39		84.45	87.42
CD ET, lb/in	Ave	1885	1838	2240	1987.80
	SD	28.86		31.67	30.26
MD TEA, ftlb/sqft	Ave	3.86	5.002	3.60	4.15
	SD	0.40		0.45	0.43
CD TEA, ftlb/sqft	Ave	3.76	2.764	3.51	3.35
	SD	0.06		0.06	0.06
MD STFI, lb/in	Ave	23.32	27.08	23.38	24.59
	SD	2.05	1.45	1.82	1.77
CD STFI, lb/in	Ave	13.05	13.19	14.69	13.64
	SD	1.05	0.68	0.94	0.89
MD Ring Crush, lb/6in	Ave	51.57	64.12	58.62	58.10
	SD	3.07	2.07	2.60	2.58
CD Ring Crush, lb/6in	Ave	34.65	40.57	43.68	39.63
	SD	4.74	1.78	0.79	2.44
Concora, lb	Ave	55.33	62.27	58.67	58.76
	SD	1.58	2.24	2.41	2.08
Friction (HOT), Felt	Ave	0.30	0.20666	0.27	0.26
	SD	0.01		0.04	0.03
Friction (HOT), Wire	Ave	0.31	0.18708	0.32	0.27
	SD	0.01		0.04	0.03
Porosity (Gurley), sec/100ml					
	Ave	20.67	27.37	12.83	20.29
	SD	2.42	2.59	1.33	2.11
Smooth. (Bendtsen), F, ml/min					
	Ave	616	1951	1024	1197.00
	SD	36.47	116.37	79.56	77.47
Smooth. (Bendtsen), W, ml/min					
	Ave	604	1905	944	1151.00
	SD	11.40	138.78	60.66	70.28

Appendix I Summary of Physical Characteristics Green Liquor

Mill Code:		X	S	D	Averages
ZDT, psi	Ave	71.4	84.07	78.6	78.02
	SD	3.65	1.58	2.07	2.43
Ext, kN/m		1263	1487	1148	1299.33
Eyt, kN/m		483	513	578	524.78
Gxyt, kN/m		303	322	318	314.44
Ezt, kN/m		20.38	23.94	15.43	19.92
Water Absorbtion, T819					
Wire up, sec		97.2	29	12.6	46.27
(A2), wire, sec.		21.3	7.3	2.8	10.47
(A2), felt, sec.		17	606	2.8	208.60
(A3), wire up, sec		54	19	8.8	27.27

Alcohol/Water sol.

Surface Tensions		F	W	F	W	F	W	F	W
dyne/cm.	72.2	129	104	38.5	41.5	17.5	10.2	61.67	51.83
	47.7	6.8	4.8	6.0	3.5	1.0	1.0	4.6	3.1
	37.7	3.0	2.5	4.0	2.5			4	2.5
	33.3	1.8	1.5						
	28.7								
	25.4								
	24.2								

Roll Moisture, %		5.2	4.8	5.6	5.20

Appendix I Summary of Physical Characteristics NSSC

Mill Code:		G	O	M	Averages
Roll No.		6926	6867	6934	
Basis Weight, lb/Msqft		26.6	26.1	27.2	26.63
Caliper (TAPPI), mil	Ave	8.65	9.47	9.53	9.22
	SD	0.30	0.42	0.28	0.33
Caliper (IPC), micron	Ave	194.04	204.13	202.99	200.39
	SD	4.99	9.79	8.10	7.63
Inches	Ave	7.64	8.04	7.99	7.89
	SD	0.20	0.39	0.32	0.30
Density (TAPPI), lb/rm−mil		3.08	2.81	2.85	2.91
Density (IPC), lb/rm−mil		3.48	3.42	3.31	3.40
MD Tensile, lb/in	Ave	35.952	48.3	47.89	44.05
	SD	0.53		0.73	0.63
CD Tensile, lb/in	Ave	13.86	15.9	17.78	15.85
	SD	0.21		0.27	0.24
MD Stretch, %	Ave	1.08	1.17	1.63	1.29
	SD	0.01		0.02	0.02
CD Stretch, %	Ave	1.69	2.11	2.70	2.17
	SD	0.03		0.04	0.04
MD ET, lb/in	Ave	5187	6239	5874	5766.60
	SD	83.45		94.50	88.98
CD ET, lb/in	Ave	1873	1806	2288	1988.87
	SD	28.78		35.27	32.03
MD TEA, ftlb/sqft	Ave	2.95	4.52	6.64	4.70
	SD	0.42		0.46	0.44
CD TEA, ftlb/sqft	Ave	2.07	3.02	4.58	3.22
	SD	0.03		0.07	0.05
MD STFI, lb/in	Ave	23.43	25.76	26.00	25.06
	SD	1.97	1.85	1.77	1.86
CD STFI, lb/in	Ave	12.12	12.01	15.04	13.06
	SD	1.30	1.19	0.91	1.13
MD Ring Crush, lb/6in	Ave	51.38	53.40	59.28	54.69
	SD	1.82	4.17	1.86	2.62
CD Ring Crush, lb/6in	Ave	36.38	39.37	47.53	41.09
	SD	3.60	2.53	1.28	2.47
Concora, lb	Ave	71.00	62.60	74.00	69.20
	SD	1.34	4.67	3.21	3.07
Friction (HOT), Felt	Ave	0.19	0.166	0.15	0.17
	SD	0.01		0.01	0.01
Friction (HOT), Wire	Ave	0.22	0.173	0.17	0.19
	SD	0.01		0.01	0.01
Porosity (Gurley), sec/100ml					
	Ave	15.00	30.00	16.33	20.44
	SD	2.37	1.76	1.21	1.78
Smooth. (Bendtsen), F, ml/min					
	Ave	894	1954	800	1216.00
	SD	92.90	92.36	29.15	71.47
Smooth. (Bendtsen), W, ml/min					
	Ave	782	2078	752	1204.00
	SD	44.38	218.11	29.50	97.33

Appendix I — Summary of Physical Characteristics — NSSC

Mill Code:		G	O	M	Averages
ZDT, psi	Ave	70.80	73.6	78	74.13
	SD	3.63	3.44	4.64	3.90
Ext, kN/m		1269	1498	1350	1372.33
Eyt, kN/m		520	524	591	545.00
Gxyt, kN/m		312	331	333	325.33
Ezt, kN/m		20.76	16.74	24.77	20.75
Water Absorbtion, T819					
Wire up, sec		3.6	27.6	5	12.07
(A2), wire, sec.		1.4	8.1	2.3	3.93
(A2), felt, sec.		1.1	7.1	2.2	3.47
(A3), wire up, sec		4.1	14.9	6	8.33

Alcohol/Water sol. Surface Tensions dyne/cm.

	F	W	F	W	F	W	F	W
72.2	10.8	12.5	34.2	19.5	12.0	12.5	19	14.67
47.7	3.2	2.8	3.5	2.0	3.2	3.5	3.3	2.77
37.7	2.0	1.5	3.0	2.0	1.5	2.0	2.17	1.83
33.3								
28.7								
25.4								
24.2								

Roll Moisture, %	6	6.7	4.8	5.83

Appendix II

Characteristics of Linerboards

Table 1–A

Mill Code			LG	LN	LO	LD	LF	LA
Basis Weight, lb/Msqft		Ave.	42.04	42.8	42.6	41.2	42.12	41.4
Caliper (TAPPI), mil		Ave.	12.28	11.87	11.10	12.13	11.34	12.36
		SD	0.20	0.04	0.11	0.20	0.16	0.16
Caliper (IPC), mil		Ave.	10.56	11.12	10.82	10.36	9.89	10.84
		SD	0.22	0.05	0.07	0.36	0.14	0.22
Density (TAPPI), lb/rm–mil		Ave.	3.42	3.61	3.84	3.40	3.71	3.35
	g/cm3	SD	0.66	0.69	0.74	0.65	0.71	0.64
Density (IPC), lb/rm–mil		Ave.	3.98	3.85	3.94	3.98	4.26	3.82
	g/cm3	SD	0.77	0.74	0.76	0.76	0.82	0.73
Friction (HOT), Felt		Ave.	0.20	0.26	0.21	0.23	0.19	0.24
		SD	0.02	0.01	0.01	0.02	0.01	0.01
Friction (HOT), Wire		Ave.	0.21	0.26	0.28	0.22	0.20	0.25
		SD	0.01	0.02	0.01	0.01	0.01	0.02
Porosity (Gurley), sec/100ml		Ave.	28.10	15.90	24.31	13.90	24.70	11.10
		SD	5.46	3.54	5.44	3.15	5.12	2.44
Smooth. (Bendtsen), F, ml/min		Ave.	1,706.19	857.50	810.00	1,630.21	1,151.66	1,454.44
		SD	83.24	91.33	62.58	147.16	99.29	173.23
Smooth. (Bendtsen), W, ml/min		Ave.	1,923.91	1,167.50	1,320.00	1,878.55	1,355.78	1,671.03
		SD	77.37	119.05	137.84	210.29	107.58	132.66
ZDT, psi		Ave.	66.00	40.00	37.00	61.00	47.00	50.00
		SD	2.73	4.30	5.80	0.79	0.97	1.37
Ultrasonic Modulus								
Ext, kN/m		Ave.	2,445.60	2,322.99	1,998.99	2,672.70	2,557.00	2,545.10
Eyt, kN/m		Ave.	969.78	819.96	1,221.88	912.00	900.50	864.61
Gxyt, kN/m		Ave.	576.18	507.39	610.97	565.38	555.56	539.81
Ezt, kN/m		Ave.	18.59	8.95	11.02	16.34	11.26	12.70
Polar Plots	Angle from MD		6.52	2.58	11.22	2.74	1.35	2.86
	MD/CD RATIO		2.535	2.837	1.684	2.914	2.811	2.957

Appendix II — Characteristics of Linerboards — Table 2–A

Mill Code			LK	LU	LR	LB	LH	LT
Basis Weight, lb/Msqft		Ave.	42.18	42.8	42.58	43	39.98	42.9
Caliper (TAPPI), mil		Ave.	11.06	11.46	12.99	13.19	11.93	12.58
		SD	0.20	0.15	0.15	0.75	0.51	0.07
Caliper (IPC), mil		Ave.	9.58	10.71	12.00	10.67	9.74	11.94
		SD	0.29	0.06	0.07	0.59	0.57	0.10
Density (TAPPI), lb/rm–mil		Ave.	3.81	3.73	3.28	3.26	3.35	3.41
g/cm3		SD	0.73	0.72	0.63	0.63	0.64	0.66
Density (IPC), lb/rm–mil		Ave.	4.40	4.00	3.55	4.03	4.10	3.59
g/cm3		SD	0.85	0.77	0.68	0.77	0.79	0.69
Friction (HOT), Felt		Ave.	0.23	0.28	0.18	0.26	0.24	0.23
		SD	0.02	0.01	0.02	0.02	0.01	0.02
Friction (HOT), Wire		Ave.	0.22	0.31	0.20	0.33	0.23	0.24
		SD	0.01	0.03	0.01	0.01	0.01	0.02
Porosity (Gurley), sec/100ml		Ave.	20.60	43.83	17.38	9.90	22.40	23.31
		SD	3.52	2.93	2.04	2.07	5.10	2.59
Smooth. (Bendtsen), F, ml/min		Ave.	969.09	1,460.00	1,655.00	1,724.33	2,138.24	1,307.50
		SD	345.80	35.75	88.82	214.58	268.35	95.05
Smooth. (Bendtsen), W, ml/min		Ave.	1,472.58	1,757.50	1,955.00	2,201.74	2,444.42	1,842.50
		SD	119.90	113.07	70.51	148.84	160.82	80.84
ZDT, psi		Ave.	60.00	51.00	38.00	49.00	63.00	43.00
		SD	3.09	12.50	8.40	2.45	2.07	10.60
Ultrasonic Modulus								
Ext, kN/m		Ave.	2,721.63	2,647.16	2,419.82	2,573.60	2,586.81	2,555.62
Eyt, kN/m		Ave.	1,000.09	1,093.25	969.47	1,023.35	920.94	1,081.81
Gxyt, kN/m		Ave.	605.25	641.56	575.34	595.65	567.38	613.36
Ezt, kN/m		Ave.	16.86	19.20	14.46	18.73	21.28	14.74
Polar Plots	Angle from MD		0.84	7.09	2.84	1.53	1.71	0.82
	MD/CD RATIO		2.778	2.402	2.476	2.527	2.805	2.383

Appendix II

Characteristics of Linerboards

Table 3–A

Mill Code			LC	LE	LX	LM	LQ	LS
Basis Weight, lb/Msqft		Ave.	41.22	42.7	43	41.7	42.9	41.4
Caliper (TAPPI), mil		Ave.	11.69	13.07	12.52	12.27	11.95	13.97
		SD	0.20	0.24	0.13	0.12	0.16	0.12
Caliper (IPC), mil		Ave.	10.15	11.38	11.93	11.25	11.09	12.91
		SD	0.27	0.20	0.12	0.09	0.18	0.12
Density (TAPPI), lb/rm–mil		Ave.	3.53	3.27	3.43	3.40	3.59	2.96
g/cm3		SD	0.68	0.63	0.66	0.66	0.69	0.57
Density (IPC), lb/rm–mil		Ave.	4.06	3.75	3.60	3.71	3.87	3.21
g/cm3		SD	0.78	0.72	0.69	0.71	0.74	0.62
Friction (HOT), Felt		Ave.	0.22	0.21	0.26	0.23	0.24	0.23
		SD	0.01	0.01	0.02	0.02	0.01	0.02
Friction (HOT), Wire		Ave.	0.20	0.28	0.28	0.19	0.17	0.24
		SD	0.01	0.02	0.02	0.01	0.02	0.01
Porosity (Gurley), sec/100ml		Ave.	21.90	16.40	11.25	24.95	24.08	9.19
		SD	4.14	0.88	1.36	2.91	5.02	1.37
Smooth. (Bendtsen), F, ml/min		Ave.	1,692.58	1,838.86	1,185.00	1,380.00	995.00	1,342.50
		SD	158.76	125.39	130.81	128.99	104.62	130.73
Smooth. (Bendtsen), W, ml/min		Ave.	1,866.08	1,969.27	1,857.50	1,875.00	1,435.00	2,072.50
		SD	198.59	152.75	127.56	123.60	127.58	151.13
ZDT, psi		Ave.	63.00	51.00	31.00	47.00	32.00	20.00
		SD	2.36	1.63	8.90	10.70	11.00	5.70
Ultrasonic Modulus								
Ext, kN/m		Ave.	2,265.10	2,610.93	2,595.12	2,541.28	2,512.99	2,489.88
Eyt, kN/m		Ave.	1,043.03	936.10	946.52	878.37	746.59	870.60
Gxyt, kN/m		Ave.	582.15	571.40	572.19	547.31	490.38	559.77
Ezt, kN/m		Ave.	16.60	14.75	11.24	14.85	9.20	8.72
Polar Plots	Angle from MD		1.15	1.74	8.58	3.37	4.49	1.5
	MD/CD RATIO		2.222	2.808	2.726	2.921	3.321	2.862

Appendix II Characteristics of Linerboards Table 4–A

Mill Code			LJ	LI	LP	LL	LY	LV
Basis Weight, lb/Msqft		Ave.	40.74	43.14	42.5	42.3	42.5	42.8
Caliper (TAPPI), mil		Ave.	12.36	13.66	10.48	11.55	11.02	12.40
		SD	0.35	0.24	0.07	0.14	0.16	0.25
Caliper (IPC), mil		Ave.	10.18	12.00	9.99	11.22	10.25	11.41
		SD	0.47	0.30	0.08	0.07	0.06	0.17
Density (TAPPI), lb/rm–mil		Ave.	3.30	3.16	4.06	3.66	3.86	3.45
g/cm3		SD	0.63	0.61	0.78	0.70	0.74	0.66
Density (IPC), lb/rm–mil		Ave.	4.00	3.60	4.25	3.77	4.15	3.75
g/cm3		SD	0.77	0.69	0.82	0.73	0.80	0.72
Friction (HOT), Felt		Ave.	0.23	0.22	0.30	0.22	0.19	0.19
		SD	0.01	0.01	0.01	0.02	0.01	0.01
Friction (HOT), Wire		Ave.	0.22	0.21	0.31	0.26	0.22	0.21
		SD	0.01	0.01	0.02	0.01	0.01	0.02
Porosity (Gurley), sec/100ml		Ave.	30.10	11.60	30.66	23.59	31.07	29.96
		SD	6.05	1.93	2.46	2.73	5.64	3.07
Smooth. (Bendtsen), F, ml/min		Ave.	2,036.18	1,948.86	787.50	885.00	1,360.00	1,747.50
		SD	169.47	130.18	105.57	87.56	79.23	110.21
Smooth. (Bendtsen), W, ml/min		Ave.	2,376.38	2,240.30	1,157.50	1,165.00	1,637.50	2,080.00
		SD	151.67	133.64	125.31	63.68	73.83	132.18
ZDT, psi		Ave.	55.00	49.00	59.00	33.00	55.00	51.00
		SD	2.83	0.88	7.80	4.80	9.50	13.60
Ultrasonic Modulus								
Ext, kN/m		Ave.	2,372.43	2,487.87	2,418.29	2,749.63	2,256.63	2,210.40
Eyt, kN/m		Ave.	1,085.17	992.12	1,107.57	881.59	1,062.58	956.72
Gxyt, kN/m		Ave.	622.05	596.22	626.34	561.03	593.91	543.96
Ezt, kN/m		Ave.	16.79	9.63	16.61	7.93	14.92	25.76
Polar Plots	Angle from MD		2.57	2.85	2.52	0.86	2.06	3.81
	MD/CD RATIO		2.224	2.559	2.209	3.14	2.092	2.283

Appendix II Characteristics of Linerboards Table 1–B

Mill Code:		LG	LN	LO	LD	LF	LA
MD Tensile, lb/in	Ave.	98.08	85.77	68.21	93.56	91.23	93.92
	SD	5.04	11.47	5.02	6.78	9.35	5.75
CD Tensile, lb/in	Ave.	36.29	29.76	38.48	34.42	35.14	31.39
	SD	1.35	1.51	5.04	1.95	1.34	1.62
MD Stretch, %	Ave.	1.72	1.39	1.39	1.19	1.33	1.40
	SD	0.16	0.26	0.15	0.14	0.22	0.13
CD Stretch, %	Ave.	4.44	3.57	2.20	3.66	3.62	3.64
	SD	0.32	0.56	0.63	0.41	0.33	0.42
MD ET, lb/in	Ave.	10,330.00	10,060.00	8,227.00	11,540.00	10,800.00	10,820.00
	SD	387.00	163.00	278.00	193.00	214.00	127.00
CD ET, lb/in	Ave.	3,475.00	2,903.00	4,338.00	3,088.60	3,261.00	3,103.00
	SD	120.10	116.00	225.00	117.56	134.00	124.00
MD TEA, ftlb/sqft	Ave.	13.24	9.33	7.35	8.30	9.35	9.91
	SD	1.86	2.75	1.31	1.64	2.31	1.55
CD TEA, ftlb/sqft	Ave.	14.85	9.80	7.35	10.17	11.27	10.50
	SD	1.56	2.06	2.92	3.81	1.43	1.59
MD STFI, lb/in	Ave.	39.41	38.23	31.07	42.04	37.84	41.95
	SD	2.07	1.89	3.24	3.31	2.49	2.71
CD STFI, lb/in	Ave.	20.95	19.76	23.45	19.60	20.59	20.56
	SD	2.32	1.36	1.49	1.45	1.63	1.63
MD Ring Crush, lb/6in	Ave.	112.00	93.35	95.65	118.00	95.00	107.00
	SD	2.59	1.40	4.19	2.74	5.85	6.83
CD Ring Crush, lb/6in	Ave.	87.00	72.20	82.65	82.00	81.00	77.00
	SD	2.75	4.60	3.32	2.44	4.88	2.49

Appendix II Characteristics of Linerboards Table 2–B

Mill Code:		LK	LU	LR	LB	LH	LT
MD Tensile, lb/in	Ave.	101.50	101.00	81.69	95.51	94.53	96.59
	SD	4.01	8.38	4.11	3.93	3.80	1.02
CD Tensile, lb/in	Ave.	38.17	42.01	37.49	33.67	31.60	41.34
	SD	1.64	0.96	1.26	1.51	1.70	1.15
MD Stretch, %	Ave.	1.34	1.50	1.46	1.53	1.49	1.48
	SD	0.12	0.19	0.21	0.07	0.10	0.09
CD Stretch, %	Ave.	3.78	4.39	4.21	3.26	3.74	3.91
	SD	0.43	0.21	0.36	0.36	0.65	0.31
MD ET, lb/in	Ave.	11,730.00	11,370.00	10,470.00	10,406.10	10,400.00	10,990.00
	SD	312.00	485.00	350.00	421.79	214.00	130.00
CD ET, lb/in	Ave.	3,530.00	3,859.00	3,513.00	3,498.00	3,257.00	3,937.00
	SD	88.00	126.00	101.00	114.00	189.00	60.00
MD TEA, ftlb/sqft	Ave.	10.13	12.02	9.87	10.71	10.76	10.99
	SD	1.36	1.77	2.18	0.94	0.97	0.91
CD TEA, ftlb/sqft	Ave.	12.79	16.57	14.27	9.87	10.50	14.49
	SD	1.97	1.04	1.50	1.48	2.28	1.50
MD STFI, lb/in	Ave.	42.42	45.40	37.51	37.77	41.02	39.21
	SD	2.70	3.67	2.88	3.77	3.75	2.16
CD STFI, lb/in	Ave.	21.88	26.62	21.63	21.31	19.78	22.67
	SD	2.20	2.04	1.22	2.22	1.62	1.89
MD Ring Crush, lb/6in	Ave.	113.00	126.45	104.00	106.00	110.00	110.95
	SD	4.43	3.56	3.11	3.59	7.30	2.23
CD Ring Crush, lb/6in	Ave.	89.00	91.70	81.70	85.00	80.00	85.35
	SD	1.60	5.82	4.38	5.47	4.78	3.02

Appendix II Characteristics of Linerboards Table 3–B

Mill Code:		LC	LE	LX	LM	LQ	LS
MD Tensile, lb/in	Ave.	82.37	95.13	92.28	87.20	93.17	82.97
	SD	6.66	3.93	3.93	4.72	6.59	8.57
CD Tensile, lb/in	Ave.	39.30	33.59	33.12	31.85	29.28	32.90
	SD	2.09	1.60	1.37	1.36	1.13	2.10
MD Stretch, %	Ave.	1.20	1.32	1.29	1.39	1.41	1.43
	SD	0.14	0.10	0.10	0.20	0.15	0.26
CD Stretch, %	Ave.	3.64	3.62	3.09	3.92	4.48	2.93
	SD	0.57	0.32	0.40	0.44	0.47	0.53
MD ET, lb/in	Ave.	10,130.00	11,560.00	10,860.00	10,890.00	10,230.00	10,890.00
	SD	437.00	335.00	184.00	170.00	370.00	436.00
CD ET, lb/in	Ave.	3,765.00	3,306.00	3,199.00	3,149.00	2,576.00	3,201.00
	SD	91.00	131.00	96.00	78.00	84.00	154.00
MD TEA, ftlb/sqft	Ave.	7.38	9.49	8.91	9.87	10.12	9.95
	SD	1.42	1.16	1.05	1.94	1.95	2.20
CD TEA, ftlb/sqft	Ave.	12.77	10.89	9.09	11.42	12.13	8.45
	SD	2.66	1.35	1.60	1.76	1.73	2.03
MD STFI, lb/in	Ave.	36.51	41.44	38.54	39.13	38.49	33.32
	SD	2.46	2.32	3.89	2.49	1.69	2.14
CD STFI, lb/in	Ave.	22.76	20.85	19.80	19.82	18.44	18.25
	SD	1.93	1.26	1.40	1.17	1.08	1.37
MD Ring Crush, lb/6in	Ave.	102.00	104.00	100.20	99.55	94.40	100.35
	SD	2.68	3.57	4.59	1.80	3.84	4.32
CD Ring Crush, lb/6in	Ave.	89.00	84.00	71.30	73.75	70.75	73.80
	SD	3.68	3.62	4.39	5.15	2.57	3.74

Appendix II Characteristics of Linerboards Table 4–B

Mill Code:		LJ	LI	LP	LL	LY	LV
MD Tensile, lb/in	Ave.	81.24	89.07	94.55	91.99	75.13	77.03
	SD	5.03	2.46	3.62	5.47	3.96	5.68
CD Tensile, lb/in	Ave.	40.25	39.67	41.67	33.19	43.20	32.32
	SD	2.22	1.87	4.88	2.26	1.49	1.75
MD Stretch, %	Ave.	1.36	1.43	1.60	1.18	1.26	1.70
	SD	0.16	0.09	0.13	0.10	0.10	0.22
CD Stretch, %	Ave.	3.51	3.73	3.30	3.04	4.04	3.17
	SD	0.42	0.41	0.75	0.58	0.30	0.46
MD ET, lb/in	Ave.	10,300.00	10,630.00	10,190.00	11,390.00	9,305.00	9,044.40
	SD	393.00	239.00	337.00	461.00	159.00	398.90
CD ET, lb/in	Ave.	3,875.00	3,443.00	3,967.00	3,221.00	3,717.00	3,438.00
	SD	211.00	87.00	295.00	92.00	228.00	138.00
MD TEA, ftlb/sqft	Ave.	8.60	9.67	11.70	8.10	7.14	10.83
	SD	1.61	0.88	1.34	1.22	0.99	2.16
CD TEA, ftlb/sqft	Ave.	12.47	12.97	12.02	8.97	15.09	9.48
	SD	2.02	2.05	3.83	2.31	1.39	1.76
MD STFI, lb/in	Ave.	37.68	35.99	38.32	35.16	33.45	36.25
	SD	3.59	1.66	3.18	3.13	2.53	1.98
CD STFI, lb/in	Ave.	21.85	20.38	24.93	18.66	21.96	21.93
	SD	2.25	1.77	2.59	1.74	1.71	1.28
MD Ring Crush, lb/6in	Ave.	110.00	99.00	99.60	87.50	97.80	101.50
	SD	4.73	4.78	5.45	2.86	2.65	2.06
CD Ring Crush, lb/6in	Ave.	81.00	78.00	85.95	62.95	81.00	79.10
	SD	4.43	3.27	4.21	6.65	3.11	3.67

Appendix II — Characteristics of Linerboards — Table 1–C

Mill Code:			LG	LN	LO	LD	LF	LA
Water Absorbtion, T819								
boat	Wire up, sec	Ave	600+	600+	600+	600+	600+	600+
		SD	--	--	--	--	--	--
pen	(A2), wire, sec.	Ave	600+	600+	600+	600+	600+	600+
		SD	--	--	--	--	--	--
curl	(A3), wire up, sec.	Ave	266.70	326.86	213.19	287.40	280.50	126.40
		SD		40.63	20.68			
Water Absorbtion, T492								
Wire side								
	Caustic, 1%	Ave	239.70	600+	600+	148.40	473.50	317.70
		SD	13.38	--	--	74.37	28.36	96.98
	Lactic acid, 10%	Ave	600+	280.68	556+	370.70	600+	238.80
		SD	--	26.52	44+	163.92	--	25.07
	Alcohol/Water sol.							
Surface	72.60 Dist. H2O	Ave	600+	600+	600+	600+	600+	600+
Tensions		SD	--	--	--	--	--	--
dyne/cm	47.20 5% Aloc.	Ave	600+	600+	600+	600+	600+	600+
		SD	--	--	--	--	--	--
	39.90 10% Aloc	Ave	600+	61.02	41.90	600+	600+	33.60
		SD	--	11.81	12.91	--	--	20.09
	34.00 15% Aloc	Ave	11.40	19.64	20.18	5.50	4.90	
		SD	3.30	2.59	2.60	0.08	1.09	
	32.30 20% Aloc	Ave		15.33	13.96	4.30	4.30	
		SD		2.12	2.29	1.19	1.26	
	27.90 30% Aloc	Ave		10.50	11.69			
		SD		1.09	1.58			
Sample Moisture, % cond. @ 50%RH, 73°F			6.70	7.84	7.28	7.10	6.90	7.00

Mill Code:	LG	LN	LO	LD	LF	LA

Appendix II — Characteristics of Linerboards — Table 2–C

Mill Code:			LK	LU	LR	LB	LH	LT
Water Absorbtion, T819								
boat	Wire up, sec	Ave	600+	600+	600+	600+	600+	600+
		SD	– –	– –	– –	– –	– –	– –
pen	(A2), wire, sec.	Ave	600+	600+	600+	600+	600+	600+
		SD	– –	– –	– –	– –	– –	– –
curl	(A3), wire up, sec.	Ave	187.50	256.55	275.91	308.70	374.40	348.32
		SD	15.09	43.79	25.36	35.79	132.47	29.76
Water Absorbtion, T492								
Wire side								
	Caustic, 1%	Ave	184.30	600+	600+	432.50	189.90	600+
		SD	27.16	– –	– –	29.64	31.50	– –
	Lactic acid, 10%	Ave	600+	467.72	600+	600+	600+	600+
		SD	– –	43.68	– –	– –	– –	– –
	Alcohol/Water sol.							
Surface	72.60 Dist. H2O	Ave	600+	600+	600+	600+	600+	600+
Tensions		SD	– –	– –	– –	– –	– –	– –
dyne/cm	47.20 5% Aloc.	Ave	600+	600+	600+	600+	600+	600+
		SD	– –	– –	– –	– –	– –	– –
	39.90 10% Aloc	Ave	426.90	246.12	600+	600+	600+	600+
		SD	135.18	42.81	– –	– –	– –	– –
	34.00 15% Aloc	Ave	8.30	46.55	377.69	10.30	26.20	49.03
		SD	1.22	8.05	75.15	2.60	6.42	14.36
	32.30 20% Aloc	Ave		27.39	24.00	5.40	11.20	19.28
		SD		5.21	4.16	1.47	2.23	5.03
	27.90 30% Aloc	Ave		14.63	12.68			14.87
		SD		1.92	4.08			2.35
Sample Moisture, % cond. @ 50%RH, 73°F			5.80	6.84	7.23	7.10	7.60	7.86
Mill Code:			LK	LU	LR	LB	LH	LT

Appendix II — Characteristics of Linerboards — Table 3–C

Mill Code:			LC	LE	LX	LM	LQ	LS
Water Absorbtion, T819								
boat	Wire up, sec	Ave	600+	600+	600+	600+	600+	600+
		SD	--	--	--	--	--	--
pen	(A2), wire, sec.	Ave	600+	600+	600+	600+	600+	600+
		SD	--	--	--	--	--	--
curl	(A3), wire up, sec.	Ave	232.00	178.20	262.88	420.70	389.33	600+
		SD			25.43	46.85	49.09	--
Water Absorbtion, T492								
Wire side								
	Caustic, 1%	Ave	193.20	172.30	600+	600+	600+	467.65
		SD	13.18	30.71	--	--	--	45.06
	Lactic acid, 10%	Ave	600+	108.00	600+	600+	600+	374.21
		SD	--	18.47	--	--	--	30.68
	Alcohol/Water sol.							
Surface Tensions dyne/cm	72.60 Dist. H2O	Ave	600+	600+	600+	600+	600+	600+
		SD	--	--	--	--	--	--
	47.20 5% Aloc.	Ave	600+	373.60	600+	600+	600+	600+
		SD	--	189.90	--	--	--	--
	39.90 10% Aloc	Ave	600+	3.30	600+	600+	600+	80.34
		SD	--	0.06	--	--	--	41.46
	34.00 15% Aloc	Ave	9.40		29.18	426.21	27.23	9.43
		SD	1.07		7.35	143.82	4.14	1.97
	32.30 20% Aloc	Ave			13.69	59.90	15.85	5.49
		SD			2.59	12.54	2.50	0.97
	27.90 30% Aloc	Ave			10.69	35.15	12.25	5.72
		SD			1.33	7.45	2.06	1.24
Sample Moisture, % cond. @ 50%RH, 73°F			7.10	6.80	7.27	7.70	7.80	6.82
Mill Code:			LC	LE	LX	LM	LQ	LS

Appendix II — Characteristics of Linerboards — Table 4–C

Mill Code:			LJ	LI	LP	LL	LY	LV
Water Absorbtion, T819								
boat	Wire up, sec	Ave	600+	600+	600+	600+	600+	600+
		SD	--	--	--	--	--	--
pen	(A2), wire, sec.	Ave	600+	600+	600+	600+	600+	600+
		SD	--	--	--	--	--	--
curl	(A3), wire up, sec.	Ave	163.70	216.10	434.86	241.57	385.33	234.28
		SD			23.68	14.55	31.67	24.87
Water Absorbtion, T492								
Wire side								
	Caustic, 1%	Ave	209.90	223.10	600+	600+	600+	600+
		SD	20.23	23.65	--	--	--	--
	Lactic acid, 10%	Ave	600+	600+	600+	247.42	600+	600+
		SD	--	--	--	31.78	--	--
	Alcohol/Water sol.							
Surface Tensions dyne/cm	72.60 Dist. H2O	Ave	600+	600+	600+	600+	600+	600+
		SD	--	--	--	--	--	--
	47.20 5% Aloc.	Ave	600+	600+	600+	600+	600+	600+
		SD	--	--	--	--	--	--
	39.90 10% Aloc	Ave	22.90	147.50	600+	26.47	600+	600+
		SD	8.55	97.61	--	3.81	--	--
	34.00 15% Aloc	Ave			247.59	20.92	457+	600+
		SD			177.07	1.88	168.9+	--
	32.30 20% Aloc	Ave			49.29	15.75	125.03	263.94
		SD			7.25	2.27	45.24	77.68
	27.90 30% Aloc	Ave			27.68	13.72	52.01	73.04
		SD			6.24	2.94	9.01	13.79
Sample Moisture, % cond. @ 50%RH, 73°F			5.90	5.80	7.80	7.55	7.77	7.34
Mill Code:			LJ	LI	LP	LL	LY	LV

Appendix III

Summary of Corrugating Trials for Mill Q

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
Q	Max	Full	1	100	23	1.44	174	6.00	253	Ave.	32.16	94.60	44.48
										SD	1.28	2.07	2.77
				200	28	1.44	178	7.00	252	Ave.	33.16	102.4	45.71
										SD	1.24	8.35	1.43
				300	44	1.44	181	7.50	247	Ave.	33.64	95.4	43.04
										SD	1.23	2.61	1.73
				400	58	1.43	184	7.90	243	Ave.	33.84	87.60	44.21
										SD	1.57	3.29	1.52
				500	64	1.43	185	8.50	237	Ave.	34.16	79.60	43.82
										SD	2.16	7.50	2.55
				600	61	1.42	186	8.90	232	Ave.	33.96	74.6	41.61
										SD	1.17	2.97	3.46
				700	100								

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
Q	Liner only	Full	1	100	23	1.44	169	5.00	259	Ave.	32.08	89.2	40.17
										SD	1.06	4.15	2.97
				200	31	1.44	165	6.00	252	Ave.	32.28	92.4	42.29
										SD	1.43	1.82	1.62
				300	56	1.44	163	6.40	248	Ave.	34.44	88.6	41.95
										SD	2.09	7.83	1.76
				400	100	1.44	159	6.50	242	Ave.	33.28	63.6	37.78
										SD	0.39	10.53	1.18
				500	100								

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.		Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
Q	Medium only	Full medium Reduced Liner	1	100	25	1.44	172	5.30	262	Ave.	30.92	74.4	37.29
										SD	1.01	17.29	5.79
				200	31	1.44	179	6.30	250	Ave.	32.48	78.2	42.16
										SD	0.77	12.28	1.72
				300	50	1.44	182	6.90	239	Ave.	31.84	53	40.1
										SD	0.93	12.67	2.91
				400	74	1.44	184	7.40	231	Ave.	27.48	50.6	41.67
										SD	15.45	12.01	3.07
				500	100								

Appendix III

Summary of Corrugating Trials for Mill A

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
A	Max	Full	1	100	23	1.44	171.00	6.30	261	Ave.	36.04	89.00	45.71
										SD	2.56	5.39	1.73
				200	26	1.45	179.00	7.60	261	Ave.	39.16	104.40	44.08
										SD	1.31	1.52	1.35
				300	35	1.44	181.00	8.40	252	Ave.	41.04	103.40	42.99
										SD	0.30	2.79	1.68
				400	59	1.45	181.00	8.70	243	Ave.	42.24	104.60	45.32
										SD	1.07	5.41	1.66
				500	58	1.45	183.00	9.00	238	Ave.	40.40	104.60	43.09
										SD	1.81	6.35	1.09
				600	63	1.45	183.00	10.10	232	Ave.	40.92	96.60	44.40
										SD	1.15	7.06	1.99
				700	100								

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
A	Liner only	Full	1	100.00	24	1.44	139.00	6.00	242	Ave.	36.24	104.40	46.06
										SD	1.26	6.88	1.89
				200.00	31	1.45	136.00	6.70	246	Ave.	38.72	114.80	43.00
										SD	0.73	3.03	1.01
				300.00	63	1.45	132.00	7.00	242	Ave.	38.76	104.00	44.04
										SD	0.30	3.46	1.46
				400.00	100								

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
A	Medium only	Full medium Reduced Liner	1	100.00	21	1.44	169.00	8.00	254	Ave.	38.24	102.20	44.99
										SD	2.50	3.90	1.71
				200.00	29	1.44	178.00	8.70	248	Ave.	40.40	110.20	45.43
										SD	1.88	4.49	1.82
				300.00	48	1.44	181.00	9.50	237	Ave.	40.80	112.60	43.22
										SD	1.19	3.91	1.51
				400.00	63	1.44	182.00	10.10	226	Ave.	40.20	112.40	43.82
										SD	1.29	8.96	2.61
				500.00	69	1.44	182.00	10.40	219		41.24	102.60	42.57
											1.85	4.98	1.89
				600.00	100								

Appendix III

Summary of Corrugating Trials for Mill S

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
S	Max	Full	1	100	17	1.44	182	6.20	256	Ave.	33.00	91.60	45.61
										SD	1.55	4.10	1.42
				200	22	1.44	188	6.60	252	Ave.	32.92	114.6	44.17
										SD	1.38	3.36	1.35
				300	40	1.44	191	6.90	249	Ave.	34.28	120	42.12
										SD	0.72	3.54	1.96
				400	66	1.44	192	7.1	243	Ave.	33.40	114.80	40.86
										SD	0.40	5.76	2.11
				500	72	1.44	193	7.5	235	Ave.	34.68	112.60	38.46
										SD	0.82	4.28	1.57
				600	60	1.44	193	7.5	233	Ave.	36.08	108.60	41.80
										SD	1.17	6.47	2.17
				700	100								

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
S	Liner only	Full	1	100	21	1.44	167	5.00	251	Ave.	32.50	106.4	43.18
										SD	1.04	8.14	1.43
				200	25	1.44	166	5.70	252	Ave.	33.60	118.4	43.73
										SD	1.01	4.56	2.47
				300	71	1.44	166	5.8	246	Ave.	32.36	117.80	43.56
										SD	0.36	4.97	2.97
				400	100								

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
S	Medium only	Full medium Reduced Liner	1	100	21	1.44	181	6.00	259	Ave.	32.80	97.8	42.72
										SD	2.33	1.79	1.87
				200	33	1.44	189	6.80	248	Ave.	33.96	119.6	43.29
										SD	0.52	5.23	2.13
				300	53	1.43	191	7.10	238	Ave.	34.56	115.80	43.99
										SD	0.99	7.05	1.71
				400	100								

Appendix III

Summary of Corrugating Trials for Mill P–1

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single–face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
P–1	Max	Full	1	100	19	1.44	--	---	--	Ave.	32.08	93.00	46.48
										SD	1.361	5.83	1.01
				200	26	1.44	188	6.40	257	Ave.	34.44	108.8	44.4
										SD	0.74	6.76	2.12
				300	32	1.44	182	6.90	252	Ave.	34.64	99.4	41.97
										SD	1.459	2.97	1.86
				400	47	1.44	185	7.5	246	Ave.	37.36	97.40	43.70
										SD	0.261	5.37	2.01
				500	58	1.44	185	8.2	238	Ave.	37.8	91.80	41.47
										SD	1.02	6.14	1.99
				600	56	1.44	184	8.7	232	Ave.	36.04	89.00	42.65
										SD	0.699	4.58	2.05
				700	69	1.44	184	9	228	Ave.	37.2	85.80	38.21

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single–face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
P–1	Liner only	Full	1	100	20	1.44	165	4.30	246	Ave.	31.8	97.6	42.47
										SD	0.97	5.68	2.00
				200	30	1.44	159	5.20	247	Ave.	32.76	108	42.2
										SD	0.434	1.87	2.24
				300	50	1.44	159	5.5	244	Ave.	34.28	98.40	42.42
										SD	1.368	4.62	2.38
				400	87	1.44	157	5.8	239	Ave.	34.36	87.20	41.37
										SD	0.888	5.54	2.34
				500	100								

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single–face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
P–1	Medium only	Full medium Reduced Liner	1	100	20	1.44	172	5.30	253	Ave.	31.28	96.6	45.68
										SD	1.08	5.22	1.22
				200	31	1.44	179	6.40	247	Ave.	34.52	109.6	45.04
										SD	0.72	8.44	1.54
				300	54	1.44	180	7.00	236	Ave.	36.60	98.60	42.19
										SD	0.71	6.07	2.46
				400	64	1.44	183	7.5	228	Ave.	35.56	95.40	42.75
										SD	1.31	2.41	3.14
				500	90	1.44	183	8	219	Ave.	35.08	90.40	43.22
				600	100								

Appendix III

Summary of Corrugating Trials for Mill AH

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
AH	Max	Full	1	100	20	1.45	174	5.10	260	Ave.	28.76	94.40	45.00
										SD	0.99	2.30	1.75
				200	26	1.44	180	5.80	259	Ave.	28.76	97.8	42.13
										SD	1.56	5.02	2.44
				300	43	1.44	182	6.40	252	Ave.	28.76	96.4	41.62
										SD	1.05	2.19	1.34
				400	52	1.44	185	6.9	245	Ave.	31.08	89.80	41.25
										SD	1.26	6.42	1.57
				500	59	1.44	185	7.2	233	Ave.	31.12	86.80	40.52
										SD	0.58	2.05	1.84
				600	59	1.44	186	7.5	226	Ave.	30.84	87.00	40.72
										SD	2.22	6.96	1.90
				700	63	1.44	186	7.9	222	Ave.	39.44	103.40	42.60
										SD	0.17	4.04	2.13

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
AH	Liner only	Full	1	100	23	1.44	164	4.40	256	Ave.	28.68	94.6	43.13
										SD	1.34	6.80	2.81
				200	36	1.44	161	5.00	250	Ave.	29.80	99.6	44.55
										SD	1.76	5.86	1.40
				300	77	1.44	158	5.3	246	Ave.	29.56	95.20	40.53
										SD	2.09	3.033	1.757
				400	100								

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
AH	Medium only	Full medium Reduced Liner	1	100	24	1.44	175	4.90	252	Ave.	28.4	95.2	45.36
										SD	0.60	4.97	2.16
				200	33	1.44	181	5.90	246	Ave.	29.08	103.8	42.425
										SD	1.35	4.15	3.94
				300	56	1.44	184	6.40	235	Ave.	29.92	102.00	40.88
										SD	1.18	6.93	3.08
				400	78	1.44	186	6.9	226	Ave.	30.96	97.80	41.03
										SD	1.452	6.69	2.39
				500	100								

Appendix III

Summary of Corrugating Trials for Mill Y

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
Y	Max	Full	1	100	15	1.436	180	4.7	257	Ave.	31.20	88.80	39.78
										SD	1.281	2.775	1.672
				200	19	1.437	183	6.8	256	Ave.	31.48	91.4	43.07
										SD	0.901	4.827	2.110
				300	33	1.432	184	6.9	249	Ave.	33.40	93	40.62
										SD	0.663	1.732	2.738
				400	44	1.433	184	7.8	241	Ave.	33.20	90.00	41.80
										SD	1.020	4.637	2.697
				500	49	1.428	185	8.4	231	Ave.	33.52	87.80	41.63
										SD	1.064	3.271	3.092
				600	50	1.429	185	8.8	225	Ave.	34.24	90.00	41.37
										SD	1.014	2.550	2.971
				700	51	1.424	185	9.4	223	Ave.	34.40	86.20	40.53
										SD	1.568	3.347	3.144
				800	60	1.425	184	9.6	219	Ave.	35.24	84.40	41.25
										SD	1.126	5.983	1.940

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
Y	Liner only	Full	1	100	15	1.442	162	3.9	253	Ave.	31.68	88.6	39.81
										SD	0.642	4.980	4.920
				200	23	1.437	158	5.4	255	Ave.	32.92	92.6	42.21
										SD	1.712	2.702	2.832
				300	50	1.435	159	5.7	249	Ave.	34.48	90.40	42.35
										SD	1.101	3.362	2.304
				400	65	1.435	158	6.2	241	Ave.	33.12	88.40	42.59
										SD	0.944	4.722	2.636
				500	76	1.434	155	6.4	235	Ave.	34.28	87.60	35.16
										SD	0.593	3.507	5.706
				600	92	1.433	146	6.6	227	Ave.	32.60	69.60	42.61
										SD	1.334	8.355	3.846

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
Y	Medium only	Full medium Reduced Liner	1	100	20	1.437	177	4.7	256	Ave.	30.36	92.4	36.14
										SD	1.260	5.128	4.037
				200	26	1.436	181	6.2	247	Ave.	32.88	95.4	38.6
										SD	0.228	4.669	3.073
				300	42	1.434	183	7.1	237	Ave.	33.40	93.80	37.71
										SD	0.283	2.864	4.656
				400	49	1.432	183	7.9	228	Ave.	33.12	92.00	41.52
										SD	1.026	2.449	0.886
				500	61	1.43	184	8.5	221	Ave.	34.24	89.00	39.27
										SD	0.963	4.472	2.758
				600	64	1.428	185	8.7	215	Ave.	33.84	87.40	40.19
										SD	0.713	4.506	1.531

Appendix III

Summary of Corrugating Trials for Mill X

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
X	Max	Full	1	100	21	1.43	176	5.50	239	Ave.	32.35	107.60	39.94
										SD	2.01	4.34	2.55
				200	23	1.44	182	6.70	240	Ave.	33.84	120.2	39.49
										SD	1.86	3.27	4.45
				300	39	1.44	185	7.00	239	Ave.	34.44	117.2	41.74
										SD	1.47	4.44	2.52
				400	48	1.438	186	7.3	230	Ave.	34.92	109.60	39.76
										SD	0.46	5.03	4.45
				500	58	1.439	187	7.7	228	Ave.	34.68	107.40	38.44
										SD	1.03	4.98	4.81
				600	54	1.438	187	8.1	223	Ave.	35.48	99.20	40.30
										SD	1.19	4.21	3.21
				700	64	1.44	186	8.2	222	Ave.	36.08	81.00	39.67
										SD	1.24	15.02	2.63

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
X	Liner only	Full	1	100	19	1.43	166	4.70	248	Ave.	32.00	106	39.14
										SD	0.72	5.24	4.94
				200	28	1.44	163	5.80	249	Ave.	33.32	110.2	41.85
										SD	0.72	9.81	2.00
				300	59	1.438	163	5.8	246	Ave.	34.12	109.60	37.87
										SD	2.02	1.82	4.20
				400	100	1.439	161	6.1	239	Ave.			
										SD			
				500	100								

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
X	Medium only	Full medium Reduced Liner	1	100	22	1.43	171	6.70	253	Ave.	32.52	104.8	42.31
										SD	0.79	4.76	1.69
				200	34	1.44	179	6.70	248	Ave.	34.32	108	40.5
										SD	1.12	116	38.1
				300	50	1.44	183	7.00	236	Ave.	35.40	116	48.3
										SD	1.17	120	44.95
				400	67	1.436	185	7.4	228	Ave.	35.28	100	35.95
										SD	0.41	94	27.95
				500	75	1.437	185	7.6	220	Ave.	36.16	99.20	33
										SD	0.89	8.61	43.9
				600	79	1.435	186	7.9	215	Ave.	36.36	95.20	41.88
										SD	1.07	10.23	2.40
				700	100								

Appendix III Summary of Corrugating Trials for Mill AC

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
AC	Max	Full	1	100	18	1.43	172	6.40	246	Ave.	35.80	110.40	43.64
										SD	1.62	1.82	1.46
				200	20	1.44	179	7.10	248	Ave.	37.45	122.4	43.9
										SD	1.17	3.85	0.72
				300	34	1.44	183	7.40	242	Ave.	39.72	118.8	43.92
										SD	1.61	4.76	1.87
				400	50	1.44	185	7.8	237	Ave.	39.40	114.20	45.44
										SD	1.31	3.42	1.98
				500	52	1.44	186	8	232	Ave.	39.36	118.80	45.15
										SD	1.13	5.63	1.51
				600	50	1.43	178	8.2	226	Ave.	40.24	110.40	43.89
										SD	2.98	2.61	1.26
				700	73	1.43	185	8.6	224	Ave.	30.00	70.60	42.30
										SD	2.32	13.22	1.26
				800	77	1.43	185	8.8	222	Ave.	40.48	93.20	41.78
										SD	1.19	1.64	3.63

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
AC	Liner only	Full	1	100	18	1.44	157	5.40	230	Ave.	35.36	118.8	43.20
										SD	2.30	7.79	4.25
				200	20	1.44	154	6.20	245	Ave.	37.44	125.2	44.4
										SD	0.71	3.27	2.65
				300	44	1.44	159	6.3	242	Ave.	39.32	118.80	44.90
										SD	1.11	4.21	3.23
				400	70	1.44	159	6.4	233	Ave.	38.96	109.00	43.29
										SD	1.07	5.79	3.06
				500	100	1.44	157	6.6	229	Ave.	39.28	74.20	39.79
										SD	2.13	10.35	4.34
				600	100								

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
AC	Medium only	Full medium Reduced Liner	1	100	20	1.44	171	5.90	244	Ave.	36.90	113.2	42.55
										SD	1.09	3.19	2.65
				200	27	1.44	177	6.90	239	Ave.	39.12	123	44.7
										SD	1.62	2.24	3.41
				300	48	1.44	181	7.30	229	Ave.	39.80	115.60	42.3
										SD	1.25	3.78	2.61
				400	57	1.44	184	7.6	221	Ave.	40.44	112.00	44.56
										SD	1.37	7.48	3.75
				500	69	1.43	185	7.9	214	Ave.	40.08	106.00	43.00
										SD	1.04	4.90	2.44
				600	67	1.43	184	8.2	208	Ave.	39.28	95.40	41.53
										SD	0.87	5.50	3.13
				700	78	1.43	184	8.5	203	Ave.	40.12	61.80	40.53
										SD	0.98	11.61	3.86
				800	100								

Appendix III

Summary of Corrugating Trials for Mill Z

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
Z	Max	Full	1	100	18	1.45	182	4.80	256	Ave.	27.88	100.00	38.48
										SD	0.30	3.08	1.68
				200	24	1.45	187	6.00	253	Ave.	30.25	118	42.51
										SD	0.50	3.74	2.85
				300	43	1.44	189	7.00	244	Ave.	32.36	107.2	41.19
										SD	1.65	3.96	2.70
				400	56	1.45	189	7.4	236	Ave.	31.52	103.60	39.24
										SD	0.94	10.16	1.30
				500	63	1.44	188	8.3	226	Ave.	32.72	98.60	41.52
										SD	0.86	6.39	2.26
				600	57	1.44	189	8.4	223	Ave.	33.84	90.20	39.30
										SD	0.78	7.29	1.04
				700	68	1.44	189	8.8	221	Ave.	34.55	80.00	42.55
										SD	0.57	4.24	2.65
				800	100								

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
Z	Liner only	Full	1	100	18	1.45	179	3.80	250	Ave.	25.60	114.2	41.09
										SD	0.75	3.49	1.14
				200	26	1.44	173	4.90	248	Ave.	28.60	117	40.49
										SD	0.94	5.66	2.06
				300	61	1.45	169	5.7	240	Ave.	31.84	106.80	40.88
										SD	1.37	3.27	2.35
				400	96	1.45	168	6.1	232	Ave.	30.84	76.40	35.87
										SD	0.30	15.95	4.60
				500	100								

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
Z	Medium only	Full medium Reduced Liner	1	100	22	1.45	182	4.60	250	Ave.	28.25	102.2	38.45
										SD	0.96	2.68	3.33
				200	21	1.45	187	5.80	242	Ave.	30.96	117.4	41.38
										SD	1.05	3.91	2.99
				300	51	1.45	188	6.70	228	Ave.	32.28	113.80	45.27
										SD	1.45	6.98	2.27
				400	72	1.45	188	7.3	220	Ave.	32.28	98.00	39.36
										SD	1.11	9.06	2.62
				500	83	1.45	189	7.7	214	Ave.	32.52	75.40	37.17
										SD	1.63	9.45	4.32
				600	100								

Appendix III

Summary of Corrugating Trials for Mill G

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
G	Max	Full	1	100	22	1.436	179	5.0	256	Ave.	31.88	83.20	40.04
										SD	0.844	3.701	2.338
				200	24	1.435	186	6.0	254	Ave.	35.85	94.2	39.79
										SD	1.088	5.805	2.539
				300	35	1.433	190	6.3	245	Ave.	36.08	90.2	44.27
										SD	1.404	6.181	2.504
				400	41	1.436	192	6.4	238	Ave.	35.36	84.80	40.61
										SD	2.582	3.834	1.954
				500	42	1.437	193	6.9	231	Ave.	37.04	78.60	41.04
										SD	1.187	2.608	1.866
				600	40	1.436	192	7.3	226	Ave.	36.40	77.60	40.96
										SD	0.316	5.030	2.036
				700	45	1.440	192	7.6	225	Ave.	37.30	71.00	40.96
										SD	1.322	3.464	0.968
				800	51	1.435	191	7.8	222	Ave.	37.52	70.40	42.32
										SD	0.867	3.130	1.652

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
G	Liner only	Full	1	100	16	1.429	170	3.6	244	Ave.	30.92	85.8	37.14
										SD	0.610	2.683	2.838
				200	22	1.430	168	4.3	246	Ave.	30.96	86.2	40.71
										SD	0.555	4.550	1.957
				300	48	1.431	169	4.8	241	Ave.	33.76	83.60	41.99
										SD	1.108	3.847	2.073
				400	63	1.432	169	5.1	234	Ave.	32.84	74.80	39.00
										SD	0.518	4.207	2.053
				500	73	1.432	168	5.1	228	Ave.	32.24	70.20	37.31
										SD	0.669	1.789	1.849
				600	77	1.431	165	5.3	223	Ave.	31.32		40.42
										SD	1.197		2.370
				700	100	1.428	160	5.4	217	Ave.	31.76	33.00	37.48
										SD	1.381	8.485	1.467
				800									

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
G	Medium only	Full medium Reduced Liner	1	100	20	1.434	177	4.7	253	Ave.			
										SD			
				200	26	1.435	185	5.6	240	Ave.	32.20	95.8	40.65
										SD	0.678	2.280	1.673
				300	39	1.437	190	5.7	233	Ave.	33.84	87.40	44.03
										SD	1.033	2.608	1.931
				400	44	1.436	192	6.3	224	Ave.	34.36	83.25	39.66
										SD	0.829	4.573	2.555
				500									
				600	49	1.424	193	6.8	209	Ave.	35.84	67.40	40.11
										SD	1.396	4.506	1.248
				700									
				800	94	1.43	192	7.5	201	Ave.	36.16	37.20	38.22
										SD	1.126	6.140	2.810

Summary of Corrugating Trials for Mill P–2

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single–face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
P–2	Max	Full	1	100	18	1.432	171	5.8	258	Ave.	31.72	93.80	45.88
										SD	1.301	3.834	2.009
				200	20	1.439	177	7.4	257	Ave.	34.45	114	43.68
										SD	1.025	4.062	1.850
				300	20	1.433	179	7.9	250	Ave.	34.72	107.8	43.66
										SD	0.832	6.535	1.425
				400	37	1.44	181	7.8	243	Ave.	34.52	103.00	41.54
										SD	1.064	6.595	1.491
				500						Ave.			
										SD			
				600	43	1.43	183	8.7	233	Ave.	34.56	97.00	43.24
										SD	1.352	4.359	1.824
				700						Ave.			
										SD			
				800	59	1.427	182	9.3	228	Ave.	34.92	89.60	41.42
										SD	1.180	3.912	1.143

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single–face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
P–2	Liner only	Full	1	100	17	1.427	165	4.6	241	Ave.	31.00	98.2	42.81
										SD	0.663	5.762	1.299
				200	19	1.435	157	6.0	247	Ave.	32.92	113.8	45.14
										SD	0.482	4.494	3.001
				300	40	1.43	157	6.5	243	Ave.	33.28	105.60	42.07
										SD	0.934	4.336	1.287
				400	60	1.43	155	6.8	233	Ave.	33.12	101.80	42.20
										SD	0.832	6.834	1.574
				500	81	1.44	153	6.9	229	Ave.	33.48	89.00	39.44
										SD	1.474	3.536	3.382
				600	100					Ave.			
										SD			

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single–face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
P–2	Medium only	Full medium Reduced Liner	1	100	19	1.437	173	5.1	240	Ave.	31.68	86.40	42.74
										SD	0.820	2.702	2.504
				200	20	1.433	177	6.2	235	Ave.	33.72	117.4	44.38
										SD	1.270	5.128	3.288
				300	39	1.433	180	6.9	225	Ave.	34.24	110.20	43.06
										SD	0.921	2.950	1.798
				400	51	1.43	183	7.4	219	Ave.	35.40	105.40	41.59
										SD	1.393	12.300	1.659
				500						Ave.			
										SD			
				600	50	1.43	183	8	210	Ave.	35.04	97.00	46.26
										SD	0.654	4.062	2.729
				700						Ave.			
										SD			
				800	83	1.43	182	8.9	201	Ave.	35.24	82.80	42.02
										SD	1.802	2.280	2.984

Appendix III

Summary of Corrugating Trials for Mill N

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tensior lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Mediur Temp. °F	Medium Moisture %	Single–face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
N	Max	Full	1	100	20	1.439	180	5.3	264	Ave.	33.68	94.25	40.13
										SD	1.701	3.775	1.407
				200	27	1.447	188	6.1	264	Ave.	34.60	115	41.47
										SD	0.589	4.472	2.537
				300	42	1.443	190	6.3	257	Ave.	35.16	110	41.94
										SD	1.590	6.819	1.675
				400	55	1.444	190	6.7	245	Ave.	37.32	108.80	42.91
										SD	0.729	3.114	2.352
				500						Ave.			
										SD			
				600	55	1.446	190	7.1	238	Ave.	37.24	102.20	42.62
										SD	1.367	6.496	1.784
				700						Ave.			
										SD			
				800	93	1.449	188	7.7	231	Ave.	38.12	91.20	39.26
										SD	1.579	3.962	2.281

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tensior lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Mediur Temp. °F	Medium Moisture %	Single–face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
N	Liner only	Full	1	100	18	1.440	173	4.6	256	Ave.	32.16	102.6	38.44
										SD	0.456	2.702	3.195
				200	29	1.445	172	5.2	255	Ave.	34.24	115.4	41.31
										SD	0.654	4.336	2.263
				300	60	1.442	170	5.4	249	Ave.	36.12	106.60	40.47
										SD	1.432	6.986	1.477
				400	100					Ave.	34.56	80.20	39.22
										SD	1.571	14.078	2.251

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tensior lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Mediur Temp. °F	Medium Moisture %	Single–face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
N	Medium only	Full medium Reduced Liner	1	100	20	1.439	179	5.2	260	Ave.	33.00	100.40	42.34
										SD	1.456	3.435	1.661
				200	27	1.447	188	5.3	264	Ave.	34.6	115	41.47
										SD	0.590	6.380	1.551
				300	50	1.443	189	6.5	241	Ave.	36.56	112.20	42.07
										SD	0.994	4.207	1.451
				400	68	1.445	191	7	233	Ave.	38.32	108.40	39.66
										SD	1.375	4.099	2.730
				500	90	1.444	190	7.1	222	Ave.	37.52	85.60	37.54
										SD	1.973	15.421	2.203
				600	75	1.441	189	7.5	217	Ave.	36.92	89.60	40.21
										SD	2.148	15.241	2.236
				700	100					Ave.			
										SD			
				800									

Appendix III

Summary of Corrugating Trials for Mill M

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
M	Max	Full	1	100	22	1.440	182	5.3	260	Ave.	41.44	106.80	41.30
										SD	2.056	2.588	2.395
				200	24	1.443	189	6.0	262	Ave.	39.95	113.20	41.63
										SD	3.304	1.643	1.913
				300	42	1.442	191	6.3	256	Ave.	43.28	107.60	43.24
										SD	0.657	5.167	1.257
				400	58	1.44	192	6.6	249	Ave.	43.56	107.20	43.57
										SD	2.151	3.114	1.794
				500						Ave.			
										SD			
				600	60	1.44	192	7	235	Ave.	43.28	107.80	40.10
										SD	1.205	2.490	3.165
				700	100								

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
M	Liner only	Full	1	100	21	1.443	175	4.1	248	Ave.	39.20	104.00	43.43
										SD	2.112	1.581	1.437
				200	32	1.440	172	5.1	254	Ave.	42.04	115.80	43.87
										SD	0.623	3.899	1.830
				300	64	1.44	171	5.3	249	Ave.	41.72	109.20	42.76
										SD	0.756	1.924	2.028
				400	100					Ave.			
										SD			

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single-face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
M	Medium only	Full medium Reduced Liner	1	100	21	1.437	177	5.0	261	Ave.	39.28	111.20	41.69
										SD	1.316	2.168	2.232
				200	33	1.448	185	5.7	254	Ave.	43.08	120.20	39.34
										SD	1.993	3.493	1.276
				300	48	1.440	187	6.3	243	Ave.	42.08	112.60	43.72
										SD	0.335	2.881	1.338
				400	66	1.44	189	6.7	232	Ave.	43.20	112.80	41.96
										SD	2.140	4.764	1.865
				500						Ave.			
										SD			
				600	67	1.44	189	7	219	Ave.	42.88	100.25	42.13
										SD	1.092	5.123	1.141
				700	100					Ave.			
										SD			
				800						Ave.			
										SD			

Appendix III

Summary of Corrugating Trials for Mill D

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single–face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
D	Max	Full	1	100	27	1.439	183	5.4	261	Ave.	32.92	101.00	44.81
										SD	1.064	2.828	2.384
				200	37	1.442	188	6.1	257	Ave.	34.00	103.2	43.6
										SD	0.762	4.919	2.200
				300	73	1.441	192	6.5	250	Ave.	36.84	105.8	46.88
										SD	0.805	5.357	2.248
				400	100								

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single–face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
D	Liner only	Full	1	100	29	1.445	175	4.6	252	Ave.	33.08	102	46.06
										SD	0.867	6.124	2.523
				200	48	1.443	171	5.1	245	Ave.	33.12	106.2	44.6
										SD	1.579	2.168	2.722
				300	100					Ave.			
										SD			

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single–face Liner Temperature °F		Flat Crush psi	Pin Adhesion, lb	ECT lb/in
D	Medium only	Full medium Reduced Liner	1	100	24	1.446	180	5.4	246	Ave.	33.16	99.4	47.47
										SD	1.252	2.608	1.743
				200	41	1.443	186	6.8	243	Ave.	35.24	111.6	46.5
										SD	1.330	8.532	1.576
				300	83	1.441	188	6.5	232	Ave.	35.96	92.60	43.5
										SD	1.590	7.635	2.547
				400	100					Ave.			
										SD			

Appendix III

Summary of Corrugating Trials for Mill O

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single–face Liner Temperature °F	Flat Crush psi	Pin Adhesion, lb	ECT lb/in
O	Max	Full	1	100	18	1.445	171	6.5	243	36.04	105.00	45.01
										1.802	4.690	1.666
				200	17	1.450	178	7.6	257	38.44	104.6	42.4
										1.769	3.847	1.827
				300	35	1.450	181	8.2	252	39.72	101.6	43.49
										0.687	2.074	1.117
				400	61	1.449	183	9.0	243	39.00	94.40	42.5
										1.844	2.074	1.521
				500	71	1.450	183	9.7	236	40.88	81.80	42.19
										1.026	18.061	2.089
				600	94	1.450	182	9.9	232	41.40	92.8	41.1
										0.849	6.611	2.675
				700	100							

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single–face Liner Temperature °F	Flat Crush psi	Pin Adhesion, lb	ECT lb/in
O	Liner only	Full	1	100	24	1.448	159	5.5	243	35.52	97	45.13
										1.481	3.391	2.070
				200	34	1.449	152	6.2	247	37.00	105.2	43.6
										1.095	2.490	1.311
				300	66	1.448	149	6.4	244	37.44	92.6	42.6
										0.518	8.325	2.726
				400	100							

Mill Code	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed ft/min	Corrugator Evaluation (with wedge) % Delamination	Draw Factor	Medium Temp. °F	Medium Moisture %	Single–face Liner Temperature °F	Flat Crush psi	Pin Adhesion, lb	ECT lb/in
O	Medium only	Full medium Reduced Liner	1	100	21	1.444	169	6.5	253	35.16	95.4	43.29
										1.014	5.505	1.298
				200	28	1.448	178	7.5	250	37.80	106.8	43.8
										0.678	3.633	1.635
				300	54	1.447	182	8.1	241	38.72	104.4	41.8
										0.820	4.278	1.850
				400	88	1.451	184	8.6	230	39.48	86.2	39.36
										1.221	10.640	2.491
				500	100							

Appendix IV

ECT,lbs,

Corrugating speed,fpm			100	200	300	400	500	600	700	800
LP	Std. Cond.	Av	45.36	44.1	46.66	45.17	44.59	46.31	40.69	
		SD	2.448	2.048	2.285	2.116	1.682	2.597	2.629	
LP	Cool Med.	Av	47.05	48.54	46.79					
		SD	2.987	2.035	2.569					
LP	Cool Liner	Av	46.11	44.85	48.22	44.5	43.9			
		SD	1.882	1.971	2.13	3.62	3.613			
LO	Std. Cond.	Av	43.89	45.12	40.86	41.01	42.49	42.23	42.44	
		SD	2.263	1.968	2.025	2.827	2.57	2.372	1.716	
LO	Cool Med.	Av	40.97	44.87	43.93					
		SD	2.432	1.318	3.184					
LO	Cool Liner	Av	45.29	42.34	40.84	41.06	42.28	41.42		
		SD	2.637	2.482	3.524	2.19	3.05	3.155		
LH	Std. Cond.	Av	45.66	45.72	43.5	48.14	45.11	49	50.43	
		SD	3.12	2.241	3.026	3.257	2.192	2.155	3.196	
LH	Cool Med.	Av	47.06	43.86	46.52					
		SD	2.478	3.901	2.818					
LH	Cool Liner	Av	48.22	46.67	47.22	44.6	42.44	45.77		
		SD	2.901	3.296	1.963	1.768	6.126	4.486		
LI	Std. Cond.	Av	43.91	41.54	44.64	39.71	43.98	43.9		
		SD	2.513	3.075	1.936	4.039	2.179	2.344		
LI	Cool Med.	Av	41.84	45.39	43.38					
		SD	2.309	3.465	2.941					
LI	Cool Liner	Av	45.18	44.21	45.15	44.29				
		SD	1.93	2.657	1.619	1.572				
LU	Std. Cond.	Av	52.33	48.11	50.65	0	51.15	49.35		
		SD	2.626	2.966	3.145	0	2.482	4.655		
LU	Cool Med.	Av	48.96	52.61	38.95					
		SD	3.166	2.416	6.986					
LU	Cool Liner	Av	50.16	49.27	49.79	39.38	40.52	46.06	36.84	
		SD	3.86	3.653	3.044	5.769	6.323	4.573	5.087	
LL	Std. Cond.	Av	41.91	40.88	40.28	36.85	39.09	38.67		
		SD	3.24	2.215	1.478	2.326	3.437	3.052		
LL	Cool Med.	Av	36.83	39	39.42					
		SD	2.909	1.916	0					
LL	Cool Liner	Av	41.29	42.03	39.37	38.15	36.67			
		SD	2.489	2.11	1.747	2.23	2.386			

Appendix IV

ECT, lbs/in.

Corrugating speed,fpm			100	200	300	400	500	600	700	800
LA	Std. Cond.	Av	42.51	43.98	46.93	43.3	40.06	42.81	43.54	
		SD	5.318	2.688	2.003	2.112	4.362	2.19	1.291	
LA	Cool Med.	Av	43.14	40.49	44.5					
		SD	2.115	2.523	2.441					
LA	Cool Liner	Av	43.41	47.7	42.24	48.82	46.42	44.42	43.94	
		SD	2.171	1.956	3.74	1.128	1.865	1.755	1.702	
LQ	Std. Cond.	Av	43.16	43.45	40.18	42.41	45.34	42.7	39.8	
		SD	1.638	2.131	2.292	2.832	1.93	1.706	3.874	
LQ	Cool Med.	Av	41.61	41.5	42.17	43.73				
		SD	3.397	2.026	2.584	0.83				
LQ	Cool Liner	Av	42.53	42.95	45.46	42.73	41.65	43.1	40.38	37.13
		SD	3.483	2.773	1.962	2.605	3.354	1.623	1.645	3.703
LX	Std. Cond.	Av	45.65		44.65	44.37	44.74	44.06	45.12	41.34
		SD	2.403		2.063	2.222	2.517	2.996	1.889	3.435
LX	Cool Med.	Av	45.15	40.44	39.79	45.01				
		SD	2.526	3.92	4.364	0.972				
LX	Cool Liner	Av	45.3	39.34	42.31	44.47	45.96	44.39	41.81	
		SD	2.128	1.612	3.437	2.84	1.92	2.443	1.114	
LY	Std. Cond.	Av	41	43.51	43.59	44.39	42.07	43.68		
		SD	3.229	3.405	2.57	1.773	2.562	2.185		
LY	Cool Med.	Av	41.5	45.24	46.53					
		SD	3.445	2.166	2.107					
LY	Cool Liner	Av	46.61	46.06	44.21	46.43	43.95			
		SD	2.422	2.795	3.512	1.457	3.025			
LC	Std. Cond.	Av	46	48.28	48.78	47.44	45.8	43.46	45.98	45.59
		SD	1.961	2.378	2.759	1.655	1.528	3.004	2.274	2.322
LC	Cool Med.	Av	45.74	41.28	46.88	45.27				
		SD	5.436	4.042	1.791	3.844				
LC	Cool Liner	Av	41.98	44.31	46.88	45.77	47.1	46.49	46.64	
		SD	3.074	2.862	3.507	2.026	2.583	2.349	2.132	
LE	Std. Cond.	Av	41.67	41.26	38.44	43.03	42	41.32	40.01	
		SD	3.608	2.47	3.733	3.077	2.176	2.046	2.886	
LE	Cool Med.	Av	42	39.92	41.49					
		SD	3.127	3.053	3.112					
LE	Cool Liner	Av	38.7	39.8	38.99	40.1	42.85	42.85	40.49	
		SD	3.468	4.86	3.506	3.08	3.208	2.615	3.687	

Appendix IV

ECT, lbs/in.

Corrugating speed,fpm			100	200	300	400	500	600	700	800
LJ	Std. Cond.	Av	45.68	43.51	38.83	43.51	45.56	44.36	43.26	43.37
		SD	2.892	2.822	4.791	2.737	2.327	1.871	2.271	2.032
LJ	Cool Med.	Av	42.56	42.13	38.3					
		SD	2.525	2.468	1.986					
LJ	Cool Liner	Av	44.26	45.89	42.96	44.1	45.01	42.22	42.69	
		SD	3.457	2.747	4.062	2.618	3.576	4.434	3.872	
LV	Std. Cond.	Av	43.68	45.65	46.04	42.93	47.06	45.35	48.31	
		SD	3.333	4.692	3.992	3.736	2.723	2.975	3.328	
LV	Cool Med.	Av	46.39	46.94	45.37					
		SD	5.001	4.405	3.988					
LV	Cool Liner	Av	42.34	45.57	47.64	48.07				
		SD	4.456	3.502	2.472	3.182				
LM	Std. Cond.	Av	39.34	45.12	43.5	39.04	45.94	41.23		
		SD	2.546	2.988	2.718	3.393	2.348	4.699		
LM	Cool Med.	Av	42.76	42.09						
		SD	3.491	3.303						
LM	Cool Liner	Av	44.05	41.4	42.68					
		SD	3.559	2.7	3.293					
LD	Std. Cond.	Av	43.75	42.74	42.55	43.13	39.71			
		SD	3.924	4.665	2.352	4.169	3.579			
LD	Cool Med.	Av	39.95	44.14	43.19					
		SD	5.029	4.348	4.352					
LD	Cool Liner	Av	43.92	47.24	44.23	43.75	39.49			
		SD	6.127	2.277	1.941	3.196	3.444			
LT	Std. Cond.	Av	47.97	48.74	44.65	43.91	45.68	45.25	47.19	
		SD	2.553	2.75	4.354	3.687	2.558	2.662	3.504	
LT	Cool Med.	Av	41.01	47.01	45.9					
		SD	4.432	3.661	2.45					
LT	Cool Liner	Av	48.33	48.27	47.48	47.9				
		SD	1.804	4.106	2.166	2.514				

Appendix IV

ECT, lbs/in.

			100	200	300	400	500	600	700	800
LN	Std. Cond.	Av	43.5	43.22	42.86	42.86	41.23	42.77		
		SD	3.567	3.485	1.68	2.542	2.017	1.955		
LN	Cool Med.	Av	39.45	39.33	42.86					
		SD	3.39	3.465	5.354					
LN	Cool Liner	Av	41.28	42.24	43.56	40.31	41.17		41.49	
		SD	4.937	1.82	2.207	3.2	3.717		2.446	
LF	Std. Cond.	Av	40.93	41.3	40.44	43.17	43.3	41.8	42.77	
		SD	5.825	2.766	2.222	3.379	2.067	0.952	2.539	
LF	Cool Med.	Av	39.55	40.8	41.74					
		SD	2.945	2.039	3.085					
LF	Cool Liner	Av	40.62	40.91	41.27	41.82	40.19	39.79	39.83	
		SD	4.519	3.098	2.217	2.748	2.052	3.992	3.447	
LB	Std. Cond.	Av	39.99	45.69	44.13	44.76	43.52	43.83		
		SD	4.164	1.555	2.39	1.933	2.296	2.105		
LB	Cool Med.	Av		43.64	45.57			46.45		
		SD		1.444	2.059			1.546		
LB	Cool Liner	Av	45.38	45.37	43.41	44.65	46.08	43.4	38.57	
		SD	2.011	2.733	1.993	2.07	1.416	4.478	3.594	
LK	Std. Cond.	Av	44.3	42.36	44.73	43.55	43.62	44.4	45.69	
		SD	1.637	4.651	3.371	2.832	2.678	2.978	1.864	
LK	Cool Med.	Av	44.23	43.62	44.44					
		SD	1.989	4.084	2.312					
LK	Cool Liner	Av	44.69	45.96	42.71	47.16	47.56	43.36	46.47	
		SD	2.374	3.181	3.902	2.731	1.603	3.612	2.557	
LG	Std. Cond.	Av	42.77	44.53	46.74	46.28	46.09	47.22	46.47	
		SD	3.473	3.632	2.628	2.472	2.063	1.644	2.657	
LG	Cool Med.	Av	43.96	45.86	45.34					
		SD	3.149	2.678	1.679					
LG	Cool Liner	Av	44.94	43.05	44.91	45.6	44.77			
		SD	2.726	2.016	2.478	2.921	2.542			

Appendix IV

PIN ADHESION, lbs

Corrugating speed, fpm			100	200	300	400	500	600	700	800
Std. Cond.	LP	Av	80.40	91.80	98.80	97.80	96.00	79.40	41.00	
		SD	2.30	3.11	5.76	4.66	2.92	18.34	12.88	
Cool Med.	LP	Av	88.8	98.8	100.6					
		SD	3.83	4.76	6.91					
Cool Liner	LP	Av	86.20	103.4	101.6	94.00	70.60			
		SD	5.45	5.37	3.85	9.35	17.54			
Std. Cond.	LO	Av	90.40	105.6	109	108.60	103.20	104.20	64.20	
		SD	2.70	3.13	3.54	2.88	4.60	3.42	14.99	
Cool Med.	LO	Av	91.00	112.4	104.8					
		SD	4.64	2.51	5.81					
Cool Liner	LO	Av	106.2	116.2	107.2	107.00	103.60	77.60		
		SD	3.96	4.55	4.38	5.79	6.07	23.90		
Std. Cond.	LH	Av	92.60	108	111.2	112.40	107.20	108.80	94.60	
		SD	4.77	2.92	1.92	2.70	8.87	1.30	8.17	
Cool Med.	LH	Av	99.8	106.8	111.8					
		SD	7.19	2.77	3.27					
Cool Liner	LH	Av	104.2	112.2	107.2	98.4	88.6	45.2		
		SD	5.54	5.07	2.59	12.90	6.50	38.25		
Std. Cond.	LI	Av	93.20	114	110.6	111.80	108.20	106.40		
		SD	1.64	4.80	3.36	3.35	3.96	1.95		
Cool Med.	LI	Av	100	115.2	113.6					
		SD	3.24	4.21	3.29					
Cool Liner	LI	Av	104.4	120.4	114.8	111.4				
		SD	5.13	3.44	3.90	2.88				
Std. Cond.	LU	Av	88.00	100.2	103.8	103.80	104.20	103.80		
		SD	1.87	3.77	2.86	5.54	4.87	4.32		
Cool Med.	LU	Av	88.80	109	105.2					
		SD	1.48	2.55	4.55					
Cool Liner	LU	Av	87.60	102.8	108.8	104.00	103.20	98.00	56.80	
		SD	1.82	6.38	3.63	3.94	3.27	3.32	17.64	
Std. Cond.	LL	Av	88.2	105.8	112.4	109.4	104.2	100.2		
		SD	2.775	4.494	3.578	3.5071	5.6303	8.3187		
Cool Med.	LL	Av	87	106.6	102					
		SD	3.742	4.159	2					
Cool Liner	LL	Av	104.4	106.8	109.4	98.4	53.4			
		SD	4.93	4.817	4.827	9.3968	14.792			

Appendix IV

PIN ADHESION, lbs

Corrugating speed, fpm			100	200	300	400	500	600	700	800
Std. Cond.	LA	Av	97.00	110.6	120.2	115.80	115.60	112.60		
		SD	3.94	4.51	6.61	4.21	2.88	3.21		
Cool Med.	LA	Av	95.2	113.4	115.4					
		SD	3.42	1.14	4.67					
Cool Liner	LA	Av	104.8	121.8	116.2	114.4	108.4	107.6	81.4	
		SD	0.84	4.66	4.82	5.98	4.98	4.62	13.79	
Std. Cond.	LQ	Av	90.40	102	107.2	107.00	104.60	106.20	101.40	
		SD	3.21	3.24	2.95	6.75	4.77	4.66	6.47	
Cool Med.	LQ	Av	92.20	101	108.6	103.80				
		SD	1.92	3.08	1.82	3.27				
Cool Liner	LQ	Av	100.2	103.2	107.6	104.40	98.80	94.60	88.00	37.20
		SD	3.11	6.14	3.44	2.61	7.19	4.56	3.46	27.32
Std. Cond.	LX	Av	87.60	91.60	100.8	104.00	97.00	96.00	90.80	49.20
		SD	4.04	4.16	6.57	2.92	5.79	5.34	5.93	14.31
Cool Med.	LX	Av	94.2	100.4	100.6	97.4				
		SD	3.49	2.30	5.50	3.78				
Cool Liner	LX	Av	97.00	100.2	103.4	103.20	95.00	82.80	79.80	
		SD	4.53	3.42	2.19	3.42	5.10	5.17	12.83	
Std. Cond.	LY	Av	82.80	114.2	121.6	116.20	112.80	109.00		
		SD	2.775	5.805	4.037	6.4576	6.3797	6.1644		
Cool Med.	LY	Av	78.60	108.4	118					
		SD	2.074	4.98	4.062					
Cool Liner	LY	Av	90.40	119	117.6	113.00	68.00			
		SD	4.099	3.606	2.881	3.5355	14.387			
Std. Cond.	LC	Av	88.8	102.8	114.8	109.4	103.8	108.2	96.8	99.6
		SD	0.447	3.271	7.328	5.0794	3.1145	1.6432	5.0695	3.7148
Cool Med.	LC	Av	91.00	106.4	106.8	97.20				
		SD	4.359	4.336	2.168	3.7683				
Cool Liner	LC	Av	95.40	107.8	102.8	105.40	107.00	101.60	101.80	
		SD	4.278	5.31	5.891	4.6152	5.831	6.5803	3.0332	
Std. Cond.	LE	Av	94.60	92.40	99.00	92.40	96.80	93.20	95.60	
		SD	2.881	5.771	4.416	7.6354	3.4928	1.3038	5.2726	
Cool Med.	LE	Av	92.00	98.00	98.40					
		SD	2.345	2.121	3.209					
Cool Liner	LE	Av	89.8	93.6	94.6	85.2	71.8	70.6	27.4	
		SD	0.837	2.074	5.727	2.3875	16.917	9.5551	16.906	

Appendix IV

PIN ADHESION, lbs

Corrugating speed, fpm			100	200	300	400	500	600	700	800
Std. Cond.	LJ	Av	81.6	93.4	101.2	101.4	107.4	104.6	108.8	104.6
		SD	2.702	4.336	6.301	4.1593	9.0719	3.7815	4.1473	4.3932
Cool Med.	LJ	Av	79.8	102.4	104.2					
		SD	12.52	2.881	4.207					
Cool Liner	LJ	Av	86.80	95.00	99.80	99.60	91.20	71.00	49.20	
		SD	7.259	6.671	3.114	4.7749	4.3818	11.158	20.945	
Std. Cond.	LV	Av	102.4	115.6	115.4	119.8	119.4	119.2		
		SD	4.278	6.914	4.393	3.7014	6.4653	2.7749		
Cool Med.	LV	Av	101.2	113	109.8					
		SD	3.271	2.121	4.025					
Cool Liner	LV	Av	105.2	114.2	114.8	114.8				
		SD	2.95	4.868	4.087	2.0494				
Std. Cond.	LM	Av	102	117.8	122.2	122.60	123.80	112.40		
		SD	2.236	5.02	5.263	3.5071	6.3008	12.178		
Cool Med.	LM	Av	106	121.2						
		SD	3.742	5.167						
Cool Liner	LM	Av	109.6	124.8	115.8					
		SD	2.881	3.962	6.099					
Std. Cond.	LD	Av	107.4	127.8	123.8	128.00	116.00			
		SD	7.829	4.817	3.768	9.5656	6.9642			
Cool Med.	LD	Av	117.2	132	127.2					
		SD	3.421	5.05	9.602					
Cool Liner	LD	Av	125.6	127.2	127.4	106.2	64.8			
		SD	5.03	4.438	6.148	11.476	11.032			
Std. Cond.	LT	Av	105.8	117.6	119.6	120.40	118.20	113.80	116.00	
		SD	2.683	5.55	6.618	4.0373	6.3797	5.933	6.9642	
Cool Med.	LT	Av	103.2	119.6	116.2					
		SD	5.02	5.899	3.834					
Cool Liner	LT	Av	113.4	116	118.2	111.20				
		SD	2.51	4.00	3.27	7.43				

Appendix IV

PIN ADHESION, lbs

Corrugating speed, fpm			100	200	300	400	500	600	700	800
Std. Cond.	LN	Av	103.2	106.4	106.2	108.60	108.00	109.40	103.60	
		SD	4.712	5.639	6.834	3.3615	4.8477	5.5045	3.7815	
Cool Med.	LN	Av	97.00	103.6	104.6					
		SD	4.183	5.079	3.715					
Cool Liner	LN	Av	100.6	100.6	102.4	103.8	105.4			
		SD	2.793	3.286	3.507	3.4928	3.2094			
Std. Cond.	LF	Av	97.80	113	116.8	121.60	117.00	121.60	114.20	
		SD	2.775	3.873	3.701	5.5946	1.8708	2.1909	2.5884	
Cool Med.	LF	Av	103.4	118.8	122.6					
		SD	5.03	4.55	10.85					
Cool Liner	LF	Av	104	119	121.2	120.00	99.60	68.40	68.60	
		SD	4.848	5.339	8.955	5.7879	9.9146	21.847	30.973	
Std. Cond.	LB	Av	99.00	104.6	110.4	114.20	109.80	108.60		
		SD	3.536	3.782	4.827	4.4385	4.6043	2.6077		
Cool Med.	LB	Av	108.6	109.2	111.6					
		SD	2.51	5.263	6.189					
Cool Liner	LB	Av	108.2	116.6	111.8	114.4	99.8	62.6	50.2	
		SD	2.387	0.894	7.855	5.8992	7.9183	32.898	7.4632	
Std. Cond.	LK	Av	96.8	113.8	116.4	118.6	117.2	117.2	122.8	
		SD	2.49	3.899	5.079	4.3359	3.5637	5.02	4.4944	
Cool Med.	LK	Av	100.4	114.4	112					
		SD	2.074	4.278	2.236					
Cool Liner	LK	Av	104.4	120.2	116.2	119.00	114.80	107.20	91.40	
		SD	4.037	4.658	5.45	3.6742	5.3572	5.2154	20.526	
Std. Cond.	LG	Av	100.2	121.8	125.2	118.00	120.80	123.60	120.40	
		SD	2.168	3.899	3.033	6.3246	5.2631	7.3689	6.269	
Cool Med.	LG	Av	110.2	120.2	125					
		SD	4.207	4.604	9.618					
Cool Liner	LG	Av	109.2	120.2	121.6	119.8	106.4			
		SD	5.263	4.919	4.219	3.0332	13.164			

Appendix IV

Corrugating Trials for Liner Mill LA

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip) Temp. degrees F	Med. Web (before nip) Moist. %	Single-face web Med. Moist. %	Single-face web Liner Temp. degrees F	Single-face board tests Hi-Los, %>3mil
LA	HH	100	16.50	174	5.10	7.85	265	3.60
		200	8.50	182	6.20	9.85	253	8.80
		300	9.25	187	6.60	10.35	242	5.90
		400	10.50	189	6.60	10.30	234	6.40
		500	35.00	187	7.00	10.35	227	6.30
		600	49.50	187	7.20	9.85	222	11.00
		700	58.75	184	7.40	9.60	218	10.00
		800	100.00					
	CH	100	25.50	139	4.10	5.85	273	3.10
		200	28.75	140	4.60	8.65	256	5.80
		300	21.00	143	4.90	9.55	241	6.60
		400	100.00	141	5.00	9.95	231	
	HC	100	20.96	172	5.40	6.30	242	3.50
		200	6.75	179	5.90	8.10	237	8.00
		300	14.75	186	6.40	9.30	225	5.10
		400	19.25	188	6.80	9.60	217	5.70
		500	55.50	188	7.20	9.95	207	7.60
		600	65.00	187	7.30	10.10	203	12.20
		700	67.00	185	7.60	9.95	198	15.80
		800	100.00	183	7.80	9.90	194	

Appendix IV Corrugating Trials for Liner Mill LB

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip)		Single-face web		Single-face board tests
				Temp. degrees F	Moist. %	Med. Moist. %	Liner Temp. degrees F	Hi-Los, %>3mil
LB	HH	100	13.25	179	4.40	3.15	254	4.30
		200	8.00	184	5.30	5.60	247	5.90
		300	7.00	187	6.10	7.05	234	8.50
		400	16.75	189	6.70	8.05	227	1.70
		500	39.75	189	6.50	8.30	219	5.20
		600	63.50	189	6.20	8.05	215	8.00
		700	100.00					
		800						
	CH	100	14.75	149	4.10	2.10	265	4.20
		200	10.00	146	4.80	4.55	248	5.22
		300	26.75	140	5.50	7.20	232	6.60
		400	100.00					
	HC	100	12.25	176	4.60	1.60	249	5.40
		200	11.25	182	5.10	3.15	235	6.90
		300	15.00	187	5.60	4.65	221	10.20
		400	35.25	188	6.10	5.90	210	3.70
		500	58.00	188	6.80	7.10	202	7.20
		600	79.00	187	6.40	6.75	192	3.70
		700	88.25	186	6.30	6.60	186	4.10
		800	100.00					

Appendix IV

Corrugating Trials for Liner Mill LC

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip)		Single–face web		Single–face board tests
				Temp. degrees F	Moist. %	Med. Moist. %	Liner Temp. degrees F	Hi–Los, %>3mil
LC	HH	100	25.75	171	4.50	3.00	258	2.00
		200	25.00	182	5.40	6.15	241	6.70
		300	2.50	187	6.00	8.00	233	2.50
		400	7.25	189	6.60	8.20	227	3.90
		500	7.25	189	7.20	8.80	222	5.20
		600	28.50	187	7.90	9.35	218	13.90
		700	42.00	185	9.10	9.40	215	0.70
		800	57.50	183	9.20	9.50	206	13.40
	CH	100	28.50	142	4.00	2.95	246	1.90
		200	27.75	138	4.70	6.10	244	5.60
		300	19.50	143	5.10	7.35	232	2.90
		400	49.50	141	5.00	7.80	227	5.20
		500	100.00					
	HC	100	11.50	173	7.90	1.90	227	4.30
		200	16.50	182	6.10	4.85	221	11.40
		300	11.75	185	6.50	6.20	216	5.30
		400	23.50	187	6.90	7.00	209	7.80
		500	36.00	187	7.30	7.35	203	12.40
		600	38.75	187	7.40	7.35	197	16.40
		700	47.00	185	7.80	7.70	194	24.70
		800	100.00					

Appendix IV

Corrugating Trials for Liner Mill LD

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip)		Single–face web		Single–face board tests
				Temp. degrees F	Moist. %	Med. Moist. %	Liner Temp. degrees F	Hi–Los, %>3mil
LD	HH	100	17.25	171	4.40	2.80	252	3.70
		200	12.50	180	5.40	5.55	241	7.50
		300	10.45	186	5.70	6.80	232	13.40
		400	28.50	188	5.90	8.35	223	5.20
		500	38.75	190	5.90	7.55	220	6.70
		600	100.00	189	6.50	8.20	214	
		700						
		800						
	CH	100	17.00	135	4.10	1.80	251	6.30
		200	22.25	138	4.50	4.30	239	7.50
		300	35.75	141	5.00	5.90	231	10.40
		400	100.00					
	HC	100	13.75	163	5.20	2.05	230	4.30
		200	9.75	179	6.30	4.50	219	8.00
		300	19.75	183	6.00	5.35	211	16.60
		400	57.25	185	5.70	5.70	205	4.50
		500	77.00	186	6.50	6.30	199	3.00
		600	100.00	187	7.30	7.05	194	
		700						
		800						

Appendix IV

Corrugating Trials for Liner Mill LE

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip)		Single–face web		Single–face board tests
				Temp. degrees F	Moist. %	Med. Moist. %	Liner Temp. degrees F	Hi–Los, %>3mil
LE	HH	100	30.75	176	4.50	3.80	262	5.80
		200	29.50	182	5.20	5.75	241	6.20
		300	22.75	189	5.70	7.50	230	7.50
		400	32.25	190	6.30	8.35	222	6.70
		500	34.75	190	6.40	8.70	216	5.80
		600	41.25	188	6.60	9.55	210	9.50
		700	64.50	186	6.80	9.40	209	12.50
		800	100.00					
	CH	100	28.40	144	3.60	1.75	259	4.30
		200	37.75	145	4.30	4.80	244	5.89
		300	27.50	148	4.70	6.60	231	6.50
		400	100.00					
	HC	100	30.75	181	4.70	1.50	238	4.00
		200	21.25	185	4.50	3.50	229	4.56
		300	29.25	188	5.00	4.55	217	5.80
		400	63.25	190	5.30	5.70	205	3.50
		500	74.25	190	5.90	6.25	197	3.60
		600	72.75	189	6.00	6.75	192	7.60
		700	96.50	187	6.40	6.90	185	2.80
		800	100.00					

Appendix IV

Corrugating Trials for Liner Mill LF

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip) Temp. degrees F	Med. Web (before nip) Moist. %	Single-face web Med. Moist. %	Single-face board tests Liner Temp. degrees F	Single-face board tests Hi-Los, %>3mil
LF	HH	100	16.25	179	4.40	4.15	256	3.30
		200	1.50	185	5.10	6.20	249	3.50
		300	2.50	187	5.80	7.55	239	8.40
		400	5.75	188	6.50	8.05	230	5.70
		500	31.75	188	7.10	8.30	224	4.40
		600	28.75	187	8.00	8.80	220	10.50
		700	65.25	185	8.40	8.75	217	0.40
		800	100.00					
	CH	100	15.00	143	4.10	3.00	252	3.20
		200	2.00	142	4.70	5.55	242	5.00
		300	20.00	145	4.90	7.10	234	8.20
		400	100.00					
	HC	100	8.25	176	4.60	2.10	249	3.30
		200	0.00	182	5.30	4.40	228	4.80
		300	4.50	186	5.80	5.95	222	11.60
		400	24.00	187	6.00	5.95	217	4.10
		500	58.75	187	6.50	6.45	210	2.60
		600	73.00	187	6.60	6.65	204	2.50
		700	77.25	186	6.40	6.30	199	3.40
		800	100.00					

Appendix IV

Corrugating Trials for Liner Mill LG

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip)		Single-face web		Single-face board tests
				Temp. degrees F	Moist. %	Med. Moist. %	Liner Temp. degrees F	Hi-Los, %>3mil
LG	HH	100	20.00	174	4.90	3.55	244	2.70
		200	2.00	183	5.50	5.50	234	6.90
		300	2.25	186	5.60	6.65	225	9.10
		400	6.00	188	6.00	7.45	220	6.20
		500	24.25	188	6.50	8.85	214	6.00
		600	44.25	187	6.60	9.10	211	9.30
		700	100.00	186	7.00	9.30	207	10.40
		800						
	CH	100	6.50	144	3.90	2.25	243	6.80
		200	4.75	145	4.40	4.60	234	7.00
		300	27.75	146	4.90	6.10	226	8.50
		400	100.00					
	HC	100	12.75	174	5.10	1.50	239	2.30
		200	4.50	181	5.00	3.15	227	4.60
		300	21.25	186	5.50	4.65	219	10.80
		400	35.25	189	5.90	5.50	209	5.00
		500	71.50	191	5.70	6.00	204	3.40
		600	100.00					
		700						
		800						

Appendix IV

Corrugating Trials for Liner Mill LH

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip)		Single–face web		Single–face board tests
				Temp. degrees F	Moist. %	Med. Moist. %	Liner Temp. degrees F	Hi–Los, %>3mil
LH	HH	100	28.25	167	6.30	6.60	249	3.70
		200	32.00	177	6.90	8.80	242	4.10
		300	4.25	183	7.40	9.55	232	4.30
		400	19.25	186	7.80	9.95	227	5.70
		500	47.75	186	8.20	9.90	222	9.10
		600	59.50	185	8.80	10.20	218	12.40
		700	75.75	182	9.60	10.15	214	6.70
		800	100.00					
	CH	100	27.75	126	5.50	6.35	236	4.90
		200	39.25	130	6.20	8.55	234	3.90
		300	27.00	134	6.40	10.15	218	6.10
		400	100.00					
	HC	100	27.25	163	6.10	5.25	231	4.90
		200	17.75	175	7.00	8.25	225	5.60
		300	44.75	183	7.20	9.15	219	5.90
		400	59.50	186	8.00	9.50	214	9.20
		500	67.50	185	8.40	9.55	207	13.10
		600	98.50	184	9.20	9.45	198	10.50
		700	100.00	182	10.00	9.40	193	
		800						

Appendix IV

Corrugating Trials for Liner Mill LI

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip) Temp. degrees F	Med. Web (before nip) Moist. %	Single–face web Med. Moist. %	Single–face board tests Liner Temp. degrees F	Single–face board tests Hi–Los, %>3mil
LI	HH	100	27.25	165	5.90	3.70	239	3.60
		200	11.50	177	6.40	7.00	232	2.80
		300	4.50	181	7.10	8.90	241	4.30
		400	30.50	184	7.90	9.40	221	4.60
		500	59.50	184	9.00	9.65	226	8.60
		600	77.50	184	9.90	10.10	219	8.50
		700	100.00					
		800						
	CH	100	26.25	128	5.10	4.15	253	3.40
		200	16.25	133	6.00	7.80	247	4.80
		300	46.50	135	6.30	9.55	230	3.20
		400	100.00					
	HC	100	27.75	164	6.10	3.05	253	3.20
		200	15.00	177	6.50	6.50	234	2.00
		300	21.50	183	7.00	7.55	225	3.50
		400	68.25	186	7.60	8.50	217	5.60
		500	100.00	187	7.80	8.25	202	
		600						
		700						
		800						

Appendix IV

Corrugating Trials for Liner Mill LJ

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip)		Single-face web		Single-face board tests
				Temp. degrees F	Moist. %	Med. Moist. %	Liner Temp. degrees F	Hi-Los, %>3mil
LJ	HH	100	31.00	177	4.10	2.55	260	2.10
		200	24.25	187	4.60	5.70	243	7.30
		300	9.75	190	4.70	6.95	232	8.90
		400	12.25	191	5.20	7.55	230	6.60
		500	28.75	191	6.30	8.85	226	12.20
		600	37.00	190	6.60	9.25	223	10.50
		700	54.25	187	7.20	9.80	217	11.80
		800	94.25	185	7.10	9.25	209	10.70
	CH	100	31.00	148	3.60	1.85	260	2.60
		200	37.50	149	4.10	4.10	244	9.80
		300	23.50	149	4.30	6.65	233	15.10
		400	100.00					
	HC	100	28.25	180	4.30	1.40	235	4.30
		200	13.50	187	5.00	3.55	230	11.40
		300	13.25	190	6.10	4.85	223	8.80
		400	43.00	190	6.00	5.70	216	7.50
		500	67.75	191	6.20	5.85	211	8.20
		600	80.00	190	6.40	5.95	200	7.30
		700	85.00	188	6.00	6.50	196	5.40
		800	100.00					

Appendix IV

Corrugating Trials for Liner Mill LK

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip)		Single–face web		Single–face board tests
				Temp. degrees F	Moist. %	Med. Moist. %	Liner Temp. degrees F	Hi–Los, %>3mil
LK	HH	100	15.50	177	4.80	4.15	269	4.70
		200	9.75	184	5.50	6.30	261	9.70
		300	5.75	189	6.00	6.75	245	13.40
		400	9.50	189	6.50	8.80	230	5.70
		500	31.00	189	6.90	8.95	225	6.60
		600	35.00	189	7.10	9.40	221	12.00
		700	53.75	187	7.20	9.15	218	6.20
		800	100.00					
	CH	100	19.25	147	4.00	3.40	257	5.40
		200	11.25	145	4.60	5.20	254	9.80
		300	27.25	146	5.10	7.20	237	14.60
		400	100.00					
	HC	100	19.50	177	4.80	2.05	257	4.30
		200	7.25	185	6.10	4.65	240	8.10
		300	9.75	187	6.90	5.60	227	12.40
		400	23.00	189	7.10	6.40	219	6.50
		500	55.50	189	7.00	6.55	210	6.20
		600	68.75	188	6.50	6.50	203	10.10
		700	75.50	187	6.60	7.20	200	10.50
		800	100.00					

Appendix IV

Corrugating Trials for Liner Mill LL

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip) Temp. degrees F	Med. Web (before nip) Moist. %	Single-face web Med. Moist. %	Single-face web Liner Temp. degrees F	Single-face board tests Hi-Los, %>3mil
LL	HH	100	29.50	167	6.00	6.90	255	3.90
		200	31.25	178	6.50	9.00	241	2.90
		300	0.80	184	7.00	9.65	232	3.40
		400	17.50	185	7.30	10.05	229	5.30
		500	23.50	185	8.70	10.10	223	8.50
		600	46.25	182	9.20	10.25	222	8.90
		700	100.00					
		800						
	CH	100	31.25	133	4.40	5.25	250	4.90
		200	35.75	136	5.00	7.70	238	5.00
		300	34.00	135	5.80	9.00	229	7.90
		400	100.00					
	HC	100	28.75	164	6.30	4.30	240	4.20
		200	13.50	176	6.70	6.55	231	2.40
		300	20.00	181	6.60	8.60	223	4.40
		400	65.25	184	7.00	8.85	213	4.90
		500	92.50	183	8.20	9.30	205	5.10
		600	100.00					
		700						
		800						

Appendix IV

Corrugating Trials for Liner Mill LM

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip)		Single–face web		Single–face board tests
				Temp. degrees F	Moist. %	Med. Moist. %	Liner Temp. degrees F	Hi–Los, %>3mil
LM	HH	100	17.25	165	4.50	3.35	253	5.30
		200	10.50	177	5.60	5.70	243	8.00
		300	11.25	183	6.30	6.75	231	13.00
		400	14.25	185	7.30	8.05	225	5.50
		500	42.25	187	8.60	8.45	221	7.10
		600	60.25	187	9.30	8.65	216	10.20
		700	100.00					
		800						
	CH	100	14.00	134	4.30	3.25	249	5.30
		200	16.00	135	4.80	5.55	238	8.80
		300	100.00					
		400						
	HC	100	17.50	165	5.10	2.50	236	7.60
		200	10.00	176	5.40	4.30	227	9.70
		300	25.75	183	5.90	5.40	218	13.60
		400	100.00	185	6.50	6.35	208	
		500						
		600						
		700						
		800						

Appendix IV

Corrugating Trials for Liner Mill LN

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip)		Single-face web		Single-face board tests
				Temp. degrees F	Moist. %	Med. Moist. %	Liner Temp. degrees F	Hi-Los, %>3mil
LN	HH	100	13.25	167	5.00	3.65	252	4.70
		200	11.00	177	5.60	6.05	233	9.78
		300	8.25	182	6.40	6.90	224	13.80
		400	15.00	185	6.70	7.95	226	7.80
		500	28.75	187	7.60	8.65	224	6.90
		600	36.00	186	8.70	9.25	217	11.00
		700	54.50	185	9.10	9.35	216	2.20
		800	100.00					
	CH	100	14.00	134	4.10	2.60	257	3.10
		200	22.50	138	4.60	5.10	250	7.70
		300	35.50	143	5.00	7.40	239	7.20
		400	100.00					
	HC	100	14.00	163	4.80	2.50	248	3.00
		200	11.75	176	5.50	4.40	239	6.10
		300	20.00	184	6.20	5.65	222	13.20
		400	30.50	185	6.50	6.20	215	5.80
		500	55.25	185	6.60	6.65	207	7.60
		600	100.00					
		700						
		800						

Appendix IV

Corrugating Trials for Liner Mill LO

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip) Temp. degrees F	Med. Web (before nip) Moist. %	Single–face web Med. Moist. %	Single–face web Liner Temp. degrees F	Single–face board tests Hi–Los, %>3mil
LO	HH	100	23.25	164	6.20	6.65	243	4.00
		200	28.00	175	7.10	9.45	233	4.40
		300	19.75	180	7.50	9.90	232	4.60
		400	21.25	183	7.30	10.20	230	7.00
		500	43.25	183	8.00	10.15	230	6.80
		600	46.00	182	7.80	10.25	223	9.00
		700	76.50	182	8.10	10.20	216	9.20
		800	100.00	183	8.10	10.20	214	
	CH	100	24.25	124	5.10	5.25	255	2.60
		200	24.50	125	5.70	8.70	241	5.00
		300	32.50	125	5.10	9.10	222	7.20
		400	100.00	126	5.90	8.70	218	
	HC	100	26.75	162	5.70	4.05	233	5.90
		200	35.50	175	6.40	6.85	225	4.10
		300	10.00	184	7.30	8.25	226	2.30
		400	43.50	186	7.80	8.50	219	8.00
		500	67.75	184	8.30	8.45	212	10.20
		600	100.00					12.30
		700						
		800						

Appendix IV

Corrugating Trials for Liner Mill LP

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip) Temp. degrees F	Med. Web (before nip) Moist. %	Single-face web Med. Moist. %	Single-face web Liner Temp. degrees F	Single-face board tests Hi-Los, %>3mil
LP	HH	100	31.75	169	5.30	6.65	265	6.10
		200	36.25	177	6.40	9.20	252	2.40
		300	31.00	181	7.00	10.20	238	4.70
		400	37.25	184	7.50	10.35	233	5.80
		500	63.50	185	7.70	10.25	232	3.80
		600	76.00	184	7.50	10.15	223	8.30
		700	93.00	183	8.00	10.00	218	9.80
		800	100.00					
	CH	100	31.75	126	5.50	6.90	249	4.90
		200	41.75	131	5.90	9.90	244	3.00
		300	49.50	129	6.40	10.30	234	8.20
		400	100.00					
	HC	100	29.00	163	5.90	4.95	247	4.90
		200	35.25	176	7.10	7.85	238	4.10
		300	24.50	180	7.30	9.35	231	3.80
		400	52.00	185	7.20	9.65	226	4.60
		500	82.75	183	7.60	9.65	219	6.40
		600	100.00					
		700						
		800						

Apppendix IV

Corrugating Trials for Liner Mill LQ

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip		Single-face web		Single-face board tests
				Temp. degrees F	Moist. %	Med. Moist. %	Liner Temp. degrees F	Hi-Los %>3mil
LQ	HH	100	19.25	172	5.00	4.30	250	2.00
		200	14.25	181	5.50	7.30	233	5.00
		300	5.50	186	6.00	8.45	227	3.50
		400	5.50	188	6.20	9.10	225	6.40
		500	28.25	188	7.10	9.60	222	7.40
		600	44.75	187	7.90	9.65	218	17.60
		700	57.75	185	8.20	9.80	216	12.20
		800	100.00					
	CH	100	15.25	138	4.60	3.20	262	4.60
		200	15.25	140	5.10	6.05	246	7.80
		300	11.25	145	5.60	7.70	235	5.90
		400	59.75	144	5.50	8.55	229	2.10
		500	100.00					
	HC	100	20.00	169	5.30	2.35	240	2.50
		200	9.75	182	6.10	5.20	235	11.00
		300	9.75	186	6.50	6.15	226	4.50
		400	20.00	189	6.40	6.50	219	6.60
		500	48.75	188	6.80	6.75	204	4.80
		600	52.50	188	7.20	7.00	204	11.10
		700	69.00	186	7.20	7.00	199	11.00
		800	100.00	185	7.50	7.35	195	11.30

Appendix IV

Corrugating Trials for Liner Mill LT

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip Temp. degrees F	Med. Web (before nip Moist. %	Single–face web Med. Moist. %	Single–face board tests Liner Temp. degrees F	Single–face board tests Hi–Los, %>3mil
LT	HH	100	16.00	171	4.40	4.25	248	3.50
		200	8.75	178	5.50	7.20	234	6.60
		300	2.75	185	6.70	8.45	225	13.70
		400	8.50	185	7.30	8.75	223	5.00
		500	25.75	185	8.30	8.55	220	7.20
		600	45.00	186	8.20	9.05	212	14.10
		700	70.25	184	9.30	9.35	205	10.50
		800	100.00					
	CH	100	20.25	133	4.20	2.80	246	3.20
		200	17.75	136	4.80	5.65	239	6.20
		300	33.00	140	5.10	6.95	230	11.60
		400	100.00					
	HC	100	18.25	167	6.10	2.85	225	5.30
		200	21.00	177	5.50	4.75	224	10.40
		300	19.00	182	5.80	5.85	216	14.40
		400	50.25	186	6.00	6.35	208	6.30
		500	100.00	187	6.60	6.90	198	
		600						
		700						
		800						

Appendix IV

Corrugating Trials for Liner Mill LU

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip Temp. degrees F	Med. Web (before nip Moist. %	Single-face web Med. Moist. %	Single-face board tests Liner Temp. degrees F	Single-face board tests Hi-Los, %>3mil
LU	HH	100	28.50	170	5.30	6.90	241	3.90
		200	33.50	178	6.20	8.75	239	5.70
		300	9.00	183	6.40	9.50	232	2.60
		400	25.25	187	6.70	10.05	228	4.30
		500	42.50	186	7.80	10.30	226	4.60
		600	46.25	183	8.10	10.30	227	11.00
		700	100.00					
		800						
	CH	100	29.75	133	5.50	6.25	243	4.80
		200	37.25	135	6.30	9.50	238	5.80
		300	17.50	136	6.40	9.75	232	5.10
		400	100.00					
	HC	100	25.25	165	5.90	5.05	240	5.00
		200	16.25	176	6.60	8.00	230	5.40
		300	12.75	182	7.10	9.40	224	3.40
		400	46.75	186	7.40	9.95	220	7.00
		500	61.75	185	7.80	10.20	212	5.10
		600	68.25	185	8.10	9.80	207	14.30
		700	89.00	184	7.80	9.60	202	14.80
		800	100.00					

Appendix IV

Corrugating Trials for Liner Mill LV

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip		Single–face web		Single–face board tests
				Temp. degrees F	Moist. %	Med. Moist. %	Liner Temp. degrees F	Hi–Los, %>3mil
LV	HH	100	22.25	178	4.40	6.95	248	4.10
		200	4.00	178	4.50	3.85	250	5.80
		300	1.75	185	5.10	5.85	236	9.90
		400	7.50	189	5.70	7.55	228	4.80
		500	24.50	192	5.90	7.85	223	5.40
		600	59.25	191	5.60	8.65	216	8.90
		700	100.00	190	5.70	8.35	211	
		800		188	6.20	9.05	211	
	CH	100	22.75	147	4.10	2.85	252	3.50
		200	20.75	150	4.50	5.10	238	11.20
		300	32.00	148	4.40	5.25	228	8.40
		400	100.00					
	HC	100	21.25	178	4.40	1.70	239	5.00
		200	4.25	183	5.10	3.35	227	6.20
		300	13.25	186	5.30	4.55	213	11.90
		400	50.00	189	6.00	5.75	208	2.50
		500	100.00	189	6.10	6.40	203	
		600						
		700						
		800						

Appendix IV

Corrugating Trials for Liner Mill LX

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip		Single–face web		Single–face board tests
				Temp. degrees F	Moist. %	Med. Moist. %	Liner Temp. degrees F	Hi–Los, %>3mil
LX	HH	100	33.50	177	4.50	3.05	266	1.40
		200	25.00	184	5.50	6.05	252	6.50
		300	4.50	189	6.10	7.55	231	5.20
		400	5.00	190	6.50	8.85	228	5.80
		500	32.00	191	6.90	9.10	225	5.10
		600	38.75	189	7.20	9.30	221	11.30
		700	48.00	187	7.50	8.95	218	12.70
		800	82.25	185	7.50	10.15	214	4.00
	CH	100	29.50	144	4.50	2.35	270	4.60
		200	20.00	143	4.90	5.10	246	4.10
		300	16.50	147	5.00	6.05	238	5.70
		400	41.00	144	5.20	6.75	231	2.20
		500	100.00					
	HC	100	24.50	180	4.60	1.75	230	1.70
		200	17.25	183	5.70	4.55	233	4.60
		300	11.75	189	6.10	5.60	224	5.40
		400	35.75	190	6.30	6.10	216	6.30
		500	58.50	189	6.40	6.75	208	5.20
		600	80.50	188	6.20	6.30	201	11.10
		700	80.25	188	6.16.16.16.	6.30	195	18.90
		800	100.00					

Appendix IV

Corrugating Trials for Liner Mill LY

Liner Code Letter	Medium /Liner Corr. Cond.	Corr. Speed fpm	% Unbonded	Med. Web (before nip) Temp. degrees F	Med. Web (before nip) Moist. %	Single-face web Med. Moist. %	Single-face web Liner Temp. degrees F	Single-face board tests Hi-Los, %>3mil
LY	HH	100	23.75	173	4.70	2.95	264	2.10
		200	22.00	183	5.50	6.90	241	4.90
		300	24.95	184	5.90	7.30	227	4.10
		400	11.50	188	6.60	7.95	222	4.60
		500	39.75	187	7.30	8.95	219	6.80
		600	44.50	187	7.50	8.60	212	11.50
		700	100.00					
		800						
	CH	100	36.25	142	3.80	2.90	257	2.60
		200	38.25	141	4.60	5.55	235	4.00
		300	7.00	143	5.20	7.75	225	3.60
		400	100.00					
	HC	100	27.75	167	4.80	2.20	237	2.50
		200	34.00	180	5.40	4.75	226	5.50
		300	14.50	187	5.70	5.85	214	4.80
		400	32.50	188	6.20	7.10	202	7.90
		500	81.50	188	6.90	7.20	194	5.50
		600	100.00					
		700						
		800						

Appendix V

Table 1
Corrugator Evaluation of Mill Q

Mill Code	Roll No.	Steam Showers	Preheaters (Med.& Line	Med Tension lb/in.	Corr. Speed	Corrugator Runnability Evaluation	Draw Factor	Medium Temperature °F	Medium Moisture %	High–Low >3 mil %	High–Low >4 mil %	Flat Crush psi
Q	6859	Full (Medium and Liner)	Full	1.00	200fpm	OK	1.44	181.00	6.50	28.80	9.70	31.50
					400fpm	OK	1.44	184.00	7.30	19.50	8.60	31.00
					600fpm	OK	1.43	186.00	7.80	19.60	7.30	31.90
					800fpm	OK	1.42	184.00	8.40	26.90	14.10	33.30
					1000fpm	OK	1.42	182.00	9.00	36.30	22.28	32.70
Q	6859	Liner only	Full	1.00	200fpm	OK	1.44	150.00	6.20	17.00	6.00	31.10
					400fpm	OK	1.44	147.00	6.90	22.50	11.40	32.00
					600fpm	OK	1.43	127.00	6.90	29.50	14.90	30.40
					800fpm	OK	1.42	122.00	7.00	45.40	28.90	31.80
					1000fpm	OK	1.40	114.00	7.00	56.30	44.70	29.90
Q	6859	Liner only	Full	3.00	200fpm	OK	1.43	161.00	5.00	32.90	18.30	32.10
					400fpm	OK	1.43	159.00	6.10	36.80	22.50	32.00
					600fpm	OK	1.42	154.00	6.50	45.30	30.60	30.70
					800fpm	FRACTURED						
					1000fpm	FRACTURED						

Appendix V

Table 2
Corrugator Evaluation of Mill A

Mill Code	Roll No.	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed	Corrugator Runnability Evaluation	Draw Factor	Medium Temperature °F	Medium Moisture %	High–Low >3 mil %	High–Low >4 mil %	Flat Crush psi
A	6861	Full (Medium and Liner)	Full	1.00	200fpm	OK	1.44	175.00	7.70	12.63	6.13	38.50
					400fpm	OK	1.45	182.00	8.70	13.60	5.60	37.70
					600fpm	OK	1.45	183.00	9.10	13.20	5.30	38.30
					800fpm	OK	1.45	182.00	9.30	12.40	4.70	39.30
					1000fpm	OK	1.45	177.00	10.10	24.40	12.90	39.60
A	6861	Liner only	Full	1.00	200fpm	OK	1.44	144.00	6.60	13.30	6.50	37.00
					400fpm	OK	1.45	123.00	7.40	13.40	6.60	36.00
					600fpm	OK	1.45	113.00	7.00	15.00	4.50	34.20
					800fpm	OK	1.44	106.00	6.40	32.10	17.60	36.20
					1000fpm	delam @ 900						
A	6861	Liner only	Full	3.00	200fpm	OK	1.44	162.00	5.20	14.00	4.90	37.00
					400fpm	OK	1.44	164.00	6.20	22.70	10.90	36.60
					600fpm	OK	1.44	162.00	7.00	27.40	13.30	37.60
					800fpm	OK	1.44	151.00	7.30	31.50	17.90	36.70
					1000fpm	delam @ 950						

Appendix V

Table 3
Corrugator Evaluation of Mill S

Mill Code	Roll No.	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed	Corrugator Runnability Evaluation	Draw Factor	Medium Temperature °F	Medium Moisture %	High–Low >3 mil %	High–Low >4 mil %	Flat Crush psi
S	6866	Full (Medium and Liner)	Full	1.00	200fpm	OK	1.44	187.00	6.50	5.40	1.70	31.20
					400fpm	OK	1.44	192.00	7.10	4.50	1.20	31.40
					600fpm	OK	1.44	191.00	7.30	16.90	6.70	32.10
					800fpm	OK	1.44	188.00	7.80	15.90	7.40	33.20
					1000fpm	OK	1.43	183.00	8.20	26.80	14.70	32.80
S	6866	Liner only	Full	1.00	200fpm	OK	1.44	167.00	5.60	7.10	1.70	30.10
					400fpm	OK	1.44	166.00	5.90	11.70	3.60	29.60
					600fpm	OK	1.44	159.00	6.00	23.20	10.10	29.90
					800fpm	OK	1.43	144.00	6.40	41.50	24.10	30.30
					1000fpm	delam @ 950						
S	6866	Liner only	Full	3.00	200fpm	OK	1.43	174.00	5.00	16.60	5.20	30.00
					400fpm	OK	1.43	172.00	5.80	22.40	9.40	30.20
					600fpm	OK	1.43	169.00	6.00	29.10	16.60	30.30
					800fpm	delam @ 800	1.44	163.00	6.20			
					1000fpm							

Appendix V

Table 4
Corrugator Evaluation of Mill O

Mill Code	Roll No.	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed	Corrugator Runnability Evaluation	Draw Factor	Medium Temperature °F	Medium Moisture %	High–Low >3 mil %	High–Low >4 mil %	Flat Crush psi
O	6867	Full (Medium and Liner)	Full	1.00	200fpm	OK	1.45	177.00	7.40	8.40	3.30	36.40
					400fpm	OK	1.45	183.00	8.20	6.40	1.30	37.70
					600fpm	OK	1.45	184.00	8.50	12.30	5.70	39.30
					800fpm	OK	1.45	181.00	9.20	17.00	7.60	39.80
					1000fpm	OK	1.45	179.00	9.30	38.10	24.50	38.20
O	6867	Liner only	Full	1.00	200fpm	OK	1.45	147.00	6.20	10.60	2.50	36.30
					400fpm	OK	1.45	146.00	6.50	16.60	7.70	34.70
					600fpm	OK	1.45	139.00	6.50	26.00	14.00	35.10
					800fpm	OK	1.45	--	--	28.00	14.90	34.50
					1000fpm	OK	1.45	147.00	6.20	62.80	53.60	34.50
O	6867	Liner only	Full	3.00	200fpm	OK	1.44	163.00	4.70	24.20	9.40	35.10
					400fpm	OK	1.44	163.00	5.80	27.40	13.60	35.00
					600fpm	OK	1.44	161.00	6.30	32.90	17.70	36.80
					800fpm	OK	1.44	150.00	6.70	35.60	21.50	35.40
					1000fpm	OK	1.44	138.00	6.80	53.30	40.40	35.00

Appendix V

Table 5
Corrugator Evaluation of Mill D

Mill Code	Roll No.	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed	Corrugator Runnability Evaluation	Draw Factor	Medium Temperature °F	Medium Moisture %	High–Low >3 mil %	High–Low >4 mil %	Flat Crush psi
D	6870	Full (Medium and Liner)	Full	1.00	200fpm	OK	1.44	186.00	6.40	8.80	2.60	33.00
					400fpm	OK	1.44	189.00	7.10	13.50	6.50	35.00
					600fpm	OK	1.44	189.00	7.90	20.40	6.90	35.90
					800fpm	OK	1.44	186.00	6.40	27.40	11.60	37.20
					1000fpm	OK	1.42	186.00	6.40	42.30	28.50	36.40
D	6870	Liner only	Full	1.00	200fpm	OK	1.44	164.00	5.70	8.20	2.40	33.10
					400fpm	OK	1.44	163.00	6.20	15.50	4.70	33.60
					600fpm	OK	1.44	153.00	6.60	30.30	14.70	33.10
					800fpm	OK	1.43	139.00	6.80	51.20	36.10	34.10
					1000fpm	OK	1.41	128.00	6.70	65.50	54.50	33.90
D	6870	Liner only	Full	3.00	200fpm	OK	1.43	167.00	4.70	24.30	12.30	33.80
					400fpm	OK	1.43	165.00	5.80	28.20	14.10	34.50
					600fpm	OK	1.43	164.00	6.30	35.60	18.00	35.30
					800fpm	OK	1.41	159.00	6.60	48.30	34.10	32.20
					1000fpm	Fractured		--	--			

Appendix V

Table 6
Corrugator Evaluation of Mill P(1)

Mill Code	Roll No.	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed	Corrugator Runnability Evaluation	Draw Factor	Medium Temperature °F	Medium Moisture %	High–Low >3 mil %	High–Low >4 mil %	Flat Crush psi
P–1	6874	Full (Medium and Liner)	Full	1.00	200fpm	OK	1.44	179.00	6.50	7.20	3.50	33.50
					400fpm	OK	1.44	185.00	7.30	4.60	1.10	33.40
					600fpm	OK	1.44	184.00	8.10	12.00	5.10	34.60
					800fpm	OK	1.44	182.00	8.60	24.50	14.00	34.60
					1000fpm	OK	1.44	180.00	9.00	29.80	17.70	35.50
P–1	6874	Liner only	Full	1.00	200fpm	OK	1.44	158.00	5.50	6.00	2.40	31.30
					400fpm	OK	1.44	156.00	6.10	9.40	3.00	32.10
					600fpm	OK	1.44	139.00	6.20	12.30	3.40	31.30
					800fpm	OK	1.43	131.00	6.50	24.10	11.30	32.40
					1000fpm	delam.		--	--			
P–1	6874	Liner only	Full	3.00	200fpm	OK	1.43	171.00	4.60	17.80	6.80	32.10
					400fpm	OK	1.43	166.00	5.70	17.10	7.30	33.30
					600fpm	OK	1.43	164.00	6.20	20.40	8.50	33.90
					800fpm	OK	1.43	159.00	6.50	24.70	11.10	33.90
					1000fpm	OK	1.43	146.00	6.80	32.60	18.90	32.50

Appendix V

Table 7
Corrugator Evaluation of Mill AH

Mill Code	Roll No.	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed	Corrugator Runnability Evaluation	Draw Factor	Medium Temperature °F	Medium Moisture %	High–Low >3 mil %	High–Low >4 mil %	Flat Crush psi
AH	6886	Full (Medium and Liner)	Full	1.00	200fpm	OK	1.45	180.00	5.90	12.20	3.98	28.30
					400fpm	OK	1.44	184.00	6.90	14.00	5.20	29.30
					600fpm	OK	1.44	185.00	7.40	19.00	6.80	29.10
					800fpm	OK	1.44	186.00	8.10	26.30	13.90	28.30
					1000fpm	OK	1.44	181.00	8.60	38.80	24.00	29.90
AH	6886	Liner only	Full	1.00	200fpm	OK	1.44	159.00	4.90	11.50	6.50	27.40
					400fpm	OK	1.44	155.00	5.70	21.38	8.40	27.80
					600fpm	OK	1.44	147.00	6.00	22.40	10.20	28.20
					800fpm	OK	1.44	134.00	6.10	36.80	23.40	28.10
					1000fpm	OK	1.43	123.00	6.30	66.60	57.00	27.40
AH	6886	Liner only	Full	3.00	200fpm	OK	1.43	166.00	4.60	25.80	14.40	29.40
					400fpm	OK	1.43	164.00	5.60	31.50	17.10	29.70
					600fpm	OK	1.43	161.00	5.90	35.50	18.90	27.40
					800fpm	OK	1.43	149.00	6.20	48.90	34.00	28.50
					1000fpm	OK	1.43	135.00	6.50	61.10	50.40	28.20

Appendix V

Table 8
Corrugator Evaluation of Mill Y

Mill Code	Roll No.	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed	Corrugator Runnability Evaluation	Draw Factor	Medium Temperature °F	Medium Moisture %	High–Low >3 mil %	High–Low >4 mil %	Flat Crush psi
Y	6899	Full (Medium and Liner)	Full	1.00	200fpm	OK	1.43	179.00	5.90	9.70	3.50	28.60
					400fpm	OK	1.43	182.00	7.30	8.90	3.60	29.00
					600fpm	OK	1.43	184.00	8.50	11.60	4.20	30.70
					800fpm	OK	1.43	183.00	9.50	14.20	5.60	30.70
					1000fpm	OK	1.42	183.00	10.30	23.20	11.50	31.70
Y	6899	Liner only	Full	1.00	200fpm	OK	1.44	151.00	5.10	7.10	2.60	28.50
					400fpm	OK	1.44	150.00	6.40	15.40	6.00	29.00
					600fpm	OK	1.44	141.00	6.80	15.80	4.70	29.00
					800fpm	OK	1.42	131.00	6.80	31.40	17.60	29.00
					1000fpm	OK	1.42	121.00	7.00	52.10	39.80	28.50
Y	6899	Liner only	Full	3.00	200fpm	OK	1.43	160.00	4.50	11.20	2.80	33.40
					400fpm	OK	1.42	161.00	5.70	16.60	7.10	33.70
					600fpm	OK	1.42	156.00	6.30	23.10	10.00	33.70
					800fpm	OK	1.41	146.00	6.60	37.40	23.10	33.90
					1000fpm	OK	1.40	133.00	6.90	49.90	36.20	30.00

Appendix V

Table 9
Corrugator Evaluation of Mill X

Mill Code	Roll No.	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed	Corrugator Runnability Evaluation	Draw Factor	Medium Temperature °F	Medium Moisture %	High–Low >3 mil %	High–Low >4 mil %	Flat Crush psi
X	6902	Full (Medium and Liner)	Full	1.00	200fpm	OK	1.44	181.00	6.50	12.20	5.20	31.70
					400fpm	OK	1.44	186.00	7.30	17.60	7.90	32.00
					600fpm	OK	1.44	187.00	7.90	26.00	11.90	32.90
					800fpm	OK	1.44	185.00	8.40	30.30	15.70	34.90
					1000fpm	OK	1.43	183.00	8.80	38.00	23.90	34.50
X	6902	Liner only	Full	1.00	200fpm	OK	1.44	163.00	5.70	16.20	5.70	31.90
					400fpm	OK	1.44	162.00	6.10	25.90	11.60	31.70
					600fpm	OK	1.44	154.00	6.40	37.90	19.70	30.90
					800fpm	OK	1.44	140.00	6.60	42.40	26.80	31.90
					1000fpm	OK	1.43	130.00	6.50	45.20	31.90	30.30
X	6902	Liner only	Full	3.00	200fpm	OK	1.43	166.00	4.70	32.10	15.90	31.50
					400fpm	OK	1.42	164.00	5.90	37.60	21.50	32.10
					600fpm	OK	1.42	163.00	6.10	43.90	28.00	31.70
					800fpm	OK	1.42	154.00	6.20	55.10	39.90	31.80
					1000fpm	OK	1.41	140.00	6.30	62.20	49.80	29.70

Appendix V

Table 10
Corrugator Evaluation of Mill AC

Mill Code	Roll No.	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed	Corrugator Runnability Evaluation	Draw Factor	Medium Temperature °F	Medium Moisture %	High–Low >3 mil %	High–Low >4 mil %	Flat Crush psi
AC	6918	Full (Medium and Liner)	Full	1.00	200fpm	OK	1.44	179.00	6.90	13.00	5.20	36.40
					400fpm	OK	1.44	184.00	7.50	8.20	1.70	36.50
					600fpm	OK	1.44	186.00	7.80	29.90	15.30	37.30
					800fpm	OK	1.43	184.00	8.40	27.20	15.20	38.10
					1000fpm	OK	1.42	182.00	8.90	28.67	17.30	36.20
AC	6918	Liner only	Full	1.00	200fpm	OK	1.44	154.00	6.10	13.30	4.80	37.10
					400fpm	OK	1.44	160.00	6.40	19.50	9.60	36.60
					600fpm	OK	1.44	152.00	6.70	26.30	11.10	37.10
					800fpm	OK	1.43	138.00	6.90	37.70	25.80	37.70
					1000fpm	delam.	--	130.00	6.80	--	--	--
AC	6918	Liner only	Full	3.00	200fpm	OK	1.43	163.00	4.90	21.00	8.60	38.00
					400fpm	OK	1.42	161.00	6.20	29.20	14.80	36.30
					600fpm	OK	1.42	159.00	6.70	35.30	19.40	36.90
					800fpm	OK	1.42	150.00	6.90	44.40	28.50	37.60
					1000fpm	OK	1.41	138.00	7.10	51.80	38.80	35.90

Appendix V

Table 11
Corrugator Evaluation of Mill Z

Mill Code	Roll No.	Steam Showers	Preheaters (Med.& Line	Med Tension lb/in.	Corr. Speed	Corrugator Runnability Evaluation	Draw Factor	Medium Temperature °F	Medium Moisture %	High–Low >3 mil %	High–Low >4 mil %	Flat Crush psi
Z	6921	Full (Medium and Liner)	Full	1.00	200fpm	OK	1.44	183.00	6.10	13.00	5.20	36.40
					400fpm	OK	1.44	186.00	7.50	8.20	1.70	36.50
					600fpm	OK	1.44	188.00	8.70	29.90	15.30	37.30
					800fpm	OK	1.44	187.00	9.40	27.20	15.20	38.10
					1000fpm	OK	1.44	186.00	9.50	28.67	17.30	36.20
Z	6921	Liner only	Full	1.00	200fpm	OK	1.44	165.00	5.20	13.30	4.80	37.10
					400fpm	OK	1.44	161.00	6.50	19.50	9.60	36.60
					600fpm	OK	1.44	150.00	6.70	26.30	11.10	37.10
					800fpm	OK	1.44	137.00	7.20	37.70	25.80	37.70
					1000fpm	delam.	--	126.00	7.00	--	--	--
Z	6921	Liner only	Full	3.00	200fpm	OK	1.43	166.00	4.90	21.00	8.60	38.00
					400fpm	OK	1.43	165.00	6.00	29.20	14.80	36.30
					600fpm	OK	1.43	162.00	6.70	35.30	19.40	36.90
					800fpm	OK	1.43	152.00	7.00	44.40	28.50	37.60
					1000fpm	delam.	--	141.00	6.70	51.80	38.80	35.90

Appendix V

Table 12
Corrugator Evaluation of Mill G

Mill Code	Roll No.	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed	Corrugator Runnability Evaluation	Draw Factor	Medium Temperature °F	Medium Moisture %	High–Low >3 mil %	High–Low >4 mil %	Flat Crush psi
G	6926	Full (Medium and Liner)	Full	1.00	200fpm	OK	1.43	184.00	5.60	19.90	9.10	33.00
					400fpm	OK	1.43	191.00	6.40	26.10	12.90	34.00
					600fpm	OK	1.43	193.00	6.70	26.10	13.40	32.90
					800fpm	OK	1.43	192.00	7.70	34.40	20.60	34.60
					1000fpm	OK	1.42	189.00	8.40	42.30	30.20	32.80
G	6926	Liner only	Full	1.00	200fpm	OK	1.43	166.00	5.10	23.30	11.30	31.00
					400fpm	OK	1.43	166.00	5.40	26.60	13.40	32.80
					600fpm	OK	1.43	163.00	5.70	36.60	18.40	31.60
					800fpm	OK	1.42	153.00	6.00	41.90	27.40	30.60
					1000fpm	Fractured	1.41	137.00	6.00	--	--	--
G	6926	Liner only	Full	3.00	200fpm	Fractured	1.39	169.00	3.90	--	--	--
					400fpm					--	--	--
					600fpm					--	--	--
					800fpm					--	--	--
					1000fpm					--	--	--

Appendix V

Table 13
Corrugator Evaluation of Mill P(2)

Mill Code	Roll No.	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed	Corrugator Runnability Evaluation	Draw Factor	Medium Temperature °F	Medium Moisture %	High–Low >3 mil %	High–Low >4 mil %	Flat Crush psi
P–2	6928	Full (Medium and Liner)	Full	1.00	200fpm	OK	1.44	175.00	6.90	12.60	7.20	31.30
					400fpm	OK	1.43	180.00	7.90	15.10	5.90	31.70
					600fpm	OK	1.43	181.00	8.70	21.30	10.50	32.00
					800fpm	OK	1.43	179.00	9.70	18.20	7.90	33.50
					1000fpm	OK	1.42	179.00	10.40	30.80	18.60	31.80
P–2	6928	Liner only	Full	1.00	200fpm	OK	1.44	156.00	5.80	5.40	1.40	31.40
					400fpm	OK	1.44	158.00	6.20	12.70	4.40	31.00
					600fpm	OK	1.43	139.00	7.20	14.00	5.10	30.50
					800fpm	OK	1.42	130.00	7.10	24.30	13.20	30.80
					1000fpm	OK	1.42	119.00	7.30	41.70	29.80	30.50
P–2	6928	Liner only	Full	3.00	200fpm	OK	1.43	163.00	4.60	21.40	7.80	30.50
					400fpm	OK	1.42	161.00	6.20	21.90	9.60	31.60
					600fpm	OK	1.43	160.00	6.80	26.40	12.50	31.40
					800fpm	OK	1.42	153.00	7.00	26.00	14.90	31.60
					1000fpm	OK	1.41	137.00	7.20	37.70	25.10	30.10

Appendix V

Table 14
Corrugator Evaluation of Mill N

Mill Code	Roll No.	Steam Showers	Preheaters (Med.& Liner)	Med Tensio lb/in.	Corr. Speed	Corrugator Runnability Evaluation	Draw Factor	Medium Temperature °F	Medium Moisture %	High–Low >3 mil %	High–Low >4 mil %	Flat Crush psi
N	6931	Full (Medium and Liner)	Full	1.00	200fpm	OK	1.44	182.00	6.30	18.40	7.50	32.70
					400fpm	OK	1.44	187.00	6.80	21.70	8.70	34.30
					600fpm	OK	1.45	188.00	7.40	27.80	11.70	35.10
					800fpm	OK	1.44	186.00	8.00	30.60	17.30	36.40
					1000fpm	OK	1.44	184.00	8.40	42.80	28.60	36.00
N	6931	Liner only	Full	1.00	200fpm	OK	1.45	157.00	5.10	17.90	7.90	33.10
					400fpm	OK	1.45	160.00	5.50	24.20	11.50	31.90
					600fpm	OK	1.45	154.00	5.70	33.50	19.70	31.90
					800fpm	OK	1.44	139.00	6.10	41.90	28.50	33.90
					1000fpm	delam.	--	--	--	--	--	--
N	6931	Liner only	Full	3.00	200fpm	OK	1.44	168.00	4.60	38.70	21.20	31.90
					400fpm	OK	1.44	168.00	5.40	38.40	22.50	32.40
					600fpm	OK	1.44	166.00	5.70	42.50	26.90	33.00
					800fpm	OK	1.44	160.00	6.00	48.50	35.60	34.30
					1000fpm	OK	1.44	150.00	6.40	55.60	41.90	33.40

Appendix V

Table 15
Corrugator Evaluation of Mill M

Mill Code	Roll No.	Steam Showers	Preheaters (Med.& Liner)	Med Tension lb/in.	Corr. Speed	Corrugator Runnability Evaluation	Draw Factor	Medium Temperature °F	Medium Moisture %	High–Low >3 mil %	High–Low >4 mil %	Flat Crush psi
M	6934	Full (Medium and Liner)	Full	1.00	200fpm	OK	1.44	182.00	6.30	7.10	2.00	42.00
					400fpm	OK	1.44	189.00	6.80	6.10	2.80	40.90
					600fpm	OK	1.45	189.00	7.50	9.50	2.70	41.40
					800fpm	OK	1.44	189.00	8.10	16.80	5.50	42.10
					1000fpm	OK	1.44	188.00	8.20	25.50	13.80	43.10
M	6934	Liner only	Full	1.00	200fpm	OK	1.44	168.00	4.90	8.50	1.80	38.80
					400fpm	OK	1.44	168.00	5.30	12.40	4.80	38.00
					600fpm	OK	1.45	162.00	5.60	19.30	9.10	38.00
					800fpm	OK	1.44	148.00	5.70	31.00	16.10	38.30
					1000fpm	delam.@900	--	--	--	--	--	--
M	6934	Liner only	Full	3.00	200fpm	OK	1.44	174.00	4.30	15.70	6.10	38.30
					400fpm	OK	1.44	171.00	5.20	22.10	9.30	39.80
					600fpm	OK	1.44	169.00	5.30	34.60	19.00	28.50
					800fpm	OK	1.44	162.00	5.40	40.80	26.90	39.80
					1000fpm	delam	1.43	148.00	5.60	--	--	--

Std. Medium Characteristics
Proj. 2696-25

Appendix VI

			Medium Sample Roll No.									
			1	2	3	4	5	6	7	8	9	10
Basis Weight, lb/Mft²			26.67	27.50	25.96	27.50	26.48	26.32	25.02	26.71	26.71	25.43
Caliper, um	Soft Platen	Ave	196.40	190.00	187.10	195.70	190.10	188.50	184.90	191.30	196.30	184.70
		SD	4.48	5.48	6.84	4.97	6.33	4.93	7.95	9.59	10.53	6.53
	Hard Platen	Ave	286.10	291.45	292.28	291.01	287.69	284.21	292.03	295.84	296.58	283.73
		SD	21.07	20.36	23.10	15.05	17.70	11.94	26.52	32.83	26.91	28.94
Caliper, In.	Soft Platen	Ave	7.73	7.48	7.37	7.70	7.48	7.42	7.28	7.53	7.73	7.27
		SD	0.18	0.22	0.27	0.20	0.25	0.19	0.31	0.38	0.41	0.26
	Hard Platen	Ave	11.26	11.47	11.51	11.46	11.33	11.19	11.50	11.65	11.68	11.17
		SD	0.83	0.80	0.91	0.59	0.70	0.47	1.04	1.29	1.06	1.14
Density, lb/cu.ft.	Soft Platen		3.45	3.68	3.52	3.57	3.54	3.55	3.44	3.55	3.46	3.50
	Hard Platen		2.37	2.40	2.26	2.40	2.34	2.35	2.18	2.29	2.29	2.28
Smoothness, Bendtsen, Wire		Ave	2,573.00	2,575.00	2,575.00	2,688.00	2,690.00	2,585.00	2,628.00	2,633.00	2,533.00	2,550.00
		SD	158.31	133.33	116.67	183.81	132.92	122.59	125.53	120.79	143.40	73.60
Felt		Ave	2,703.00	2,653.00	2,625.00	2,700.00	2,713.00	2,750.00	2,610.00	2,685.00	2,715.00	2,633.00
		SD	132.52	159.19	120.76	160.73	113.80	117.26	134.47	175.28	119.72	129.66
Porosity, Gurley		Ave	18.28	15.12	17.16	18.30	14.06	17.02	12.92	16.02	14.22	19.30
		SD	3.39	3.78	3.69	2.79	2.77	2.03	0.75	2.43	4.99	3.07
ZDT, psi		Ave	55.58	56.97	58.69	56.36	57.40	56.48	56.24	56.47	55.66	56.88
		SD	5.26	4.92	3.01	3.71	3.22	4.18	3.34	3.69	3.07	3.37
Water Drop, T819		Ave	15.16	18.92	27.66	23.54	23.72	30.08	31.94	22.75	28.33	38.17
		SD	1.17	2.23	1.95	2.02	2.11	6.68	2.47	1.63	3.17	3.88
Water Drop, T819-A2, Felt		Ave	16.30	14.64	25.80	18.92	17.16	19.51	22.26	16.00	19.51	25.26
		SD	1.53	1.67	3.14	2.62	0.98	1.96	3.42	1.99	3.41	2.47
Water Drop, UM596, Felt		Ave	242.00	283.20	363.20	270.40	267.00	364.40	363.80	250.80	263.80	410.60
		SD	11.73	21.27	31.35	27.55	30.98	43.02	20.38	11.52	43.45	22.39
Wire		Ave	213.60	259.60	353.60	265.60	261.20	342.00	329.40	247.20	318.60	402.60
		SD	12.70	35.00	31.63	11.78	22.86	28.57	20.01	11.21	35.37	18.69