Institute of Paper Science and Technology

IMPULSE DRYING OF MULTI-PLY LINERBOARD CONTAINING RECYCLED FIBER: PILOT SCALE STUDIES

Project 3753-93

Report 2

to the

THE TECHNICAL DIVISION OF THE CONTAINERBOARD AND KRAFT PAPER GROUP OF THE AMERICAN FOREST AND PAPER ASSOCIATION

December 31, 1993

IPST

Atlanta, Georgia

INSTITUTE OF PAPER SCIENCE AND TECHNOLOGY
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INSTITUTE OF PAPER SCIENCE AND TECHNOLOGY

Atlanta, Georgia

IMPULSE DRYING OF MULTI-PLY LINERBOARD CONTAINING RECYCLED FIBER: PILOT SCALE STUDIES

Project 3753-93

Report 2

A Progress Report

to the

THE TECHNICAL DIVISION OF THE CONTAINERBOARD AND KRAFT PAPER GROUP
OF
THE AMERICAN FOREST AND PAPER ASSOCIATION

by

David I. Orloff and Paul M. Phelan

December 31, 1993

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SUMMARY

Experiments have been conducted on a sheet-fed pilot-scale shoe press to compare impulse drying and double-felted pressing. Both an IPST ceramic coated and a Beloit Type A press roll have been evaluated for linerboard sheet structures having a wide range of z-direction permeability. Both roll surfaces evaluated had thermal properties that are covered by IPST impulse drying patents.

The objective of the experiments was:

1) To find ways of correcting previously observed sheet sticking problems.

2) To compare the performance of the IPST-C ceramic and Beloit-A press roll surface coatings.

3) To obtain process data over a wide range of linerboard sheet structures.

4) To evaluated the resulting linerboard in terms of important physical properties.

The results of these experiments, in terms of the first three objectives has been reported to the U.S. Department of Energy (1) under contract FG02-85CE40738 and to IPST member companies (2). The results of the experiments, in terms of the fourth objective, are the subject of this report.

The experiments showed that impulse drying was superior to double felted pressing in both press dryness and important paper physical properties. In particular, the experiments showed the following:

Critical Impulse Drying Temperature: As in previous laboratory-scale experiments (4), critical impulse drying temperature was found to depend on the hydrodynamic specific surface of the heated layer of the sheet. As expected, critical impulse drying temperature was higher for the "low thermal mass" IPST -C ceramic press roll than for the "higher thermal mass" Beloit -A press roll. Interestingly, it was also observed that the choice of felt can influence critical temperature.

Press Dryness: The experiments showed that, for a given set of pressing conditions, press dryness tends to decrease when the hydrodynamic-specific surface of the entire sheet is increased. In addition, press dryness resulting from impulse drying was generally higher than that achieved by double-felted pressing. Differences in dryness ranged from 8 percentage points for sheets having low heated ply hydrodynamic specific surface to 3 percentage points for less permeable sheets. The Beloit -A roll surface yielded higher press dryness than the IPST modified ceramic roll even though it was generally operated at a lower temperature (this was unexpected and deserves further study). While increasing the press load from 6000 pli to 8500 pli increased press dryness, the improvement was observed to be relatively small.

STFI Compression Strength: The Geometric mean STFI compression strength of impulse dried sheets were consistently higher than that obtained by double-felted pressing. The difference in strength tended to be more significant for the more permeable sheet structures. For two-ply sheets, the STFI compression strength resulting from impulse drying was as much as 17 percent higher than that produced by double-felted pressing. No substantial strength difference was observed comparing sheets impulse dried with the Beloit -A roll to those dried using the IPST-C ceramic coated press roll.

Gurly Porosity: For all furnishes, the impulse dried sheets were less porous than double-felted pressed sheets, which in turn were less porous than the control sheets that were pressed to 52% solids.

Ink Penetration Test: The rate of change of the contact angle for black flexographic ink drops on the felt side of the samples were measured. Impulse dried and double-felted samples were generally independent of furnish and similar to commercial samples.

Sheet Surface Roughness: The roughness of the wire side of sheets was measured by Sheffield and Bendson roughness tests. It was concluded that while the method of pressing and the extent of refining control surface smoothness, the method of pressing is the dominant variable. In general, impulse dried samples were smoother than single-felted pressed samples, which were smother than double-felted pressed samples.

ZD Tensile: The zd tensile strength is a measure of ply-bond strength. Through these measurements it was concluded that impulse drying can be used to increase ply-bond strength.

Burst Index: Impulse drying tended to increase burst strength as compared to double-felted pressing.

Cracking Angle: Cracking angle was found to be dependent on the level of refining of the fibers on the wire side of the sheet and the method of pressing. Refining was found to be the dominant effect, in that excessive refining leads to a low cracking angle. Impulse dried samples tended to have slightly lower cracking angles than double or single-felted pressed sheets. Since impulse drying performs best when the heated ply (wire side) is not heavily refined, there should no problem in achieving acceptable cracking angle results in commercial practice.

OVERVIEW AND OBJECTIVES

Ongoing laboratory and pilot scale research at the Institute of Paper Science and Technology (IPST) has demonstrated that heavy weight grades of paper, such as linerboard, can be successfully impulse dried. That research has shown that deleterious sheet delamination can be avoided by a combination of processing strategies. These strategies include steps to make the pre-pressed sheets highly permeable to water flow and steps to reduce excessive pressure dependent heat transfer to the sheet that results in excessive internal flash evaporation at the exit of the impulse dryer.

Research at IPST suggests that high sheet Darcian permeability (low hydrodynamic specific surface) can be obtained by limiting refining to the minimum required for product aesthetics and by pre-pressing the sheet to as high a dryness as possible [2, 3]. In addition, IPST research suggest that excessive pressure dependent heat transfer can be eliminated by using press roll surfaces composed of materials having low thermal conductivity, low heat capacity , and low density [5-14].

Much of the previous IPST research was conducted with single-ply linerboard sheets composed of virgin southern pine that was minimally refined to eliminate shives. In contrast, commercial linerboard is usually two or three ply and composed of blends of virgin Kraft and recycled fiber. While current recycle content varies from mill to mill, there is increasing environmental pressure to increase recycle content. Mills in the U.S. typically use recycled fiber from old corrugated containers which are collected at warehouses and other high volume locations. In current practice, the amount of recycled fiber, included in linerboard, is limited by the fact that sheet

strength properties decrease when recycle content is increased without further refining. Recycled fiber has the additional disadvantage in that it has a poor physical appearance. To improve the appearance of liner made with recycled fiber, U.S. manufacturers typically form a multi-ply sheet where the recycled fiber is contained in a bottom or inner layer, and outer layers are made from virgin Kraft sufficiently refined to impart a good appearance to the product.

Laboratory-scale impulse drying simulation experiments have been conducted with; virgin southern pine, virgin Douglas fir, OCC and single and double-ply sheets made from combinations of these furnishes [4]. Both virgin furnishes have been successfully impulse dried in these laboratory experiments. OCC performed best, with regard to moisture removal and strength development, when blended with a virgin Kraft at concentrations of about 50% or less by weight. The performance of double-ply sheets was found to be controlled by the furnish characteristics of the heated-ply.

Previous laboratory and pilot scale work [13,14] has demonstrated that pressure profile, felt design, and press load have an influence on impulse drying efficiency. The present experiments were, in part, designed to confirm these effects over a wide range of linerboard furnishes on the Beloit pilot shoe-press.

Laboratory-scale experiments had identified a methodology for structuring sheets so that they could be successfully impulse dried. The present experiments were also designed to confirm the scale-up of that methodology to conditions more representative of commercial conditions. Single and double-ply sheet structures were chosen that made use of southern pine, Douglas fir and OCC pulps. Those structures were also chosen to span a wide range of hydrodynamic specific surfaces.

Additional objectives of the present experiments were to compare impulse drying to double-felted and single-felted hot pressing and to unpressed controls, and to compare and contrast the performance of the IPST modified ceramic and Beloit "A" press roll surfaces.

EXPERIMENTAL PLANS AND PROCEDURES

Experimental Plans:

The pilot experiments were conducted in March of 1993 at Beloit Corporation's Rockton, Illinois research laboratory. The X2 pilot shoe press on machine number 2, as shown in Figure 1, was used.

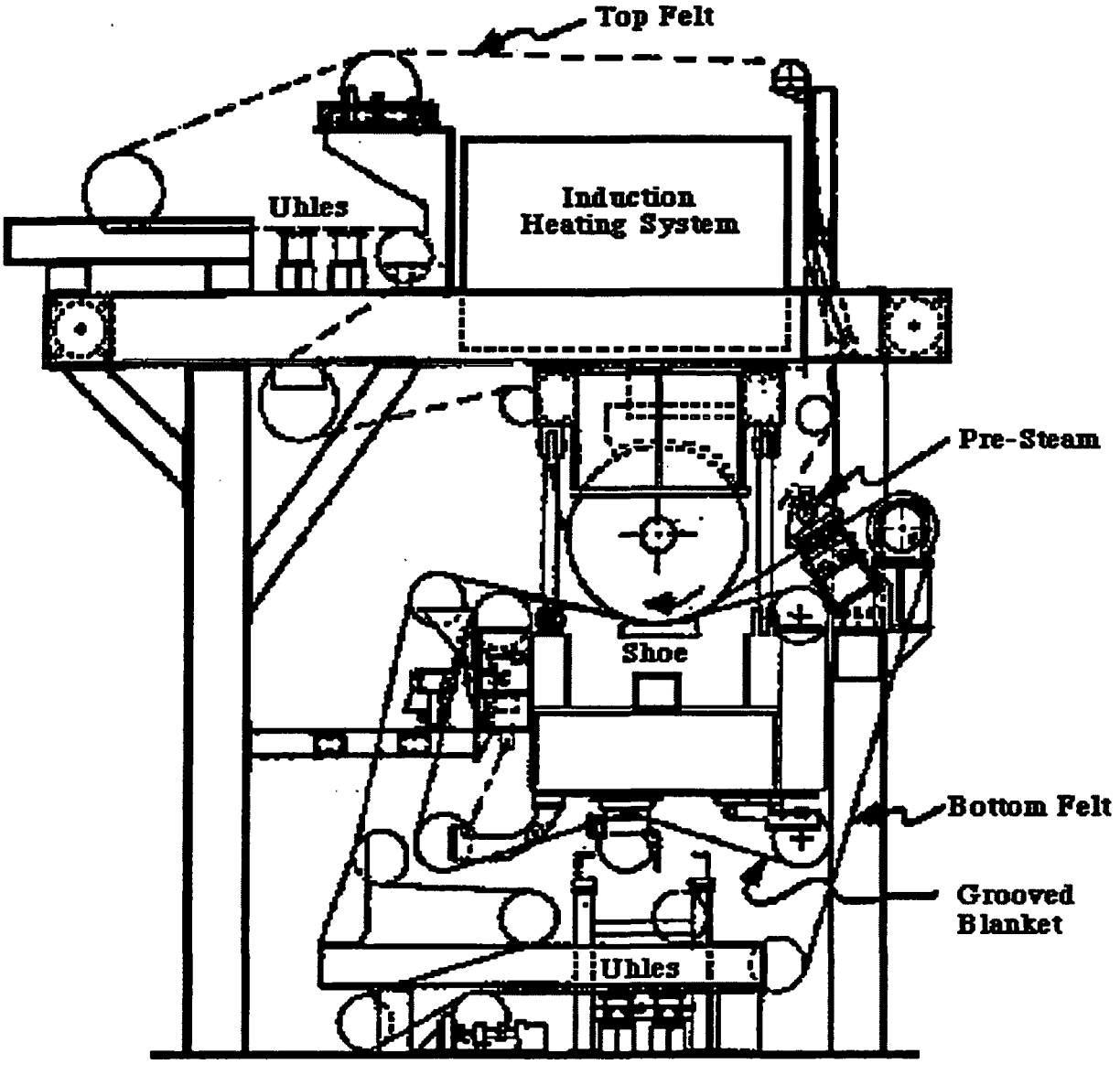


Figure 1. Pilot shoe press configured for impulse drying, double-felted or single-felted pressing

In order to meet the stated objectives the experimental conditions as shown in Table 2 were established. These conditions represent the minimum set of cases that were to be run for each of six furnishes spanning a wide range of hydrodynamic specific surface.

Table 1. Planned Experimental Conditions

Machine	X2 Shoe Press																							
Configuration	Double Felted								Impulse Drying															
Felt Type	B				S				B								S							
Pivot Position	0		+2		0		+2		0				+2				0				+2			
Roll Cover	Not Applicable								A		C		A		C		A		C		A		C	
Load	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L
No. Of Temps.	Not Applicable								6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
No. Of Repeats	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

Notes:
Speed: 1200 fpm
Load: L = 6000 pli, H = 8500 pli.
Roll surface temperatures typically : 100°C, 150°C, 200°C, 250°C, 300°C, 350°C.
All sheets to have ingoing solids of 52%.
Deionized water to be used for the felt wash system.
All sheets to be steamed prior to impulse drying or double felted pressing using the same apparatus on the press.

The pulp used in these experiments was taken from the same batch used in conducting the laboratory-scale experiments (4). That earlier work demonstrated that the hydrodynamic specific surface of the heated layer of the sheet controls the maximum temperature of impulse drying. For this reason, sheets having a wide range of hydrodynamic-specific surfaces were produced for the pilot-scale work. Table 2 shows the composition of the seven furnishes that were to be investigated. Cases with the prefix WF were produced on the Institute's low speed web former while furnish cases having a FD prefix were produced on the Institute's Formette Dynamique at conditions similar to those used in the earlier work (4).

Table 2. Planned Furnish Compositions

	Composition Of Top Ply			Composition Of Bottom Ply		
Furnish Case	Pulp Type	Freeness ml	Weight %	Pulp Type	Freeness ml	Weight %
WF1	HKSP	740	100			0
WF2	HKSP	600	100			0
WF3	HKDF	720	100			0
WF4	OCC	600	100			0
WF5	OCC	450	100			0
FD6	HKSP	740	20	HKSP OCC	740 600	40 40
FD7	HKDF	720	20	HKDF OCC	720 600	40 40

Experimental Procedures:

Each furnish was refined to the appropriate freeness level and formed into 205 g/m^2 sheets. The general procedure was to form the sheets on the IPST slow speed web former (cases: WF1,WF2, WF3, WF4, and WF5) or on the Formette Dynamique (cases: FD6 and FD7) and press the sheets on our Baldwin large platen press with blotters on both sides of the sheet. All the sheets were pressed to a target outgoing dryness of 52%. The pressing conditions used for each furnish are listed in Table 3. For example, the WF1 sheets were pressed in three batches. In the first batch, the sheets had an ingoing dryness of between 32 and 37%. These sheets were placed in the Baldwin press with one blotter on top and one blotter on bottom and pressed at a pressure of 50 psi for 120 seconds. The blotters were then changed, the sheets inverted, and pressed a second time at a pressure of 50 psi for 150 seconds.

Table 3. Pressing Conditions

	Pressing Parameters						
		First Pressing			Second Pressing		
Furnish Case	Ingoing Dryness (%Solids)	Pressure (psi)	Time (seconds)	Number Of Blotters	Pressure (psi)	Time (seconds)	Number Of Blotters
WF1	32	35	120	1T;1B	35	150	1T;1B
	32	35	95	1T;1B	35	95	1T;1B
	42	35	230	1T;1B	-	-	-
WF2	35	35	160	1T;1B	35	160	1T;1B
	35	35	360	2T;2B	-	-	-
WF3	28	35	180	2T:2B	35	180	1T:1B
	32	35	180	2T:2B	30	120	1T:1B
WF4	38	35	60	1T:1B	n/a	n/a	n/a
	40	35	120	1T:1B			
WF5							
FD5	13	50	360	2T;2B	50	600	2T;2B
FD6	13	50	360	2T;2B	50	420	2T;2B
FD7	12	50	360	2T;2B	50	450	2T;2B

The results of permeability measurements indicated that the OCC sheets, produced on the web former, did not have the specific surface that was required (see Results section). Therefore, duplicate sheets for the OCC 450 ml CSF case were made on the Formette Dynamique (Case FD5). Table 4 lists the compositions of the sheets actually used in the present experiment.

Table 4. Actual Furnish Compositions

	Composition Of Top Ply			Composition Of Bottom Ply		
Furnish Case	Pulp Type	Freeness ml	Weight %	Pulp Type	Freeness ml	Weight %
WF1	HKSP	740	100			0
WF2	HKSP	600	100			0
WF3	HKDF	720	100			0
FD5	OCC	450	100			0
FD6	HKSP	740	20	HKSP	740	40
				OCC	600	40
FD7	HKDF	720	20	HKDF	720	40
				OCC	600	40

After pressing, sheets were cut to 8.5"x11" and the solids were adjusted to 52% by air drying or water misting as necessary. The sheets were then randomized to reduce any systematic errors resulting from the preparation procedures, and doubled bagged for shipment to Beloit.

In actual practice, events during the experiments precluded some conditions while opening up opportunities to examine additional variables. Table 5 lists the experimental conditions that were actually used and coded case numbers used in the remainder of this report.

Table 5. Actual Experimental Conditions

	Conditions						
Case	Pressing Type	Roll Cover	Felt	Pivot	Speed (ft/min)	Load (pli)	Wash Water
Con	Control	n/a	n/a	n/a	n/a	n/a	n/a
D1	D.F.	n/a	B	0	1200	6000	Deionized
D2	D.F.	n/a	B	0	1200	8500	Deionized
D3	D.F.	n/a	B	+2	1200	6000	Deionized
D4	D.F.	n/a	S	0	1200	6000	Deionized
D5	D.F.	n/a	S	0	1200	8500	Deionized
D6	D.F.	n/a	S	+2	1200	6000	Deionized
C1S	S.F.	IPST-C	B	0	1200	6000	Deionized
C2S	S.F.	IPST-C	B	0	1200	8500	Deionized
C3S	S.F.	IPST-C	B	+2	1200	6000	Deionized
A1S	S.F.	Beloit-A	B	0	1200	6000	Deionized
A4S	S.F.	Beloit-A	S	0	1200	6000	Deionized
A5S	S.F.	Beloit-A	S	0	1200	8500	Deionized
C1	I.D.	IPST-C	B	0	1200	6000	Deionized
C2	I.D.	IPST-C	B	0	1200	8500	Deionized
C3	I.D.	IPST-C	B	+2	1200	6000	Deionized
A1	I.D.	Beloit-A	B	0	1200	6000	Deionized
A2	I.D.	Beloit-A	B	0	1200	8500	Deionized
A4	I.D.	Beloit-A	S	0	1200	6000	Deionized
A5	I.D.	Beloit-A	S	0	1200	8500	Deionized
A6	I.D.	Beloit-A	S	+2	1200	6000	Deionized
A4F	I.D.	Beloit-A	S	0	1500	6000	Deionized
A5F	I.D.	Beloit-A	S	0	1500	8500	Deionized
A4H	I.D.	Beloit-A	S	0	1200	6000	Normal
A5H	I.D.	Beloit-A	S	0	1200	8500	Normal

RESULTS

Fiber Identification and Length Analysis:

For each furnish, samples from the prepared sheets were sent to John D. Hankey & Associates for fiber analysis. The results of the fiber identification are in Table 6. Table 7 summarizes the average fiber dimensions.

Table 6. Fiber Identification For Various Pulp Samples

Furnish	Pulp Type	USWK %	UHWK%	Softwood Species	Hardwood Species
WF1	S.Pine High Kappa	97-98	2-3	Southern yellow pine (Hard Cook) Trace of Semibleached Kraft	Mixed, incl. Gum, Yellow Poplar, and Oak
WF2	S.Pine High Kappa	97-98	2-3	Southern yellow pine (Hard Cook) Trace of Semibleached Kraft	Mixed, incl. Gum, Yellow Poplar, and Oak
WF3	D.Fir High Kappa	100(-)	Trace	Douglas Fir, Ponderosa and/or Lodgepole pine, Balsam Fir, Hemlock, Trace of Cedar and White Pine (Hard Cook)	Alder
FD5	OCC	n/a	n/a	Mixed Unbleached Kraft, and Semibleached Kraft	Mixed Kraft, Unbleached Semichemical Kraft, NSSC Pulps, and Mechanical Pulps
FD6	HKSP & OCC	90-95	5-10 & semi-chemical	Mixed Species incl. Hard Pine (Southern Yellow Pine, Ponderosa Pine, and/or Lodgepole Pine, etc.), Douglas Fir, Balsam Fir, Hemlock	Mixed, incl. Gum, Oak, Yellow Poplar, and Maple
FD7	HKDF & OCC	90-95	5-10 & semi-chemical	Mixed Species incl. Hard Pine (Southern Yellow Pine, Ponderosa Pine, and/or Lodgepole Pine, etc.), Douglas Fir, Balsam Fir, Hemlock	Mixed, incl. Gum, Oak, Yellow Poplar, and Maple

Table 7. Fiber Dimensions

Furnish Case	Pulp Type	Kappa No.	Top Ply Freeness (ml CSF)	Length (mm)			Width (µm)	Perimeter (µm)	Cell Wall Thickness (µm)	Coarseness (mg/100 m)
				Arith	LW	WW				
WF1	S.Pine	109.2	740	2.52	3.21	3.73	36.6	87.2	3.5	36.0
WF2	S.Pine	109.2	600	1.78	2.47	3.07	34.8	83.7	3.5	34.2
WF3	D.Fir	89.6	720	1.95	2.71	3.31	33.1	74.6	2.1	24.2
WF4	OCC	114.6	600	1.42	2.19	2.98	30.7	72.6	2.8	27.2
WF5	OCC	114.6	450	1.05	1.64	2.45	28.0	67.6	2.9	28.2
FD5	OCC	114.6	450	1.00	1.44	2.07	27.9	68.3	3.1	29.2
FD6	S.Pine &OCC	n/a	740	1.80	2.68	3.43	33.7	79.8	3.1	29.4
FD7	D.Fir &OCC	n/a	720	1.66	2.52	3.20	34.5	78.6	2.4	26.8

For case FD5 the dimensions given are an arithmetic average of four batches that were tested. Also note that there are three cases for OCC. The WF4 and WF5 cases were web former cases and were not used for the pilot trial because of a low hydrodynamic specific surface. Fiber dimension data is included here for a comparison of the different formation techniques. Figure 2 shows the difference between the two fiber length distributions.

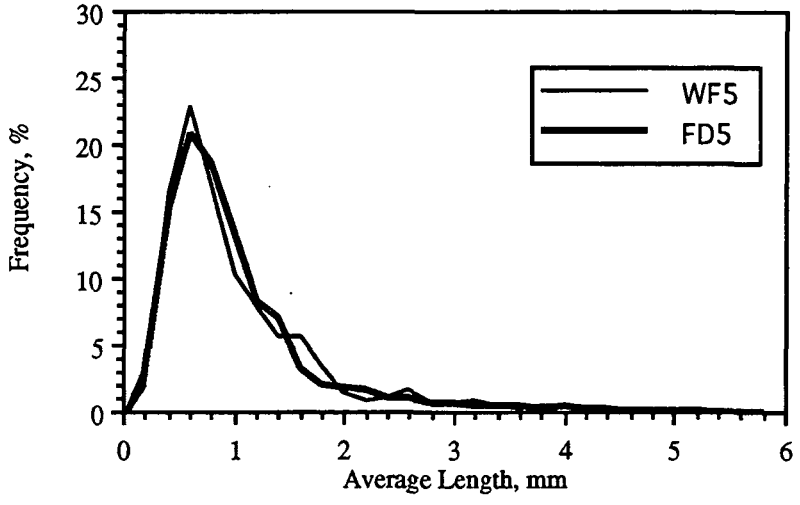


Figure 2. Comparison between fiber length distributions for webformer and formette sheets

Specific Surface:

The measured hydrodynamic specific surfaces for each furnish are in Table 8.

Table 8. Hydrodynamic Specific Surface

Furnish Case	Specific Surface (m^2/g)	Standard Deviation	Specific Volume (cm^3/g)	Standard Deviation
WF1	1.3	0.5	1.0	0.2
WF2	3.1	0.7	1.1	0.1
WF3	2.3	0.8	1.1	0.1
WF4	1.3	0.2	1.1	0.0
WF5	1.8	0.2	1.2	0.0
FD5	10.5	0.6	1.0	0.0
FD6	1.4	0.2	1.2	0.1
FD7	2.0	0.3	1.1	0.0

Plots of permeability verses porosity for each furnish are shown in Appendix C.

Controls

Because of the limited time available on the Beloit pilot equipment, the authors wanted to perform as much preliminary work at IPST as possible.

The hydrodynamic specific surface is highly dependent on the pressing history of the sample. When the procedures for preparing the sheets for this experiment were developed, it was decided that all furnish cases should be pressed in the same manner. Formette sheets are very bulky and weak before pressing and can only be pressed on the Baldwin large platen press. Therefore, even the Webformer sheets were pressed on the Baldwin press.

Using a low pressure, long time history results in sheets with the correct solids content, but the sheet density may be lower than expected. This is most apparent in a minimally refined sheet particularly case WF1.

Critical Temperatures:

During transport and storage before the experiment,moisture migrated within the sheets to some extent. Therefore, during the experiment, the sheets were selected from the bags to achieve a balanced moisture distribution. Table 9 lists the actual properties of all the sheets used during the experiments and the ranges of acceptable values for data analysis. Appendix A tabulates all of the acceptable data while the rejected data is tabulated in Appendix B.

Table 9. Ingoing Sheet Properties And Accepted Limits

	Target	Average	Std Dev	Accepted SD	Accepted Range
Basis Weight, g/m^2	205	204.53	9.81	~2 s	185-225
Ingoing Solids, %	52	51.51	2.35	~1.5 s	48-55

Critical temperatures for each impulse drying case were determined from the SEM, %CV of SEM, and the visual delamination observation data as discussed in References 1 and 2. Table 10 lists the determined critical temperatures and the uncertainties for each case.

Table 10. Critical Temperatures (In Degrees Celsius)
for Impulse Drying on the X2 Shoe Press with Upper and Lower Uncertainties

Case	Description	WF1	WF2	WF3	FD5	FD6	FD7
C1	IPST-C/ Felt B/ 0 Pivot/ 6000 pli	245 +50 -0	195 +50 -0	195 +50 -0	155 +35 -0	240 +50 -0	240 +50 -0
C2	IPST-C/ Felt B/ 0 Pivot/ 8500 pli	245 +50 -50	245 +50 -0	195 +50 -0	150 +45 -50	245 +50 -0	150 +45 -0
C3	IPST-C/ Felt B/ +2 Pivot/ 6000 pli	150 +50 -50	150 +50 -0	150 +50 -0	145 +55 -45	245 +50 -0	245 +50 -45
A1	Beloit-A/ Felt B/ 0 Pivot/ 6000 pli	200 +55 -0	175 +25 -0	175 +25 -35	145 +55 -0	200 +55 -0	145 +55 -0
A2	Beloit-A/ Felt B/ 0 Pivot/ 8500 pli	200 +55 -0	175 +25 -0	175 +25 -35	120 +25 -0	200 +55 -0	145 +55 -0
A4	Beloit-A/ Felt S/ 0 Pivot/ 6000 pli	155 +55 -0	155 +55 -0	155 +55 -0	130 +25 -0	130 +25 -0	155 +55 -0
A5	Beloit-A/ Felt S/ 0 Pivot/ 8500 pli	155 +55 -0	155 +55 -0	155 +55 -0	100 +30 -0	155 +55 -0	130 +25 -0
A6	Beloit-A/ Felt S/ +2 Pivot/ 6000 pli	150 +25 -0	150 +25 -0	150 +25 -0	120 +30 -0	150 +25 -0	150 +25 -0
A4F	Beloit-A/ Felt S/ 0 Pivot/ 6000 pli/ 30 ms	<150	<150	<150	<150	<150	<150
A5F	Beloit-A/ Felt S/ 0 Pivot/ 8500 pli/ 30 ms	175 +25 -0	150 +25 -0	150 +25 -0	100 +50 -0	175 +25 -25	150 +25 -50
A4H	Beloit-A/ Felt S/ 0 Pivot/ 6000 pli/ hard water	175 +∞ -0	175 +∞ -0	150 +25 -0	100 +50 -0	175 +25 -0	150 +25 -0
A5H	Beloit-A/ Felt S/ 0 Pivot/ 8500 pli/ hard water	150 +25 -0	150 +25 -0	150 +25 -0	100 +50 -0	175 +25 -25	150 +25 -0

For case A4F, sheet sticking precluded testing any temperature other than 150° C. All of those sheets were delaminated and no further testing was performed.

Water Removal and Physical Properties:

For the control, single felted pressing, and double felted pressing cases, the water removal and physical property data was averaged and a 95% confidence interval was calculated using the standard equation below. The results are shown in Appendix B.

$$C.I. = \pm t_{\alpha/2,n-1} \frac{s}{\sqrt{n}}$$

where,
confidence = $(1-\alpha)100\%$
n = number of data points
s = standard deviation of the data
t = student t-distribution.

Previous experiments have shown that, for impulse drying, water removal and physical property development can be approximated by a linear function of temperature below the critical temperature. To determine a value for each property at the critical temperature for the impulse dried cases, a linear regression was performed on the best data. The data was filtered to remove data that showed a drop in properties above the critical temperature. Also, any data below 100°C that shows evidence that the sheets may have stuck to the roll were eliminated. All data between 100°C and the critical temperature were retained. Figure 3 shows a typical case before and after the questionable data were removed.

After removing the questionable data, a linear regression was performed and the 95% confidence limits on the true mean were calculated. The following equation was used to calculate the confidence limits on the regression mean.

$$C.L. = \pm t_{\alpha/2,n-2}\ s \sqrt{\frac{1}{n} + \frac{(x - \bar{x})^2}{S_{xx}}}$$

where,

confidence = $(1-\alpha)100\%$
n = number of data points
t = student t-distribution
s = standard distribution of data
$\bar{x}$ = temperature mean

$$S_{xx} = \sum_{i=1}^{n} x_i^2 - \frac{\left(\sum_{i=1}^{n} x_i\right)^2}{n}$$

For the impulse dried cases, physical properties at the critical temperature were determined from the regression. These values are in Appendix B. The upper and lower uncertainties were determined from the region bounded by the confidence limits on the regression mean and the upper and lower limits of the critical temperature.

Figure 3 shows a typical case before the questionable data were removed and the remaining data with the regression line and calculated confidence limits. The shaded region indicates the region bound by the confidence limits for the critical temperature and the regression mean.

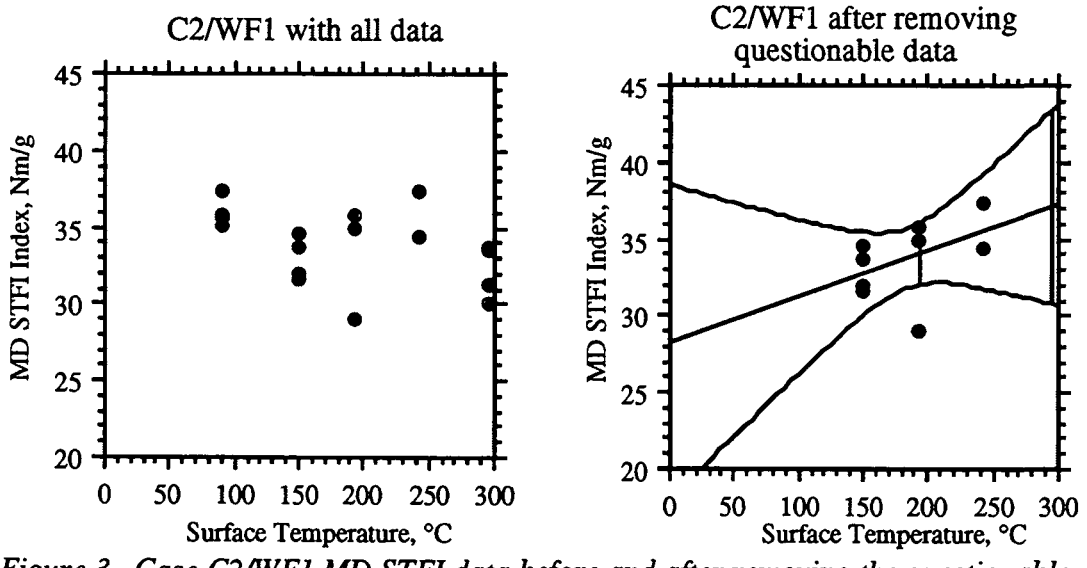


Figure 3. Case C2/WF1 MD STFI data before and after removing the questionable data and calculating the linear regression and confidence limits on the mean value. The critical temperature was 245°C ± 50°.

Figures 4 through 9 show outgoing solids as a function of furnish for each of the process variables. Note that the furnishes are arranged in order of increasing hydrodynamic specific surface. In these, and subsequent figures, the legend symbols are used to identify the method of pressing used and the specific process case. For example, (D1) indicates that the data

corresponds to double-felted pressing at Case 1 process conditions. Similarly, (C2) and (A2) correspond to impulse drying at Case 2 process conditions using the IPST-C and Beloit-A press roll surfaces respectively.

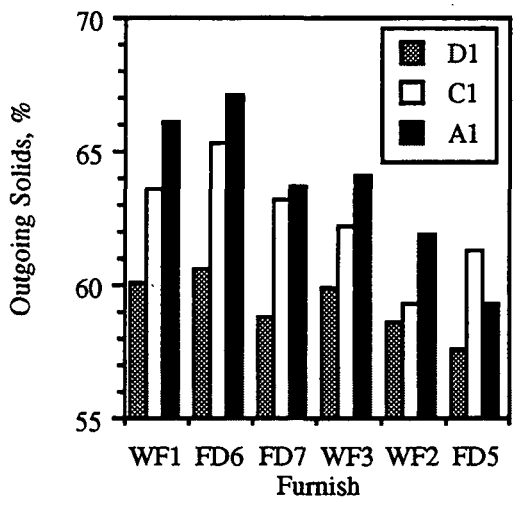


Figure 4. Outgoing Soliods For Case 1.

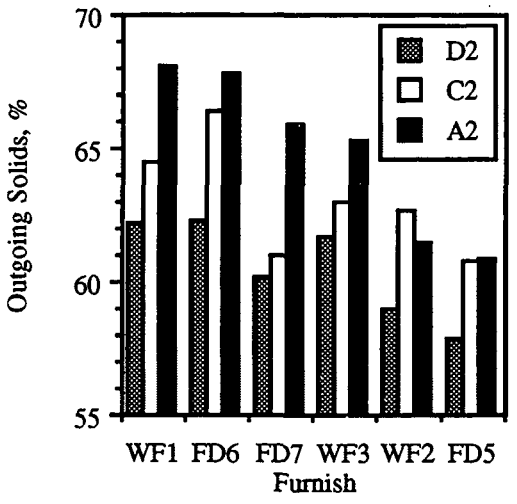


Figure 5. Outgoing Soliods For Case 2.

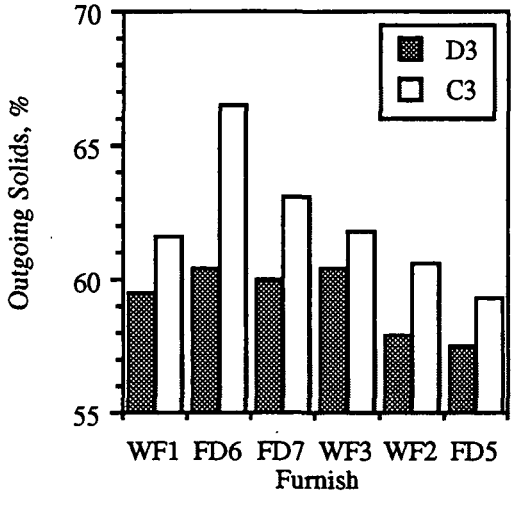


Figure 6. Outgoing Soliods For Case 3.

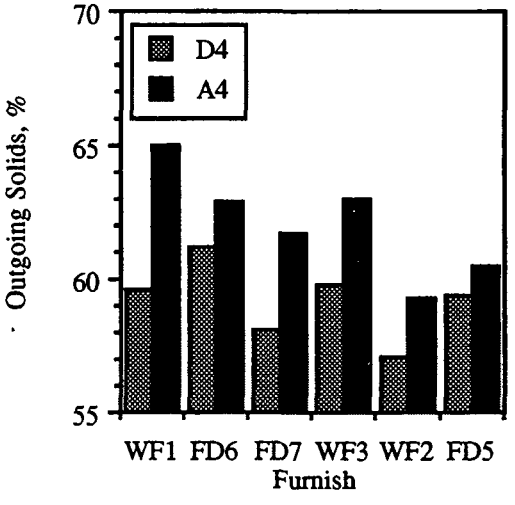


Figure 7. Outgoing Soliods For Case 4.

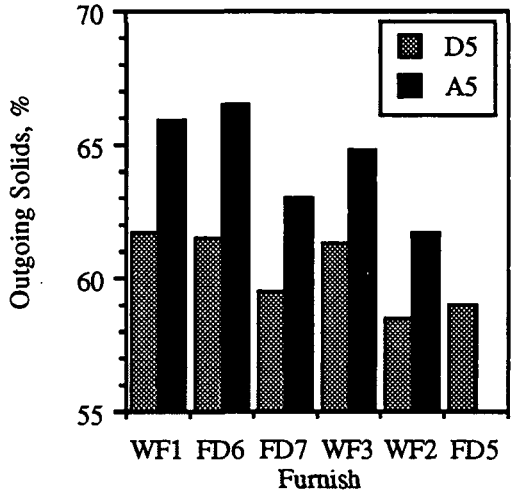


Figure 8. Outgoing Soliods For Case 5.

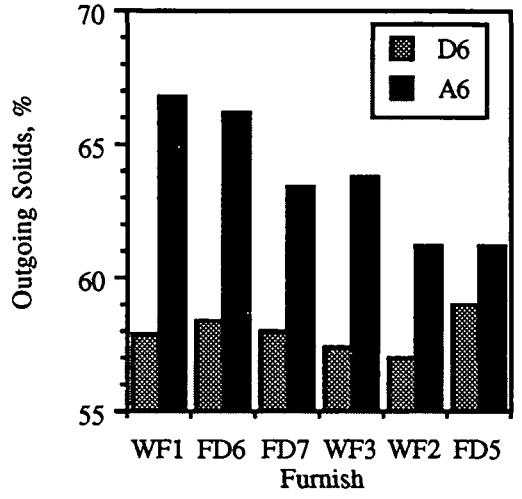


Figure 9. Outgoing Soliods For Case 6.

It may be observed from Figures 4 through 9, that impulse drying is always superior to double-felted pressing in terms of achievable outgoing solids. In addition, there is evidence that the Beloit-A roll surface resulted in higher outgoing solids than the IPST-C surface.

In a similar way, Figure 10 shows the effect of increasing the machine speed of the impulse dryer from 1200 fpm to 1500 fpm (or reducing nip residence time from 40 ms to 30 ms). For the conditions investigated, such a speed increase resulted in an outgoing solids reuction of about 1%. Figure 10 also shows the effect of using hard felt wash-water in place of de-ionized felt wash-water. It was observed that use of hard felt wash-water tended to increase outgoing solids. It may be speculated that this may have been caused by longer post nip contact between the press roll and the sheet when calcium carbonate has had a chance to build up on the roll surface.

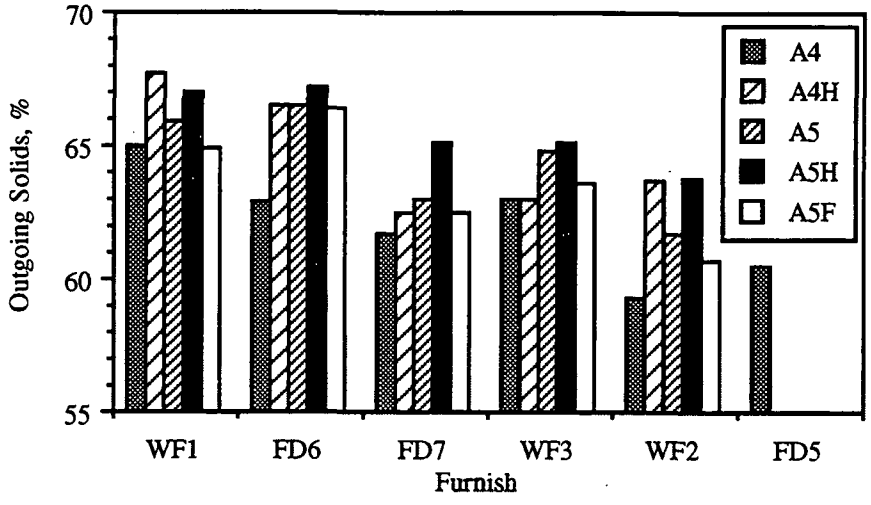


Figure 10. The Effect of Machine Speed and Felt Wash-Water Hardness On Outgoing Solids Case 4 and Case 5 Using the Beloit-A Press Roll.

Figures 11 through 16 show the geometric mean STFI indexes for Case 1 through Case 6, comparing double felted pressing (D) to impulse drying with the IPST-C press roll (C), and to impulse drying with the Beloit-A press roll (A).

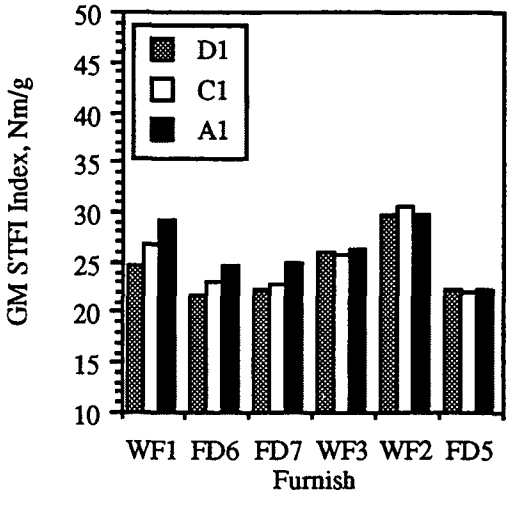


Figure 11. GM STFI Index For Case 1.

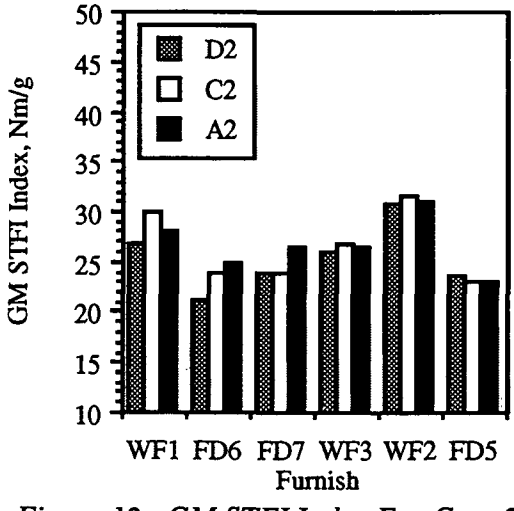


Figure 12. GM STFI Index For Case 2.

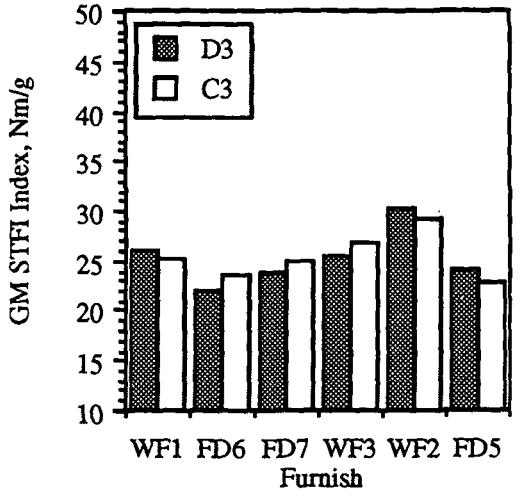


Figure 13. GM STFI Index For Case 3.

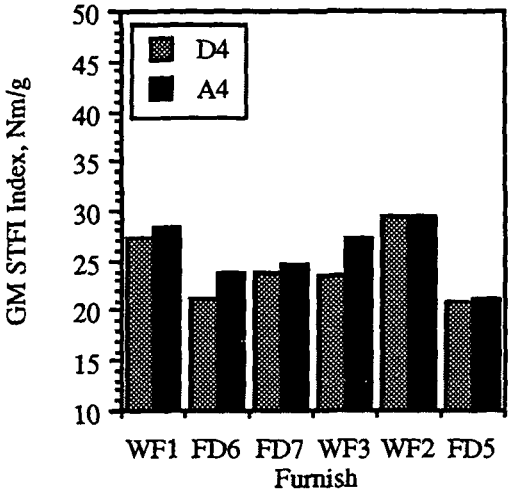


Figure 14. GM STFI Index For Case 4.

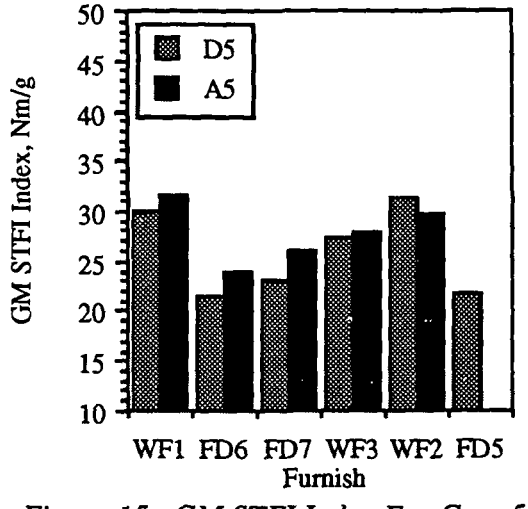


Figure 15. GM STFI Index For Case 5.

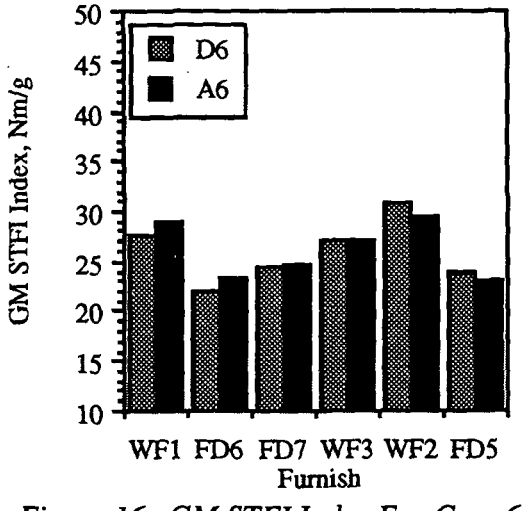


Figure 16. GM STFI Index For Case 6.

Figures 11 through 16 show that the STFI compression strength of impulse dried sheets tends to be at least as high as that achieved by double-felted pressing, while differences due to press roll surface were negligble. Statistical analysis of the data, previously reported in Reference 1 and 2, confirms these findings.

In addition to STFI compression strength, other important physical properties were measured on double-felted and single-felted pressed samples and on samples impulse dried at the critical temperature. These properties were: Sheffield and Bendtsen roughness, Gurley porosity, Cracking angle, Ink penetration, z-direction tensile, and Burst. These data are tabulated in Appendix B and summarized for Case 1 through Case 6 in Figures 17 through Figure 74.

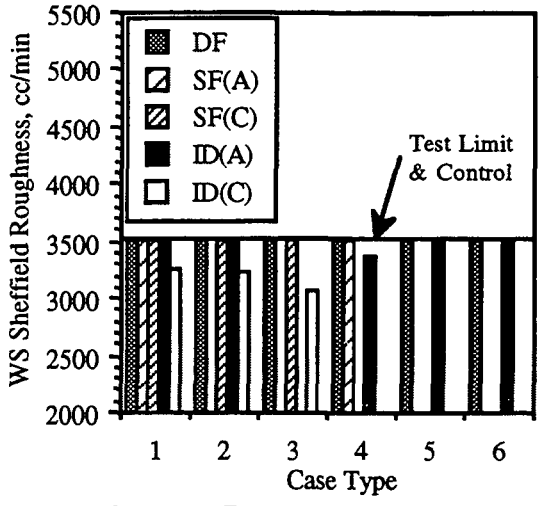


Figure 17. Furnish WF1.

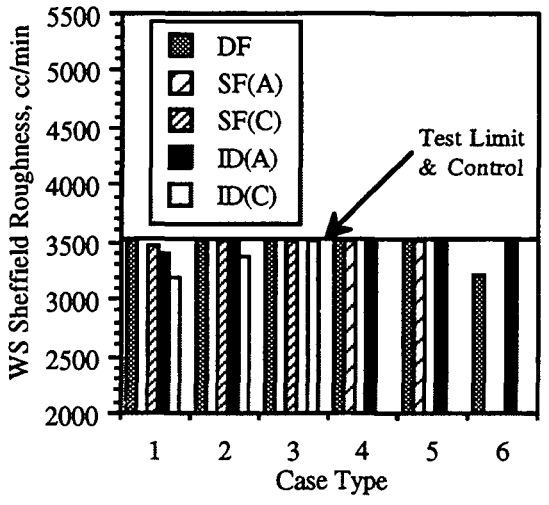


Figure 18. Furnish WF2.

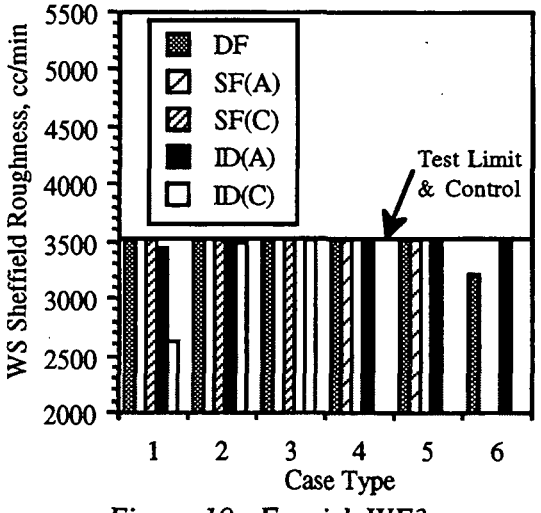


Figure 19. Furnish WF3.

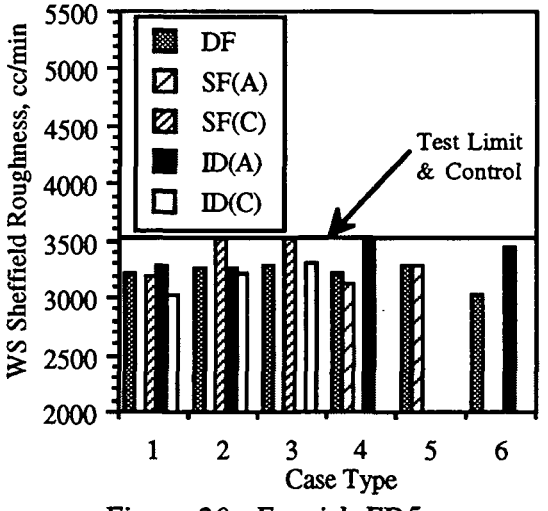


Figure 20. Furnish FD5.

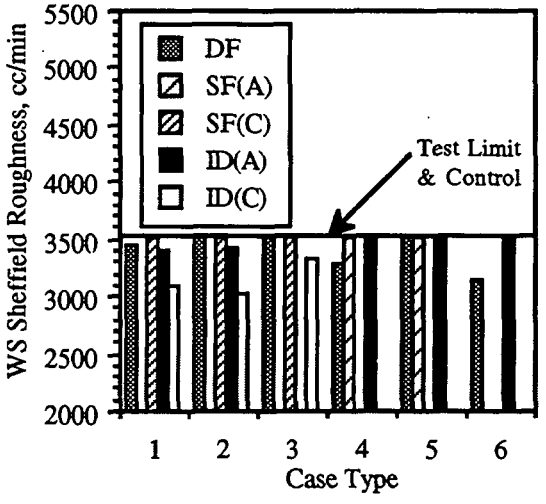


Figure 21. Furnish FD6.

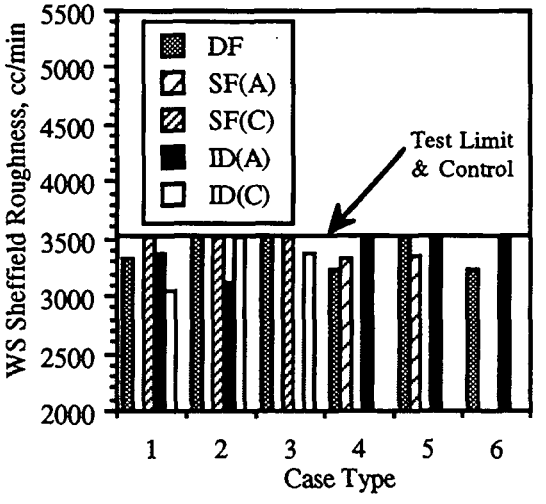


Figure 22. Furnish FD7.

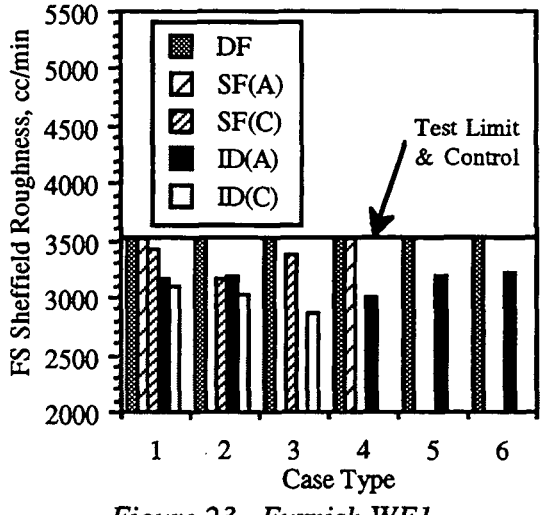


Figure 23. Furnish WF1.

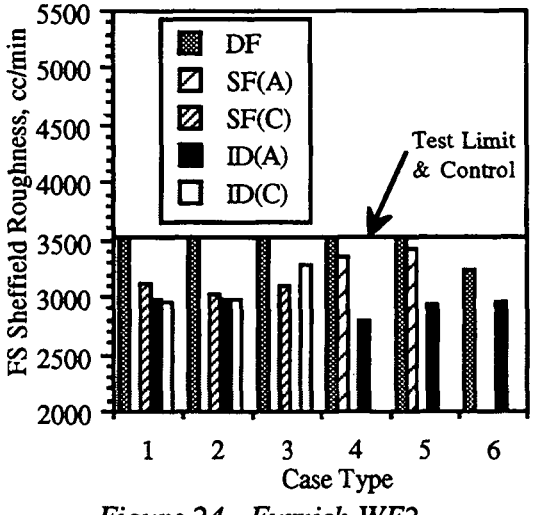


Figure 24. Furnish WF2.

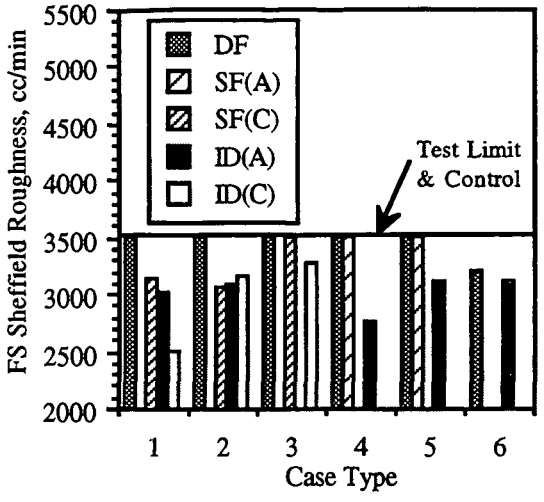


Figure 25. Furnish WF3.

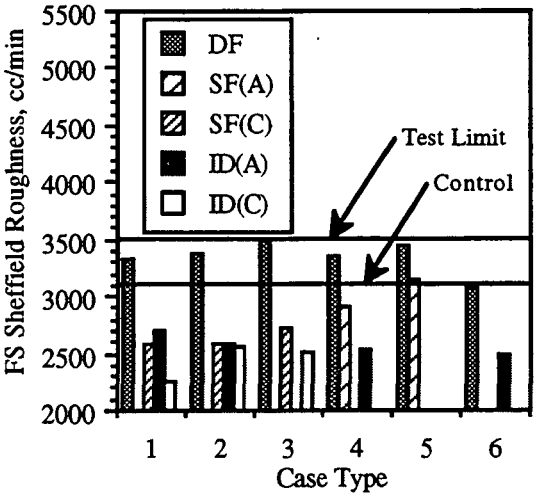


Figure 26. Furnish FD5.

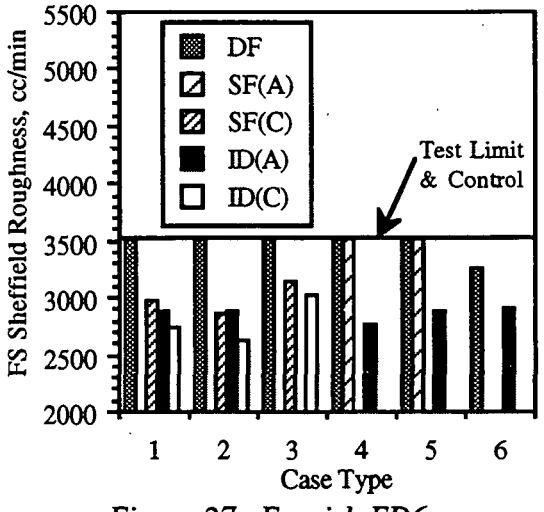


Figure 27. Furnish FD6.

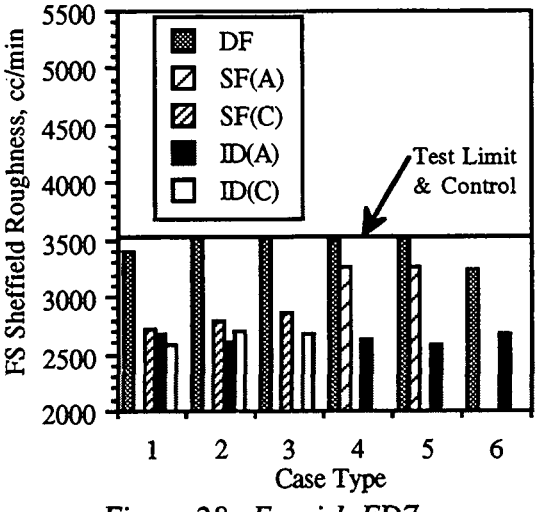


Figure 28. Furnish FD7.

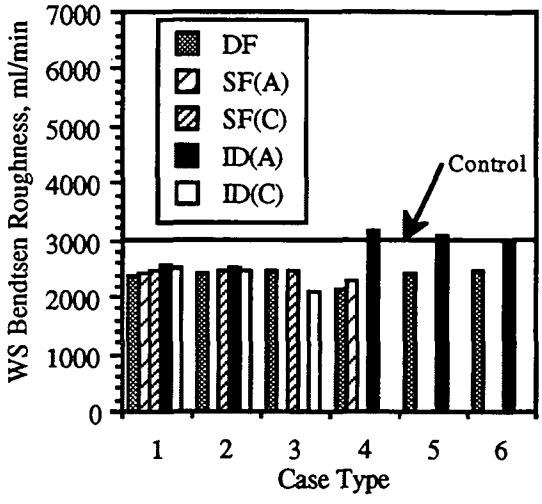


Figure 29. Furnish WF1.

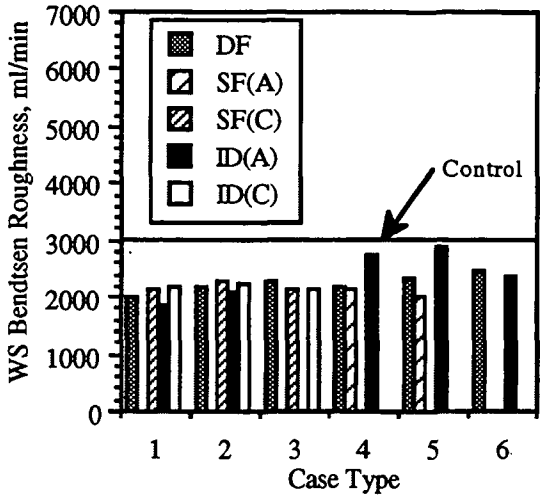


Figure 30. Furnish WF2.

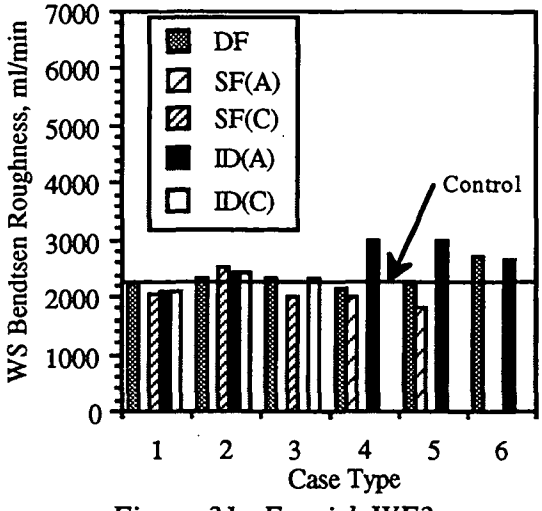


Figure 31. Furnish WF3.

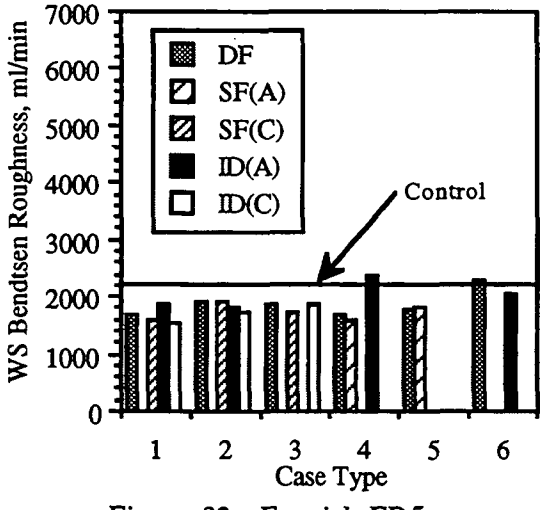


Figure 32. Furnish FD5.

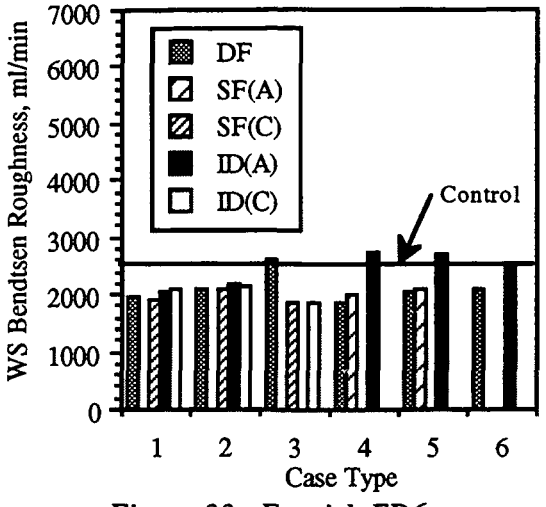


Figure 33. Furnish FD6.

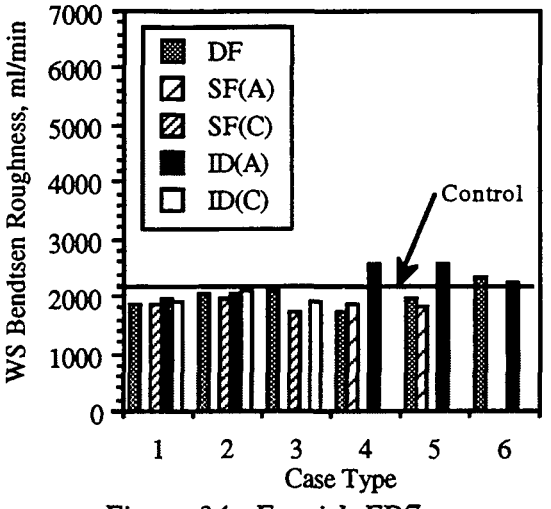


Figure 34. Furnish FD7.

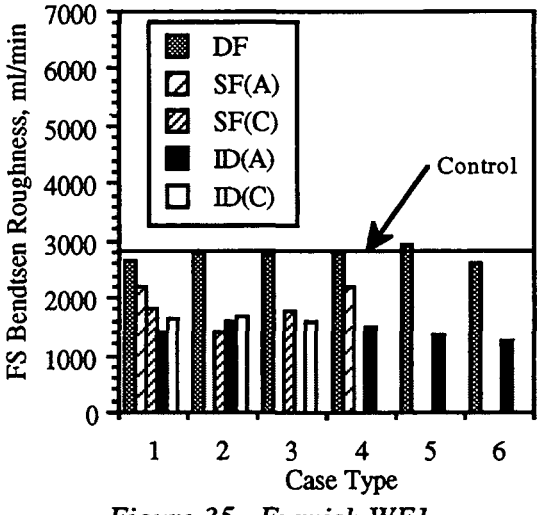


Figure 35. Furnish WF1.

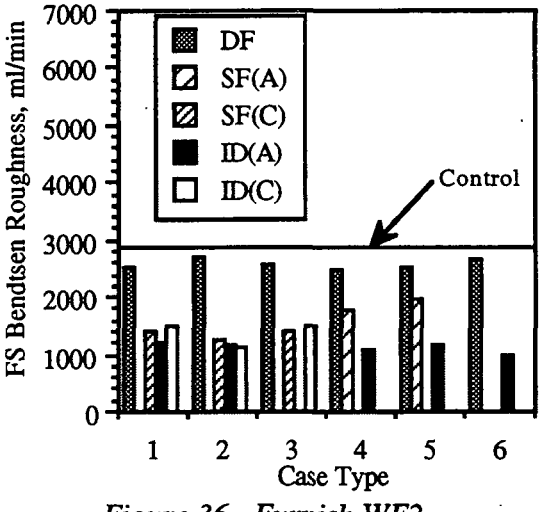


Figure 36. Furnish WF2.

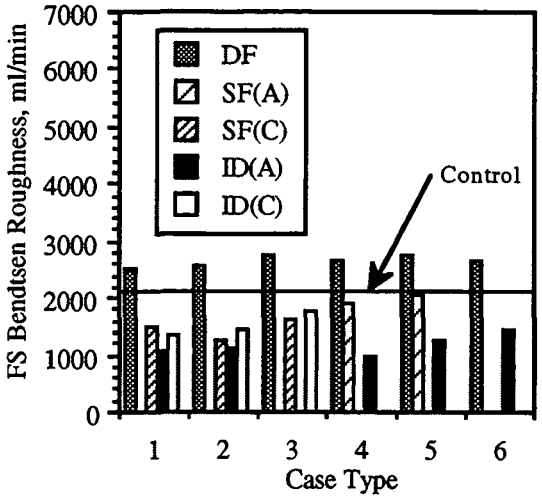


Figure 37. Furnish WF3.

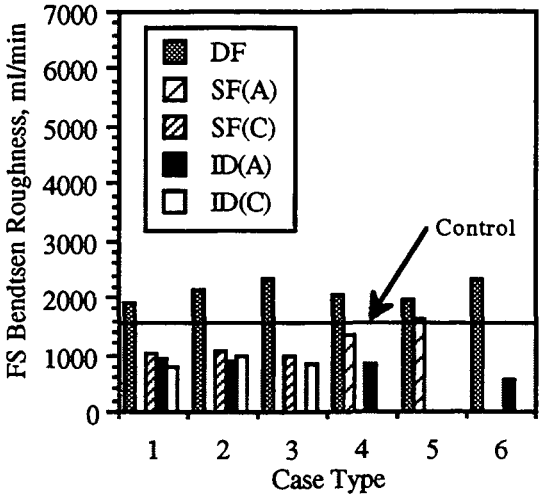


Figure 38. Furnish FD5.

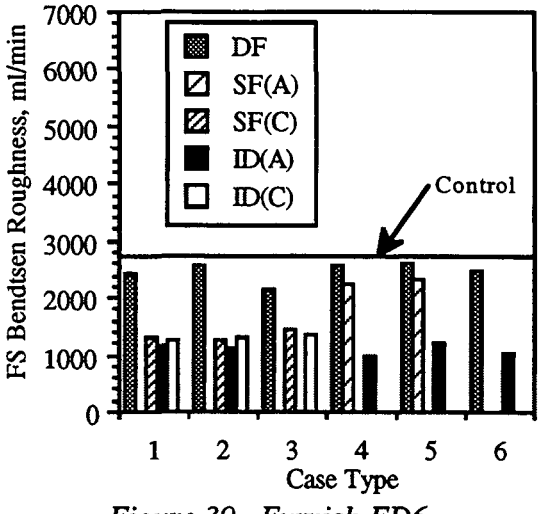


Figure 39. Furnish FD6.

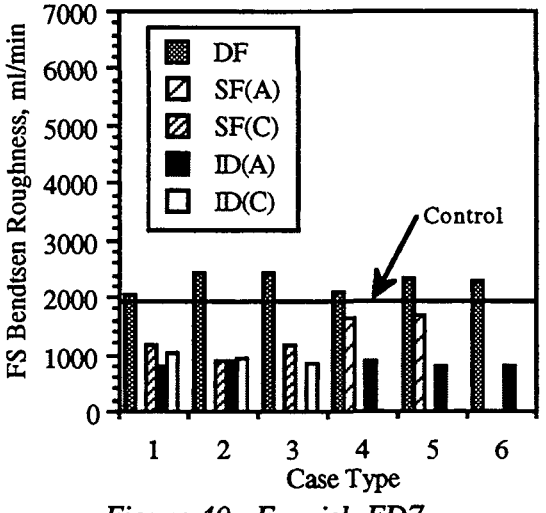


Figure 40. Furnish FD7.

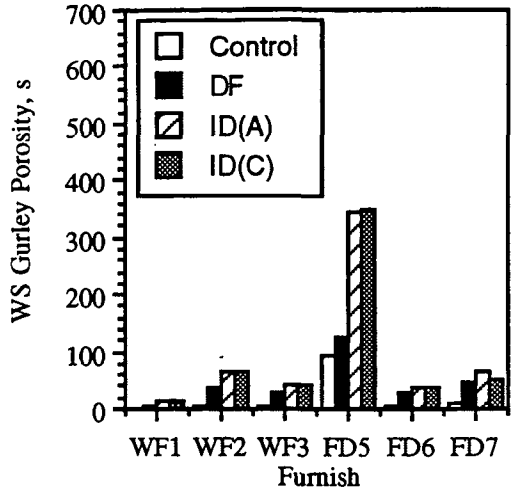


Figure 41. Case 1, full scale.

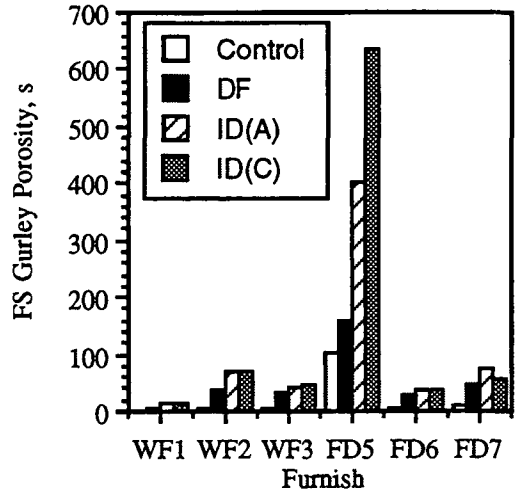


Figure 42. Case 1, full scale.

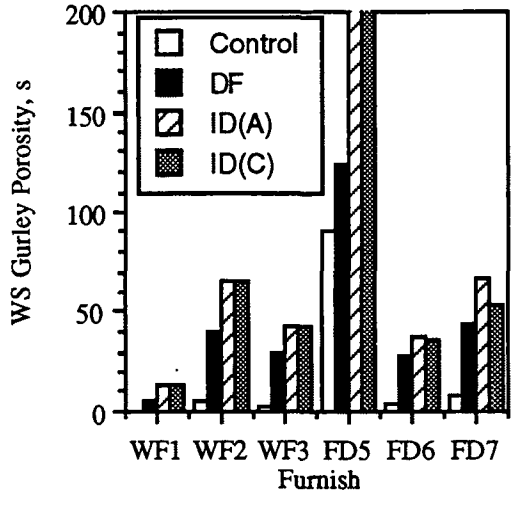


Figure 43. Case 1, expanded scale.

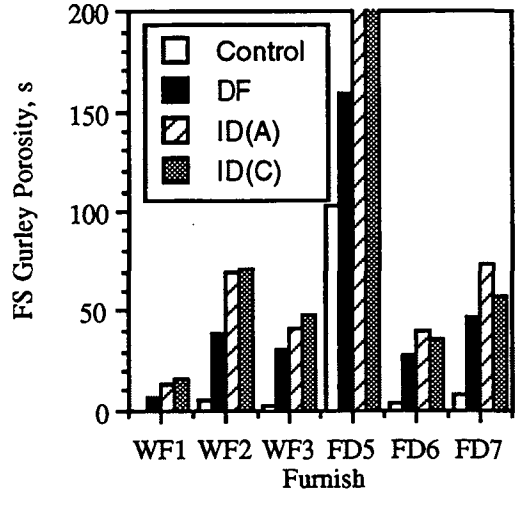


Figure 44. Case 1, expanded scale.

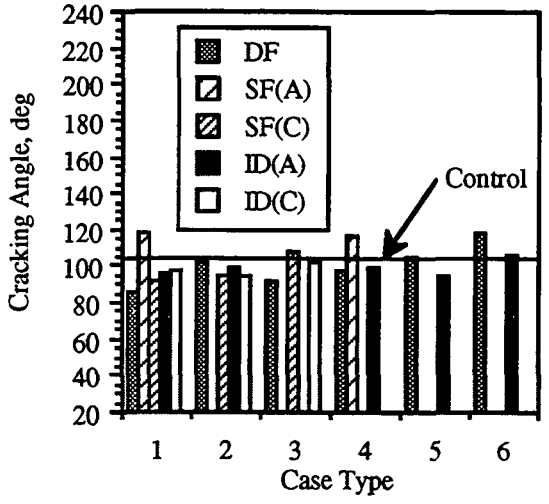


Figure 45. Furnish WF1.

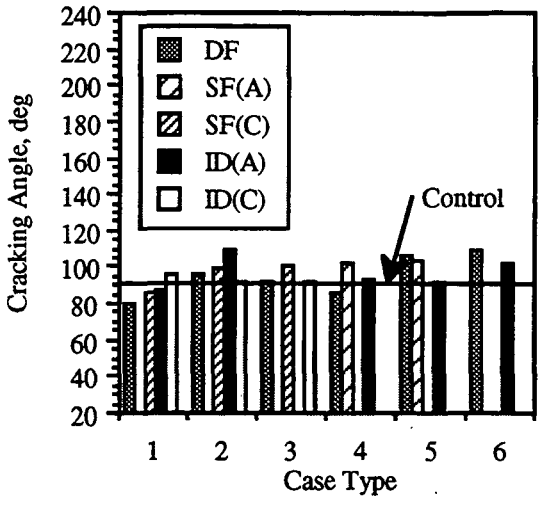


Figure 46. Furnish WF2.

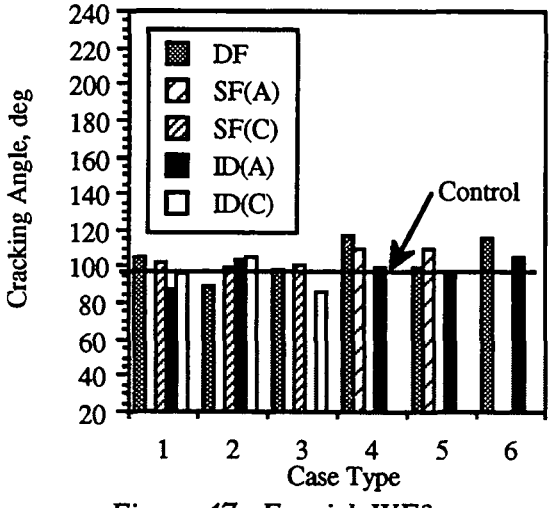


Figure 47. Furnish WF3.

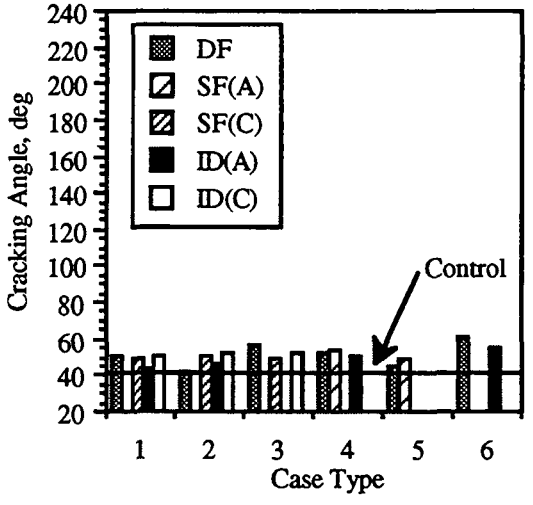


Figure 48. Furnish FD5.

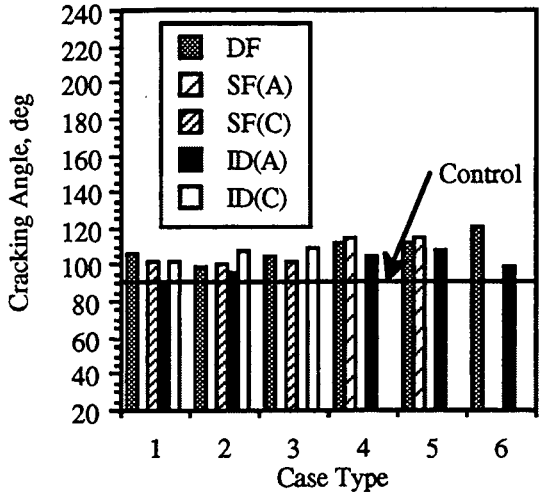


Figure 49. Furnish FD6.

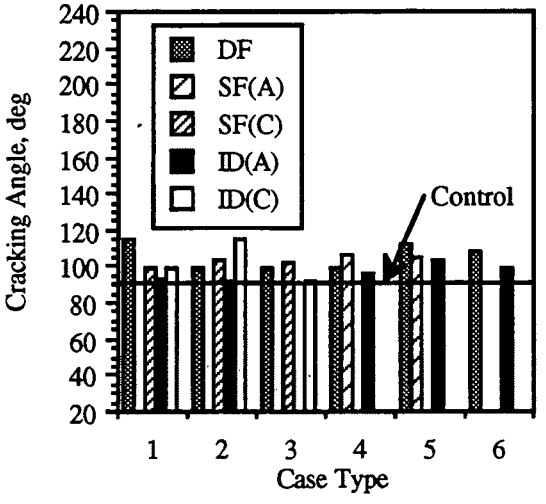
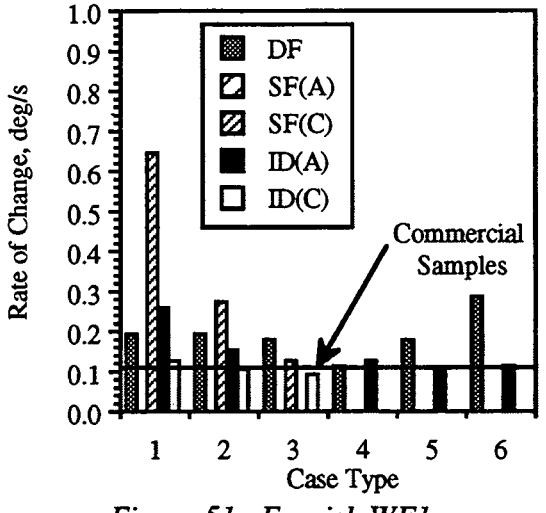


Figure 50. Furnish FD7.



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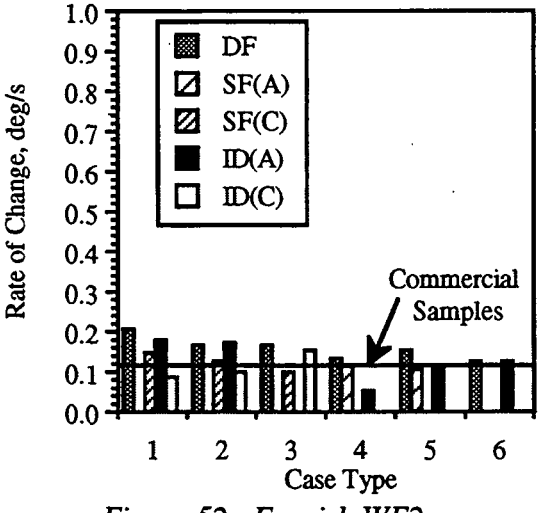

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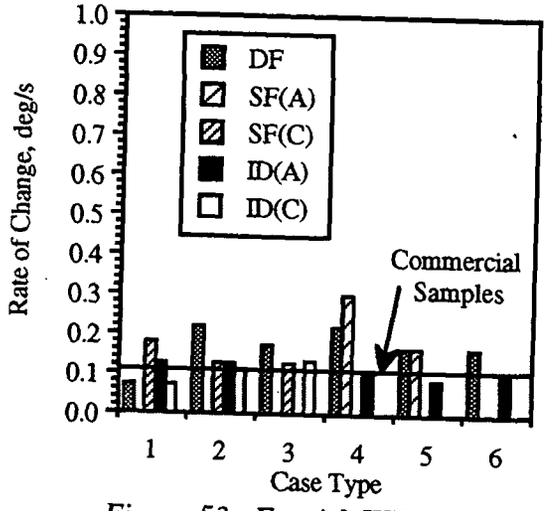

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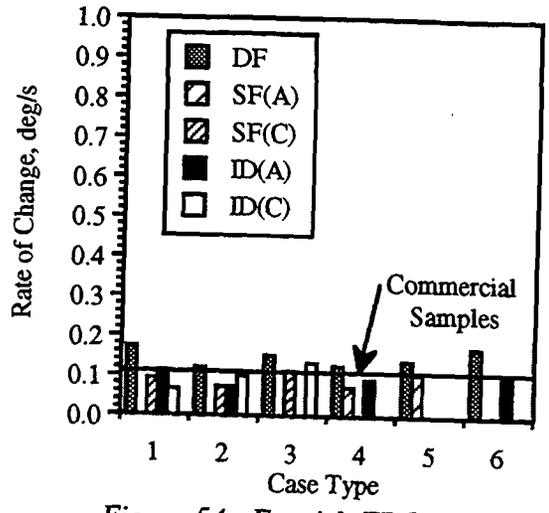

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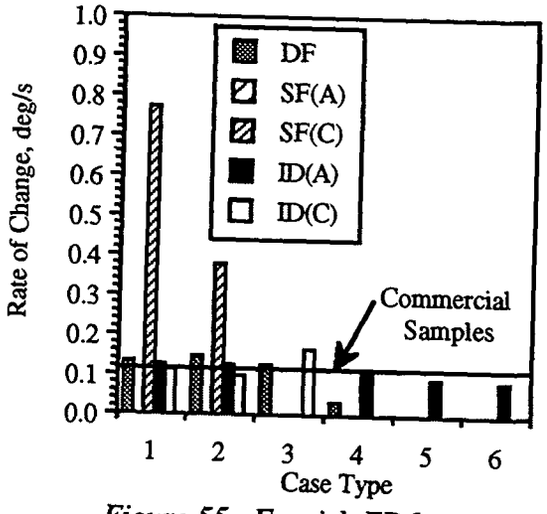


Figure 55. Furnish FD6.

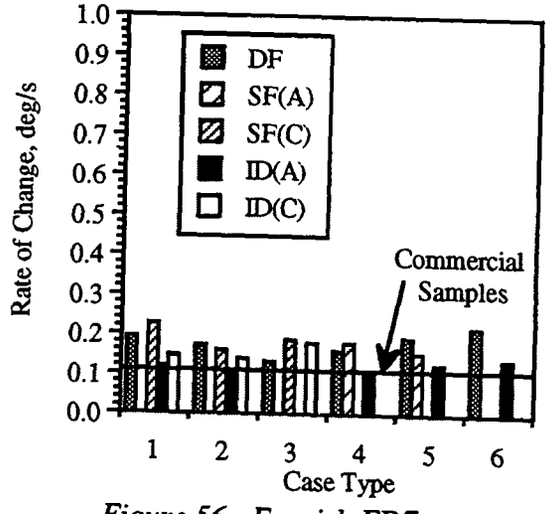
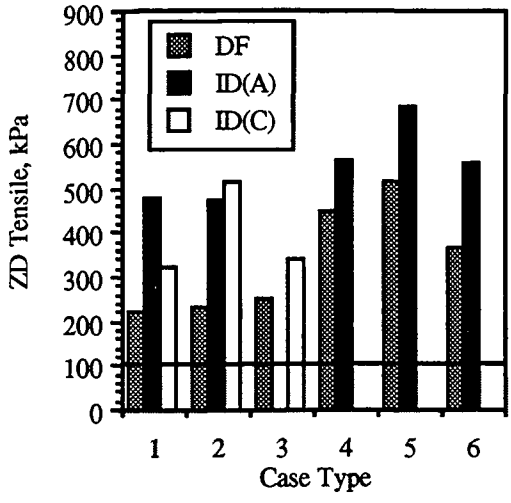


Figure 56. Furnish FD7.



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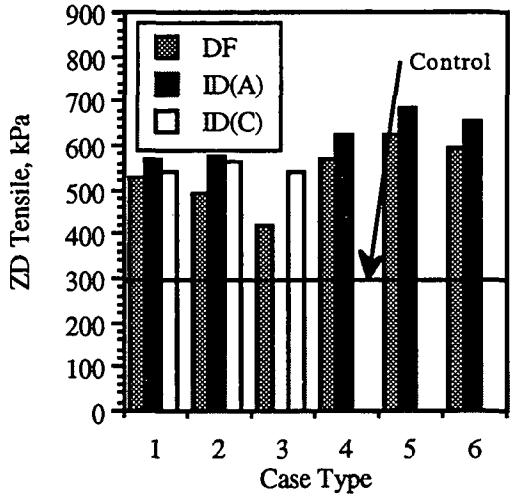

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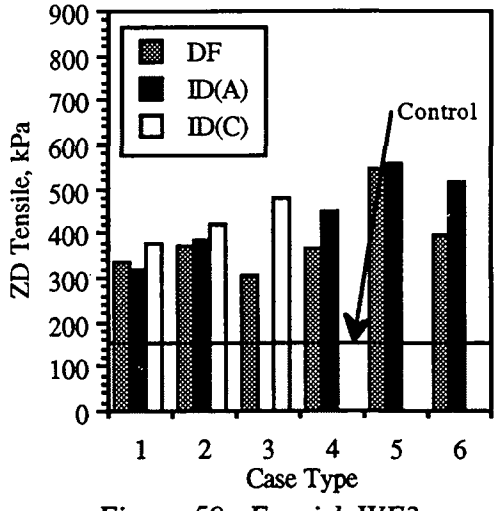


Figure 59. Furnish WF3.

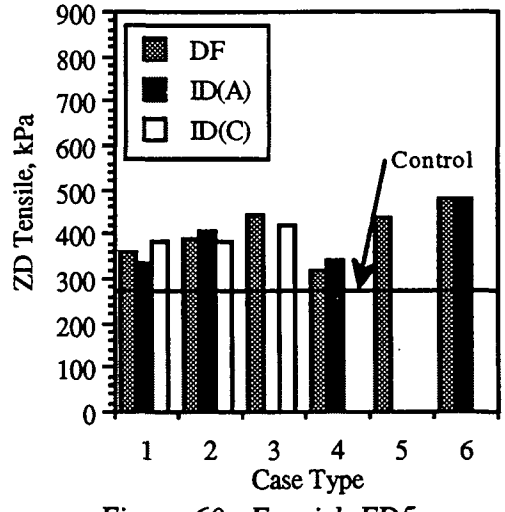
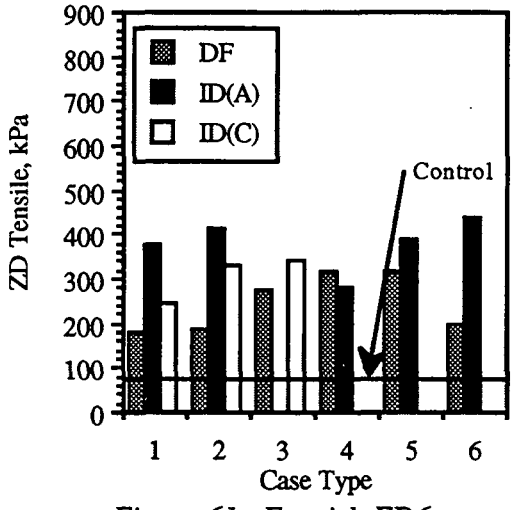


Figure 60. Furnish FD5.



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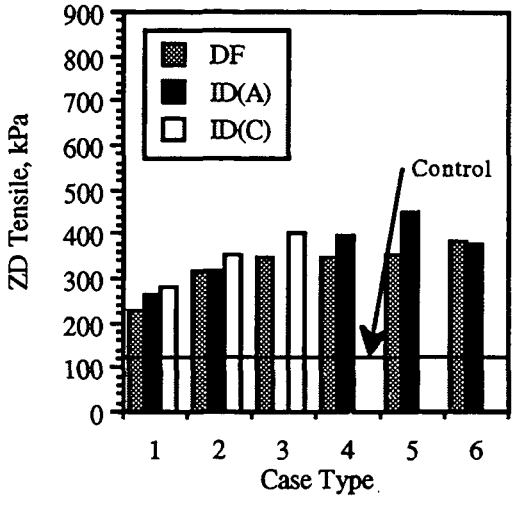
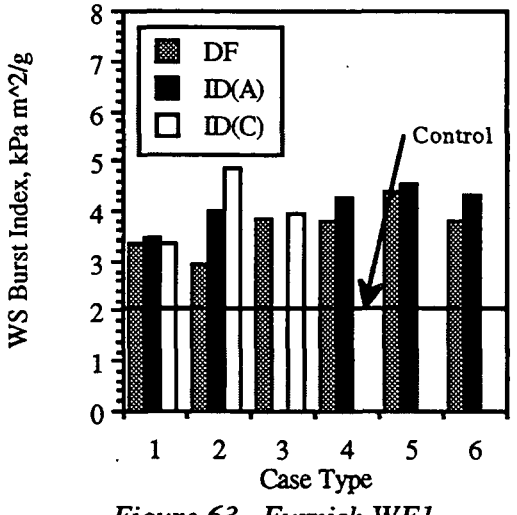


Figure 62. Furnish FD7.



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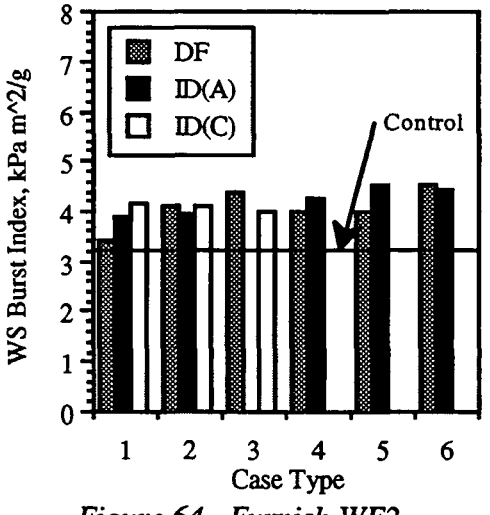

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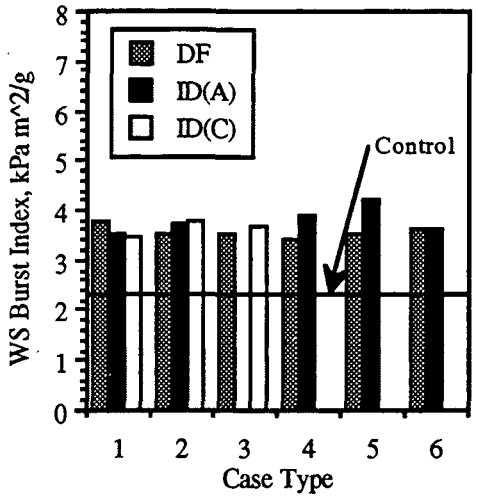

Figure 65. Furnish WF3.

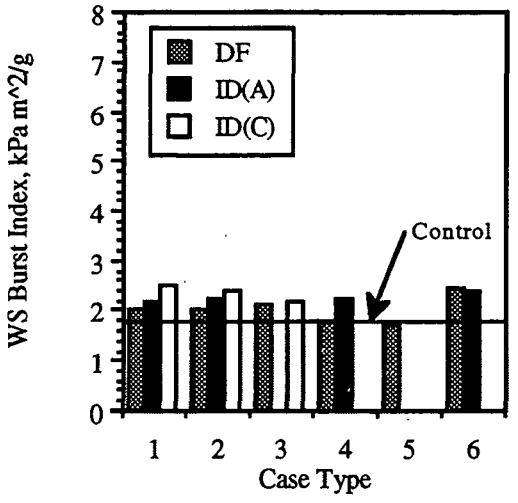

Figure 66. Furnish FD5.

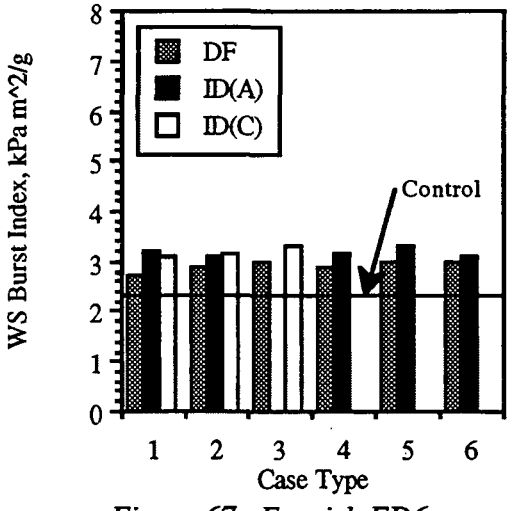

Figure 67. Furnish FD6.

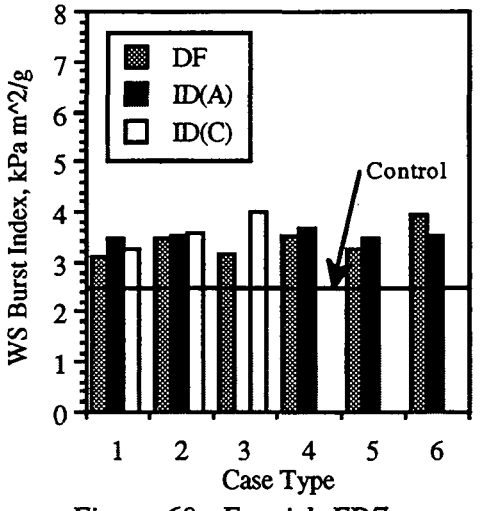

Figure 68. Furnish FD7.

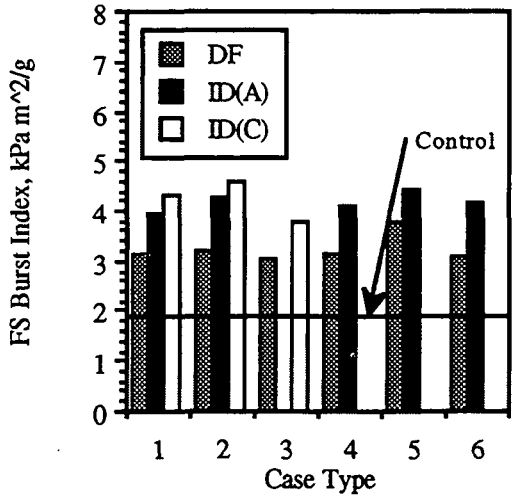

Figure 69. Furnish WF1.

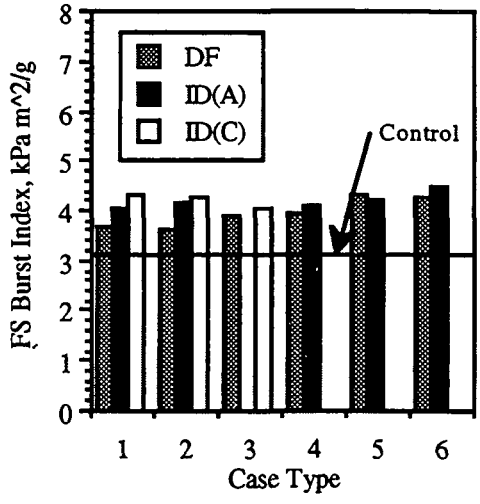

Figure 70. Furnish WF2.

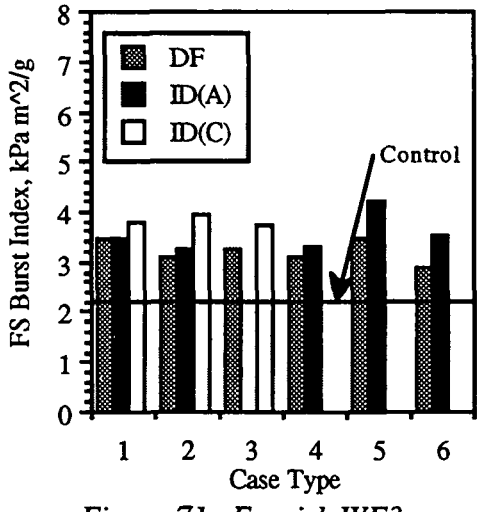

Figure 71. Furnish WF3.

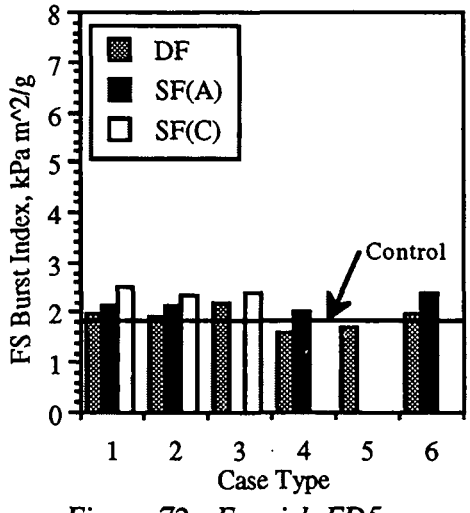

Figure 72. Furnish FD5.

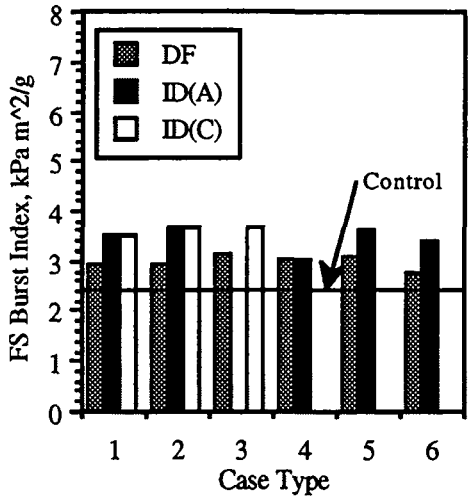

Figure 73. Furnish FD6.

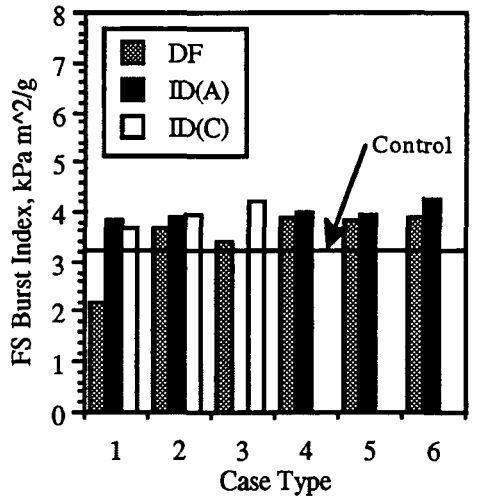

Figure 74. Furnish FD7.

CONCLUSIONS

Experiments have been completed on the Beloit sheet-fed pilot impulse drying shoe press. The major conclusions to be drawn from these experiments may be summarized as:

Critical Impulse Drying Temperaturee: As in previous laboratory-scale experiments (4), critical impulse drying temperature was found to depend on the hydrodynamic specific surface of the heated layer of the sheet. As expected, critical impulse drying temperature was higher for the "low thermal mass" IPST modified ceramic press roll than for the "higher thermal mass" Beloit "A" press roll. Interestingly, it may also be concluded that the choice of felt can influence the critical temperature.

Press Dryness: It may be concluded that, for a given set of pressing conditions, press dryness tends to decrease when the hydrodynamic specific surface of the sheet is increased. In addition, it may be concluded that press dryness resulting from impulse drying was generally higher than that achieved by double-felted pressing. Differences in dryness ranged from 8 percentage points for sheets having low heated ply hydrodynamic specific surface to 3 percentage points for less permeable sheets. The Beloit "A" roll yielded higher press dryness than the IPST modified ceramic roll even though it was generally operated at a lower temperature. While increasing the press load from 6000 pli to 8500 pli increased press dryness, the improvement was observed to be relatively small.

STFI Compression Strengh: The Geometric mean STFI compression strength of impulse dried sheets were consistently higher than that obtained by double-felted pressing. The difference in strength tended to be more significant for the more permeable sheet structures. For two-ply sheets, the STFI compression strength resulting from impulse drying was as much as 17 percent higher than that produced by double-felted pressing. No substantial strength difference was observed comparing sheets impulse dried with the Beloit "A" roll to those dried using the IPST modified ceramic coated press roll.

Gurly Porosity: For all furnishes, the impulse dried sheets were less porous than double-felted pressed sheets, which in turn were less porous than the control sheets that were pressed to 52% solids.

Ink Penetration Test: The rate of change of the contact angle for black flexographic ink drops on the felt side of the samples were measured. Impulse dried and double-felted samples were generally independent of furnish and similar to commercial samples.

Sheet Surface Roughness: The roughness of the wire side of sheets was measured by Sheffield and Bendson roughness tests. It was concluded that while the method of pressing and the extent of refining control surface smoothness, the method of pressing is the dominant variable. In general, impulse dried samples were smoother than single-felted pressed samples, which were smother than double-felted pressed samples.

ZD Tensile: The zd tensile strength is a measure of ply-bond strength. Through these measurements it was concluded that impulse drying can be used to increase ply-bond strength.

Burst Index: Impulse drying tended to increase burst strength as compared to double-felted pressing.

Cracking Angle: Cracking angle was found to be dependent on the level of refining of the fibers on the wire side of the sheet and the method of pressing. Refining was found to be the dominant effect, in that excessive refining leads to a low cracking angle. Impulse dried samples tended to have slightly lower cracking angles than double or single-felted pressed sheets. Since, impulse drying performs best when the heated ply (wire side) is not heavily refined, there should no problem in achieving acceptable cracking angle results in commercial practice.

RECOMMENDATIONS

Based on the research results to date, IPST is forming a joint venture with Union Camp Corporation and Beloit Corporation for the purpose of commercializing impulse drying technology. Four initiatives are planned:

1) Optimization of roll coatings for performance and durability.

2) Development of mechanical equipment culminating in continuous, high speed, pilot paper machine experiments.

3) Development, construction, and demonstration on a wide-width, commercial paper machine producing linerboard.

4) Extending the use of impulse drying to a wide range of paper grades.

The first initiative will be conducted at IPST in FY'94, and is being funded by a continuation of Contract No. FG02-85CE40738. The initiative consists of a number of interrelated tasks. These included experiments to optimize the thermal and mechanical strength properties of the heated press roll surface, construction and use of a high speed test stand to monitor stresses and long term durability of optimized roll surface coatings, and theoretical work to predict stress and temperature within the prototype press rolls.

The second initiative will be jointly conducted by Beloit, Union Camp and IPST in FY'94 and FY'95. That initiative will consist of the engineering design, construction and experimentation

associated with the evaluation of a continuous commercial speed impulse dryer. The dryer will be installed on Beloits' new #4 pilot paper machine. The focus of early experimentation will on verifying the mechanical and runnability aspects of the impulse dryer. Experiments to define the furnish variables specific to the eventual Union Camp commercial application will also be undertaken. In addition, paper produced on the pilot paper machine will be converted to corrugated board to allow final use testing and evaluation.

The third initiative will be conducted if the second initiative is successful. The work will be jointly conducted by Union Camp, Beloit and IPST in FY'96 through FY'99. In this initiative, a commercial width impulse dryer will be designed, constructed, and installed on a Union Camp commercial paper machine. Experiments will then be conducted to evaluate impulse drying technology. Once operational, the performance of the impulse dryer will be monitored over a period of two years.

The fourth initiative will be coordinated by the Beloit, Union Camp, IPST joint venture, while various aspects of the work may be sub-contracted to Beloit, IPST or such organizations as the Herty Foundation. This initiative can begin once the mechanical equipment has been perfected (FY'97 at the earliest). The purpose of the initiate will be to expand the application of impulse drying technology to a wide range of grades and furnishes.

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Director of Engineering and Paper Materials Division

Paul M. Phelan, Assistant Scientist

APPENDICES

APPENDIX A

The following tables contain data that were used for physical testing and analysis.

Table A1. Control Samples that were Finish Dried without Pressing

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59162.3		191.2	54.8				0.060	0.060	10.0	6.7	0.434	0.433	20.50	11.47
WF1	59162.4		204.1	53.9				0.061	0.057	9.8	8.8	0.425	0.427	20.64	11.60
WF2	59163.1		199.0	51.5				0.111	0.098	3.6	7.1	0.541	0.539	25.98	16.98
WF2	59163.2		210.1	51.9				0.119	0.123	7.6	6.5	0.561	0.561	29.19	17.84
WF2	59163.3		208.1	48.8				0.129	0.123	7.8	6.5	0.544	0.546	28.09	18.52
WF2	59163.4		209.9	51.1				0.128	0.127	6.3	8.7	0.548	0.550	26.73	18.10
WF3	59164.2		200.5	49.2				0.070	0.063	8.6	11.1	0.497	0.503	18.92	13.10
WF3	59164.3		213.3	50.2				0.055	0.059	10.9	13.6	0.472	0.497	17.02	12.66
WF3	59164.4		201.5	50.2				0.066	0.069	6.1	5.8	0.499	0.509	19.43	13.48
FD5	59165.1		193.3	49.8				0.122	0.115	4.1	3.5	0.626	0.620	26.44	13.90
FD5	59165.2		201.8	50.2				0.120	0.108	5.8	6.5	0.649	0.621	23.24	17.21
FD5	59165.3		189.2	49.5				0.107	0.098	2.8	4.1	0.592	0.587	19.46	17.17
FD5	59165.4		204.1	49.6				0.118	0.111	6.8	9.0	0.620	0.622	25.65	12.81
FD6	59166.1		206.5	53.0				0.069	0.061	4.3	8.2	0.503	0.495	17.97	13.72
FD6	59166.2		206.1	51.3				0.065	0.056	9.2	5.4	0.497	0.490	20.40	12.19
FD6	59166.3		199.2	51.8				0.069	0.065	7.2	4.6	0.517	0.510	21.00	12.17
FD6	59166.4		205.1	51.2				0.059	0.050	8.5	8.0	0.485	0.483	17.98	13.19
FD7	59167.1		196.3	50.5				0.073	0.067	2.7	6.0	0.565	0.555	20.86	12.88
FD7	59167.2		193.5	50.5				0.080	0.076	6.3	7.9	0.557	0.551	20.67	13.45
FD7	59167.3		197.0	51.4				0.076	0.072	6.6	6.9	0.550	0.534	20.87	13.58
FD7	59167.4		201.8	52.0				0.091	0.084	7.7	16.7	0.557	0.546	22.58	14.46

Table A2. Double Felted Pressing for Case D1 on the X2 Shoe Press
(Felt B, 0" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59104.1	49	201.0	52.0	59.1			0.147	0.142	12.9	6.3	0.771	0.753	32.01	19.14
WF1	59104.2	49	207.3	54.8	60.2			0.176	0.172	6.3	15.7	0.787	0.767	34.00	21.16
WF1	59104.3	49	214.9	53.5	60.3			0.119	0.125	21.0	26.4	0.741	0.733	31.49	19.24
WF1	59104.4	49	194.7	53.1	60.8			0.108	0.129	18.5	28.7	0.683	0.706	28.59	17.66
WF2	59105.2	49	206.8	52.9	59.3			0.262	0.257	5.0	7.8	0.836	0.840	38.57	25.90
WF2	59105.3	49	214.9	52.6	58.7			0.215	0.195	7.4	13.3	0.817	0.785	37.36	23.65
WF2	59105.4	49	203.8	52.5	58.0			0.209	0.191	18.7	8.4	0.780	0.761	35.06	21.77
WF3	59106.2	49	217.6	51.5	60.1			0.202	0.200	8.4	5.5	0.817	0.825	33.00	23.34
WF3	59106.3	49	216.6	51.5	59.9			0.158	0.175	13.9	11.4	0.755	0.790	28.67	22.44
WF3	59106.4	49	220.7	51.7	59.5			0.150	0.219	38.0	4.6	0.760	0.812	26.35	22.83
FD5	59107.1	49	196.3	49.6	57.7			0.129	0.129	6.2	9.3	0.746	0.776	23.51	20.52
FD5	59107.2	49	199.2	49.8	57.9			0.112	0.110	4.5	14.5	0.719	0.731	29.69	15.32
FD5	59107.3	49	204.5	48.2	55.9			0.141	0.123	2.8	10.6	0.797	0.791	29.95	15.89
FD5	59107.4	49	187.9	53.1	58.9			0.134	0.132	6.7	9.8	0.815	0.812	24.76	22.15
FD6	59108.1	49	213.4	51.4	61.1			0.133	0.126	9.0	15.1	0.775	0.775	24.31	18.96
FD6	59108.3	49	201.6	52.2	60.8			0.126	0.122	9.5	18.9	0.759	0.780	25.42	18.85
FD6	59108.4	49	204.3	54.1	60.0			0.147	0.117	12.9	23.9	0.771	0.756	24.24	19.14
FD7	59109.1	49	200.2	48.0	58.8			0.149	0.146	10.1	9.6	0.772	0.781	28.08	17.71

Table A3. Double Felted Pressing for Case D2 on the X2 Shoe Press
(Felt B, 0" pivot, and 8500 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59110.1	66	218.2	52.9	62.1			0.236	0.229	6.8	12.2	0.852	0.847	36.90	22.97
WF1	59110.2	66	208.3	52.5	62.3			0.165	0.156	20.6	16.7	0.811	0.810	30.20	19.90
WF2	59111.1	66	204.0	53.6	60.3			0.270	0.253	7.0	9.1	0.900	0.900	36.77	25.11
WF2	59111.2	66	208.0	50.2	57.2			0.277	0.260	5.8	8.8	0.874	0.891	37.82	26.06
WF2	59111.4	66	209.9	51.7	59.4			0.302	0.288	10.6	5.6	0.928	0.935	37.31	25.73
WF3	59112.1	66	222.7	52.9	62.0			0.218	0.231	15.1	2.2	0.876	0.899	31.79	23.16
WF3	59112.2	66	206.0	52.2	61.4			0.194	0.206	6.2	14.1	0.827	0.858	30.69	21.76
WF3	59112.4	66	213.8	51.7	61.6			0.207	0.167	14.0	18.6	0.852	0.833	30.23	20.90
FD5	59113.1	66	214.9	48.5	55.5			0.137	0.130	3.6	4.6	0.793	0.789	31.93	17.53
FD5	59113.2	66	201.0	49.5	58.4			0.129	0.135	6.2	8.1	0.779	0.799	30.91	17.51
FD5	59113.3	66	204.3	49.5	59.2			0.153	0.152	6.5	11.8	0.790	0.773	33.51	16.99
FD5	59113.4	66	222.9	51.6	58.4			0.135	0.133	6.7	5.3	0.815	0.815	32.08	17.02
FD6	59114.1	66	210.1	53.4	62.8			0.127	0.113	13.4	23.9	0.812	0.799	24.65	16.62
FD6	59114.2	66	216.3	52.0	62.8			0.144	0.150	17.4	11.3	0.807	0.835	28.33	16.27
FD6	59114.3	66	188.0	50.9	61.8			0.120	0.137	12.5	6.6	0.796	0.823	26.02	16.74
FD6	59114.4	66	194.3	52.2	61.9			0.126	0.145	16.7	12.4	0.756	0.813	22.28	20.57
FD7	59115.1	66	198.5	49.3	60.2			0.156	0.176	9.6	4.0	0.814	0.847	28.58	19.95
FD7	59115.2	66	204.8	49.5	60.2			0.175	0.167	4.6	7.8	0.827	0.835	29.63	20.60
FD7	59115.3	66	191.2	48.5	59.9			0.140	0.145	10.0	7.6	0.806	0.814	25.16	21.86
FD7	59115.4	66	198.7	49.4	60.7			0.149	0.160	11.4	9.4	0.809	0.809	27.94	19.67

Table A4. Double Felted Pressing for Case D3 on the X2 Shoe Press
(Felt B, 2" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59116.1	66	201.8	52.4	59.7			0.155	0.122	12.9	12.3	0.815	0.797	34.38	19.04
WF1	59116.2	66	202.0	52.4	59.7			0.152	0.157	20.4	20.4	0.828	0.834	32.23	20.98
WF1	59116.3	66	207.0	52.7	59.1			0.167	0.150	11.4	36.7	0.823	0.817	33.82	20.97
WF2	59117.1	66	212.8	53.1	57.5			0.242	0.247	8.7	7.3	0.847	0.850	38.09	25.40
WF2	59117.2	66	205.3	54.5	60.6			0.243	0.215	7.0	10.7	0.848	0.851	36.86	23.29
WF2	59117.3	66	210.8	49.8	55.1			0.218	0.190	9.2	9.5	0.822	0.815	37.03	24.86
WF2	59117.4	66	199.2	51.2	58.5			0.242	0.243	5.0	7.8	0.879	0.885	36.30	25.15
WF3	59118.2	66	206.0	51.0	59.9			0.164	0.184	6.7	13.0	0.837	0.872	28.12	21.60
WF3	59118.4	66	201.3	51.7	60.9			0.197	0.188	5.6	17.6	0.866	0.869	30.85	22.35
FD5	59119.1	66	213.4	50.6	57.5			0.180	0.166	10.0	8.4	0.815	0.807	29.80	19.65
FD5	59119.2	66	195.2	50.7	58.2			0.196	0.182	3.1	3.8	0.827	0.823	33.58	17.25
FD5	59119.3	66	214.9	50.4	56.1			0.208	0.160	4.3	15.0	0.824	0.791	32.43	16.99
FD5	59119.4	66	209.8	52.4	58.3			0.193	0.199	5.7	9.0	0.836	0.840	29.20	20.39
FD6	59120.1	66	201.8	51.0	59.9			0.170	0.135	8.2	16.3	0.803	0.781	26.09	19.49
FD6	59120.2	66	208.5	51.6	60.3			0.133	0.126	21.8	6.3	0.777	0.786	25.87	16.36
FD6	59120.3	66	200.0	51.7	61.1			0.175	0.159	5.7	5.7	0.802	0.797	31.39	16.95
FD6	59120.4	66	210.4	51.8	60.2			0.134	0.135	23.1	11.9	0.782	0.806	24.01	19.64
FD7	59121.1	66	206.5	51.2	58.8			0.196	0.173	6.6	11.6	0.854	0.844	30.47	20.09
FD7	59121.2	66	208.8	50.7	59.8			0.160	0.162	8.8	15.4	0.810	0.833	27.54	21.93
FD7	59121.3	66	205.8	50.3	61.6			0.183	0.164	5.5	11.0	0.841	0.832	28.85	18.56
FD7	59121.4	66	193.2	49.4	59.5			0.155	0.165	7.7	7.3	0.818	0.828	27.80	19.31

Table A5. Double Felted Pressing for Case D4 on the X2 Shoe Press
(Felt S, 0" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59274.1	49	193.3	50.8	61.2			0.259	0.216	9.7	12.5	0.764	0.746	36.00	21.62
WF1	59274.2	49	189.9	50.6	59.3			0.239	0.268	6.3	6.0	0.746	0.773	36.40	23.23
WF1	59274.3	49	193.0	52.4	56.8			0.097	0.169	17.5	27.8	0.645	0.715	26.80	21.22
WF1	59274.4	49	212.3	52.7	61.3			0.266	0.289	4.1	4.2	0.763	0.791	33.62	24.13
WF2	59275.1	49	204.1	50.2	55.5			0.245	0.251	6.1	4.0	0.745	0.767	35.69	25.15
WF2	59275.2	49	206.8	51.8	59.2			0.266	0.251	4.1	8.4	0.756	0.751	35.38	23.12
WF2	59275.3	49	201.0	49.3	56.7			0.274	0.283	2.9	3.9	0.752	0.781	37.93	24.87
WF2	59275.4	49	203.0	50.3	57.1			0.286	0.281	3.5	5.3	0.758	0.760	35.51	22.92
WF3	59276.1	49	221.4	52.0	58.7			0.202	0.229	6.4	6.6	0.746	0.794	28.86	21.06
WF3	59276.2	49	199.3	50.3	60.9			0.193	0.181	13.0	15.5	0.765	0.754	26.02	18.92
WF3	59276.3	49	210.4	50.0	59.7			0.199	0.201	7.5	6.5	0.770	0.785	29.25	19.46
FD5	59277.1	49	214.1	52.5	59.4			0.121	0.118	3.3	5.1	0.717	0.716	28.61	15.75
FD5	59277.3	49	219.1	53.0	59.3			0.108	0.107	5.6	4.7	0.685	0.693	26.42	15.80
FD6	59278.1	49	200.3	54.5	62.7			0.148	0.150	10.1	8.7	0.692	0.695	23.75	19.96
FD6	59278.2	49	204.8	51.8	62.0			0.124	0.137	16.9	10.9	0.669	0.689	24.33	16.55
FD6	59278.3	49	213.4	48.6	60.2			0.159	0.140	3.8	12.1	0.707	0.692	28.40	15.59
FD6	59278.4	49	200.5	52.5	59.9			0.162	0.173	9.3	5.2	0.696	0.706	23.30	20.79
FD7	59279.1	49	200.7	50.6	58.7			0.169	0.162	4.7	7.4	0.730	0.727	30.80	19.72
FD7	59279.2	49	185.9	49.6	58.1			0.158	0.167	5.7	9.6	0.697	0.717	27.94	19.52
FD7	59279.3	49	198.8	49.8	57.9			0.184	0.184	3.3	4.3	0.726	0.731	31.22	20.70
FD7	59279.4	49	197.5	48.9	57.6			0.141	0.142	6.4	6.3	0.700	0.710	26.85	17.51

Table A6. Double Felted Pressing for Case D5 on the X2 Shoe Press
(Felt S, 0" pivot, and 8500 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59280.1	49	204.3	51.9	62.9			0.236	0.258	11.9	5.4	0.864	0.892	34.97	25.40
WF1	59280.2	49	201.6	50.1	61.7			0.238	0.240	6.7	7.1	0.878	0.881	36.99	23.98
WF1	59280.3	49	212.4	50.7	61.5			0.270	0.276	4.1	8.3	0.868	0.874	38.63	25.30
WF1	59280.4	49	205.3	53.1	60.8			0.244	0.263	9.8	5.3	0.847	0.853	33.77	24.89
WF2	59281.1	49	203.6	52.2	58.4			0.266	0.257	5.6	3.9	0.847	0.871	37.59	25.19
WF2	59281.2	49	195.8	50.3	58.6			0.274	0.262	2.9	3.4	0.855	0.866	39.51	26.14
WF2	59281.3	49	207.0	49.0	57.1			0.269	0.267	2.2	6.0	0.867	0.870	39.16	26.77
WF2	59281.4	49	204.3	52.1	59.7			0.261	0.242	3.1	4.1	0.855	0.875	38.12	24.43
WF3	59282.1	49	221.6	50.5	60.7			0.227	0.251	10.1	3.6	0.919	0.920	32.52	24.76
WF3	59282.2	49	196.3	50.3	62.0			0.203	0.205	2.0	6.3	0.878	0.896	31.34	22.58
WF3	59282.4	49	199.5	50.4	61.1			0.225	0.208	5.8	4.3	0.879	0.874	31.82	23.29
FD5	59283.1	49	207.0	51.2	59.1			0.134	0.132	5.2	4.5	0.758	0.763	30.58	16.43
FD5	59283.2	49	207.6	51.6	60.2			0.143	0.142	2.8	4.2	0.776	0.779	31.50	15.63
FD5	59283.3	49	206.6	50.0	57.4			0.121	0.114	5.8	10.5	0.807	0.797	30.88	15.07
FD5	59283.4	49	200.0	53.2	59.2			0.111	0.108	10.8	6.5	0.793	0.788	27.71	14.80
FD6	59284.1	49	206.0	52.5	61.9			0.188	0.158	4.3	9.5	0.853	0.826	26.62	18.87
FD6	59284.2	49	201.1	51.3	62.1			0.166	0.173	12.7	11.0	0.803	0.820	25.06	18.66
FD6	59284.3	49	210.8	52.0	61.0			0.142	0.124	9.2	15.3	0.789	0.779	22.79	18.48
FD6	59284.4	49	202.1	51.8	61.0			0.149	0.121	7.4	11.6	0.783	0.767	24.66	17.87
FD7	59285.1	49	187.5	48.2	59.7			0.186	0.184	3.8	6.0	0.803	0.809	28.62	20.14
FD7	59285.2	49	194.7	48.0	59.7			0.151	0.149	4.6	8.1	0.780	0.794	26.57	18.65
FD7	59285.3	49	197.0	48.7	59.4			0.166	0.154	8.4	8.4	0.788	0.780	27.02	19.59
FD7	59285.4	49	195.7	49.1	59.4			0.174	0.184	8.0	8.2	0.785	0.797	27.74	19.47

Table A7. Double Felted Pressing for Case D6 on the X2 Shoe Press
(Felt S, 2" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59286.1	49	210.8	52.5	60.7			0.188	0.183	9.0	15.8	0.943	0.957	35.56	22.28
WF1	59286.2	49	214.8	51.7	57.5			0.121	0.182	19.0	15.9	0.861	0.948	31.08	24.55
WF1	59286.3	49	187.0	51.0	55.9			0.114	0.180	14.0	17.8	0.828	0.936	31.05	23.23
WF1	59286.4	49	224.2	49.9	57.3			0.156	0.209	19.2	7.7	0.913	0.970	32.94	24.01
WF2	59287.1	49	208.8	52.7	58.6			0.264	0.251	4.5	6.0	0.781	0.794	37.43	24.75
WF2	59287.2	49	198.0	51.5	57.5			0.297	0.283	4.4	4.6	0.821	0.832	37.40	25.51
WF2	59287.3	49	208.8	50.8	56.3			0.287	0.274	3.8	5.5	0.825	0.819	38.75	26.58
WF2	59287.4	49	205.6	51.3	55.5			0.258	0.256	4.3	4.3	0.781	0.788	36.19	25.34
WF3	59288.1	49	224.9	51.9	58.3			0.224	0.254	8.5	4.7	0.812	0.846	32.55	23.97
WF3	59288.2	49	216.6	51.0	56.7			0.185	0.255	12.4	3.9	0.775	0.801	29.82	24.61
WF3	59288.3	49	204.8	50.4	57.3			0.182	0.216	11.5	6.5	0.761	0.799	29.19	22.88
FD5	59289.1	49	206.0	53.3	60.5			0.184	0.185	6.0	6.5	0.748	0.754	25.02	23.08
FD5	59289.2	49	205.8	51.7	58.2			0.189	0.187	8.5	2.1	0.741	0.742	31.69	18.13
FD5	59289.3	49	215.9	51.8	58.5			0.185	0.181	5.9	8.8	0.746	0.758	27.71	18.33
FD5	59289.4	49	191.2	54.0	58.9			0.204	0.198	2.0	3.5	0.769	0.775	34.07	17.09
FD6	59290.1	49	205.5	54.4	61.7			0.178	0.178	8.4	12.9	0.755	0.767	28.42	19.78
FD6	59290.2	49	193.2	51.1	56.2			0.096	0.140	8.3	29.3	0.695	0.739	22.21	19.68
FD6	59290.3	49	195.5	52.3	59.9			0.114	0.101	6.1	12.9	0.710	0.714	26.32	17.53
FD6	59290.4	49	196.5	50.9	55.9			0.097	0.144	8.2	19.4	0.699	0.748	24.83	19.23
FD7	59291.4	49	204.5	48.5	58.0			0.172	0.177	7.6	7.9	0.828	0.832	29.21	20.41

Table A8. Impulse Drying for Case C1 on the X2 Shoe Press using the IPST-C roll
(Felt B, 0" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59064.2	91	196.5	51.6	62.2		0	0.190	0.175	4.2	4.6	0.839	0.852	34.27	23.33
WF1	59064.3	91	203.0	50.6	61.2		0	0.205	0.199	6.8	6.5	0.846	0.858	38.11	23.73
WF1	59064.4	91	200.2	50.8	55.5		0	0.056	0.054	17.9	9.3	0.721	0.721	26.27	16.93
WF1	59018.1	147	198.5	51.7	61.7		0	0.125	0.152	19.2	8.6	0.832	0.870	34.56	23.82
WF1	59018.2	147	206.1	51.8	58.7		0	0.105	0.127	29.5	26.0	0.803	0.852	30.63	20.87
WF1	59018.3	147	207.5	53.1	58.9		0	0.086	0.126	30.2	30.2	0.784	0.830	31.41	20.75
WF1	59018.4	147	207.3	52.3	61.4		0	0.149	0.167	10.1	8.4	0.854	0.857	34.76	22.49
WF1	59024.1	161	204.5	51.6	60.5		0	0.093	0.076	14.0	10.5	0.764	0.760	28.68	19.18
WF1	59024.2	161	203.6	50.4	60.7		0	0.129	0.160	19.4	11.3	0.784	0.805	31.73	22.03
WF1	59024.3	161	203.5	50.6	60.9		0	0.085	0.099	22.4	26.3	0.716	0.736	29.71	19.45
WF1	59024.4	161	200.8	51.6	61.6		0	0.096	0.111	35.4	37.8	0.710	0.749	29.00	17.99
WF1	59031.1	202	199.2	51.9	63.0		0	0.126	0.105	18.3	16.2	0.880	0.873	32.41	19.88
WF1	59031.2	202	195.0	51.4	62.5		0	0.148	0.152	15.5	12.5	0.896	0.893	34.86	22.06
WF1	59031.3	202	207.8	51.7	58.9		0	0.088	0.054	28.4	11.1	0.815	0.762	31.04	17.02
WF1	59031.4	202	201.5	52.6	63.9		0	0.155	0.147	19.4	17.7	0.862	0.888	31.67	22.29
WF1	59043.1	243	195.2	54.3	66.0		0	0.158	0.154	13.9	13.6	0.917	0.936	33.74	21.29
WF1	59043.2	243	200.2	51.8	65.5		0	0.196	0.211	13.8	7.1	0.944	0.949	39.29	23.07
WF1	59043.3	243	216.4	51.3	62.0		0	0.146	0.103	20.5	15.5	0.860	0.856	33.35	21.81
WF1	59043.4	243	207.1	51.0	60.8		0	0.092	0.069	15.2	10.1	0.858	0.833	31.62	17.74
WF1	59054.1	293	204.0	52.6	63.2		2	0.129	0.107	21.7	47.7	0.915	0.929	30.81	20.16
WF1	59054.2	293	201.0	51.3	66.1		2	0.112	0.077	23.2	57.1	0.895	0.882	29.39	19.35
WF1	59054.3	293	194.0	50.2	67.5		0	0.169	0.167	11.8	13.8	0.956	0.984	35.08	22.75
WF1	59054.4	293	195.5	51.6	66.8		2	0.128	0.086	25.0	43.0	0.935	0.923	31.62	20.69
WF2	59065.1	91	196.8	53.4	60.1		0	0.238	0.238	6.7	4.2	0.909	0.911	38.15	25.65
WF2	59065.2	91	201.3	50.2	55.8		0	0.245	0.242	5.7	5.8	0.865	0.867	37.55	25.71
WF2	59065.3	91	207.3	49.2	58.1		0	0.281	0.272	3.9	4.4	0.855	0.864	37.31	26.12
WF2	59065.4	91	200.3	49.4	53.2		0	0.161	0.170	4.3	10.0	0.756	0.773	34.32	23.56
WF2	59019.1	151	207.5	49.2	55.7		0	0.181	0.190	7.7	7.4	0.807	0.836	34.55	24.16
WF2	59019.2	151	203.5	51.5	59.4		0	0.217	0.232	13.4	9.9	0.846	0.855	33.37	22.99

Table A8 Continued. Impulse Drying for Case C1 on the X2 Shoe Press using the IPST-C roll (Felt B, 0" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF2	59032.1	192	197.8	51.8	60.6		0	0.202	0.234	18.3	6.8	0.871	0.918	36.16	24.65
WF2	59032.2	192	204.8	48.4	57.9		0	0.231	0.233	7.4	5.2	0.879	0.880	38.17	26.31
WF2	59032.3	192	192.2	50.4	60.5		0	0.198	0.205	19.2	8.3	0.878	0.891	34.70	24.68
WF2	59032.4	192	200.3	49.6	58.2		0	0.200	0.187	4.0	9.1	0.849	0.856	36.77	25.84
WF2	59044.1	243	205.0	52.8	62.8		3	0.201	0.219	26.4	7.3	0.873	0.891	33.29	24.29
WF2	59044.2	243	203.6	49.8	60.9		3	0.137	0.198	34.3	24.7	0.814	0.870	28.99	22.58
WF2	59044.3	243	198.3	50.4	62.2		0	0.226	0.225	7.1	7.6	0.928	0.929	36.09	24.26
WF2	59044.4	243	212.8	52.5	62.2		3	0.123	0.121	53.7	62.8	0.823	0.823	30.46	19.59
WF2	59055.1	293	200.3	51.9	62.7		0	0.200	0.186	10.0	7.0	0.848	0.844	34.77	24.39
WF2	59055.2	293	199.7	50.4	60.4		2	0.093	0.132	22.6	18.9	0.755	0.779	30.50	21.88
WF2	59055.3	293	199.5	51.8	62.6		0	0.202	0.187	6.4	4.8	0.813	0.820	34.50	23.93
WF2	59055.4	293	210.9	53.7	63.0		0	0.147	0.181	12.2	7.2	0.754	0.793	32.55	21.98
WF3	59066.1	91	213.6	51.0	60.4		0	0.213	0.218	6.6	5.0	0.890	0.901	32.07	24.32
WF3	59066.2	91	192.4	50.3	60.8		0	0.154	0.141	11.0	8.5	0.859	0.852	28.59	21.72
WF3	59020.1	154	215.6	50.5	61.1		0	0.214	0.216	3.3	4.6	0.875	0.892	32.42	24.26
WF3	59020.4	154	217.7	50.7	61.4		0	0.199	0.192	8.0	7.3	0.866	0.872	30.07	23.11
WF3	59033.2	192	202.3	50.2	62.7		0	0.189	0.167	15.3	10.8	0.876	0.909	29.03	21.65
WF3	59033.3	192	204.6	49.9	61.9		0	0.162	0.199	15.4	9.0	0.836	0.875	29.44	20.32
WF3	59033.4	192	223.2	50.5	61.9		0	0.220	0.221	5.5	4.5	0.887	0.903	31.31	23.98
WF3	59045.1	242	214.9	50.3	63.7		3	0.116	0.082	53.4	74.4	0.826	0.810	27.68	18.54
WF3	59045.2	242	199.8	49.7	64.0		3	0.190	0.162	8.4	23.5	0.896	0.883	31.81	22.20
WF3	59045.4	242	199.5	50.5	65.4		3	0.045	0.034	22.2	20.6	0.799	0.742	25.42	16.65
WF3	59056.3	293	223.1	49.7	62.2		1	0.183	0.196	10.4	5.1	0.761	0.780	30.84	22.60
WF3	59056.4	293	199.3	50.4	64.5		0	0.159	0.173	20.1	12.1	0.760	0.796	28.99	21.56
FD5	59067.1	91	221.9	55.5	59.2		0	0.142	0.136	4.2	3.7	0.843	0.843	31.50	16.43
FD5	59067.2	91	216.4	52.3	57.2		0	0.130	0.139	5.4	3.6	0.812	0.830	25.06	21.58
FD5	59067.3	91	206.5	51.2	58.2		0	0.113	0.115	4.4	5.2	0.798	0.820	30.39	17.11
FD5	59067.4	91	207.6	54.1	59.0		0	0.129	0.120	5.4	6.7	0.834	0.826	30.64	17.82
FD5	59021.1	157	185.0	53.7	61.3		0	0.115	0.125	4.3	5.6	0.844	0.852	30.23	16.02

Table A8 Continued. Impulse Drying for Case C1 on the X2 Shoe Press using the IPST-C roll (Felt B, 0" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD5	59034.1	191	208.9	52.6	59.9		2	0.066	0.072	25.8	30.6	0.757	0.791	18.92	19.49
FD5	59034.2	191	200.7	52.8	62.6		0	0.131	0.136	3.8	2.9	0.885	0.898	25.65	22.58
FD5	59034.3	191	207.6	51.3	58.4		2	0.082	0.060	22.0	10.0	0.785	0.765	28.17	13.13
FD5	59034.4	191	191.0	52.5	60.6		2	0.101	0.055	21.8	10.9	0.830	0.771	29.19	14.79
FD6	59068.1	91	204.6	53.0	62.2		0	0.111	0.113	20.7	10.6	0.814	0.830	25.98	15.32
FD6	59068.2	91	189.5	50.9	58.0		0	0.076	0.068	5.3	7.4	0.764	0.768	23.16	16.93
FD6	59068.4	91	197.7	50.8	61.6		0	0.152	0.145	4.6	6.2	0.839	0.828	25.73	19.29
FD6	59023.3	164	199.5	53.4	62.5		0	0.110	0.117	10.9	13.7	0.879	0.896	23.10	19.59
FD6	59023.4	164	194.8	52.3	62.3		0	0.131	0.128	6.9	5.5	0.896	0.884	25.85	19.96
FD6	59035.1	192	198.3	53.0	64.0		0	0.106	0.113	25.5	27.4	0.829	0.844	25.68	17.66
FD6	59035.2	192	208.1	50.1	61.6		0	0.143	0.129	11.9	10.9	0.824	0.818	27.54	17.39
FD6	59035.3	192	207.5	49.8	62.6		0	0.143	0.141	11.2	12.8	0.816	0.812	24.49	20.67
FD6	59035.4	192	204.1	51.0	64.1		0	0.156	0.147	7.7	6.8	0.820	0.825	26.02	20.36
FD6	59047.1	241	198.2	52.2	65.4		0	0.180	0.165	4.4	19.4	0.832	0.828	28.03	19.35
FD6	59047.2	241	207.8	50.1	65.1		0	0.175	0.165	8.0	10.3	0.823	0.822	23.85	21.98
FD6	59047.3	241	194.3	50.8	64.8		0	0.156	0.144	3.8	8.3	0.825	0.833	26.52	19.68
FD6	59047.4	241	204.5	50.4	65.8		0	0.193	0.204	5.7	3.4	0.849	0.862	27.85	19.98
FD6	59057.1	293	201.5	51.5	66.0		2	0.135	0.112	8.9	32.1	0.850	0.836	24.39	18.89
FD6	59057.2	293	204.8	51.9	67.0		1	0.112	0.099	23.2	14.1	0.839	0.839	25.57	16.45
FD6	59057.3	293	203.0	51.3	66.6		0	0.127	0.129	22.0	12.4	0.836	0.861	24.44	19.77
FD6	59057.4	293	196.2	51.7	68.1		0	0.136	0.125	15.4	13.6	0.857	0.865	25.46	18.42
FD7	59069.1	91	201.0	52.4	60.1		0	0.166	0.162	2.4	6.8	0.860	0.863	29.25	19.94
FD7	59069.2	91	195.8	51.9	61.4		0	0.160	0.165	4.4	8.5	0.871	0.894	27.15	21.88
FD7	59069.3	91	197.0	51.6	61.2		0	0.161	0.158	4.3	4.4	0.875	0.879	29.72	19.20
FD7	59069.4	91	200.0	52.5	59.5		0	0.158	0.153	5.1	2.6	0.852	0.850	30.50	19.91
FD7	59022.1	161	198.2	54.4	61.9		0	0.125	0.114	8.8	20.2	0.859	0.872	25.30	19.12
FD7	59022.2	161	195.0	51.0	59.8		0	0.137	0.130	10.9	13.1	0.874	0.859	28.68	19.47
FD7	59022.3	161	198.3	49.5	59.4		0	0.122	0.136	10.7	6.6	0.825	0.847	25.54	19.39
FD7	59022.4	161	201.3	49.5	59.5		0	0.144	0.137	4.2	5.8	0.825	0.820	28.50	18.09

Table A8 Continued. Impulse Drying for Case C1 on the X2 Shoe Press using the IPST-C roll (Felt B, 0" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD7	59036.1	192	196.5	48.9	61.2		0	0.146	0.117	9.6	23.9	0.855	0.884	27.23	19.12
FD7	59036.2	192	191.2	48.8	60.8		0	0.141	0.151	7.8	5.3	0.869	0.890	28.47	20.70
FD7	59036.3	192	192.4	49.7	62.9		0	0.131	0.145	12.2	11.7	0.865	0.870	28.51	19.61
FD7	59036.4	192	199.5	49.9	61.2		0	0.148	0.150	10.1	7.3	0.853	0.858	29.09	19.05
FD7	59048.1	241	195.7	50.4	62.9		0	0.136	0.151	11.0	11.3	0.858	0.873	25.86	20.55
FD7	59048.2	241	193.7	49.2	63.3		0	0.145	0.145	9.0	7.6	0.862	0.874	27.53	18.03
FD7	59048.3	241	192.4	49.7	63.7		0	0.150	0.144	4.0	4.9	0.861	0.875	25.94	20.37
FD7	59048.4	241	189.5	50.6	62.8		0	0.156	0.143	5.8	13.3	0.879	0.882	29.35	18.43
FD7	59058.1	293	191.0	50.3	63.9		1	0.090	0.102	14.4	14.7	0.821	0.848	23.53	17.11
FD7	59058.2	293	195.8	50.4	63.6		1	0.099	0.100	21.2	13.0	0.830	0.833	22.95	17.09
FD7	59058.3	293	192.8	48.4	63.9		2	0.109	0.091	8.3	18.7	0.833	0.822	26.69	18.01
FD7	59058.4	293	194.7	50.9	64.9		1	0.099	0.115	16.2	9.6	0.845	0.861	22.16	19.94

Table A9. Impulse Drying for Case C2 on the X2 Shoe Press using the IPST-C roll
(Felt B, 0" pivot, and 8500 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59070.1	91	199.0	51.7	64.5		0	0.237	0.226	5.5	3.1	0.898	0.907	37.31	25.21
WF1	59070.2	91	188.4	51.1	63.8		0	0.221	0.215	2.7	3.3	0.886	0.903	35.09	23.81
WF1	59070.3	91	205.6	51.1	63.0		0	0.224	0.209	3.6	16.3	0.931	0.930	35.56	23.96
WF1	59070.4	91	188.5	51.2	63.8		0	0.217	0.201	4.1	4.0	0.942	0.941	35.80	24.65
WF1	59030.1	151	199.3	51.3	59.9		0	0.158	0.180	27.8	37.2	0.756	0.781	31.93	21.82
WF1	59030.2	151	209.9	52.7	63.9		0	0.217	0.241	11.1	4.6	0.806	0.818	33.64	23.05
WF1	59030.3	151	203.1	51.4	56.8		0	0.211	0.236	19.9	9.3	0.789	0.816	34.53	25.27
WF1	59030.4	151	206.3	51.4	62.2		0	0.184	0.183	23.9	30.6	0.763	0.769	31.68	22.79
WF1	59037.1	194	200.3	51.6	60.2		0	0.109	0.071	27.5	14.1	0.846	0.802	29.06	16.49
WF1	59037.3	194	201.6	51.4	63.3		0	0.184	0.154	10.9	29.2	0.890	0.917	34.88	22.73
WF1	59037.4	194	193.8	51.0	64.2		0	0.215	0.190	7.0	6.3	0.943	0.926	35.85	21.88
WF1	59049.2	243	206.0	54.6	67.5		0	0.259	0.250	4.2	6.0	0.979	0.992	37.38	25.04
WF1	59049.3	243	202.1	53.1	61.5		0	0.159	0.233	18.2	7.7	0.941	1.027	34.44	25.02
WF1	59059.1	295	206.0	52.1	66.3		0	0.162	0.198	6.2	10.6	0.945	0.986	33.56	23.42
WF1	59059.2	295	211.3	51.1	64.6		2	0.106	0.095	17.0	20.0	0.853	0.864	31.21	19.38
WF1	59059.3	295	207.8	51.3	67.3		0	0.148	0.177	30.4	10.7	0.873	0.927	30.00	22.90
WF1	59059.4	295	195.7	52.9	68.5		0	0.176	0.175	11.9	10.9	0.938	0.921	33.79	23.57
WF2	59071.1	91	196.5	51.4	60.9		0	0.235	0.233	6.8	3.4	0.964	0.997	36.88	26.73
WF2	59071.2	91	200.5	48.8	58.8		0	0.241	0.226	4.1	3.5	0.977	1.015	38.05	27.59
WF2	59071.3	91	209.1	52.3	61.7		0	0.244	0.251	4.1	3.6	0.985	0.994	37.30	25.80
WF2	59071.4	91	200.0	50.6	60.8		0	0.263	0.245	4.2	4.1	0.951	0.967	38.61	26.31
WF2	59025.2	158	203.0	52.5	59.4		0	0.231	0.236	5.2	2.5	1.003	0.999	36.15	27.07
WF2	59025.3	158	207.5	53.3	62.2		0	0.243	0.247	5.8	10.5	0.958	0.958	37.69	25.61
WF2	59025.4	158	208.3	51.6	59.0		0	0.201	0.196	8.0	13.8	0.921	0.936	37.32	24.76
WF2	59038.1	194	208.3	49.3	59.5		0	0.255	0.273	7.8	4.8	0.950	0.973	37.60	27.52
WF2	59038.2	194	202.0	48.9	59.0		0	0.246	0.236	5.3	10.2	0.935	0.918	38.15	27.08
WF2	59038.3	194	197.7	50.0	61.6		0	0.255	0.268	6.7	5.6	0.963	0.975	39.65	27.31
WF2	59038.4	194	203.6	48.7	58.6		0	0.245	0.227	6.5	8.8	0.908	0.925	39.51	26.76

Table A9 Continued. Impulse Drying for Case C2 on the X2 Shoe Press using the IPST-C roll
(Felt B, 0" pivot, and 8500 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF2	59050.1	243	206.0	53.1	62.0		0	0.214	0.239	6.5	7.1	0.920	0.918	38.33	26.61
WF2	59050.2	243	207.3	52.0	63.6		0	0.243	0.250	4.9	6.8	0.924	0.943	38.78	25.97
WF2	59050.4	243	195.0	48.1	62.5		0	0.246	0.246	5.3	6.9	0.935	0.935	35.64	26.54
WF2	59060.1	295	207.8	53.1	65.0		0	0.189	0.208	5.8	5.8	0.948	0.947	34.98	24.48
WF2	59060.2	295	205.6	48.9	59.6		0	0.099	0.095	34.3	25.3	0.858	0.850	32.17	21.57
WF2	59060.3	295	204.3	50.2	63.0		0	0.177	0.188	7.9	10.6	0.935	0.959	35.66	25.60
WF2	59060.4	295	207.8	49.2	60.2		1	0.110	0.104	42.7	44.2	0.854	0.859	32.63	22.87
WF3	59072.1	91	214.4	50.5	62.7		0	0.235	0.239	4.7	2.9	0.946	0.997	32.92	24.02
WF3	59072.2	91	200.7	49.4	63.0		0	0.212	0.210	5.7	3.8	0.941	0.974	31.13	23.63
WF3	59072.3	91	222.1	48.3	61.5		0	0.237	0.231	3.4	3.9	0.943	0.951	33.86	25.45
WF3	59026.2	153	199.3	53.3	63.0		0	0.190	0.216	4.2	3.7	0.962	0.957	30.69	23.71
WF3	59026.3	153	208.1	51.2	61.7		0	0.191	0.175	12.0	12.0	0.900	0.933	33.06	20.75
WF3	59026.4	153	216.3	51.9	62.4		0	0.214	0.184	5.1	6.0	0.927	0.926	33.30	23.56
WF3	59039.1	195	214.9	51.9	62.2		0	0.202	0.198	7.4	4.5	0.930	0.937	31.96	23.52
WF3	59039.2	195	199.0	49.5	64.3		0	0.187	0.224	8.0	3.1	0.938	0.943	30.28	23.93
WF3	59039.3	195	209.8	48.4	62.2		0	0.205	0.174	5.4	22.4	0.904	0.905	30.78	21.57
WF3	59039.4	195	205.5	50.2	63.2		0	0.226	0.228	4.4	2.6	0.945	0.960	32.23	23.45
WF3	59051.1	243	210.8	51.7	65.3		0	0.222	0.201	6.3	5.5	0.926	0.958	33.04	23.62
WF3	59051.2	243	220.9	48.9	64.2		3	0.194	0.115	12.4	55.7	0.922	0.926	30.62	22.62
WF3	59051.3	243	205.3	49.6	65.1		3	0.122	0.199	51.6	25.6	0.847	0.937	27.74	23.79
WF3	59051.4	243	210.4	51.1	65.1		0	0.209	0.221	9.6	5.9	0.951	0.947	32.59	24.16
WF3	59061.1	295	212.1	51.1	64.2		2	0.198	0.180	4.0	8.9	0.812	0.798	29.35	20.02
WF3	59061.2	295	197.8	49.7	65.3		2	0.182	0.174	18.7	12.1	0.793	0.794	28.61	21.85
WF3	59061.3	295	220.9	49.5	64.0		2	0.208	0.213	2.9	6.6	0.802	0.816	30.00	22.44
WF3	59061.4	295	220.7	50.6	64.5		1	0.209	0.191	5.3	5.2	0.817	0.812	30.20	22.05
FD5	59073.1	91	202.5	51.2	59.8		0	0.169	0.169	5.3	7.7	0.856	0.849	26.92	22.90
FD5	59073.2	91	215.3	50.5	57.6		0	0.149	0.146	4.7	10.3	0.819	0.820	31.30	18.56
FD5	59073.3	91	219.2	50.1	57.2		0	0.152	0.137	5.3	3.6	0.824	0.800	29.70	20.64
FD5	59073.4	91	198.5	50.3	59.1		0	0.145	0.148	3.4	4.1	0.839	0.848	33.00	18.09

Table A9 Continued. Impulse Drying for Case C2 on the X2 Shoe Press using the IPST-C roll
(Felt B, 0" pivot, and 8500 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD5	59027.2	151	200.5	54.8	60.4		0	0.112	0.110	13.4	7.3	0.827	0.829	30.37	17.11
FD5	59027.3	151	189.7	53.4	60.8		0	0.103	0.122	10.7	7.4	0.822	0.848	29.75	16.55
FD5	59027.4	151	209.1	54.5	61.0		0	0.121	0.130	7.4	6.2	0.846	0.855	26.76	21.07
FD5	59040.1	196	206.5	52.0	61.5		3	0.118	0.125	5.1	5.6	0.850	0.864	28.30	20.79
FD5	59040.3	196	191.4	53.4	61.4		3	0.123	0.080	19.5	31.3	0.840	0.780	31.59	14.14
FD5	59040.4	196	209.6	52.4	59.4		3	0.095	0.076	30.5	39.5	0.789	0.753	29.68	14.40
FD6	59074.1	91	201.6	50.8	63.6		0	0.180	0.181	3.3	3.9	0.950	0.946	28.45	21.72
FD6	59074.2	91	202.5	49.4	63.9		0	0.175	0.177	2.9	3.4	0.933	0.896	27.52	21.76
FD6	59029.1	151	199.3	52.2	64.2		0	0.166	0.165	6.0	6.1	0.872	0.871	25.89	22.61
FD6	59029.2	151	200.2	51.2	63.1		0	0.152	0.153	7.2	12.4	0.841	0.848	25.60	20.47
FD6	59029.3	151	204.0	51.9	63.4		0	0.148	0.141	5.4	5.0	0.825	0.819	26.86	20.27
FD6	59029.4	151	209.4	50.5	63.1		0	0.170	0.170	5.9	5.9	0.840	0.837	26.39	22.07
FD6	59041.1	197	201.5	50.9	65.0		0	0.161	0.165	7.5	5.5	0.901	0.901	26.53	22.83
FD6	59041.2	197	205.1	50.7	64.4		0	0.141	0.167	12.8	6.0	0.869	0.884	28.83	19.07
FD6	59041.3	197	197.8	50.2	61.8		0	0.107	0.099	10.3	14.1	0.824	0.810	24.50	21.16
FD6	59041.4	197	198.7	50.6	64.2		0	0.147	0.184	7.5	6.0	0.827	0.859	28.54	19.86
FD6	59052.1	243	202.1	51.6	66.5		0	0.205	0.172	7.3	10.5	0.866	0.841	27.64	20.13
FD6	59052.2	243	207.8	50.2	65.0		0	0.188	0.187	10.6	11.2	0.830	0.836	28.77	19.98
FD6	59052.3	243	201.3	51.4	67.4		0	0.206	0.193	5.8	13.0	0.835	0.819	28.60	20.74
FD6	59052.4	243	204.8	51.8	66.7		0	0.196	0.170	15.8	17.6	0.808	0.799	30.04	18.06
FD6	59062.1	295	194.0	52.0	67.8		0	0.178	0.187	7.9	6.4	0.809	0.814	28.87	18.66
FD6	59062.2	295	195.8	50.8	67.2		0	0.188	0.153	5.9	18.3	0.802	0.779	27.34	18.48
FD6	59062.4	295	199.7	51.2	67.1		0	0.153	0.167	5.9	7.8	0.809	0.830	24.55	22.19
FD7	59075.2	91	191.5	49.8	62.8		0	0.169	0.164	13.6	16.5	0.910	0.906	29.09	20.60
FD7	59075.3	91	204.1	51.4	62.8		0	0.183	0.176	3.3	5.7	0.919	0.957	30.04	18.61
FD7	59075.4	91	194.3	52.6	62.3		0	0.165	0.151	3.6	6.6	0.947	0.946	27.58	17.20
FD7	59028.1	151	197.0	48.1	60.3		0	0.192	0.199	7.8	6.0	0.795	0.815	30.33	20.72
FD7	59028.2	151	198.5	49.5	62.1		0	0.161	0.182	9.9	9.9	0.779	0.794	25.78	19.37
FD7	59028.4	151	201.6	49.2	60.8		0	0.151	0.153	4.6	11.8	0.765	0.780	26.47	21.47

Table A9 Continued. Impulse Drying for Case C2 on the X2 Shoe Press using the IPST-C roll
(Felt B, 0" pivot, and 8500 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD7	59042.1	197	185.7	49.8	63.0		0	0.173	0.165	6.9	5.5	0.958	0.949	28.43	22.24
FD7	59042.2	197	197.7	49.3	62.1		0	0.148	0.122	9.5	15.6	0.922	0.888	26.80	19.29
FD7	59042.3	197	194.2	48.6	62.1		0	0.148	0.157	4.1	10.8	0.906	0.900	27.29	21.34
FD7	59042.4	197	188.9	48.7	61.7		0	0.124	0.138	13.7	13.0	0.867	0.867	26.96	19.73
FD7	59053.1	243	201.3	50.9	63.2		0	0.115	0.133	17.4	9.0	0.894	0.937	27.34	18.91
FD7	59053.2	243	198.2	49.6	63.2		0	0.152	0.129	7.9	6.2	0.959	0.942	27.10	19.92
FD7	59053.3	243	197.3	50.9	63.6		0	0.166	0.159	5.4	5.0	0.977	0.985	29.46	22.71
FD7	59053.4	243	197.7	51.1	64.7		0	0.158	0.152	8.2	9.2	0.977	0.988	27.07	22.77
FD7	59063.1	295	191.9	51.3	64.5		1	0.112	0.117	6.3	3.4	0.934	0.946	27.39	22.62
FD7	59063.2	295	198.7	51.0	64.6		1	0.134	0.131	5.2	2.3	0.964	0.956	28.26	21.89
FD7	59063.3	295	190.2	50.5	63.6		0	0.108	0.117	6.5	3.4	0.927	0.974	27.79	20.69
FD7	59063.4	295	198.7	51.4	64.1		0	0.122	0.132	7.4	9.8	0.940	0.947	29.13	20.27

Table A10. Impulse Drying for Case C3 on the X2 Shoe Press using the IPST-C roll
(Felt B, 2" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59098.1	91	201.5	50.9	58.8		0	0.134	0.205	44.0	5.9	0.825	0.932	29.20	22.65
WF1	59098.3	91	203.1	51.0	63.9		0	0.210	0.191	4.8	4.2	0.930	0.911	36.24	21.68
WF1	59076.1	152	211.9	51.9	53.6		0	0.058	0.074	25.9	8.1	0.729	0.821	22.77	18.48
WF1	59076.2	152	195.7	51.5	64.0		0	0.165	0.165	9.1	10.3	0.883	0.902	33.53	22.62
WF1	59076.3	152	208.0	51.1	64.1		0	0.157	0.145	15.9	5.5	0.910	0.890	32.69	21.95
WF1	59076.4	152	204.3	52.4	64.9		0	0.148	0.151	13.5	13.2	0.909	0.913	31.64	22.09
WF1	59082.1	200	212.1	51.5	64.5		0	0.112	0.129	22.3	24.0	0.887	0.919	28.30	19.02
WF1	59082.2	200	193.3	51.8	63.5		0	0.064	0.107	40.6	25.2	0.792	0.873	25.30	18.56
WF1	59082.3	200	205.5	50.7	64.3		0	0.084	0.116	23.8	13.8	0.861	0.921	28.39	20.58
WF1	59082.4	200	204.5	52.1	65.0		0	0.063	0.141	23.8	15.6	0.757	0.918	27.70	21.24
WF1	59088.1	247	204.8	52.1	64.7		0	0.118	0.116	16.1	12.9	0.927	0.954	29.27	20.12
WF1	59088.2	247	193.3	53.1	66.2		0	0.092	0.114	26.1	23.7	0.878	0.951	26.32	21.49
WF1	59088.3	247	207.6	51.9	65.2		0	0.134	0.186	13.4	10.8	0.896	0.931	27.14	21.53
WF1	59088.4	247	199.7	51.9	64.9		0	0.077	0.095	24.7	11.6	0.774	0.809	26.06	19.28
WF2	59099.1	91	212.9	53.6	58.1		0	0.223	0.210	4.9	3.3	0.886	0.913	36.43	24.14
WF2	59099.2	91	211.3	52.4	60.9		0	0.234	0.252	4.7	5.2	0.898	0.911	38.77	26.45
WF2	59099.3	91	202.1	51.0	58.5		0	0.214	0.188	7.5	10.6	0.882	0.869	36.29	23.42
WF2	59099.4	91	209.4	49.5	58.0		0	0.228	0.243	3.9	3.3	0.913	0.930	39.01	26.98
WF2	59077.1	150	199.7	50.5	60.7		0	0.148	0.186	41.9	22.6	0.815	0.833	32.01	22.91
WF2	59077.2	150	210.1	51.1	60.4		0	0.222	0.258	6.8	7.4	0.832	0.863	34.22	25.44
WF2	59077.3	150	210.6	52.2	61.6		0	0.261	0.273	7.3	2.9	0.847	0.861	35.43	24.95
WF2	59077.4	150	210.9	51.1	59.7		0	0.283	0.301	7.1	4.3	0.836	0.845	38.04	25.26
WF2	59083.1	200	204.3	48.1	59.1		0	0.086	0.103	30.2	37.9	0.680	0.737	26.86	20.59
WF2	59083.2	200	202.1	50.0	61.1		0	0.127	0.231	27.6	13.0	0.743	0.819	33.22	23.15
WF2	59083.3	200	206.6	48.9	59.7		0	0.145	0.179	18.6	22.3	0.768	0.791	32.65	23.10
WF2	59083.4	200	203.3	52.0	62.5		0	0.206	0.243	24.8	5.8	0.802	0.834	35.04	24.02
WF2	59089.1	247	211.3	53.6	64.0		0	0.193	0.162	7.3	9.9	0.855	0.862	31.83	21.93
WF2	59089.2	247	202.5	49.5	60.9		0	0.172	0.188	12.2	3.2	0.842	0.857	33.01	23.61
WF2	59089.3	247	209.4	51.8	62.2		0	0.225	0.222	7.1	4.1	0.844	0.868	34.93	23.97
WF2	59089.4	247	204.5	50.8	61.9		0	0.169	0.160	10.1	9.4	0.851	0.853	33.69	22.61

Table A10 Continued. Impulse Drying for Case C3 on the X2 Shoe Press using the IPST-C roll (Felt B, 2" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF3	59100.1	91	204.8	51.5	61.9		0	0.206	0.179	8.3	22.9	0.829	0.811	29.73	21.41
WF3	59100.2	91	214.9	50.5			0	0.156	0.241	25.0	5.4	0.758	0.839	28.24	22.32
WF3	59100.3	91	194.8	50.8	61.9		0	0.195	0.213	10.8	7.0	0.802	0.818	29.10	22.01
WF3	59078.2	148	213.3	52.0	63.1		0	0.228	0.225	11.0	7.1	0.927	0.937	32.73	23.75
WF3	59078.3	148	208.1	52.4	64.8		0	0.205	0.214	8.8	5.6	0.913	0.924	29.90	23.52
WF3	59078.4	148	201.0	51.6	57.6		0	0.179	0.201	6.1	13.4	0.851	0.879	31.29	22.02
WF3	59084.1	200	217.1	53.2	65.4		3	0.103	0.094	39.8	30.9	0.790	0.823	22.66	19.56
WF3	59084.2	200	223.7	52.7	64.5		3	0.126	0.131	30.2	29.0	0.827	0.840	30.05	21.41
WF3	59084.3	200	195.3	50.9	64.9		3	0.138	0.154	21.7	22.7	0.814	0.835	28.28	22.43
WF3	59084.4	200	199.3	50.9	63.9		3	0.132	0.159	17.4	17.0	0.813	0.829	32.32	20.82
WF3	59090.1	247	219.9	51.8	64.3		0	0.176	0.191	14.2	11.5	0.912	0.914	31.83	23.15
WF3	59090.2	247	216.6	51.7	65.0		0	0.147	0.168	12.9	11.9	0.896	0.893	29.14	21.13
WF3	59090.3	247	209.1	49.9	65.4		0	0.141	0.162	10.6	10.5	0.892	0.905	28.29	21.75
WF3	59090.4	247	210.4	49.5	63.8		0	0.129	0.135	10.9	12.6	0.957	0.991	30.02	21.71
FD5	59101.1	91	185.0	51.7	58.8		0	0.179	0.159	4.5	22.6	0.815	0.803	30.02	16.60
FD5	59101.2	91	218.7	50.8	55.9		0	0.179	0.147	6.1	16.3	0.793	0.781	28.12	18.06
FD5	59101.3	91	191.9	51.2	57.8		0	0.178	0.176	6.2	5.1	0.801	0.809	32.83	16.79
FD5	59101.4	91	216.7	50.6	54.7		0	0.184	0.173	2.2	6.4	0.799	0.785	30.91	16.44
FD5	59079.1	147	190.2	51.9	59.5		0	0.173	0.156	6.4	7.1	0.846	0.834	30.66	17.06
FD5	59079.2	147	209.4	50.0	57.2		0	0.168	0.151	6.5	9.3	0.799	0.793	27.71	17.85
FD5	59079.3	147	204.0	50.2	58.7		0	0.142	0.138	11.3	8.0	0.789	0.799	29.87	16.23
FD5	59079.4	147	190.4	51.6	61.8		0	0.150	0.159	8.0	4.4	0.811	0.825	31.01	18.04
FD5	59085.2	200	187.4	54.8	63.2		3	0.124	0.112	8.1	21.4	0.800	0.799	27.01	17.00
FD5	59091.2	247	201.3	53.4	64.8		2	0.139	0.118	3.6	12.7	0.943	0.923	24.94	22.92
FD5	59091.3	247	213.9	52.1	60.7		2	0.127	0.128	4.7	9.4	0.875	0.876	29.10	16.75
FD6	59102.1	91	201.6	53.4	63.0		0	0.129	0.120	5.4	11.7	0.845	0.843	27.11	17.68
FD6	59102.2	91	219.1	51.8	61.2		0	0.129	0.101	7.0	17.8	0.824	0.807	26.38	18.46
FD6	59102.3	91	205.3	51.8	61.0		0	0.159	0.152	5.0	11.8	0.842	0.843	27.58	19.27
FD6	59102.4	91	198.8	52.2	61.8		0	0.135	0.114	10.4	21.1	0.815	0.811	26.38	17.32

Table A10 Continued. Impulse Drying for Case C3 on the X2 Shoe Press using the IPST-C roll (Felt B, 2" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD6	59080.2	146	211.6	53.7	64.5		0	0.149	0.152	8.1	6.6	0.904	0.959	26.38	20.67
FD6	59080.3	146	192.5	52.9	65.2		0	0.131	0.149	3.1	5.4	0.946	0.957	26.13	20.86
FD6	59080.4	146	197.7	51.4	64.0		0	0.138	0.128	5.8	12.5	0.923	0.923	26.71	21.83
FD6	59086.1	200	207.5	51.7	65.2		0	0.154	0.151	5.8	6.6	0.854	0.847	26.02	20.32
FD6	59086.2	200	198.2	52.8	66.0		0	0.164	0.159	3.0	4.4	0.854	0.848	27.33	20.02
FD6	59086.3	200	207.0	50.6	64.7		0	0.168	0.175	6.0	3.4	0.856	0.853	25.99	21.12
FD6	59086.4	200	203.0	51.6	65.3		0	0.166	0.162	4.2	11.1	0.856	0.858	25.45	20.77
FD6	59092.1	247	200.5	51.1	65.0		0	0.148	0.166	17.6	7.8	0.843	0.859	25.94	18.91
FD6	59092.2	247	207.6	50.7	66.3		0	0.170	0.176	4.7	11.9	0.867	0.860	25.65	22.94
FD6	59092.3	247	197.8	50.9	67.2		0	0.145	0.160	6.9	3.8	0.906	0.901	25.91	21.31
FD6	59092.4	247	201.0	51.7	67.6		0	0.164	0.164	4.9	5.5	0.887	0.878	26.68	21.52
FD6	59094.1	297	203.6	51.7	68.7		0	0.164	0.150	11.0	8.7	0.864	0.843	28.89	17.64
FD6	59094.2	297	207.1	50.2	67.6		0	0.088	0.094	27.3	28.7	0.778	0.781	22.18	18.26
FD6	59094.3	297	203.0	51.0	65.6		0	0.155	0.145	11.6	11.0	0.811	0.804	27.62	18.78
FD6	59094.4	297	199.2	51.4	67.2		0	0.179	0.176	14.0	8.5	0.817	0.810	24.68	21.58
FD6	59096.1	316	207.0	50.4	67.4		0	0.129	0.131	13.2	12.2	0.953	0.955	25.49	20.07
FD6	59096.2	316	210.4	52.9	68.1		0	0.108	0.117	14.8	13.7	0.907	0.905	28.18	16.48
FD6	59096.3	316	205.0	50.9	69.2		0	0.134	0.148	9.7	7.4	0.930	0.921	25.83	22.39
FD6	59096.4	316	199.0	51.2	69.2		0	0.147	0.140	6.8	10.0	0.907	0.901	25.89	22.93
FD7	59103.1	91	201.0	49.2	59.2		0	0.145	0.126	9.7	7.9	0.862	0.855	28.60	20.19
FD7	59103.3	91	197.0	48.2	58.4		0	0.145	0.145	6.2	7.6	0.835	0.834	29.10	20.88
FD7	59103.4	91	194.3	50.1	59.7		0	0.155	0.147	9.0	11.6	0.852	0.849	29.98	19.80
FD7	59081.1	145	199.8	51.3	60.7		0	0.160	0.127	5.0	7.9	0.962	0.948	30.61	21.01
FD7	59081.3	145	195.7	53.8	63.3		0	0.162	0.161	3.7	3.7	0.964	0.962	29.81	22.17
FD7	59081.4	145	197.0	53.7	63.2		0	0.170	0.165	4.1	9.1	0.956	0.935	29.26	20.46
FD7	59087.1	200	192.7	51.2	64.2		0	0.187	0.187	3.7	4.8	0.805	0.806	29.44	19.47
FD7	59087.2	200	204.3	50.8	63.3		0	0.209	0.204	5.3	3.4	0.805	0.805	29.78	20.40
FD7	59087.3	200	199.0	49.6	62.7		0	0.196	0.210	5.6	2.9	0.801	0.801	28.98	22.69
FD7	59087.4	200	193.2	49.8	62.1		0	0.192	0.195	5.7	4.1	0.796	0.804	28.31	21.94

Table A10 Continued. Impulse Drying for Case C3 on the X2 Shoe Press using the IPST-C roll
(Felt B, 2" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD7	59093.1	247	194.5	50.7	64.3		0	0.178	0.168	8.4	8.3	0.815	0.803	27.66	18.41
FD7	59093.2	247	195.7	49.5	64.5		0	0.172	0.175	5.2	5.7	0.807	0.803	26.33	21.07
FD7	59093.3	247	196.7	48.9	64.2		0	0.175	0.190	6.3	4.2	0.815	0.794	27.58	19.26
FD7	59093.4	247	202.8	48.8	62.9		0	0.181	0.192	9.4	4.7	0.761	0.766	24.74	20.28
FD7	59095.1	297	187.5	49.2	64.3		2	0.119	0.131	31.1	6.1	0.741	0.799	24.84	21.08
FD7	59095.2	297	198.3	49.4	65.3		1	0.138	0.142	11.6	9.9	0.804	0.803	27.49	20.58
FD7	59095.3	297	193.3	48.5	65.7		1	0.121	0.132	17.4	6.1	0.784	0.778	28.41	19.23
FD7	59095.4	297	187.0	50.4	67.2		1	0.115	0.108	20.0	20.4	0.784	0.766	27.93	16.98
FD7	59097.1	316	194.3	49.0	66.4		1	0.088	0.109	27.3	11.9	0.867	0.878	26.43	20.24
FD7	59097.2	316	191.5	48.7	65.5		1	0.098	0.079	12.2	29.1	0.878	0.913	26.97	20.76
FD7	59097.4	316	195.5	48.9	65.7		0	0.110	0.111	7.3	10.8	0.924	0.932	27.49	19.43

Table A11. Impulse Drying for Case A1 on the X2 Shoe Press using the Beloit-A roll
(Felt B, 0" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59161.1	71	197.5	53.1	61.2		0	0.132	0.156	33.3	10.3	0.768	0.826	29.60	21.02
WF1	59161.4	71	211.1	52.0	61.0		0	0.074	0.115	44.6	33.0	0.710	0.751	24.34	17.95
WF1	59122.1	144	203.1	51.4	65.7		0	0.188	0.195	3.2	7.2	0.930	0.982	35.69	22.60
WF1	59122.2	144	217.1	54.2	67.0		0	0.195	0.202	4.1	7.4	0.903	0.911	35.21	24.92
WF1	59122.3	144	213.6	54.2	67.2		0	0.189	0.194	9.5	3.1	0.902	0.929	36.09	23.13
WF1	59122.4	144	207.5	51.9	64.6		0	0.218	0.218	5.0	4.1	0.911	0.927	37.25	23.53
WF1	59134.1	202	216.6	54.2	67.3		0	0.206	0.220	4.4	7.7	0.936	0.958	34.78	25.63
WF1	59134.2	202	210.6	53.9	69.1		0	0.200	0.191	8.0	11.5	0.928	0.917	34.85	22.46
WF1	59134.3	202	210.1	52.9	66.9		0	0.194	0.185	4.6	20.5	0.899	0.897	35.39	24.42
WF1	59134.4	202	209.6	52.1	67.1		0	0.194	0.216	15.5	6.9	0.903	0.918	33.06	24.85
WF1	59145.1	254	202.1	52.7	70.4		0	0.161	0.161	14.9	8.7	0.900	0.919	34.80	22.05
WF1	59145.2	254	204.1	51.8	68.3		0	0.179	0.184	14.5	10.9	0.901	0.899	34.15	23.80
WF1	59145.3	254	201.5	52.6	71.0		0	0.167	0.159	12.6	13.8	0.898	0.902	34.99	21.99
WF1	59145.4	254	206.6	53.0	71.7		3	0.080	0.102	53.8	56.9	0.834	0.827	31.08	19.39
WF2	59123.1	144	208.9	53.8	63.8		0	0.238	0.238	9.2	5.9	0.901	0.901	36.55	25.54
WF2	59155.1	177	204.3	51.2	61.9		0	0.217	0.218	8.8	12.4	0.921	0.939	36.49	24.39
WF2	59155.2	177	207.6	50.5	61.3		0	0.197	0.210	7.6	4.8	0.889	0.894	36.58	24.96
WF2	59155.3	177	200.3	52.6	63.7		0	0.191	0.193	11.5	17.1	0.885	0.909	34.80	23.20
WF2	59155.4	177	208.9	51.5	60.6		0	0.215	0.224	9.8	6.3	0.900	0.934	37.34	25.75
WF2	59135.1	202	216.1	51.2	63.2		0	0.240	0.250	8.3	7.2	0.940	0.938	37.65	26.28
WF2	59135.2	202	210.9	49.4	60.2		0	0.198	0.214	10.6	6.1	0.910	0.926	36.42	26.30
WF2	59135.3	202	198.8	52.0	64.3		0	0.222	0.223	10.4	8.5	0.919	0.971	36.81	25.06
WF2	59135.4	202	202.6	53.0	57.3		1	0.075	0.052	37.3	21.2	0.778	0.781	28.86	18.07
WF2	59146.1	254	209.6	54.6	67.8		0	0.172	0.174	9.9	7.5	0.895	0.931	33.88	23.81
WF2	59146.2	254	210.9	52.5	64.4		0	0.144	0.129	6.9	10.1	0.874	0.886	34.69	22.12
WF2	59146.3	254	202.6	51.4	65.1		0	0.177	0.207	9.6	8.7	0.905	0.907	34.89	24.36
WF2	59146.4	254	211.8	52.7	64.5		0	0.166	0.165	8.4	9.1	0.858	0.857	35.04	22.67
WF3	59124.1	144	201.6	51.1	65.1		0	0.211	0.197	3.3	4.6	0.871	0.884	28.53	22.29
WF3	59124.2	144	216.7	51.3	64.1		0	0.239	0.233	4.6	3.0	0.869	0.868	32.36	23.81
WF3	59124.3	144	221.7	54.2	64.5		0	0.232	0.246	3.9	3.3	0.876	0.868	32.46	23.48

Table A11 Continued. Impulse Drying for Case A1 on the X2 Shoe Press using the Beloit-A roll (Felt B, 0" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF3	59157.1	177	212.6	50.8	63.4		0	0.190	0.207	13.2	6.8	0.819	0.814	31.03	22.82
WF3	59157.2	177	205.6	51.2	65.2		0	0.204	0.214	6.9	3.3	0.812	0.832	29.25	22.29
WF3	59157.3	177	211.3	50.8	63.8		0	0.199	0.212	6.0	10.8	0.827	0.857	30.70	22.53
WF3	59157.4	177	204.0	51.3	64.1		0	0.174	0.198	18.4	9.1	0.815	0.862	30.18	22.66
WF3	59136.1	202	212.1	48.5	65.6		0	0.193	0.213	7.3	7.5	0.878	0.905	31.95	24.02
WF3	59136.3	202	219.4	52.7	65.4		2	0.130	0.211	59.2	6.2	0.786	0.890	28.45	22.19
WF3	59147.1	254	213.3	52.2	67.4		0	0.176	0.168	6.8	7.1	0.835	0.802	29.86	20.87
WF3	59147.2	254	218.2	51.2	66.3		3	0.119	0.148	33.6	39.9	0.767	0.760	29.10	20.60
FD5	59159.4	121	207.6	52.5	60.2		0	0.117	0.118	6.8	7.6	0.789	0.801	30.35	16.03
FD5	59125.3	144	213.9	50.9	58.5		0	0.139	0.129	8.6	10.9	0.790	0.784	31.42	16.23
FD5	59125.4	144	208.3	49.5	60.0		3	0.122	0.115	4.1	8.7	0.787	0.769	25.82	18.29
FD5	59137.2	202	200.0	54.3			3	0.048	0.066	14.6	15.2	0.706	0.758	21.60	14.89
FD5	59137.4	202	191.4		63.8		3	0.068	0.072	7.4	6.9	0.726	0.749	27.48	14.80
FD6	59126.4	144	191.9	55.0	66.8		0	0.179	0.186	5.6	7.0	0.826	0.836	29.93	18.42
FD6	59138.1	202	203.8	52.7	68.1		0	0.193	0.187	7.8	9.1	0.862	0.871	26.41	21.64
FD6	59138.2	202	202.1	51.1	66.9		0	0.183	0.187	4.4	5.9	0.848	0.858	29.65	20.12
FD6	59138.3	202	202.3	50.7	66.1		0	0.181	0.159	5.5	19.5	0.842	0.845	26.24	22.39
FD6	59138.4	202	191.0	51.0	67.3		0	0.190	0.189	4.2	5.3	0.876	0.882	30.06	22.64
FD6	59148.1	254	201.8	52.1	69.8		3	0.106	0.081	37.7	33.3	0.845	0.812	24.84	17.19
FD6	59148.2	254	208.5	50.6	69.5		3	0.130	0.121	13.8	30.6	0.856	0.861	24.79	20.80
FD6	59148.3	254	214.4	51.8	68.0		0	0.128	0.144	7.0	5.6	0.845	0.872	28.21	17.30
FD6	59148.4	254	206.1	51.1	69.4		0	0.143	0.161	11.2	10.6	0.866	0.886	27.18	20.33

Table A11 Continued. Impulse Drying for Case A1 on the X2 Shoe Press using the Beloit-A roll (Felt B, 0" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD7	59127.3	144	203.8	53.5	63.5		0	0.165	0.174	3.0	6.9	0.850	0.868	28.69	20.50
FD7	59127.4	144	194.8	52.2	63.9		0	0.180	0.184	3.9	6.0	0.856	0.863	29.23	22.05
FD7	59139.1	202	201.8	52.5	65.2		2	0.143	0.117	9.8	23.9	0.883	0.859	27.89	17.88
FD7	59139.2	202	205.1	52.9	63.9		1	0.154	0.150	4.5	8.7	0.872	0.878	31.52	19.53
FD7	59139.3	202	198.7	53.5	66.5		2	0.155	0.163	21.3	5.5	0.886	0.902	29.18	19.06
FD7	59149.1	254	197.5	51.1	66.0		1	0.105	0.115	16.2	13.0	0.853	0.861	26.28	20.44
FD7	59149.2	254	205.1	49.9	66.2		2	0.089	0.108	20.2	14.8	0.823	0.825	24.87	20.49
FD7	59149.3	254	198.5	50.7	66.8		1	0.080	0.092	11.3	13.0	0.819	0.828	26.92	18.36
FD7	59149.4	254	213.3	53.3	68.0		2	0.102	0.081	20.6	13.6	0.826	0.822	28.56	17.73

Table A12. Impulse Drying for Case A2 on the X2 Shoe Press using the Beloit-A roll
(Felt B, 0" pivot, and 8500 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59128.1	144	196.5	52.8	65.3		0	0.210	0.204	9.0	9.8	0.918	0.915	37.04	23.13
WF1	59128.2	144	205.3	51.5	65.7		0	0.226	0.234	9.7	2.6	0.911	0.922	36.09	24.28
WF1	59128.3	144	200.3	52.1	65.8		0	0.233	0.232	10.3	7.3	0.914	0.886	37.65	24.47
WF1	59128.4	144	197.7	53.4	67.1		0	0.218	0.222	10.1	7.2	0.893	0.922	34.35	22.09
WF1	59140.1	202	208.0	53.1	67.6		0	0.216	0.228	9.3	9.2	0.923	0.931	35.37	23.29
WF1	59140.2	202	211.3	52.2	68.5		0	0.217	0.254	16.6	8.3	0.909	0.938	34.06	24.74
WF1	59140.3	202	210.8	53.0	68.3		0	0.144	0.205	20.8	17.6	0.849	0.927	30.70	23.07
WF1	59140.4	202	212.1	52.7	67.9		0	0.231	0.228	6.5	15.4	0.929	0.930	35.95	22.52
WF1	59150.1	254	213.9	52.9	68.8		0	0.198	0.216	16.7	9.7	0.912	0.924	33.38	23.85
WF1	59150.2	254	190.9	52.0	71.1		1	0.112	0.155	55.4	41.9	0.846	0.918	30.48	20.97
WF1	59150.3	254	216.4	52.4	69.6		3	0.063	0.077	12.7	36.4	0.770	0.814	26.12	18.52
WF1	59150.4	254	187.5	52.8	69.6		2	0.096	0.120	39.6	29.2	0.846	0.896	30.29	19.94
WF2	59129.1	144	209.8	50.9	62.0		0	0.221	0.224	4.1	5.8	0.919	0.925	37.72	27.56
WF2	59129.2	144	204.0	51.6	62.7		0	0.233	0.242	3.4	5.0	0.917	0.947	36.42	27.47
WF2	59129.3	144	205.8	50.7	61.9		0	0.227	0.216	6.2	4.2	0.915	0.917	38.09	26.04
WF2	59129.4	144	212.1	50.9	63.0		0	0.241	0.242	3.3	3.7	0.917	0.943	38.31	28.09
WF2	59156.1	177	208.5	52.2	59.6		0	0.193	0.211	10.4	9.5	0.883	0.894	36.77	26.16
WF2	59156.2	177	210.4	52.1	61.6		0	0.207	0.211	10.1	15.2	0.866	0.902	37.98	25.49
WF2	59156.3	177	209.4	53.0	64.6		0	0.217	0.233	12.0	5.2	0.890	0.888	35.33	25.23
WF2	59156.4	177	210.6	49.8	60.4		0	0.226	0.243	10.2	7.4	0.868	0.885	38.41	27.62
WF2	59141.1	202	215.6	53.6	65.9		0	0.213	0.223	13.6	9.0	0.883	0.900	37.84	27.08
WF2	59141.2	202	207.6	51.4	63.1		0	0.192	0.203	13.5	7.4	0.867	0.872	35.78	25.19
WF2	59141.3	202	213.9	52.9	64.3		0	0.242	0.217	5.8	7.8	0.883	0.869	36.41	24.01
WF2	59141.4	202	205.1	50.8	63.1		0	0.229	0.214	5.7	11.2	0.873	0.886	38.67	27.30

Table A12 Continued. Impulse Drying for Case A2 on the X2 Shoe Press using the Beloit-A roll (Felt B, 0" pivot, and 8500 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF2	59151.1	254	200.8	50.9	65.2		0	0.202	0.175	3.5	4.6	0.883	0.883	35.04	23.96
WF2	59151.2	254	209.6	51.2	65.4		0	0.158	0.166	5.1	7.8	0.847	0.851	36.30	24.05
WF2	59151.3	254	209.9	53.3	66.6		0	0.194	0.220	7.2	7.3	0.844	0.883	36.02	25.91
WF2	59151.4	254	209.1	52.9	64.9		1	0.091	0.089	34.1	18.0	0.767	0.777	28.66	21.17
WF3	59130.2	144	205.1	49.9	65.1		0	0.247	0.251	3.2	3.2	0.832	0.844	31.20	23.14
WF3	59130.3	144	220.6	50.0	63.9		0	0.235	0.244	6.0	3.7	0.826	0.842	30.83	22.50
WF3	59130.4	144	216.1	51.2	64.7		0	0.238	0.242	6.3	4.5	0.822	0.846	32.86	23.65
WF3	59158.2	177	204.1	50.9	65.6		0	0.202	0.204	7.4	6.9	0.804	0.821	29.79	23.64
WF3	59158.4	177	211.8	50.4	65.1		0	0.220	0.197	4.5	6.1	0.822	0.819	30.49	23.16
WF3	59142.1	202	207.1	52.6	68.6		0	0.230	0.227	3.5	4.4	0.832	0.833	30.78	24.20
WF3	59142.2	202	217.9	52.1	66.3		3	0.113	0.215	67.3	11.6	0.753	0.829	26.35	22.18
WF3	59142.4	202	209.1	54.5	62.7		0	0.174	0.153	4.6	10.5	0.790	0.800	29.54	20.91
WF3	59152.2	254	201.1	51.0	69.8		3	0.143	0.147	32.2	25.9	0.821	0.818	26.39	20.59
WF3	59152.3	254	218.1	50.6	68.0		0	0.209	0.219	4.3	6.4	0.857	0.857	31.02	22.93
WF3	59152.4	254	215.6	51.6	68.4		3	0.146	0.129	36.3	36.4	0.808	0.810	28.30	21.05
FD5	59160.1	121	208.3	52.6	59.8		0	0.162	0.158	6.8	7.0	0.739	0.746	32.11	17.20
FD5	59160.2	121	210.1	52.6	61.0		0	0.144	0.147	9.0	8.2	0.737	0.738	31.13	17.15
FD5	59160.3	121	187.7	52.8	62.9		0	0.150	0.110	10.0	18.2	0.724	0.814	30.88	15.26
FD5	59160.4	121	213.1	51.3	59.9		0	0.144	0.137	9.0	7.3	0.813	0.817	25.88	21.25
FD5	59131.2	144	210.6	49.8	61.0		2	0.152	0.141	5.9	10.6	0.848	0.845	30.89	18.50
FD5	59131.3	144	197.5	50.3	63.6		3	0.082	0.109	39.0	41.3	0.790	0.828	27.73	15.83

Table A12 Continued. Impulse Drying for Case A2 on the X2 Shoe Press using the Beloit-A roll (Felt B, 0" pivot, and 8500 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD6	59132.1	144	204.8	53.8	68.6		0	0.209	0.216	2.4	3.7	0.939	0.957	28.32	24.82
FD6	59132.4	144	210.3	52.6	66.1		0	0.205	0.196	5.9	5.6	0.867	0.850	27.76	22.37
FD6	59143.1	202	202.5	51.9	67.1		0	0.170	0.199	8.2	8.0	0.827	0.833	26.67	23.67
FD6	59143.2	202	209.6	52.1	68.2		0	0.203	0.208	4.9	3.8	0.842	0.845	30.82	19.02
FD6	59143.3	202	208.3	50.6	66.8		0	0.233	0.224	4.3	7.6	0.841	0.846	28.76	24.25
FD6	59143.4	202	208.5	52.2	69.0		0	0.206	0.200	10.7	23.5	0.834	0.829	29.02	19.39
FD6	59153.1	254	210.9	51.6	69.3		1	0.155	0.159	14.8	18.2	0.791	0.788	28.55	17.41
FD6	59153.2	254	204.8	51.7	71.3		1	0.157	0.192	12.1	8.9	0.788	0.801	24.87	21.65
FD6	59153.3	254	198.0	50.3	70.1		1	0.200	0.201	8.0	12.4	0.802	0.792	28.85	23.60
FD6	59153.4	254	205.0	50.3	69.0		2	0.131	0.146	32.1	32.9	0.759	0.755	26.86	21.93
FD7	59133.1	144	198.8	53.2	65.1		0	0.198	0.217	8.1	5.1	0.788	0.795	30.93	20.50
FD7	59133.2	144	206.1	52.0	66.4		0	0.225	0.239	4.9	3.3	0.787	0.800	31.33	24.15
FD7	59133.3	144	209.6	52.3	68.1		0	0.234	0.232	3.4	7.8	0.793	0.792	32.65	21.36
FD7	59133.4	144	203.8	49.4	64.1		0	0.227	0.225	5.7	9.8	0.776	0.778	32.88	21.85
FD7	59144.1	202	197.8	51.4	67.2		0	0.204	0.196	5.4	5.1	0.777	0.772	28.60	23.12
FD7	59144.2	202	191.2	52.5	67.6		3	0.090	0.160	51.1	20.6	0.689	0.776	26.24	18.31
FD7	59144.3	202	199.5	52.4	66.4		0	0.177	0.161	6.2	4.3	0.794	0.786	29.38	19.41
FD7	59144.4	202	204.8	52.5	66.6		3	0.178	0.169	9.0	17.2	0.800	0.804	28.02	19.30
FD7	59154.1	254	200.2	49.9	67.8		3	0.135	0.129	8.9	13.2	0.789	0.790	28.33	20.47
FD7	59154.2	254	197.7	50.9	68.4		1	0.136	0.139	11.0	15.1	0.794	0.795	28.84	19.79
FD7	59154.3	254	196.0	50.1	67.7		1	0.098	0.106	17.3	14.2	0.906	0.895	28.09	20.61
FD7	59154.4	254	195.7	50.9	68.0		1	0.098	0.113	28.6	10.6	0.899	0.898	28.16	20.33

Table A13. Impulse Drying for Case A4 on the X2 Shoe Press using the Beloit-A roll
(Felt S, 0" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59292.1	49	207.3	52.2	60.6		0	0.119	0.139	15.1	17.3	0.773	0.775	26.57	19.41
WF1	59292.3	49	203.6	50.2	59.2		0	0.115	0.123	38.3	26.0	0.769	0.739	26.41	17.22
WF1	59292.4	49	196.7	52.0	61.0		0	0.174	0.175	9.2	5.1	0.746	0.748	30.42	21.07
WF1	59292.5	49	189.7	50.8	57.0		0	0.170	0.190	16.5	7.9	0.732	0.738	29.73	21.35
WF1	59168.1	129	187.2	54.0	65.5		0	0.176	0.236	10.8	7.6	0.827	0.853	30.91	23.07
WF1	59168.2	129	209.4	51.7	63.5		0	0.198	0.234	16.7	9.8	0.821	0.855	31.54	23.90
WF1	59168.3	129	218.6	51.4	63.2		0	0.212	0.212	15.1	17.9	0.828	0.841	34.39	22.23
WF1	59168.4	129	197.2	51.7	64.3		0	0.258	0.240	4.7	6.3	0.863	0.866	37.02	21.78
WF1	59180.1	157	215.3	53.2	64.5		0	0.224	0.263	7.6	4.6	0.843	0.877	32.37	22.68
WF1	59180.2	157	202.1	50.9	65.2	Yes	0	0.223	0.225	9.9	6.7	0.816	0.844	34.81	22.44
WF1	59180.3	157	201.0	51.7	66.4		0	0.267	0.271	7.5	3.3	0.855	0.882	34.12	24.29
WF1	59180.4	157	210.9	51.0	63.9	Yes	0	0.268	0.265	4.1	3.4	0.873	0.908	37.79	23.43
WF1	59192.3	210	201.0	50.8	67.2		2	0.229	0.163	10.9	52.8	0.936	0.905	33.43	22.08
WF1	59192.4	210	202.1	50.6	67.0		2	0.067	0.079	26.9	62.0	0.778	0.810	28.78	20.31
WF1	59204.1	210	188.9	51.9	69.2		0	0.265	0.243	6.0	13.6	0.805	0.786	34.05	21.87
WF1	59204.2	210	208.3	51.2	67.4		0	0.247	0.251	5.7	5.6	0.806	0.811	33.23	21.12
WF1	59204.3	210	199.5	50.0	67.4		0	0.306	0.293	4.2	4.1	0.812	0.808	37.15	23.53
WF1	59204.4	210	200.5	50.6	66.7		2	0.280	0.264	3.9	3.8	0.793	0.792	33.42	23.01
WF1	59205.1	232	195.2	51.9	69.2		1	0.164	0.179	37.2	33.0	0.742	0.736	30.71	19.12
WF1	59205.2	232	206.3	51.0	68.1		3	0.078	0.105	10.3	40.0	0.647	0.728	25.06	19.59
WF1	59205.3	232	199.7	51.4	68.2		3	0.075	0.150	6.7	50.0	0.681	0.757	27.10	20.32
WF1	59205.4	232	212.4	50.9	67.1		0	0.304	0.280	3.6	4.3	0.858	0.856	36.07	22.81

Table A13 Continued. Impulse Drying for Case A4 on the X2 Shoe Press using the Beloit-A roll
(Felt S, 0" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF2	59293.1	49	216.4	51.3	55.5		0	0.182	0.187	6.0	10.7	0.721	0.736	32.60	21.34
WF2	59293.2	49	207.1	49.3	55.0		0	0.164	0.171	15.9	15.8	0.718	0.713	32.21	20.94
WF2	59293.3	49	209.6	51.6	56.5		0	0.221	0.223	3.6	8.5	0.719	0.717	33.74	21.65
WF2	59293.4	49	198.8	49.2	54.6		0	0.211	0.222	6.6	4.1	0.718	0.740	33.08	22.58
WF2	59169.1	129	202.8	51.4	59.3		0	0.214	0.221	3.7	6.3	0.872	0.885	36.49	25.04
WF2	59169.2	129	208.5	54.1	61.7		0	0.237	0.229	11.0	6.6	0.872	0.889	34.37	23.38
WF2	59169.3	129	200.0	54.1	61.8		0	0.247	0.250	7.3	8.8	0.893	0.905	36.26	23.67
WF2	59181.1	157	196.5	48.8	58.0		0	0.221	0.224	4.1	2.7	0.877	0.895	35.98	25.18
WF2	59181.2	157	199.8	50.4	59.5		0	0.234	0.242	3.8	3.7	0.921	0.928	37.29	23.72
WF2	59181.3	157	208.6	49.4	57.8	Yes	0	0.220	0.225	14.1	5.3	0.871	0.893	33.84	25.04
WF2	59181.4	157	199.7	53.2	61.8		0	0.268	0.240	4.1	4.2	0.908	0.953	35.63	23.40
WF2	59193.1	210	210.1	50.6	63.3		1	0.240	0.225	5.4	8.0	0.946	0.956	34.77	23.81
WF2	59193.2	210	204.0	51.2	63.7		1	0.209	0.204	7.7	7.4	0.921	0.988	35.47	23.97
WF2	59193.3	210	202.0	50.0	61.6		1	0.073	0.085	49.3	35.3	0.824	0.835	26.64	17.15
WF2	59193.4	210	197.2	51.7	62.8		1	0.196	0.189	7.1	9.0	0.940	0.189	33.80	24.32
WF3	59294.1	49	188.0	48.4	58.0		0	0.155	0.151	6.5	11.3	0.717	0.739	26.83	18.99
WF3	59294.2	49	196.7	50.8	58.7		2	0.152	0.132	11.8	25.0	0.733	0.732	26.11	19.25
WF3	59294.3	49	213.4	49.1	57.6		0	0.128	0.114	13.3	12.3	0.730	0.720	25.80	17.38
WF3	59294.4	49	210.3	50.3	58.5		2	0.148	0.182	14.9	3.8	0.732	0.779	26.67	20.76
WF3	59170.1	129	213.3	53.0	62.4	Yes	0	0.194	0.173	10.3	16.2	0.905	0.911	31.40	20.55
WF3	59170.2	129	207.8	49.9	62.7		0	0.179	0.197	5.0	4.6	0.899	0.908	30.39	22.57
WF3	59170.4	129	197.5	49.6	61.9	Yes	0	0.180	0.181	11.1	7.2	0.884	0.900	30.13	22.49
WF3	59182.1	157	221.4	49.6	62.6		0	0.226	0.217	3.1	5.1	0.920	0.949	32.06	23.67
WF3	59182.2	157	204.0	49.3	63.4		0	0.179	0.186	6.7	10.8	0.889	0.926	30.93	23.19
WF3	59182.4	157	202.3	49.3	63.1	Yes	0	0.202	0.193	6.9	6.2	0.921	0.927	31.95	23.93
WF3	59194.1	210	200.8	53.8	67.9		1	0.179	0.174	5.6	11.5	0.951	0.941	31.12	21.35
WF3	59194.2	210	201.8	52.9	65.7		2	0.075	0.066	56.0	59.1	0.792	0.808	27.35	17.81

Table A13 Continued. Impulse Drying for Case A4 on the X2 Shoe Press using the Beloit-A roll (Felt S, 0" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD5	59295.1	49	197.0	54.6	58.8		0	0.080	0.089	3.1	5.1	0.688	0.696	26.89	13.91
FD5	59295.4	49	185.4	54.0	59.3		3	0.065	0.093	6.7	10.8	0.645	0.669	16.51	19.30
FD5	59171.1	129	198.2	50.2	60.8		0	0.125	0.125	6.9	6.2	0.730	0.727	29.19	15.89
FD5	59171.2	129	197.7	50.1	60.3		0	0.131	0.139	5.6	11.5	0.727	0.732	30.60	14.92
FD5	59171.3	129	206.6	50.5	59.3		0	0.128	0.121	56.0	59.1	0.719	0.721	29.63	15.14
FD5	59171.4	129	193.5	53.2	61.6		3	0.087	0.122	3.1	5.1	0.694	0.728	24.76	17.37
FD5	59183.1	157	190.7	50.9	62.3		1	0.107	0.118	6.7	10.8	0.720	0.726	27.41	15.99
FD5	59183.2	157	200.2	50.1	60.2		1	0.077	0.090	6.9	6.2	0.684	0.696	23.31	15.92
FD5	59183.3	157	191.5	49.6	62.4	Yes	1	0.125	0.112	5.6	11.5	0.726	0.718	22.33	18.91
FD5	59183.4	157	205.0	51.4	60.2		1	0.094	0.104	56.0	59.1	0.705	0.711	25.44	16.01
FD6	59296.1	49	206.1	52.1	59.6	Yes	0	0.089	0.095	24.7	15.8	0.694	0.710	20.88	16.66
FD6	59296.2	49	200.8	50.8	59.0		0	0.080	0.092	21.3	25.0	0.663	0.687	22.07	14.99
FD6	59296.3	49	204.1	50.8	58.7		0	0.091	0.094	26.4	22.3	0.668	0.691	23.69	13.67
FD6	59296.4	49	205.3	50.2	58.7		0	0.090	0.082	20.0	25.6	0.678	0.685	21.72	16.18
FD6	59172.1	129	200.5	53.3	63.4		0	0.181	0.191	8.8	9.9	0.743	0.756	26.10	21.18
FD6	59172.2	129	205.5	51.0	62.6		0	0.210	0.230	8.1	6.1	0.761	0.785	26.67	21.38
FD6	59172.3	129	195.0	51.8	63.5		0	0.157	0.172	4.5	4.1	0.834	0.860	26.54	21.67
FD6	59172.4	129	210.8	50.5	62.0		0	0.176	0.184	5.0	5.4	0.846	0.854	28.70	19.82
FD6	59184.1	157	199.5	52.4	64.4		0	0.176	0.171	8.5	5.8	0.857	0.869	27.79	20.72
FD6	59184.2	157	206.6	51.0	64.7		0	0.153	0.162	22.9	5.6	0.849	0.868	28.56	18.20
FD6	59184.3	157	199.7	50.6	64.2		0	0.189	0.166	4.2	8.4	0.867	0.857	26.53	22.45
FD6	59184.4	157	201.1	50.7	63.8		0	0.175	0.168	12.6	10.1	0.850	0.863	29.14	18.87
FD6	59196.1	210	203.5	51.6	66.3		0	0.187	0.184	4.8	7.6	0.863	0.879	27.64	22.43
FD6	59196.2	210	206.0	50.9	66.7		0	0.173	0.172	6.9	12.2	0.862	0.872	28.12	22.22
FD6	59196.3	210	209.8	52.0	67.4		2	0.149	0.164	18.8	7.9	0.841	0.855	29.06	18.47
FD6	59196.4	210	211.6	50.8	66.4		0	0.150	0.154	12.0	6.5	0.845	0.858	25.37	20.58

Table A13 Continued. Impulse Drying for Case A4 on the X2 Shoe Press using the Beloit-A roll
(Felt S, 0" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD7	59297.1	49	197.5	48.0	56.6		0	0.063	0.108	38.1	7.4	0.649	0.690	21.25	16.91
FD7	59297.2	49	193.7	53.1	59.2		0	0.086	0.111	32.6	16.2	0.683	0.700	20.93	17.32
FD7	59297.3	49	193.0	54.2	58.8		0	0.126	0.116	5.6	11.2	0.698	0.702	24.76	16.82
FD7	59173.1	129	204.8	50.0	60.7		0	0.158	0.144	8.2	9.7	0.810	0.824	28.25	19.65
FD7	59173.2	129	195.3	49.1	60.6		0	0.153	0.163	6.5	2.5	0.815	0.827	26.34	21.63
FD7	59173.3	129	196.7	51.2	60.8		0	0.152	0.155	5.3	3.9	0.816	0.829	28.32	19.56
FD7	59185.1	157	192.0	49.1	62.3		0	0.182	0.155	6.0	9.0	0.845	0.828	28.66	21.88
FD7	59185.2	157	193.3	48.9	61.3	Yes	0	0.163	0.176	3.7	4.5	0.824	0.846	30.10	20.53
FD7	59185.3	157	199.3	49.1	62.0		0	0.176	0.172	5.1	8.1	0.835	0.839	29.19	21.30
FD7	59185.4	157	200.2	50.3	61.2		0	0.151	0.157	15.2	7.6	0.798	0.815	26.87	20.89
FD7	59197.1	210	196.5	50.6	64.7		0	0.148	0.126	8.8	17.5	0.819	0.795	27.01	17.85
FD7	59197.2	210	203.0	51.9	65.1		1	0.139	0.125	12.2	35.2	0.792	0.777	26.67	18.06
FD7	59197.3	210	192.0	53.4	65.9		2	0.134	0.131	40.3	28.2	0.759	0.759	26.83	18.11

Table A14. Impulse Drying for Case A5 on the X2 Shoe Press using the Beloit-A roll
(Felt S, 0" pivot, and 8500 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59174.1	129	195.3	52.8	66.6		0	0.254	0.259	6.3	4.2	0.857	0.868	34.39	23.77
WF1	59174.2	129	218.2	52.0	65.5		0	0.275	0.271	4.4	4.8	0.887	0.905	34.95	24.24
WF1	59174.3	129	195.8	50.8	65.3		0	0.269	0.268	3.7	3.7	0.874	0.879	36.76	24.05
WF1	59174.4	129	203.0	51.4	65.4		0	0.259	0.267	4.6	5.6	0.881	0.889	35.29	25.83
WF1	59186.1	157	187.7	51.3	66.8		0	0.242	0.243	5.4	6.2	0.886	0.912	38.15	24.60
WF1	59186.2	157	198.5	49.8	66.0		0	0.226	0.245	6.6	3.3	0.938	0.954	38.80	25.97
WF1	59186.3	157	215.8	49.2	65.3		0	0.256	0.269	4.7	3.0	0.949	0.935	38.87	25.98
WF1	59186.4	157	206.5	48.6	65.4	Yes	0	0.255	0.260	4.7	9.6	0.920	0.940	38.41	26.69
WF1	59198.1	210	202.1	51.8	69.0		1	0.224	0.197	13.8	19.8	0.928	0.921	37.45	20.93
WF1	59198.2	210	206.0	51.3	68.9		1	0.194	0.168	16.5	22.6	0.919	0.912	33.57	21.88
WF1	59198.3	210	192.5	50.6	69.1		1	0.153	0.164	23.5	10.4	0.890	0.912	30.57	21.06
WF1	59198.4	210	202.3	51.1	68.9		1	0.226	0.252	11.5	6.3	0.914	0.937	36.06	23.97
WF1	59203.1	210	189.2	51.7	69.4		2	0.116	0.141	60.3	50.4	0.749	0.770	25.87	19.01
WF1	59203.3	210	224.7	50.9	67.8		1	0.196	0.219	23.5	10.0	0.809	0.831	35.87	22.24
WF1	59203.4	210	196.5	50.3	68.9		3	0.088	0.104	50.0	61.5	0.709	0.727	28.63	17.35
WF1	59206.1	232	202.3	53.5	71.8		1	0.166	0.183	10.2	13.7	0.792	0.791	31.61	21.15
WF1	59206.2	232	197.8	50.8	69.6		1	0.139	0.142	29.5	19.0	0.784	0.791	33.41	22.58
WF1	59206.3	232	223.2	50.0	68.0		3	0.086	0.085	27.9	48.2	0.707	0.790	28.99	18.79
WF1	59206.4	232	208.9	51.8	68.8		3	0.069	0.077	10.1	42.9	0.727	0.781	26.39	19.54

Table A14 Continued. Impulse Drying for Case A5 on the X2 Shoe Press using the Beloit-A roll (Felt S, 0" pivot, and 8500 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF2	59299.1	49	193.8	51.0	57.5		0	0.215	0.238	16.7	10.5	0.757	0.775	33.29	23.76
WF2	59299.2	49	199.0	49.7	54.9		0	0.213	0.201	6.1	7.5	0.728	0.745	35.37	23.09
WF2	59299.3	49	204.1	49.3	56.7		0	0.231	0.220	3.5	8.2	0.747	0.774	32.85	23.17
WF2	59299.5	49	194.7	50.1	57.6		0	0.182	0.195	20.9	5.6	0.754	0.777	30.42	20.89
WF2	59175.1	129	200.7	50.4	59.1		0	0.230	0.221	2.6	4.1	0.915	0.916	37.02	25.07
WF2	59175.2	129	206.0	50.3	61.3		0	0.266	0.274	5.3	6.2	0.924	0.921	38.09	27.39
WF2	59175.3	129	202.0	50.2	59.3		0	0.269	0.250	2.6	2.8	0.886	0.875	37.82	25.07
WF2	59175.4	129	201.3	52.3	61.2		1	0.271	0.268	5.2	2.6	0.882	0.883	38.35	26.09
WF2	59187.1	157	205.8	50.0	61.4		0	0.232	0.200	6.9	5.5	0.870	0.847	34.24	22.92
WF2	59187.2	157	212.9	51.0	61.5		0	0.300	0.292	2.3	4.1	0.879	0.886	37.52	26.06
WF2	59187.3	157	192.0	50.3	61.3		0	0.255	0.246	3.9	4.9	0.849	0.869	35.16	25.77
WF2	59187.4	157	211.6	52.6	62.7		0	0.278	0.264	2.9	4.2	0.874	0.864	37.21	23.54
WF2	59199.1	210	207.0	48.8	64.2		2	0.072	0.074	45.8	41.9	0.696	0.721	22.69	15.02
WF2	59199.3	210	204.1	48.3	62.6		1	0.206	0.184	8.7	12.0	0.837	0.837	34.81	22.73
WF2	59199.4	210	206.8	49.6	62.1		2	0.063	0.053	12.7	11.3	0.710	0.696	28.31	15.17
WF3	59300.4	49	208.8	50.4	59.5		1	0.112	0.141	28.6	10.6	0.690	0.728	22.57	20.25
WF3	59176.2	129	202.6	49.5	63.5		0	0.221	0.234	5.4	3.4	0.881	0.886	31.74	22.49
WF3	59176.3	129	218.9	50.2	63.4		0	0.245	0.239	2.0	5.0	0.879	0.889	33.09	23.28
WF3	59176.4	129	209.6	49.6	63.8	Yes	0	0.231	0.219	6.5	18.3	0.864	0.850	29.87	21.94
WF3	59188.2	157	217.7	51.6	64.8		0	0.261	0.235	3.4	6.4	0.893	0.881	33.39	22.94
WF3	59188.3	157	219.6	50.1	64.9		0	0.256	0.259	3.5	3.5	0.896	0.900	33.73	23.53
WF3	59188.4	157	207.6	49.2	64.7		0	0.246	0.224	6.1	5.8	0.898	0.897	33.37	23.18
WF3	59200.1	210	203.5	50.5	66.5		2	0.094	0.086	61.7	46.5	0.789	0.790	26.45	18.44
WF3	59200.2	210	212.1	51.0	66.4		3	0.093	0.082	46.2	39.0	0.787	0.789	28.40	19.32
WF3	59200.3	210	209.9	51.6	66.8		2	0.072	0.096	18.1	54.2	0.756	0.785	24.34	19.03

Table A14 Continued. Impulse Drying for Case A5 on the X2 Shoe Press using the Beloit-A roll (Felt S, 0" pivot, and 8500 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD5	59301.1	49	200.7	50.1	58.0		3	0.057	0.059	12.3	18.6	0.709	0.724	18.20	12.86
FD5	59301.2	49	191.9	51.2	59.8		0	0.069	0.080	18.8	20.0	0.752	0.757	17.34	16.77
FD5	59301.3	49	203.6	50.9	58.0	Yes	0	0.078	0.077	15.4	11.7	0.731	0.749	22.78	14.01
FD5	59301.5	49	210.6	52.9	58.3		3	0.070	0.087	7.1	16.1	0.737	0.767	25.05	14.48
FD5	59177.1	129	194.3	49.8	61.0		1	0.073	0.088	13.7	19.3	0.820	0.843	26.59	13.54
FD5	59177.2	129	209.9	49.7	58.4		1	0.072	0.065	13.9	26.2	0.785	0.803	28.08	13.47
FD5	59177.3	129	215.6	49.6	60.0		2	0.098	0.088	8.2	20.5	0.816	0.829	25.08	15.99
FD5	59177.4	129	201.6	51.6	60.3		1	0.064	0.047	12.5	14.9	0.803	0.771	26.38	12.64
FD5	59189.1	157	213.3	50.6	61.4		3	0.042	0.041	9.5	7.3	0.751	0.756	23.80	14.12
FD5	59189.2	157	212.3	50.2	62.1		3	0.115	0.120	30.4	10.0	0.844	0.844	24.73	19.93
FD5	59189.3	157	202.6	49.6	60.7		3	0.043	0.042	11.6	7.1	0.706	0.708	21.44	12.67
FD5	59189.4	157	215.1	50.5	60.1		3	0.044	0.050	13.6	20.0	0.729	0.760	22.00	15.72
FD6	59302.1	49	200.2	51.5	61.0		0	0.059	0.097	15.3	9.3	0.692	0.739	19.12	16.99
FD6	59302.3	49	207.8	49.7	59.2		1	0.098	0.110	22.4	17.3	0.704	0.726	24.84	13.65
FD6	59302.4	49	198.8	50.2	59.2		3	0.073	0.108	19.2	14.8	0.669	0.762	20.77	15.51
FD6	59302.5	49	212.6	50.1	59.2		0	0.064	0.052	23.4	30.8	0.679	0.673	18.89	11.80
FD6	59178.1	129	201.0	53.1	66.1		1	0.156	0.169	15.4	7.1	0.870	0.907	27.65	19.15
FD6	59178.2	129	205.3	50.4	64.3		0	0.200	0.160	5.0	19.4	0.917	0.914	30.94	19.67
FD6	59178.3	129	208.1	49.9	64.6		0	0.208	0.190	4.8	4.2	0.915	0.915	28.63	23.35
FD6	59178.4	129	196.3	50.1	64.9		0	0.245	0.246	5.3	4.9	0.777	0.787	28.13	21.71
FD6	59190.1	157	198.2	52.3	67.1		0	0.233	0.225	6.9	8.4	0.777	0.780	28.24	20.68
FD6	59190.2	157	210.8	49.7	65.5		0	0.211	0.211	8.5	7.6	0.781	0.782	26.07	20.06
FD6	59190.3	157	207.8	51.1	66.7		0	0.241	0.238	6.6	10.5	0.781	0.787	28.28	20.58
FD6	59190.4	157	205.1	50.6	66.7		0	0.258	0.252	1.9	6.7	0.785	0.785	27.36	22.38
FD6	59201.1	210	206.5	51.6	66.6		1	0.126	0.091	33.3	53.8	0.739	0.711	27.94	15.26
FD6	59201.2	210	206.3	49.7	68.5		2	0.133	0.142	42.9	57.7	0.738	0.725	25.63	19.00
FD6	59201.3	210	202.0	51.0	69.3		3	0.071	0.073	21.1	38.4	0.665	0.659	23.43	16.29
FD6	59201.4	210	206.5	49.7	67.7		1	0.199	0.193	7.5	16.1	0.770	0.760	27.40	21.49

Table A14 Continued. Impulse Drying for Case A5 on the X2 Shoe Press using the Beloit-A roll
(Felt S, 0" pivot, and 8500 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD7	59303.1	49	197.5	49.2	58.2		0	0.105	0.114	22.9	8.8	0.719	0.736	23.56	16.95
FD7	59303.2	49	195.8	48.2	57.6	Yes	0	0.079	0.115	19.0	20.9	0.673	0.714	21.48	16.94
FD7	59303.3	49	193.8	48.6	58.0		3	0.081	0.110	17.3	16.4	0.662	0.701	21.60	17.18
FD7	59303.4	49	195.3	48.9	58.3	Yes	0	0.111	0.123	12.6	7.3	0.707	0.711	21.69	18.00
FD7	59303.5	49	193.3	49.2	57.7	Yes	0	0.080	0.084	37.5	19.0	0.659	0.667	21.10	16.11
FD7	59179.1	129	195.0	49.2	62.9		0	0.214	0.197	3.7	6.6	0.744	0.734	29.75	22.42
FD7	59179.2	129	189.7	48.7	62.6	Yes	0	0.241	0.231	5.0	3.5	0.744	0.732	33.31	22.95
FD7	59179.3	129	193.3	49.7	63.1		0	0.226	0.205	3.5	1.5	0.739	0.733	30.78	20.76
FD7	59179.4	129	192.8	52.0	63.3		0	0.235	0.231	1.7	5.2	0.726	0.731	29.43	22.48
FD7	59191.1	157	199.2	51.8	64.8		0	0.162	0.105	24.1	47.6	0.698	0.672	24.48	15.34
FD7	59202.1	210	188.7	49.9	67.2		2	0.094	0.079	39.4	41.8	0.672	0.662	24.65	14.01
FD7	59202.2	210	201.5	49.8	65.9		2	0.048	0.076	31.3	39.5	0.773	0.797	23.51	14.44
FD7	59202.3	210	192.7	50.0	67.7		2	0.051	0.041	27.5	56.1	0.762	0.699	20.93	12.12
FD7	59202.4	210	193.7	50.3	66.4		1	0.099	0.101	28.3	29.7	0.788	0.795	23.48	17.60

Table A15. Impulse Drying for Case A6 on the X2 Shoe Press using the Beloit-A roll
(Felt S, 2" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59207.1	121	196.5	54.9	65.2		0	0.244	0.284	12.3	2.8	0.815	0.827	34.89	24.65
WF1	59207.2	121	191.2	50.9	63.8		0	0.251	0.253	7.2	7.1	0.802	0.799	34.26	23.16
WF1	59207.3	121	200.5	51.4	64.6		0	0.296	0.300	4.7	4.3	0.755	0.793	36.60	25.18
WF1	59207.4	121	209.1	52.5	65.3		0	0.191	0.247	30.4	11.3	0.784	0.822	30.21	22.63
WF1	59213.1	149	214.1	51.5	65.6		0	0.298	0.291	3.4	4.8	0.842	0.838	35.04	23.10
WF1	59213.2	149	215.9	51.9	66.5		0	0.308	0.309	3.2	5.2	0.836	0.847	36.03	24.88
WF1	59213.3	149	203.8	53.5	67.9		0	0.246	0.285	9.3	4.2	0.810	0.825	33.34	24.62
WF1	59213.4	149	205.3	52.1	67.1		0	0.290	0.278	3.8	3.6	0.841	0.852	34.46	23.44
WF1	59219.1	177	202.6	48.7	66.5		1	0.272	0.245	4.0	8.2	0.835	0.840	34.76	24.53
WF1	59219.2	177	191.0	52.4	67.5		0	0.288	0.266	4.5	3.8	0.865	0.877	36.24	22.87
WF1	59219.3	177	213.3	51.9	65.7	Yes	0	0.258	0.246	5.4	6.5	0.931	0.910	35.02	25.13
WF1	59219.4	177	205.1	52.2	67.3	Yes	0	0.225	0.222	19.1	14.9	0.915	0.921	33.93	24.01
WF1	59225.1	199	206.0	53.0	66.7	Yes	1	0.213	0.188	8.5	26.6	0.879	0.889	34.65	23.60
WF1	59225.2	199	206.1	54.6	70.6		1	0.141	0.193	39.7	11.9	0.876	0.891	32.68	23.15
WF1	59225.4	199	209.1	53.2	67.2		1	0.194	0.187	16.0	5.3	0.912	0.933	33.89	23.57
WF2	59208.1	121	205.1	53.4	62.5		0	0.235	0.198	7.7	19.7	0.926	0.885	35.07	22.81
WF2	59214.1	149	206.3	49.9	60.4		0	0.201	0.211	8.5	7.6	0.899	0.907	33.95	25.97
WF2	59214.2	149	203.8	51.0	60.9		0	0.236	0.241	5.1	4.6	0.927	0.935	36.54	25.84
WF2	59214.3	149	210.8	50.8	60.4		0	0.180	0.196	13.3	10.7	0.907	0.909	32.52	23.71
WF2	59214.4	149	199.0	53.0	62.9		0	0.221	0.236	6.8	5.5	0.956	0.957	35.50	25.41
WF2	59220.1	177	206.6	48.1	59.5		1	0.177	0.192	9.6	11.5	0.877	0.915	32.44	24.94
WF2	59220.2	177	198.5	51.3	63.2		1	0.205	0.217	6.3	6.0	0.899	0.912	35.85	24.45
WF2	59220.3	177	207.3	50.6	62.2		1	0.089	0.118	32.6	31.4	0.832	0.875	29.13	22.01
WF2	59220.4	177	202.5	50.2	63.1		1	0.166	0.188	22.3	8.5	0.920	0.924	32.23	24.45
WF2	59226.1	199	213.6	52.2	64.2		1	0.114	0.125	12.3	15.2	0.820	0.809	33.24	21.48
WF2	59226.2	199	210.8	52.5	65.0		1	0.138	0.162	9.4	14.2	0.837	0.829	33.50	22.19
WF2	59226.3	199	206.0	48.9	61.9		1	0.119	0.123	13.4	10.6	0.784	0.791	32.63	20.14
WF2	59226.4	199	203.3	51.9	64.8		1	0.125	0.153	14.4	14.4	0.801	0.811	32.91	23.59

Table A15 Continued. Impulse Drying for Case A6 on the X2 Shoe Press using the Beloit-A roll (Felt S, 2" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF3	59209.1	121	218.9	51.5	63.1		0	0.255	0.248	2.4	3.2	0.899	0.889	31.31	23.48
WF3	59209.2	121	214.8	51.6	62.6		0	0.263	0.258	3.8	6.2	0.872	0.882	34.01	22.27
WF3	59209.3	121	202.1	51.4	63.4		0	0.255	0.256	2.7	3.5	0.879	0.884	32.18	23.30
WF3	59209.4	121	210.3	51.8	61.1		0	0.261	0.265	3.1	3.0	0.872	0.883	33.22	23.25
WF3	59215.1	149	213.1	50.8	64.1		0	0.253	0.240	4.3	6.3	0.861	0.859	31.29	23.36
WF3	59215.3	149	203.0	50.3	63.6		0	0.196	0.197	4.1	2.5	0.965	0.964	30.57	23.36
WF3	59215.4	149	203.3	51.0	63.8		0	0.220	0.218	4.5	5.0	0.945	0.944	33.17	22.74
WF3	59221.1	177	196.0	49.8	65.5		1	0.200	0.194	4.0	1.5	0.902	0.881	30.22	23.81
WF3	59221.2	177	217.7	48.4	63.0		1	0.197	0.199	5.6	4.5	0.867	0.870	30.89	23.57
WF3	59221.3	177	202.5	49.5	64.8		1	0.205	0.211	5.9	2.4	0.858	0.859	30.09	22.34
WF3	59221.4	177	201.5	49.5	63.6	Yes	1	0.148	0.187	14.9	21.9	0.789	0.823	26.39	20.66
FD5	59210.2	121	200.3	53.8	62.1		0	0.170	0.158	5.3	3.8	0.776	0.764	26.82	20.20
FD5	59210.3	121	189.4	52.2	60.2		0	0.178	0.167	6.7	6.6	0.757	0.745	31.43	16.41
FD5	59216.3	149	189.9	50.8	64.2		1	0.107	0.105	26.2	11.4	0.812	0.826	21.24	18.30
FD5	59216.4	149	212.9	53.7	61.7		1	0.084	0.104	9.5	21.2	0.799	0.820	27.39	15.35
FD5	59222.1	177	195.2	52.2	64.9		1	0.055	0.062	14.5	12.9	0.773	0.782	25.29	14.09
FD5	59222.2	177	186.0	53.0	65.2		1	0.060	0.063	21.7	20.6	0.768	0.809	24.42	14.25
FD5	59222.3	177	207.1	53.2	63.5		1	0.054	0.066	7.4	21.2	0.772	0.778	26.43	13.71
FD6	59211.1	121	205.3	54.1	64.5		0	0.196	0.188	4.1	4.8	0.954	0.939	28.34	21.72
FD6	59211.2	121	196.5	52.7	64.7		0	0.178	0.167	5.6	3.6	0.906	0.927	30.01	18.48
FD6	59211.3	121	199.5	51.2	63.7		0	0.194	0.197	3.6	3.6	0.925	0.916	29.24	19.82
FD6	59211.4	121	204.5	50.1	63.1		0	0.199	0.183	5.5	5.5	0.904	0.904	26.80	21.43
FD6	59217.1	149	193.7	51.6	67.5	Yes	0	0.200	0.201	5.0	4.5	0.913	0.920	26.40	22.73
FD6	59217.2	149	212.4	50.6	64.7		0	0.174	0.177	6.3	9.0	0.871	0.890	29.62	16.71
FD6	59217.3	149	187.9	50.3	66.3		0	0.169	0.184	13.6	9.2	0.885	0.905	28.62	17.92
FD6	59217.4	149	191.4	50.0	66.1	Yes	0	0.201	0.180	2.5	17.8	0.930	0.931	26.65	21.53
FD6	59223.3	177	205.6	53.1	66.0		0	0.184	0.180	6.0	5.0	0.912	0.930	29.27	17.92
FD6	59223.4	177	198.0	53.7	67.2	Yes	1	0.157	0.166	9.6	7.8	0.891	0.908	29.46	17.22

Table A15 Continued. Impulse Drying for Case A6 on the X2 Shoe Press using the Beloit-A roll
(Felt S, 2" pivot, and 6000 pli at 40 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD6	59227.1	199	209.9	53.3	68.6		1	0.175	0.187	9.7	10.2	0.803	0.805	25.55	21.81
FD6	59227.2	199	209.6	53.5	69.7		1	0.178	0.180	18.0	22.8	0.821	0.825	26.01	21.52
FD6	59227.3	199	212.8	52.4	67.3		1	0.165	0.147	6.7	16.3	0.826	0.827	28.26	16.36
FD6	59227.4	199	199.7	51.7	68.4		1	0.197	0.188	3.6	4.3	0.820	0.820	28.70	20.60
FD7	59212.2	121	204.3	49.5	60.9		0	0.186	0.173	5.4	6.4	0.892	0.882	30.16	19.33
FD7	59212.3	121	200.0	52.1	62.3		0	0.176	0.172	7.4	2.9	0.914	0.925	29.65	18.80
FD7	59218.1	149	197.7	51.1	63.4		0	0.168	0.156	11.3	9.6	0.936	0.934	28.70	18.20
FD7	59218.2	149	194.3	51.6	64.6		0	0.177	0.173	4.0	5.2	0.958	0.956	29.91	20.63
FD7	59218.3	149	206.1	48.3	62.8		0	0.175	0.172	2.9	6.4	0.903	0.907	27.54	22.24
FD7	59218.4	149	194.0	48.3	62.7		0	0.182	0.182	3.3	3.3	0.906	0.908	31.26	22.38
FD7	59224.1	177	202.8	54.2	65.3		1	0.076	0.100	31.6	48.0	0.812	0.820	25.26	16.57
FD7	59224.2	177	195.2	54.8	65.4		1	0.126	0.137	24.6	10.2	0.828	0.824	27.20	19.91
FD7	59224.4	177	205.6	54.5	63.9		1	0.132	0.127	9.1	28.3	0.821	0.813	27.82	17.27

Table A16. Impulse Drying for Case A4F on the X2 Shoe Press using the Beloit-A roll
(Felt S, 0" pivot, and 6000 pli at 30 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59228.1	149	219.9	50.8	60.6	Yes	2	0.071	0.056	54.9	12.5	0.677	0.663	24.84	18.20
WF2	59229.1	149	202.5	50.5	57.1		0	0.124	0.144	12.1	17.4	0.778	0.805	31.53	22.33
WF2	59229.2	149	198.0	51.0	59.1		1	0.147	0.168	23.8	18.5	0.762	0.787	34.54	22.81
WF2	59229.3	149	203.1	50.7	56.7		0	0.164	0.164	11.0	16.5	0.764	0.773	33.75	22.87
WF2	59229.4	149	208.1	53.8	60.7		1	0.181	0.209	8.3	8.1	0.779	0.815	34.07	22.91
WF3	59230.1	149	198.5		61.8		1	0.091	0.140	34.1	13.6	0.675	0.741	23.27	18.94
WF3	59230.2	149	224.2	49.8	58.8		1	0.069	0.109	26.1	17.4	0.647	0.700	21.93	17.97
FD5	59231.1	149	196.0	53.2	62.6		1	0.116	0.115	3.4	6.1	0.700	0.694	27.93	13.42
FD5	59231.2	149	208.9	53.9	63.6		1	0.111	0.103	4.5	9.7	0.697	0.693	23.16	17.13
FD5	59231.3	149	205.6	50.9	57.9		1	0.105	0.093	6.7	14.0	0.683	0.680	27.16	13.61
FD5	59231.4	149	211.3	54.3	61.0		1	0.109	0.106	4.6	5.7	0.692	0.693	25.28	16.64
FD6	59232.1	149	197.5	52.6	62.1		1	0.098	0.105	19.4	21.9	0.660	0.674	20.85	18.20
FD6	59232.2	149	213.4	50.2	59.8		1	0.082	0.087	14.6	14.9	0.646	0.772	22.35	15.55
FD7	59233.1	149	192.4	48.6	57.6		1	0.062	0.064	16.1	9.4	0.746	0.763	23.59	15.53

Table A17. Impulse Drying for Case A5F on the X2 Shoe Press using the Beloit-A roll
(Felt S, 0" pivot, and 8500 pli at 30 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59234.1	149	211.8	54.7	63.7	Yes	1	0.126	0.194	23.8	7.7	0.769	0.820	27.13	20.88
WF1	59234.2	149	204.6	51.7	62.7		0	0.144	0.203	20.1	6.4	0.761	0.798	30.93	23.16
WF1	59234.3	149	199.7	51.1	62.9	Yes	1	0.209	0.229	7.7	9.2	0.801	0.841	33.18	22.71
WF1	59234.4	149	211.9	52.4	64.0	Yes	1	0.229	0.239	12.7	6.7	0.836	0.873	33.35	22.51
WF1	59240.1	177	210.1	52.6	65.3		1	0.201	0.219	12.4	15.1	0.780	0.811	33.38	23.38
WF1	59240.2	177	204.1	51.6	65.4		1	0.225	0.228	7.1	3.1	0.857	0.870	34.41	23.72
WF1	59240.3	177	201.5	51.2	65.7	Yes	1	0.215	0.233	11.2	5.6	0.865	0.865	35.97	22.44
WF1	59240.4	177	210.4	53.3	63.1		1	0.213	0.227	8.0	5.3	0.796	0.802	36.35	22.87
WF1	59246.1	199	215.1	51.7	66.7		2	0.070	0.211	35.7	18.0	0.709	0.818	26.86	21.40
WF1	59246.2	199	197.3	51.6	67.0		1	0.147	0.130	33.3	42.3	0.774	0.771	27.83	21.27
WF1	59246.3	199	207.5	52.1	66.6		0	0.232	0.229	5.6	8.3	0.774	0.793	36.56	24.53
WF1	59246.4	199	201.0	52.8	65.4		0	0.219	0.234	5.9	12.0	0.763	0.775	36.92	22.97
WF2	59235.1	149	206.1	51.0	60.5		1	0.218	0.225	6.4	6.2	0.786	0.793	33.41	22.78
WF2	59235.2	149	207.6	53.9	61.3		0	0.306	0.302	4.2	2.3	0.829	0.830	36.56	25.35
WF2	59235.3	149	203.3	49.3	59.2		1	0.259	0.243	3.9	6.6	0.796	0.801	35.27	24.01
WF2	59235.4	149	210.4	52.8	61.9		1	0.264	0.271	6.8	4.8	0.802	0.839	34.34	22.88
WF2	59241.1	177	195.8	51.3	61.8		1	0.251	0.241	7.2	5.8	0.833	0.851	34.17	23.92
WF2	59241.2	177	211.6	52.6	62.5		1	0.258	0.261	3.5	4.6	0.817	0.825	35.39	23.93
WF2	59241.3	177	204.6	49.9	60.1		1	0.105	0.108	23.8	30.6	0.750	0.781	28.18	19.18
WF2	59241.4	177	197.8	51.3	61.4		1	0.271	0.235	4.4	11.5	0.846	0.816	37.48	23.56
WF2	59247.1	199	203.3	51.7	62.0		1	0.223	0.214	8.1	5.1	0.811	0.797	35.64	23.13
WF2	59247.2	199	211.4	50.9	60.9		1	0.084	0.072	40.5	30.6	0.701	0.699	27.59	16.91
WF2	59247.3	199	205.5	52.6	64.2		1	0.201	0.200	16.4	14.0	0.797	0.784	32.95	22.02
WF2	59247.4	199	209.8	49.8	60.0		1	0.147	0.106	14.3	33.0	0.755	0.714	30.98	18.08
WF3	59236.3	149	204.8	49.9	63.6		0	0.225	0.213	1.8	8.5	0.828	0.847	30.16	22.42
WF3	59236.4	149	207.1	50.7	63.6		0	0.231	0.231	3.9	6.1	0.825	0.847	32.29	21.60
WF3	59242.1	177	198.0	50.0	64.0		1	0.168	0.217	41.7	6.5	0.776	0.801	27.68	22.37
WF3	59242.2	177	203.0	49.3	61.2		1	0.233	0.225	3.4	4.9	0.807	0.807	31.83	22.75
WF3	59242.3	177	199.0	50.7	64.4		1	0.225	0.206	3.6	10.2	0.788	0.785	31.11	22.69
WF3	59242.4	177	210.6	50.7	62.3		1	0.217	0.215	4.6	5.6	0.769	0.776	32.85	22.08

Table A17 Continued. Impulse Drying for Case A5F on the X2 Shoe Press using the Beloit-A roll (Felt S, 0" pivot, and 8500 pli at 30 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD5	59237.1	149	204.8	51.8	62.4		3	0.053	0.052	13.2	23.1	0.647	0.645	22.91	12.02
FD5	59237.2	149	226.4	51.3	60.9		3	0.057	0.053	7.0	11.3	0.610	0.599	22.31	11.81
FD5	59237.3	149	202.8	51.1	63.2		3	0.064	0.094	18.8	22.3	0.683	0.707	19.43	16.42
FD5	59237.4	149	208.5	52.6	62.4		3	0.047	0.050	4.3	14.0	0.643	0.660	21.70	12.21
FD5	59243.1	177	209.1	50.8	64.6		3	0.063	0.066	12.7	21.2	0.668	0.673	19.81	16.95
FD5	59243.2	177	202.6	50.8	63.3		3	0.055	0.058	9.1	13.8	0.648	0.664	17.86	16.34
FD5	59243.3	177	204.3	51.8	62.8		3	0.054	0.053	9.3	9.4	0.629	0.653	24.09	12.40
FD5	59243.4	177	213.9	52.0	62.5		3	0.045	0.044	6.7	13.6	0.622	0.625	20.19	13.42
FD6	59238.1	149	198.8	56.5	66.8		1	0.179	0.144	16.2	20.1	0.745	0.729	24.40	20.69
FD6	59238.2	149	210.4	54.8	65.9		0	0.194	0.181	8.8	6.1	0.772	0.783	27.28	21.25
FD6	59238.3	149	220.6	54.2	65.3		0	0.148	0.149	6.1	8.1	0.885	0.902	25.88	19.79
FD6	59238.4	149	197.0	53.8	66.3		1	0.163	0.157	5.5	8.3	0.883	0.866	24.60	21.08
FD6	59244.1	177	208.6	55.0	67.5		1	0.175	0.144	5.1	11.8	0.866	0.871	25.73	20.97
FD6	59244.2	177	226.4	55.3			1	0.155	0.151	10.3	7.3	0.840	0.858	26.70	20.14
FD6	59244.3	177	201.3	54.6	68.1		1	0.170	0.166	10.0	6.6	0.864	0.873	27.54	20.33
FD6	59244.4	177	211.4	51.6	63.6		1	0.144	0.134	12.5	13.4	0.829	0.841	26.64	18.88
FD6	59248.1	199	205.8	52.7	65.7		0	0.158	0.156	4.4	5.1	0.868	0.866	27.98	19.39
FD6	59248.2	199	209.9	51.9	66.8		2	0.156	0.133	7.1	21.1	0.867	0.859	28.76	17.89
FD6	59248.3	199	206.5	51.5	66.2		2	0.162	0.127	3.1	22.0	0.865	0.853	26.28	20.33
FD6	59248.4	199	204.1	52.3	67.1		1	0.131	0.153	25.2	11.8	0.835	0.872	23.94	20.37

Table A17 Continued. Impulse Drying for Case A5F on the X2 Shoe Press using the Beloit-A roll (Felt S, 0" pivot, and 8500 pli at 30 ms)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD7	59239.1	149	198.3	50.3	62.7		0	0.157	0.139	3.8	5.8	0.862	0.866	28.09	20.03
FD7	59239.2	149	194.5	49.7	62.3		0	0.154	0.120	5.8	27.5	0.853	0.820	29.45	17.86
FD7	59239.3	149	197.3	51.5	63.3		0	0.139	0.128	11.5	17.2	0.843	0.830	24.67	18.51
FD7	59239.4	149	203.0	50.3	61.7		0	0.152	0.141	5.3	4.3	0.856	0.851	27.50	19.34
FD7	59245.1	177	202.8	52.1	64.0		2	0.102	0.079	23.5	34.2	0.810	0.799	25.41	17.02
FD7	59245.2	177	200.5	51.2	64.4		1	0.111	0.112	11.7	15.2	0.827	0.838	26.72	17.60
FD7	59245.3	177	201.6	51.5	64.3		1	0.108	0.103	20.4	20.4	0.816	0.802	22.97	15.87
FD7	59245.4	177	199.5	52.3	64.6		2	0.102	0.102	16.7	30.4	0.813	0.823	24.40	16.85
FD7	59249.1	199	203.5	53.8	65.4		3	0.058	0.034	22.4	29.4	0.689	0.622	21.22	11.69
FD7	59249.3	199	198.8	55.8	67.4		3	0.047	0.036	10.6	27.8	0.661	0.622	19.94	10.38
FD7	59249.4	199	199.5	56.8	66.9		3	0.055	0.065	20.0	35.4	0.696	0.699	22.57	15.36

Table A18. Impulse Drying for Case A4H on the X2 Shoe Press using the Beloit-A roll
(Felt S, 0" pivot, and 6000 pli at 40 ms using hard felt wash water)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59250.1	149	210.1	51.1	62.7		0	0.148	0.178	15.5	19.7	0.717	0.728	32.65	22.24
WF1	59250.2	149	197.2	51.6	64.9		0	0.214	0.202	6.1	8.4	0.739	0.741	36.24	21.59
WF1	59250.3	149	200.7	51.2	64.2		0	0.221	0.254	6.8	7.5	0.753	0.770	35.21	24.33
WF1	59250.4	149	202.0	52.1	65.1		0	0.169	0.194	25.4	17.0	0.731	0.756	30.69	19.88
WF1	59262.2	177	200.2	52.7	68.4		0	0.256	0.204	5.5	17.2	0.782	0.757	34.11	21.09
WF1	59262.3	177	198.5	51.8	68.0		0	0.262	0.279	4.6	6.1	0.762	0.767	35.24	23.95
WF1	59262.4	177	199.2	51.3	66.6		0	0.276	0.283	6.2	2.1	0.794	0.791	36.70	24.32
WF2	59251.1	149	209.6	51.7	61.9		0	0.285	0.281	2.8	2.8	0.775	0.779	34.94	24.26
WF2	59251.2	149	197.2	50.0	60.3		0	0.289	0.288	1.7	3.5	0.777	0.785	36.58	24.77
WF2	59251.3	149	205.0	48.9	58.7		0	0.264	0.250	2.7	5.2	0.770	0.773	35.30	24.45
WF2	59251.4	149	207.5	53.3	62.5		0	0.249	0.251	3.2	3.6	0.762	0.763	31.96	22.29
WF2	59263.1	177	205.8	53.2	64.0		0	0.298	0.296	3.0	3.7	0.794	0.788	37.34	25.52
WF2	59263.2	177	206.5	51.6	62.3		1	0.206	0.203	11.7	10.3	0.742	0.746	34.61	22.61
WF2	59263.3	177	214.1	54.2	66.2		0	0.273	0.274	4.8	2.6	0.769	0.783	35.79	23.71
WF2	59263.4	177	218.9	51.3	62.2		0	0.285	0.293	3.9	3.4	0.768	0.776	36.29	26.06
WF3	59252.1	149	200.0	51.5	64.1		0	0.208	0.201	5.8	7.0	0.748	0.750	27.13	20.28
WF3	59252.2	149	199.3	48.8	61.6		0	0.161	0.181	9.3	8.3	0.713	0.740	30.73	20.54
WF3	59252.3	149	215.3	50.4	62.9		0	0.210	0.212	7.1	6.1	0.751	0.759	30.42	22.43
WF3	59252.4	149	210.8	52.5	63.5		0	0.209	0.211	4.8	6.6	0.889	0.878	33.08	23.19
WF3	59264.1	177	223.7	51.2	64.3		0	0.210	0.218	5.7	5.0	0.874	0.863	30.46	22.96
WF3	59264.2	177	224.2	51.7	65.5		1	0.211	0.215	6.2	5.1	0.863	0.869	30.62	22.73
WF3	59264.3	177	197.2	50.1	65.2		1	0.203	0.195	4.4	11.3	0.856	0.865	27.23	21.71
WF3	59264.4	177	210.6	50.4	64.3		2	0.067	0.080	47.8	76.3	0.705	0.723	23.38	15.97
FD5	59253.1	149	208.9	50.9	60.1		2	0.077	0.063	10.4	23.8	0.718	0.700	25.81	11.88
FD5	59253.2	149	195.8	50.7	63.2		2	0.085	0.064	17.6	15.6	0.731	0.699	19.39	15.90
FD5	59253.3	149	189.2	50.9	62.6		1	0.105	0.080	8.6	15.0	0.736	0.721	26.43	12.96
FD5	59253.4	149	208.8	51.8	61.5		1	0.084	0.071	9.5	9.9	0.713	0.701	22.94	15.54

Table A18 Continued. Impulse Drying for Case A4H on the X2 Shoe Press using the Beloit-A roll
(Felt S, 0" pivot, and 6000 pli at 40 ms using hard felt wash water)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD6	59254.1	149	199.8	51.2	64.8		0	0.153	0.152	16.3	11.8	0.766	0.779	23.52	18.88
FD6	59254.2	149	204.6	51.5	64.4		0	0.156	0.159	14.1	13.2	0.771	0.775	27.63	16.01
FD6	59254.3	149	203.5	49.8	63.1		0	0.167	0.165	3.6	9.7	0.764	0.759	25.71	19.95
FD6	59254.4	149	207.3	51.7	65.2		0	0.136	0.143	19.9	13.3	0.749	0.762	23.00	19.24
FD6	59265.1	177	209.6	51.3	65.8		0	0.203	0.200	3.0	5.5	0.786	0.800	30.70	19.32
FD6	59265.2	177	205.3	51.7	67.4		0	0.205	0.204	2.9	3.4	0.792	0.795	27.02	23.36
FD6	59265.3	177	208.8	51.9	66.8		0	0.206	0.204	3.4	2.9	0.812	0.817	30.97	18.72
FD6	59265.4	177	205.6	51.0	65.8		0	0.203	0.204	2.0	5.9	0.794	0.803	27.79	23.35
FD6	59272.1	199	197.3	51.2	67.5		2	0.072	0.093	45.8	60.2	0.714	0.725	23.39	18.34
FD6	59272.2	199	200.8	51.2	67.0		2	0.060	0.059	10.0	15.3	0.687	0.712	25.90	15.06
FD6	59272.3	199	201.1	51.8	69.6		2	0.154	0.158	11.7	13.9	0.792	0.779	26.79	19.20
FD7	59255.1	149	197.2	51.7	63.0		0	0.154	0.155	3.2	4.5	0.803	0.809	27.89	19.47
FD7	59255.2	149	192.0	51.8	61.9		0	0.147	0.159	5.4	5.0	0.792	0.805	28.22	19.20
FD7	59255.3	149	195.5	51.5	62.1		0	0.165	0.166	3.6	3.6	0.801	0.808	26.70	20.25
FD7	59255.4	149	199.3	52.6	63.0		0	0.151	0.144	14.6	10.4	0.806	0.807	25.31	17.54
FD7	59266.1	177	202.5	51.5	65.5		2		0.113	#DIV	49.6		0.766	27.77	20.04
FD7	59266.2	177	212.3	51.7	64.4		0	0.149	0.114	6.7	21.9	0.800	0.782	28.53	16.56
FD7	59266.3	177	208.3	52.1	65.4		1	0.111	0.108	24.3	22.2	0.753	0.742	26.93	15.59
FD7	59266.4	177	191.5	49.5	61.9		1	0.142	0.157	21.1	7.0	0.776	0.785	28.41	19.82

Table A19. Impulse Drying for Case A5H on the X2 Shoe Press using the Beloit-A roll
(Felt S, 0" pivot, and 8500 pli at 40 ms using hard felt wash water)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
WF1	59256.1	149	191.5	52.5	67.9		0	0.269	0.260	3.7	4.6	0.852	0.858	37.36	24.60
WF1	59256.2	149	216.3	50.6	65.7		0	0.280	0.291	5.7	2.1	0.856	0.849	37.36	26.54
WF1	59256.3	149	219.7	51.5	66.7		0	0.274	0.260	4.0	9.2	0.854	0.851	38.45	24.32
WF1	59256.4	149	200.5	52.2	67.9		0	0.267	0.262	3.0	1.9	0.851	0.861	35.08	22.90
WF1	59267.2	177	204.5	51.7	68.8		0	0.274	0.251	6.2	25.5	0.842	0.838	36.97	25.96
WF1	59267.3	177	208.5	51.3	67.4		0	0.276	0.282	4.3	6.0	0.843	0.828	38.61	25.26
WF2	59257.3	149	211.9	53.6	63.3		0	0.231	0.216	6.9	10.6	0.802	0.812	36.16	24.84
WF2	59257.4	149	210.1	54.0	64.3		0	0.278	0.271	3.6	6.6	0.916	0.896	39.44	26.01
WF2	59268.1	177	209.6	51.4	62.2		1	0.188	0.174	6.9	13.8	0.854	0.818	34.90	22.46
WF2	59268.2	177	199.3	51.6	64.0		0	0.267	0.261	2.6	3.8	0.871	0.856	36.60	24.84
WF2	59268.3	177	202.5	48.0	60.0		0	0.195	0.183	7.7	21.3	0.818	0.811	34.47	23.80
WF2	59268.4	177	197.2	51.1	63.5		0	0.289	0.276	4.8	4.0	0.836	0.843	39.01	26.27
WF3	59258.1	149	208.5	50.9	65.3		0	0.252	0.247	5.2	6.1	0.817	0.816	31.65	23.50
WF3	59258.2	149	212.4	50.9	64.5		0	0.260	0.258	3.8	2.7	0.818	0.814	32.24	23.54
WF3	59258.3	149	202.8	51.3	65.6		0	0.260	0.259	1.5	3.5	0.806	0.795	32.62	24.42
WF3	59258.4	149	223.4	52.4	65.0		0	0.265	0.266	2.6	4.1	0.804	0.788	32.91	23.32
WF3	59269.1	177	213.3	51.2	65.4		2	0.201	0.180	23.4	43.3	0.766	0.764	29.44	21.34
WF3	59269.2	177	217.4	51.5	65.6		2	0.062	0.149	22.6	53.0	0.667	0.765	25.40	20.43
WF3	59269.3	177	206.3	50.5	65.8		1	0.243	0.252	4.9	3.2	0.796	0.803	30.73	23.37
WF3	59269.4	177	200.0	51.2	65.7		1	0.152	0.182	27.6	22.5	0.746	0.757	30.29	20.05
FD5	59259.1	149	199.5	50.5	60.8		3	0.066	0.098	18.2	30.6	0.653	0.684	24.87	13.70
FD5	59259.3	149	217.7	50.3	61.7		3	0.071	0.079	8.5	12.7	0.672	0.689	23.71	15.80
FD5	59259.4	149	204.1	51.9	63.6		2	0.066	0.067	22.7	35.8	0.676	0.677	25.18	11.91
FD6	59260.1	149	210.1	54.4	70.9		0	0.220	0.211	4.1	9.0	0.787	0.788	29.70	21.98
FD6	59260.2	149	218.2	52.5	68.9		0	0.231	0.232	5.2	2.2	0.791	0.795	27.80	23.78
FD6	59260.3	149	218.7	53.0	68.6		0	0.200	0.197	4.5	5.1	0.840	0.842	32.91	18.48
FD6	59260.4	149	200.7	50.6	65.9		0	0.212	0.215	3.8	3.7	0.833	0.844	28.65	23.00

Table A19 Continued. Impulse Drying for Case A5H on the X2 Shoe Press using the Beloit-A roll
(Felt S, 0" pivot, and 8500 pli at 40 ms using hard felt wash water)

Furnish	Sample ID	Roll Temp °C	Basis Weight g/m²	Solids In %	Solids Out %	Surf. Pick	Delam. Code	SEM MN·m/kg		CV SEM %		Density g/cm³		STFI Index N·m/g	
								MD	CD	MD	CD	MD	CD	MD	CD
FD6	59270.1	177	198.2	51.7	66.7		0	0.208	0.197	6.7	4.6	0.837	0.831	30.74	19.36
FD6	59270.2	177	205.5	50.9	67.1		0	0.213	0.217	1.9	4.1	0.822	0.823	28.37	24.06
FD6	59270.3	177	204.3	50.6	66.3		0	0.178	0.175	4.5	5.7	0.927	0.925	31.44	19.71
FD6	59270.4	177	195.8	51.3	68.6		0	0.182	0.178	8.2	4.5	0.930	0.932	27.54	24.24
FD6	59273.1	199	198.3	50.8	67.7		2	0.081	0.096	53.1	40.6	0.815	0.834	22.53	17.95
FD6	59273.2	199	207.3	51.4	68.6		2	0.084	0.123	53.6	27.6	0.817	0.863	26.59	17.02
FD6	59273.3	199	197.0	50.9	67.8		2	0.087	0.063	39.1	50.8	0.784	0.805	26.87	16.54
FD7	59261.1	149	206.8	52.4	66.0		0	0.161	0.160	5.6	6.9	0.888	0.889	29.28	20.98
FD7	59261.2	149	202.6	52.4	66.2		0	0.151	0.112	7.3	18.8	0.888	0.886	29.05	18.55
FD7	59261.3	149	197.0	51.4	65.3		0	0.171	0.161	2.9	5.6	0.925	0.916	29.70	23.29
FD7	59261.4	149	192.2	50.5	62.9		0	0.162	0.161	5.6	5.0	0.918	0.922	30.79	20.11
FD7	59271.1	177	198.8	50.9	65.3		2	0.096	0.121	49.0	41.3	0.854	0.876	25.92	20.97
FD7	59271.2	177	200.7	50.4	65.0		2	0.092	0.124	45.7	20.2	0.836	0.893	28.20	19.73
FD7	59271.3	177	191.9	49.1	62.9		2	0.125	0.132	34.4	18.2	0.870	0.878	28.05	19.67
FD7	59271.4	177	200.0	50.6	66.2		2	0.110	0.085	38.2	44.7	0.853	0.829	26.18	17.91

APPENDIX B

Table B1. Outgoing Solids, CD STFI Index, MD STFI Index, Density Test Results (From Reference 1).

Case	Furnish	Sample ID	Outgoing Solids %			CD STFI Index N·m/g			MD STFI Index N·m/g			Density g/cm^2		
			Ave.	+95% C.I.	-95% C.I.	Ave.	+95% C.I.	-95% C.I.	Ave.	+95% C.I.	-95% C.I.	Ave.	+95% C.I.	-95% C.I.
Con	WF1	59162				11.5	1.1	1.1	20.6	1.2	1.2	0.430	0.007	0.007
Con	WF2	59163				17.9	1.0	1.0	27.5	2.3	2.3	0.549	0.007	0.007
Con	WF3	59164				13.1	1.0	1.0	18.5	3.2	3.2	0.496	0.013	0.013
Con	FD5	59165				15.3	3.6	3.6	23.7	5.0	5.0	0.617	0.016	0.016
Con	FD6	59166				12.8	1.2	1.2	19.3	2.5	2.5	0.498	0.010	0.010
Con	FD7	59167				13.6	1.0	1.0	21.3	1.4	1.4	0.552	0.008	0.008
D1	WF1	59104	60.1	1.2	1.2	19.3	2.3	2.3	31.5	3.6	3.6	0.743	0.029	0.029
D1	WF2	59105	58.7	1.5	1.5	23.8	5.1	5.1	37.0	4.4	4.4	0.803	0.034	0.034
D1	WF3	59106	59.9	0.8	0.8	22.9	1.1	1.1	29.3	8.4	8.4	0.793	0.032	0.032
D1	FD5	59107	57.6	2.0	2.0	18.5	5.4	5.4	27.0	5.3	5.3	0.773	0.031	0.031
D1	FD6	59108	60.6	1.4	1.4	19.0	0.4	0.4	24.7	1.6	1.6	0.769	0.010	0.010
D1	FD7	59109	58.8	∞	∞	17.7	∞	∞	28.1	∞	∞	0.777	0.081	0.081
D2	WF1	59110	62.2	2.3	2.3	21.4	27.6	27.6	33.6	60.2	60.2	0.830	0.036	0.036
D2	WF2	59111	59.0	3.9	3.9	25.6	1.2	1.2	37.3	1.3	1.3	0.905	0.024	0.024
D2	WF3	59112	61.7	0.8	0.8	21.9	2.8	2.8	30.9	2.0	2.0	0.858	0.028	0.028
D2	FD5	59113	57.9	2.6	2.6	17.3	0.5	0.5	32.1	1.7	1.7	0.794	0.013	0.013
D2	FD6	59114	62.3	0.9	0.9	17.6	3.2	3.2	25.3	4.0	4.0	0.805	0.020	0.020
D2	FD7	59115	60.2	0.5	0.5	20.5	1.6	1.6	27.8	3.0	3.0	0.820	0.012	0.012
D3	WF1	59116	59.5	0.9	0.9	20.3	2.8	2.8	33.5	2.8	2.8	0.819	0.013	0.013
D3	WF2	59117	57.9	3.7	3.7	24.7	1.5	1.5	37.1	1.2	1.2	0.850	0.020	0.020
D3	WF3	59118	60.4	9.0	9.0	22.0	6.7	6.7	29.5	24.5	24.5	0.861	0.026	0.026
D3	FD5	59119	57.5	1.7	1.7	18.6	2.7	2.7	31.3	3.3	3.3	0.820	0.013	0.013
D3	FD6	59120	60.4	0.8	0.8	18.1	2.7	2.7	26.8	5.1	5.1	0.792	0.010	0.010
D3	FD7	59121	60.0	1.9	1.9	20.0	2.3	2.3	28.7	2.1	2.1	0.833	0.012	0.012

Table B2 Outgoing Solids, CD STFI Index, MD STFI Index, Density Test Results (From Reference 1).

Case	Furnish	Sample ID	Outgoing Solids %			CD STFI Index N·m/g			MD STFI Index N·m/g			Density g/cm^2		
			Ave.	+95% C.I.	-95% C.I.	Ave.	+95% C.I.	-95% C.I.	Ave.	+95% C.I.	-95% C.I.	Ave.	+95% C.I.	-95% C.I.
D4	WF1	59274	59.6	3.3	3.3	22.6	2.2	2.2	33.2	7.1	7.1	0.743	0.038	0.038
D4	WF2	59275	57.1	2.5	2.5	24.0	1.8	1.8	36.1	1.9	1.9	0.759	0.009	0.009
D4	WF3	59276	59.8	2.8	2.8	19.8	2.8	2.8	28.0	4.4	4.4	0.769	0.019	0.019
D4	FD5	59277	59.4	0.4	0.4	15.8	0.5	0.5	27.5	19.7	19.7	0.703	0.026	0.026
D4	FD6	59278	61.2	2.2	2.2	18.2	4.0	4.0	24.9	3.7	3.7	0.693	0.010	0.010
D4	FD7	59279	58.1	0.7	0.7	19.4	2.1	2.1	29.2	3.4	3.4	0.717	0.011	0.011
D5	WF1	59280	61.7	1.4	1.4	24.9	1.0	1.0	36.1	3.4	3.4	0.870	0.012	0.012
D5	WF2	59281	58.5	1.7	1.7	25.6	1.7	1.7	38.6	1.4	1.4	0.863	0.008	0.008
D5	WF3	59282	61.3	1.6	1.6	23.5	2.8	2.8	31.9	1.5	1.5	0.894	0.022	0.022
D5	FD5	59283	59.0	1.8	1.8	15.5	1.1	1.1	30.2	2.7	2.7	0.783	0.014	0.014
D5	FD6	59284	61.5	0.9	0.9	18.5	0.7	0.7	24.8	2.5	2.5	0.803	0.024	0.024
D5	FD7	59285	59.6	0.3	0.3	19.5	1.0	1.0	27.5	1.4	1.4	0.792	0.009	0.009
D6	WF1	59286	57.9	3.2	3.2	23.5	1.6	1.6	32.7	3.4	3.4	0.920	0.042	0.042
D6	WF2	59287	57.0	2.2	2.2	25.6	1.2	1.2	37.4	1.7	1.7	0.805	0.018	0.018
D6	WF3	59288	57.4	2.1	2.1	23.8	2.2	2.2	30.5	4.4	4.4	0.799	0.031	0.031
D6	FD5	59289	59.0	1.6	1.6	19.2	4.3	4.3	29.6	6.4	6.4	0.754	0.010	0.010
D6	FD6	59290	58.4	4.5	4.5	19.1	1.7	1.7	25.4	4.2	4.2	0.728	0.023	0.023
D6	FD7	59291	58.0	∞	∞	20.4	∞	∞	29.2	∞	∞	0.830	0.036	0.036

Table B3. Outgoing Solids, CD STFI Index, MD STFI Index, Density Test Results (From Reference 1).

Case	Furnish	Sample ID	Outgoing Solids %			CD STFI Index N·m/g			MD STFI Index N·m/g			Density g/cm^2		
			Ave.	+95% C.I.	-95% C.I.	Ave.	+95% C.I.	-95% C.I.	Ave.	+95% C.I.	-95% C.I.	Ave.	+95% C.I.	-95% C.I.
C1S	WF1	59064	59.6	9.0	9.0	21.3	9.5	9.5	32.9	15.0	15.0	0.806	0.070	0.070
C1S	WF2	59065	56.8	4.7	4.7	25.3	1.8	1.8	36.8	2.7	2.7	0.850	0.048	0.048
C1S	WF3	59066	60.6	3.7	3.7	23	23.3	23.3	30.3	31.2	31.2	0.876	0.038	0.038
C1S	FD5	59067	58.4	1.4	1.4	18.2	3.7	3.7	29.4	4.7	4.7	0.826	0.013	0.013
C1S	FD6	59068	60.6	5.6	5.6	17.2	5.0	5.0	25.0	3.9	3.9	0.807	0.035	0.035
C1S	FD7	59069	60.5	1.4	1.4	20.2	1.8	1.8	29.2	2.3	2.3	0.868	0.012	0.012
C2S	WF1	59070	63.8	1.0	1.0	24.4	1.0	1.0	35.9	1.5	1.5	0.917	0.018	0.018
C2S	WF2	59071	60.6	1.9	1.9	26.6	1.2	1.2	37.7	1.2	1.2	0.981	0.017	0.017
C2S	WF3	59072	62.4	1.9	1.9	24.4	2.4	2.4	32.6	3.5	3.5	0.959	0.023	0.023
C2S	FD5	59073	58.4	2.0	2.0	20.1	3.5	3.5	30.2	4.1	4.1	0.832	0.016	0.016
C2S	FD6	59074	63.7	2.4	2.4	21.7	0.4	0.4	28.0	8.3	8.3	0.931	0.039	0.039
C2S	FD7	59075	62.6	0.8	0.8	18.8	4.3	4.3	28.9	3.1	3.1	0.931	0.023	0.023
C3S	WF1	59098	61.3	45.8	45.8	22.2	8.7	8.7	32.7	63.3	63.3	0.900	0.080	0.080
C3S	WF2	59099	58.9	2.2	2.2	25.3	2.8	2.8	37.6	2.3	2.3	0.900	0.017	0.017
C3S	WF3	59100	61.9	0.3	0.3	21.9	1.2	1.2	29.0	1.9	1.9	0.810	0.030	0.030
C3S	FD5	59101	56.8	2.9	2.9	17.0	1.2	1.2	30.5	3.1	3.1	0.798	0.010	0.010
C3S	FD6	59102	61.8	1.4	1.4	18.2	1.4	1.4	26.9	0.9	0.9	0.829	0.014	0.014
C3S	FD7	59103	59.1	1.6	1.6	20.3	1.4	1.4	29.2	1.7	1.7	0.848	0.012	0.012
A1S	WF1	59161	61.1	1.3	1.3	19.5	27.5	27.5	27.0	47.3	47.3	0.764	0.077	0.077
A4S	WF1	59292	59.5	2.9	2.9	19.8	3.0	3.0	28.3	3.3	3.3	0.753	0.014	0.014
A4S	WF2	59293	55.4	1.3	1.3	21.6	1.1	1.1	32.9	1.1	1.1	0.723	0.008	0.008
A4S	WF3	59294	58.2	0.8	0.8	19.1	2.2	2.2	26.4	0.8	0.8	0.735	0.016	0.016
A4S	FD5	59295	59.1	3.9	3.9	16.6	48.4	48.4	21.7	93.2	93.2	0.675	0.036	0.036
A4S	FD6	59296	59	0.6	0.6	15.4	2.1	2.1	22.1	1.9	1.9	0.685	0.013	0.013
A4S	FD7	59297	58.2	3.5	3.5	17.0	0.7	0.7	22.3	5.3	5.3	0.687	0.021	0.021
A5S	WF2	59299	56.7	2.0	2.0	22.7	2.0	2.0	33.0	3.2	3.2	0.757	0.015	0.015
A5S	WF3	59300	59.5	∞	∞	20.3	∞	∞	22.6	∞	∞	0.709	0.341	0.341
A5S	FD5	59301	58.5	1.4	1.4	14.5	2.6	2.6	20.8	5.9	5.9	0.741	0.016	0.016
A5S	FD6	59302	59.6	1.5	1.5	14.5	3.6	3.6	20.9	4.4	4.4	0.706	0.028	0.028
A5S	FD7	59303	58	0.4	0.4	17.0	0.8	0.8	21.9	1.2	1.2	0.695	0.020	0.020

Table B4. Outgoing Solids, CD STFI Index, MD STFI Index, Density Test Results (From Reference 1).

Case	Furnish	Sample ID	Outgoing Solids %			CD STFI Index N·m/g			MD STFI Index N·m/g			Density g/cm^2		
			Ave.	+95% C.I.	-95% C.I.	Ave.	+95% C.I.	-95% C.I.	Ave.	+95% C.I.	-95% C.I.	Ave.	+95% C.I.	-95% C.I.
C1	WF1	59043	63.8	4.0	1.6	20.5	2.7	3.1	34.3	5.8	2.8	0.885	0.076	0.027
C1	WF2	59032	59.6	5.0	1.7	25.5	7.0	2.7	36.6	10.1	4.1	0.881	0.118	0.024
C1	WF3	59033	62.4	2.1	1.0	22.3	3.2	4.2	30.3	3.4	3.8	0.880	0.032	0.026
C1	FD5	59021	59.8	2.6	1.4	17.6	3.1	3.7	30.2	12.9	12.0	0.847	0.053	0.030
C1	FD6	59047	65.1	3.7	1.5	20.3	3.4	1.6	26.4	2.8	1.7	0.841	0.022	0.011
C1	FD7	59048	62.8	2.4	1.0	19.2	1.0	1.6	27.1	1.5	2.6	0.866	0.017	0.013
C2	WF1	59049	64.6	5.5	4.3	23.4	7.4	6.2	35.5	7.8	4.8	0.992	0.249	0.153
C2	WF2	59050	61.4	2.0	1.1	26.6	1.2	1.1	38.0	1.8	1.6	0.928	0.020	0.047
C2	WF3	59039	63.3	2.9	0.9	23.1	1.6	0.7	31.6	1.1	2.5	0.931	0.014	0.022
C2	FD5	59027	60.7	6.0	3.7	18.1	4.6	4.9	28.9	5.5	7.5	0.838	0.032	0.023
C2	FD6	59052	66.1	4.6	1.7	19.8	1.6	3.4	28.7	4.4	1.7	0.836	0.025	0.041
C2	FD7	59028	61.0	2.2	1.5	20.5	1.7	1.7	27.4	1.6	1.6	0.800	0.115	0.057
C3	WF1	59076	62.4	3.5	5.1	21.3	3.9	5.3	30.2	11.5	15.7	0.865	0.062	0.083
C3	WF2	59077	60.2	2.0	1.0	24.6	3.0	4.0	35.1	1.7	3.4	0.851	0.021	0.043
C3	WF3	59078	62.9	4.1	2.0	23.1	4.2	2.1	31.4	7.5	3.5	0.909	0.196	0.055
C3	FD5	59079	59.2	5.1	4.6	17.3	2.3	1.7	29.8	3.7	5.0	0.812	0.043	0.023
C3	FD6	59092	66.4	2.8	1.1	21.4	2.9	1.4	26.0	0.5	1.0	0.880	0.042	0.028
C3	FD7	59087	64.1	2.9	2.4	20.3	1.4	1.7	27.4	1.8	2.9	0.802	0.054	0.087
A1	WF1	59122	67.9	5.5	2.0	24.7	5.8	2.3	36.0	9.4	4.0	0.941	0.137	0.047
A1	WF2	59155	61.8	2.5	2.1	24.6	2.9	4.3	36.3	3.1	3.5	0.908	0.039	0.027
A1	WF3	59157	64.7	1.5	1.9	22.9	1.0	1.0	30.5	2.5	2.5	0.851	0.036	0.036
A1	FD5	59125	60.2	12.0	6.0	17.3	57.6	51.7	28.5	126	134	0.782	0.040	0.100
A1	FD6	59138	67.5	2.9	1.2	21.6	10.5	4.3	28.2	6.5	10.0	0.860	0.067	0.014
A1	FD7	59127	63.7	2.7	2.2	21.3	13.9	13.9	29.0	3.0	3.0	0.860	0.034	0.018
A2	WF1	59140	68.0	3.7	1.1	23.4	2.4	2.6	34.1	3.5	7.8	0.917	0.042	0.029
A2	WF2	59141	62.8	1.9	1.2	26.4	0.8	1.8	37.3	0.9	1.3	0.896	0.010	0.035
A2	WF3	59158	65.4	2.5	3.5	22.9	1.7	1.6	30.2	3.9	3.5	0.819	0.034	0.031
A2	FD5	59160	60.8	4.8	2.3	17.7	4.0	4.0	30.0	4.5	4.5	0.763	0.121	0.038
A2	FD6	59143	68.3	3.1	1.2	21.7	6.1	9.9	28.8	5.2	3.7	0.839	0.033	0.141
A2	FD7	59133	65.9	1.9	1.3	22.0	2.5	2.5	32.0	1.5	1.5	0.789	0.007	0.007

Table B5. Outgoing Solids, CD STFI Index, MD STFI Index, Density Test Results (From Reference 1).

Case	Furnish	Sample ID	Outgoing Solids %			CD STFI Index N·m/g			MD STFI Index N·m/g			Density g/cm^2		
			Ave.	+95% C.I.	-95% C.I.	Ave.	+95% C.I.	-95% C.I.	Ave.	+95% C.I.	-95% C.I.	Ave.	+95% C.I.	-95% C.I.
A4	WF1	59180	64.9	5.1	1.6	23.3	4.9	1.8	34.8	8.9	3.2	0.865	0.111	0.031
A4	WF2	59181	60.3	5.2	1.8	24.4	3.8	1.4	35.9	4.3	1.6	0.913	0.188	0.054
A4	WF3	59182	63.5	6.5	2.3	23.3	6.1	2.4	31.7	7.3	2.7	0.932	0.203	0.062
A4	FD5	59171	60.6	1.6	0.9	16.3	1.6	1.6	28.6	12.3	8.0	0.723	0.046	0.022
A4	FD6	59172	62.9	2.8	1.6	21.1	7.1	3.9	27.1	6.3	3.5	0.806	0.111	0.055
A4	FD7	59185	62.2	4.9	1.7	21.1	5.4	1.9	28.8	8.7	3.1	0.836	0.147	0.041
A5	WF1	59186	66.4	3.7	1.1	25.7	7.3	2.0	38.3	14.1	2.1	0.926	0.179	0.022
A5	WF2	59187	61.2	4.7	1.6	25.4	4.0	1.6	37.2	5.8	2.2	0.893	0.130	0.038
A5	WF3	59188	64.5	4.7	1.5	23.2	4.2	1.4	33.7	15.2	4.8	0.903	0.189	0.047
A5	FD5		59.6	1.6	0.9	14.1	1.6	2.1	24.5	7.0	3.6	0.784	0.057	0.023
A5	FD6	59190	66.5	8.3	2.8	21.6	9.0	3.2	28.8	9.9	3.5	0.832	0.137	0.047
A5	FD7	59179	62.7	3.8	2.2	22.2	6.1	3.4	31.0	10.6	5.8	0.736	0.042	0.022
A6	WF1	59213	66.9	5.4	1.7	24.0	2.6	2.5	34.7	5.8	4.5	0.838	0.075	0.021
A6	WF2	59214	61.7	2.0	1.4	25.3	8.2	3.8	34.6	6.2	7.0	0.925	0.069	0.035
A6	WF3	59215	63.9	4.3	2.0	23.2	1.4	1.3	31.6	3.0	4.8	0.925	0.106	0.035
A6	FD5	59210	61.1	3.6	3.1	18.3	34.1	34.1	29.1	41.4	41.4	0.758	0.097	0.039
A6	FD6	59217	65.8	2.7	1.2	19.7	5.1	6.2	28.5	2.0	1.6	0.911	0.010	0.023
A6	FD7	59218	63.4	3.2	1.2	20.9	7.4	4.1	29.3	3.6	4.6	0.927	0.064	0.023
A5F	WF1	59240	64.9	3.1	1.0	23	2.8	1.4	34.8	10.7	3.7	0.830	0.073	0.040
A5F	WF2	59235	60.7	1.9	1.3	23.8	1.9	1.9	34.9	2.1	2.1	0.810	0.017	0.017
A5F	WF3	59236	63.6	0.0	0.0	22	7.4	7.4	31.2	19.1	19.1	0.837	0.019	0.019
A5F	FD5		60.2	4.2	4.2									
A5F	FD6	59244	66.3	1.5	1.4	20.1	1.5	2.5	26.6	3.8	2.4	0.853	0.111	0.069
A5F	FD7	59239	62.6	2.9	7.7	18.9	1.5	1.5	27.4	3.2	3.2	0.848	0.013	0.013
A4H	WF1	59262	67.4	∞	∞	23	∞	∞	35.2	∞	∞	0.773	∞	∞
A4H	WF2	59263	63.5	∞	∞	24.4	∞	∞	35.9	∞	∞	0.771	∞	∞
A4H	WF3	59252	63.1	3.0	1.5	21.6	2.3	2.3	30.3	3.9	3.9	0.780	0.093	0.052
A4H	FD6	59265	66.3	3.9	1.2	21	8.4	3.6	28.8	10.9	3.5	0.797	0.061	0.014
A4H	FD7	59255	62.6	3.3	1.8	19.1	1.8	1.8	27.1	2.0	1.3	0.804	0.005	0.005
A5H	WF1	59256	67.1	3.0	1.5	24.6	3.3	1.7	37.1	3.0	1.7	0.854	0.003	0.003
A5H	WF2	59257	63.8	8.8	8.8	25.4	10.5	10.5	37.8	29.5	29.5	0.857	0.092	0.092
A5H	WF3	59258	65.1	1.0	0.5	23.7	0.8	0.8	32.4	0.9	0.9	0.807	0.009	0.009
A5H	FD6	59270	67.9	1.9	2.0	21.8	5.7	5.7	29.5	4.5	4.9	0.874	0.136	0.095
A5H	FD7	59261	65.1	2.4	2.4	20.7	3.1	3.1	29.7	1.2	1.2	0.904	0.015	0.015

Table B6. Sheet Roughness Test Results.

Case	Furnish	Sample ID	WS Sheffield Roughness (Standard cc/min)			FS Sheffield Roughness (Standard cc/min)			WS Bendtsen Roughness (ml/min)			FS Bendtsen Roughness (ml/min)		
			Ave.	Num.	95% C.I.	Ave.	Num.	95% C.I.	Ave.	Num.	95% C.I.	Ave.	Num.	95% C.I.
Con	WF1	59162	>3515.2	20	n/a	>3515.2	20	n/a	2995.9	20	65.1	2981.8	20	86.5
Con	WF2	59163	>3515.2	40	n/a	>3515.2	40	n/a	2395.5	40	93.4	2085.9	40	86.5
Con	WF3	59164	>3515.2	30	n/a	>3515.2	30	n/a	2244.7	30	80.8	2102.9	30	82.0
Con	FD5	59165	>3515.2	40	n/a	3120.4	40	36.2	2203.6	40	92.4	1561.4	20	79.1
Con	FD6	59166	>3515.2	40	n/a	>3515.2	40	n/a	2508.3	40	56.4	2691.2	40	52.7
Con	FD7	59167	>3515.2	40	n/a	>3515.2	40	n/a	2167.8	40	63.8	1927.7	40	55.9
D1	WF1	59104	>3515.2	40	n/a	>3515.2	40	n/a	2360.1	40	71.0	2682.7	40	64.9
D1	WF2	59105	>3515.2	30	n/a	>3515.2	30	n/a	2021.7	30	89.1	2497.0	30	74.1
D1	WF3	59106	>3515.2	30	n/a	>3515.2	30	n/a	2254.1	45	65.5	2518.7	45	61.6
D1	FD5	59107	3213.60	40	31.60	3326.4	40	32.5	1700.4	20	78.7	1915.8	20	89.9
D1	FD6	59108	3455.29	30	34.44	>3515.2	30	n/a	1977.7	25	76.8	2425.0	25	75.1
D1	FD7	59109	3337.97	10	42.55	3399.00	10	36.2	1882.0	10	125.2	2057.0	10	75.8
D2	WF1	59110	>3515.2	20	n/a	>3515.2	20	n/a	2440.3	20	111.8	2786.7	20	109.2
D2	WF2	59111	>3515.2	30	n/a	>3515.2	30	n/a	2215.6	40	101.4	2726.6	40	91.2
D2	WF3	59112	>3515.2	30	n/a	>3515.2	30	n/a	2319.9	20	188.3	2583.0	20	111.3
D2	FD5	59113	3248.52	40	28.97	3372.0	40	22.8	1927.2	20	126.4	2125.6	20	77.0
D2	FD6	59114	>3515.2	40	n/a	>3515.2	40	n/a	2108.3	40	95.3	2568.7	40	76.7
D2	FD7	59115	>3515.2	40	n/a	>3515.2	40	n/a	2033.5	40	88.4	2431.8	40	70.2
D3	WF1	59116	>3515.2	30	n/a	>3515.2	30	n/a	2479.0	30	85.2	2756.9	30	94.5
D3	WF2	59117	>3515.2	40	n/a	>3515.2	40	n/a	2282.9	40	73.1	2557.9	40	70.2
D3	WF3	59118	>3515.2	20	n/a	>3515.2	20	n/a	2343.9	20	162.1	2749.3	20	125.7
D3	FD5	59119	3285.30	40	28.70	3484.2	40	14.0	1864.8	20	102.0	2329.7	20	75.3
D3	FD6	59120	>3515.2	40	n/a	>3515.2	40	n/a	2609.0	40	64.7	2148.3	40	92.1
D3	FD7	59121	>3515.2	40	n/a	>3515.2	40	n/a	2078.8	40	114.0	2406.3	40	83.6

Table B7. Sheet Roughness Test Results .

Case	Furnish	Sample ID	WS Sheffield Roughness (Standard cc/min)			FS Sheffield Roughness (Standard cc/min)			WS Bendtsen Roughness (ml/min)			FS Bendtsen Roughness (ml/min)		
			Ave.	Num.	95% C.I.	Ave.	Num.	95% C.I.	Ave.	Num.	95% C.I.	Ave.	Num.	95% C.I.
D4	WF1	59274	>3515.2	40	n/a	>3515.2	40	n/a	2169.5	40	86.2	2777.7	40	74.1
D4	WF2	59275	>3515.2	40	n/a	>3515.2	40	n/a	2212.1	40	106.9	2482.8	40	64.0
D4	WF3	59276	>3515.2	30	n/a	>3515.2	30	n/a	2165.7	30	106.5	2649.1	30	114.3
D4	FD5	59277	3218.8	20	31.8	3355.1	20	30.8	1694.7	20	87.1	2032.0	20	99.8
D4	FD6	59278	3292.4	40	29.7	>3515.2	40	n/a	1856.3	20	85.6	2569.3	40	80.3
D4	FD7	59279	3236.3	40	41.5	3492.0	40	14.3	1723.0	20	147.6	2098.1	40	141.7
D5	WF1	59280	>3515.2	40	n/a	>3515.2	40	n/a	2445.9	40	96.5	2956.3	40	61.3
D5	WF2	59281	>3515.2	40	n/a	>3515.2	40	n/a	2311.3	40	82.3	2501.2	40	80.5
D5	WF3	59282	>3515.2	30	n/a	>3515.2	30	n/a	2220.1	30	125.2	2758.8	30	88.5
D5	FD5	59283	3280.3	40	56.4	3443.9	40	30.0	1791.1	20	113.5	1947.0	20	75.2
D5	FD6	59284	>3515.2	40	n/a	>3515.2	40	n/a	2046.2	40	83.6	2617.5	40	58.6
D5	FD7	59285	>3515.2	40	n/a	>3515.2	40	n/a	1976.8	40	105.5	2329.7	40	78.7
D6	WF1	59286	>3515.2	40	n/a	>3515.2	40	n/a	2464.4	40	94.2	2590.5	40	85.2
D6	WF2	59287	3207.1	40	9.3	3241.4	40	13.7	2467.2	40	75.5	2681.3	40	74.4
D6	WF3	59288	3206.4	30	20.4	3202.8	30	16.7	2707.7	30	130.9	2647.2	30	95.3
D6	FD5	59289	3034.5	40	24.5	3084.2	40	19.7	2288.6	40	120.1	2326.9	40	102.7
D6	FD6	59290	3144.6	40	21.3	3250.2	40	19.6	2097.3	40	82.0	2481.4	40	79.1
D6	FD7	59291	3229.3	10	80.9	3236.0	10	42.6	2335.4	10	166.7	2284.4	10	95.2

Table B8. Sheet Roughness Test Results.

Case	Furnish	Sample ID	WS Sheffield Roughness (Standard cc/min)			FS Sheffield Roughness (Standard cc/min)			WS Bendtsen Roughness (ml/min)			FS Bendtsen Roughness (ml/min)		
			Ave.	Num	95% C.I.	Ave.	Num	95% C.I.	Ave.	Num	95% C.I.	Ave.	Num	95% C.I.
C1S	WF1	59064	>3515.2	30	n/a	3421.2	30	60.2	2467.5	30	145.8	1798.1	25	178.2
C1S	WF2	59065	3481.6	40	22.2	3110.8	40	48.9	2148.3	35	87.1	1399.8	20	150.5
C1S	WF3	59066	>3515.2	20	n/a	3144.4	20	52.3	2068.9	20	136.1	1507.6	20	172.4
C1S	FD5	59067	3179.5	40	25.4	2593.3	40	57.8	1609.6	20	95.1	1037.0	20	131.6
C1S	FD6	59068	>3515.2	30	n/a	2973.8	30	31.7	1904.5	30	83.5	1309.1	15	119.2
C1S	FD7	59069	>3515.2	40	n/a	2719.5	40	61.1	1856.3	40	76.0	1144.7	20	131.5
C2S	WF1	59070	>3515.2	40	n/a	3172.0	40	41.9	2482.8	40	67.9	1414.0	20	133.8
C2S	WF2	59071	>3515.2	40	n/a	3038.1	40	43.4	2270.2	40	68.2	1258.1	20	96.3
C2S	WF3	59072	>3515.2	30	n/a	3064.0	30	55.7	2497.9	30	93.2	1260.0	15	107.8
C2S	FD5	59073	>3515.2	40	n/a	2589.8	40	55.8	1918.6	40	83.0	1054.0	20	109.5
C2S	FD6	59074	>3515.2	20	n/a	2870.2	20	73.3	2094.4	40	62.7	1263.8	10	128.0
C2S	FD7	59075	>3515.2	30	n/a	2784.5	30	84.2	1976.3	10	187.3	893.3	15	125.3
C3S	WF1	59098	>3515.2	20	n/a	3366.4	20	77.7	2477.1	20	124.6	1779.7	10	165.0
C3S	WF2	59099	>3515.2	40	n/a	3105.4	40	52.9	2151.1	40	79.5	1411.2	20	92.9
C3S	WF3	59100	>3515.2	30	n/a	>3515.2	30	n/a	1997.1	30	127.5	1645.5	30	156.8
C3S	FD5	59101	>3515.2	40	n/a	2728.3	40	69.2	1740.3	40	76.5	968.9	20	99.8
C3S	FD6	59102	>3515.2	40	n/a	3145.5	40	77.1	1846.4	40	66.8	1456.5	20	138.7
C3S	FD7	59103	>3515.2	30	n/a	2867.6	30	72.9	1743.8	30	74.4	1180.6	15	122.6
A1S	WF1	59161	>3515.2	20	n/a	>3515.2	20	n/a	2440.3	20	141.3	2190.8	20	109.0
A4S	WF1	59292	>3515.2	40	n/a	>3515.2	40	n/a	2287.2	40	62.2	2173.8	40	71.8
A4S	WF2	59293	>3515.2	40	n/a	3351.3	40	57.2	2168.1	40	88.4	1751.4	30	149.5
A4S	WF3	59294	>3515.2	40	n/a	>3515.2	40	n/a	2003.7	40	94.4	1924.3	40	73.3
A4S	FD5	59295	3122.7	20	54.3	2915.8	20	51.4	1569.9	20	115.0	1337.5	20	88.6
A4S	FD6	59296	>3515.2	40	n/a	>3515.2	40	n/a	2017.9	40	88.3	2224.8	40	125.2
A4S	FD7	59297	3327.1	30	62.2	3260.2	30	79.5	1853.4	15	103.6	1649.3	15	216.5
A5S	WF2	59299	>3515.2	40	n/a	3433.3	40	48.89	2005.1	40	77.2	1942.5	40	119.2
A5S	WF3	59300	>3515.2	10	n/a	>3515.2	10	n/a	1830.0	10	158.1	2046.0	10	179.5
A5S	FD5	59301	3287.2	40	47.4	3148.4	40	47.8	1796.7	20	101.8	1655.0	20	118.4
A5S	FD6	59302	>3515.2	40	n/a	>3515.2	40	n/a	2110.0	40	96.0	2349.6	40	105.2
A5S	FD7	59303	3343.0	50	33.2	3255.2	50	51.3	1796.7	25	84.9	1692.4	25	110.0

Table B9. Sheet Roughness Test Results.

Case	Furnish	Sample ID	WS Sheffield Roughness (Standard cc/min)			FS Sheffield Roughness (Standard cc/min)			WS Bendtsen Roughness (ml/min)			FS Bendtsen Roughness (ml/min)		
			Ave.	Num.	95% C.I.	Ave.	Num.	95% C.I.	Ave.	Num.	95% C.I.	Ave.	Num.	95% C.I.
C1	WF1	59043	3269.0	40	18.1	3087.8	40	34.6	2525.3	60	67.6	1615.3	60	91.3
C1	WF2	59032	3196.3	40	17.8	2965.9	40	42.8	2204.9	60	65.1	1492.5	60	84.8
C1	WF3	59033	2640.5	30	155.7	2524.5	30	166.7	2079.2	55	112.2	1360.7	55	122.4
C1	FD5	59021	3026.1	10	52.2	2256.2	10	103.3	1535.9	5	208.8	810.2	5	160.5
C1	FD6	59047	3104.9	40	18.1	2756.1	40	58.8	2091.6	60	66.2	1279.8	60	89.9
C1	FD7	59048	3050.0	40	32.2	2592.0	40	69.6	1921.5	60	63.3	1034.1	60	55.9
C2	WF1	59049	3240.2	20	20.9	3035.3	20	50.2	2457.3	20	172.5	1660.7	20	137.6
C2	WF2	59050	3387.3	30	59.5	2984.6	30	75.7	2257.1	30	107.0	1127.7	15	95.5
C2	WF3	59039	3496.6	40	11.0	3178.3	40	58.4	2404.8	40	103.3	1456.5	20	106.0
C2	FD5	59027	3208.4	30	62.9	2563.0	30	103.0	1728.7	30	104.9	989.7	30	157.3
C2	FD6	59052	3027.0	40	30.8	2621.9	40	56.9	2166.7	40	82.2	1296.4	40	102.2
C2	FD7	59028	>3515.2	30	n/a	2707.1	30	n/a	2080.2	15	127.4	927.3	15	105.4
C2	FD7	59042	2886.5	40	38.8	2530.2	40	64.8	2066.1	40	n/a	1204.2	40	130.2
C3	WF1	59076	3074.4	40	17.0	2861.4	40	39.2	2088.7	40	71.6	1575.6	40	98.0
C3	WF2	59077	>3515.2	40	n/a	3284.9	40	82.6	2131.3	40	73.3	1505.7	30	129.1
C3	WF3	59078	>3515.2	30	n/a	3282.5	30	78.3	2339.2	30	125.5	1779.7	15	127.7
C3	FD5	59079	3298.0	40	30.3	2507.0	40	110.3	1871.9	40	74.4	827.2	40	76.7
C3	FD6	59092	3324.2	40	53.2	3035.5	40	61.4	1847.8	40	73.6	1334.6	40	72.3
C3	FD7	59087	3375.4	40	32.9	2677.3	40	98.2	1904.5	20	73.5	852.7	20	118.2
A1	WF1	59122	3511.2	40	4.8	3158.7	40	47.8	2561.9	40	83.7	1411.2	20	109.1
A1	WF2	59155	3396.5	40	18.7	2969.3	40	50.7	1850.6	20	197.7	1215.6	20	102.0
A1	WF3	59157	3452.7	40	20.6	3024.5	40	68.2	2085.9	20	84.4	1090.8	20	119.3
A1	FD5	59125	3286.6	20	42.8	2695.5	20	106.7	1853.4	10	138.9	912.2	10	132.8
A1	FD6	59138	3388.6	40	23.7	2877.1	40	75.7	2068.9	20	105.4	1144.7	20	117.1
A1	FD7	59127	3377.3	20	45.1	2665.4	20	126.3	1966.8	10	133.6	810.2	10	144.1
A2	WF1	59140	3498.5	40	10.0	3190.4	40	35.3	2513.7	40	65.2	1564.3	20	69.9
A2	WF2	59141	3427.2	40	19.8	3069.8	40	66.1	2111.4	20	126.5	1388.5	20	157.3
A2	WF2	59156	>3515.2	40	n/a	2973.9	40	46.5	2091.6	20	106.3	1158.9	20	114.1
A2	WF3	59158	3491.4	20	24.7	3098.5	20	88.2	2406.8	20	110.8	1116.3	10	172.9
A2	FD5	59160	3264.6	40	28.2	2588.7	40	101.4	1816.6	20	138.7	906.5	20	88.5
A2	FD6	59143	3419.9	40	24.2	2894.1	40	80.9	2182.3	40	93.3	1141.9	20	119.4
A2	FD7	59133	3128.1	40	25.1	2599.8	40	102.0	2071.7	20	149.5	869.7	20	138.9

Table B10 Sheet Roughness Test Results.

Case	Furnish	Sample ID	WS Sheffield Roughness (Standard cc/min)			FS Sheffield Roughness (Standard cc/min)			WS Bendtsen Roughness (ml/min)			FS Bendtsen Roughness (ml/min)		
			Ave.	Num.	95% C.I.	Ave.	Num.	95% C.I.	Ave.	Num.	95% C.I.	Ave.	Num.	95% C.I.
A4	WF1	59180	3372.7	40	20.7	3002.7	40	46.2	3180.2	20	81.0	1484.9	20	138.1
A4	WF2	59181	>3515.2	40	n/a	2801.1	40	65.2	2774.8	40	61.3	1076.7	20	92.5
A4	WF3	59182	>3515.2	30	n/a	2759.7	30	68.7	2993.1	30	91.4	968.9	15	150.5
A4	FD5	59171	>3515.2	40	n/a	2527.7	40	63.2	2382.2	40	66.1	858.4	20	111.3
A4	FD6	59172	>3515.2	40	n/a	2777.2	40	36.7	2757.5	40	57.5	957.6	20	92.9
A4	FD7	59185	>3515.2	40	n/a	2625.7	40	90.7	2584.9	40	68.0	866.9	20	122.9
A5	WF1	59186	>3515.2	40	n/a	3186.4	40	36.1	3083.8	40	51.8	1331.8	20	126.6
A5	WF2	59187	>3515.2	40	n/a	2934.4	40	59.5	2886.8	40	67.8	1181.5	20	114.3
A5	WF3	59188	>3515.2	30	n/a	3115.0	30	67.5	3000.7	30	76.6	1241.1	15	111.8
A5	FD6	59190	>3515.2	40	n/a	2876.3	40	48.4	2699.7	40	67.5	1190.1	20	162.3
A5	FD7	59179	>3515.2	40	n/a	2586.2	40	75.2	2573.5	40	89.2	781.8	20	99.7
A6	WF1	59213	>3515.2	40	n/a	3217.2	40	39.3	3001.6	40	71.1	1269.4	20	101.1
A6	WF2	59214	>3515.2	40	n/a	2966.4	40	47.2	2399.2	40	85.7	1000.1	20	86.2
A6	WF3	59215	>3515.2	30	n/a	3117.8	30	62.3	2639.7	30	114.3	1445.2	15	196.1
A6	FD5	59210	3455.4	20	36.8	2496.1	20	136.0	2034.9	10	119.7	566.4	10	96.1
A6	FD6	59217	>3515.2	40	n/a	2903.5	40	73.7	2502.7	40	105.0	1039.8	20	144.7
A6	FD7	59218	>3515.2	40	n/a	2670.2	40	94.4	2253.2	40	81.8	787.5	20	75.7
A5F	WF1	59240	>3515.2	40	n/a	3211.9	40	52.2	2525.3	40	91.0	1215.6	20	126.7
A5F	WF2	59235	>3515.2	40	n/a	2979.7	40	57.7	2321.2	40	100.6	1292.1	20	155.2
A5F	WF3	59236	>3515.2	20	n/a	3032.8	20	110.2	2335.4	20	151.1	1229.7	10	289.8
A5F	FD6	59244	3482.0	40	21.8	2729.2	40	79.2	1921.5	20	105.6	946.2	20	137.1
A5F	FD7	59239	3273.2	40	33.4	2607.3	40	95.7	1660.7	20	96.9	759.1	20	90.3
A4H	WF1	59262	>3515.2	30	n/a	3149.3	30	51.2	2749.3	30	115.0	1180.6	15	137.7
A4H	WF2	59263	>3515.2	40	n/a	2929.0	40	68.5	2523.9	40	114.4	1065.3	20	115.9
A4H	WF3	59252	3461.7	40	32.2	3107.4	40	58.7	1983.9	20	125.2	1178.7	20	132.3
A4H	FD6	59265	>3515.2	40	n/a	2726.2	40	63.2	2237.6	40	83.1	844.2	20	84.1
A4H	FD7	59255	3210.7	40	30.2	2694.7	40	88.1	1715.9	40	121.5	1014.3	40	103.2
A5H	WF1	59256	>3515.2	40	n/a	3171.4	40	47.4	2480.0	40	134.6	1552.9	20	176.0
A5H	WF2	59257	>3515.2	20	n/a	2881.1	20	117.6	2267.4	15	153.7	832.8	10	149.1
A5H	WF3	59258	>3515.2	40	n/a	2980.8	40	65.6	2319.8	40	111.6	1082.3	20	156.5
A5H	FD6	59270	>3515.2	40	n/a	2773.7	40	71.7	2295.7	40	105.3	917.9	20	87.8
A5H	FD7	59261	3354.7	40	27.8	2574.7	40	116.4	2000.9	40	97.1	949.1	40	102.7

Table B11. Gurley Porosity, Cracking Angle, and Ink Penetration Test Results.

Case	Furnish	Sample ID	WS Gurley Porosity (s)			FS Gurley Porosity (s)			Cracking Angle (deg)			FS Ink Contact Angle (deg)					Rate of Change (deg/s)	
			Ave	Num	95% CI	Ave	Num	95% CI	Ave	Num	95% CI	5 sec Ave	Num	95% CI	60 sec Ave	95% CI	Value	95% CI
Con	WF1	59162	0.6	10	0.05	0.6	10	0.06	102.4	8	13.39	15.2	5	9.27	3.4	9.44	0.215	0.241
Con	WF2	59163	5.6	12	0.75	5.8	12	0.97	88.9	8	6.63	34.8	5	7.42	30.2	7.30	0.084	0.189
Con	WF3	59164	2.5	12	0.14	2.4	12	0.19	95.4	8	7.46	37.2	5	5.29	27.4	2.16	0.178	0.104
Con	FD5	59165	91.3	12	37.02	102.0	12	32.60	39.6	8	5.85	30.6	5	7.00	28.6	3.20	0.036	0.140
Con	FD6	59166	3.8	12	0.34	3.8	12	0.29	90.3	8	6.35	0.0	5	0.00	0.0	0.00	n/a	n/a
Con	FD7	59167	8.0	12	0.81	7.9	12	0.78	91.8	8	13.80	31.2	5	4.39	21.8	2.66	0.171	0.093
D1	WF1	59104	5.9	12	0.93	6.6	12	0.88	86.1	8	8.17	48.2	5	10.76	37.4	6.83	0.196	0.232
D1	WF2	59105	39.6	9	7.96	38.8	9	9.06	80.5	8	3.90	48.6	5	7.16	37.4	2.57	0.204	0.138
D1	WF3	59106	29.3	9	4.44	30.3	9	2.99	105.6	8	8.28	49.0	5	10.92	44.8	10.65	0.076	0.277
D1	FD5	59107	123.8	12	21.30	158.8	12	39.70	50.8	8	3.91	37.8	5	6.42	28.2	4.59	0.175	0.144
D1	FD6	59108	27.7	9	2.71	27.5	9	3.74	106.6	8	4.32	36.6	5	4.93	29.4	7.78	0.131	0.168
D1	FD7	59109	44.6	10	3.78	47.3	10	4.21	115.2	8	5.17	48.8	5	4.16	38.0	6.27	0.196	0.137
D2	WF1	59110							101.6	8	8.00	60.4	5	5.60	49.6	6.06	0.196	0.150
D2	WF2	59111							96.3	8	6.04	58.6	5	7.16	49.4	6.18	0.167	0.172
D2	WF3	59112							89.4	8	9.27	62.8	5	11.89	50.8	9.75	0.218	0.280
D2	FD5	59113							42.6	8	3.50	46.4	5	3.69	39.8	3.33	0.120	0.090
D2	FD6	59114							98.6	8	7.90	48.6	5	12.15	40.4	10.78	0.149	0.295
D2	FD7	59115							98.8	8	3.44	55.2	5	4.68	45.6	4.27	0.175	0.115
D3	WF1	59116							91.5	8	7.21	53.2	5	10.84	43.2	9.51	0.182	0.262
D3	WF2	59117							92.0	8	4.45	51.6	5	2.07	42.4	2.42	0.167	0.058
D3	WF3	59118							97.6	8	5.18	54.8	5	8.21	45.2	6.17	0.175	0.187
D3	FD5	59119							56.3	8	6.03	45.2	5	1.84	36.8	1.37	0.153	0.042
D3	FD6	59120							104.4	8	5.76	43.0	5	3.40	36.0	4.21	0.127	0.098
D3	FD7	59121							99.3	8	5.69	49.6	5	7.11	42.4	6.37	0.131	0.174

Table B12. Gurley Porosity, Cracking Angle, and Ink Penetration Test Results.

Case	Furnish	Sample ID	WS Gurley Porosity (s)			FS Gurley Porosity (s)			Cracking Angle (deg)			FS Ink Contact Angle (deg)					Rate of Change (deg/s)	
			Ave	Num	95% CI	Ave	Num	95% CI	Ave	Num	95% CI	5 sec Ave	Num	95% CI	60 sec Ave	95% CI	Value	95% CI
D4	WF1	59274							97.8	8	6.78	38.8	5	10.03	32.4	8.65	0.116	0.241
D4	WF2	59275							85.9	8	3.77	45.0	5	7.32	37.8	7.34	0.131	0.188
D4	WF3	59276							117.1	8	6.08	27.2	5	8.11	15.0	8.78	0.222	0.217
D4	FD5	59277							52.6	8	6.37	19.4	5	3.99	12.4	5.86	0.127	0.129
D4	FD6	59278							112.1	8	7.18	5.4	5	6.18	3.4	5.80	0.036	0.154
D4	FD7	59279							99.9	8	3.82	26.6	5	14.46	17.8	10.11	0.160	0.321
D5	WF1	59280							105.6	8	8.29	16.4	5	15.52	6.4	11.02	0.182	0.346
D5	WF2	59281							106.5	8	4.21	31.6	5	1.89	23.0	2.48	0.156	0.057
D5	WF3	59282							99.9	8	3.44	36.0	5	5.55	27.0	5.04	0.164	0.136
D5	FD5	59283							45.0	8	3.24	19.6	5	6.37	12.0	7.60	0.138	0.180
D5	FD6	59284							112.5	8	5.89	1.0	5	2.78	0.0	0.00	n/a	n/a
D5	FD7	59285							112.6	8	5.07	23.6	5	8.44	13.0	10.79	0.193	0.249
D6	WF1	59286							118.0	8	5.45	7.2	5	8.75	0.0	0.00	0.288	0.350
D6	WF2	59287							110.1	8	4.36	25.4	5	2.57	18.4	3.69	0.127	0.082
D6	WF3	59288							115.0	8	5.67	28.0	5	11.25	19.0	14.48	0.164	0.333
D6	FD5	59289							61.0	8	3.37	14.6	5	6.12	5.0	6.27	0.175	0.159
D6	FD6	59290							121.8	8	2.89	0.0	5	0.00	0.0	0.00	0.000	0.000
D6	FD7	59291							107.3	4	7.49	28.6	5	5.02	16.6	13.18	0.218	0.256

Table B13. Gurley Porosity, Cracking Angle, and Ink Penetration Test Results.

Case	Furnish	Sample ID	WS Gurley Porosity (s)			FS Gurley Porosity (s)			Cracking Angle (deg)			FS Ink Contact Angle (deg)					Rate of Change (deg/s)	
			Ave	Num	95% CI	Ave	Num	95% CI	Ave	Num	95% CI	5 sec Ave	Num	95% CI	60 sec Ave	95% CI	Value	95% CI
C1S	WF1	59064	6.5	10	1.87	7.0	10	1.88	92.5	8	6.32	16.2	5	4.51	0.0	0.00	0.648	0.180
C1S	WF2	59065	51.0	12	9.66	53.2	12	6.66	86.6	8	4.98	41.6	5	5.31	33.4	9.31	0.149	0.195
C1S	WF3	59066	31.6	10	4.31	33.2	10	3.63	102.4	8	2.68	43.2	5	7.62	33.4	8.98	0.178	0.214
C1S	FD5	59067	284.2	12	75.40	345.7	12	130.1	49.6	8	5.70	25.2	5	3.86	20.0	3.17	0.095	0.091
C1S	FD6	59068	21.8	12	2.96	22.2	12	2.37	102.8	8	3.49	19.4	5	8.85	0.0	0.00	0.776	0.354
C1S	FD7	59069	58.4	12	7.06	57.6	12	4.69	99.8	8	1.53	25.8	5	3.09	13.4	9.36	0.225	0.179
C2S	WF1	59070							95.5	8	4.58	26.8	5	4.42	11.8	10.84	0.273	0.213
C2S	WF2	59071							99.3	8	3.09	38.4	5	4.69	31.6	2.86	0.124	0.100
C2S	WF3	59072							99.3	8	3.89	45.8	5	10.02	38.8	10.94	0.127	0.270
C2S	FD5	59073							50.9	8	7.03	24.8	5	2.69	20.8	2.83	0.073	0.071
C2S	FD6	59074							101.1	8	3.27	27.6	5	5.86	6.6	8.12	0.382	0.182
C2S	FD7	59075							103.9	8	6.21	36.0	5	3.40	27.2	2.22	0.160	0.074
C3S	WF1	59098							107.9	8	3.75	30.6	5	7.32	23.8	5.71	0.124	0.169
C3S	WF2	59099							100.6	8	4.58	32.4	5	10.44	27.0	10.28	0.098	0.266
C3S	WF3	59100							100.3	8	4.09	35.2	5	8.34	28.4	8.17	0.124	0.212
C3S	FD5	59101							48.8	8	4.95	22.4	5	8.80	16.2	8.75	0.113	0.226
C3S	FD6	59102							101.6	8	6.29	2.2	5	3.76	0.0	0.00	n/a	n/a
C3S	FD7	59103							102.0	8	5.62	19.8	5	12.68	9.4	9.96	0.189	0.293
A1S	WF1	59161	5.6	10	0.74	4.9	10	0.94	118.6	8	4.33	0.0	5	0.00	0.0	0.00	0.000	0.000
A4S	WF1	59292							116.9	8	5.64	1.4	5	2.11	0.0	0.00	n/a	n/a
A4S	WF2	59293							102.5	8	5.18	28.6	5	4.05	22.2	3.55	0.116	0.098
A4S	WF3	59294							109.9	8	6.65	23.0	5	6.70	6.4	9.86	0.302	0.217
A4S	FD5	59295							53.6	8	6.01	26.8	5	4.67	22.8	5.36	0.073	0.129
A4S	FD6	59296							114.6	8	3.65	5.4	5	12.40	0.0	0.00	n/a	n/a
A4S	FD7	59297							106.8	8	6.98	26.0	5	7.70	16.0	9.68	0.182	0.225
A5S	WF2	59299							103.9	8	4.84	35.0	5	3.43	29.2	3.36	0.105	0.087
A5S	WF3	59300							110.0	4	14.19	27.0	5	3.48	18.0	6.70	0.164	0.137
A5S	FD5	59301							49.9	8	6.58	21.2	5	9.63	15.4	11.55	0.105	0.273
A5S	FD6	59302							115.8	8	6.38	5.0	5	7.61	0.0	0.00	n/a	n/a
A5S	FD7	59303							104.8	8	12.28	14.4	5	9.68	6.0	4.97	0.153	0.198

Table B14. Gurley Porosity, Cracking Angle, and Ink Penetration Test Results.

Case	Furnish	Sample ID	WS Gurley Porosity (s)			FS Gurley Porosity (s)			Cracking Angle (deg)			FS Ink Contact Angle (deg)					Rate of Change (deg/s)	
			Ave	Num	95% CI	Ave	Num	95% CI	Ave	Num	95% CI	5 sec Ave	Num	95% CI	60 sec Ave	95% CI	Value	95% CI
C1	WF1	59043	13.6	12	2.3	15.3	12	1.9	97.8	8	4.1	32.2	5	3.86	25.4	25.40	0.124	0.078
C1	WF2	59032	65.3	12	11.7	70.5	12	12.9	95.8	8	5.1	38.6	5	2.86	33.8	33.80	0.087	0.068
C1	WF3	59033	43.2	12	2.7	47.8	12	3.0	96.3	8	5.4	48.8	5	5.36	44.6	44.60	0.076	0.134
C1	FD5	59021	349.1	10	170.9	636.1	10	657.8	50.8	4	5.3	30.4	5	1.42	26.8	26.80	0.065	0.032
C1	FD6	59047	35.6	12	2.3	35.7	12	3.6	101.6	8	2.4	26.4	5	5.16	20.2	20.20	0.113	0.140
C1	FD7	59048	53.2	12	3.1	56.8	12	4.4	99.5	8	3.2	38.8	5	4.59	30.8	30.80	0.145	0.131
C2	WF1	59049							95.3	8	7.9	38.2	5	9.60	32.2	7.72	0.109	0.224
C2	WF2	59050							92.3	8	5.3	39.6	5	1.89	34.2	3.09	0.098	0.066
C2	WF3	59039							104.5	8	7.1	48.2	5	2.22	41.8	1.04	0.116	0.045
C2	FD5	59027							53.0	8	4.0	32.8	5	3.44	27.4	3.89	0.098	0.094
C2	FD6	59052							107.3	8	4.4	27.4	5	11.20	22.0	10.24	0.098	0.276
C2	FD7	59028							115.1	8	4.3	29.6	5	10.14	21.8	11.32	0.142	0.276
C2	FD7	59042							103.1	8	3.8	44.4	5	5.80	39.0	5.39	0.098	0.144
C3	WF1	59076							102.5	8	5.7	21.6	5	22.82	16.63	19.23	0.091	0.543
C3	WF2	59077							92.25	8	3.9	35.8	5	3.76	27.4	3.35	0.153	0.092
C3	WF3	59078							86.0	8	4.3	43.0	5	4.97	35.6	3.58	0.135	0.111
C3	FD5	59079							52.0	8	4.7	26.0	5	5.04	18.6	11.43	0.135	0.227
C3	FD6	59092							110.1	8	5.9	11.2	5	8.31	2.0	5.55	0.167	0.182
C3	FD7	59087							92.0	8	3.9	24.4	5	5.92	14.4	7.88	0.182	0.179
A1	WF1	59122	12.8	12	1.2	13.3	12	1.0	96.0	8	3.6	27.2	5	4.92	13.0	10.64	0.258	0.213
A1	WF2	59155	65.3	12	9.2	70.0	12	9.7	86.9	8	4.0	29.6	5	10.52	19.8	16.57	0.178	0.357
A1	WF3	59157	42.1	12	2.8	41.5	12	2.5	87.8	8	5.6	39.4	5	3.58	32.4	5.60	0.127	0.121
A1	FD5	59125	345.3	10	93.6	400.0	10	80.6	44.1	8	5.9	24.2	5	2.97	18.0	2.63	0.113	0.072
A1	FD6	59138	37.6	12	3.3	39.4	12	2.8	90.0	8	4.4	23.0	5	2.63	16.2	4.59	0.124	0.096
A1	FD7	59127	67.0	10.0	5.9	73.4	10	6.5	92.8	8	3.7	31.4	5	4.17	24.8	3.76	0.120	0.102
A2	WF1	59140							98.5	8	5.0	18.2	5	13.72	9.6	14.23	0.156	0.359
A2	WF2	59141							89.3	8	4.7	39.6	5	8.55	32.4	6.21	0.131	0.192
A2	WF2	59156							109.6	8	5.1	32.0	5	10.39	22.6	7.88	0.171	0.237
A2	WF3	59158							103.1	8	2.1	34.6	5	5.45	27.8	3.76	0.124	0.120
A2	FD5	59160							45.8	8	4.1	24.6	5	3.99	20.6	3.12	0.073	0.092
A2	FD6	59143							96.8	8	4.6	24.8	5	3.22	18.0	3.17	0.124	0.082
A2	FD7	59133							92.3	8	6.3	37.2	5	9.98	31.6	8.85	0.102	0.243

Table B15. Gurley Porosity, Cracking Angle, and Ink Penetration Test Results.

Case	Furnish	Sample ID	WS Gurley Porosity (s)			FS Gurley Porosity (s)			Cracking Angle (deg)			FS Ink Contact Angle (deg)					Rate of Change (deg/s)	
			Ave	Num	95% CI	Ave	Num	95% CI	Ave	Num	95% CI	5 sec Ave	Num	95% CI	60 sec Ave	95% CI	Value	95% CI
A4	WF1	59180							98.5	8	3.31	45.4	5	3.00	38.4	3.56	0.127	0.085
A4	WF2	59181							93.5	8	4.58	47.2	5	7.95	44.3	9.17	0.053	0.221
A4	WF3	59182							99.4	8	3.95	46.8	5	4.39	41.0	3.76	0.105	0.105
A4	FD5	59171							51.0	8	4.54	39.4	5	4.48	34.4	2.89	0.091	0.097
A4	FD6	59172							104.8	8	2.60	44.2	5	7.18	38.2	6.59	0.109	0.177
A4	FD7	59185							95.6	8	1.78	48.0	5	3.76	42.2	3.18	0.105	0.090
A5	WF1	59186							95.3	8	2.99	46.0	5	5.15	40.6	3.56	0.098	0.114
A5	WF2	59187							91.8	8	6.69	49.2	5	3.08	43.4	4.20	0.105	0.095
A5	WF3	59188							94.6	8	3.16	52.4	5	3.29	47.6	3.74	0.087	0.091
A5	FD6	59190							108.3	8	4.56	40.8	5	2.14	35.6	1.27	0.095	0.045
A5	FD7	59179							103.4	8	3.85	50.2	5	5.46	43.4	3.00	0.124	0.113
A6	WF1	59213							106.3	8	3.70	44.6	5	3.00	38.2	2.41	0.116	0.070
A6	WF2	59214							102.1	8	5.92	46.4	5	2.02	39.6	2.02	0.124	0.052
A6	WF3	59215							104.8	8	6.29	48.6	5	3.10	42.6	2.31	0.109	0.070
A6	FD5	59210							55.1	8	1.81	41.0	5	4.08	35.0	3.69	0.109	0.100
A6	FD6	59217							99.8	8	5.03	42.2	5	5.29	37.4	5.13	0.087	0.134
A6	FD7	59218							99.0	8	2.41	50.6	5	4.88	43.0	4.64	0.138	0.122
A5F	WF1	59240							102.5	8	3.50	47.4	5	4.42	40.6	2.02	0.124	0.088
A5F	WF2	59235							93.88	8	6.37	47.0	5	5.66	41.2	4.33	0.105	0.130
A5F	WF3	59236							94.5	8	5.27	56.8	5	5.52	47.8	5.52	0.164	0.142
A5F	FD6	59244							103.0	8	2.61	45.2	5	5.52	39.8	3.87	0.098	0.123
A5F	FD7	59239							101.8	8	4.35	49.8	5	5.40	44.3	4.33	0.101	0.126
A4H	WF1	59262							100.3	8	3.89	39.4	5	3.56	30.6	3.39	0.160	0.089
A4H	WF2	59263							80.5	8	1.90	36.8	5	2.14	31.2	2.14	0.102	0.055
A4H	WF3	59252							90.13	8	6.44	37.2	5	9.91	28.6	12.91	0.156	0.296
A4H	FD6	59265							101.1	8	4.21	31.0	5	2.36	25.4	2.78	0.102	0.066
A4H	FD7	59255							103.8	8	7.21	33.4	5	9.04	28.4	10.53	0.091	0.252
A5H	WF1	59256							95.9	8	7.22	35.6	5	1.86	30.2	2.41	0.098	0.055
A5H	WF2	59257							94.0	8	4.15	35.2	5	4.87	28.6	5.07	0.120	0.128
A5H	WF3	59258							97.5	8	3.58	42.6	5	2.78	38.8	2.88	0.069	0.073
A5H	FD6	59270							96.9	8	6.23	34.0	5	6.13	29.8	6.26	0.076	0.159
A5H	FD7	59261							99.4	8	6.08	36.2	5	4.47	34.3	4.72	0.035	0.118

Table B16. ZD Tensile and Burst Test Results.

Case	Furnish	Sample ID	ZD Tensile (kPa)			WS Burst (psi)			WS Burst Index (kPa m²/g)		FS Burst (psi)			FS Burst Index (kPa m²/g)	
			Ave	Num	95% CI	Ave	Num	95% CI	Ave	95% CI	Ave	Num	95% CI	Ave	95% CI
Con	WF1	59162	104.6	5	3.23	58.5	2	6.4	2.04	0.87	53.0	2	12.7	1.85	0.89
Con	WF2	59163	292.2	5	69.27	96.0	4	21.8	3.20	0.74	93.0	4	10.6	3.10	0.38
Con	WF3	59164	149.2	5	15.39	67.0	3	38.8	2.25	1.32	64.7	3	12.3	2.17	0.45
Con	FD5	59165	267.1	5	53.13	50.0	4	15.7	1.75	0.56	51.0	4	13.7	1.78	0.49
Con	FD6	59166	76.1	5	11.55	67.8	4	15.6	2.29	0.53	72.3	4	2.4	2.44	0.10
Con	FD7	59167	121.1	4	39.46	70.0	4	15.0	2.45	0.53	91.3	4	13.5	3.19	0.48
D1	WF1	59104	222.7	4	126.48	99.3	4	33.7	3.35	1.16	92.5	4	6.2	3.12	0.30
D1	WF2	59105	527.8	4	117.10	104.0	3	35.0	3.44	1.18	111.0	3	39.7	3.67	1.34
D1	WF3	59106	338.4	4	101.19	120.3	3	33.9	3.80	1.08	109.7	3	26.8	3.46	0.85
D1	FD5	59107	362.4	4	97.69	57.0	4	5.4	2.00	0.22	56.3	4	5.9	1.97	0.23
D1	FD6	59108	181.2	4	59.34	82.0	3	14.9	2.74	0.54	88.7	3	11.7	2.96	0.45
D1	FD7	59109	230.6	2	323.44	89.0	1	n/a	3.07	n/a	63.0	1	n/a	2.17	n/a
D2	WF1	59110	231.2	4	122.35	91.5	2	108.0	2.96	3.60	98.5	2	82.6	3.18	2.83
D2	WF2	59111	492.3	4	202.53	122.7	3	35.2	4.08	1.18	109.7	3	11.7	3.65	0.41
D2	WF3	59112	372.1	4	56.16	109.3	3	29.6	3.52	1.01	95.7	3	18.6	3.08	0.67
D2	FD5	59113	390.3	4	259.17	61.8	4	9.4	2.02	0.34	59.3	4	5.4	1.94	0.23
D2	FD6	59114	183.3	4	24.18	85.0	4	14.1	2.90	0.57	86.5	4	12.5	2.95	0.53
D2	FD7	59115	320.0	4	185.19	100.0	4	8.9	3.48	0.35	105.8	4	15.7	3.68	0.57
D3	WF1	59116	252.9	4	187.74	113.0	3	22.8	3.83	0.78	90.3	3	14.1	3.06	0.49
D3	WF2	59117	420.8	4	219.88	131.8	4	20.2	4.39	0.70	116.8	4	15.0	3.89	0.53
D3	WF3	59118	307.2	4	118.85	103.5	2	19.1	3.50	0.82	96.0	2	88.9	3.25	3.05
D3	FD5	59119	445.8	4	97.53	64.8	4	14.3	2.14	0.49	66.8	4	17.7	2.21	0.60
D3	FD6	59120	273.4	4	76.37	89.5	4	12.2	3.01	0.43	93.0	4	8.0	3.13	0.30
D3	FD7	59121	347.2	4	141.12	93.3	4	13.6	3.16	0.49	100.3	4	11.6	3.40	0.44

Table B17. ZD Tensile and Burst Test Results.

Case	Furnish	Sample ID	ZD Tensile (kPa)			WS Burst (psi)			WS Burst Index (kPa m^2/g)		FS Burst (psi)			FS Burst Index (kPa m^2/g)	
			Ave	Num	95% CI	Ave	Num	95% CI	Ave	95% CI	Ave	Num	95% CI	Ave	95% CI
D5	WF1	59274	447.1	4	202.1	108.3	4	42.0	3.79	1.50	89.5	4	18.9	3.13	0.71
D5	WF2	59275	567.3	4	116.9	118.0	4	17.0	3.99	0.58	117.3	4	23.8	3.97	0.81
D5	WF3	59276	368.5	4	116.3	103.7	3	53.4	3.40	1.81	94.0	3	45.6	3.08	1.55
D5	FD5	59277	316.1	4	85.1	57.5	2	57.2	1.83	1.84	51.0	2	12.7	1.62	0.47
D5	FD6	59278	317.4	4	58.4	85.3	4	9.8	2.87	0.36	91.0	4	10.9	3.06	0.40
D5	FD7	59279	347.1	4	61.9	100.0	4	17.9	3.52	0.66	110.3	4	12.1	3.88	0.48
D6	WF1	59280	515.8	4	134.9	130.5	4	17.5	4.37	0.61	112.8	4	15.9	3.78	0.55
D6	WF2	59281	622.7	4	44.1	118.0	4	27.2	4.01	0.94	126.5	4	14.7	4.30	0.53
D6	WF3	59282	545.2	4	74.0	104.7	3	56.9	3.51	1.99	103.7	3	56.7	3.47	1.98
D6	FD5	59283	435.8	4	71.4	51.0	4	2.6	1.71	0.10	50.3	4	7.4	1.69	0.25
D6	FD6	59284	319.5	4	208.1	89.0	4	6.5	2.99	0.24	91.8	4	20.3	3.09	0.69
D6	FD7	59285	355.4	4	180.4	90.8	4	7.9	3.23	0.30	107.8	4	17.9	3.83	0.65
D7	WF1	59286	366.8	4	132.5	114.8	4	7.7	3.78	0.52	93.8	4	7.6	3.09	0.45
D7	WF2	59287	591.6	4	130.8	135.0	4	10.1	4.53	0.38	126.5	4	22.9	4.25	0.79
D7	WF3	59288	398.7	4	84.5	113.3	3	63.5	3.63	2.07	90.7	3	34.9	2.90	1.17
D7	FD5	59289	478.6	4	98.0	73.3	4	28.8	2.47	0.99	59.0	4	10.6	1.99	0.39
D7	FD6	59290	198.9	4	100.4	85.3	4	9.8	2.97	0.36	79.3	4	13.6	2.76	0.49
D7	FD7	59291	385.5	2	167.1	117.0	1	n/a	3.94	n/a	115.0	1	n/a	3.88	n/a

Table B18. ZD Tensile and Burst Test Results.

Case	Furnish	Sample ID	ZD Tensile (kPa)			WS Burst (psi)			WS Burst Index (kPa m²/g)		FS Burst (psi)			FS Burst Index (kPa m²/g)	
			Ave	Num	95% CI	Ave	Num	95% CI	Ave	95% CI	Ave	Num	95% CI	Ave	95% CI
C1S	WF1	59064	434.2	3	386.8	105.3	3	46.9	3.63	1.62	106.7	3	46.2	3.68	1.60
C1S	WF2	59065	514.2	4	131.4	122.5	4	6.4	4.19	0.26	124.5	4	22.6	4.26	0.79
C1S	WF3	59066	352.1	2	1127.5	103.5	2	158.8	3.52	5.88	92.0	2	76.2	3.12	3.32
C1S	FD5	59067	388.9	4	92.1	66.3	4	9.1	2.14	0.32	64.0	4	4.7	2.07	0.19
C1S	FD6	59068	223.4	3	219.4	75.0	3	20.3	2.62	0.75	83.0	3	6.6	2.90	0.36
C1S	FD7	59069	365.2	4	99.6	101.8	4	12.4	3.54	0.44	116.8	4	2.4	4.06	0.12
C2S	WF1	59070	538.1	4	38.3	130.8	4	24.4	4.61	0.92	116.0	4	6.6	4.09	0.37
C2S	WF2	59071	611.8	4	25.5	121.5	4	13.7	4.16	0.50	116.8	4	11.1	3.99	0.41
C2S	WF3	59072	486.8	3	120.7	117.3	3	43.5	3.81	1.49	106.7	3	34.3	3.46	1.20
C2S	FD5	59073	449.4	4	31.3	67.3	4	11.0	2.22	0.40	66.5	4	10.3	2.20	0.38
C2S	FD6	59074	424.5	2	257.0	88.5	2	69.9	3.02	2.39	94.5	2	31.8	3.22	1.09
C2S	FD7	59075	302.8	3	259.4	83.3	3	19.0	2.92	0.71	98.7	3	25.0	3.46	0.92
C3S	WF1	59098	521.6	2	692.7	99.0	2	228.7	3.37	7.80	106.0	2	76.2	3.61	2.60
C3S	WF2	59099	602.5	4	79.2	125.0	4	13.6	4.13	0.47	134.3	4	16.5	4.43	0.57
C3S	WF3	59100	524.7	3	82.0	106.0	3	36.1	3.57	1.29	103.3	3	48.8	3.48	1.70
C3S	FD5	59101	484.6	4	49.0	71.3	4	24.7	2.42	0.90	57.5	4	11.7	1.95	0.47
C3S	FD6	59102	325.7	4	28.2	95.0	4	17.6	3.18	0.63	93.5	4	6.2	3.13	0.30
C3S	FD7	59103	392.7	3	183.6	101.3	3	22.3	3.54	0.79	102.7	3	25.9	3.59	0.92
A1S	WF1	59161	358.5	2	1380.0	88.5	2	31.8	2.99	1.66	74.0	2	152.5	2.50	5.25
A4S	WF1	59292	367.1	4	74.6	103.3	4	18.4	3.57	0.67	88.5	4	27.5	3.06	0.97
A4S	WF2	59293	464.3	4	86.1	118.5	4	19.6	3.93	0.69	106.5	4	17.3	3.53	0.60
A4S	WF3	59294	270.5	4	167.9	91.3	4	16.2	3.11	0.63	85.8	4	16.8	2.93	0.64
A4S	FD5	59295	302.5	2	115.0	60.5	2	19.1	2.18	1.09	57.0	2	63.5	2.06	2.42
A4S	FD6	59296	134.5	4	85.1	79.3	4	11.5	2.68	0.39	79.0	4	5.4	2.67	0.19
A4S	FD7	59297	213.2	3	101.6	84.7	3	18.6	3.00	0.67	81.3	3	43.8	2.88	1.55
A5S	WF2	59299	474.5	4	246.8	112.3	4	21.2	3.91	0.75	101.5	4	19.5	3.54	0.69
A5S	WF3	59300	296.1	1	n/a	120.0	1	n/a	3.96	n/a	91.0	1	n/a	3.00	n/a
A5S	FD5	59301	294.4	4	63.0	58.0	4	13.0	1.98	0.46	46.8	4	18.2	1.60	0.63
A5S	FD6	59302	160.3	4	129.8	85.5	4	6.9	2.88	0.28	81.8	4	15.2	2.75	0.53
A5S	FD7	59303	186.3	5	90.8	85.4	5	6.7	3.02	0.24	88.2	5	5.8	3.12	0.21

Table B19. ZD Tensile and Burst Test Results.

Case	Furnish	Sample ID	ZD Tensile (kPa)			WS Burst (psi)			WS Burst Index (kPa m²/g)		FS Burst (psi)			FS Burst Index (kPa m²/g)	
			Ave	Num	95% CI	Ave	Num	95% CI	Ave	95% CI	Ave	Num	95% CI	Ave	95% CI
C1	WF1	59043	324.0	4	360.4	100.3	4	20.8	3.38	0.74	128.0	4	16.6	4.31	0.64
C1	WF2	59032	541.3	4	119.2	120.5	4	19.8	4.18	0.71	124.8	4	15.0	4.33	0.55
C1	WF3	59033	376.6	4	70.2	105.7	3	22.9	3.47	0.89	115.0	3	32.5	3.78	1.18
C1	FD5	59021	383.7	4	24.7	67.0	1	n/a	2.50	n/a	67.0	1	n/a	2.50	n/a
C1	FD6	59047	247.4	4	121.2	89.5	4	8.0	3.07	0.31	103.3	4	12.6	3.54	0.46
C1	FD7	59048	282.7	4	89.4	91.0	4	10.9	3.25	0.39	102.3	4	12.7	3.66	0.46
C2	WF1	59049	518.6	4	65.6	143.5	2	6.4	4.85	0.63	135.5	2	108.0	4.58	3.69
C2	WF2	59050	562.1	4	80.7	121.0	3	15.5	4.11	0.63	126.0	3	21.7	4.28	0.82
C2	WF3	59039	417.8	4	167.9	114.0	4	22.2	3.79	0.76	119.5	4	17.6	3.97	0.62
C2	FD5	59027	383.3	4	19.4	69.3	3	25.1	2.39	0.91	68.0	3	9.0	2.35	0.42
C2	FD6	59052	330.0	4	52.2	92.5	4	8.5	3.13	0.30	108.8	4	8.3	3.68	0.29
C2	FD7	59028	356.2	3	324.2	103.3	3	16.0	3.58	0.56	114.7	3	44.8	3.97	1.56
C2	FD7	59042	294.1	4	89.1	98.8	4	7.0	3.55	0.30	112.3	4	13.6	4.04	0.52
C3	WF1	59076	343.7	4	211.1	117.0	4	22.2	3.94	0.77	112.3	4	15.8	3.78	0.57
C3	WF2	59077	538.2	4	102.0	121.0	4	17.0	4.01	0.59	122.0	4	19.0	4.05	0.65
C3	WF3	59078	482.5	4	73.0	110.0	3	67.2	3.66	2.25	112.3	3	30.7	3.73	1.06
C3	FD5	59079	419.5	4	57.0	63.5	4	13.2	2.21	0.49	68.5	4	9.5	2.38	0.38
C3	FD6	59092	344.5	4	164.5	97.3	4	13.6	3.32	0.48	107.0	4	12.8	3.66	0.45
C3	FD7	59087	400.0	4	165.8	114.0	4	8.5	3.98	0.35	121.0	4	16.6	4.23	0.61
A1	WF1	59122	482.1	4	101.8	106.3	4	8.3	3.48	0.32	120.5	4	18.2	3.95	0.63
A1	WF2	59155	568.5	4	140.3	116.5	4	9.8	3.91	0.35	120.5	4	13.8	4.05	0.48
A1	WF3	59157	317.7	4	25.6	106.5	4	17.3	3.52	0.58	105.5	4	10.4	3.49	0.36
A1	FD5	59125	336.8	2	84.5	67.5	2	19.1	2.20	0.72	64.5	2	69.9	2.11	2.31
A1	FD6	59138	378.4	4	66.3	92.3	4	3.0	3.18	0.18	101.8	4	6.5	3.51	0.28
A1	FD7	59127	267.0	2	506.7	100.0	2	12.7	3.46	1.09	111.5	2	31.8	3.86	1.56
A2	WF1	59140	474.5	4	256.5	122.5	4	12.2	4.01	0.40	130.8	4	17.6	4.28	0.58
A2	WF2	59141	579.7	4	204.8	136.3	4	17.8	4.46	0.61	131.0	4	17.9	4.29	0.61
A2	WF2	59156	578.5	4	149.9	120.8	4	16.0	3.97	0.53	126.8	4	30.6	4.17	1.01
A2	WF3	59158	381.2	2	2099.0	113.5	2	158.8	3.76	5.34	97.5	2	69.9	3.23	2.44
A2	FD5	59160	405.1	4	83.2	66.0	4	6.5	2.22	0.30	63.8	4	9.8	2.15	0.38
A2	FD6	59143	415.2	4	83.2	92.3	4	8.8	3.07	0.30	110.0	4	6.9	3.66	0.25
A2	FD7	59133	316.8	4	78.6	104.8	4	16.5	3.53	0.57	115.5	4	12.1	3.89	0.43

Table B20. ZD Tensile and Burst Test Results.

Case	Furnish	Sample ID	ZD Tensile (kPa)			WS Burst (psi)			WS Burst Index (kPa m²/g)		FS Burst (psi)			FS Burst Index (kPa m²/g)	
			Ave	Num	95% CI	Ave	Num	95% CI	Ave	95% CI	Ave	Num	95% CI	Ave	95% CI
A4	WF1	59180	561.9	4	109.9	129.0	4	27.3	4.29	0.94	124.0	4	17.9	4.12	0.63
A4	WF2	59181	624.0	4	123.0	124.3	4	24.8	4.26	0.87	120.0	4	16.6	4.11	0.59
A4	WF3	59182	447.7	4	214.8	117.3	3	17.6	3.87	0.76	101.0	3	12.4	3.33	0.58
A4	FD5	59171	339.7	4	100.7	64.0	4	13.9	2.22	0.49	59.3	4	10.7	2.05	0.38
A4	FD6	59172	284.4	4	125.5	91.8	4	5.1	3.12	0.24	89.5	4	9.4	3.04	0.36
A4	FD7	59185	394.4	4	87.3	105.3	4	14.7	3.70	0.53	114.3	4	15.8	4.01	0.57
A5	WF1	59186	681.1	4	103.9	132.3	4	31.4	4.51	1.15	130.3	4	19.0	4.44	0.77
A5	WF2	59187	686.6	4	53.5	135.0	4	17.4	4.53	0.67	125.3	4	8.6	4.20	0.42
A5	WF3	59188	559.9	3	56.4	132.0	3	54.5	4.23	1.78	130.7	3	31.1	4.19	1.04
A5	FD6	59190	390.2	4	135.1	98.8	4	12.5	3.31	0.44	108.5	4	3.8	3.64	0.20
A5	FD7	59179	451.1	4	69.5	97.3	4	9.9	3.48	0.36	109.5	4	8.4	3.92	0.31
A6	WF1	59213	559.4	4	93.4	132.0	4	22.1	4.34	0.75	126.8	4	18.3	4.17	0.63
A6	WF2	59214	655.6	4	59.5	131.3	4	13.1	4.41	0.47	133.8	4	12.3	4.50	0.45
A6	WF3	59215	517.7	3	253.2	108.0	3	21.2	3.61	0.75	105.0	3	20.3	3.51	0.72
A6	FD5	59210	477.5	2	136.6	68.0	2	76.2	2.41	2.83	67.5	2	57.2	2.39	2.19
A6	FD6	59217	438.0	4	81.8	87.5	4	6.2	3.07	0.35	97.8	4	10.6	3.43	0.48
A6	FD7	59218	377.1	4	261.1	101.5	4	7.5	3.53	0.31	121.8	4	9.9	4.24	0.40
A5F	WF1	59240	622.2	4	35.2	104.5	4	14.5	3.49	0.50	130.8	4	13.0	4.37	0.46
A5F	WF2	59235	668.5	4	47.6	126.5	4	11.7	4.22	0.40	129.5	4	17.3	4.32	0.58
A5F	WF3	59236	513.9	4	18.0	95.5	2	235.1	3.20	7.87	114.0	2	127.1	3.82	4.26
A5F	FD6	59244	368.9	4	103.6	93.5	4	n/a	3.04	n/a	107.3	4	9.9	3.49	0.42
A5F	FD7	59239	396.6	4	56.5	93.8	4	2.7	3.26	0.13	108.0	4	11.3	3.76	0.41
A4H	WF1	59262	605.0	3	175.4	124.7	3	8.7	4.31	0.31	126.0	3	22.8	4.36	0.79
A4H	WF2	59263	612.4	4	86.2	116.3	4	11.5	3.79	0.42	129.5	4	17.1	4.23	0.59
A4H	WF3	59252	473.1	4	89.7	108.8	4	31.5	3.63	1.08	99.5	4	25.9	3.32	0.89
A4H	FD6	59265	437.9	4	67.3	95.3	4	10.8	3.17	0.36	106.5	4	7.2	3.54	0.25
A4H	FD7	59255	317.2	4	128.7	96.0	4	11.8	3.38	0.42	99.3	4	16.6	3.49	0.59
A5H	WF1	59256	606.1	4	128.9	121.8	4	25.5	4.06	0.94	137.8	4	26.9	4.59	1.01
A5H	WF2	59257	592.8	2	528.3	119.0	3	21.7	3.89	0.74	121.0	3	23.7	3.95	0.80
A5H	WF3	59258	388.0	4	206.2	117.5	4	19.5	3.83	0.68	114.8	4	28.3	3.74	0.95
A5H	FD6	59270	434.6	4	26.3	94.5	4	12.1	3.24	0.43	108.3	4	20.4	3.71	0.71
A5H	FD7	59261	430.0	4	18.8	99.8	4	9.8	3.44	0.38	112.8	4	5.6	3.89	0.28

APPENDIX C

The following figures show permeability versus porosity data for each furnish produced.

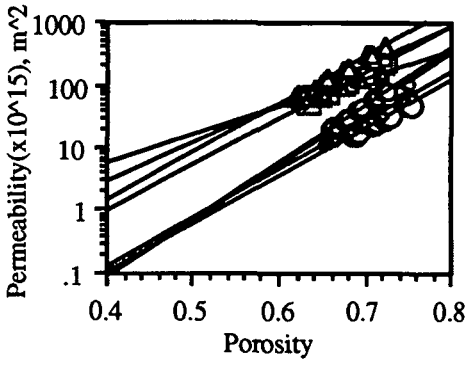

Figure C1. Furnish WF1.

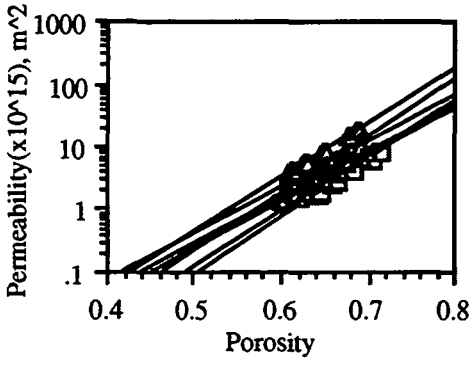

Figure C2. Furnish WF2.

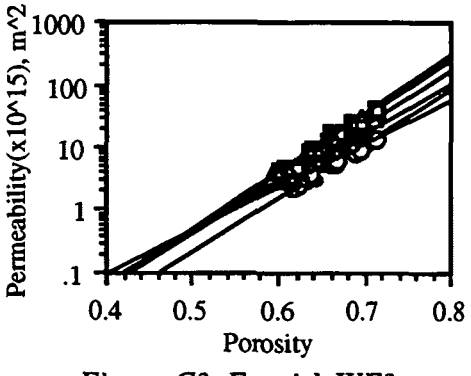

Figure C3. Furnish WF3.

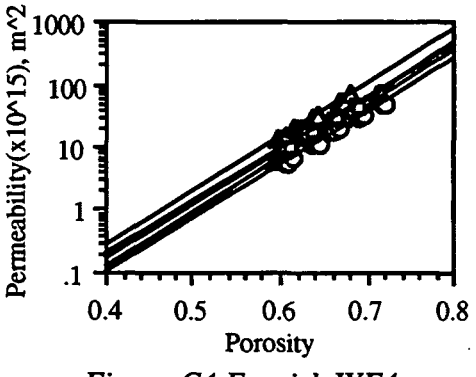

Figure C4 Furnish WF4.

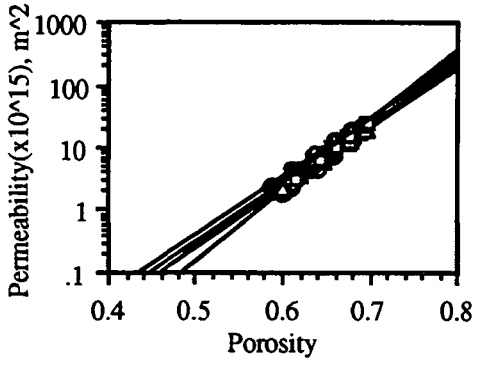

Figure C5. Furnish WF5.

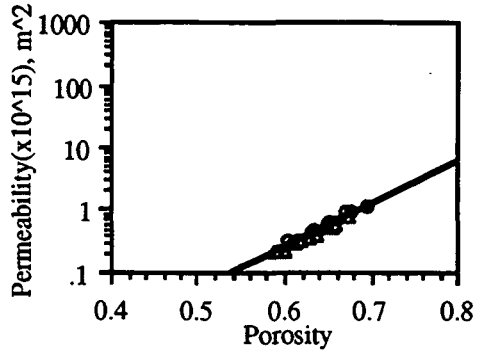

Figure C6. Furnish FD5.

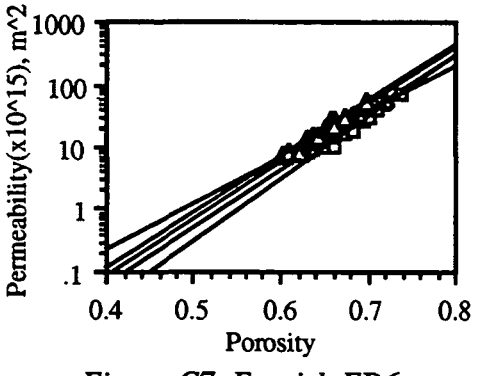

Figure C7. Furnish FD6.

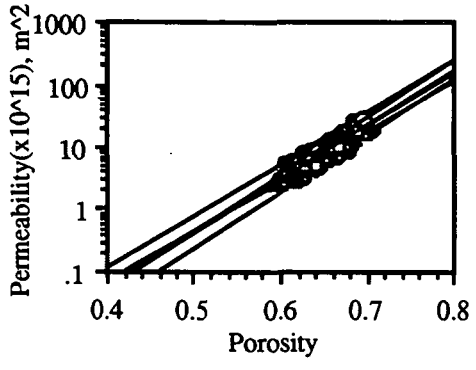

Figure C8. Furnish FD7.

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