



THE INSTITUTE OF PAPER CHEMISTRY, APPLETON, WISCONSIN

SELECTIVE DELIGNIFICATION OF WOOD AND OTHER FIBROUS MATERIALS:

A FINAL REPORT ON PROCESS STUDIES AND
PAPERMAKING CHARACTERISTICS

Project 2500

Supplement

to

Report Nineteen

A Progress Report

to

THE GRANTORS

July 5, 1973

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SUPPLEMENT

WEB FORMER TRIAL

To compare further the papermaking characteristics of a loblolly pine high-yield kraft pulp and chlorine dioxide/chlorine-alkali pulp, sufficient amounts of these have been prepared and made into paper in a small web former trial.

For the chlorine dioxide/chlorine-alkali pulp, the existing results described in this report were used in selecting process conditions. The impregnation/fiberization conditions were as for the case with the larger amount of alkali in Tables VIII and IX; in fact, that material was used. Delignification conditions were essentially the same as for Pulps 11.7/4.5/80 and 11.7/7.5/72 in Table II, except that the chemical equivalent of 6.0% chlorine dioxide was used for lignin modification and this was added as 5.0% chlorine dioxide and 2.7% chlorine which is 65:35 on a w/w basis. Other details on the process conditions which gave a 75% yield pulp are included in Table XLI.

The high-yield kraft loblolly pine pulp required for a basis of comparison was obtained in 57% yield from the same lot of chips and using conditions as described for Pulp HYK/56.

After primary refining in a 12-in. Sprout-Waldron machine, the above two pulps were beaten and converted to a nominal 20 lb./1000 sq. ft. sheet on a 12-in. wide web former. The machine operating conditions were the same for both

TABLE XLI

PRODUCTION OF CHLORINE DIOXIDE/CHLORINE-ALKALI LOBLOLLY
PINE PULPS FOR WEB FORMER TRIAL

Chip Impregnation/Fiberization: A53 (as in Tables VIII and IX)

Lignin Modification: temp., 25-35°C. in 60 min.; consistency, 8.0%

Run	1	2	3	4	5
Chlorine dioxide, %	————		4.98	————	
Chlorine, %	————		2.68	————	
Reaction time, min.	40	40	45	40	40
Final pH	1.8	1.7	1.7	1.7	1.7

Alkali Extraction: temp., 90°C.; consistency, 12.0%

Run	1	2	3	4	5
Sod. hydroxide, %	————		8.5	————	
Final pH	10.9	11.0	11.0	11.0	11.0
Yield, % (mean, 74.7)	75.0	74.2	73.4	76.1	74.7
Kappa number	————	94.5 (composite) ^a			————

^aAfter Sprout-Waldron refining (see later table).

pulps. Runnability was similar, with the exception that at the wet end, air began to pass through the wet mat on the wire as it was leaving the first suction box for the high-yield kraft pulp compared with as the wire was passing over the second suction box for the chlorine dioxide/chlorine-alkali pulp. Test results obtained on the two lots of paper from this trial are given in Table XLII. The trial was run with the intention of making sheets of comparable density and the amount of beating needed to achieve this was determined on the basis of preliminary testing, the results of which are given in Table XLIII.

From Table XLII, it can be seen that near comparable sheet densities were obtained as a result of beating the chlorine dioxide/chlorine-alkali pulp for approaching twice the time applicable to the high-yield kraft pulp. A significantly lower freeness was obtained as a consequence of the longer beating time. This is in accordance with an earlier conclusion that the advantage of much greater yields is accompanied by the disadvantage of greater filtration resistance when some sheet properties are equated.

The data in Table XLII also show that at near comparable sheet density, breaking length, burst, tensile stiffness, and modified ring crush are significantly higher for the chlorine dioxide/chlorine-alkali pulp. On the other hand, tear factor is lower.

A comparison of the appearance of the sheets can be made directly from the attached samples. That marked with an "H" is from the chlorine dioxide/chlorine-alkali pulp and that with a "K" is from the high-yield kraft pulp. The sheets have similar brightness levels (Table XLII), although there is an observable difference in color. There is a marked difference in the

TABLE XLII
COMPARATIVE DATA ON WEB FORMER TRIAL

	Pulp ^a	
	ClO ₂ /Cl ₂ -NaOH	HYK
Pulp yield, %	75	57
Beating time, min.	36	20
Canadian freeness, ml.	270	720
Basis weight, a.d. lb./1000 ft. ²	19	19
Sheet density, g./cc.	0.49	0.51
Breaking length, km.	MD	3.0
	CD	1.8
Stretch, %	MD	1.1
	CD	2.1
Burst factor (TAPPI)	16	11
Burst, p.s.i.g.	22	15
Tear factor (Elmendorf)	MD	78
	CD	104
Tensile stiffness, Et., kg./cm.	MD	399
	CD	193
Modified ring crush, lb./in.	MD	7
	CD	5
TAPPI brightness, %	14	15
Dirt, p.p.m. ^b	13 ^c	33 ^c

^aSprout-Waldron refined as in Table XLIII.

^bTAPPI Standard T 437 ts-63.

^cDirt and shives.

cleanliness, as indicated quantitatively in Table XLII and as readily discernible by viewing with transmitted light. This is certainly a significant difference between these two kinds of pulps.

TABLE XLIII
EVALUATION DATA OF LOBLOLLY PULPS FOR WEB FORMER TRIAL

Test	C1O ₂ /Cl ₂ -NaOH Pulp ^a				HYK Pulp ^b			
	PFI mill, counter rev.							
	450	750	1150	1650	450	750	1150	1650
Canadian freeness, ml.	600	410	250	180	720	680	590	350
Handsheet drainage, sec.	4.7	5.1	6.0	8.0	4.6	4.8	5.0	5.4
Handsheet density, g./cc.	0.390	0.435	0.450	0.488	0.494	0.527	0.538	0.565
Breaking length, km.	4.62	5.38	5.64	6.57	5.73	6.35	6.70	6.91
Stretch, %	2.0	2.4	2.3	2.8	2.6	2.8	2.9	3.0
Burst factor	28	34	37	38	39	44	46	49
Tear factor (Elmendorf)	119	104	95	89	116	109	110	99

^aSprout-Waldron refined with 0.010 in. plate gap at 5% consist., water temp. 190°F., and 300 g. o.d. pulp/min.

^bSprout-Waldron refined as above, except with 0.018 in. plate gap.

These results of a web former trial in essence substantiate results and conclusions reported in the main body of this report.

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