

DEPITHED BARK: A NEW SOURCE OF FIBERS FOR KRAFT PULPING

C.E.B. Foelkel*, C. Zvinakevicius**, J. Kato**

*Riocell - Rio Grande Cia de Celulose do Sul
Guaíba - R.S.-Brazil

** Cenibra - Celulose Nipo-Brasileira S.A.
Belo Oriente - MG - Brazil

Presented By

Celso E. B. Foelkel, Riocell

ABSTRACT

Bark of commercial pulpwood trees is a huge source of fibers, which is being neglected by most pulp producers. Usually bark is pulped together with chips, in a conventional procedure. A new technology is suggested in this paper for using bark. This technology is supposed to let the utilization of bark fibers without bringing problems to the operation of digesters, screeners, evaporators, washing filters, etc. It also brings no significant differences in pulp quality, compared with the pulp obtained from debarked chips. The technology is as follows: a) pulpwood comes with bark to mill site; b) bark is removed using conventional debarkers; c) bark is depithed, probably by means of conventional depithing equipments. Depithing is defined as the removal of non-fiber materials from bark. Depithing yields have been found around 40 - 50% for most eucalypt species. Eucalyptus urophylla was the raw material used for testing; d) depithed bark is added to normal wood chips to feed the digester. The use of depithed bark mixed with eucalypt wood chips let a 1000 a.d.t. bleached pulp/day mill to increase production in 7,000 a.d.t./year or to economize 25,000 solid cubic meters of round-wood per year. Non-fibrous bark materials may be discarded, burned as fuel or transformed in wood panels.

There are no doubts that predictions of fiber shortages in a near future are correct. Available wood fiber supply has to be increased to avoid problems in the pulp and paper production. One of the most promising approaches is the increasing usage for bark. Bark of commercial pulpwood trees is a huge source of fibers which is being neglected by most of pulp producers. The reasons are well known: when wood chips containing bark are pulped, many operational problems appear and pulp quality decreases. This is true also for kraft pulping, the only chemical pulping process that has no limitation of fibrous raw materials.

The conventional idea for using bark is to chip the roundwood as received and to pulp bark and wood chips together. This idea is not recent and now-a-days it has been very used, although the problems it carries with. Nothing has been done to improve the quality of the bark which goes to the digester.

The purpose of this paper is to suggest a new way for using bark. This new technology is supposed to let the utilization of bark

fibers without bringing problems to the operation of digesters, screeners, evaporators, washing filters, etc. It also brings no significant differences in pulp quality, compared with the pulp obtained from debarked chips.

It is well known that the bark of the trees has as constituents a certain percentage of fiber-like cells and a large percentage of non-fibrous cells (cortical tissue, parenchyma cells, epithelial tissue, etc). These last types of cells are not desired for pulping since : a) they will require a higher chemical charge; b) they are not fibrous and pulp strengths will go down because their presence; c) they usually contain high amounts of extractives and lignin, so, they make cooking and bleaching more difficult; d) because of their small cell dimensions, they plug wires, they cause incrustation in evaporators, etc; e) they have a great ability to swell in alkaline conditions and this usually causes plugging in continuous digesters.

Eucalyptus urophylla was the raw material

selected for testing. In general, bark represents 10 to 15% of eucalypt round-wood o.d. weight. If non-fibrous cells are conveniently removed from bark, this will lead 5 to 7.5% of bark fibers, based on o.d. wood weight. These bark fibers represent a huge amount of material that can be used for a pulp mill without operational and pulp quality problems. For instance, a kraft pulp mill, which produces 1,000 a.d.t. of eucalypt bleached pulp/day, requires a minimum of 2,000t. of equivalent oven-dried wood/day. Depending on wood species and tree age, the weight of bark which comes with the logs is around 200 to 300 o.d. tons. If this bark be conveniently separated and non-fibrous cells removed, the available bark fibers for the mill will be around 100 to 150 t. of dry material. Non-fibrous bark material looks like a coarse powder, usually rich in ash content, which may be discarded, burned as fuel, or transformed in wood panels.

Using the same terminology as that for preparation of sugar-cane bagasse for pulping, we can call this step in bark purification as depithing. Procedures for depithing many materials, as agricultural residues, are well developed. It can be assumed that no major changes have to be made for depithing bark. In laboratory trials, the barks of several eucalypt wood species were easily depithed.

The technology which the authors of this paper are proposing is the following: a) pulpwood comes with bark to mill site; b) bark is removed using conventional mechanical debarkers; c) bark is depithed, probably by means of conventional depithing equipments. Depithing yields have been found around 40-50%; d) depithed bark is added to normal wood chips to feed the digester. The charge of depithed bark to the digester should be around the same percentage of bark fiber content which enters the mill with roundwood.

The authors carried out an extensive research program on kraft pulping of eucalypt wood containing bark or not. Wood chips were blended with several different percentages of normal and depithed bark. The pulps obtained from wood chips plus bark (depithed or not) were compared with the pulp obtained from 100% eucalypt wood chips. It was found that the maximum content of depithed bark on total o.d. blended chips weight should be about 10%, to assure pulp quality similar to that obtained from debarked chips. This charge is normally a little higher than the depithed bark content based on wood, which results after the removal and purification of bark by depithing.

When normal bark was blended with wood chips, even in amounts as low as 5% on o.d. weight, pulp quality decreased. Pulp tensile strength was the property found to be most sensitive to bark content. Bark content affects mainly the following pulp properties: pulp yields; reject content; unbleached and bleached pulp CED viscosity and pulp GE brightness; total active chlorine and total caustic soda charges in pulp bleaching; post

color number of bleached pulp; tensile and burst strengths of bleached and unbleached pulp. The effect of normal bark content was very significant, but depithed bark addition results only in a slightly change of pulp quality.

The use depithed bark mixed with conventional eucalypt wood chips let a 1,000 a.d.t. eucalypt bleached pulp/day mill to increase production in 7,000 a.d.t./year or to economize 25,000 solid cubic meters of roundwood per year.

Important consideration is that a new source of fibers becomes available, pulp quality is not affected by the controlled addition of the depithed bark, chemical consumptions are lower than those for pulping bark-containing wood, and operational problems in digesters, evaporators, screeners and filters are supposed to be mostly avoided.

EXPERIMENTAL

Eucalyptus urophylla wood was debarked and the logs chipped by an industrial chipper. Bark was divided in two fractions: one was handily chipped and the other was depithed. Depithing was done by the following way: a) wet bark was passed through a disc refiner with maximum clearance between discs; b) the defibered material was screened by washing with water in a 1 mm hole diameter wire. The retained material was considered to be fibers and the fine materials, the pith. Depithing yield was found to be 40 to 50%.

Pulping followed the kraft process. Pulping conditions were as follows: Active alkali = 14% Na₂O; Sulfidity = 25%, Liquor to wood ratio = 6:1; Maximum temperature = 170°C; Time to 170°C = 90 min.; Time at 170°C = 60 min.

The following mixtures with normal wood chips were tested: 5; 10; 20 and 100% of depithed bark; 5; 10; 20; 40; 50 and 100% of normal bark; 100% wood chips. A total of eleven treatments was studied.

Unbleached pulps were washed, screened and the following determinations were performed in them: total pulp yield, screened pulp yield; reject content, kappa number, CED TAPPI viscosity and GE brightness.

Pulp bleaching was performed according to CE₁HD₁E₂D₂ bleaching sequence. Chemical charges in the three first stages were varied according to pulp lignin content. The objective was to obtain bleached pulp with 92-93% GE brightness and CED viscosity around 13 cP.

Bleached and unbleached pulps were beaten in a PFI mill to develop strengths. Handsheets were formed according to TAPPI Standard T 205 and tested according to TAPPI Standard T 220. Prior to testing, handsheets were conditioned at 65% relative humidity and 20°C temperature.

RESULTS

TREATMENT	% DEPITHED		BARK		
	0	5	10	20	100
<u>Cooking</u>					
Total yield, %	50.4	48.3	46.5	42.3	36.1
Screened yield, %	48.5	47.2	44.7	39.1	36.0
Reject content, %	1.9	1.1	1.8	3.2	0.1
<u>Unbleached pulp</u>					
Kappa number	17.6	17.4	17.7	20.4	27.4
Viscosity, cP	39.6	40.7	37.2	20.4	18.3
Brightness, °GE	29.6	29.4	29.4	25.1	14.3
Properties at 350 CSF					
- PFI revolutions, 10 ³	11.0	11.0	9.5	10.0	0.6
- Density, g/cm ³	0.628	0.638	0.648	0.680	0.514
- Breaking length, km	8.5	8.4	8.6	6.8	3.5
- Burst factor	67	63	71	66	17
- Tear factor	123	123	128	120	37
- Double folds, MIT	425	392	345	195	6
- Stretch, %	3.0	3.9	4.0	3.3	2.6
<u>Bleaching</u>					
Total active chlorine, kg/t	60.6	58.2	59.6	64.3	80.2
Total caustic soda, (without caustic to prepare hypochlorite), kg/t	29.6	29.3	29.4	30.3	34.3
<u>Bleached pulp</u>					
Viscosity, cP	14.8	13.8	13.0	13.7	6.0
Brightness, °GE	93.0	92.7	93.2	93.6	88.1
Post-color number	0.48	0.45	0.46	0.47	0.52
Properties at 350 CSF					
- PFI revolutions, 10 ³	10.0	7.5	6.5	5.8	0.6
- Density, g/cm ³	0.630	0.670	0.725	0.685	0.579
- Breaking length, km	7.3	7.1	7.0	5.8	3.7
- Burst factor	50	51	51	46	18
- Tear factor	124	127	105	95	42
- Double folds, MIT	90	230	175	75	4
- Stretch, %	3.5	3.0	2.3	1.9	3.6
- Light scattering coefficient, cm ² /g	360	345	385	370	509

Table 1. Properties of the kraft pulps obtained from the wood of *Eucalyptus urophylla* containing different percentages of depithed bark.

TREATMENT	% BARK						
	0	5	10	20	40	50	100
<u>Cooking</u>							
Total yield, %	50.4	46.1	45.5	43.1	41.8	36.4	34.1
Screened yield, %	48.5	44.4	42.1	39.0	24.6	19.2	32.4
Reject content, %	1.9	1.7	3.4	4.1	17.2	17.2	1.7
<u>Unbleached pulp</u>							
kappa number	17.6	18.1	18.3	21.5	32.9	47.2	67.4
Viscosity, cP	39.6	39.3	39.6	39.8	27.6	20.2	17.2
Brightness, °GE	29.6	28.8	27.4	25.3	19.6	17.0	10.4
Properties at 350 CSF							
- PFI revolutions, 10 ³	11.0	10.0	10.0	10.0	2.0	0.6	0.1
- Density, g/cm ³	0.628	0.616	0.691	0.690	0.515	0.556	0.580
- Breaking length, km	8.5	8.1	8.0	6.5	5.7	6.1	1.8
- Burst factor	67	63	57	65	41	35	4
- Tear factor	123	128	116	125	103	88	26
- Double folds, MIT	425	300	310	330	138	105	1
- Stretch, %	3.0	3.3	4.4	3.4	1.9	2.9	1.1
<u>Bleaching</u>							
Total active chlorine, kg/t	60.6	58.7	60.4	66.5	89.0	106.1	186.7
Total caustic soda, (without caustic to prepare hypochlorite), kg/t	29.6	30.3	29.6	30.7	37.4	42.0	56.6
<u>Bleached pulp</u>							
Viscosity, cP	14.8	13.6	11.7	12.4	7.0	6.0	4.1
Brightness, °GE	93.0	93.3	93.0	92.7	91.2	90.7	88.9
Post-color number	0.48	0.50	0.39	0.41	0.61	0.88	0.69
Properties at 350 CSF							
- PFI revolutions, 10 ³	10.0	8.5	7.0	7.5	2.5	0.35	-
- Density, g/cm ³	0.630	0.620	0.630	0.685	0.630	0.626	-
- Breaking length, km	7.3	6.1	6.3	6.4	5.9	6.1	-
- Burst factor	50	54	43	53	39	32	-
- Tear factor	124	123	124	105	70	74	-
- Double folds, MIT	90	125	45	56	49	41	-
- Stretch, %	3.5	3.3	2.7	2.9	2.6	3.1	-
- Light scattering coefficient, cm ² /g	360	350	340	380	377	393	-

Table 2. Properties of the kraft pulps obtained from the wood of Eucalyptus urophylla containing different percentages of bark.

CONTENTS

Paper Number	Title and Author(s)	Page Number
	TAPPI's Antitrust Policy Statement & General Rules of Antitrust Compliance	1
G1-1	Mexico 1979 General Industrial Background	3
	R. PARDO GRANDISON	
† A1-1	A Computer Controlled Vapor Phase Digester with a Pre-Impregnation Vessel	9
	O. FADUM, G. BOSTROM	
‡ A1-2	Formation of Calcium Carbonate Scale in a Kamyrdigester	17
	L. D. MARKHAM, J. R. G. BRYCE	
A1-3	Characteristics of Pulps Obtained from HMDA Pulping	23
	L. M. JULIEN	
✕ A1-4	Multiple Correlation of Oakwood Kraft Pulp Against Digestion Conditions	31
	J. L. LOPEZ-RUIZ	
✕ A2-1	Pulp Mill Reject Handling Systems	35
	L. D. MARKHAM, V. L. MAGNOTTA	
A2-2	The Effects of Deshiving Refining on High Yield Kraft Linerboard Pulp	41
	W. J. BUBLITZ, D. P. KNUTSEN	
‡ A2-3	A New Approach to Centralized Batch Digester Control	49
	C. J. BEACHAM, A. M. YARCHUK	
‡ A3-1	An Integrated Approach to Reausticizing and Lime Mud Reburning	63
	N. K. MEHRA	
‡ A3-2	Computerized Control of the Lime Reburning Process, Principle and Experience ...	73
	P. SKJOTH	
‡ A3-3	Non-Process Chemical Elements in the Kraft Recovery System	77
	H. MAGNUSSON, K. MORK, B. WARNQVIST	
‡ A3-4	Development of By-Products from Kraft Unbleached Black Liquor	85
	E. MORODO SANTISTEBAN	
A4-1	Kraft Green Liquor Pulping of Red Alder for Corrugating Medium	89
	W. J. BUBLITZ, J. L. HULL	
A4-2	An Evaluation of Mixtures of Different Types of Oak for Manufacturing Medium Paper	97
	S. SANCHEZ SOTO, R. SANJUAN DUENAS	
✕ A4-3	Sulphite — An Option Whose Time Has Come Again	111
	A. WONG	
A4-4	Spent Sulfite Liquor Burning and Recovery	123
	G. J. BETTS, F. E. PHILIPS, R. S. SERENIUS	
A4-5	Sodium Sulfite Recovery System Offers Evolutionary Step for Sulfite and Kraft	129
	W. G. FARIN	
A5-1	Current Situation and Prospects for the Supply of Fibrous Raw Materials in Mexico	133
	B. ULLOA	
† A5-2	Raw Material Value & Allocation	139
	G. F. FINKE	
‡ A5-3	Fiber Raw Material Handling and Processing at the Mill Site	143
	E. B. HOFF	
‡ A5-4	Comparison of Storage Methods for Southern Pine Chips ¹	149
	E. L. SPRINGER	
‡ A5-5	The Usefulness of "Waste" Wood and Bark-Problems, Potentials, Pitfalls	155
	R. C. JOHNSON	

CONTENTS (Cont'd)

Paper Number	Title and Author(s)	Page Number
✓ A5-6	Advances in Forest Genetics — An R & D Report R. C. KELLISON, R. J. WEIR	159
✓ A6-1	Localized Corrosion in Bleach Plants — A Review L. B. RITTER	165
✕ A6-2	Kinetics of Oxygen Bleaching L. OLM, A. TEDER	169
✕ A6-3	Review of the Hot Hypochlorite Workshop International Pulp Bleaching Conference, Toronto, Canada, June 13, 1979 B. VAN LIEROP, N. LIEBERGOTT	181
✕ RT3A-2	The Pulp Mill Waste Heat Recovery System at Westvaco, Charleston J. F. MOLE, JR.	187
RT4A-1	Fiber Raw Material Quality Monitoring — Roundtable Discussion G. W. CHRISTENSEN	189
✕ RT4A-2	The Domtar Variable Slot Chip Thickness Classifier R. C. MALITO	191
✕ RT4A-3	Progress Toward a TAPPI Chip Quality Standard C. E. MURRAY	193
RT6A-1	Bleach Chemical Preparation — Roundtable H. C. SCRIBNER	195
RT6A-2	Bleached Chemical Preparation Roundtable Chlorine Dioxide Generation at Allied Paper Incorporated D. W. WIGGINS	197
✕ RT7A-2	The Strengths of Kraft-AQ and Soda-AQ Pulps Part I — Bleachable-Grade Pulps J. M. MacLEOD, B. I. FLEMING, G. J. KUBES, H. I. BOLKER	199
✕ RT7A-3	The Influence of Sulfidity on the Bleachability and Strength Properties of Alkaline-Anthraquinone Softwood Pulps T. J. BLAIN	205
✕ RT7A-4	Anthraquinone in Kraft Pulping K. GOEL, A. M. AYROUD, B. BRANCH	213
S1-1	Hydrogen Peroxide in Washing Deinking Systems J. DECEUSTER, R. R. KINDRON	221
S1-2	Bleaching of Pulp from Washed Deinked Newsprint Z. F. ROZYCKI, R. W. BARTON	235
S1-3	Nature and Environmental Behavior of Manufacturing Derived Solid Wastes of Secondary Fiber Origins D. W. MARSHALL, R. O. BLOSSER	243
✕ S2-1	Selective Dry Processing, Pulp Cleaning and Paper Making Tests on Three Feedstocks from Municipal Solid Wastes M. L. RENARD	247
+ S2-2	Production of Paper-Making Furnish from the Mixed Solid Waste Stream A. R. NOLLET, A. R. BALDWIN, E. T. SHERWIN	259
✕ S2-3	Recovery of Paper from Municipal Solid Waste C. CEDERHOLM, J. G. HEDENHAG	275
S2-4	Upgrading of Mixed Waste Papers by Dry Sorting M. STRADAL, N. ROBERGE	281
S2-5	The Cleaning and Bleaching of Pulp Produced from Household Wastes R. B. NELSON, L. C. ALDRICH	289

CONTENTS (Cont'd)

Paper Number	Title and Author(s)	Page Number
S3-1	Paper Stock Standards and Practices — The Uses and Abuses of PS-77 H. I. STOVROFF	295
S3-2	Fibre Sourcing to Reduce the Threat of Contaminants through Improved Internal and External Communication D. G. BAILEY	303
✧ S3-3	Present and Future Fibre Usage and Supply O. NAGAWA	309
S3-4	Substitute Grades in a Changing Market F. D. SPARKS	313
S4-1	Flotation Systems for Deinking B. D. HARTEL	317
S4-2	Deinking by Washing or Flotation — A Comparison from the Viewpoint of Process Engineering and Process Application L. PFALZER	319
S4-3	Deinking Takes a New Shape D. L. HARBRON	325
S4-4	Factors Affecting Washing and Flotation Systems for Ink Removal — Panel Discussion F. R. HAMILTON	331
S5-1	Reverse Cleaning for Light and Sticking Contaminant Removal T. BLISS	333
S5-2	Performance of the Hett Secondary Pulper/Separator N. BARBER	339
S5-3	Practical Experience with the Stickers Problem — Panel Discussion H. W. VERSEPUT	345
S6-1	The Use of Waste Paper in Mexico M. VIGNA	347
S6-2	Use of the Effluent from a Deinking Paper Mill in Agriculture M. I. RODRIGUEZ, G. G. TORRES	351
S6-3	The ATS-N High Consistency Deinking System H. E. ORTNER	363
✧ S6-4	Depithed Bark: A New Source of Fibers for Kraft Pulping C. E. B. FOELKEL, C. ZVINAKEVICIUS, J. KATO	371

**1979
PULPING
CONFERENCE
PROCEEDINGS**



**Technical Association
of the
Pulp and Paper Industry**