EFFECTIVE TCF BLEACHING OF EUCALYPTUS TO MARKET BRIGHTNESS

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ABSTRACT

A laboratory study was conducted to produce totally chlorinated compound free (TCF) eucalyptus market grade high brightness (90+ ISO) pulp using oxygen, ozone and peroxide. Chips were prepared by Riocell, laboratory cooked via extended delignification by Econotech and processed by OZQP and OZQPZ bleaching sequences employing C-Free™ pulp production methodology by Union Camp. The study achieved final product characteristics indistinguishable from current mill product at low chemical consumption. Simulated filtrate carryover techniques were employed in order to represent expected mill conditions. Strength, brightness, reversion and other physical and optical properties were tested and evaluated.

KEYWORDS

Bleaching, eucalyptus, ozone, high consistency, peroxide, TCF, market pulp.

INTRODUCTION

The pulp bleaching industry is quickly evolving away from the use of chlorine as a bleaching agent. The bulk of this evolution has been by direct replacement of chlorine with chlorine dioxide. Newer technology systems such as Union Camp's ozone based pulp bleaching operation at Franklin, Virginia [1-3] have emerged to provide the additional environmental benefits of bleach plant closure and reduced operating costs associated with ozone.

Heightened environmental awareness and changing market perceptions continue to put pressure on bleaching technology. Since the start-up of the Franklin system, there has been a flurry of papers reporting on ozone studies. The direction of these studies has been towards the total elimination of chlorinated compounds in bleaching, designated "TCF". Numerous sequences have been proposed using oxygen, ozone and peroxide as principle oxidants.

Oxygen is generally accepted as the first bleaching stage due to its excellent delignification and filtrate recycling characteristics. Extensive variation of sequences past the oxygen stage have been proposed [4-9]. Generally these processes are tailored to a specific pulp due to the distinctively different characteristics of individual pulp species. The emergence of effective extended delignification methods in digesting has been recognized as a very important feature to successful TCF bleaching [4]. The proper integration of the digesting and bleaching processes is key to successful TCF production. For truly optimal environmental performance, the process must tolerate a closed filtrate recovery system. These features have been successfully demonstrated at Franklin [1].

Foelkel [4] posed the question on whether it is possible to bleach to market brightness (89-90% ISO) without the use of chlorinated compounds and still maintain acceptable brightness stability and other overall properties. In a joint effort between Riocell and Union Camp, a study was conducted on eucalyptus fiber with the objective of attaining TCF market grade eucalyptus pulp with a quality equivalent to Riocell's current product. The TCF results achieved by the Union Camp bleaching pulp process are presented and discussed in this paper.

MATERIALS AND METHODS

Sequence Testing Plan

Riocell requested that market grade 88+% ISO brightness pulp be produced as TCF with an intrinsic viscosity of 700 dm^3/kg. It was projected that this could be done in four stages. Riocell also indicated a desire to achieve 90+% ISO brightness eucalyptus pulp as an alternate secondary pulp target. Research indicated that, a high brightness fifth stage may be required and that, the fifth stage will optimally be an ozone brightening stage.

Riocell indicated that the pulping method to be selected for their process would be of an extended delignification type. Union Camp strongly agrees that the use of extended cooking processes enhances the ability of the bleaching process to achieve market brightness with lower chemical application. Since Riocell's existing process did not utilize extended delignification, the testing program had to be initiated from chips.

The principle concern for the study was that strength of the pulp had to be maintained. There was little doubt that brightness could be achieved. The issues shown in **Fig. 1** were addressed in this study. To more appropriately address the chemical

Phase I - Brownstock preparation from Riocell supplied chips	
COOKING	Confirm extended modified continuous cooking provides satisfactory starting pulp
Phase II - Primary sequence to 88+ ISO brightness	
OXYGEN STAGE	Confirm medium consistency selectivity at delignification required
OZONE STAGE	Confirm bleaching selectivity on Riocell eucalyptus pulp
CHELANT STAGE	Confirm the need for a chelant wash stage
PEROXIDE STAGE	Establish dosages required to achieve 88+ ISO brightness in 4 stages
Phase III - Secondary sequence to 90+ ISO brightness	
PEROXIDE STAGE	Establish dosages required to achieve 87+ ISO brightness as a 4th stage
OZONE POLISHING STAGE	Confirm brightening ability to 90+ ISO with minimal strength impact

Fig. 1. Bleaching Issues Reviewed

demand and bleachability effects of the mill environment, interstage carryover of filtrates was also simulated. Sequences of OZQP and OZQPZ were studied using the program outlined in **Fig. 2**.

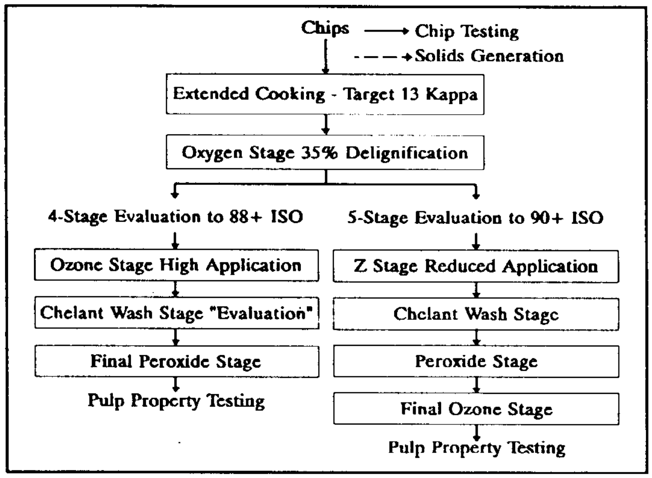

Fig. 2. Testing Plan for Riocell

Chip Samples

Chips were prepared by Riocell to simulate their mill mix of species, principally eucalyptus, that are being fed to the digester. The primary sample species was Eucalyptus saligna at 72% with secondary species Eucalyptus tereticornis - 13.5% and Acacia mearnsii - 14.5%. The chips were laboratory screened at Riocell to simulate mill preparation and sent to Econotech Services Ltd, New Westminster, B.C. Canada for digesting.

Pulp Preparation

The wood was processed in the lab at Econotech. The pulping conditions are provided in **TABLE I**. Econotech simulates extended modified continuous cooking of a mill digester by adjusting the alkali profile in stages within their laboratory batch digester. White liquor is applied at the appropriate rate so as to simulate the alkali profile of a co-current cook zone, extraction, and counter-current cook zone of the digester. To maintain the same liquor-to-wood ratio, black liquor must be drained from the recirculation line during white liquor injection periods. This laboratory simulation results in higher application on wood than typically found in the mill.

TABLE I
LABORATORY PREPARATION OF EUCALYPTUS BROWNSTOCK

Pulping Technique	Extended Modified Continuous Cooking
Pulping conditions	
H Factor	1293
Effective Alkali, as NaOH	26% *
Sulfidity based on AA	18.6%
Screened Yield	50.3%
Unscreened Yield	51.2%
Brownstock conditioning -	Defibered, Screened & Blended

* Excess alkali "applied" to simulate cooking conditions, not expected to translate to mill application.

The reaction is quenched by injecting water into the digester at the end of the cook. Pulp is removed from the digester via the basket within the digester (i.e. no blow is simulated). Chips are then removed from the basket, defibered, washed and screened.

The eucalyptus responded very well to cooking and targeted kappa number was achieved (kappa 12.5). The 1305 dm^3/kg viscosity exceeded Riocell's desired minimum (1250).

Solids Simulation

To assess the impact of solids on the bleaching system, a limited process computer model was constructed for Riocell's application. Conventional bleach plant drum washers were assumed in the simulation to use worse case conditions of carry-forward. Two wash-presses were assumed after the oxygen stage for optimum washing and filtrate closure.

Due to the uncertain brownstock washing configuration, solids carryover from the pulp mill was assumed to be a worse case condition. Solids carryover was based on previous pulp mill measurements. A portion of Riocell's chips was cooked via conventional Kraft method to generate brownstock solids.

The process model was used to set fresh incoming solids to each stage. The laboratory bleaching was performed with solids carry-forward simulated, based on the washing conditions projected. The required brightness and viscosity were obtained without excessive chemical consumption. The uncertainty of the metal content of the filtrate system and the extent to which metals will cycle up in the bleach stages lead to the possibility that the chelant wash stage, peroxide stage or final polishing Z stage may have to have some purge. Detailed metal analysis and balancing will be required to determine the extent of purging required. It should be noted that these streams are very low in organics and toxic compounds and purging may present little concern. It may even be practical to reuse some of this effluent in other parts of the mill cycle.

Oxygen Stage Characterization

Riocell wished to evaluate Union Camp's pulp bleaching technology using a medium consistency oxygen stage, since lower brownstock lignin levels would be achieved with extended pulping delignification. A low level of oxygen delignification was targeted (30-35%), and medium consistency oxygen was employed for the testing program.

Oxygen bleached pulp was produced in a Quantum Technologies mixer. Oxygen bleaching conditions were 12% consistency, 60 psig O_2 pressure, 30 minutes and 95°C. 2% caustic was applied and, for conservatism, magnesium was applied at 0.1% Mg^{++} on pulp. Magnesium is not expected to be needed for mill O_2 delignification at this level. Simulated brownstock solids were added equivalent to predicted conventional washer losses. Two separate batches of essentially equivalent laboratory pulps were produced.

Bleaching of the pulp in the oxygen stage was performed using caustic. Oxidized white liquor can be used as the alkali source and provides significant chemical cost saving benefits. Also, use of white liquor assists in balancing pulp mill chemicals.

Ozone Stage

Union Camp conducted laboratory high consistency ozone bleaching at 42% consistency on the prepared oxygen stage pulp. The procedures used have been found by Union Camp to be representative of pilot plant and mill response to bleaching with ozone. Laboratory ozonation conditions included spiking with O-stage solids, pre-acidification to 2.0 pH and application of 0.2% DTPA prior to achieving target consistency. Ozone was applied in a tumbling reactor using 6% concentration ozone.

Ozone application targets were chosen to produce mid 70% ISO brightness pulp. The ozone consumption includes carry-forward solids effects. The higher ozone consumption case, 0.48% was run to achieve market brightness in four stages. The lower dosage case was chosen in expectation of the need for strength protection during the extended bleaching to higher brightness in five stages.

The ozone bleaching efficiency of the laboratory generated O stage pulp was high. A brightness increase of 3.4-4.3% ISO/kg ozone was achieved for the two pulps tested.

Excellent viscosity retention was achieved through the ozone reaction stage, ending up at 816 and 850 dm^3/kg viscosity in both cases. Selectivity (brightness increase divided by viscosity loss) remained high.

Chelant Wash Stage

It has been found that the peroxide stage is particularly vulnerable to metals and that a pre-wash chelant stage, "Q", significantly improves bleaching efficiency and selectivity in the peroxide stage [10-12].

The Riocell pulp was thought to be relatively low in metal content, and it was deemed that elimination of the chelant wash stage may be a possibility. Therefore, part of the qualification program was set to defining the need for a chelant wash ahead of the peroxide stage.

Pilot studies were performed and clearly show that, even for the Riocell eucalyptus pulp, a substantial additional loss in viscosity occurred in the peroxide stage without a chelant wash prior to the peroxide stage. **TABLE II** provides experimental data where all other variables were held constant except for a chelant and wash treatment. Varying peroxide application in the follow-up stage was performed to substantiate the results. The chelant treatment results showed clearly superior higher viscosity at equivalent brightness. On this basis, it is judged that a chelant treatment stage is needed preceding the peroxide stage for good peroxide stage performance.

A chelant treatment stage was performed on the bulk ozone bleached pulps. Z stage solids were added to the pulp to simulate carryover. DTPA was applied to the Z stage pulp at 0.2% and soaked at 5% consistency and 90°C for 1 hour, then washed.

TABLE II

EFFECTS OF INTERMEDIATE CHELANT WASHING ON VISCOSITY LOSS IN THE PEROXIDE STAGE

	P-Only No Chelation	O + P Chelation Wash
Low Peroxide Treatment	0.5%	0.5%
Pulp Brightness, %ISO	85.2	85.4
Pulp Viscosity, cps	13.6 (687)*	16.4 (749)*
Med. Peroxide Treatment	1.25%	1.0/1.5%
Pulp Brightness, %ISO	88.2	87.3/88.1
Pulp Viscosity, cps	10.8 (619)*	13.1/12.8 (673)*
High Peroxide Treatment	2.0%	2.0%
Pulp Brightness, %ISO	88.9	89.4
Pulp Viscosity, cps	8.5 (554)*	14.7 (712)*

* Calculated intrinsic viscosity dm^3/kg from relationships.
Laboratory ozone starting pulp, 77.2 %ISO, 816 dm^3/kg.

Peroxide Stage

The ozone bleached chelant washed pulps were then treated with peroxide at 90°C for 4.5 hours at 12% consistency. An application of 1% peroxide was used. Magnesium was applied at 0.05% Mg^{++} on pulp for peroxide stability. **TABLE III** summarizes the process stage results for the 4-stage sequence.

Selectivities of 0.10 and 0.11 were achieved with peroxide. For the 4-stage pulp, a brightness level of 90.2% ISO was achieved, exceeding the target brightness by approximately two units. Viscosity was acceptable for this pulp.

The peroxide treated pulp for the 5-stage process also showed good potential for entry into the final polishing Z stage. Brightness was at target 88.5% ISO and viscosity showed excellent retention at 718 dm^3/kg (see **TABLE IV**).

TABLE III

FOUR STAGE BLEACHING EVALUATION
LABORATORY PREPARED EUCALYPTUS PULP

	Chemical Application	Viscosity dm^3/kg	Brightness %ISO	Kappa
Extended cooking	-----	1305	-----	12.5
Omc	2% NaOH	920	61.1	8.9
Z	0.5% O_3	816	77.2	--
Q-P	1% H_2O_2	689	90.2	-----

TCF Pulp Production

Second Ozone Stage

Previous research had indicated that as much as 3-5 brightness units could be attained with a polishing Z stage with very little ozone application. Due to the light application expected, medium consistency ozonation was considered for this final stage as a potential capital cost saving measure.

A Quantum Technologies mixer was used for the laboratory medium consistency ozonation. P stage filtrate was added to washed peroxide stage sample to simulate carryover. Bleaching conditions were set at 12% consistency, 27°C and 4 pH. No chelant was applied.

The exiting gas ozone was adsorbed in Potassium Iodide and the reactant adsorbent strength measured to determine residual. Conversion was approximately 70% in this lab medium consistency polishing ozone stage.

TABLE IV summarizes the 5-stage bleaching evaluation results. The second stage Z was able to achieve the high brightness target (90.4% ISO). Selectivity of the Z polishing stage was significantly less than the primary Z stage. Optimization may yield improved performance and research is continuing in this area.

TABLE IV
FIVE STAGE BLEACHING EVALUATION
LABORATORY PREPARED EUCALYPTUS PULP

	Chemical Application	Viscosity dm^3/kg	Brightness %ISO	Kappa
Extended Cooking	-----	1305	-----	12.5
Omc	2% NaOH	939	57.7	8.6
Z	0.4% O_3	850	73.7	-----
Q-P	1% H_2O_2	718	88.5	-----
Z	0.12% O_3*	667	90.4	-----

* Laboratory medium consistency ozone was 70% utilized.

TCF Pulp Production

Riocell Mill Pulp

Riocell supplied "never dried" bleach plant pulp for testing comparisons by Union Camp lab procedures. This pulp was produced by conventional continuous digesting of Riocell's typical Eucalyptus chip species mix. The bleaching sequence used was O(DC)ED(EH)D. Brightness and viscosity for the Riocell mill pulp tested at 89.6% ISO and 660 dm^3/kg, respectively. **TABLE V** provides a summary of property tests on the Riocell mill pulp compared to the laboratory prepared TCF pulp. Brightness and viscosity of the TCF pulps are very close to Riocell's current product. At a Canadian Standard Freeness of 300 ml, physical property tests show the TCF lab pulps to be similar to the Riocell pulp.

TABLE V
CHARACTERISTIC COMPARISON
RIOCELL BLEACH PLANT PRODUCT
VS. TCF LABORATORY PULPS

	Bleach plant pulp	lab OZQP	lab OZQPZ
Brightness, %ISO	89.6	90.2	90.4
Viscosity, dm^3/kg	660	689	667
*Tear Index, Nm^2/kg	8.7	9.5	9.0
*Tensile Index, Nm/g	95	75	88
*Burst, kPa m^2/g	5.4	5.7	6.2
*Stretch, %	4.0	4.9	5.4
*Bulk, cm^3/g	1.4	1.4	1.4
*Opacity, %(Tappi std. R_0/R_{89})	75	75	75

* At a Canadian Standard Freeness of 300 ml, CSF

PHYSICAL PROPERTY RESULTS

Physical property testing was done at Union Camp's Research Center in Princeton, New Jersey. Refining was conducted using standard PFI equipment and methods. Handsheets were prepared using standard Tappi methods and tested via Tappi procedures. Results are reported on an O.D. basis. Freeness was measured as Canadian Standard Freeness, ml CSF.

Thermal reversion testing was performed under conditions of 105°C and 50% humidity for 2, 6 and 18 hours. Post-color reversion was also measured for these conditions.

Tear/Tensile

Tear versus tensile profiles are commonly employed to explore possible strength differences between various pulps. As illustrated in **Fig. 3** (tear x tensile), the 4-stage and 5-stage TCF pulps proved equivalent in strength to the Riocell fully bleached pulp. The specific tear index and tensile index refining profiles are also provided in **Figs. 4-5**, respectively. The tear index development (**Fig. 4**) illustrates indistinguishable refining behavior between the TCF pulps and the Riocell pulp; the tensile index development (**Fig. 5**) suggests that the tensile index development for the 4-stage TCF pulp may possibly be lower than the other two pulps. If this tensile difference is real, the source is not immediately apparent from the available data; factors could include higher chemical charges in the 4-stage sequence or the choice of baseline pulp. Regardless of the specific refining deviations, the tear versus tensile profiles of **Fig. 3** definitively exemplifies the fully bleached strength acceptability of the TCF pulps produced by this method.

Burst

Burst testing resulted in very similar relationships of the TCF pulps to the current Riocell product, **Fig. 6**.

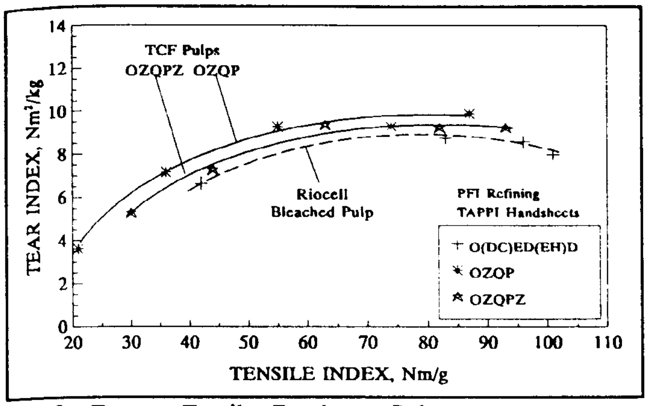

Fig. 3. Tear vs. Tensile, Eucalyptus Pulp

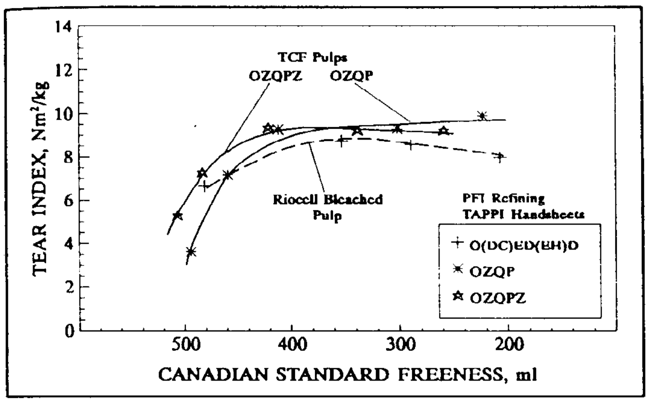

Fig. 4. Tear vs. Freeness, Eucalyptus Pulp

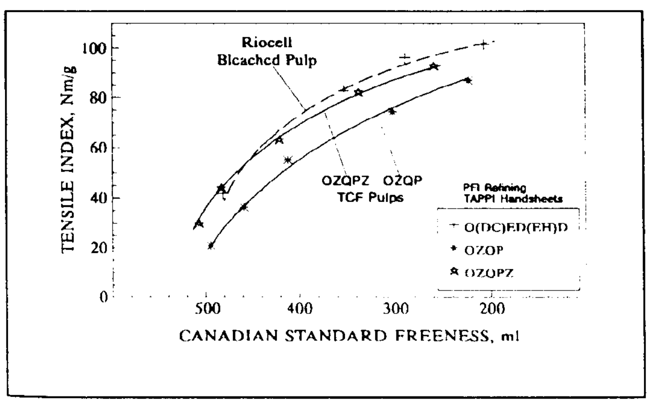

Fig. 5. Tensile vs. Freeness, Eucalyptus Pulp

Stretch

Fig. 7 shows the stretch freeness relationships of the pulps tested. Stretch is biased higher for the TCF pulps. Because this is a lab versus production comparison, conclusions from this data are tenuous. It is certainly an area to be examined for potential gain, however, since improved stretch may reflect advantage in paper machine runnability.

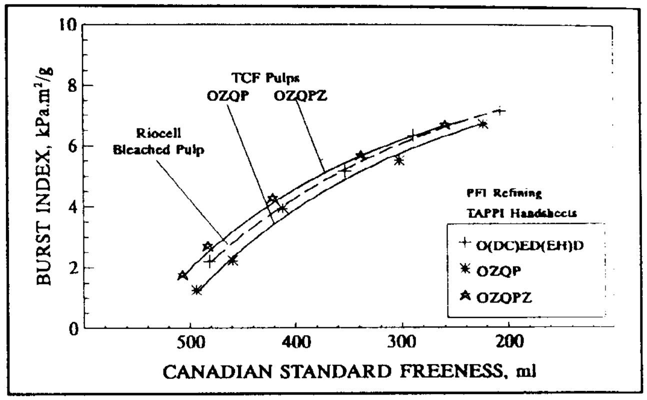

Fig. 6. Burst vs. Freeness, Eucalyptus Pulp

Bulk

Bulk development with beating, over the freeness range of interest, was found to be as good as current Riocell pulp; for example, see **TABLE V.**

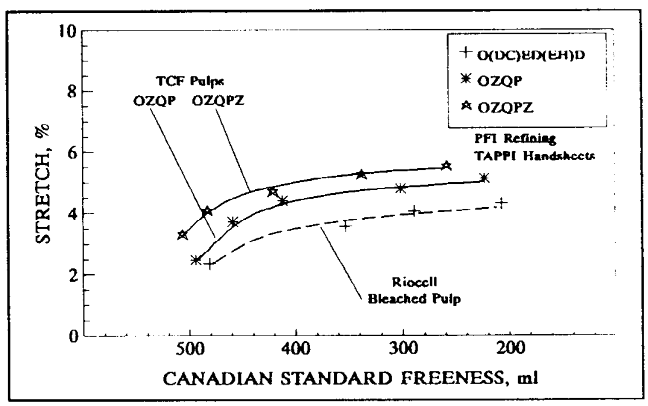

Fig. 7. Stretch vs. Freeness, Eucalyptus Pulp

Brightness

High final market brightness was achieved using the TCF sequences tested. The final bleached laboratory TCF pulp brightness was equivalent to the base pulp provided by Riocell.

Opacity

Opacity test data for the Riocell product and lab bleached TCF pulps, in the normal machine range of freeness, were indistinguishable from each other. This result, coupled with the nearly identical bulk development with beating, provides assurance that eucalyptus pulp produced by this methodology should have a bulk-opacity relationship identical to Riocell's current product. This is very important since eucalyptus pulps are considered to be superior regarding bulk and opacity.

Reversion

A reversion assessment was made on the bleached sample obtained from Riocell and the TCF pulps produced in the lab

Fig. 8 shows thermally reverted brightness for the Riocell product pulp and the TCF pulps. The mill product and TCF pulps reacted nearly identically, dropping approximately two and one-half points in two hours. The lab produced pulps had an initial starting brightness slightly higher than the Riocell product causing the reverted brightness to be higher over the range. The general shape of the 4-stage pulp curve agreed with the shape of the current Riocell pulp and therefore, at the same brightness level, identical performance is expected. The slightly higher brightness 5-stage pulp appeared to retain brightness better with extended thermal reversion test. This stability is likely the result of lower lignin residual.

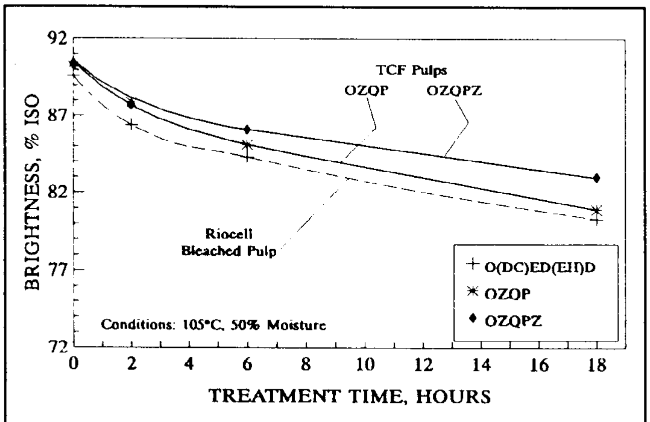

Fig. 8. Thermal Reversion Testing, Eucalyptus Pulp

Post-color (PC) numbers were also generated for the pulps examined. The post-color number is the difference between the absorption to scattering coefficient ratio after and before aging. The correlation of this index to color increase is based on the theory that the absorption to scattering ratio is independent of reflectance level. This, in effect, is normalizing sheet-to-sheet preparation, heating/handling effects, etc. **Fig. 9** provides a plot of post-color number for the stocks examined. These data show similar trends for the 4-stage TCF pulp compared to mill bleached pulp. The 5-stage TCF sequence showed an advantage for developing less reverted color as measured by the PC method.

Other Properties

Riocell noted other results in the course of their testing of the final stock, **TABLE VI,** that indicated the TCF pulps had lower DCM extractives (pitch tendency indicator), absorbed water readily (equivalent to their stock) and had lower air resistance. Transition metals showed similar levels compared to mill pulp, though caution should be employed in using lab to mill comparisons. Magnesium levels of the TCF pulp reflects addition in the lab sequence. Calcium levels of the final pulp reflect possible retention by the TCF process not found in an open conventional sequence. Copper and manganese levels are low in all cases. Iron levels could reflect lab processing influence.

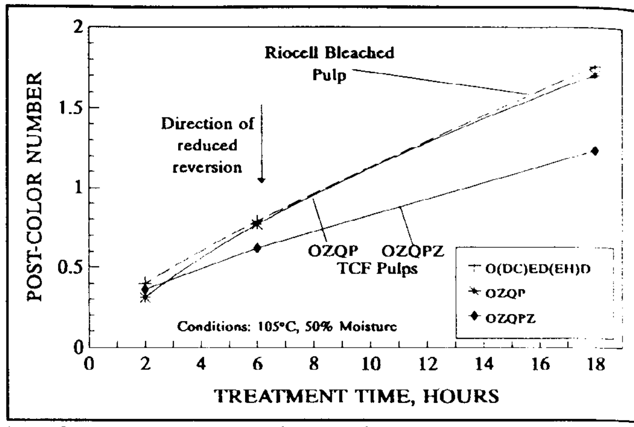

Fig. 9. Post-Color Reversion Testing, Eucalyptus Pulp

TABLE VI
OTHER FINAL PULP PROPERTIES
EUCALYPTUS BLEACHED PULP

	Riocell pulp	lab OZQP	lab OZQPZ
Ash, %	0.19	0.21	0.23
DCM extractives, %	0.10	0.05	0.05
Air resistance, s/100cm*	15.8	6.9	9.5
Klemm water absorption, mm/10 min.**	91	102	91
------ METALS ------			
Mn, ppm	1.2	1.3	2.0
Co, ppm	0.9	1.6	2.9
Fe, ppm	15.3	25.3	34.7
Mg, ppm	22	145	200
Ca, ppm	105	405	380

* Tested at Schopper Riegler 30
** Tested at unbeaten conditions
All tests by Riocell

CHEMICAL COSTS

An assessment of chemical costs can be made for the TCF bleaching process based on the raw material cost assumptions from **TABLE VII.**

The cost assigned to ozone includes oxygen and power, and assumes a gas recirculating system for the efficient production of the ozone. Oxygen usage was set at 2.9 kgO_2/kgO_3. Power consumption was assumed at 11.1 $kwhr/kgO_3$, representing expected production costs for using advanced technology generators and 6% concentration [13]. A typical mill power cost was assumed as $40/MWhr. No credit was taken for re-use of vented oxygen purge. Based on Union Camp experience [3] an efficiency of 95+% was assumed for the Z stage.

TABLE VII
CHEMICAL COST BASES
(TYPICAL COSTS EXPECTED FOR BRAZIL)

Chemical Costs *	$US/kg
Oxygen (Liquid-LOX)	0.12
OWL (Oxidized White Liquor)	0.03**
Magnesium Sulfate	0.48
Ozone (including Oxygen)	0.79
Sulfuric Acid	0.12
Chelant	1.65
Caustic (Sodium Hydroxide)	0.15
Hydrogen Peroxide	1.10
Chlorine Dioxide***	0.29

* Typical market cost assumed, no capital effects included.
** OWL cost does not include NaOH value since it is recovered.
*** Expressed as active chlorine

TABLE VIII
EXPECTED OZQP BLEACHING REQUIREMENTS
EUCALYPTUS PULP TO 90% ISO BRIGHTNESS

O2 STAGE	EXPECTED* APPLICATION	kg/** ADMT	$/ ADMT
Oxygen	1.5%	13.5	$1.62
White Liquor	2.0%	18.0	$0.54
Z STAGE			
Ozone	0.5%	4.4	$3.48
Sulfuric Acid	2.5%	22.1	$2.65
Chelant	0.1%	1.0	$1.65
Caustic	0.3%	2.6	$0.40
Q STAGE			
Chelant	0.2%	1.8	$2.97
P STAGE			
Peroxide	1.0%	8.7	$9.57
Caustic	0.8%	7.0	$1.05
Mag. Sulfate	0.2%	2.1	$1.02
			$24.95

* Starting brownstock, Eucalyptus Kappa No. 12.5
** Yield losses factored

This study indicates that an application rate of 1% is suitable for the peroxide stage on eucalyptus pulp. No optimization was performed in this regard, however, and actual mill results may vary depending on level of metals, washing performance, etc.

A chelant application of 0.1% on pulp is assumed for the Z stage based on experience and 0.2% is used for the Q stage based on lab application. A magnesium sulfate application of 0.2% as $MgSO_4$ was assumed for the peroxide stage.

An assessment of chemical costs is provided in **TABLE VIII.** Using the assumptions noted, an expected bleaching cost for producing market grade TCF eucalyptus pulp can be approximately $25 per ton for an OZQP sequence. This cost could be reduced by as much as $2 per ton if cost effective on-site oxygen is used.

For rough assessment, current conventional sequences can be used for comparison purposes. Active chemical dosages have been reported for production of eucalyptus pulp to 90% ISO brightness using ECF chlorine dioxide sequences [14]. **TABLE IX** summarizes the chemical applications noted for this reference with minor assumption for OWL use in the oxygen stage. Chemical costs from **TABLE VII** applied to the more conventional bleaching applications, result in comparable cost of $24.50 per ton for a D(EO)DED sequence and $19 per ton for a OD(EO)DED sequence. Thus, an OZQP type of TCF process is projected to have operating costs comparable to non-oxygen based chlorine dioxide ECF systems. This assumes little optimization of the process. Environmental advantages, which may be significant, are also not credited.

TABLE IX
COMPARABLE CHEMICAL REQUIREMENTS
CHLORINE DIOXIDE BASED ECF SEQUENCES

ECF SEQUENCE [14]	D(EO)DED		OD(EO)DED	
	kg/ ADMT	$/ ADMT	kg/ ADMT	$/ ADMT
WHITE LIQUOR	NA	NA	10.0	$0.30
OXYGEN (inc. O Stage)	6.0	$0.72	16.0	$1.92
CAUSTIC	17.6	$2.65	13.3	$2.00
CHLORINE DIOXIDE	72.0	$21.13	50.6	$14.85
		$24.50		$19.07

Modified continuous cooked brownstock as starting pulp.
Minor impact of oxidized white liquor oxygen usage estimated.

CONCLUSIONS

Based on this study it is concluded that good quality eucalyptus pulp can be produced by emerging TCF technology. Market brightness can be achieved at the same levels as chlorine compound based sequences. This can be done with reasonable TCF pulp bleaching costs comparable to ECF systems. Brightness reversion of fully bleached TCF pulps can be as stable or even better than conventional based systems.

From an overall physical property standpoint, laboratory bleached eucalyptus market pulp bleached by this TCF method exhibits similar tear/tensile, stretch, bulk and opacity properties comparable to current reference conventional mill bleach plant product.

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Recognition is given to all Union Camp and Riocell technical personnel who really did a super job handling the details of this work particularly in light of the scarcity of furnish. We are indebted to their service. Special thanks to secretaries Kay and Lois for their effort and patience and to Econotech Services Ltd. +

PAPER PRESENTATIONS
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1994 INTERNATIONAL PULP BLEACHING CONFERENCE

PAPERS
to be presented

June 13–16, 1994
Hyatt Regency Hotel
Vancouver, British Columbia

TECHNICAL SECTION C.P.P.A. TAPPI SPCI EUCEPA Secrétariat Général PARIS

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1994 INTERNATIONAL PULP BLEACHING CONFERENCE

Conference Chairman:
Ants Teder
Cellulose Technology Department
Royal Institute of Technology
S-10044 Stockholm, Sweden
46 8 790-8100; Fax: 46 8 790 8101

Program Chairman:
Douglas Reeve
Pulp & Paper Centre
University of Toronto
200 College Street
Toronto, Ont. M5S 1A4
(416) 978-3062; Fax: (416) 971-2106

Please reply to:

November 14, 1993

D.R. Lazar
Senior Applications Engineer
Union Camp Technology
P.O. Box B
Eastover, SC
29044 USA

Dear Mr. Lazar

Re: "Effective TCF Bleaching of Eucalyptus to Market Brightness"

There has been intense competition among the more than 140 abstracts submitted to the Program Committee and so I am pleased to advise you that your abstract has been selected for presentation at the International Pulp Bleaching Conference. Congratulations!

The CPPA (Glen Black) will send you an author information kit for manuscript and slide preparation. Your presentation time allotment will be twenty minutes, not including questions and answers.

I will require that you complete the attached form and return it to me by mail or fax no later than December 17. Please note this offer is conditional on successful review of the manuscript and slides.

Thank you for your contribution to the success of the conference.

Yours sincerely

Lindy Tam
for Douglas Reeve
Program Chairman

Attachment: 1) Form

DR/ct

Celso, For your info.

UNION CAMP TECHNOLOGY, INC.
Hwy. 601 S., P.O. Box B
Eastover, SC 29044
Phone: (803) 353-7080
Fax: (803) 353-7026

PEDIR CÓPIA ANAIS

November 24, 1993

Celso Foelkel
Director of Technology and Environment
Riocell, S.A.
Rua São Geraldo, 1680-C.P.-108
92500, Gualba-RS-Brazil

Celso:

You should be pleased to know that our paper has been selected for the Vancouver International Bleaching Conference in June. Attached, for your information, is a preliminary program. Judging from the other papers, this should be a very interesting conference. I welcome your support and I hope you can make it.

As you can see from Doug Reeves' note, there was good competition. We should have little trouble meeting the February and April deadlines.

Sincerely,

Doug Lazar

D.R. Lazar
Senior Applications Engineer

cc: W.E. Nutt
D.F. Seiter

\MEMOS\CUSTOMER\RIOCELL\CPPACOM3.CF

"Minimizing Strength Degradation during Totally Chlorine-free Bleaching including an Ozone Stage", C. CHIRAT and D. LACHENAL, Ecole Française de Papeterie et des Industries Graphiques, Domaine Universitaire, Saint-Martin d'Hères Cédex, France

THE NEXT GENERATION OF ENZYME BLEACHING
Tuesday, June 14 1400-1700

"Oxidative Bleaching Enzymes; the Next Generation?", M.G. PAICE, R. BOURBONNAIS, F. ARCHIBALD, I.D. REID and L. JURASEK, Paprican, Pointe Claire, PQ

"Biobleaching Process Using Hyper Lignolytic Fungus, Strain IZU-154 and its Mutants", M. KAKEZAWA, Biotechnology Research Laboratory, Kobe Steel Ltd., Ibaraki, Japan

"Role of Pulp Metal Profile on Enzyme-aided TCF-bleaching", J. BUCHERT and L. VIIKARI, VTT Biotechnical Laboratory, Espoo, Finland

"Novel Enzyme Treatment for Dioxin-free Bleaching of Kraft Pulp with High Kappa Factor and Low ClO_2 Substitution", J.S. TOLAN and B.E. FOODY, Iogen Corporation, Ottawa, ON

"Microscopic and Chemical Examination of the Effect of Treating Unbleached Softwood Kraft Pulp with Hemicellulase Enzymes", X. YU, J.L. MINOR, R.H. ATALLA, M.M. LABBAUF and R.L. FARRELL, USDA Forest Service, Forestry Products Laboratory, Madison, WI and Sandoz Chemicals Biotach Research Corporation, Lexington, MA

Tuesday, June 14 1830

CONFERENCE BANQUET

TCF BLEACHING - TOWARDS HIGH STRENGTH, HIGH BRIGHTNESS AND COST COMPETITIVENESS
Wednesday, June 15 0830-1200

"Effective TCF Bleaching of Eucalyptus to Market Brightness", D.R. LAZAR, Union Camp Technology, Eastover, SC; C. FOELKEL, Riocell, S.A. Gualba-RS-Brazil; D.F. SEITER, Union Camp Corporation, Princeton, NJ

"TCF Bleaching of Industrial Softwood Kraft Pulp to High Brightness with and without Ozone, J. ODERMATT, R. PATT, O. KORDSACHIA, Universität Hamburg, Hamburg, Germany

"TCF Bleaching of Softwood and Birch Kraft Pulps to High Brightness - Sequences and Pulp Quality", R. MALINEN, T. RANTANEN, R. RAUTONEN and L. TOIKKANEN, The Finnish Pulp and Paper Research Institute, Espoo, Finland

"OZP-Bleaching of Softwood and Hardwood Kraft Pulps to Full Brightness", S. NORDÈN and U. GERMGÅRD, Sunds Defibrator, Sundsvall, Sweden

"Energy Efficiency in ECF and TCF Bleaching", T. LAXÉN, Rintekno Oy, Espoo, Finland, K. HENRICSON, Ahlstrom Corp. Finland

NEW OXIDANTS FOR BLEACHING
Wednesday, June 15 1400-1530

"Activated Oxygen (Dimethyldioxirane), a Selective Bleaching Agent for Chemical Pulp Bleaching Part IV A Successful Pilot Trial and Process Designs for an Industrial Application", C.-L. LEE[1], R. HOGIKYAN[1], A.T. SKOTHOS[2,3], G. SACCIADIS[3], J.T. WEARING[1], [1]Vancouver Laboratory, PPRIC, Vancouver, BC; [2]Noranda Technology Centre, Pointe Claire, PQ; [3]Pointe Claire Laboratory, PPRIC, Point Claire, PQ, C.W. OLOMAN, University of British Columbia, Vancouver, BC, B. AMINI, W.W. TEETZEL, E.I. Du Pont De Nemours & Company Inc., Deepwater, NJ, P. FETISSOFF, L. TENCH, S. HARPER, Chemetics International Comp. Ltd., Vancouver, BC

"Totally Chlorine Free Bleaching with Dimethyldioxirane", T.J. McDONOUGH, A. MARQUIS and A.J. RAGAUSKAS, Institute of Paper Science and Technology, Atlanta, GA

"Persulphate Bleaching of Softwood Kraft Pulp", A. WONG, S. WU, C. CHIU and J. ZHAO, Arbokem Inc., Vancouver, BC

Wednesday, June 15 1530-1830

POSTER SESSION
(approximately 45 poster presentations)

Date: 24 November 1993

To: Doug Reeve
Pulp & Paper Centre
University of Toronto
200 College Street
Toronto, Ontario
M5S 1A4 Canada
Fax No.: (416) 971 2106

From:

NAME	Douglas R. Lazar
COMPANY	Union Camp Technology
ADDRESS	P.O. Box B
	Eastover SC 29223
PHONE NO.	803-353-7917
FAX NO.	803-353-7026

PAPER TITLE: Effective TCF Bleaching of Eucalyptus to Market Brightness

I accept the invitation to present the above paper at the 1994 International Pulp Bleaching Conference and warrant that the paper has not been and will not, prior to the IPBC, be presented at any other conference.

I agree to make submissions to the program committee as specified below:

Manuscript to review	-	not later than February 28, 1994
Final Manuscript to CPPA	-	not later than April 29, 1994
Slides to review	-	not later than April 29, 1994

I agree to abide by the guidelines for slides as below (further details will be sent with the author kit):

1. A clear simple message
2. Horizontal format
3. All letters larger than 1/50 of the distance from the top to bottom of the image
4. Sharp image and good contrast between colours
5. A maximum of 30 slides for the 20 minute presentation

I understand that failure to comply with the above may result in removal of this paper from the program.

SIGNED Douglas R. Lazar