ECF Bleaching of Eucalyptus Pulp to High Brightness

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ABSTRACT

A study has been carried out to develop an approach of minimal impact on environment during pulping and bleaching of Eucalyptus wood. Additive pulping, followed by single stage oxygen delignification and D - EOP - D bleaching sequence produced a pulp of high brightness with generation of very low quantities of conventional and non-conventional pollutants. In comparison to traditional modified cooking for lowering lignin content in pulp which are capital intensive additive pulping using anthraquinone was preferred as a low cost alternative.

INTRODUCTION

For mills with chemical recovery, the major concern of conventional and non-conventional pollutants is from the bleach plants. The generation of pollutants has been related to the initial lignin content of pulp and all on going efforts are directed towards reducing the lignin content of pulp to be subjected to bleaching using conventional, ECF or TCF bleaching sequences. Since for the pulp mills of 100-300 tonnes/ day adoption of modified cooking followed by oxygen delignification is sometimes problematic as the investments are high, other modified approaches should also be investigated, including biotechnological. Treatment of pulp wood with white rot fungus, Alkaline leaching of pulp, enzymatic pre-bleaching of pulp, increasing substitution of chlorine by chlorine dioxide, oxidative extraction, hydrogen peroxide reinforced oxidative extraction, etc can minimise the generation of adsorbable organic halogens, COD, Colour and BOD at the source. The present work is directed towards achieving greater delignification during sulfate cooking followed by oxygen delignification and an ECF (Elementary free chlorine) bleaching to produce a pulp of high brightness with reduced conventional and non conventional pollutants. To a large extent oxygen delignification has become a necessary stage in chemical pulps fibre lines, providing a bridge between the cooking process and the bleach plant. Fundamentally it can extend the cooking process, by lowering Kappa number (lignin content) of pulp without further degrading pulp fibres. Extracted chemicals and organics from the oxygen stage can be reused in the pulp fibre line, but are typically burned for energy in the recovery process. Lower lignin content pulps generally results in lower chemical consumption in the bleach plant. Further adoption of shorter bleaching sequences for energy reduction, waste water shorter bleaching sequences for energy reduction, waste water minimization and improved waste water quality is also made possible.

OBJECTIVE

The objective of this study was to produce a bleached pulp of 88-90° brightness (Elrepho) with maximum retention of strength properties, meeting the environmental considerations for the mills of the future.

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EXPERIMENTAL

Eucalyptus chips were collected from pulp mill, the chips were air dried and then screened. Screened chips (-25 mm) were cooked in the laboratory tumbling digester with the addition of 0.1% Anthraquinone and 15% effective alkali (as Na_2O) on O.D. chips. Sulphidity of cooking liquor was 15% and H factor 922 to produce an unbleached pulp of 12 permanganate number. This pulp was air dried and used for oxygen delignification, under different conditions. A chelation step for complexing metallic ions with EDTA was also tried but no added benefit was obtained. Ash analysis of the pulp given in Table-1 showed that most of the metallic ions are present in small quantities and the presence of Mg + + may be beneficial in oxygen delignification. The oxygen delignified pulp was bleached using D-EOP-D sequence under different conditions. All the conditions used are not given in the text of the article, only optimal conditions that enable to meet the objective are given in Table-2. The combined waste water from D-Eop-D SO_2 sequence was tested for adsorbable organic halogens (AOX), COD, BOD, Colour, and some chlorophenolic compounds. The results are given in Table -3.

TABLE-1

Metallic ions results of Eucalyptus pulp

	%
Copper (as Cu)	0.0016
Iron (as Fe)	0.0097
Manganese (as Mn)	0.0014
Cobalt (as Co)	0.0002
Magnessium (as Mg)	0.0633

The strength characteristics of the unbleached and bleached pulps are given in Table-4.

RESULTS AND CONCLUSIONS

Eucalyptus responds well to additive pulping. Addition of anthraquinone enabled to produce a pulp of 12 permanganate number without loss of pulp quality. Under controlled conditions of oxygen

TABLE-2

Bleaching Data & Final Pulp Characteristics

SEQUENCE	D	EOP	D	SO_2
CONSISTENCY, %	10	10	10	3
TEMPERATURE, °C	70	70	70	28
TIME, MINUTES	210	60	210	30
ClO_2 ON PULP, %	1.75	---	0.8	---
NaOH ON PULP %	---	1.5	---	---
H_2O_2 ON PULP % (100% PURITY)	---	0.5	---	---
OXYGEN PRESSURE, kg/cm^2	---	2	---	---
SO_2 ON PULP, %	---	---	---	0.3
FINAL pH	4.6	10.4	5.2	4.5
BRIGHTNESS % (ELREPHO)	79.6	84.5	89	89.4
YELLOWNESS %	11.9	7.7	5	4.5
POST COLOUR NUMBER	---	---	---	0.23
VISCOSITY cps (0.5% CED)	---	---	---	9.5
SHRINKAGE DURING BLEACHING %	---	---	---	8
YIELD OF BLD PULP ON UNBLD PULP, %	---	---	---	40.9

TABLE-3

Combined Waste Water Characteristics of D-Eop-D-SO_2

pH	8.3
AOX	0.35 kg/tonne of O.D. Bleached pulp
COD	50.0 kg/tonne of O.D. Bleached pulp
BOD	8.6 kg/tonne of O.D. Bleached pulp
Colour	7.5 kg/tonne of OD Bleached pulp
2,4,6, Trichlorophenol	40 gram/tonne of OD Bleached pulp
3 Chloro catechol	2.4 gram/tonne of OD Bleached pulp

TABLE-4

Strength Characteristics of Unbleached and Bleached Pulp (Standard Hand Sheets of 60 g/m²)

	UNBLEACHED PULP			BLEACHED PULP		
Beater PFI Mills, Revolutions	0	2500	3500	0	2700	3750
Beating degree °CSF	594	400	300	600	410	1.28
Bulk cm^3/g	1.77	1.34	1.20	1.88	1.38	1.28
Breaking length km	3.34	6.60	7.50	2.32	6.30	7.90
Burst factor	11	42	48	9	47	53
Tear factor	37	77	73	49	88	89
Double fold	3	67	117	2	62	132

delignification almost 50% reduction in permanganate number was brought about. The oxygen delignified pulp responded well to D-EOP-D sequence. The pulp was easier to bleach and retained all the strength characteristics of unbleached pulps.

The pulp has good brightness stability as measured by Post colour number.

Going by the results of brightness, yellowness, post colour number, strength characteristics of pulp and waste water characteristics, it could be concluded that most of the benefits of adopting improved technology are realised well on Eucalyptus wood and guidelines given in the paper mill will be benefit to the Pulp and Paper Industry.

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