

Purified Pulps from Eucalyptus Hybrid for Cellulose Industries.

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INTRODUCTION

The possibilities of utilising Eucalyptus wood for the production of high Alpha pulps have attracted the attention of Chemists and Technologists for some time past. The sulphite process has been reported to be used successfully in several countries for rayon grade pulp production from young and clean Eucalyptus wood of uniform quality.

The sulphate process has been mainly developed in Australia. A pre-requisite for the manufacture of dissolving pulp by any process from wood is that the timber should be clean, sound, (that is free from decay) and of uniform maturity and quality. Both immature and overmature woods are unsuitable for rayon grade pulp in as much as the yield and quality of pulp produced is poor (1). The method used in Australia consists essentially of an acid prehydrolysis, followed by a normal sulphate cook. Meller (2) obtained a pulp from Australian Eucalyptus containing 95.5 per cent Alpha cellulose and less than 2 per cent pentosans, by the water prehydrolysis sulphate process and a conventional three stage bleaching treatment. Viscose pulps were prepared from Eucalyptus camaldulensis by prehydrolyzing the wood for two hours with 0.06 per cent Sulphuric acid

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Purified Eucalyptus pulps were prepared using prehydrolysis sulphate and post hydrolysis cold alkali purification processes. Using prehydrolysis sulphate process unbleached pulp yields of 33-38% with pentosan content of 1.4-4.0% were obtained. Bleaching of the pulps by C|E|H|D|E|D and C|E|H|D|H gave brightness levels of 87-88.5% with a curprammonium viscosity of approximately 20 cp. The Alpha cellulose content was ranging from 94-96% and the bleached pulp yield was 36% at a pentosan content of 3 percent.

Post hydrolysis and cold alkali purification studies were made on a sulphate pulp containing 14.4% pentosan. Treatment of this pulp after chlorination with 2% Hcl (on pulp basis) at 80°C for 3 hours and incorporating a cold alkali purification stage in the multistage bleaching sequence gave a bleached pulp with 98.5% Alpha cellulose and 4.1% pentosans. The Alpha cellulose was containing about 3% pentosans. The bleached pulp yield was 37% at a brightness of 84% and viscosity 10 cp. Post hydrolysed pulps were obtained with a lower viscosity when compared to prehydrolysed sulphate pulps.

Post hydrolysis cold alkali purification process appears to be quite attractive; if suitable provision is made to recover and reuse strong alkali liquors, after separating the hemicelluloses which could be used at some other place in the pulp and paper industry. The process will be free of stream pollution problem also. High Alpha pulps prepared by both the above two processes may be considered suitable for rayon and other cellulose industries.

at 105°C followed by a two hour kraft cook. Yield of 36 per cent, brightness 84-6, 95.5 per cent Alpha cellulose and 0.07 per cent ash have been obtained. Bhat (4) obtained Viscose rayon pulp from Eucalyptus globulus using water prehydrolysis sulphate process.

In contrast to prehydrolysis of the original wood before pulping, other methods based upon post hydrolysis of the pulp with or without cold alkali purification stage have also been reported. For post hydrolysis, treatment of the unbleached pulp with agents such as 2 to 8 per cent chlorine (as chlorine water) (5-6), 0.5 to 20 per cent mineral acids (7) and 10 per cent calcium hypochlorite (8) have been reported. Libby and Tasker (9) prepared rayon grade pulp from maple wood by subjecting the pulp to treatment with 20 per cent HCl (on pulp basis) for 2 hours at 90°C. In another method the acidic treatment of pulp that utilises the acid formed in a chlorination stage has been patented (10) as

a procedure in the purification of pulp for viscose. The same principle is found in a patented procedure for the production of bamboo pulp, the treatment consists of heating the pulp for one hour in the temperature range of 90-150°C and the pH of 2. Meller (12) prepared high alpha pulps from Australian Eucalyptus using a cold alkali purification stage in the multistage bleaching sequence of a sulphate pulp. However, the bleached pulp was containing a fairly high proportion of "resistant xylan fraction".

The literature cited above (1-12) will show that considerable work has been done on the preparation of purified pulps by following both the prehydrolysis and post hydrolysis procedures. However, the information about the application of these processes on Eucalyptus can still be considered far from satisfactory, because of the number of species available and the widely different characteristics of each. For this reason we have investigated the

suitability of Eucalyptus hybrid* available in Mysore State for high Alpha pulps, following the principles of developments described above (1-12) and in United States Patents (7, 13) and by German workers (14, 15)

EXPERIMENTAL

A. Prehydrolysis Sulphate Pulping:

Billets of 4 feet length of Eucalyptus hybrid of Mysore origin, without bark, were obtained. They were then chipped in mill chipper and about 20 kgs. of the chips of fairly uniform size were collected and put in a polythene bag. For prehydrolysis and cooking studies a number of charges equivalent to 1.5 kg. (O.D.) were weighed out. A portion of the chips was subjected to proximate analysis according to TAPPI Standards after pulverising and screening. The results of the analysis are recorded in Table No. 1.

Table I. Proximate Chemical Analysis Of Eucalyptus Hybrid
(—40 + 60 fraction*

Ash, %	0.64
Silica, %	0.02
Cold water soluble, %	0.77
Hot water soluble, %	1.71
1% NaOH solubility, %	11.40
Alcohol Benzene solubility %	1.30
Water solubility after alcohol benzene leaching, %	1.16
Lignin, corrected for ash, %	30.40
Total pentosans, 1%	12.30
Alpha Cellulose, corrected for ash, %	44.22
Calculated Holocellulose, %	66.50

* All values are expressed on moisture free basis.

Alpha cellulose was isolated from chlorite holocellulose prepared according to the method of Sen Gupta, A.B., Majumdar, S.K., and MacMillan, W.G., Indian J. Appl. Chem. Vol 21, No. 3 (1958).

Prehydrolysis and sulphate pulping experiments were carried out in a Rotary Digester of 16 litre capacity and fitted with a stainless steel liner. The Digester was electrically heated and rotated at 2 r.p.m.

* It has now been identified as E. tereticornis but since it is still widely known as E. hybrid, this name is being used in this investigation.

TABLE II. Prehydrolysis of Eucalyptus Hybrid Chips

Cook No.	1	2	3	4	5
Medium	Water	Acid	Acid	Acid	Alkali
H ₂ SO ₄ /NaOH added on chips, %	—	0.4	0.4	0.2	0.3
Concentration of H ₂ SO ₄ /NaOH, gpl	..	0.8	0.8	0.4	1.0
Yield of prehydrolyzed chips, %	88.7	83.9	89.6	84.8	89.3
pH of prehydrolyzed liquor	3.5	2.6	2.6	3.1	4.1
Pentosans in prehydrolyzed chips, %	8.1	7.7	9.7	8.2	10.3
Pentosans on basis of original chips, %	7.20	6.46	8.69	6.95	9.20
Pentosans removed, on original chips, %	41.5	47.5	29.4	43.5	25.2

Constant conditions

Moisture in chips % 12; water: chips 5:1

Time to raise to max temperature Mts 90; Time at max. temperature mts 90; Max. Temp °C 160 (For cook No. 3 Max temp was 150°C).

Prehydrolysis of the chips was carried out using water, acid and alkali. After the prehydrolysis period was over, the digester was relieved to 4 kg/cm² and the waste liquor was allowed to drain from the chips. The chips were then washed free of residual acid as thoroughly as possible and allowed to condition. The yield of the prehydrolysed chips was calculated after ascertaining the moisture. A portion of the prehydrolyzed chips was analysed for pentosan content to determine the loss of pentosans during prehydrolysis. The prehydrolyzed liquor was analysed for pH. The conditions of prehydrolysis used and the results obtained are recorded in Table II. For sulphate cooking prehydrolyzed chips equivalent to 1.0 kg. (O.D.) were used. The pulps were analysed for yield, KMnO₄ number, pentosans and viscosity. The conditions used during sulphate cooking of prehydrolyzed chips and the results obtained are recorded

in Table No. III. Bleaching of the pulps was carried out using sequences C/E/H/H/D, C/E/H/D/E/D and C/E/H/D/H. All the pulps were finally subjected to acidification by SO₂. The bleaching data is given in Table No. IV. The bleached pulps were analysed for shrinkage, brightness, cuprammonium viscosity (1 per cent), Alpha cellulose, pentosans, etc. The analytical characteristics of the bleached pulps are given in Table No. v.

RESULTS AND DISCUSSION

It could be seen from the results of analysis of Eucalyptus hybrid (Table No. I that the wood is characterised by a relatively high lignin content and lower amount of pentosans. The Alpha cellulose content of 44 per cent compares favourably with that of bamboo (44.82 per cent) (16). The ash content is much less compared to bamboo, bagasse etc. and the silica content is also low.

TABLE III: Kraft Cooking Of Prehydrolyzed Chips

Cook No.	1	2	3	4	5
Chemicals as such % (NaOH + Na ₂ S)	23.0	24.0	22.0	24.0	22.0
Maximum Temp., °C	160	154	160	160	160
Unbleached yield on original chips %	38.1	32.6	37.7	35.3	39.7
KMnO ₄ No. (40 ml)	12.2	11.7	13.4	7.9	14.2
Pentosans, %	2.90	1.38	3.91	1.73	5.5
Viscosity, cP	64	30	67	42.5	70

Moisture in prehydrolysed chips % 40; Sulphidity % 21; Liq: chips 5:1; Time to get max temp. mts 60; Time at max temp. mts 150.

TABLE IV Bleaching of Prehydrolysed Sulphate Pulps

Cook Sequence No.	Chlorina- tion		I Extrac- tion		Hypochlorite				Hypochlorite				Chlorine Dioxide		II Ex- traction		Chlorine Dioxide	
	C12 added %	C12 Consumed %	Final pH	C12 added %	C12 Consumed %	Final pH	Time Mts.	C12 added %	C12 Consumed %	Final pH	Time Mts.	C12 added %	C12 Consumed %	Final pH	Final pH	C102 added %	C102 consumed %	Final pH
1. C/E/H/H/ D/SO2	3.0	2.93	11.1	1.5	1.12	11.1	120	0.5	0.28	9.8	60	0.25	0.20	6.2	..	..	..	..
3. C/E/H/D/ E/D/SO2	2.5	2.49	10.8	2.0	1.20	10.8	120	..	..	..	..	0.6	0.32	6.5	11.0	0.30	1.16	6.6
4. C/E/H/D/ H/SO2	2.0	1.96	11.1	1.6	1.10	10.3	120	0.5	0.18	10.5	180	0.6	0.36	5.4	..	..	..	..
5. C/E/H/D/ E/D/SO2	3.0	2.90	10.8	2.0	1.26	10.8	120	..	..	..	..	0.6	0.33	6.5	11.0	0.30	0.16	6.6

Chlorination		I Extraction		Sodium Hypochlorite		Chlorine Dioxide	
Consistency %	: 3	Consistency %	: 5	Consistency %	: 5	Consistency %	: 5
Temperature °C	: 23	Temp. °C	: 60	Temperature, °C	: 40	Temperature, °C	: 70
Time, Mts.	: 60	Time, Mts.	: 90			Time, Mts.	: 120
		NaOH added %	: 2				
		II Extraction		SO2 Treatment (for all pulps)			
		Consistency %	: 5				
		Temperature °C	: 60			SO2 added %	: 0.5
		Time, Mts.	: 60			Time, Mts.	: 15
		NaOH added, %	: 0.5				

/ Stroke denotes a washing step.

TABLE V. Chemical Characteristics of Prehydrolyzed Sulphate Bleached Pulps

Cook No.	1	3	4	5
Shrinkage during bleaching %	3.8	4.0	2.4	3.7
Yield of bleached pulp on chips, %	36.6	36.2	34.4	38.2
Brightness, %	85.0	88.5	88.5	87.5
Tappi Viscosity, cP	21.0	21.5	14.0	22.5
Total C12 consumed, %	4.83	4.89	4.14	5.38
S ₁₀ , %	4.72	6.42	6.89	6.67
S ₁₈ , %	3.18	4.35	3.93	4.76
R, %	96.0	94.90	94.73	96.50
S ₁₀ — S ₁₈ %	1.54	2.07	2.96	1.91
7.14% NaOH solubility %	6.36	8.08	7.04	8.01
Pentosans, %	2.83	3.70	1.80	5.31
Resistant pentosans, %	1.42	1.50	0.95	1.85
Ash, %	0.15	0.17	—	0.22
Silica, %	0.052	0.060	—	0.048
Et OH: C ₆ H ₆ solubility, % (1:2)	0.30	0.32	0.28	0.54

From the results for the removal of pentosans during prehydrolysis (Table No. II) it could be seen that the temperature has greater effect on the removal of pentosans than the acid concentration. In cook No. 3 when the temperature of prehydrolysis was reduced to 150°C, the extent of removal of pentosans was much less compared to even that of water prehydrolysed chips. The acid concentration influences the results of prehydrolysis to a certain extent when the temperature used was 160°C. The real effect of the acid concentration during prehydrolysis was evident after sulphate pulping of the prehydrolysed chips. This could be seen from the comparison of the results of unbleached pulps for cook No. 2 and 4. In cook No. 2, even when the cooking temperature was 154°C a more degraded pulp with low yield was obtained, which could be ascribed to probably severe conditions of prehydrolysis.

Alkaline prehydrolysis can also be adopted, but in the present case the pentosan content in the unbleached pulp was found relatively high. It may be possible to reduce the pentosan content further either by reducing the amount of alkali on chips or preferably by increasing the temperature. Where both the prehydrolysis and sulphate cooking are carried out in the same digester (batch), alkaline prehydrolysis has a practical advantage. The sequence of operation in such a digester will be prehydrolysis — sulphate — prehydrolysis — sulphate and so on which indicates that the prehydrolysis liquor quite likely will be contaminated with small amounts of alkali left from the previous

cook inside the digester shell, pumps, heater etc. In case of water prehydrolysis this will naturally raise the pH, and to neutralize this alkalinity some acid will be required. If alkaline prehydrolysis can be carried out with the reasonable amount of alkali, this neutralization step can be avoided.

The effect of the medium of prehydrolysis (under other constant conditions) on the effectiveness of removal of pentosans during prehydrolysis and cooking is shown in Fig. No. I. It could be seen from this figure that the acid prehydrolysis is better over water or alkaline hydrolysis. Probably acid prehydrolysis has the greater effect of producing degraded hemicelluloses (pentosans) with reducing end groups which are further degraded by the peeling off reaction and goes into solution during sulphate cooking.

The results for the unbleached pulps (Table No. III) indicate that pulps in satisfactory yield, viscosity, pentosans and permanganate number were obtained. Further the pulps were easily bleached to 85-88 per cent brightness by a five or six stage bleaching sequence. The fact that the unbleached pulp of cook No. 4 could be bleached to 88.5 per cent brightness by the sequence C/E/H/D/H implies that a simple bleaching sequence would suffice to get high brightness, provided brightness increment at each stage of treatment is properly controlled by correct proportioning of the bleaching chemicals. The result of the analysis of bleached pulps indicate that pulps of good purity have been obtained using both the water and acid prehydrolysis. The chemical characteristics of

most of the pulps meet the specifications for those normally required in rayon pulps (17) (Table No. VI), except for ash and silica. However, these can be reduced to acceptable limit by vortex cleaning and using deionized water as a final stage in treatment.

B. Post Hydrolysis and Cold Alkali Purification of Sulphate Pulps

For carrying out studies on post hydrolysis and cold alkali purification, sulphate pulps were produced under two different conditions of pulping. In one case a prewashing stage for the chips before the actual sulphate cooking was included. However, the final characteristics of the two pulps, prepared by a straight sulphate process and with the prewashing of the chips did not differ much (Table No. VII). The pulp of Cook No. 6 (Table No. VII) was used for carrying out the preliminary experiments on post hydrolysis, and the pulp of Cook No. 7 (Table No. VII) was used for post hydrolysis followed by cold alkali purification of pulps.

Preliminary post hydrolysis studies on the sulphate pulp (Cook No. 6) were carried out after first chlorinating it and then using in one case the hydrochloric acid produced during chlorination, and in others by adding different levels of HCl in order to raise the acid concentration. No washing was performed in between the chlorination

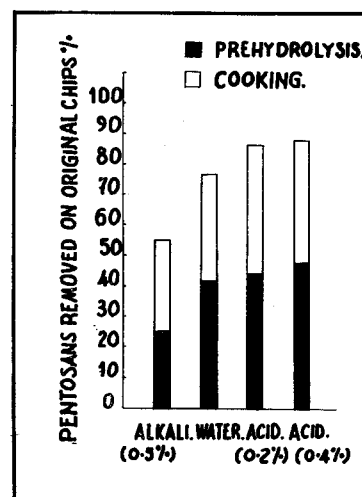


FIG. NO.1

Fig. 1 : Effect of the medium of prehydrolysis on the removal of pentosans during prehydrolysis and cooking.

TABLE VI. Specifications For Dissolving Pulp
(% on Dry basis)

Alpha Cellulose	..	Greater than	90
Beta Cellulose	..	Less than	4
Gama Cellulose	..	Less than	5
Extractibles	..	Less than	0.5
Ash	..	Less than	0.1
Brightness (Higgins)	..	Greater than	85
Viscosity (Tappi)cP	..	Around	30
Copper number	..	Less than	2
Ash Constituents :			
Iron	..	Less than	0.0010
Copper	..	Less than	0.0005
Calcium	..	Less than	0.03
Magnesium	..	Less than	0.005
Silica	..	Less than	0.01
Manganese	..	Less than	0.0001

TABLE VII. Sulphate Pulps from Eucalyptus Hybrid

Cook No.	6	7
Prewashing of the Chips:		
Water : Chips	5:1	..
Maximum Temperature, °C	110	..
Time to get max. temp. Mts.	30	..
Time at Max. temperature, Mts.	30	..
Sulphate Cooking +		
Chemicals % (NaOH + Na ₂ S)	24	25
Liquor : Chips	4.1 : 1	4.0 : 1
Maximum Temperature, °C*	170	166
Time to get max. temp. Mts.	60	90
Time at max. temp., Mts.	90	90
Sulfidity, %	24	24
Unbleached yield, %	43.3	44.1
KMnO ₄ No (40 ml)	11.5	10.0
Pentosans %	14.7	14.4
Viscosity, cP	33	30

+ The water of the treated chips was drained off before pulping.

* The temperature at 170 °C was held for 10 mts. only and then cooking was carried out at 164 °C for another 80 minutes.

TABLE VIII. Effect of Acid Addition during Post Hydrolysis On the Shrinkage and Pentosan Content of Alkali Extracted Pulp.

Expt. No.	1	2	3	4
Total HCl on pulp,* %	..	9.74	19.18	24.64
Concentration of acid, g/l	..	3.00	5.94	7.63
Shrinkage, %	1.3	1.5	2.1	2.8
Pentosans, %	14.8	14.7	14.5	14.3

* Includes the acid generated during Chlorination.

and post hydrolysis. In one case hydrochloric acid as high as 24.6 per cent was applied to pulp and all the pulps after alkali extraction were analysed for shrinkage and pentosan content. The constant conditions of chlorination, post hydrolysis, and alkali extraction are given below :

Chlorination :

Chlorine used, 3.0%
Pulp Consistency, 3.0%
Temperature, 30°C
Time, 45 mts.
Chlorine consumed, 2.91%
HCl produced on pulp basis, 0.613 g.
HCl concentration, 0.48 g/litre

Post hydrolysis :

Pulp consistency, 3.0%
Temperature, 75°C
Time taken from raising temperature from 30-75°C, 30 mts.
Time at 75°C, 60 mts.

Alkali Extraction :

NaOH on pulp basis, 2.6%
Plp consistency, 5.0%
Temperature, 70°C
Time, 90 mts.
pH, 11.6—11.7

Only during post hydrolysis the amount of acid added on pulp was varied and its effect on the pentosan content of the pulps was observed. The results are given in Table No. VIII.

It could be seen from this set of experiments that the pentosan content was practically unchanged even by adding acid as high as 24.0% (on pulp weight). It was felt that the acid concentration may be equally or even more important as the amount of acid added and for this reason in the next series of experiments the chlorinated pulp was de-watered to a high consistency. Except for the different amounts of acid added during post hydrolysis, all other conditions were maintained constant. The conditions used during post hydrolysis and alkali extraction are given below. Chlorination was carried out under similar conditions as given earlier. The post hydrolysis and alkali extraction conditions are given below :

Post hydrolysis :

Pulp consistency 10%
Temperature 80°C
Time taken to raise temperature to 80°C 30 mts.
Time at 80°C 180 mts.
Caustic Extraction :
NaOH on pulp basis 2.6%
Pulp consistency 5%
Temperature 75°C
Time 90 mts.
pH 11.6—11.7

The results given in Table No. IX show that reduction in pentosan content have been obtained to a certain extent by using high acid concentrations, but still the level of pentosan in pulps was much above the limits of tolerance for purified pulps. Moreover, using drastic conditions of hydrolysis, lowers the viscosity of the pulps appreciably and also the yield, which are undesirable.

It was concluded from this study that the post hydrolysis of pulps with conventional alkali extraction stage will not be helpful in lowering the pentosan content to acceptable limits, required for purified pulps. Another line of approach was then investigated in which the hot extraction stage was replaced by a cold alkali purification stage. It is well established that by using cold alkali purification of sulphate pulps, appreciable lowering of the pentosan content can be obtained. Meller (12) obtained a bleached pulp from Australian Eucalyptus sulphate pulp by using a cold alkali purification stage in the bleaching sequence, with the alpha cellulose content of 95 to 96% and 6 to 8 per cent xylan. The same principle has been applied here in which a cold alkali purification stage was included in the multi-stage bleaching sequence of sulphate pulp. For comparison, cold alkali purification was also carried out of post hydrolyzed pulps.

The sequence C/E/H/D/A/H was used during the bleaching process with the only addition that a post hydrolysis step was introduced after the chlorination was over. The pulp was first chlorinated and then dewatered to a consistency of 10%. It was then subjected to post hydrolysis as such (Expt No. 9) and also after adding 2% and 4% HCl (Expt Nos. 10 & 11) at 80°C for 3 hours. Simultaneously a control experiment (Expt No. 8 Table No. X) was carried out where the chlorinated pulp was thoroughly washed and subjected to the same purification stages as of other pulps. All other conditions used during the various and purification stages are given below.

Chlorination :

Chlorine added on
basis of pulp, 2.6%
Pulp consistency, 3%
Temperature 30°C
Time 45 mts.

TABLE IX. Effect of Acid Concentration during Post Hydrolysis on the Final Properties of Alkali Extracted Pulps.

Expt. No.	5	6	7
Total HCl on pulp* weight, %	7.61	15.22	22.83
Acid concentration, g/l	8.45	16.91	25.36
Shrinkage, %	4.7	6.6	7.1
Yield of alkali extracted pulp on chips, %	41.3	41.4	40.2
Pentosans, %	13.35	12.15	12.10
Pentosans basis original pulp, %	12.72	11.35	11.24
% reduction in pentosan content	13.5	22.8	23.5
Viscosity, cP	10	7	7

* Includes the acid left after dewatering the chlorinated pulp.

TABLE X. Posthydrolysis of the Chlorinated Pulp

Expt. No.	8	9	10	11
HCl added on pulp weight %	Nil	Nil	2	4
	Pulp thoroughly washed after chlorination.	Pulp simply dewatered		

TABLE XI. Characteristics of the Bleached Cold Alkali Purified Pulps.

Expt. No.	8	9	10	11
Shrinkage during bleaching, %	13.0	15.0	16.0	16.0
Yield of pulp on chips, %	38.4	37.5	37.0	37.0
Brightness, %	85	84	84	84.5
Viscosity, cP	19	15	10	10
Alpha cellulose, %	97.30	97.62	98.50	98.56
Pentosans in Alpha, %	4.21	4.33	2.82	3.08
Alpha cellulose, pentosan free, %	93.20	93.40	95.72	95.53
Pentosans in Pulp, %	6.18	6.05	4.10	3.74
7.14% NaOH solubility, %	7.16	6.53	6.96	7.14
Ash, %	0.17	..	0.18	..
Silica	0.062	..	0.058	..
Alcohol : benzene solubility % (1 : 2)	0.41	..	0.40	..

Post hydrolysis :

Pulp consistency	10%
Temperature,	80°C
Time	180 mts.

Alkali Extraction :

NaOH added on basis of pulp	1.5%
Pulp consistency	5%
Temperature	70°C
Time	90 mts.
Final pH	11.4—11.5
Sodium Hypochlorite Stage	

Hypochlorite Chlorine added	1%
Pulp consistency	5%
Temperature	40°C
Chlorine consumed	0.8 to 0.84%
Final pH	11.4—11.5

Chlorine Dioxide :

ClO ₂ used on basis of pulp	0.4%
Pulp consistency	6%
Temperature	70°C
Time	90 mts.
ClO ₂ consumed	0.32%
Final pH	5.4

Cold Alkali :

Pulp consistency,	2%
Temperature	29°C
Sulphur Dioxide :	
SO ₂ on basis of pulp	0.6%
Time	30 mts.
Final pH	5.3

The results in Table No. XI will show that the pentosan content in a cold alkali purified pulp (Expt. No. 8) is only 6.18% compared to 14% in the fully bleached but unextracted (cold alkali) pulp; an appreciable reduction. The pentosan content was further reduced to 4.10% and 3.74% respectively (Expt. Nos. 10 and 11) by giving the pulps treatment with 2% and 4% HCl after the chlorination. One of the advantages of the post hydrolysis stage is that the Alpha cellulose level was increased and the amount of resistant pentosans reduced. However, the post hydrolyzed pulps were obtained with a lower viscosity.

It could be inferred from the results given in Table No. XI that pulps of high purity with relatively low pentosan content have been obtained from a sulphate pulp by post hydrolysis and a cold alkali purification stage in the multistage bleaching sequence. This method of making high Alpha pulp offers some advantages over prehydrolyzed sulphate pulps. Outwardly because of higher amounts of sodium hypochlorite used in cold alkali purification may make the process

unattractive and uneconomical, but with the type of machinery and equipment now available it is possible to recover these strong alkaline liquors, and after the proper recovery of the hemicellulose, could be recycled into the process. The recovery of hemicelluloses (18) which would be almost in the form of pure compounds, would serve as an useful by-product and at the same time will eliminate the stream pollution problem, which is a disadvantage with the prehydrolysis sulphate process.

CONCLUSIONS

1. High Alpha pulps suitable for rayon and other cellulose industries could be prepared from Eucalyptus hybrid using prehydrolysis-sulphate and post hydrolysis cold alkali purification process.
2. By water and acid prehydrolysis bleached pulps in yields of 34-36%, Alpha cellulose 95-96%, pentosan content 1.8-3.7% could be prepared by following any of the conditions used in Cook Nos. 1, 3 and 4 (Table Nos. II and III depending on the end use of the product.
3. Post hydrolysis and cold alkali purification process appears to be quite attractive, provided efficient recovery for reuse is made of the strong alkaline solutions and hemicelluloses (xylose) obtained as a byproduct.
4. The recovered hemicelluloses could be used as beater additives in commercial paper making.

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