

Influence of Process Parameters in Pre-Bleaching Stages of "Dandrocalamus Strictus" Chemical Pulp on Bleach Plant Waste Water Quality.

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ABSTRACT

India is the leader in using Bamboo which is the non-wood fibre for paper making. Dandrocalamus strictus is more widely available in southern parts of the country. Indian paper industry is still dependent on bamboo as its rawmaterial. The industry is under environmental pressure to reduce its waste generation. Pulp bleaching is one of the main source of pollution load in its waste water. Conventional prebleaching stages generate maximum pollution load. Laboratory studies, on the "Influence of process parameters in prebleaching stages of Bamboo Chemical pulp on bleach plant waste water quality" has been conducted. The effects of lignin content in pulp and black liquor carry over to the pulp bleaching on waste water quality has been studied. The results show that the BOD and Colour Content are linearly dependent on Kappa No. and the higher the washing losses in pulp, higher would be the pollution load along within the increased consumption of bleaching chemicals.

INTRODUCTION

Straws, Bagasse and Bamboo are the leading fibres being used from quantity stand point, but many other non-wood plant fibres are being used for speciality pulps. Pulp production in many countries is based on 100% non-wood fibres and some 25 countries depend on non-wood plant fibres for more than 50% of pulp production, with China and India being the leaders. For straw pulp, China is leading producer with 85% of the world's capacity, whereas India is the leader for Bamboo pulp and Mexico for Bagasse pulp. Table-I and II shows the world non-wood plant pulp production.

India, sucessfully developed technology for Bamboo pulping more than 100 years age, the earliest pulping process used rotary type digesters with two stage or fractional cooking. Modern methods based on vertical stationary digesters with forced circulation using "KRAFT PROCESS" are in use in almost all large pulp mills. In India two species of Bamboo, Dendrocalamus strictus and Bambusa arundinacea are in common use. In Southern India, Dandrocalamus strictus is largely available. Bamboo is a mix of long,

medium and short fibres. Table-III shows the state-wise supplies of Bamboo to Paper mills by Govt. Forest Departments. (1).

NEED FOR WASTE WATER POLLUTION LOAD REDUCTION IN BAMBOO BASED PULP AND PAPER MILLS

Pulping, bleaching and paper making are the three major waste water sources for the paper industry. It is well known that pulp bleaching process produces classic components which causes highest pollution loads such as colour, COD, BOD and AOX. The Chlorinated organics generated during the Bleaching process, not only exert oxygen demand, but also contributes effluent colour and toxicity, which are reported to be responsible for the mutagenicity and Carcinogenicity of the effluent (2). Though steps are being taken by many countries to implement environmentally friendly techniques like elemental Chlorine Free (ECF) and Total Chlorine Free (TCF) bleaching sequences, immediate implementation of

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COUNTRY	CAPACITY 10 ³ MT
CHINA ..	10,000
INDIA ..	2,100
MEXICO ..	500
USA ..	400
PERU ..	340
OTHER ..	3,660
TOTAL ..	17,000

such technologies in Indian Context requires major modifications, investments and time. Hence, the immediate option would be to reduce the pollution load from pulp bleaching by minimising the carry over of lignin to pulp bleaching in the existing bleaching system of CEHH.

It is reported that in pulp bleaching, Chlorination and Alkali extraction stages generate maximum pollution in waste water (3&4). The Chloro lignin content in the waste water is dependent on lignin content in the unbleached pulp. To understand the relation-ship of pollution loads such as BOD₅ and Colour in waste waters generated in prebleaching of Dandro calamus strictus (Bamboo) pulp of varied Kappa Number, Laboratory prebleaching experiments are conducted (5).

S. STATE No.	Bamboo Supply by Forest Dept 10 ³ MT	Bamboo Consumed by Paper Mills 10 ³ MT
1. West Bengal ..	--	--
2. Uttar Pradesh ..	--	20.7
3. Karnataka	154.1	91.2
4. Tamil Nadu	7.3	4.8
5. Maharastra	201.2	226.3
6. Andhra Pradesh ..	168.3	237.7
7. Orissa ..	201.6	128.2
8. Punjab ..	--	--
9. Haryana ..	--	105.4
10. Himachal ..	--	--
11. Gujarat ..	--	--
12. Madhya Pradesh..	130.8	424.9
13. Nagaland ..	13.0	7.6
14. Assam ..	46.2	295.8
15. Kerala ..	--	81.0

Raw material	Production 10 ³ PA
Straw (Wheat, Rice etc) ..	9,100
Bagasse ..	2,900
Bamboo ..	1,800
Reeds ..	1,600
Cotton Linter ..	400
MIS (Grass, Hemp, Jute etc) ..	1,200

* Source : Joint Committee of the Paper Industry in India & Asian Paper '96.

LABORATORY EXPERIMENTS

To study the influence of Process Parameters in pre-bleaching stages of Bamboo Chemical pulp on bleach plant waste water quality, studies has been carried out in two stages.

I. Lignin content of the unbleached pulp

To find out how the pollutant profile of bleach plant effluent is affected by the Kappa Number of the outgoing pulp a series of Bamboo kraft pulps of varied Kappa No. were laboratory pulped and bleached with conventional Laboratory techniques using the sequence of CEHH.

II. Influence of washing of Unbleached Bamboo pulp on prebleaching Waste Water Quality

The thoroughness with which unbleached pulp is washed has a bearing on the chemical consumption in the prebleaching stage and also the properties of the effluents.

LIGNIN CONTENT IN UNBLEACHED BAMBOO PULP

Chips of Dandracalamus strictus are pulped in Laboratory digester at varies percentages (12-17%) of active alkali as Na₂O on Chips at standard pulping conditions to obtain different pulps of varied Kappa Numbers of 22 to 40. The unbleached bamboo pulps samples of 100 gms (BDW) of varied Kappa No. were bleached in C.E.H.H. System in the Laboratory under batch conditions to obtain a final pulp brightness of 780GE. The bleaching conditions are shown in Table-IV. The chlorine addition varied with Kappa No. The Chlorinated pulp is filtered and washed with one litre of fresh water and filtered, pressed to 10% consistency. The filtrate obtained is measured for volume and analysed for BOD₅ and Colour.

STATES	Consistency %	% Cl ₂ on BDW of pulp	Time Min	NaOH% on BDW of pulp	Temp °C
1. CHLORINATION ..	3	7	30	--	30
2. EXTRACTION ..	10	--	60	2.5	65
3. HYPO-I ..	10	3	150	0.5	30
4. HYPO-II ..	10	1	150	0.2	30

After the pulp alkali is extracted, pulp is filtered, washed with one litre of fresh water and pressed to 10% consistency. The filtrate volume is measured and analysed for BOD₅ and Colour.

INFLUENCE OF WASHING OF UNBLEACHED BAMBOO PULP ON PREBLEACHING WASTE WATER QUALITY.

To study, the extent to which the unbleached pulp has been washed and its effect on prebleaching waste water quality, Bamboo unbleached pulp of Kappa No. 28 has been used.

In the laboratory, the above mentioned pulp sample is fully washed, so that there is no residual black liquor in the pulp. To each sample of 100 gms (BDW) pulp, calculated amount of black liquor is added to obtain unwashed pulps containing 5, 10, 15, 20 and 25 Kg. Na₂SO₄/tonne of pulp.

Then the pulp is chlorinated and alkali extracted as mentioned in above section. In Chlorination stage, Chlorine addition is so adjusted such that after chlorination, the residual chlorine content in the filtrate is 20 mg/l. The pulp washings are done as mentioned in above section. The volume of the filtrates of chlorination and alkali extraction were measured and analysed for BOD₅ and colour.

OBSERVATIONS

Influence of lignin content in pulp

Unbleached bamboo pulps of Kappa No. 22 to 40 were prebleached (C+E) in the laboratory. Kappa Number is a measure of lignin content in pulp. The percentage of lignin content approximately equal to Kappa No. X 0.15. The volume of waste water generated at chlorination and alkali extraction stages along with its colour and BOD₅ are shown in Table-V. From the table, it can be seen that for Kappa No. of 25, the colour content was 150 Kg. Pt. Co. per tonne of unbleached bamboo pulp and BOD₅ load was 17.3 Kg per tonne of unbleached Bamboo pulp.

As the unbleached Kappa No. increased, the BOD₅ and colour in the waste water increased. Graphs of Kappa No. Vs. BOD₅ and Colour are shown in Fig. 1&2 respectively. It can be seen that BOD and Colour are linearly dependent on Kappa No. of the pulp, i.e. they are directly dependent on the lignin content in the unbleached bamboo pulp. From the figures, it can be seen that for every one unit reduction in Kappa No. in the bamboo pulp, there was a reduction in BOD₅ by 0.2 kg/T of U.B. pulp and colour by 5.2 Kg. Pt. Co./T of U.B. pulp respectively.

S.No.	Kappa No.	Quantity of pulp taken for bleaching gms	Chlorination Waste water Vol. Lts	Extraction Waste water Vol. Lts.	Total BOD ₅ Kg/T of U.B. pulp	Total Colour Kg.Pt.Co/T of U.B. pulp
1.	22	100	6.9	7.0	16.7	130
2.	25	100	7.0	6.8	17.3	150
3.	28	100	6.8	7.0	18.3	160
4.	30	100	7.2	7.2	18.7	180
5.	35	100	7.0	6.9	19.3	200
6.	36	100	6.9	7.0	19.4	212
7.	40	100	7.1	7.2	20.3	225

Fig.1. Effect of Bamboo Pulp Kappa No. on BOD₅ of The Prebleaching Stage Waste Water.

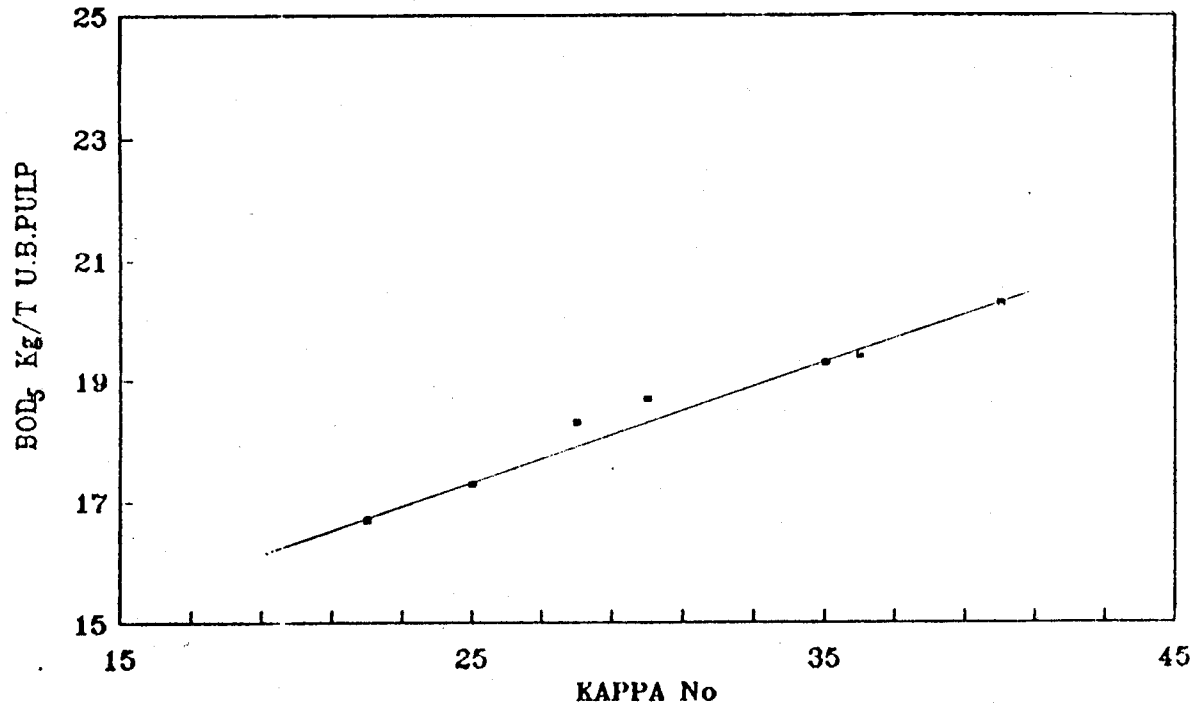


Fig.2. Effect of Bamboo Pulp Kappa No. on Colour of The Prebleaching Stage Waste Water.

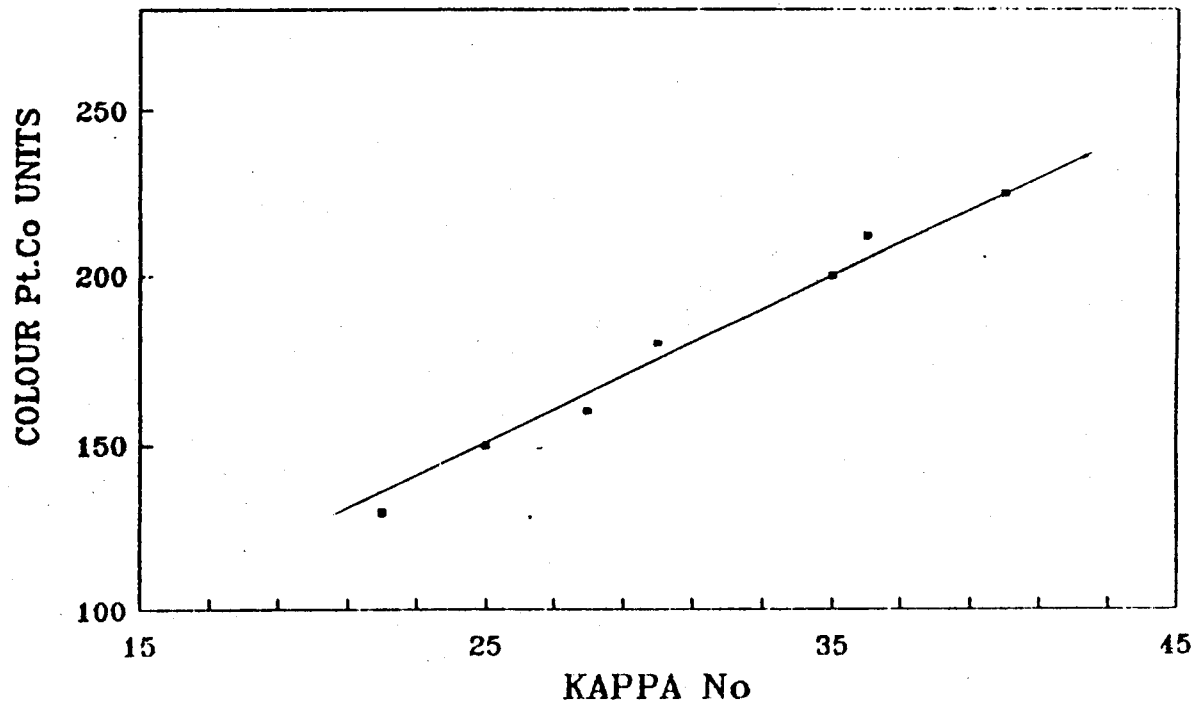


Fig.3. The Effect of Chemical Loss With Bamboo Pulp on BOD₅ of The Prebleaching Waste Water.

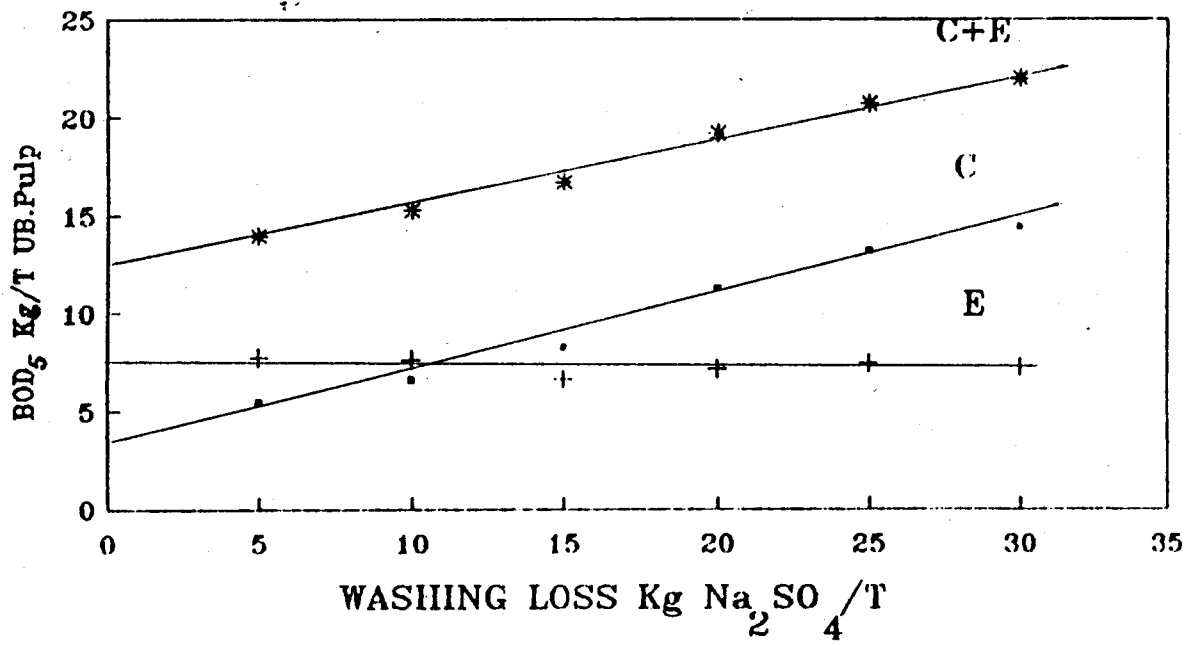


Fig.4. The Effect of Chemical Loss With Bamboo Pulp on Colour of The Prebleaching Waste Water.

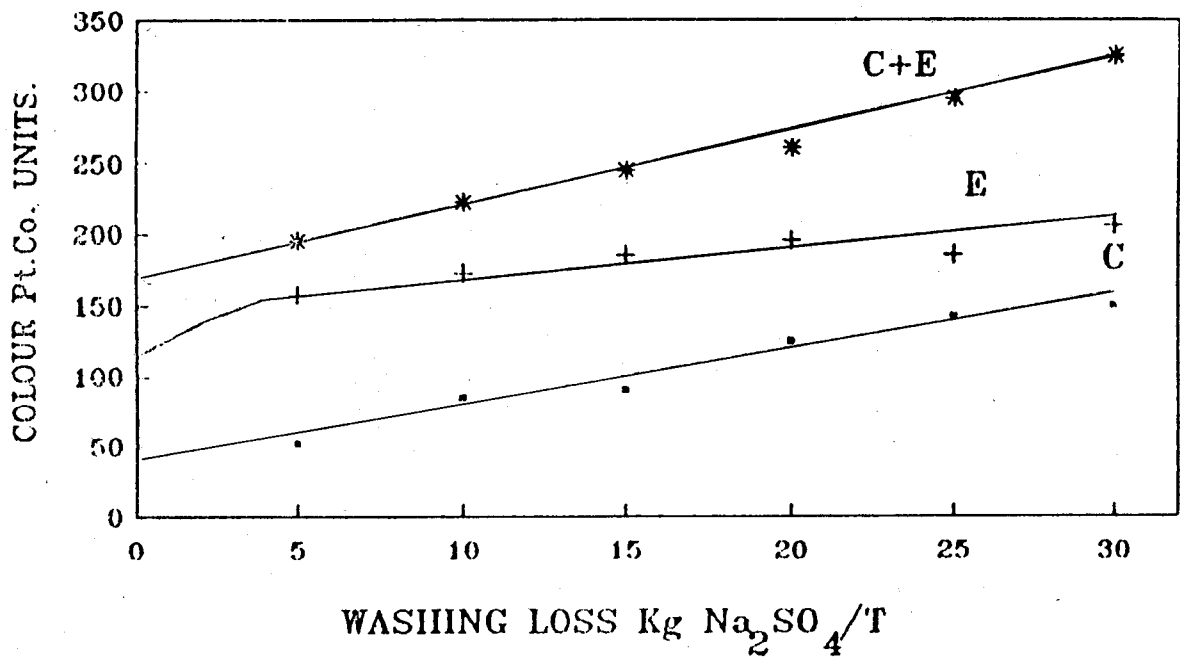


Table-VI
Effect of Unbleached Bamboo Pulp Washing on The Quality of Waste Water.

Sl. No.	Washing loss KgNa ₂ SO ₄ /T	CHLORINATION STAGE (C)			EXTRACTION STAGE (E)			C + E	
		Waste water Vol.Lts.	BOD ₅ Kg/T	Colour Kg.Pt. Co./T	Waste water Vol.Lts.	BOD ₅ Kg/T	Colour Kg.Pt. Co./T	BOD ₅ Kg/T	Colour Kg.Pt. Co./T
1.	5	7	5.5	52.5	7.1	7.8	157.5	14	195
2.	10	7.2	6.7	85	7	7.7	172.5	15.3	222.5
3.	15	6.8	8.3	90	7.2	6.7	185	16.7	245
4.	20	7	11.3	125	6.9	7.2	195	19.2	260
5.	25	7.2	13.2	142.5	7	7.5	185	20.7	295
6.	30	7.1	14.5	150	7.1	7.3	205	22	325

INFLUENCE OF WASHING OF UNBLEACHED BAMBOO PULP ON PREBLEACHING WASTE WATER QUALITY

Unbleached pulp of Bamboo containing 5 to 30 Kgs. Na₂SO₄ per tonne of pulp were prebleached (C+E). Volume of waste water generated, BOD₅ and Colour content of waste water generated for each pulp is shown Table-VI. Graphs are plotted for washing losses Vs. BOD₅ and another for washing losses Vs. Colour, which are shown in Fig. 3&4 respectively. From the graphs, it can be seen that BOD in Chlorination stage waste water increased with increase in washing losses, but from the extraction stage waste water, it was unaffected. The chlorine requirement also increased with washing losses, to give a level of residual chlorine of 20 mg/l. At chlorination stage, for each Kg. of Na₂SO₄ per tonne of pulp, one kg of chlorine addition was required. It can be further observed that the discharge of colour from both the chlorination and alkali extraction stages increased with the washing losses. When the washing losses rose from 0 to 30 kg of Na₂SO₄/T of pulp, the waste water (C+E) discharge of BOD₅ increased from 155 to 325 Kg Pt. Co. per tonne of pulp.

From the above results, it can be seen that, higher the washing losses in the pulp, higher would be the pollutant load in the waste waters from prebleaching stages and there would be proportionate increase in the bleaching chemicals consumption.

CONCLUSION

Large integrated pulp and paper mills in India use mostly forest produce such as bamboo. These mills are under environmental pressures to reduce its

waste generation. In Paper Industry, pulp bleaching with conventional chemicals generate maximum pollutants especially, it occurs in prebleaching stages where chlorination and alkali extractions are done. The Laboratory studies highlights that the during the prebleaching of bamboo pulp, the BOD and colour content in waste water were linearly dependent on the lignin content of the unbleached bamboo pulp. It also highlights that the presence of black liquor in pulp, increases the BOD and colour load in waste water and also increases the chemical requirements for the pulp bleaching. Till the cleaner technologies are adopted in pulp bleaching in India, it is advisable to pulp the raw material to a lower Kappa No. as far as possible and minimise carry over of the black liquor to pulp bleaching stages. By which considerable pollution load generation in pulp bleaching stages waste water can be reduced.

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