Bleaching Of Agro Residue Pulp And Environmental Issue

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INTRODUCTION

The conventional bleaching operational sequence as followed by large wood based pulp and paper mills and medium size agro base pulp and paper mills in India involves chlorination and calcium Hypochlorite.

The agro base mills in the absence of a viable chemical recovery system and prevailing high cost of alkali, use less chemical at cooking stage which in turn results in excess chlorine consumption at bleaching.

It was proved beyond doubt that the spent bleach liquors discharged from the bleaching process contain persistent, chlorinated organic compounds which may have large scale, detrimental effects on environment.

The experience of number of agro based pulp and paper mills show that there are several process cleaner technologies which could be implemented. The impact of introducing cleaner technologies has a cascading effect on other sections.

Better raw materials preparation, low kappa number pulp availabilities and efficient pulp washing all have its beneficial effect in bleaching operation. These measures ultimately contribute to reduction in environmental costs due to reduction in end-of pipe pollution control requirement.

OXYGEN-ALKALI DELIGNIFICATION-PRELUDE TO CHLORINE FREE BLEACHING

-O- A pulping and extended bleaching has considered to be cost effective technology in reducing the environmental discharges associated with chemical pulp bleaching. The kappa number after the extended delignification can be reduced to almost half with the consequent proportionate reductions in pollution load in the subsequent bleaching.

OXYGEN-ALKALI COOKING PROCESS FOLLOWED BY SINGLE STAGE OR TWO STAGES PEROXIDE-HYPOCHLORITE BLEACHING

A novel process developed by KAWASAKI HEAVY INDUSTRIES LIMITED, JAPAN is considered to be a state of art technology which is mainly standardised for agro-residue raw material (1).

Comparative pulping and bleaching parameters of batch type, pandia continuous type and O-A process using bagasse straw pulps are as presented in **TABLE-1** with O-A process and subsequent bleaching with H_2O_2 and mild Sodium Hypochlorite in two stages, the following improvements in comparison with conventional nonwood pulping and bleaching can be expected of-

(1) High brightness pulp 80% ISO. suitable for writing and printing paper.

(2) Low consumption of Chemicals which will be about a half of Conventional Soda process.

(3) Cooking and bleaching operations at low temperature and pressure, with shortened bleaching process, will result in very low steam and water consumption.

(4) Low pollution problem:

Low chemical consumption and recycling cooking solution will result in very low BOD and COD. load in waste water going to sewer.

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The agro residue base mills in future will have to go for simplified oxygen-alkali delignification and extended bleaching to cope up with stringent Environmental regulations.

HYDROGEN PEROXIDE IN THE ALKALI EXTRACTION STAGE OF C-EP-H BLEACHING VIS-A-VIS ONLY C-E-H SEQUENCE

Chloro-lignins formed in chlorination stage of the bleaching process are dissolved and extracted in alkali extractions stage (E-Stage). The retention period in E-Stage is considered a "dead period" as the colour is darkened without imparting brightness.

By introducing Hydrogen Peroxide in alkaline extraction stage, the so called dead period can be utilised to improve brightness of the pulp instead of darkening. Washed pulp after E-P stage is easily bleachable further with calcium Hypo Chlorite either in single or in two stages, H or HH

- enhances the brightness to produce semi bleached pulp.
- enhances the colour/brightness stability of pulp.
- Reduces the colour and BOD & COD of the effluent.

Agro base pulps with comparatively less lignin relative to wood pulp can be easily bleached to 4 ISO units more using 0.5% (100% basis) of H_2O_2 in C-EP-H Stages.

Introduction of H_2O_2 in E-stage of C-E-H sequence undoubtedly reduces C-E/P K.No. with the consequent less hypo demand.

Available literatures also confirm the utility value of H_2O_2 in small amounts in improving the efficiencies of bleaching in the case of bamboo, mixed hardwoods and bagasse. (2), (3) & (4). Hindustan Newsprint Limited has successfully replaced the Hypochlorite stage of CH bleaching sequence of chemical pulp by Hydrogen Peroxide (CH to CP) (5). This had resulted in saving of 95% of the chlorine consumed in Hypo stage in the bleaching of Chemi-mechanical and Chemical pulps.

It is expected that the generation of toxic chlorinated organic compounds is also reduced to the extent with the reduction of hypochlorite.

HYDROGEN PEROXIDE RE-INFORCED ALKALI EXTRACTION OF AGRO RESIDUE PULPS-AN EXPERIENCE IN A 65 TPD AGRO BASED PULP AND PAPER MILLS

Soda chemical pulp or soda-Anthra Quinone chemical pulp produced from a batch pulping process is continuously bleached by conventional C-E-H sequence with intermediate bleach washer after each stage.

The bleach plant in the bagasse, bagasse/grass/ straw based mill is a standard full fledged system of operation, strictly adhering to standard laid down parameters. The mill has also the provision of chlorine dispersor-static mixer and KMW mixer combination in their chlorination system. Lacking in such mills are the basic instrumentation part like magnetic flow meter and consistency regulator with ORP system in Chlorination and tower level recorders.

In the earlier practiced C-E-H sequential operation, bagasse pulp of 27-30 kappa number was bleached using 8-9% elemental chlorine in C-Stage and 8% clacium Hypo chlorite in H-Stage. The percentage is mainly expressed on bleached pulp produced but not based on unbleached pulp.The shrinkage after bleaching in the plant was 12-13%.

Based on extensive laboratory trials (6), the agro pulp & paper mill had switched over to Hydrogen Peroxide bleaching in the alkaline extraction stage (E-Stage) of the C-E-H system.

The Hydrogen peroxide had to be introduced in C-EP-H sequence of operation mainly-

- to control the reversion of brightness of bleached pulp giving good stability.
- to reduce the drastic oxidative effect of Hypochlorite on cellulose and in turn reduce overall chlorine consumption.
- to minimize formation of chlorinated organic compounds with lesser Hypochlorite.

Table-1

Comparative Table of Non Wood Chemical Pulp, Product of 80% ISO brightness

Process	Batch Type Process	Pandia Type Process	O.A. Process
System	Batch Cooking, Soda Process	Continuous cooking,Soda Process	Continuous Cooking Soda Process
Characters	Higher alkali density, higher pressure and higher temperature at loose cooking,	Higher alkali density,higher pressure and higher temperature at rapid cooking,	Lower alkali density, lower pressure and lower temperature at mild cooking,
Pulping	Alkali cooking NaOH Density : 10-12% Cooking Temp.: 140°C-170°C Cooking Time : 2.5-4.0 hours	Impregnation + Alkali cooking a) Impregnation b) Alkali cooking NaOH Density : 10-12% Cooking Temp : 160°-190°C Cooking Pressure: 8-12 Kg/cm² Cooking Time : a + b=60 min	Alkali soaking + O_2-Reactor a) Alkali soacking NaOH Density : 4-5% Soacking Temp. : 40° Soaking Time : 40-60 min. b) O_2- Reactor Cooking Temp. : 90° Cooking Pressure : 4-5 Kg/cm² Cooking Time : 40-60 min.
Bleaching sequence	C.E.H/C.E.D.E.D., 3-5 Stage bleaching	C.E.H.3 stage bleaching	P.H.2 stage bleaching.
Yield			
-on bleached pulp	35 - 40 %	40 - 45 %	44 - 49 %
-on unbleached pulp	40 - 45 %	45 - 50 %	45 - 50 %
Chemical consumption		pulping, NaOH : 320 Kg/BD to bleaching, H_2O_2 : 60 Cl_2 : 42 total 422 Kg/BD to	pulping, NaOH : 210 Kg/BD to bleaching, H_2O_2 : 21 Na-hypo : 12 total 243 Kg/BD ton
Utility			
- steam		2 ton/BD ton	1 ton/BD ton
- process water		25 M_2/BD ton	13 m_2/BD ton
Brightness, % ISO			
- Unbleached pulp		35	45-60
- Bleached pulp		80	80
Washed water Treatment			
Black liquor			
Washing Water			
Advantage	1)Easy to operate, but difficult to changes during batch operation.	1) Easy to adjust an operating condition in accordance with changes of raw material. 2) Lower consumption on steam and water. 3) Lower chemical consumption.	1) More easy to adjust an operating condition in accordance with changes to raw material 2) More less consumption on steam and water 3) Less polution
Disadvantage	1) Difficult to treat wasted water. 2) Large consumption of steam and water		1) O_2 supplying facility in additional required.

The standard parameters maintained in EP stage of C-EP-H are:

- temperature at heater mixer 62 ± 2°C
- pH of pulp : 10.8-10.0
- Adequate retention time of 120 minutes (65-70% of the tower level).
- Consistency : 8.5-9.0%
- H_2O_2 (50 volumes) : 5-8 Kg. ptp. depending on brightness requirement.

The chlorine demand in the operation was reduced to 14 percent by 3 percent points as compared to C-E-H sequence.

The brightness stability as expressed by Post Colour No. for bagasse bleached pulp was maintained between 1.0 to 1.2 as against earlier recorded value of 2.8 to 3.2 prevailed in the case of C-E-H sequential system.

Agro based mill had conveniently switched over to value added brighter superprint grade of 75% ISO brightness from the low brightness cream wove.

Once, a regular marketing contraint due to frequent Complaints on colour shade reversion of paper supplied, had become the thing of the past.

With the expertise gained in Peroxide bleaching of bagasse pulp, the mill was able to achieve 78-80% brightness even with 20% rice straw in the bagasse furnish mix.

Further, by introducing C-EP-HP sequential bleaching of bagasse/grass pulp with split dosing of Peroxide, 80-85% in EP stage and 20-15% in H-STAGE.

The hypo washer repulper to retain in High Density Storage tower as Hypo II/Peroxide Stage (C-EP-H to C-EP-HP). The final washing of HD tower pulp.

The brightness of final bleached pulp could be reasonably enhanced to 82-84% with good stability (P.C.No. 0.9-1.2 and copper number 0.6-0.8).

With the high brightness bagasse pulp, High bright COPIER with a reasonably good whiteness and brightness of 80-81% could be made on machine.

With the split dosing of Peroxide as stated above, the chlorine as Hypo Chlorite was cut down by 3.5-4.0 percent point on bleached pulp produced.

The overall reduction in chlorine consumption was 35-40 tonnes for a bleached pulp production of 1200 tonnes in a month. The H_2O_2 (50 volumes) consumption recorded as 6.0 tons.

There was no appreciable difference in strength characteristics of the bleached pulps with either C-E-H or C-EP-H sequence.

The plant scale results of bleaching bagasse pulp with C-E-H, C-EP-H and CE-P-HP sequence are given in TABLE No.1.

ENVIRONMENTAL CONSIDERATIONS

The Peroxide bleaching of Soda chemical pulp has resulted in the reduction of pollution load in the bleach plant effluents as presented in TABLE No.2.

There is a reduction in the quantity of effluent discharge to the tune of 99 KL/hour from the CEH bleaching process discharge of 242 KL/hour, by reycling most part of EP stage effluent.

The hypochlorite washer filtrate was totally recycled in the process. The pollution load in bleach plant effluent was on account of E-stage washer filtrate (75% of the volume generated) and mere

TABLE-2

Pollution loads in the bleach plant effluent discharges

	C	EP	HP	C	E	H
1.EFFLUENT DISCHARGE, K1/hr.	100	35	8.0	132	100	10
2.S.S. mg/l	420	520	365	660	740	478
3.BOD, mg\L	400	580	92	600	700	196
4.C.O.D. mg/L	2200	1800	240	2100	2200	460
5.COLOUR, Pt-cobalt Unit	--	2000	--	--	2800	--
6.SS.Load Kgpt	19.2	9.1	1.57	39.9	37.0	2.58
7.BOD Load Kgpt	18.3	10.15	0.40	36.3	37.0	1.05
8.COD Load Kgpt.	10.23	31.5	1.06	128.9	110	2.55

* EP Stage and H-stage filtrates are recycled in the process. Only E-stage filtrate seal pit water mostly goes to drain.

17% of EP stage effluent. (TABLE No.3). The suspended solids, COD and BOD loads are reduced by 47.36%, 56.1% and 55.8% respectively with H_2O_2 bleaching..

Further reduction in hypochlorite and elemental chlorine consumption can be brought about by achieving low kappa number of unbleached pulp to level of 20-22. The Agro-base pulp and paper mills especially of 50-60 tpd capacity must go for Peroxide bleaching with a view to phase out Hypochlorite and chlorine stepwise.

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