Improved Bleached Pulp Quality by Replacing Calcium Hypo Chlorite With Hydrogen Peroxide

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ABSTRACT

The availability of Bamboo is dwindling, and as we are going for more of hardwoods, it has become necessary to adapt to alternate pulping and bleaching techniques, which can produce a reasonably good quality pulp.

This paper deals with replacement of Hypo bleaching stage in the conventional bleaching sequence (C/D-Ep-H-D), with Hydrogen peroxide, so as to improve upon the pulp strength properties and to reduce the effluent load. Hydrogen peroxide in the 2nd stage in place of Hypo proves to be good alternative, particularly for the pulps with more and more Hardwoods. The new sequence would be C/D-Ep-Ep-D.

INTRODUCTION

In the present scenario of increasing prices, diminishing and unpredictable supply of bamboo, the pulp & paper industry is forced to use more and more of mixed hard woods in the pulp furnish. The short fibers of mixed hard woods are resulting in lower strength of the bleached pulp and higher fines generation effecting the runnability of the paper machines. More over the pollution control authorities are also emphasizing on the reduction of organic-chlorinated compounds in the mill effluents.

APPROACH TOWARDS IMPROVEMENT

Considering the above factors so as to improve upon the situation the following steps have been undertaken:

1. Optimizing of chlorine in chlorination by installing Kajaani brightness controller.
2. Addition of Chlorine Dioxide in chlorination stage.
3. Hydrogen peroxide in extraction stage.

The above changes in the present bleaching sequence (C/D-Ep-H-D) have shown appreciable augmentation in the pulp strength and marginal reduction in pollution. But the presence of hypo in the existing sequence is stymieing further improvement in the pulp properties. It is well known that in Hypo bleaching there is considerable loss of pulp strength, color reversion and higher Chlorine Dioxide demand due to the presence of Calcium, Iron, Manganese and

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the formation of carbonyl groups. Hence keeping in view the effect of hypo in bleaching sequence we aimed to replace it by:

1. Lower Unbleached pulp kappa number to bleaching.
2. Addition of another Chlorine dioxide stage.
3. Addition of one more Hydrogen peroxide stage.

Lower kappa number in the range of 11-13 can be achieved with contemporary cooking methods like RDH/SUPER BATCH/KAMYR-PULPING, OXYGEN DELIGNIFICATION. Because of the higher cost involved in low kappa number pulping and additional D-stage as well as inadequate capacity of our ClO_2 generation the first two options were not pursued further, where as the third option was more feasible in our existing plant, involving marginal increase in chemical cost on pulp basis, nevertheless, with negligible capital investment and minor modifications. Visualizing the above merits addition of one more Hydrogen peroxide stage has been considered and put into practice.

HYDROGEN PEROXIDE CHEMISTRY

The final decomposition products of peroxide are water and oxygen. Control of the reaction conditions is of primary importance in determining which transient intermediates are formed. The intermediates include hydroxyl (OH*), and per hydroxyl (OHH^-) radicals. The hydroxyl ion is highly non-selective and results in polysaccharide splitting. The perhydroxyl ion on the other hand is an active bleaching agent via nucleophilic reaction with the lignin-based chromophoric groups. The perhydroxyl concentration increases with the increase in the pH. Therefore high pH is a key factor for delignification and bleaching with peroxide. Temperature also plays a key role over peroxide reactivity. It is understood that higher temperature in the range of 70-90°C yields best delignifying results, enhanced pulp brightness and lower caustic consumption as well as minimum residual peroxide leftover after the reaction.

Consistency is also visualized as a major parameter in effective peroxide bleaching. Studies show that there is an appreciable reduction in kappa number, and a remarkable increase in the brightness for the same dosage of peroxide at high consistency (30%), when compared with medium consistency (10%) peroxide bleaching. Transition metals (especially manganese, copper and iron) decompose peroxide into undersired free radicals resulting in deterioration of cellulose. Chelating agents can control the metal ion effect on the peroxide reaction. However the use of peroxide in the first or second extraction stage doesn't normally necessitate the use of chelating agents as chlorine in the first stage of bleaching eliminates majority of the transition metals by converting them in to highly water soluble metallic chlorides and washed out of the system.

FURNISH AND PULPING CONDITIONS

The two-stage peroxide bleaching has been done at following mill conditions:

Raw material furnish:	Bamboo	: 10%
	Subabul	: 20%
	Eucalyptus	: 60%
	Mixed hard wood	: 10%
Pulping conditions :	Active Alkali	: 16.5/17%
	Temperature	: 165°C
	Kappa No.	: 21-23
	Unbleached Viscosity	: 12-13Cp
	Sulfidity	: 21-22 %

MILL TRIAL WITH TWO-STAGE HYDROGEN PEROXIDE BLEACHING

I.T.C.Bhadrachalam is already having the bleaching sequence with one stage Hydrogen peroxide reinforcement i.e **C/D-Ep-H-D**. In the modified system calcium hypo chlorite has been eliminated by the introduction of another hydrogen peroxide. The new sequence is **C/D-Ep-Ep-D.**

BLEACHING CONDITIONS

A comparative operating conditions regarding the existing and modified stages of bleaching have been presented in Table-1.

CHEMICAL CONSUMPTION

Table-2 shows the comparative chemical consumption. It can be observed that hypo is eliminated, an increase in peroxide consumption by 8.0 kg/T of pulp and a marginal increase in caustic consumption.

TABLE - 1 : COMPARISON OF EXISTING AND MODIFIED BLEACHING CONDITIONS

EXISTING BLEACHING CONDITIONS				
PARAMETER	**C/D**	**E(p)**	**H**	**D**
CONSISTENCY %	2.5	10	10	10
TEMP (°C)	AMBIENT	70	45	70
REACTION TIME (MIN)	30	100	120	180
EXIT pH (VAT)	1.7-2.0	9.5-10.5	7.5-8.5	3.0-4.5

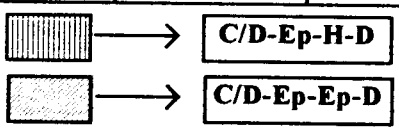
MODIFIED BLEACHING CONDITIONS				
PARAMETER	**C/D**	**E(p1)**	**E (p2)**	**D**
CONSISTENCY %	2.5	10	10	10
TEMP (°C)	AMBIENT	70	70	70
REACTION TIME (MIN)	30	100	120	180
EXIT pH (VAT)	1.7-2.0	9.5-10.5	9.5-10	3.0-4.5

TABLE - 2 : BLEACHING CHEMICALS CONSUMPTION (kg/T of PULP)

	EXISTING	**MODIFIED**
CHLORINE	36	36
HYPO (as CHLORINE)	27	NIL
NaOH	24 (Ep) + 3 (BUFFER)	25 (Ep1) + 6 (Ep2)
CHLORINE DIOXIDE	9	9
H_2O_2	4.5	7 (Ep1) + 5.5 (Ep2)

TABLE -3 : COMPARISON OF STRENGTH PROPERTIES

	C/D-Ep-H-D	**C/D-Ep-Ep-D**
Viscosity (Cps)	6.2	7.9
Breaking Length (m)	4890	5240
Tear Factor	58	65
Burst Factor	35	36
Bulk (c.c./gm)	1.56	1.47



IMPACT ON PULP PROPERTIES

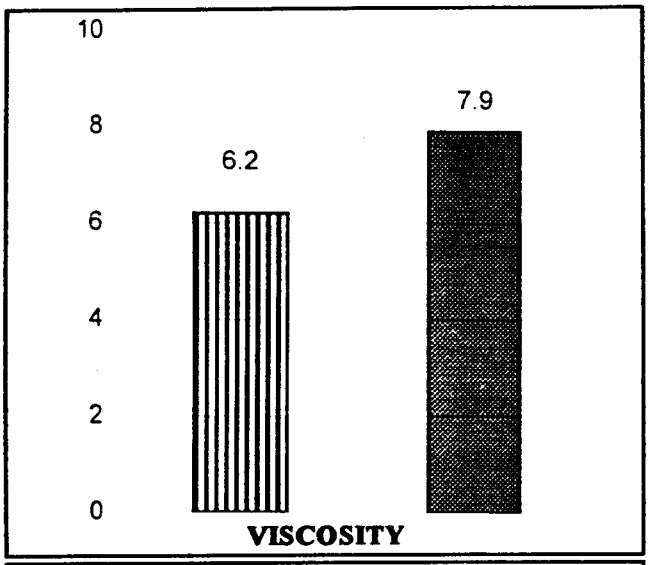
The properties of pulp such is viscosity, bulk, tear factor, burst factor and breaking length have been depicted in Table-3. The observation of each property is as follows.

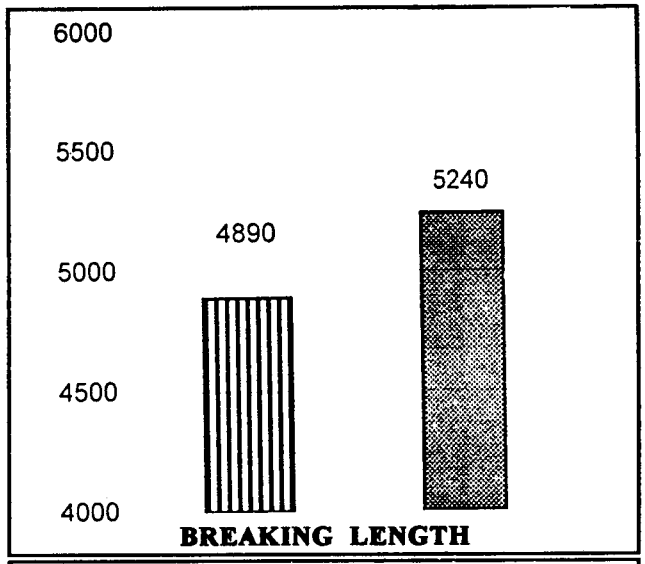
VISCOSITY

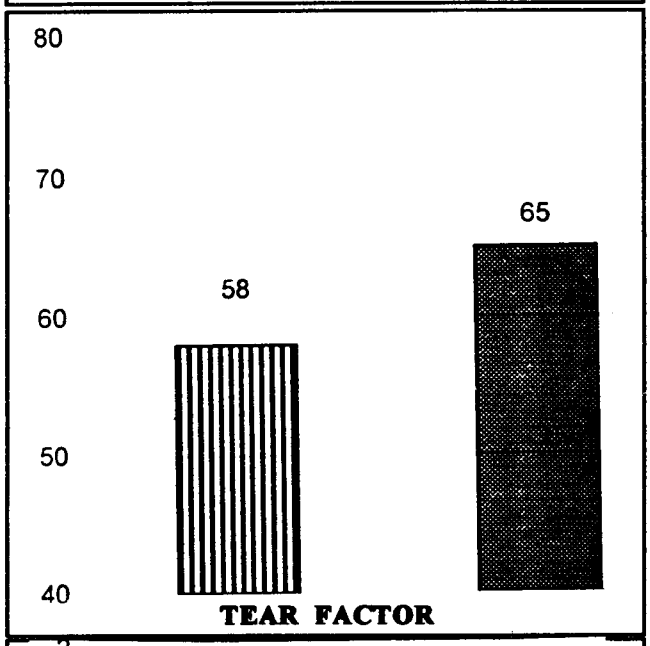
The deterioration of the pulp viscosity by hypo bleaching has to some extent protected by Hydrogen peroxide. A viscosity rise of 27% can be observed, which has given a boost to the weak hard wood pulp.

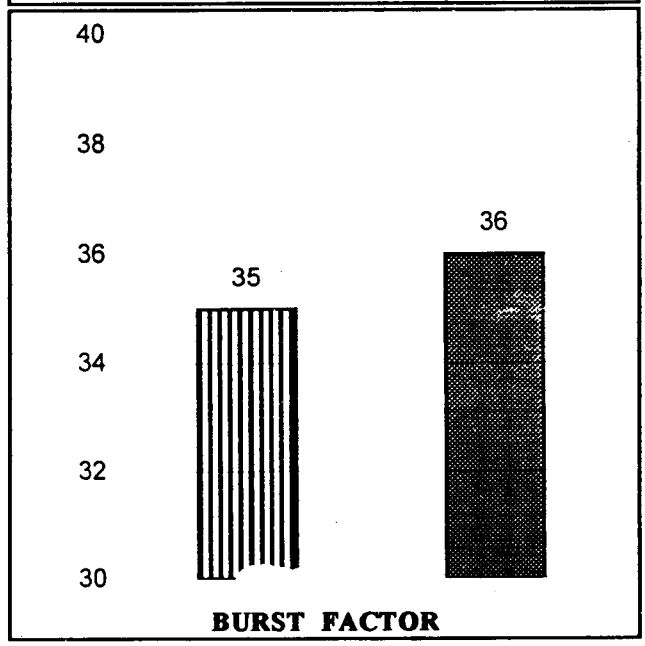
STRENGTH PROPERTIES

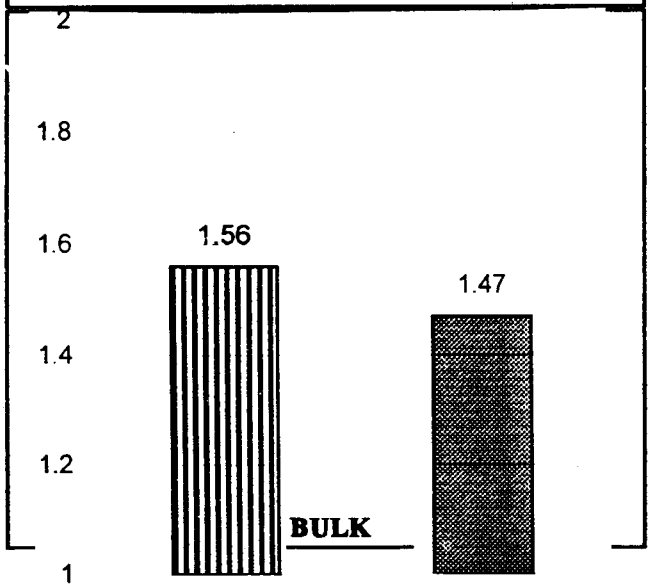
The tear factor and breaking length have











increased by 12% and 7% respectively. There is a marginal increase in the burst factor and a reduction in bulk by 6%.

FIBER CLASSIFICATION (Table-IV)

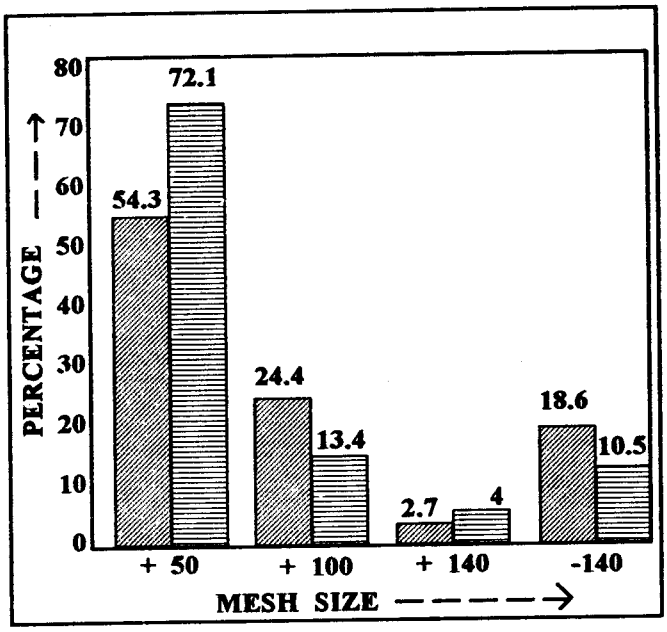
An increase in the fiber retention on+50 mesh by 32% and a remarkable reduction in the fiber passing through-140 mesh by 43%, shows reduced fine generation in bleaching.

BRIGHTNESS & COLOR REVERSION (Table-V)

The final pulp brightness has remained more or less the same. The reduction in post color number

TABLE - IV : COMPARISON OF FIBER CLASSIFICATION

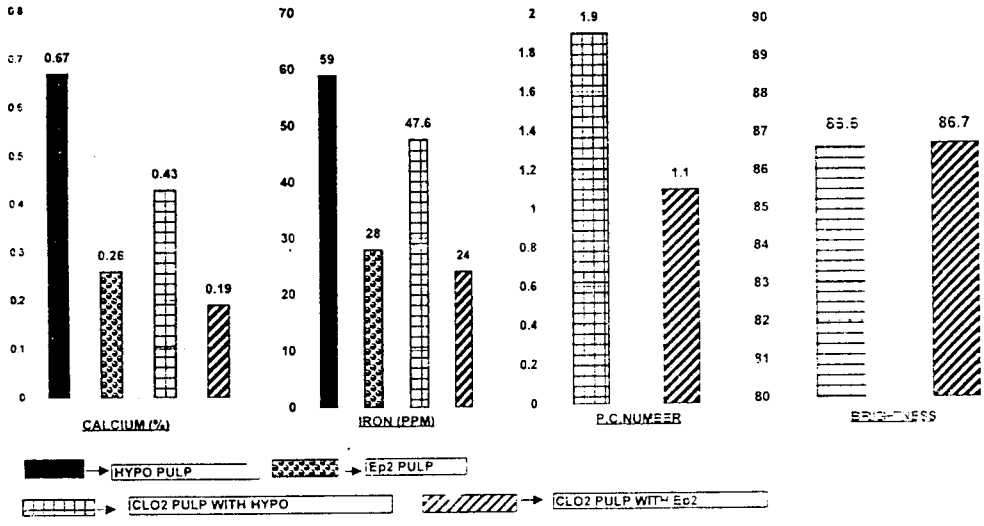
MESH SIZE	C/D-Ep-H-D	C/D-Ep-Ep-D
+ 50	54.3	72.1
+ 100	22.4	13.4
+ 140	2.7	4
- 140	18.6	10.5



by 43% exhibits an enhancement in the color stability of the ClO_2 pulp, which has resulted by the lessening of Calcium ions by 56% and Iron by 50% due to the elimination of Hypo.

TABLE - V : METALLIC IONS & P.C. NUMBER

	HYPO STAGE	Ep2	ClO_2 (C/D-Ep-H-D)	ClO_2 (C/D-Ep1-Ep2-D)
Calcium (%)	0.67	0.26	0.43	0.19
Iron (PPM)	59	28	47.6	24
P.C. Number	=		1.9	1.1
Brightness °G.E	=		86.6	86.7



FURTHER ADDITION

We are in a process of oxygen addition in the first stage of extraction.

BENEFITS

- Flexibility of using varied raw materials furnish.
- An enhanced brightness can be attained with slight increase in peroxide.
- Improved environment due to reduced lime handling.
- Lower chlorine handling, resulting in lesser safety hazard.
- Improved runnability of equipment and cleanliness by virtue of reduced calcium scale and lesser ash/silica.
- Reduced power consumption and water consumption due to elimination of hypo and use of Ep2 back water in Eop stage.

A study on effluent characteristic is in progress.

FEED BACK

The feedback from the machine has been positive regarding the behavior of the pulp on the machine.

CONCLUSION

Replacement of Calcium hypo chlorite by Hydrogen peroxide has resulted in enhanced pulp strength properties and lower color reversion of the bleached pulp, with negligible capital investment.

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