IMPROVEMENT IN PULP AND PAPER QUALITY WITH REDUCED POLLUTION LOAD - A NEW INNOVATIVE CONCEPT IN BLEACHING.

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Abstract

Bindals Papers creates a new light by reducing the effluent load at source with improvement in quality of pulp by changing Bleaching sequences. The use of environment friendly process is becoming more popular in the Pulp and Paper industry now-a-days. The focus has shifted towards cleaner production option followed by reduction of pollutants discharged from the bleach plant.

The principal goal of chemical pulp bleaching is to remove residual lignin and decolourize the pulp without adversely damaging the cellulosic matrix.

The Pulp and Paper industry has invested enormous amount of time and money to abandon at least elemental chlorine and to develop more environment friendly bleaching process. Oxygen based chemicals such as Oxygen and Ozone can be employed for bleaching of High Bright Pulp.

The increasing number of environmental and marketing constraints are leading the Pulp Mill to change their bleaching sequences in order to reduce the chlorinated organics produced in the bleach plant effluent.

Most of the bleach pulp is produced by conventional and ECF bleaching technologies. It is therefore reasonable and relevant to optimize and develop further the existing ECF bleaching process.

At BINDALS PAPERS MILLS LTD, Pulp was bleached by D_0-E_{OP}-D_1 bleaching sequence (where D represents chlorine Di oxide and E_{OP} represents Hydrogen Peroxide reinforced alkaline extraction) using "Bagasse and Wheat straw" as raw material.

As an early bird BINDALS PAPERS MILLS LTD ,took initiative for correction of pollution load at the source itself.

In this connection Laboratory and Plant scale trials were conducted by replacing Extraction stage reinforced with Hydrogen Peroxide with **"Oxidative chemical"** which has resulted in reduction of COD, BOD & COLOUR of the discharged effluents from Bleaching plant and improving the desired pulp characteristics of Agro residue.

The Paper is focused on systematic approach in our lab trial as well as plant trial and finally adopted Oxidative chemical in place of H_2O_2 Extarction stage. Plant is in operation since more than Six months..

Introduction

In the past, pulp bleaching was carried out with elemental chlorine and hypochlorite, which constitutes a severe source of environment pollution, Today there are many other techniques available to produce elemental chlorine free solution for the bleaching of pulp of different Raw materials.

During last two decades Hydrogen Peroxide has been reinforced in Extraction stage of Bleaching sequence as a major sources of Oxidation.

Since most of the effluent is generated from initial caustic extraction stage, which produces about 80% of Pulp mill effluent color as well as 60% of its COD and 30% of its BOD, it became essential to focus on this stage to reduce the pollution load in effluent discharge to help in complying the environment norms.

Pulp mill generate varieties of pollutants depending upon the type of the pulping process. Though the pulp and paper manufacturing is very much based on renewable resources but it is still viewed as an industry which increases pollution. The mills require a continuous focus on process optimization and innovate the new technology, which are more environment friendly. Keeping all this in view and to get rid of maximum effluent load from extraction stage, Bindals Papers Mills has made **TARGET** to overcome this problem. In this connection series of Laboratory trials with different chemicals were conducted in our R & D laboratory to reduce the pollution load.

BINDALS PAPERS MILLS LTD. has now adopted a pro-active approach, experimented with OXIDATIVE BLEACH Chemical with an objective to maintain the Brightness as well as other properties in ECF bleaching sequence by eliminating Extraction stage and minimize the pollution level in the effluent.

"This Oxidative chemical at neutral / alkaline (pH between 7.5-8.5) selectively removes residual Lignin from the fiber and facilitates bleaching".

Bindals Papers Mills Ltd. is an Agro residue (Bagasse & Wheat straw) based mill producing bleached grade papers. The main varieties are Photocopier paper, SS Maplitho and offset printing paper. Pulp Mill is equipped with continuous digester (Pandya type), multistage Brown stock washers, followed by screening &cleaning and bleaching section.

The bleaching sequence is D_0, E_{OP} and D_1 where D_0 & D_1 are chlorine dioxide Stages and E_{OP} is Alkali extraction stages where Oxygen and Hydrogen peroxide are introduced.

The characteristic of E_{OP} pulp was acceptable but effluent generated was having high loads in terms of COD,BOD & COLOUR.

Having continuous pressure from Regulatory authorities towards cleaner production and Zero liquid discharge (ZLD), we were in a difficult situation to treat existing effluent in activated sludge process treatment.

Finally the target of reducing pollution load at source was achieved by introducing Oxidative chemical in place of H_2O_2 reinforced Extraction stage.

EXPERIMENT

A Laboratory trial of Oxidative chemical against Hydrogen Peroxide was conducted in Research and Development Lab. keeping all the parameters as same as that of plant condition. The result obtained are encouragable.

Table 1 : Phase-1(Lab trial Oxidative v/s existing extraction process)

Sample collected from- D_0 stages (Furnish = 50% Bagasse + 50% Wheat straw)

Initial pH = 4.5 ISO Brightness = 49.0% Yellowness = 27.0% Whiteness = 2.52% Kappa no. = 4.9

Parameter	Unit	H_2O_2 @ 8kg/t	Oxidative @ 8kg/t	Oxidative @ 8kg/t	Oxidative @ 10kg/t	Oxidative @ 10kg/t
Caustic addition	Kg/ton	40	40	30	30	20
pH	-	11.0	11.0	9.2	9.5	8.2
Kappa no.	-	2.6	2.35	2.40	2.3	2.35
Brightness	%	65.0	62.6	62.7	64.6	64.8
Whiteness	%	45.0	38.0	39.5	40.2	40.6
Retention	min.	90	90	90	90	90
Temperature	°C	70°	60°	60°	60°	60°

The results shows that kappa no. slightly reduces with same level of brightness which was an indication of good strength and less pollution load. such as COD, BOD, and decolorization of discharged effluent.

After the laboratory trial of Oxidative Bleaching chemical against Hydrogen Peroxide, a further Lab trial was couducted to optimize the added chemical and to observe its performance. These conditions were monitored to suit the existing process conditions.

Table 2 : Phase-2 (Optimization of Oxidative chemical)

Sample collected from- D_0 stages (Furnish = 50% Bagasse + 50% Wheat straw)

Initial pH = 4.6 ISO Brightness = 48.1% Yellowness = 26.5% Whiteness = 2.61% Kappa no. = 5.0

Parameters	Dosing of Oxidative chemical			
	@6kg/t	@8kg/t	@10kg/t	@12kg/t
Caustic addition(kg/ton)	20	20	20	20
pH	8.3	8.3	8.4	8.6
Kappa No.	3.1	2.8	2.6	2.4
Brightness	60.5	62.8	64.5	66.3
Yellowness	16.10	15.5	14.7	14.1
Whiteness	42.0	42.6	43.0	43.2
Retention(minutes)	90	90	90	90
Temperature	60°C	60°C	60°C	60°C

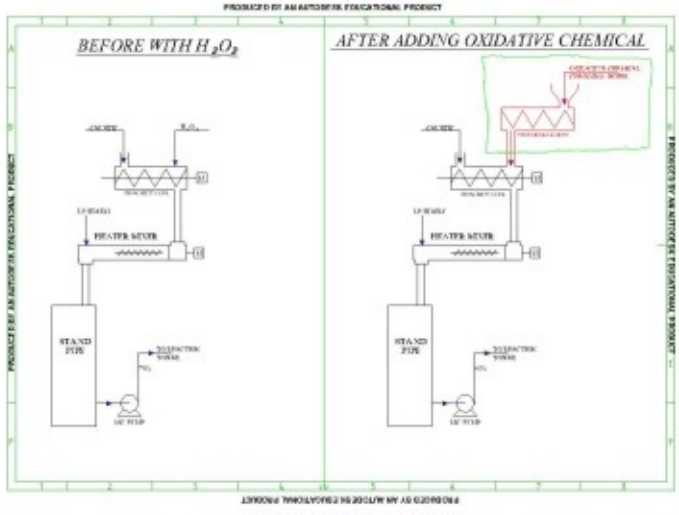
In Bindals several attempts were made to keep all the parameters same by totally eliminating Hydrogen Peroxide in the extraction stage. During the Laboratory trial for optimization of newly introduced Oxidative chemical, different doses were monitored to achieve the Brightness level to 60-62% & kappa no. (3.0-3.1) in the required stage.

The Oxidative chemical pulp was further treated with chlorine dioxide to attain a Brightness level of 83.0-84.0% in the final stage. The findings were shown below in table no.3.

The level of required parameters were well achieved with the doses of @ 8kg/ton of Oxidative chemical.

Table 3 : Further Treated With (Clo_2 @ 10Kg/t)

Parameters	@6kg/t	@8kg/t	@10kg/t	@12kg/t
pH	2.5	2.5	2.4	2.5
Brightness	82.5	83.1	83.5	83.9
Yellowness	3.05	2.76	2.51	2.06
Whiteness	77.8	79.0	80.3	81.2
Retention(time)	180(minutes)	180(minutes)	180(minutes)	180(minutes)
Temperature	70°C	70°C	70°C	70°C



(Fig 1)

Phase - 3 (Plant trial of Oxidative in comparision of our existing process)

Chemical dosing system was modified for introduction of Oxidative Chemical in the plant i.e. Installation of Metering Screw along with the charging Hopper. (Ref Fig.1).

Based on above Laboratory findings, plant trial with different doses of Oxidative chemical was conducted, A comparative optimized study of bleaching with Hydrogen Peroxide and Oxidative chemical is Shown in table 4.

The detailed study on plant trial of oxidative chemical has shown appreciable reduction in Caustic and Steam consumptions.

→ Three conditions were Studied in plant,

(a) Bleaching with addition of Hydrogen Peroxide @8kg/t.

(b) Bleaching with addition of Oxidative chemical @8kg/t.

© Bleaching with addition of Oxidative chemical @10kg/t.

Table 4 : Plant trial with H2O2 V/S Oxidative Chemical

Parameters	With H_2O_2	With Oxidative chemical	
	@ 8kg/t	@8kg/t	@10kg/t
Caustic charge (kg/ton)	40	20	20
PH	11.0	8.3	8.4
Kappa No.	2.2-2.8	2.0-2.6	1.8-2.4
Brightness	62.0-65.0	60.4-62.0	62.0-63.8
Yellowness	10.29-12.54	17.3-18.0	15.2-16.5
Whiteness	48.2-54.9	34.0-38.5	39.4-42.5
Retention (time)	90 (minutes)	90 (minutes)	90 (minutes)
Temperature	70°C	60°C	60°C
Clo_2 Consumed (kg/t)	8.0	8.0	7.5
D1 final brightness	83.0-84.0	83.0-84.0	83.0-84.0+

After the Plant trial was completed and its findings were evaluated, we came across several tangible and intangible benefits from its out come.

1. Brightness of the pulp remained unchanged.
2. Kappa No. is lowered by 0.2 to 0.4 points, which helped to maintain the Brightness at D1 stage.
3. Yellowness increased slightly with same level of brightness , which became a big advantage to maintain the Opacity in final product. (Table no. - 5)

   Maintaining opacity for Agro based producers is a major issue.
4. Freeness (°SR) of final stage pulp (D1 stage) was in the desired range of 18-20, which turned as a good advantage to maintain Head Box Freeness to 26-28 °SR as against earlier of 30-32 °SR. This helped in improving drainage parameter (30sec) to the range of 600-620 ml which contributed in better Machine runnability. (Table no. 6).
5. Improvement in the drainage of pulp which enhanced the Bleaching plant capacity.
6. Seeing the improved performance of Machine runnability and optimum wet-end parameters i.e. Improved Head Box drainage, Freeness, FPR & FPAR, and lower back water consistency, increasing the loading material was inevitable and now Bindals Papers Mills is using 100 % GCC and maintaining high level of FPR and FPAR parameters.(Table- 7).
7. Reduced operating temperature of the Oxidation stage has helped in reducing the temperature of bleach plant effluent mix by 10°C (Earlier it was 60-65°C which reduced to 50-55°C). This has minimized the load on ETP cooling tower for reducing the effluent temperature (Table-8).
8. The major benefits that came across and for only reason the whole exercise was carried out is the pollution load, that has **reduced such as BOD,COD and COLOUR of our effluent** (Table-8).

   Further more benefits or improvements are under observation/evaluation which will be established during continuous run of Oxidative chemical.

(Table 5 : Comparison of Opacity in our 57 GSM and Copier Paper 70 & 75 GSM)

	Opacity in 57 GSM	*Opacity in Copier Paper 70 GSM & 75 GSM*
With Extraction Stage	86.2 - 87.8	89.5 - 92.2
With Oxidative Chemical	89.8 - 92.3	92.0 - 96.4

(Table 6 : Comparison of Freeness in Final pulp & Head Box and Drainage of Head Box)

	Final Pulp Freeness(^{0}SR) (D1 stage)	*Head Box Freeness (^{0}SR)*	*Head Box drainage (ml/30 Sec)*
With Extraction Stage	20-22	30-32	420-450
With Oxidative Chemical	18-20	26-28	600-620

(Table 7 : Comparison of FPR and FPAR)

	FPR %	*FPAR %*	*Back water consistency %*
With Extraction Stage	77 - 80	45 - 50	0.16 - 0.18
With Oxidative Chemical	82 - 85	60 - 65	0.13 - 0.14

ECONOMICS

There is no additional cost to run the Bleach plant with Oxidative chemical.

REDUCTION OF EFFLUENT LOAD IN ETP

There are many industrial processes across the nation and around the world that discharge huge amount of waste water effluent in to local waterways and ground Soil.

A Kraft pulp mill will usually be the highest user of water just because the process requires to dissolve various chemicals and there a lot of water and steam involved.

This industrial waste consists inorganic and organic substance.

Here at BINDALS PAPERS MILL LTD. introduction of this Oxidative chemical in place of Alkali Extraction (Eop) stage , made some huge strides in improving the quality of our waterway, Such as COD,BOD, and COLOUR of the waste water.

(Table 8 : Reduction of Effluent load parameters with Oxidative Chemical)

S.no.	Parameter	Unit	Oxidative chemical @ 8kg/ton
1.	Reduction in Temperature	^{0}C	15 - 16 %
2.	Reduction in COD	ppm	20 - 25%
3.	Reduction in BOD	ppm	18 - 20%
4.	Reduction in COLOUR	PCU	40 - 45%

RESULT & DISCUSSION

With the addition of Oxidative chemical, The Bleaching sequence D_0 (Oxidative)/ Eop (Akali Extration reinforced with H_2O_2 / D_1 (Oxidative) has changed to D_0 (Oxidative)/ Ox (Oxidative)/ D_1 (Oxidative).

Now the Bleaching sequence at Bindals Papers Mills Ltd. has change completely to "Oxidative Bleaching" stages.

CONCLUSION

After successful lab and plant trials, since December'2015 M/S Bindals Papers Mills Ltd. has adopted the innovative technology for its fiber line and are able to establish an "Oxidative Chemical stage" in bleaching Sequence in place of Eop stage for its Agro based plant and have been successful in reducing the pollution load from the source itself.

Bleaching with Oxidative chemical offers an affordable ECF Bleaching system. It improves pulp & paper quality without any increase in cost. Seeing the future global environmental pressure and corporate social responsibility (CSR), industries have to adopt environment friendly Bleaching technologies with value added quality of finished product.

In longer terms this technology will gain importance in terms of cost effectiveness for the pulp and paper industry and many more advantages envisaged in future after continuation in operation.

ACKNOWLEDGEMENT

The Authors express their gratitude to **Shri Ankur Bindal** & **Shri Mayank Bindal** (Directors) of Bindals Papers Mills Ltd., for granting permission to present the article .

Special thanks to **Shri A.K Vidhyarthi (Additional Director) CPCB Delhi** & **Dr. Suresh Panwar (Sc.F & Head E.M Div) CPPRI Saharanpur**, who took initiative and offered all guidance and support to conduct the studies on new innovative technology of Bleaching with "Oxidative" chemical.

Thanks are also due to Mr. Praveen Kumar Goel(Sr. G.M. Pulp Mill), Mr. Atul Bhardwaj (Head Business Excellence), Mr. Manoj Pundir(AGM QC/R&D) and Mr. H.S. Bhatia (Manager QC/ R&D) for their support in lab & plant trials as well as in the publication of the article and Mr. U.P. Verma (Sr. G.M. Mechanical) and entire mechanical team for providing necessary dosing system in execution of the same.

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