INTRODUCING POST BLEACHING ENZYMES IN AGRO PULP BLEACHING IN M/S BPML

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Abstract

As global trends and customer preferences are switching towards cleaner and greener products, a key challenge faced by the pulp and paper industry nowadays is the adoption of elemental chlorine-free (ECF) and totally chlorine free (TCF) bleaching technologies, which reduce the toxic chemical usage and the pollution load with potential for better product quality. The main aim of these technologies is to reduce or to phase out the use of elemental chlorine and chlorine-based chemicals from the bleaching sequences. Paper mill are moving in this direction by adopting Eco-friendly technologies such as oxygen delignification and enzymatic prebleaching.

Bindals Papers Mills Ltd. has moved ahead in the direction of more cleaner and greener technology by adopting Oxidative chemicals instead of Extraction stage and Post Bleaching Enzyme. Thus Bindals Papers Mills Ltd has become the **first User of Post Bleaching Enzyme Globaly**.

This paper is focused on a systematic approach of using " **Post Bleaching Enzyme**" after Bleaching Stage . The technical benefits derived in terms of saving in Bleaching Chemicals, with the same level of final pulp Brightness and reduction in pollution load of discharged effluent from bleaching section.

The experience were highlighted with laboratory trial studies & Plant scale studies.

Introduction

Enzymes are naturally occurring, protein based molecules that accelerate the various chemical reaction in all living things. Enzymes are true catalysts in that they are not consumed in the reaction, and each enzyme molecule can catalyze thousand upon thousands of reactions per second. Enzymes are very specific to the reaction that they drive, each type of enzyme does one thing and one thing only. That makes them especially effective tools for achieving specific results.

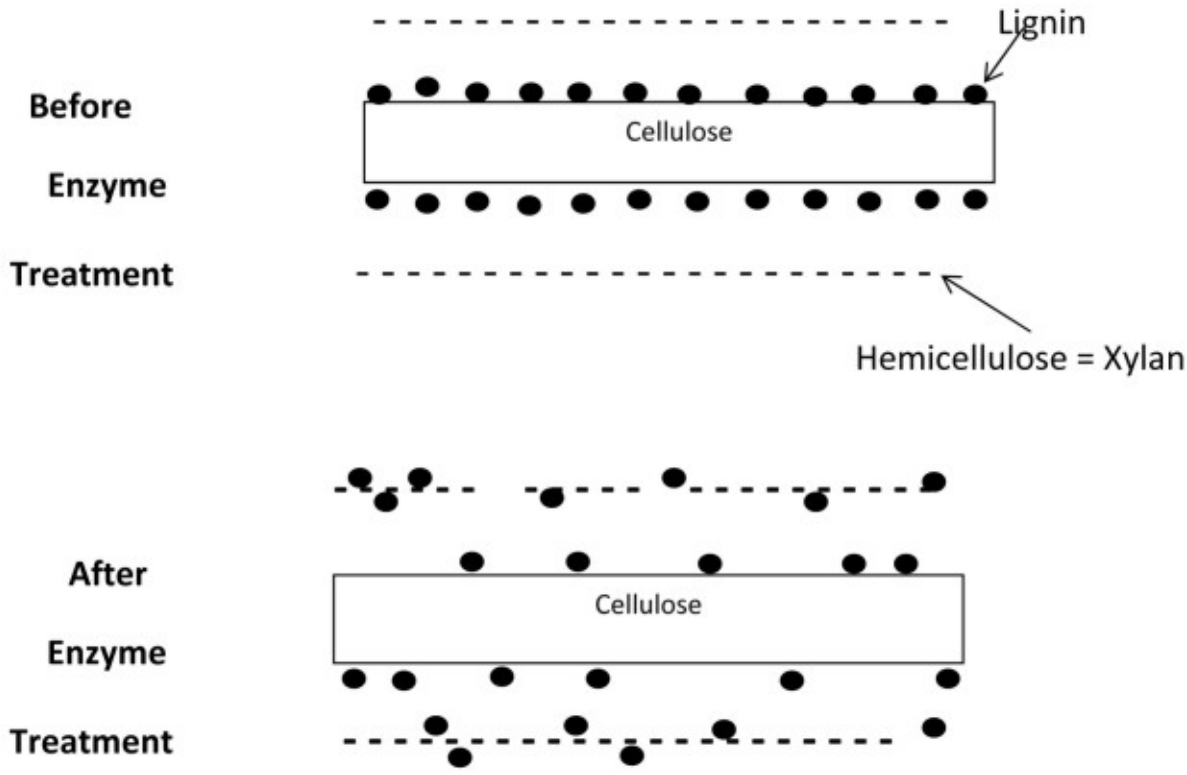
Mounting environmental pressure and awareness has led the Paper industry to look for cleaner production option in terms of minimizing the pollution load in the discharge effluents. The pulp and paper industry processes huge quantities of lignocelluloses biomass every year. The technology for pulp manufacture is highly diverse and numerous opportunities exist for the application of microbial enzymes.

Most the pulp and paper mills worldwide use chlorine dioxide as elemental chlorine free (ECF) bleaching agent for production of high quality pulp. Therefore the major interest has been environmentally benign bleaching technologies for reduced bleaching discharged. In this aspect enzymatic bleaching of pulp offers a potential viable option to achieve a clean and green technology for pulp bleaching.

Post bleaching enzyme remove "residual Chloro phenolic material, residual lignin, degraded Carbohydrates, extractives, metals and various oxidizable compounds that remain in the pulp which detract from brightness and also may cause reversion".

Fig 1 shows the Xylan Decomposition and Pulp Bleach-ability.

Chemistry Behind the Bleaching Process with Post Bleaching Enzyme



Most of the commercial chemicals can be effective, they can have many more effects that one can intend and can lead to high energy use and undesirable by products. Enzymes, on the other hand, are specific, so they can be used to do a particular task without any adverse side effects.

Using "Post Bleaching Enzyme" has led us to reduce the Bleach chemicals, also helped us to control the pollution parameters of Bleach discharge without adversely affecting the properties of pulp.

A close interaction and studies in collaboration with supplier has resulted in development of an improved pulp quality, wet end parameter, finished product quality and minimizing the pollution load in bleach plant effluent.

EXPERIMENT

A Laboratory trial of "Post Bleaching Enzyme" with different doses and at varied Temperature was conducted in Research & Development to ascertain the effectiveness of "Post Bleaching Enzyme". During the lab trial Pulp Consistency, Retention time, Enzyme doses, and Temperature were particularly monitored & optimized. The result obtained are depicted in **Table 1.**

Table 1

Furnish : 100 % Wheat Straw Retention Time ; 90 minutes

Enzyme dosing	Temperature °C	Brightness %	Yellowness	Whiteness
Blank (Final D1 Pulp)	35	82.3	2.04	83.2
@100gm/ton	35	83.1	1.55	83.63
GAIN		**0.80**	**-0.49**	**0.43**
@200gm/ton	35	83.3	1.45	83.81
GAIN		**1.00**	**-0.37**	**0.61**
@500gm/ton	35	82.8	1.90	83.50
GAIN		**0.50**	**-0.14**	**0.30**
Blank (Final D1 Pulp)	45	82.3	2.04	83.0
@100gm/ton	45	83.05	1.51	83.53
GAIN		**0.75**	**-0.53**	**0.53**
@200gm/ton	45	83.58	1.39	84.5
GAIN		**1.28**	**-0.65**	**1.50**
@500gm/ton	45	83.33	1.76	83.7
GAIN		**1.03**	**-0.28**	**0.7**
Blank (Final D1 Pulp)	60	82.3	2.04	83.6
@100gm/ton	60	83.92	1.22	84.6
GAIN		**1.62**	**-0.92**	**1.00**
@200gm/ton	60	83.98	1.29	85.1
GAIN		**1.68**	**-0.75**	**1.50**
@500gm/ton	60	83.62	1.50	84.8
GAIN		**1.32**	**-0.54**	**1.20**

The trial was conducted with 100gm, 200gm & 500gm/ton of Enzyme dosing and observed that the gain in Brightness, Whiteness and reduction in Yellowness is comparably high with 100gm/ton dose at Temperature 60 °C.Based on Laboratory findings , Plant trial was conducted . Enzyme was dosed at outlet of D_1 washer @ 100gm/ton.

The detailed results were tabulated in **Table 2.**

Table 2 : Plant scale Trial

Furnish : 100 % Wheat straw, Residual Chlorine : < 10-15 ppm, Temperature : 55 - 60 °C

Retention Time : 90 Minutes

D1 PULP			AFTER ENZYME TREATED			GAIN IN BRIGHTNESS
BRIGHTNESS	WHITENESS	YELLOWNESS	BRIGHTNESS	WHITENESS	YELLOWNESS	
DAY 1						
83.9	79.7	3.72	85.1	85.1	2.16	1.2
84.4	80.9	3.82	85.4	85.6	1.89	1.0
83.4	76.3	3.74	84.7	84.69	2.31	1.3
83.6	77.7	3.81	84.8	84.76	2.11	1.2
83.8	78.8	3.31	85.1	85.03	1.67	1.3

Table 2 : Plant scale Trial *Contd...*

DAY 2						
82.6	76.2	3.9	84.2	84.0	2.14	1.6
83.2	76.8	3.41	84.6	84.1	2.02	1.4
83.5	78.02	3.5	84.7	84.32	2.4	1.2
83.7	80.2	2.89	84.9	84.66	1.93	1.2
85.0	83.28	2.18	85.6	85.43	1.8	0.6
DAY 3						
83.5	76.3	3.78	84.8	85.1	2.0	1.3
85.0	82.56	2.31	85.7	85.3	1.88	0.7
82.0	75.34	4.18	83.8	83.3	2.44	1.8
81.8	77.51	4.31	83.9	83.61	2.36	1.7
83.7	77.6	3.54	84.8	84.1	2.1	1.1

Initially the trial was started with the dose of 100gm/ton & than optimized to 50gm/ton. The trial results shows that the gain in Brightness % is maximum when the initial Brightness is Kept around 82% at D1 stage. Brightness which is high at initial stage (D1) does not show its effectiveness in BHD tower. This helped us to save Chlorine di oxide consumption by **0.5 kg/ton**. to maintain the final Bleach pulp brightness to the range of **82.0 - 82.5** maximum.

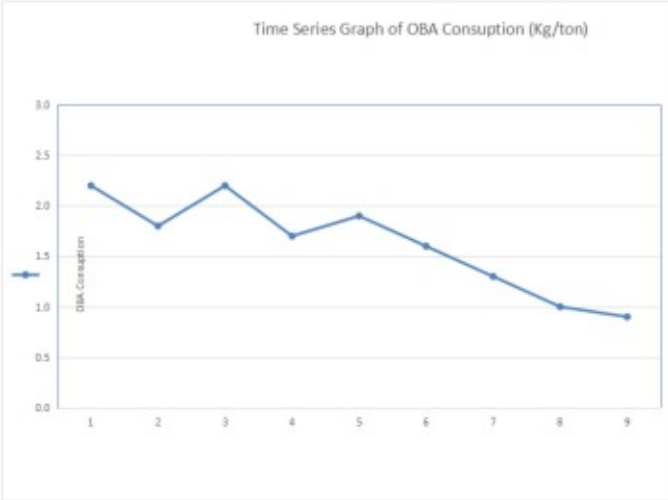
Potential benefits were evaluated after using Post Bleach enzymes In Plant

1. Increase Brightness approx by 0.6-1.8 degree depending on initial brightness.
2. Reduce bleach chemicals.
3. Reduce pollution load of Bleached discharged. (**Table 3**)
4. Reduces OBA consumption in stock preparation (**Fig 2**)
5. Most important ,the variation in the Brightness level has been overcome by achieving the consistent Brightness 84.5 - 85.0 at wet end.
6. Thus reduces the complaint on account of variation in BRIGHTNESS of Paper.
7. Addition of "Post Bleaching Enzyme" helped us in manufacturing paper of High Brightness i.e. 90.0+, which we could not able to achieve earlier.

Table 3 : Reduction in the Pollution level of Bleached discharged

S.no.	Parameter	Unit	% Reduced
1.	COD	ppm	10 - 15
2.	BOD	ppm	8 - 10

Fig 2 : Reduction in the consumption of OBA



RESULTS & DISCUSSION

The Purpose of the trial was :

1. To reduce Bleaching chemical 2. To Reduce pollution load of bleach discharged effluents.

As excess Bleaching chemical was running at Bindals to achieve the requirement brightness of 85° in final stage. Excess bleaching chemicals in pulp reduces the pulp strength , also effects on Yellowness in final paper. Addition of "Post Bleaching Enzyme" helped us to optimise the dose of Chlorine di oxide and the Brightness level was set to the target of 82.5-83.5 to achieve the Target of final pulp Brightness of 85° at wet end after retention of 1.30 hr. It is concluded that this "Post Bleaching Enzyme" worked as a "Shock absorber" In spite of having lower Brightness at D_1 stage, a Brightness level of 84-85 can be achieved at BHD tower.

CONCLUSION

Based on studies carried out on Enzymatic Post bleaching , it was concluded that there is considerable potential for its implementation in the Paper industry. An improvement in the optical properties of the pulp, particularly a gain in the brightness level was noticed , also played a significant role in reducing the bleach chemicals, thereby helping to reduce the pollution level of bleach discharge by 10-15%. It also helps in reducing the Whitening agent, used in paper making.

Thus Bio bleaching employing enzymatic Post bleaching techniques is now considered to be one of the preferred technique , primarily because of number of advantages offered over existing /conventional bleaching sequence.

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