Oxidative Alkali Extraction in an Agro Pulp Mill - A Case Study

S. K. Sharma, P. Verma and K. N. Tiwari

Shreyans Industries Ltd., Unit Shreyans Paper Ahmedgarh (Punjab)

Results of plant scale operation of alkali extraction in an Agro based pulp mill employing wheat straw at E, Ep, Eo and Eop stages are discussed. Reduction in chlorinated pulp K. No. at E stage was 38%, Ep stage 42%, Eo stage 43% and Eop stage 58% respectively. Gain in alkali extracted pulp brightness over CE stage was 3.2 point at CEp, 3.5 point at CEo and 11.7 point at CEop stages respectively. Gain in final bleached pulp brightness over CEHH was 2 points both in case of CEpHH and CEoHH stages of bleaching at the extra cost of Rs. 328/T and Rs.70/ T respectively, whereas 4 point gain was found in case of CEopHH at Rs. 214/T extra cost. BOD, COD and colour reduction over CE stage remained between 15 to 20%. Whiteness and brightness stability was improved in Oxidative alkali extraction.

INTRODUCTION

ECF and TCF bleachings are the talk of the day. Much work has been done and is being done in the field, adopting various options such as oxygen delignification and/or improved bleaching. Various factors involved in changing bleaching sequences vis-a-vis economic health of an industry is being judged critically by the Industry and steps are taken which suit a particular industry.

Following options are available for reducing/ eliminating chlorine during bleaching.

i) Extended delignification.

ii) Improved washing.

iii) Oxygen delignification

iv) Enzyme pre-teatment

v) Oxidative Alkali extraction either by

(a) Oxygen

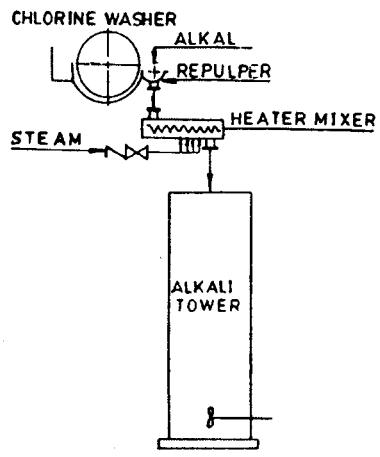

Fig. 1 : Alkali Extraction System

(b) Hydrogen peroxide or

(c) Both oxygen and peroxide combined

vi) Substitution of chlorine dioxide in place of molecular chlorine.

The aim behind all these steps is to reduce lignin or kappa number of pulp before being subjected to chlorine treatment so that :-

- Less chlorine is used and less organic halides are generated resulting in less pollutants generation, whether it is colour, COD, BOD or AOX.
- Selective reaction with pulp preserving strength properties of bleached pulp.
- Obtain increased brightness of pulp with lower doze of bleaching chemicals.

Among the alternatives listed above, commercial exploitation of improved washing and oxidative alkali extraction is being done at Shreyans Papers. A short trial was taken for oxygen delignification which gave encouraging results. Extended trial is being planned. Outcome of trial shall be shared very soon. Advantage of improved washing has been obtained in terms of reduced alkali and chlorine consumption.

About the Mill

Shreyans Papers, a unit of Shreyans Group of Industries, is situated in the heart of Punjab in Sangrur District. It is engaged in manufacture of superior quality of Writing and Printing grades of paper utilizing Wheat Straw, Sarkanda and Jute Waste - the non-conventional, eco friendly - raw materials.

The mill was commissioned in 1982 with an installed capacity of 10,000 MT per annum and

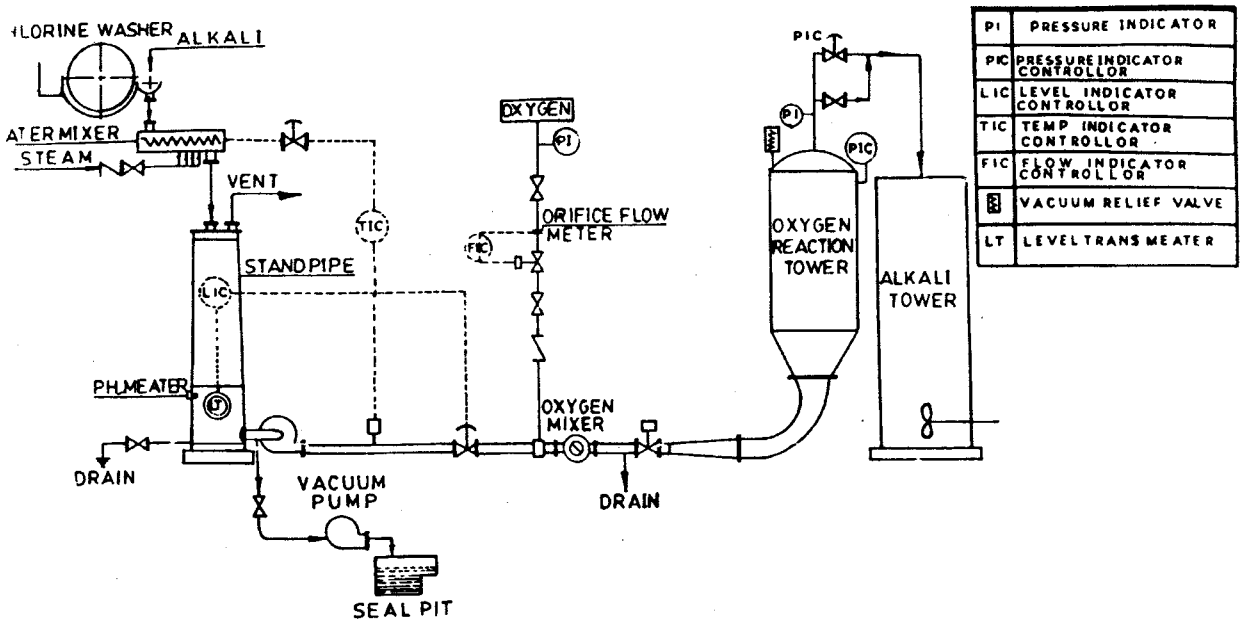

Fig. 2 : Oxidative Alkali Extraction System

has increased its capacity three fold by taking timely modernization steps. Along with its commercial needs, the Company is very much alive to the needs of the Society. It has installed a full fledged effluent treatment plant based on Activated Sludge Process comprising of Primary Clarifier, Aeration tank with four number Aerators of 50 HP each, Secondary Clarifier, Secondary Aeration tank with three numbers Aerators of 50 HP each followed by another Clarifier, Sludge treatment plant is comprising of Vacuum Filter, Twin Wire Sludge dewatering machine and Sludge filter press.

Steam and Power are generated by burning Rice Husk - an eco friendly raw material. Air pollution is taken care of and the Company is meeting the standards of State Pollution Control Board.

The Company has the pride of installing and running first Fluidized bed Reactor in the world to recover Soda from Wheat Straw and Sarkanda Black Liquor. Wheat straw and Sarkanda are cooked together in continuous digester. Jute waste is cooked in batch rotary digester and mixed with Wheat straw pulp for washing (Five Stage Counter current Washing), Screening and Bleaching Pandia type continuous digester was installed in 2001 for improved cooking. Pulp washing section was further strengthened by introducing two more efficient washers to reduce carry-over of spent liquor.

In an endeavour to reduce the pollution load arising from bleaching section, the mill introduced the use of Oxygen and Hydrogen Peroxide at Alkali extraction stage.

Oxidative Alkali Extraction

Oxygen reinforced Alkali Extraction system was retrofitted in the then existing CEHH sequence of bleaching equipments were used. Fig.1 details the old and Fig.2 the existing system of Alkali Extraction.

Chlorinated pulp after washing, is shredded in pulper where alkali is mixed to maintain required pH. The pulp is then heated mixer to maintain required reaction temperature. The heated pulp is taken into a Stand pipe where constant level is maintained.

The MC pump feeds the pulp to MC oxygen mixer where pressurized oxygen gas is introduced. The pulp goes to pressurized Oxygen Reaction Tower. From there it goes to Alkali Extraction Tower for further reaction. Hydrogen Peroxide is added as and when required. The extracted pulp is washed and treated with Hypochlorite to get final bleached pulp.

In order to maintain steady conditions during reaction, Level controllers, Flow controllers, pH controllers, Pressure controllers and Temperature controllers etc are provided.

Operational Parameters of Oxidative Alkali Extraction

Consistency	: 10%
Reaction temperature	: 70 °C
Retention time in Reaction tube	: 30 Min.
Reactor pressure	: 2.5 Kg/cm^2
oxygen feed rate	: 4Kg/tonne of pulp

Table 1. Results at Different Stages of Bleaching

Particular	'Unit	Sequence of bleaching			
		CEHH	CEpHH	CEoHH	CEopHH
Washed unbld Pulp K. No.	-	14-15	14-15	14-15	14-15
Washed unbld Pulp brightness	%	50.8	50.2	50.2	50.5
Chlorine charge during C. stage	%	6.05	6.05	6.05	6.05
Chlorinated Pulp K.No.	_	9.7	9.2	9.0	9.5
Chlorinated Pulp Brightness	%	49.7	49.3	49.6	49.5
Alkali charged	%	4.0	4.0	4.0	4.0
Oxygen charged	%	-	-	0.4	0.4
Hydrogen peroxide charged	%	-	1.2	-	0.6
Alkali extracted pulp K. No.	-	6.0	5.3	5.1	4.0
Alkali extracted Pulp brightness	%	53.8	57.0	57.3	65.5
Chlorine in Hypo stages	%	5.45	4.95	4.95	4.5
Final bleached pulp brightness	%	81-82	83-84	83-84	85-86
Strength properties					
a. B. F.	-	25	23	24	25
b. T. F.	-	65	66	66	67
c. B. L.	M	3660	3480	3530	3580
COD in combined bleach plant effluent	mg/l	2080	1960	1880	1675
BOD in combined bleach plant effluent	mg/l	790	720	705	630
Colour in combined bleach plant effluent	Pt. Co. unit	1700	1400	1380	1320

pH : 10.5

RESULTS AND DISCUSSION

Oxidative extraction system is running smoothly.Data for plain alkali extraction, extraction with H_2O_2, extraction using oxygen alone and in admixture with hydrogen peroxide were analysed and comparative results area tabulated in Table 1. Effect of oxidative alkaline extraction in given in Table 2. It can be seen from above tables that Washed pulp K. No. reduced by about 33-38% on chlorination. Further reduction in K.No. during plain alkali extraction was 38.1% and 42.4% when hydrogen peroxide was used during extraction. A reduction of 43.3% was observed when oxygen alone and 57.9% when hydrogen peroxide was used alongwith oxygen during oxidative extraction. Gain in alkali extracted pulp brightness over plain alkali extraction was approx. 3.2 points when H_2O_2 was used. 3.5 point when oxygen was used and 11.7 points when hydrogen peroxide and oxygen both were used at extraction stage. Strength properties of finally bleached pulp remained more or less same. By considering prevailing rates of chlorine, oxygen and hydrogen peroxide, following extra cost of power and chemicals was observed

Table 2. Result of Oxygen and Oxygen· Peroxide Bleaching of Wheat Straw Pulp Based on Figures reported in Table -1

Particular	Unit	Sequence of bleaching			
		CEHH	CEpHH	CEoHH	CEopHH
Reduction in K. No. of pulp by chlorination	%	33.1	36.6	37.9	34.5
Reduction in K.No. on alkali extraction over chlorination	%	38.1	42.4	43.3	57.9
Increase in alkali extracted pulp brightness over unbleached pulp	%	5.9	13.5	14.1	29.7
Increase in final bleached pulp brightness over unbleached pulp.	%	60.4	66.3	66.3	69.3
Increase in oxidative extracted pulp brightness over plain alkali extracted pulp brightness	%	-	5.9	6.5	21.7
Increase in final bleached pulp brightness with oxidative axtraction over CEHH pulp brightness	%	-	2.5	2.5	4.9
Reduction in BOD of Bleach plant effluent over CEHH effluent	%	-	8.9	10.8	20.3
Reduction in COD of Bleach plant effluent over CEHH effluent	%	-	6.8	9.6	19.5
Reduction in Colour of Bleach plant effluent over CEHH effluent	%	-	17.6	18.8	22.4

for achieving 2-4 points brightness gain over CEHH pulp.

Doze of Chlorine is given in Table no. 1 Sr. no. 11. It can ben seen that Chlorine consumption reduced in Oxidative extraction from 5.45% in case of CEHH.

Ep Brsightness gain 2 points, Extra cost Rs. 328/- per MT over plain extraction.

Eo Brightness gain 2 points, Extra cost Rs. 70/- per MT over plain extraction.

Eop Brightness gain 4 points, Extra cost Rs. 214/- per MT over plain extraction.

Cost of Oxygen Rs. 40/-+cost of H_2O_2 Rs. 189/-+Cost of power Rs. 80/- Total cost of Rs. 309/MT-Cost of Chlorine Rs. 95. Thus extra cost is Rs. 309-Rs. 95=Rs.214/-

Improvement in Whiteness and brightness stability of pulp after oxidative extraction was observed.

Reduction in COD, BOD and colour of bleach plant effluent was observed in the range of 7-17% when peroxide was used, 10-19% when oxygen was used and 20-22% when oxygen and peroxide both were used.

AOX was measured after Oxidative extraction only and found about 1.3 kg/T of paper. As the earlier AOX fig. is not available, we could not substantiate the reduction in AOX. However, it is obvious that by adding Oxygen/Peroxide and subsequent reduction in Chlorine must have reduced the AOX content in the effluent.

CONCLUSION

Oxidative extraction improves brightness, whiteness and brightness stability maintaining more or less similar strength properties. Effluent toxicity with respect to B.O.D., C.O.D. and colour is also reduced by 10-20% in bleach plant effluent.

ACKNOWLEDGEMENT

Authors are thankful to the Management of M/s. Shreyans Industries Limited for encouragement given during the study expecially to Shri Anil Kumar, ED and CEO for his able guidance and support to handle the project successfully.