Importance of Raw Material Preparation in Wheat Straw Based ECF Pulp Plant - An Experience

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ABSTRACT

Paper consists of a web of pulp fibres derived from wood or other plants from which lignin and other non-cellulose components are separated by cooking them with chemicals at high temperature. The fibre properties of raw material affect the quality and use of paper.

The present study describes the use of wheat straw as raw material for making pulp of 83%ISO Brightness using ECF technology from Metso , Sweden. The aim was to determine the factors hampering efficiency of plant in terms of capacity utilization and consumption norms. The experimental part of study consisted of silica removal from wheat straw, impact of season on cooking conditions, raw material storage and handling , screening and washing efficiency. The outcome was to produce bleached pulp of best quality using OD0EopD1 sequence in bleaching.This paper also provides solutions to operational problems and advises towards stable runnability of pulping plant in coordination with recovery to improve overall product quality, reduce costs and enhance customer satisfaction.

About The Mill

M/s Trident Limited(Paper) is an integrated pulp and paper mill situated at Dhaula, District Barnala, Punjab. It is a part of Trident Limited group. The mill produces Eco-friendly paper of various grade using wheat straw(mainly) and Hardwood/Bamboo/Veneer chip.

The paper division of Trident was established at Barnala (Dhaula), Punjab in the year 1993. The mill was implanted as a 75 tpd Writing and Printing grade paper mill, based primarily on Wheat Straw. Trident has upgraded its paper as well as pulp mill to expand the capacity and make the operations more environmentally friendly. Presently the mill produces 392 tpd of Printing and Writing paper grades, which are widely accepted in national and international markets.with latest Eco-friendly technologies. The new Fibre line supplied by the world leader Metso Sundsval AB., Sweden, with an ECF bleaching sequence of $OD_1E(OP)D_2$ to get the brightness of bleach pulp of 83+ %ISO.

Introduction

Total global papermaking fibre consumption is projected to increase from about 300 millions tones for 1998 to about 425 million tones by Jaakko Poyry Consultants (1). The new fibre requirement will come from Recovered fibre, Non-wood fibre and fast growing wood plants. Atchison (2) estimates that the global supply of Agricultural residues which could be used for paper making is in the order of 2.45 billion bone dry metric tones. Of this, about half is Straw which, in fact, the most widely used Non-wood plant fibrous raw material in the Pulp and Paper Industry. As per Robert W.Hurter (3), China 73.5%, India 6.3%, Pakistan 2.0%, Mixico 1.6% and Peru amounts to 1.4% of the total global Non-wood pulping capacity.

With ever increasing awareness towards pollution abatement and with the implementation of stricter environmental regulations, the pulp and paper industry is forced to look for alternatives to meet the stringent effluent regulations and ever growing competition. IFC Environmental Review Report (4) has recommended M/s Packages Limited, Punjab Province, Pakistan to go for ECF bleaching of $\mathbf{D_1E(OP)D_2}$ sequence for their new 2005-2008 Wheat Straw Sulphite pulp project, to reduce the AOX emissions.

Generally free radical present in Chlorine Dioxide is very sensitive and also highly reactive as an oxidizing agent in ECF bleaching sequence of Chemical pulps. It is specific in reacting with pulp constituent component getting oxidized (5). This results in preserving strength while giving high brightness, less colour reversion of bleached pulp and low AOX discharge level when compared to that of conventional CEHH bleaching sequence. This paper discusses about silica removal from wheat straw, impact of season on cooking conditions, raw material storage and handling , screening and washing efficiency, optimization of Oxygen Delignification and ClO2 bleaching conditions. It also focuses on the benefits of using $\mathbf{OD_1E_pD_2}$ bleaching sequence to produce 83 %ISO brightness pulp from Soda Wheat Straw chemical pulp.

Challenges and solutions- an experience

Trident Paper, Barnala is one of largest ECF wheat straw based

Metso fiberline in the world. This mill is designed for 225 BDT/d, started in April 08 and makes 83%ISO brightness pulp. Wheat straw as raw material for making pulp through ECF bleaching poses many challenges to get desired quality of pulp with minimum cost at sustainable basis. The main challenges faced can be categorized as under :

1. Raw material handling quality of wheat straw/consistent feed to continuous Digestor
2. Washing high soda loss and screening/cleaning
3. Equipment Health MC pumps/screw conveyors and Scaling

Raw Material Handling

Wheat straw is bulky raw material with bulk density of 56kg/m^3(6) and we require 574TPD as such raw material to make 225TPD bleached pulp. Wheat straw is coming directly from field, contains dust(4-5%) and moisture(7-12%, high during rain).The chemical composition of wheat straw is 27.1% α-cellulose, 28.9% hemi cellulose, 23% lignin, 9.99% ash, 6.3% silica silicate,4.7% EtOH Benzene extractives(7). Silica removal from wheat straw is utmost priority before feeding it to continuous digestor. In 2008, online dedusting was used with two dedusters(12BD TPH each) installed and Pin Drum Feeder(PDF) above them to control feed but we faced frequent jamming problem and breakdown in slat chain conveyor which was used to distribute material in dedusters. Offline dedusting was installed in 2010 to cater this problem and simultaneously the hole size of deduster basket increased from 4mm to 4x6mm for better dedusting efficiency.

About 80% of Wheat straw requirement is procured within 100km radius from vicinity of mill, still we observe variation in input quality of wheat straw. Variation in wheat straw is of two types seasonal impact and external contamination. To know seasonal impact, Pulping optimization of wheat straw (new) and wheat straw (old) was conducted using various dosages i.e. 12% to 14% as mentioned in Table 1. Unbleached pulps of kappa number ~ 15 were obtained. The detailed pulping optimization results are incorporated in the Table 2. To arrest external contamination in wheat straw , SOP has been implemented where QC/Production/RM plays its role together in sampling and testing is done by QC.

During rainy season, storage of wheat straw also poses challenge as it starts deteriorating faster. The color from golden yellow turns to dark brown and it lowers yield and brightness and increases chemical consumption. The storage of material on Kacha yard makes situation worse due to high heat generated from ground during rainy season. It is advisable to store wheat straw on RCC floor and rotate material on FIFO basis.

Table 1: PROPORTION

Set No.	Wheat Straw (New) %	Wheat Straw (Old) %	TAA % (as Na2O)
1	100	0	**13**
2	100	0	**14**
3	0	100	**12**

Table 2 Pulping optimization

Parameter	Wheat straw (New) (100%)		Wheat straw (Old) (100%)
Set No.	**1**	**2**	**3**
Active alkali (%)	**13**	**14**	**12**
Bath ratio	**1:5**	**1:5**	**1:5**
Kappa no.	**16.4**	**14.8**	**15.2**
Unbleached yield (%)	**50.8**	**50.1**	**49.7**
Brightness (%)	**38.2**	**39.8**	**37.3**
Total Solids (%)	**12.0**	**12.3**	**12.1**
RAA (g/l)	**4.8**	**5.4**	**5.3**
pH	**12.3**	**12.2**	**12.2**
CONDITIONS			
Time to Temperature 167^{0}C	90	90	90
Time at Temperature 167^{0}C	50	50	50

Table 3: Adherent silica in feed(BC-3) to Continuous Digestor

Month	BC-1, % Adhere Silica	BC-3, % Adhere Silica	Wet Washing efficiency,%
Jan-12	0.71	0.33	53.5
Feb-12	0.82	0.31	62.2
Mar-12	0.77	0.3	61.0
Apr-12	0.71	0.32	54.9

Dedusting is able to remove 25% of adherent silica from wheat straw. Wet washing plays crutial role in removal of silica with the help of warm water(condensate from Soda Recovery).Feed fluctuation and filterate tank cleaning were the major problems faced for better wet washing efficiency. VFD control is applied on feeding belt conveyor to have consistent feed.We have also done filterate tank modification(2 tanks with baffles construction, one in operation) and installed 4 rotary screens(2 in operation).This has given an opportunity to clean filterate tank on daily basis. The filterate(purging 10-15%) is treated in biomethanation plant to generate CH4 gas and reduce COD.We maintain adherent silica in range of 0.33-0.35% in feed(Table 3) going to continuous digestor.

Washing

Washing stage is combination of submerged type drum filter followed by twin roll press. Due to poor vacuum in drum filter we have faced problem of high soda loss and thus high ClO_2 consumption initially.We have modified vacuum valve by increasing its size with the help of Metso(OEM) and also optimized barometric leg(increased dia from 200mm to 300mm) to increased vacuum and thus reduction of soda loss.

Screening has slot type basket to have lesser shive content. Metso initially recommnded 0.25mm slot in primary screen basket but we could not get desired throughput(10TPH) and frequent basket jamming problems after

certain throughput(8TPH). Then we changed slot size to 0.35mm slot in consultation with Metso and able to normalize throughput without any major impact on quality. MD cleaner is installed in between primary screen and secondary screen to get better life of secondary screen. We also faced problem of WBL balance in system wrt to washing efficiency, soda loss,DR and WBL going to recovery. Then we have increased capacity of WBL filteration and thus able to maintain washing efficiency and able to increase WBL solids from 9.5% to 11% going to Soda Recovery. This resulted into soda loss reduction and thus chemical reduction in bleaching.

Fig 1

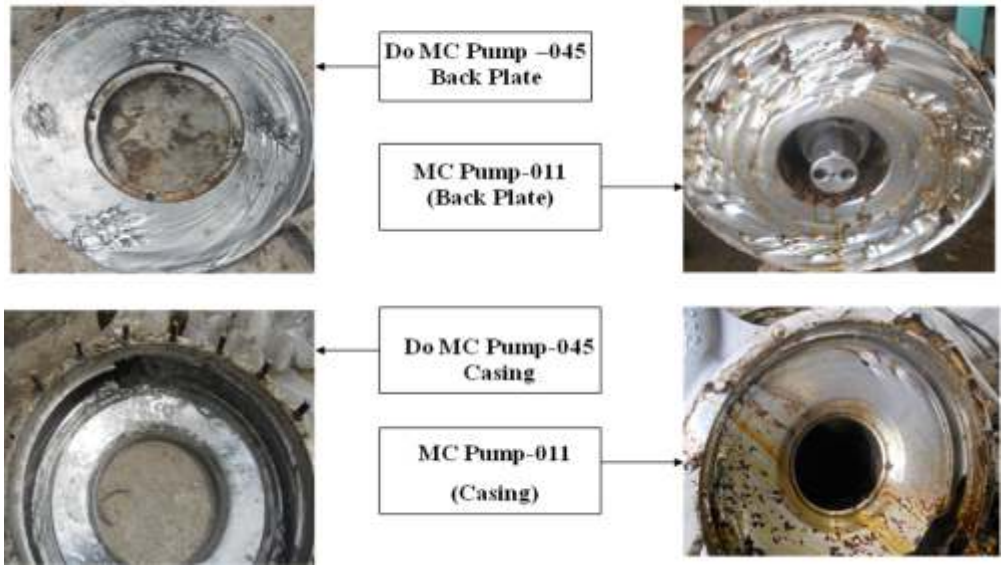
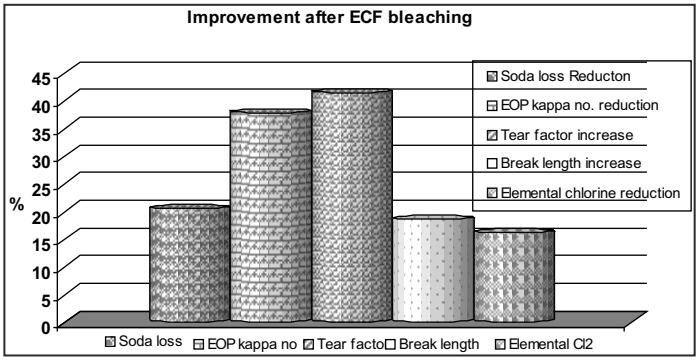


Table-3 Physical and strength properties of straw pulp with conventional (CEHH) and ECF bleaching (ODL, D0, EOP, D1)

Sr.NO	Parameters	Unit	Test results	
			CEHH	ECF
1	Digester Kappa no		16.9	15.8
2	Soda loss	kg/t as Na2SO4	34.0	30.5
3	Extraction stage Kappa no.		4.5	2.8
4	Final brightness	ISO	80.0	82.5
5.	Tear factor		40.0	56.5
6.	Break length	m	4600	5450



Equipment Health

Bleaching uses Twin roll presses for washing of pulp after reaction before going to next stage. We have faced severe scaling problem in ODL stage and EOP stage which hampered our production as plant has to shut for 10-12 hours for press boil out after every 25-30 days. Then we got sample of scale tested for both stages and found out that scale at ODL stage contains mainly Calicium as CaO, 40%(8) and Silica as SiO2, 33%(8) on the ash basis. Scale at EOP stage contains mainly Calcium as CaO, 38%(8) and Silica as SiO2, 41%(8) on the ash basis.We have taken online descaling program based on scale analysis and have got improvement in press efficiency in terms of all parameters and boil out frequency has reduced from 30 days to 300days in ODL press and from 25 days to 100 days in EOP press.

MC pumps are the heart of plant and plant performance depends on health of MC pumps. Initially we faced wear and tear of MC pump internals and it lead to lower throughput, higher power consumption and poor quality. Then we worked on study of its life patterns, cavitation(see Fig1) and MOC of pumps (increase in Cr and Ni% for hardness) and able to run plant smoothly with preventive maintenance.

Comparision between Conventional Bleaching(CEHH) Vs ECF Bleaching

Adoption of ECF technology in wheat straw pulping has transformed pulp properties and we have got consistent and better pulp properties. The table 3 gives details about all critical properties of pulp in comparision.

Conclusion

Consistent and stable runnability of plant is most important factor in optimizing all process parameters. Dedusting and wet washing plays crutial role and further technology adopted takes care in getting desired output in terms of quality and quantity. The comparision of conventional bleaching Vs ECF Bleaching reveals reduction in soda loss 10.3%, EOP kappa reduction 37.7% and active chlorine reduction 12 kg/t. The improvement was also observed in strength properties with increase in tear factor by 41.3%, breaking length by 18.5%.

Limitations

1. Brightness sealing of wheat straw
2. Black spots which are carried in paper
3. Variation in wheat straw behavior due to seasonal impact

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