Challenges in Agro Based Chemical Recovery to Improve Its Overall Performance

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ABSTRACT

The prime purpose of Soda Recovery Boiler is to recover chemicals and heat from the black liquor, efficient generation of steam and electrical power from the fuel values of the black liquor. Recovery operation consists of concentrating the weak black liquor for firing in the Recovery Boiler & to produce white liquor which is returned to the Pulp Mill for cooking. Overall purpose is to have maximum caustic recovery with minimum wastages, minimum conversion cost & meeting all the environmental norms.

The present study describes the recovery of caustic from black liquor generated out of Baggase/Wheat straw cooking and the challenges/problems associated with the use of Baggase/Wheat straw WBL as raw material for the Chemical recovery plant. Paper describes the counter measures were taken to efficiently run the recovery plant to meet the pulp mill requirement with minimum make up & conversion cost & unique practices being followed in the Recovery Operations to overcome these difficulties. The practical difficulties faced on account of high silica along with a host of non process elements (NPEs) & low GCV of Bagasse/Straw WBL. Major challenges in agro-based chemical recovery are overall recovery efficiency drop, low concentration of black liquor from evaporator, steam economy, steam generation, ESP breakdowns, high lime consumption in causticizing, scaling, deposition at heat transfer surfaces, high moisture inside the ESP, improper combustions etc.

Introduction

Current paper production at Yash Papers Limited is 120 MT/day. The raw material used for making paper is Baggase and Wheat Straw as per the seasonal availability. The Recovery Boiler at Yash Papers Limited supplied by M/s Enmas Andritz Pvt. Ltd., Chennai which was commissioned in October 2007, is a single drum type unit designed for maximum continuous rating of 140 TDS/D black liquor solids. The boiler is equipped with a cascade type direct contact evaporator after which the black liquor dry solid content is around 62 %. The recovery boiler is designed to produce steam at 465±10 ^{0}C and 65 bar (a) the net super-heated steam generation of approximately 12.384 tph.

Various aspects of running Recovery on Agro based liquor

Operating conventional recovery plant with agro based liquor as compared to wood or bamboo liquor involves big challenges. The composition of Baggase/Wheat Straw liquor is severely mutated due to the presence of certain NPEs (Non Process Elements). This difference in composition is translated not only in operational and design challenges but economical stiffness as well.

Steps taken to reduce the impact of high silica in WBL

Brief Description of Recovery Plant Technology & Capacity:

SECTION	RECOVERY	
	Supplier	Capacity
Evaporator	Alfa Laval	Six Effect FFFF Plant Type – Tubular Falling Film Water Evaporation – 68 TPH Steam Economy – 5.2 O/L Concentration – 50%
Recovery Boiler	Enmas Andritz	140 TDS /day Firing Capacity Steam Generation – 12.384 TPH
Causticizing	Hindustan Dorr Oliver	32 TPD (TAA as NaOH)

○ **Controlling the final SCBL viscosity by effective addition of white liquor to feed & Cascade-**

RAA of the feed liquor in the weak black liquor is being maintained in the range of 4 to 5 gpl by controlled dosing of the solution with TTA 75 to 80 gpl as Na_2O that result in a greater fluidity in a liquor which maintain the production rate and steam economy above 5.2.

○ **Effectiveness of HP cleaning-**

Viscosity of different Black Liquors at different Solids (RAA 5-6 gpl):

Raw Material	Viscosity(cps) at 100^0 at Total Solids % w/w					
	35	**45**	**50**	**55**	**60**	**65**
Pine	2.9	9.1	18	40	-	-
Eucalyptus	3.4	2.3	83	380	-	-
Eta Reeds	8.7	41	100	395	-	-
Bamboo	-	-	11	31	125	398
Wheat Straw	-	-	89	199	450	1000
Bagasse	84	125	161	912	-	-
Rice Straw	33	112	316	-	-	-

Weak Black Liquor Specification at YPL:

Organics	%	54.22
Inorganic	%	45.78
TTA as Na_2O	gpl	30.92
RAA as Na_2O	gpl	7
Free alkali	gpl	6 to 7
Suspended solids	ppm	-100
pH		>=12

Viscosity of Black Liquor:

Predicted viscosity data and specific gravity at various concentrations is considered as follows:

Total Solids (%)	Viscosity(cps) @ 900C
18	10
24	20
34	30
43	50
50	200

Cleaning schedule is followed based on the time, pressure drop & delta T of each calendria. Approximately 12-15 bodies are cleaned every month to reduce the scaling.

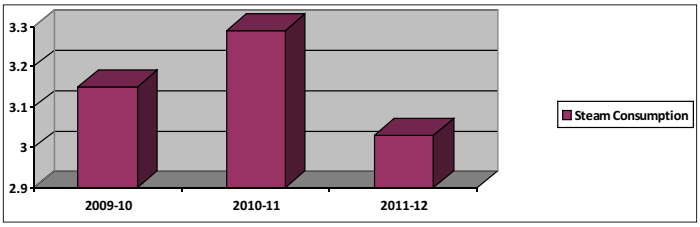
o **Maintaining the vacuum in the PHE>625 mmHG-**

Vacuum plays a very important role in evaporation & scaling of the heat transfer area. Vacuum is maintained in the range of 630-650 mmHG by efficient operation of cooling tower & regular cleaning of PHE. Benefits of PHE are better heat transfer rate due to its construction & compactness also it is very easy to clean with high pressure jet.

o **CIP system for first & Second effects-**

CIP System (Cleaning In Place) which has a combination of caustic soda & nitric acid in the ratio of 10%:2% solution could be used for wash up particularly for 1st and 2nd effect. And regular boiling of effects is taken to keep HT surfaces in healthy condition. Bypassing arrangement was provided in 2nd (proposed 3rd & 4th) as a part of design. The 2nd body can be bypassed without shutting the plant.

Particular	UOM	2009-10	2010-11	2011-12
Total Steam Consumption	MT/MT-BLS	3.15	3.29	3.03



Steps taken to counter high carry over in Evaporator to reduce the Conductivity

- Product flash vapour to 2nd & 3rd effect was modified to avoid direct impingement of liquors.
- Baffle has been provided inside the feed flash vessel & exit orifice was provided to arrest the contaminations.
- Re-fixed the NRV in SCFT-1 & 2 vapour line to 1st & 2nd effect which results pure condensate conductivity drop down up to 4µ from 10µ.

Steps taken to counter high Silica/NPE's content & Low GCV of the WBL in the Boilers

o **Strict adherence to the Effective Soot Blowing operation-**

The purpose of the Soot Blowers is the cleaning of the heat transfer surfaces with high pressure steam, from one or more nozzle openings located at the end of a long rotating lance tube. SB operation is based on both time & pressure drop across different zones. Points taken care for effective soot blowing to minimize the HP steam consumption as well as to maximize the steam generation are:

o Area wise pressure:

- Super Heater Soot Blowers 20-22 bar
- Boiler Bank 16-18 bar
- Economizer 12-15 bar

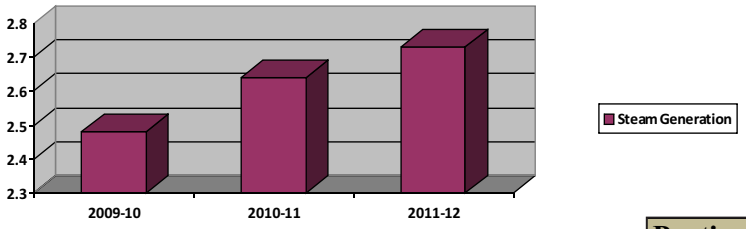
- The number and spacing of the soot blowers are based on the effective radius for steam blowing in Recovery Blower Service.
- SB's are operated based on the pressure drop across Super heaters, Boiler Bank, Economizers.
- All the soot blowers were provided with mechanical stoppers in spite of limit switches to avoid the malfunctioning of soot blowers.

o **Maintaining the Furnace stability/flame-**

- Liquor temperature is maintained in the range of 122-125^{0}C.
- Oxygen is maintained in the range of 3-4% to ensure uniform & complete combustion.
- Positive draft is being maintained in the range of 5-8 mmWC as per the liquor concentration, calorific valve.
- Viscosity of the liquor is maintained from Evaporator mentioned earlier.
- Combustion was optimized by PA and SA fan suction was modified to have better flow.
- Spray gun angles towards hearth were modified to 42-45^0 which results better liquor profile & avoid the carryover.
- ID fan casing online wash-up was done to avoid the breakdowns of ID fan.

- **Dilution of firing liquor was optimized.**
- **Indirect heater was kept in circuit.**
- **Combustion air temp was maintained above 180 ^{0}C.**

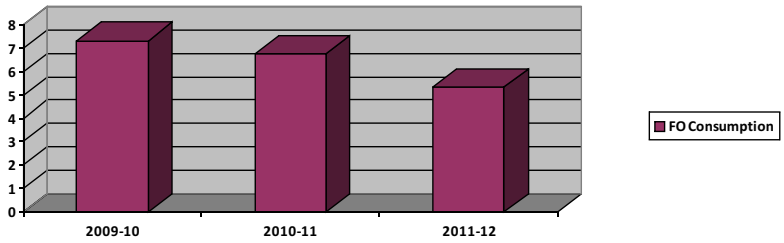
Particular	UOM	2009-10	2010-11	2011-12
Steam Generation	MT/MT-BLS fired	2.48	2.64	2.73



Steps taken to reduce the FO consumption

- Reduction in spray gun changeover time by provided standby arrangement.
- Burner housing modified for better combustion.
- Relocate the temp transmitter to avoid the vapour lock and the temp. 105-110^{0}C.
- Avoid F.O. consumption during soot blowing by keeping furnace draft slightly high +10 mmWC.
- Burner tip was modified for 4 holes of dia 0.8-1.2mm.

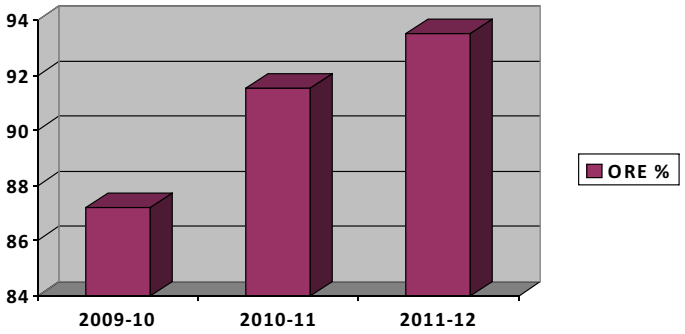
Particular	UOM	2009-10	2010-11	2011-12
FO Consumption	Ltrs/MT-BLS fired	7.32	6.77	5.34



Steps taken to improve the performance of ESP & Overall Efficiency

- Improve and maintain the ESP Inlet temp. 170 ^{0}C by firing the density of BL 1.366 gm/ml with 64 ^{0}Tw.
  - Cascade inlet liquor temp. was maintained upto 95-98 ^{0}C.
  - Cascade dosing funnel was re-locate to areest the droplet carryover, in addition to that deflecting plate was provided inside the Cascade.
  - DC heater inlet steam nozzle size was modified.
- All the supports and shaft insulators were covered with Teflon sheet (of high resistance temp.) to avoid the impact of moisture on insulators which results drastic reduction in insulator breakage.
- Uniform distribution of flue gas through the GD screen was achieved by modifying the inlet duct of ESP.
- SS cladding of ESP top roof were done to avoid the fallen of RCC which improved run ability of ESP.
- Soda loss at pulp mill was optimized up to 17-18 Kg/MT-Pulp as Na_2SO_4.

Particular	UOM	2009-10	2010-11	2011-12
ORE%	%	87.22	91.54	93.51



2009-10	
Month	ORE%
Apr-09	77.33
May-09	88.51
Jun-09	88.22
Jul-09	85.09
Aug-09	90.26
Sep-09	87.18
Oct-09	88.29
Nov-09	92.1
Dec-09	86.8
Jan-10	87.2
Feb-10	87.65
Mar-10	88.01
Average	**87.22**

2010-11	
Month	ORE%
Apr-10	93.61
May-10	91.09
Jun-10	94.36
Jul-10	90.03
Aug-10	93.94
Sep-10	90.26
Oct-10	89.31
Nov-10	93
Dec-10	92.5
Jan-11	88.22
Feb-11	88.76
Mar-11	93.34
Average	**91.54**

2011-12	
Month	ORE%
Apr-11	92.49
May-11	93.86
Jun-11	93.1
Jul-11	93.5
Aug-11	91.33
Sep-11	92.16
Oct-11	94.21
Nov-11	94.51
Dec-11	93.32
Jan-12	94.29
Feb-12	94.64
Mar-12	94.7
Average	**93.51**

Steps taken for efficient operation in the causticizing

- **Online Swapping of the GL/WWL lines to reduce the fouling of GL lines**

- Manual valves are provided in both the Causticizing & Recovery Boiler for swapping the GL & WWL lines.
- Lines are interchanged after 24 hours to avoid any build up of scale in GL transfer line.
- Lines are being cleaned with HP once in 2 years.

Maintained the Concentration of GL at boiler

- Online density measurements are provided to maintain the concentration of the GL right from MDT to processing system.
- Avoid processing of high GPL green liquor & hence scaling in the lines.
- This also helps in maintaining the downstream operation like lime addition, temp & WL conc.

Efficient Operation of the Lime Mud Filters

- Modification at mud filters receiver & condenser to arrest the vapour entrainment of excess lime.
- Ant scale dosing in vacuum pump to avoid the frequent jamming of vacuum pump & vacuum drop.
- Installations of VFD to control the RPM of Mud filter drum which results better cake disposal.
- By keeping 65-70^{0}C temp in slurry which results reduction in moisture of cake & effective washing of cake reduce the alkali loss.
- NRV was re-fixed at filtrate pump delivery to avoid the air locking which results avoid of vat overflow as well as vacuum drop.

Steps Taken to reduce the Lime consumption

- VFD was installed at table feeder and rake classifier which results proper mixing of GL with Lime, reduction of excess lime, reduction in choking of slacker chute and proper removal of grits with less alkali loss.
- Slacker baffles were modified to have a better retention of slurry to achieve complete slacking.
- Agitator was installed at sump box for uniform mixing.
- First in & first out system was followed at lime stock area to avoid the in-house purity drop.
- Table feeder area was covered with old felt to avoid the moisture contamination in feed lime.
- Washing efficiency was improved at Slacker & rake classifier which results reduction in alkali loss.
- Temp control valve were installed at causticizer No. 01 to maintain the equilibrium of reaction.
- Standardized the purity of lime 82-85% as CaO.
- Reduce the SS of GL by maintaining the frequency of circulation & discharge of dregs efficiently.

PARTICULARS	UOM	2009-10	2010-11	2011-12
Steam Consumption	MT/MT – BLS	3.15	3.29	3.03
Power Consumption	KwH/MT – WL Prod.	496	435	399
F.O. Consumption	Ltrs/MT – BLS Fired	7.32	6.77	5.34
Lime Consumption	Kg/MT – WL Prod.	973	999	963
Steam Generation	MT/MT – BLS Fired	2.48	2.64	2.73
WL Production	MT	601.52	698.93	685.72
Average RAA	gpl	3.9	4.2	3.9
ORE	%	87.22	91.54	93.51

Particular	UOM	2009-10	2010-11	2011-12
Lime Consumption	Kg/MT-WL Prod.	973	999	963

Conclusion

The greater opportunity for increasing energy and chemical recovery efficiency and for improving overall operating performance through advanced energy integration and mill-wide control. Following are the parameters/targets being maintained in Recovery unit to effectively meet the pulp requirements keeping the minimum cost of conversion.

Referance

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