Minimum Impact Manufacturing (MIM) At M/s Seshasayee Paper And Boards Limited

Marimuthu. P. , Mahrotra A.K.

ABSTRACT

Global renewed interests on improved environmental protection have constrained the industry to re-think its prevalent practices in terms of environmental impacts and adherence to the principles of sustainable development. Pulp and paper industries in this context confront an augmented challenge because of its profound reliance on energy consumption to optimize the pulp and paper manufacturing process, it becomes highly pertinent.

This paper describes the cleaner technology adopted in that would go a long way to conserve and preserve natural sources. The approach of pulp and paper industry has changed by adopting the cleaner production techniques and by making changes in the production process, focus on to reduce the pollution levels at the source. Cleaner technology improvement means the elimination of the polluting and emission creating installations and substituting them with better and proven modern equipments, supplied by technology leaders in the globe. While the pollutants cannot be totally avoided, the fluids are treated with better facilities. Also the pollutants are utilized in a productive manner, benefiting out of a problem.

This paper expounds the methods adopted to save the natural resources and avoiding the emissions in an exemplary manner. This paper highlights the achievements made by SPB Tamilnadu by adopting cleaner technology towards Minimum Impact manufacture.

Introduction

Global environment has been adversely affected as a by-product of rapid growth of industries aiming extensive prosperity of mankind. While the growth is essential, the care for the environment must be equally focused in the process of development and progress. Only environmentally sustained growth adds on to the overall social-economic welfare. Sustainable development implies meeting the needs of the present while preserving the natural resources for the future generations. Our posterity will be cursing us, if we fail to achieve a satisfactory level of harmony between the development and environment. It is imperative to take necessary steps to ensure that the environment protection remains on top of our agenda. An effective environmental management approach involves progressive adoption of cleaner technology practices and identifying and minimizing the risks posed to the protection of environment and community.

Development of various new technologies in pulp and paper making process is on-going in order to save the natural forest while meeting the steadily increasing demand of paper without increasing the costs of production and never compromising on the quality required by the customer and the global standard. Present trend is to aim a closure of chemical cycles, achieving maximum efficiency with minimum pollution.

Sheshasayee Paper and Boards Ltd, Erode-638007 (Tamilnadu.)

Cleaner technology means any technical measures taken in various industries to reduce or even eliminate production of any nuisance, pollution or waste at source. This helps to save raw materials, natural sources and energy. Following are the advantages of cleaner technology.

- Cost saving through reduced raw material consumption
- Improved product quality thro' process control
- Reduction of energy consumption
- Increased competitiveness
- Improved customer focus relationship
- Improved compliance with environment requirement

'Cleaner technology' results in greater benefits in saving the overall operations of the industry and addressed the future environmental challenges.

M/s Seshasayee Paper And Boards is a large integrated pulp and paper mill using mixed Hard wood and Bagasse as the raw materials and equipped with full fledged chemical recovery stream, Co-generation plant and an effluent treatment plant. The Mill has undergone a major change-over through the Mill Development Plan envisaged in the year 2007- 08 as a part of its mission to migrate to adoption cleaner technology.

The Mill Development Plan [MDP] includes:

- Installation of a new modern Hard wood pulp mill of 400 tpd capacity with double displacement RDH cooking Technology GL&V USA
- Single stage oxygen delignification
- An ECF bleaching sequence comprising of Chlorine di oxide (Do) followed by EOP and finally with D1 to get brightness level of + 87%
- Replacing two less-energy efficient Evaporator streets with Single Street Multi-effect Falling Film type with water evaporation capacity 200 t/hr from M/s.Alfa Laval India
- Replacing two chemical recovery Boilers operating at low pressure to one single chemical recovery high pressure Boiler, with a capacity of 900 TPD and a pressure of 65 atm, from M/s.Enmas Andritz India
- Replacement of old TG sets of smaller capacities with a single Extraction cum back pressure turbine of 16MW from M/s .BHEL, India

- Retrofitting of causticizing section with WLCD and installation of Rotary Lime Kiln of 200 TPD from M/s.FLSmidth, India
- Installation of producer gas plant for oil replacement / cost reduction.
- Installation of Mist Cooling System for Evaporator condensate as water conservation.

RDH-Pulping

The RDH pulping system briefly comprise of black liquor addition at different temperature profiles with topped-up white liquor to maintain required chemical to wood & heating the chips through displacement of cold with hot black liquor in stages to reach the designated temperature. This hot spent black liquor at the end of the cook is collected through displacement with weak black liquor from brown pulp washer stored in three different storage tanks with temperature gradients. This provides possibility to heat the chips slowly with controlled alkali profile through white liquor addition and higher sulphidity in the system.

The advantages are:

- Less steam consumption in cooking process: Reduction of steam by 60-70%
- Shorter cooking cycle, benefiting on the yield and strength of the Pulp
- Better pulp with low H- factor
- Possible to produce pulp with uniform & low kappa number saving chemical consumptions
- Pre-treatment of chips
- Improved yield with the low shive content

OXIGEN DELIGNIFICATION

Oxygen delignification has been developed as a powerful tool to reduce the residual lignin content in the unbleached pulp before bleaching. It also a tool to reduce the pollution load in the pulping and bleaching processes. The Oxygen delignification reduces

- Bleach chemical costs
- Discharge of organic matter in the effluent thereby reducing COD
- Discharge of chlorinated organics (AOX) in the effluent stream
- Provide potential possibility to recover the organic back into recovery loop

The advantage of Oxygen delignification is related to the beneficial effects on the environmental parameters especially in the reduction of AOX. Similarly there is a reduction in the COD load to the effluent treatment plant as part of the organics is oxidized within the process itself.

ECF BLEACHING PROCESS

Chlorine di oxide is the most important chemicals used for bleaching chemical pulp as it reacts selectively on lignin without significant degradation of the carbohydrates. At the same time it gives the benefit of higher brightness kraft pulp with better strength properties.

Advantages are

- Better brightness stability i.e. less brightness reversion.
- Lesser in Pollution Load
- Improved pulp viscosity and strength

CHLORINE DIOXIDE PLANT (R8 Process)

Chlorine-di-Oxide (ClO_2) is generated by the reduction of Sodium chlorate in acid medium at controlled conditions. Industrially the production of ClO_2 is generally is through Integrated or Non-Integrated process. On-site generation of sodium chlorate using the electrolysis of brine solution forms the major expensive part of the equipment, in the integrated process. Using the commercially available chlorate as the raw material is used in the Non-integrated process.

Canadian ERCO's non -integrated technology is less expensive and does not constitute the complex electrolytic cell components. The quality of the product is superior since the dissolved chlorine is very minimum and hence useful for the ECF Bleaching. The only effluent is the Sodium sesqui sulphate which is a good substitute for the salt cake in the Recovery, after neutralizing the acidity in the by-product. Any number of start -ups and shut downs do not release any unwanted emissions on account of its quick reaction at right concentrations. The concentration of the product is achieved fast as soon as the generation of ClO_2 is started and hence bleaching quality parameters are not non-uniform.

Advantages:

- Utilization of by product:

A by-product namely Sodium Sesqui sulphate generated in the chlorine dioxide plant - 9-10 t per day of high cost white sodium sulphate is eliminated

CHEMICAL RECOVERY PLANT:
Evaporators

Double stream of time-tested Evaporators replaced with a single stream seven effect Falling Film type with water evaporation capacity of 200 t/hr, supplied by M/s.Alfa Laval India

WATER RECYCLING / CONSERVATION TECHNIQUES

1. EFFLUENT WASTE HEAT RECOVERY SCHEME

The hot effluents which are highly alkaline (pH:~11) cannot be discharged as such. It is normal practice for the same to be cooled by spray /in cooling tower. However, as we find substantial amount of thermal energy is wasted unutilized, efforts are on to tap this useful but difficult energy. Since the effluent has preponderance of fibre content which can choke/foul any heat exchanger (Shell &Tube or Plate Heat Exchanger), a new heat recovery device is being proposed.

Wide-Gap PHE specially designed for hot fluids with fibre content is being planned to be put up for recovering this valuable heat energy. Alternate plates would be having wide gap of, say 12mm (to allow the hot fibrous solution to move across freely without blocking the movement of fluid across the PHE) with 4mm gap in between. Cooling water and the hot effluents shall be flowing in alternate plates (Fig.1).

Being a specialized design with usage of high cost alloyed plates (SS-316) as heat transfer surface, the cost of installation of the wide gap PHE is expectedly high. Counteracting the above, is quantum saving in L.P. steam

The advantages are tabulated as under:
1. Evaporators

Rising film(Old)	Falling Film (New) -
5 effects	7 effects
Low steam economy(4.5t/t)	High steam economy(6.3 t/t)
Low outlet concentration (52 to 57%)	High outlet concentration(70%)
More down time	Low down time
Needs more manpower	Less man power
FC high power consumption	No F.C first effect 3 body – under rotation sequence
Electronic control system	DCS control system
Frequent tube cleaning	Very rare tube cleaning

2. Recovery Boilers.

Old recovery boilers	New recovery boiler
Secondary evaporation required	No secondary evaporation
Low output steam pressure temperature(30kg/cm^2 and 371°C)	Large Economiser High out put steam Press 65 kg. cm^2 and 460°C +10°C
ESP dust emission 150 mg/Nm^3	ESP particulate emission (50mg/ Nm^3)
Low black liquor solids handling (180 t/day)	High black liquor solids handling (550 t/day)
Single spray gun and one ordinary spout on the front side	Eight spray guns and three decanting spouts on the rear side
Wall spray liquor firing	Suspension spray ie. Firing in the space
Dual level combustion air	Vertical air– 3 level Combustion air staging
Steam generation 3.0 t / t of solids	3.3 t / t of solids
Double drum boiler feed water temperature 105°C	Single drum feed water temperature 135°C
Attemparator for steam temperature control	Multi-level Attemperator with feed water spray

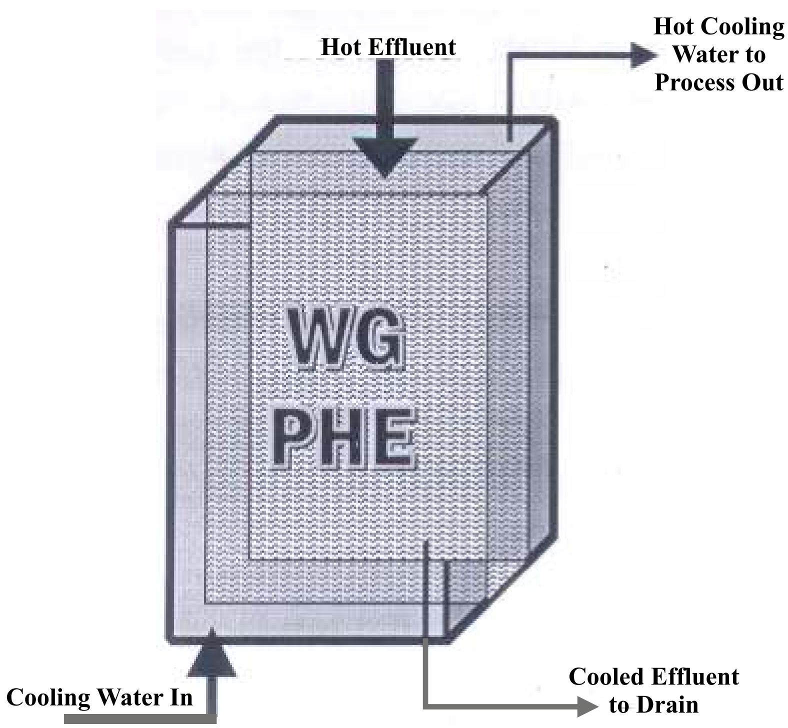

Fig.1. Effluent Heat Recovery Wide Gap PHE

Table - 1
DESIGN SPECIFICATIONS OF WG PHE

Parameter		Effluent Stream	Cooling Water
Side		Hot	Cold
PHE Gap for flow	mm	12	4
Flow	TPH	80	115
Temperature in	°C	85	34
Temperature out	°C	40	65
Heat Load		4 MW t	
Equiv. LP Steam saving		6½ -7 TPH	

consumption through WHR by use of PHE. The broad design and operating specifications are appended in Table-1.

1. MIST COOLING SYSTEM IN CHEMICAL RECOVERY PLANT

Clarified water was used as sealing water in the vacuum pumps in the Evaporation plant and in the Lime Mud Clari Disc Filter and in the White Liquor Clari Disc filter compressor. The rotor of the vacuum pumps and compressor used to get scaled due to the hardness in the mill water and the efficiency / availability of the equipment was coming down. Descaling Chemicals in these equipment were being used regularly which was adding to the cost of production.

Efforts will made to use the process condensate from the evaporator as sealing water for the vacuum pumps & compressors. The process condensate generated in the evaporation plant is let out at 60°C. The same has to be cooled to a temperature below 32 / 33°C before using as sealing water. For reducing the temperature of the process condensate, a Mist Cooling System had been installed (Fig.2). In the new unit, the process condensate @ 60 °C is sprayed in the form of a mist and collected in a sump and pumped as sealing water @ 32 / 33 °C.

Mist Cooling Unit in Operation

Evaporation plant present water evaporation is 175TPH. Process condensate generation is around 170TPH. Out of the 170 TPH of process condensate produced, 100TPH is used as Hot Water in the Recausticizing plant for Lime Mud Washing and of the balance 70TPH , 50TPH is used in the Mist Cooling system. This meets the Sealing Water requirement of 45TPH.

Benefits

a) Mill water usage had got reduced by 1050 m^3 per day. (i.e., ~30,000 m^3/month)
b) Usage of descaling chemicals is totally avoided resulting in cost reduction
c) Improved performance of the vacuum pumps & compressor had been ensured.

The Mist cooling system can very well be replicated in other pulp and paper mills having Recovery island in their complex.

3. Rotary Lime Kiln with Producer Gas substitution.

Before Mill Development Plan (MDP), SPB was forced to use purchased Burnt lime entirely for the causticzing plant. Lime sludge produced during the operation is disposed off to a near -by cement factory to a possible maximum amount. But, under MDP, a rotary lime kiln is installed with a capacity of 200 tpd. Utilizing to reburn 75% of the lime sludge produced. The purity of lime produced is in the range of 74-77% on a regular basis.

In the present scenario, with sky rocketing oil cost reburning of lime is not an economical solution unless alternate fuel like Bio-gas, producer gas etc. is used. SPB had been using furnace oil in their lime kiln of the order of 24-25 t / Day In order to reduce the cost of lime, producer gas is identified as partial substitute for furnace oil as fuel. A producer gas plant has been installed and commissioned with coal as fuel. The generation of producer gas at the rate of 2000 Nm^3/hr has resulted in over 30% reduction in oil consumption..

4. Captive Cogeneration plant:

Energy conservation is multifaceted, with power, steam, and water and environment management. Cogeneration implies steam and power generation from the same source. Pulp and Paper industry is energy intensive. Compared to the International standards, unit steam consumption for Indian paper and pulp industry is relatively higher. This impacts not only the production costs, but also impairing environment and climate. SPB thought it fit to go for in-house power generation complementing steam requirement of the process there by reducing the dependence on the unsteady grid power.

SPB has installed the state of- art high pressure Captive Co generation Plant to meet the bulk of steam and power requirements with high degree of efficacy. The high pressure steam(105 bar, 510°C) generated in the atmospheric fluidized bed combustion boiler supplied by M/s. Enmas Andritz is integrated to the highly efficient double extraction condensing steam turbine of M/s BHEL for the combined heat and power requirements of the paper mill. The boiler is firing imported coal with thermal efficiency of 85% on GCV of the fuel. With high combustion efficiency and advanced ESP in place at the back -end of the boiler , the particulate emission through the stack is well under 50 mg/Nm3 - which is on par with International Standards. Extraction steam from the turbine at 10bar and 4 bar are being used in the process apart from meeting Deaerator steam requirements. Specific steam consumption is around 5 tph/Mw in the cogeneration mode of operation.

Fig. 2. Mist Cooling System

The salient feature s of co generation plant is as under:

- Highest steam pressure coal fired boiler with very high thermal efficiency (85% on GCV)
- Double-Extraction condensing steam turbo-generator with low specific steam consumption(5 TPH/MW)
- Conservation and very high condenser vacuum(0.91 ata)
- Operating in islanding mode or parallel with Grid
- Uninterrupted high quality power
- Quality steam at the desired pressure levels for process
- Flexibility in manouvering to system / process requirements
- Flexibility in change over for additional power / steam generation to suit
- Higher Deaerator operating pressure and temperature (135 °C) enhancing cycle efficiency (over 70%).

Benefits achieved are:

- With the successful operation of the high pressure cogeneration plant , steam and power are made available through in-house generation thus greatly reducing the dependence on import power there -by improving reliability.
- High thermal efficiency of the AFBC boiler- low stack gas temperature and very high combustion efficiency relates to high evaporation ratio.
- With increase in operating pressure of the boiler the lowered specific steam consumption has resulted in increased power generation
- VFD s installed for the fans in boiler had greatly contributed to lowering of station power consumption of CCP

5. CONDENSATE POLISHING UNIT

Through polishing of the Indirect Process Condensate preceded by heat recovery from the otherwise wasted thermal energy, gains achieved are 2-fold viz., reduction in steam & treated D.M. water consumption. The heat in the process condensate is first recovered through a Plate Heat exchanger through transfer of heat to the incoming cold D.M. make-up water; then the cooled condensate is sent to polishing unit consisting of AC filter followed by D.M. unit. The treated high quality D.M. water is sent to boiler feed water storage tank. The design & operating conditions of PHE alongwith the gains in steam reduction are outlined in Table -2 , for ready reference.

In the absence of CPU Heat recovery scheme in place, the hot process water has to be drained out ; with the result , fresh water of around 600 to 700 m^3/day is required for DM plant for boiler make-up feed water. Based on the success of the above, the scheme had been extended in Recovery Cogeneration island.

6. LOW TEMPERATURE WASTE HEAT RECOVERY

Cooling water return from turbine /evaporator condenser, being warm, is presently being led to the cooling tower; cooled water along with the required make-up water is returned to the condenser for removing thermal energy from exhaust steam. The closed cycle cooling continues unabated. The proposal, which is in the early stages of implementation, is one of recovery of the waste thermal energy for useful purposes.

It is proposed to direct part of the warm water from the condenser return to be taken directly for process use. The process water shall now be heated from 45°C instead from 35 °C to the desired final temperature of 75°to 80°C, as required by the fibre-line.(See Fig.3).Through this scheme of heat recovery, ~7 TPH LP steam can be saved. Either additional power can be generated in DEC turbine; alternatively fossil fuel firing can be reduced.

EFFLUENT TREATMENT PLANT:

Our Effluent treatment plant consists of an anaerobic lagoon for the treatment of high BOD effluent generated from bagasse preparation plant and the overflow from the lagoon is treated by activated sludge process along with waste waters from all other the plants.

ACTIVATED SLUDGE PROCESS:

The activated-sludge process is a biological method of wastewater treatment that is performed by a variable and mixed community of microorganisms in an aerobic aquatic environment. These microorganisms derive energy from carbonaceous organic matter in aerated wastewater for the production of new cells in a process known as synthesis, while simultaneously releasing energy through the conversion of this organic matter into compounds that contain lower energy, such as carbon dioxide and water, in a process called respiration. As well, a variable number of microorganisms in the system obtain energy by converting ammonia nitrogen to nitrate nitrogen in a process termed nitrification. This consortium of microorganisms, the biological component of the process, is known collectively as activated sludge. The typical analysis of discharged effulent is as given below.

Final treated Effluent characteristics:

Description	UOM	Before MDP	After MDP
pH	-	6.5-7.5	7.0-7.5
Total suspended solids	ppm	50-100	10-20
COD	ppm	150-200	80-100
BOD	ppm	20-25	8-10
AOX	Kg/ t of paper	0.8 - 1.0	0.05 - 0.1

Conclusion:

By adopting the available new various technologies our mill achieving continuous improvement as given;

- ➢ With RDH pulping process considerable energy saving in steam consumption of 0.7 t against 1.7 t /t as before.
- ➢ Steam demand in digester 15 t/hr for 250 tpd as against12 t/hr for 150 tpd
- ➢ Water consumption after MDP 25 m^3 as against 56 m^3 / t of pulp
- ➢ Improved quality of pulp with respect to yield
- ➢ Improved pulp strength and viscosity with better brightness.
- ➢ Reduction in pollution load in terms of COD, BOD and AOX values
- ➢ Reduction of furnace oil consumption due to producer gas resulting cost saving in kiln lime production
- ➢ Improved chemical recovery efficiency at 95-96%
- ➢ Overall improvement in environment performances

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TABLE -2
PROCESS CONDENSATE WHR PHE

Parameter	Hot side	Cold Side
Fluid	Process Condensate	DM Water
Temp.in/out , °C	90 ® 35	32 ® 60/65
Flow , TPH	25 to 30	40 to 50
Heat Duty	1.5 MWt	
L.P. Steam Saving	~ 2.5 TPH	

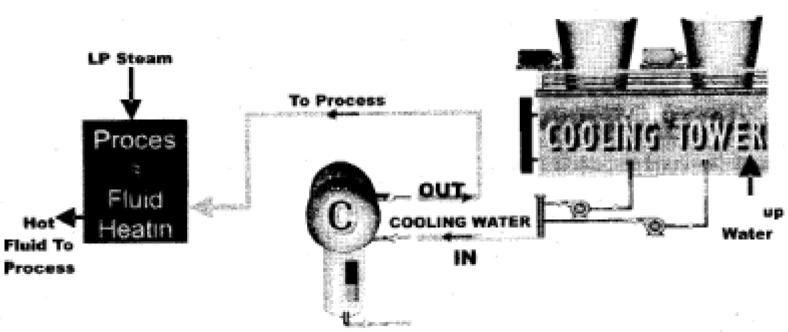

Fig.3. Warm water diversion scheme related to Existing Cooling Tower