Developmental Needs of Chemical Recovery System

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Chemical Recovery System in The Mysore Paper Mills Ltd., is a conventional one. Technologically the present system is old and absolete. With increase in energy cost and environmental restrictions, it is imperative to upgrade the present recovery plant with energy efficient and environmental friendly technology. The present paper mainly concentrates on the scheme for the use of falling film evaporation technology in the evaporation process and removal of DCE and augmentation of economiser in Recovery Boiler. The advantages expected are. Energy savings, Increased captive pulp production, Reduced TRS emissions and increased life of ESP and Reduction in furnace all consumption.

INTRODUCTION

MPM is an integrated Pulp and Paper Mill producing 30,000 TPA writing & printing paper, 75,000 TPA Newsprint & Sugar Mill with cane crushing capacity of 2,500 TPD. Recently the MPM got ISO 14001 certification from M/s DNV. The pulp for the above production level is met by Chemical pulp mechanical pulp and imported pulp. The chemical pulp and mechanical pulp are in-house production and it amounts to about 40,000 TPA of Bleached chemical bagasse and wood pulp and 42,000 TPA bleached mechanical pulp respectively. A chemical utility plant with conventional LTV evaporator. Recovery Boiler and Causticizing plant is available to process weak black liquor and convert it to usable white liquor for pulping. The makeup chemicals used are sodium sulphate and caustic soda. Purchased burnt lime is used in causticizing plant for conversion of sodium carbonate to sodium hydroxide and the available Cao is 60-62% on average.

It is widely accecpted fact that Chemical Recovery section in an integrated Pulp and Paper Mill is backbone of the Mill. The economics of operation of a paper industry lies heavily on the efficient operation of Chemical Recovery module. But for the availability of modern technologies to convert the spent chemicals from Pulp Mills to chemicals suitable for reuse, it would have been impossible for Pulp and Paper Mills to survive considering the enormous pollution load generated in the process and the pollution standards to be met in the final discharge of effluent. In the process of converting the waste chemicals to useful form, HP steam is obtained as a by-product from Recovery Boiler. By passing the steam through Turbo Generator, substantial power is generated. The process steam requirement of the Mills at various temperature and pressure conditions are also met partly by the steam generated in Recovery Boiler.

In Chemical Recovery unit operations such as Evaporation, Combustion, Mixing, Classification, Clarification, Filtration and material handling consume energy. Hence, economics of this unit solely depend on optimum usage of energy. In MPM chemical recovery consists of

- Conventional LTV Evaporator (quintuple effect)
- Recovery Boiler
- Causticizing Plant

Of these three modules, multiple effect Evaporators and Recovery Boiler are identified as units operating at low energy efficiency levels and three is scope for improvement.

Evaporator Module

Present Status

The existing evaporator is quintaple effect supplied by M/s Thungabhadra Machine Tools Ltd., Karnool. It was commissioned in the year 1980. It was designed

for 100 T/Hr water evaporation. The inlet concentration of WBL was considered as 13% T.S. and outlet concentration expected was 50% T.S. The steam economy expected was 4.2.

The inlet concentration of WBL is 12% T.S. and outlet concentration is 45-47% at present.

The problems associated with the present system are:

- Loss of evaporation capacity i.e. 50 T/D against 100 T/D designed:
- lower steam economy - 3.2 T against designed 4.2 T:
- Rapid scaling of finishers and II effect Calcium and silica scales are high:
- Occasional fouling of secondary condensate due to tube leakages in IV & V bodies. These are M.S. tubes and due for renewal:
- Frequent failure of circulation pump glands in the finisher bodies:
- Low vacuum at the end of street due to low efficiencies of surface condenser and vaccum pumps:
- Super heated live steam used in the I effect:
- Inadequate liquor pre-heating system available:
- Inadequate and obsolete entertainment separators in the System:
- Water cooling for glands in the pumps handling high concentrated liquor:

The last five years data of Evaporators is enclosed in the Table 1. The data indicates that there is a drop in water evaporation rate steam economy and product liquor concentration. Increase in LP steam consumption and power consumption per tonne of chemical pulp is also observed. Even though the pulp mills have built in capacity to produce about 200 tonnes per day unbleached chemical pulp, it is being restricted at about 130 to 35 tonnes per day due to low capacity utilisation in evaporators. Due to this every day about 40 tonnes of imported pulp being made up to meet the requirement of paper production.

Proposal for new street Multiple Effect Evaporator

Proposals to retrofit the existing Evaporator with falling film finishers and other required modifications in the existing unit to achieve the designed parameters was thought of. The investment was expected around 10 Crores (as estimated in the year 2002).

As this evaporator is already 20 years old, addition of falling film finishers and other accessories to the Old LTV may not give the effect FFFF tubular evaporator for evaporating 100 T/Hr water with a steam economy of +6.0 with "IREDA" (Indian Renewable Energy Development Authority) assistance. The final product liquor concentration of 65% T.S. was the target. The salient features of the multiple effect evaporator are, it is a seven effect 10 bodies. Falling Film Tubular Evaporator. The first effect subdivided into three bodies out of which two shall be working and one shall be working as standby to switch over. II body shall have a stand by body of equal area with an arrangement for switch over. The project cost was estimated around 15 crores.

Benefits

Savings in terms of value

1) Reduction in L.P. steam consumption :

- Present steam requirement in Evaporator = 2.70 T
  3.2 at steam economy per T of Unbl. Pulp production
- After installing new evaporator at 6.0 steam economy :
- Steam requirement is 2.7 3.2/6.0 = 1.44 T
- Reduction in steam = 1.26 T
  consumption/T of pulp
- Saving per day = 1.25 lacs
  (@ Rs. 550/T of steam) 180*1.26*550

2) Power saving :

- Present power requirement/T of pulp = 70 KWH
- With new Evaporator power
  Requirement / T of pulp = 45 KWH
- Reduction in Power/T of pulp = 25 KWH
- Savings per day @ Rs. 4/KWH 180*25*4=Rs.18,000
- Annual saving (1+2) 1.43*330 =Rs.472 lacs

Recovery Boiler

Present Status :

MPM Recovery Boiler supplied by M/s BHEL, in 1980 had a capacity to handle 270 TPD black liquor solids. A retrofit was done in 1994 by M/s Enmas in the furnace pressure parts air distribution system etc. and the capacity of the boiler was re-assessed as 300 TPD. After the above retrofit by M/s Enmas the boiler runnability improved pressure part failures reduced. Because of bottlenecks in evaporator the boiler is running at 65-70% loading.

Efficient operation of Recovery Boiler depends on the

following black liquor parameters:

- Black liquor solid concentration that is fired.
- Temperature of black liquor fired.
- Calorific value of the BLS fired.
- Proper distribution of hot combustion air at different zones of furnace:
- Inorganics v/s organics in BLS.

Problems associated with existing boiler are :

- Low firing liquor concentration - root cause is low concentration of product liquor in evaporator and direct steaming of the firing liquor from 80°C to 120°C in Recovery Boiler :
- Boiler being loaded to 60-70% MCR:
- Low smelt reduction:
- Low steam solid ratio:
- Higher usage of furnace oil:
- Carry over and fouling of flue gas passage warranting frequent soot blowing to maintain draughts:
- Reduced life of ESP internals due to high moisture in flue gas (water evaporated in DCE add upto flue gas):
- Weekly wash boil out of cascade evaporator:
- Increased insert load in the smelt (inorganic chemicals coming out from Recovery Boiler after combustion:
- Increased TRS emissions from DCE.

Proposal

Many Mills having undergone such problem with low product liquor concentration with LTV evaporators have gone for FFFF evaporators where the product liquor concentration of 65% T. S. is easily achievable and on a sustained basis. Installation of indirect heaters for heating the B/L to the required firing temperature has helped to avoid dilution of the liquor. Once the firing liquor concentration is achieved in the evaporator itself the D.C.E. becomes obsolete. The energy consumed in running D.C.E., the down time of Recovery Boiler an account of wash boiling in D.C.E., reduction in furnace oil consumption due to shut down and start up after wash boil out are the positive gains expected after getting the required black liquor concentration in the evaporator itself. The cost of additional economiser in place of DCE and indirect liquor heaters with control systems is estimated around 500 Lacs.

Savings in terms of value

1) Power saving by installing economiser and removing DCE i.e. 35*24*300*4 =10Lacs/Annum
2) Increased steam generation by maintaining 65% TS and removing DCE.

- Present steam generation =2.6T/Tof BLS
- Expected steam generation after installation of economiser = 3.0T/Tof BLS
- BLS fired at present = 220 TPD
- BLS expected to be fired = 280 TPD
- Steam generation at present 220*2.6 = 570 TPD

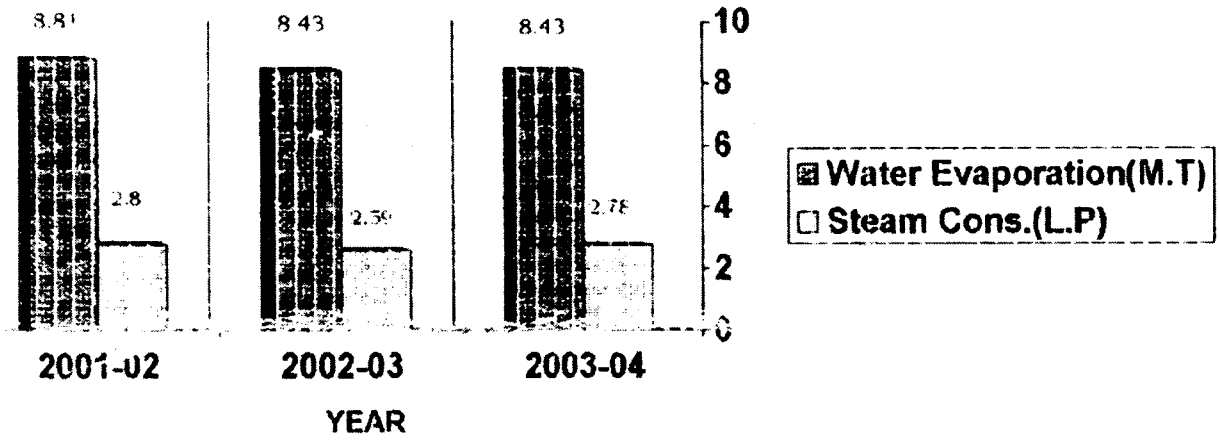

Fig. 1 : Per tonne of Unbleached Chemical Pulp Production

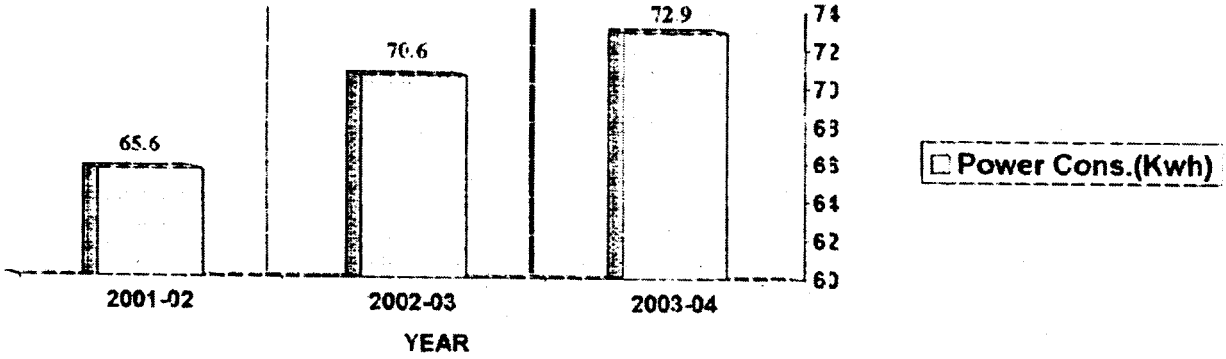

Fig. 1 : Per tonne of Unbleached Chemical Pulp Production

Table 1 : Year Wise Performance Evaporators

		Years		
Particular	**Unit**	01-02	02-03	03-04
Unbleached pulp production	MT	44887	46227	49268
Weak Black Liquor received				
a) Quantity (by Volume)	M^3	519506	520716	551593
b) By Wt./Wt.	MT	545255	547444	580635
c) Total solid	MT	69084	70945	75426
d) Total solid	%	12.67	12.06	12.0
e) Total titrable alkali as Na_2O	MT	19432.9	20278.1	21462.1
f) Strength of liq. as Na_2O	GPL	37.40	38.9	38.9
Concentrated Black Liq.				
a) Quantity (by Volume)	M^3	121275	127910	133936
b) By Wt./Wt.	MT	149775	157969	165411
c) Total solid	MT	69084	70945	75426
d) Total solid	%	46.2	44.9	45.6
e) Total titrable alkali as Na_2O	MT	19432.9	20278.1	21462.1
f) Strength of liq. as Na_2O	GPL	160.2	158.5	160.2
LP Steam consumed for Evap.	MT	125424	119589	136786
Water evaporation	MT	395484	389475	425224
Steam economy	MT	3.15	3.27	3.07
Power consumption	Kwh	2942585	3263208	3589806
Evaporator running	Hrs	8043.50	8229.50	8336.00

- Steam generation expected after modification 280*3.0 = 840 TPD
- Net excess steam generated = 270 TPD
- considering HP steam cost @ Rs. 600/T and 300 days availability per annum the savings works out to Rs. = 486 Lacs

3) Furnace oil savings expected per annum = 200 KL

- @ Rs. 14,000/KL savings in terms of value (200*14,000) = 28 Lacs
- Total saving (1+2+3) = 524 Lacs
- Total savings per annum in Evaporator & Recovery Boiler Module = 996 Lacs
- Total investment in Evaporator and Recovery Boiler is = 2000 Lacs
- The pay back period (Maximum) is = 30 Months

CONCLUSTION

On implementation of above project the following improvements in terms of efficiency throughput and energy conservation are expected.

Table 2 : Year Wise Performance of Recovery Boiler

Particular	Unit	Years 01-02	02-03	03-04
Unbleached pulp production	MT	44887	46227	49268
Weak Black Liquor received				
a) Quantity (by Volume)	M^3	117890	123810	130000
b) By Wt./Wt.	MT	145740	152506	160447
c) Total solid	MT	67332	68475	73164
d) Total solid	%	46.2	44.9	45.6
e) Total titrable alkali as Na_2O	MT	10001.0	19663.9	20817.7
f) Strength of liq. as Na_2O	GPL	160.3	158.8	161.1
Steam generation	MT	185638	181138	186495
Steam pro tonne of BLS	MT	2.76	2.65	2.55
Recovery Boiler running	Hrs	7366.0	7709.00	7775.50

Table 3 : Per tonne of Unbleached chemical Pulp

Particular	Unit	Years 01-02	02-03	03-04
a) Water evaporation	M^3	8.81	8.43	8.43
b) Steam consumption (LP)	MT	3.80	3.59	3.78
c) Power consumption	Kwh	65.6	70.6	72.9
d) Weak black liq. generation	M^3	11.15	10.79	10.57
e) Black liq. solids generation	MT	1.5	1.48	1.48
f) Strength generation (H.P.)	MT	4.14	3.92	3.79

- The steam economy shall be boosted up to level of +6.0 from the existing level of 3.2 :
- Increased steam generation per tonne of black liquor solids (2.6 T/T of BLS at present to 3.0 T/T of BLS).
- Reduction in Furnace oil consumption from present level of 40 KL per month to 20 KL as cascade evaporator is replaced with economizer and consistent high solid content black liquor available for firing.
- As cascade evaporator is eliminated there is a power saving of 35 Kwh.
- Power consumption per tonne water evaporation would decrease from 8 Kwh per tonne to about 5 Kwh per tonne.
- Increase in the loading of boiler to MCR level as consistent higher concentration in black liquor is available and thus improve Boiler thermal efficiency.
- Improved salt cake reduction resulting in higher sulphidity levels in white liquor.
- Reduced down time of Recovery Boiler on account of cascade wash boil out as cascade evaporator is eliminated.
- Increased life of ESP internals as water vapour in flue gas is reduced considerably by eliminating cascade evaporator.
- Reduction in TRS and SO_2 emission after removal of cascade evaporator.
- ID fan load decrease considerably as the quantity of flue gas handled reduces.
- About 35-40 Tons at extra pulp production is expected by implementing both the proposals thus reducing the dependence on imported pulp.

From the above study we can conclude that an investment of Rs. 20 Crores in Chemical Recovery module would definitely improve the over all productivity of the Mills. The proposals are techno-economically feasible and in line with our ISO 14001 environment policy.

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REFERENCES

1. Detailed project report submitted to "IREDA".
2. Yearly performance reports.