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ENERGY SAVING EFFORTS AND RESULTS IN TNPL

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Abstract:

Global climate change issues are high on the agenda for the scientific community, policy makers and for the industry professional as well. When it comes to the aspect of Energy conservation and environment protection, the role of Pulp and Paper sector cannot be overlooked. Producing 1 MT of paper requires 5-17 GJ of process heat depending on the paper type and technology applied. Paper making, being energy-intensive, will need innovation and best practices to be implemented to become more energy efficient.

TNPL is a leading eco-friendly agro and wood based paper and paperboards manufacturer in the country/world. Our vision is to adopt state of the art contemporary technology and be a prominent leader in global market with self sustained development and excellence in paper and paper board products and quality. This paper describes how TNPL approached the challenges in energy management and environment related issues. Further this paper explores how minor modifications in the existing process/ method could end up in huge amount of energy savings. Driven with the concepts of Manufacturing Excellence and Energy management, we have discussed the case studies that were experimented and implemented in the process which proved energy efficient and reduced the overall energy consumption.

Key words: *Manufacturing Excellence, Sustained Development, Energy Management.*

. Introduction:

"Little drops of water make a mighty ocean". When the majority concentrated on significant changes like finding alternate energy resources, CO2 emission reduction, obsolete technology, we concentrated on less significant things which were not obvious that it is also more energy consuming. TNPL which believes that continual improvement in the process is the key to sustainability has used data driven statistical tools and energy monitoring system in several case studies which contributed for energy optimization. The data and results are discussed in detail.

Energy Optimization by using Energy Management System (EnMS):

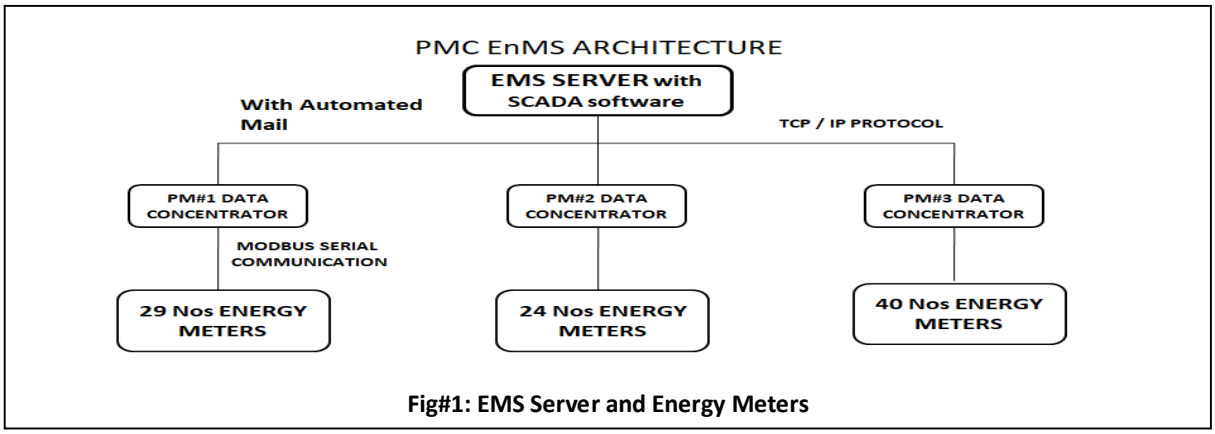
Energy monitoring is the first step in Energy Conservation Program. Hence, Energy Management System is introduced and subsequently, Energy saving is achieved by identifying the Potential Energy saving equipments. The EnMS consists of Servers, Data Concentrators and Energy Meters. The Server and Data Concentrator are communicating via our existing ERP Network.

The communication between the data concentrator and Energy Meters are via RS485-Serial communication protocol. By using the Local Area Network (LAN), the EnMS system can be viewed by everyone across the Factory as well as through Mobile devices. More suggestions towards Energy savings are emerging from all domains due to the availability of EnMS System.

Process:

For Paper Making, several Motors are being used in the various voltage ranges from 230V to 11KV and the power rating of Motors are up to 1.4 MW. DC drives and AC drives are also being used for Paper making process with state of Art technology.

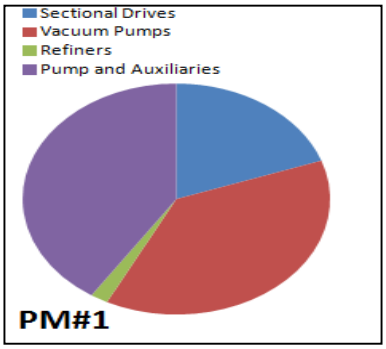
With the features of Energy Monitoring System, wherein Energy Meters are provided for high energy consuming equipments, Real time data are collected; compiled, analyzed and potential energy saving equipment are identified. Energy Consumption Reports are also available for Hour Wise, Shift wise, Day Wise, Month Wise and Year Wise. From the data generated, it was evident that major energy consuming equipments could be classified under four categories as Vacuum pumps, Refiners, Sectional drives, Pumps and auxiliaries.

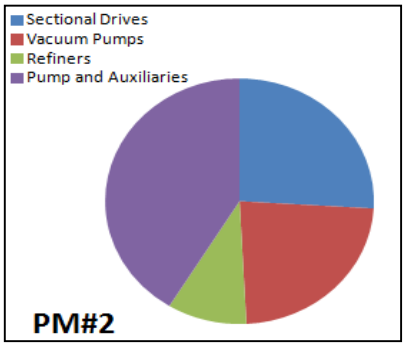


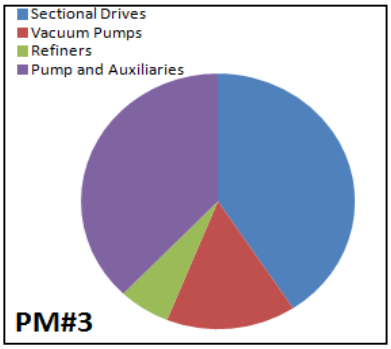
Fig#1: EMS Server and Energy Meters

TABLE 1. ENERGY CONSUMPTION REPORTS- DASHBOARD

PM#1	MW	PM#2	MW	PM#3	MW
Sectional Drives	1.37	Sectional Drives	2.24	Sectional Drives	3.47
Vacuum Pumps	2.65	Vacuum Pumps	2.01	Vacuum Pumps	1.31
Refiners	0.13	Refiners	0.83	Refiners	0.52
Pump and Auxiliaries	2.85	Pump and Auxiliaries	3.56	Pump and Auxiliaries	3.22
Total	**6.94**	**Total**	**8.8**	**Total**	**9.27**







From the data report, it is evident that power consumption by 'Process pumps and auxiliaries' emerges as one of the major factors while considering power saving and cost saving concepts for energy efficient operation. Following are a few different case studies from Paper Machine No#3.

CASE STUDY NO.1:

ENERGY SAVING BY MODIFYING THE LOGIC IN PULPER OPERATIONS

BRIEF DESCRIPTION:

When the pulper operation in paper machine is closely studied, it is noticed that there is scope in energy optimization if a new logic is introduced. Six pulpers are in operation from Wire part to winder, out of which we take PDS and Reel pulper in Manual mode very often for loose broke feeding, whereas it does not require manual operation for other pulpers as much. As per the existing logic, once the pulper is taken in manual mode, the agitator which is driven by high capacity motor of 315KW would run for 600 seconds continuously for slushing the loose broke.

SYSTEM MODIFICATION APPLIED:

Finding the fact 600 seconds of agitator operation is not required for loose broke feeding, the agitation time is reduced to 400 seconds. The average running time of the Reel pulper was 12hrs/day and after the logic modification it has come down to 9hrs/day. For the PDS pulper, the average running time was 7hrs/day and after the agitation time reduction in logic, the average running time dropped to 4hrs/day saving 3hrs of running time in both the pulpers. The power savings and cost savings from this minor modification in logic are illustrated below. The benefits incurred from this case study motivated us further to look more in the category 'pumps and auxiliaries' to identify the potential energy saving equipments.

RESULTS:

With the efforts to save power, we incurred cost savings of around 28.5 lakhs per annum, without investing additional cost.

CASE STUDY NO.2:

REDUCE POWER CONSUMPTION BY STOPPING 6.0 BAR & WARM WATER MAKEUP PUMP

BRIEF DESCRIPTION:

We have two vital roles for 6 bar pumps in Paper machine. To maintain desired pressure above 3 bar for Retention chemical preparation system and in addition to that the other sole purpose is to take care of the cleaning process in stock and wet end area of paper machine. The 6 bar pump is operated continuously with VFD drive having 55KW motor capacity.

TABLE 2. PULPER AGITATOR OPERATION OPTIMIZATION IN PM#3			
Description	UOM	**Reel Pulper**	**PDS Pulper**
		Parameters	Parameters
Pulper agitator motor capacity	KW	315	315
Agitator full load current	Amp	318	318
Agitator normal running current	Amp	250	250
Agitator Running Power	KW	240	240
Pulper agitator running time as per existing logic	Sec	600	600
Modified Pulper agitator running time	Sec	400	400
Time saved as per new logic	Sec	200	200
Average running time of Pulper agitator	Hrs/day	**12**	**7**
Average running time after logic change of Pulper agitator	Hrs/day	**9**	**4**
Total Time saved due to logic change	Hrs/day	**3**	**3**
Total Power saved due to logic change	Unit/day	720	720
Power Cost	Rs/Unit	6.0	6.0
Total Cost saving by modifying the logic of pulper agitator operation	Rs/day	4320	4320
Saving per Annum (Assuming 330 days operation)	**Lakhs/Annum**	**14.25**	**14.25**
TOTAL SAVINGS (REEL & PDS PULPER), SAY		**28.5**	

SCOPE:

Apart from Retention chemical preparation system, the 6 bar requirement is very less during normal running, since effective cleaning with high pressure could be carried out in stoppage alone. So the continuous operation of this high capacity pump falls under the red zone in energy consumption.

MODIFICATION PROPOSED:

In-order to reduce power consumption, it is suggested that 6.0 bar pump shall be replaced with same pressure line to fulfill the current fresh water requirement without affecting the existing operation of paper machine. Fresh (Filter) water supply line from Water treatment plant (WTP) with the line pressure of 6-8 bar is being used in Paper machine#3 process as per system requirement. Hence, it is decided to use the WTP line water for the above scheme, accordingly necessary schematic diagram was developed to arrange the necessary materials (pipe line and valve).

CHANGE IMPLIED:

A 100 NB line interconnection with manual isolation valve provided between Clarified water storage fresh water makeup line and 6.0 bar pump delivery line to deliver the fresh water with the equivalent line pressure. After the line modification, the 6 bar pump completely stopped and since the line pressure got maintained and retention chemical preparation system worked seamlessly fine.

TABLE 3. POWER SAVING CALCULATION			
DESCRIPTION	**UOM**	**6.0 bar pump**	**WW makeup pump**
		PARAMETER	**PARAMETER**
Motor KW	KW	**55**	**30**
Motor Full load current	Amps	96	52
Running Current	Amps	25	15
Running Power	Unit	25	15
Net savings per day	Unit/day	600	360
Cost of Power	Rs/unit	6.0	6.0
Total Savings	Rs/day	3600	2160
Saving per Annum (Assuming 330 days operation)	**Lakhs/Annum**	**11.88**	**7.13**
TOTAL SAVINGS		**19.01**	

TABLE 3(A). PAYBACK CALCULATION		
Description	**UOM**	**Parameters**
Investment to complete the above scheme	Rs	20,000
Pay back	**Days**	**4**

RESULTS:

The 6 bar pump of 55KW power stopped permanently which reduced 25 Amps running load from the course of action. Similarly, the warm water pump was stopped after optimizing the 6.0 bar pump recirculation valve to make up the desired level as per system requirement which

helped to conserve 15 KW power saving in the department without affecting the existing process.

In view of safe operation of paper machine, the additional interlock was provided for warm water makeup pump to maintain the tank level in case of failure /pressure drop in modified system. As per the new logic if the warm water tank level is dropped below 60%, the warm water makeup pump will start and same will be stopped when level reaches 90%, and this will ensure the safe operation of PM #3. After stopping the above pumps the procurement of spares shall be minimized and maintenance cost and labor engagement shall also be reduced.

CASE STUDY NO.3:

REDUCE POWER CONSUMPTION BY PROVIDING VFD IN HYDROMIX MAKEUP PUMP

BRIEF DESCRIPTION:

The function of Hydromix makeup pump (P) is to pump excess white water from DuoD tank to Hydromix and to maintain the Hydromix level as per the process requirement. The existing pump motor capacity is 75KW and being operated with Direct on Line control (DOL). DuoD tank level will be maintained according to level set point with the help of control valve installed at pump delivery line. During the normal operation, it is observed that auto control valve is being operated at 40-45% and the pump is running with high load and speed to maintain the DuoD tank level with respect to grade running on machine.

SCOPE:

Power consumption can be optimized/ reduced by providing Variable frequency drive (VFD control) for the pump operation instead of DOL.

CHANGE IMPLIED:

About 35 days trial was taken by changing the pump operations from Direct on line (DOL) to Variable frequency drive (VFD) control to check the performance of the pump, control valve operation, DuoD Level and reduction in power consumption.

TABLE 4. COST SAVING CALCULATION

PARTICULARS	OUM	DOL control	VFD Control
Motor KW	KW	**75**	**75**
Motor Full load current	Amps	**130**	-
Running Current	Amps	76	21
Running Power	KW	43.7	13.5
Power Saving per day	Unit/day	1048.8	324
Net savings	Unit/day	724.8	
Cost of Power	Rs/unit	6.0	
Total Savings	Rs/day	4348.8	
Savings per Annum	**Lakhs/Annum**	**14.35**	

TABLE 5. PAYBACK CALCULATION

PARTICULARS	UOM	COST
Cost of YASKAWA DRIVE 75 KW	lakhs	2.5
Cable 3CX150sqmm & Other expenses	lakhs	1.0
Total Investment	lakhs	3.5
Savings due to VFD	Rs/month	90425
Pay back	**Months**	**4**

RESULTS:

During DOL operation of the makeup pump (P), the 75KW motor was running at 100% speed with the control valve operating at 30-40%. After changing the control to VFD, the motor speed got reduced to 60% with control valve operating at 85% opening. The drive change from DOL to VFD control resulted in the power consumption reduction from 76Amps to 21Amps without affecting the process.

CASE STUDY NO.4:

REDUCE POWER AND WATER CONSUMPTION BY REPLACING MACHINE BACK WATER FROM FRESH WATER FOR NATIVE STARCH FILTER FLUSHING AT PM#3 SIZE PRESS.

BRIEF DESCRIPTION:

The size press filter auto flushing is provided for top & Bottom applicator filter station to maintain the minimum desired differential pressure and supply the native starch slurry without any foreign material. Accordingly, the 3.0 Bar Pump is designed to supply fresh water to size press filter station and wet end roll lubrication. The 3.0 par pump delivery line pressure will be maintained 400Kpa during normal operation.

SCOPE:

It is observed that frequent size press filter flushing is leading to more fresh water consumption. The minimum flushing interval time is maintained 40-60 minutes based on the starch quality and operating condition. The fresh water consumption for starch filter flushing is 60-70 m3/day. During the size press filter flushing the 3.0 bar line pressure is fluctuating from 250Kpa to 500Kpa against the pressure set point of 450Kpa, which leads to more power consumption during normal operation. The Pressure set point shall be reduced after correcting the pressure fluctuation.

CHANGE IMPLIED:

In order to reduce environmental aspect, the Paper machine excess back water is introduced for Fixed and Pivoted roll filter station to conserve fresh water. Also, after changing Machine back water, the 3.0 bar line pressure fluctuation shall be avoided and hence total line pressure shall be reduce to maximum possible.

TABLE.6 COST SAVINGS DUE TO FRESH WATER CONSERVATION		
PARTICULARS	**UOM**	**Before Modification**
Fresh water conserved	M3/day	**70**
Cost of Process water	Rs/M3	10
Total savings, say	Rs/day	700
Annual saving	**Lakhs/Annum**	**2.31**

TABLE.7 COST SAVINGS BY REDUCING 3 BAR LINE PRESSURE SET POINT		
PARTICULARS	**UOM**	**PARAMETERS**
Existing current before modification	Amps	**40**
Running Current after modification	Amps	34
Running Power	KW	6
Power Saving per day	Unit/day	144
Cost of Power	Rs/unit	6
Total Savings	Rs/day	864
Savings per Annum,(A)	**Lakhs/annum**	**2.85**

TABLE.8 COST SAVINGS BY REDUCING 3 BAR LINE PRESSURE FLUCTUATION		
PARTICULARS	**UOM**	**PARAMETERS**
Current fluctuation per days	No/day	**50**
Duration of fluctuation	sec	30
Total time taken	Min/day	25
Minimum current	Amp	**40**
Maximum current	Amp	62
Average current during fluctuation	Amp	12
Total Power consumed due to fluctuation	Unit/day	**288**
Power cost	Rs	6
Total Savings	Rs/day	1728
Savings per Annum, (B)	**Lakhs/annum**	**5.70**
TOTAL SAVINGS (A+B), SAY	**Lakhs/annum**	**8.55**

TABLE 9. PAYBACK CALCULATION		
PARTICULARS	**UOM**	**COST**
Pipe line and valve installation	lakhs	0.25
Pay back	Days	10

RESULTS

Fresh water conserved 70 cubic meters per day.

3 bar line pressure fluctuation eliminated and thereby power saved by 144 units per day.

Conclusion:

The Pulp and Paper industry is facing significant challenges in meeting the growing demand for sustainable, eco-friendly and socially responsible products. These challenges are multi-faceted and require a comprehensive approach to address them. One of the key solutions is to adopt sustainable practices. Energy cost - saving measures are much important for companies to prioritize. By reducing energy costs, companies can improve their profitability while also being more sustainable. Hence measures such as implementing energy efficient production process & reducing water usage would take us all towards green earth when “Fostering the future of Energy & Environment in Pulp and Paper industry”.

Acknowledgement

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