Pilot Interventions in the Sugar sector to Implement Water and Energy Best Management Practices

A Case Study

Living Ganga Programme

Introduction

One of the key components of Living Ganga Programme under HSBC Climate Partnership was to develop and implement pollution abatement strategies, demonstrating benefits for key stakeholders and to promote pilot measurements for managing industrial effluents from three key industries (Sugar, Pulp & Paper and Tannery sector) in the Ganga Basin.

With an attempt to reduce the footprint of the sector by implementing water and wastewater management best practices, WWF-India in association with FICCI (Federation of Indian Chambers of Commerce and Industry) embarked on a detailed framework which involved scoping study, developing recommendations, pilot interventions and monitoring. This was done in collaboration with identified Sugar units.

The various steps involved in the process of the bringing about Pilot interventions in Pulp & Paper Sector:

HSBC Climate Partnership is a ground-breaking five year partnership between HSBC Bank and WWF and other NGOs that aims to combat the urgent threat of Climate Change by inspiring action by individuals, businesses and governments worldwide.

In India, the partnership is working with WWF-India, through **Living Ganga Programme** which aims to develop and implement integrated strategies for sustainable energy and water resources management within the Ganga basin, in the face of Climate Change. The programme has four arms – research, pilot projects, policy advocacy and communication and awareness generation.

1. Scoping Study

A scoping study was taken up by WWF India and FICCI for the Sugar sector in Ganga Basin. While it was known that this is one of most water-intensive sectors, there was a need to assess the water use in the sector and look for solutions to control the same. The objective of the scoping exercise was to identify key best management practices for bringing down the water consumption. In this study, two units viz. Upper Doab Sugar Mill and Unn Sugar Complex were identified for the pilot interventions based on various parameters like motivation and interest levels, willingness to change.

Some of the issues identified in these units (as must be in others to at varying levels) included:

- No Water level indicators in the fresh water storage tanks
- Lack of high pressure nozzles for Washing and Cleaning Activities
- Loss of Sugarcane juice vapours and steam condensate
- Non-Segregation of concentrated effluents from non-contact or less contaminated effluent
- In-efficient Oil & grease removal from wastewater generated from milling section
- Poor recovery of by product (molasses) from the sugar
- Use of freshwater for Molasses cooling without recirculation in Molasses Storage Tanks
- No Water metering and Accounting System
- Ineffective disinfection of treated water causing skin problems
- Conventional & Poorly maintained ETP for wastewater treatment
- Lack of Good Housekeeping Practices

The detailed water audits facilitated a rational outlook on the economics of the recommendations made for improvements at these units.

2. Best Management Practices Recommended for the demonstration units

The following Best Management Practices were recommended for Implementation in the demonstration units as a result of the water and waste water audit findings.

a. Installation of Water Level Indicators in Freshwater Storage Tank & Overhead Tank to avoid overflows from the tanks
b. Installation of optimum nozzle size of hosepipes to maintain high pressure of water for washing & cleaning activities in the Mill House
c. Efficient Oil & grease removal from Mill house wastewater before ETP
d. Separate collection of sugarcane juice vapours to maximize condensate recovery
e. Segregation of concentrated effluents from non-contact or less contaminated effluent before ETP
f. Recirculation of water for molasses cooling in molasses storage tank
g. Water metering & Accounting of water at the source and avarious sections of the plant
h. Adoption of effective disinfection technology before reusing treated effluent
i. Modification of the existing conventional ETP design to improve the quality of treated wastewater for recycle and reuse
j. Follow Good Housekeeping Practices and impart training to the workers
k. Adopt and implement advanced Effluent Treatment Technologies for improving the quality of treated wastewater for recycle and reuse

3. BMP's Implemented in the demonstration unit:

3.1 WWF-FICCI Initiative

3.1.1 Recirculation of cooling water for Molasses tank no. 5, 6 & 7

It was observed that the unit has 7 large tanks for storage of molasses (byproduct of sugar unit sold to distilleries). Molasses are perishable, thus to avoid the gas generation through fermentation, the molasses tank needs to be maintained at a temperature below 30 deg. For this water is sprayed on the surface of the molasses tank regularly. It was observed that a significant amount of water is required for this. In the earlier system, pump of 30 HP with discharge rate of 65 m3/hr was used as common header for molasses cooling of tank no. 5, 6 and 7 to meet the 45 m3/hr (15m^3/hr each) of required cooling water. There was no separate pump for pumping the water to the system. Also the water used for cooling was neither collected nor reused but was allowed to flow out through the municipal drain. Therefore, it was suggested that the unit should re-circulate the cooling water with a separate pumping system.

This resulted in the reduction of freshwater consumption in the unit and also the energy consumption.

Benefits of the Molasses cooling with recirculation of Water

The implementation of the proposed practice led to a saving of about 60,750 m^3/year of water as shown in table 1 below. In addition to water saving about 33750 HP of energy is saved per year. Subsequent to water & energy saving, the wastewater discharge to municipal drain from the earlier system has also been eliminated.

Table 1: Annual Fresh Water & Energy saving by Recirculation of Molasses Cooling Water

Details	Annual Water consumption (m^3)	Annual Energy Use (HP)
Before Installation	67500	45000
After Installation	6750	11250
Saving	**60750**	**33750**



Figure 1 Molasses cooling without recirculation system



Figure 3 Collection pit under construction

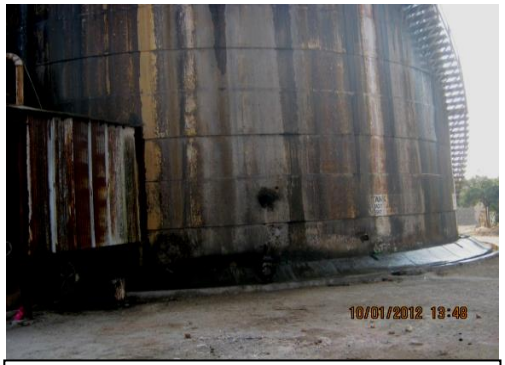


Figure 2 Molasses cooling with recirculation system



Figure 4 Collection pit for recirculation of water

3.1.2 Installation of water level Controller in Over Head Tank (OHT-1)

It was observed that substantial amount of energy and water is wasted in the existing water storage system of the unit. The unit has 2 nos. of Overhead Tanks (OHT 1 & 2) and distant location of tanks makes manual inspection of water level very difficult. In the absence of any arrangement to make out or maintain optimum level of water in overhead tanks (OHT), the raw water is continuously pumped to the OHT 1 leading to substantial overflow (196 m3/hr). Hence, the system is pumping 668 m3/hr of water to the OHT-1 and only about 472 m3/hr water is required within the process leading to overflow from the OHT 1. The overflow from the OHT 1 goes to an underground tank (UGT). To avoid overflow from the UGT the water is again pumped to the OHT 1. The two pumps (100 HP and 60 HP @ 24 hrs) continuously pump water to the OHT-1 and significant energy and water is wasted in the present system due to unnecessary continuous running of pumps and resulting overflow. Therefore, it was recommended to install an ***Automatic Water Level Controller*** to maintain the optimum water level in the OHT-1, eliminating water overflows and reducing pumping hours as per the proposed practice.

Benefits of the proposed practice:

The installation of AWLC (***Automatic Water Level Controller*****)** has led to reduction in the pumping hours of 100 HP pump by 75% and saved about 2,70,000 HP per year as shown in table below. The unit saved about Rs 10 lakhs per year by reducing the pumping hours of 100 HP pump from 24hrs to 4-6 hrs. In addition to energy saving the frequent overflow from tanks will be eliminated leading to water saving as well.

Table2: Energy saving by installing AWLC in OHT 1

Details	Energy used for water in OHT 1 (HP/hr)	Pumping duration (Hrs/day)	Total Energy Used (HP/day)	Energy Used per year @ 150 days (HP/yr)
Before Installation	100 HP + 60 HP	24	3840	576000
After Installation	60 HP 100 HP	24 4-6	2040	306000
Savings			**1800**	**270000**



Figure 5: Overflow from OHT 1 (Before Implementation)



Figure 6 Overflow from OHT 1 is stopped completely after installing AWLC



Figure 7 Control Panel of AWLC

3.1.3 Installation of water flow meters at major water use sections

It was observed that the unit does not have a proper water metering and accounting system. The unit has only three water meters at the fresh water source [as water cess is paid as per water use]. The water use in all other sections is just estimated and effluent generation quantities are not metered. Therefore it was recommended that the units should install water meters not only at the water source but also at the major water use sections for water accounting and management. The water metering and accounting helps the unit in planning for water conservation and management in major water consuming sections.

Benefits of the proposed practice: By installing Electromagnetic water flow meters in the major water use sections, the unit has been able to measure the actual water use and excess consumption in the system, if any and continuous monitoring of the consumption in the metered sections has been done by the unit and steps have been taken for optimum use of water. Therefore the continuous measurement & monitoring of major water consuming sections has eliminated water wastages leading to reduction in specific water consumption.

Fig.8: Installed Electromagnetic Water Flow meters





3.2 Initiatives taken up by the demonstration unit

WWF India in partnership with FICCI recommended interventions for reducing the water and energy footprint of the sugar sector and general and demonstration unit in specific and also contributed towards implementation of three interventions. The demonstration unit i.e. Upper Doab Sugar Ltd too contributed to three interventions to show their buy-in and to maximize impacts.

3.2.1 Installation of VFD (Variable Frequency Drive) at four ID Fans at Boilers to save energy

The unit had been operating the four ID fans on boilers at 1440 rpm. To regulate the steam pressure and temperature of boilers, dampers were being used which continued to run the ID fans at a constant rpm of 1440. The unit has now installed four Variable Frequency Drives (VFD's) on each fan.

Benefits of the installed VFD's at four ID Fans

With the installation of the VFD's at the four ID fans of boiler section the speed is locked to a maximum of 1350 RPM module. By installation of the VFD's, dampers are no longer used to regulate steam pressure and temperature of boilers through a the controller box on each fan which reduces the rpm the rpm of the motor. This has reduced the power consumption of the unit by 150KW/hr.





Fig.9: Installed VFD at ID Fan of Boiler

3.2.2 Installation of Electrical Heaters at Sulphur burners to melt sulphur for saving energy

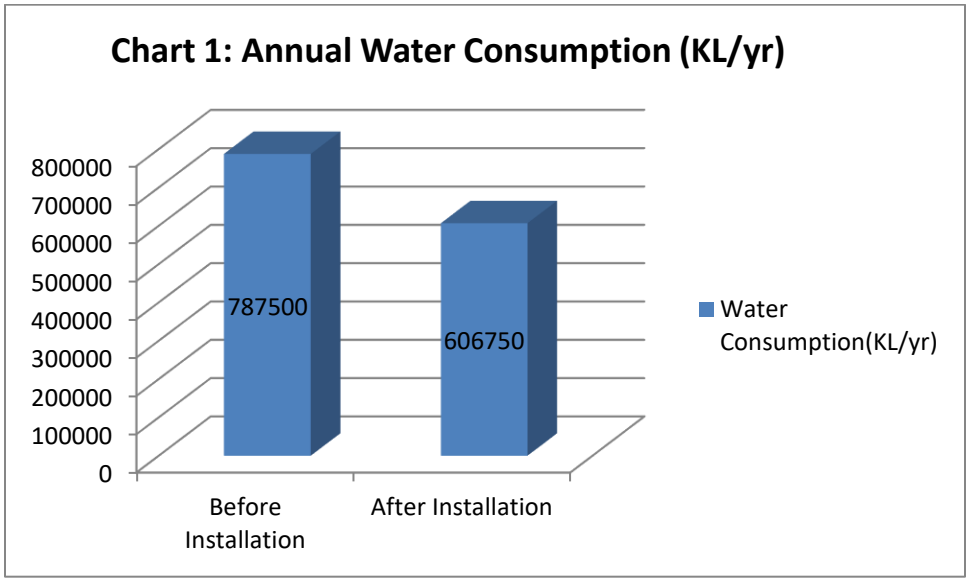
The steam from boiler house was fed to sulphur burners to melt sulphur, resulting in huge condensation losses occuring in the system. The unit took the initiative themselves and installed an electrical Boiler at sulphur burners.

Benefits of Electrical Heaters

The new installation has saved 1% of steam (@1.1 ton/hr), ultimately saving the fuel supplied to the boiler , i.e. bagasse used for steam generation.

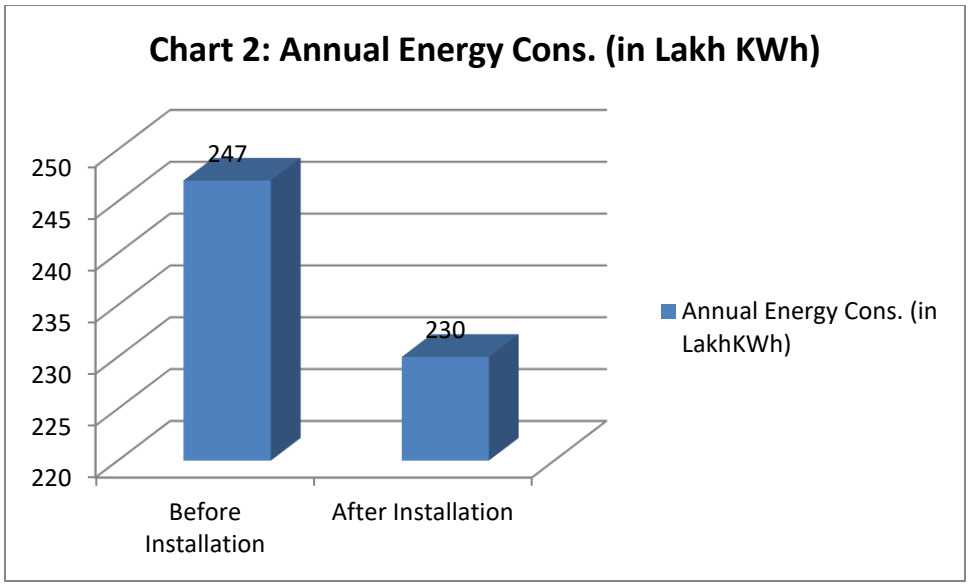
Water Savings from the best practices

Based on measurements and calculations it is observed that mill was consuming around 787500 KL/year (Inclusive of Freshwater) before implementation of best practices. Successful implementation of proposed practices (i.e. Automatic Water Level Controllers and Recirculation of molasses tank cooling) has lead to total water savings of 180750KL/year. Hence, Water Consumption has been reduced from 787500 KL/day to about 606750KL/day as shown in Chart 1. Therefore, the implementations have reduced the fresh water consumption of the unit by about 23%.



Energy Savings from the implementation

As a result of implementation of the best practices under the project and the initiative taken by the unit towards better management of the resource the annual energy consumption within the mill also reduced by around 7%.



Cost benefit Analysis of Best Practices

S.No.	Best Management Practices	Operational & Environmental benefits	Annual Resource Savings	Investment (Rs. In lakhs)	Annual Monetary Savings (Rs. In lakhs)	Simple Payback Period (Years)
1	**Installation of Water Level indicators for Over Head Tank and Underground Water Service Tank**	Energy Saving of 56.25 KW/hr as the overflow from the Overhead tank has stopped completely As a result, the 100HP pump running 24hrs earlier is now running for 4-6 hrs/day	Energy Savings 270000 HP (201420 KW) Water Savings cannot be directly quantified	0.56	10.07	Immediate
2	**Installation of Electromagnetic Water meters on Power House and Boiler Mill House (major water usage sections)**	Measure the actual water use and excess consumption if any in the system Will eliminate water wastages leading to reduction in SWC & subsequently reduced effluent generation.	- the unit is optimizing/ will be able to optimize the water in the Power House and Boiler Mill House Section by keeping an account of the water use.	2		Immediate
3	**Scheme for Recirculation of Molasses tank**	Uses recycled water and conserve freshwater and energy and also enable recycling leading to less	Water Saving 60750 KL Energy Savings	5.52	1.87	2.9

	cooling tower	effluent generation.	33750 HP (25186 KW)			
			SUB-TOTAL	**8.08**	**11.94**	**0.67**
4	**VFD installed at ID Fans on 4 No. of Boilers**	Less energy consumption by the motors as it runs as per the required rpm	Energy Saving 723600 HP (540000 KW)	20	27	0.7
5	**Electrical Heaters at Sulphur burners to melt sulphur**	Saving of steam @ 1.1 ton/hr	Bagasse saving 1980 ton (0.55 ton/hr), which is sold by the unit in the market	7	29.7	Immediate
6	**Plate Heat Exchanger Super Heat Wash at Centrifugal station**	Saving of 0.3% steam/hr	Saving of bagasse 1350 ton (0.375 ton/hr)	5	20.25	Immediate
			SUB-TOTAL	**32**	**76.95**	**0.4**
			GRAND TOTAL	**40.08**	**88.89**	**0.45**

Conclusion

In terms of investment, WWF India contributed an amount of Rs 8.08 Lakhs which resulted in a saving of Rs 11 .94 per Annum. Two of the three implementations gave immediate pay-offs while molasses cooling through recirculation had a payback period of 2 years and nine months. The demonstration contributed a sum of Rs 32 Lakhs which resulted in an annual saving of Rs 88.89 Lakhs. Two of the implementations gave instant pay-offs while VFD installations had a payback period of 7 months.

The implementations show that a) a periodic water and energy audit is essential to get information on the specific process-wise water use. b) This can then be used to find appropriate interventions, particularly in processes which use high amount of water and energy with the help of technical partners. c) during and even after the implementations, water and energy use monitoring must continue.