

ENERGY AUDIT IN SUGAR INDUSTRY A PASSPORT TO PROSPERITY

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ABSTRACT:

Energy audit is an important tool in transforming the fortunes of any organisation. This is highly relevant to the sugar industry as it deals with a renewable energy source and looked upon as rural power house. The scope for conservation is immense and if properly harnessed can take the organisation to the path of prosperity. Energy audit becomes all the more important in view of the energy conservation Act 2001 enacted by Government of India and the proposed New provisions 18A(1), (2) & (3) to the Boiler Amendment Bill – 2000 (Indian Boilers Act – 1923). A case study of the Energy audit of a sugar factory that identified scope for saving more than Rs. 800 lakhs per annum is illustrated as an example.

PREAMBLE:

Sugarcane is an Energy crop and it is a renewable source. It is the nature's gift to mankind. Sugarcane synthesises energy from the SUN and Man extracts it from sugarcane in the form of sugar, heat energy, mechanical energy and electrical energy. The production of electrical energy from sugarcane fibre which is termed as Co-generation is assuming great importance day by day because of its renewable nature and attractive economics it offers to the sugar industry. Newer and better technologies are under constant development to harness this energy from sugarcane in the sugar factory. The success of cogeneration schemes depend upon maximizing the energy output and minimizing the energy expenditure in the factory operations. With the advent of cogeneration in sugar industry with high pressure technologies and export to the government grids, a lot of emphasis is being laid on reducing the power inputs in all the areas of sugar and power production in the factory operations in order to maximize the power export to the grid and increase the revenue generation to the factory.

The concept of cogeneration has enhanced the value of bagasse as a main source of raw material for generation of power and those sugar factories which do not have cogeneration systems look to bagasse as a major source of revenue earner for the factories and therefore implement all systems to save more bagasse by increasing efficiency of operations and reducing power consumption in all areas. This welcome awareness has been capitalised only by a few factories and majority of the factories nearly 85% of them are yet to adopt the changes and reap the benefits because of their own limitations.

INTRODUCTION OF STATUTES FOR ENERGY CONSERVATION:

This paper is meant to highlight the importance of energy conservation to enhance the viability of operations of sugar industry and also to prepare the industry to meet the requirements of the proposed legislation as per Boiler amendment Bill – 2000 (Indian Boilers Act – 1923), which envisages energy audit as mandatory in Industries.

The industrial sector in India is a major energy user accounting for more than 48% of the commercial energy consumption in the country. The sector is becoming increasingly energy intensive and to achieve self reliance besides looking at enhancing energy production to meet the increasing demand, looking at ways and means of reducing the energy requirements by improving the efficiencies of applications and operations is also another positive way of meeting the challenge.

Taking the specific case of sugar industry there are wide variations in energy consumption among different units using comparable technology. The energy saving potential in sugar sector is estimated to be at least 30% of its present utilisation, making the sector with the maximum potential in the country's economy. The sector can easily be termed as rural power houses and any conservation here will not only serve the cause of national economy but also enhance the profitability and stability of the sector. This is where the energy audit and energy norms become vital for the sugar sector as a whole.

Only to realize the potential of energy efficiency in the country, the government of India enacted the Energy conservation act 2001 which came into force since 1st March 2001. Under the provisions of this act, the Bureau of Energy Efficiency (BEE) has been established with effect from 1st March 2002, to implement the provisions of the Energy conservation act. The government of India has also been announcing fiscal incentives for implementing energy conservation measures in all sectors.

ENERGY & SUGAR SECTOR:

In the light of the above developments, it has become the paramount need of the sugar sector at present to become energy efficient for maximizing their profits as well as to support the government, in their quest for additional energy resources. Any augmentation from sugar sector will be a boon to any national economy as it will not be at the expense of their fossil reserves. Therefore for every unit in the sugar sector, a self introspection in the form of a detailed energy audit will do a world of good at this juncture, without waiting for the intervention of statutes. In this context, sharing of experience based on the energy audits carried out and the improvement made in some of the sugar factories in our country will be very useful.

STEAM GENERATION:

At the outset the steam and power production areas will be highlighted before going into the details of energy consumption areas. For steam production bagasse being the only fuel, it is very important to ensure that uniform feed of the fuel of not exceeding 50% moisture content is assured always to the boilers. More than 60% of the factories in India work with Boiler systems of less than 20 kg/sq.cm pressure rating. Whatever may be the operating parameters of the boilers, the need for maintaining the boilers in excellent health to work at the rated efficiencies does not require over emphasis. Typically in a well maintained boiler there is a variation of 0.8% in the efficiency of boiler for every percentage of moisture variation in bagasse. A moisture level of 50% in bagasse is generally taken as the benchmark as all the sugar mills as well as boiler manufacturers adopt this for their designs. Though bagasse drying can improve boiler efficiency further, it has to be carefully planned in the heat balance of the plant, while optimizing the power cycle.

It is important to take note of the following thumbrules for quantifying the energy conservation in boiler operations. Every 20°C reduction in back end temperature: 1.0%

increase in boiler efficiency. 10% reduction in excess air: 0.4% increase in boiler efficiency. 1% reduction in bagasse moisture: 0.8% increase in boiler efficiency. For 1TPH steam generation with 0.5% increase in boiler efficiency, there is saving in 3 kg/hr of bagasse. For 1 TPH steam generation, by installing flash steam recovery system for continuous blowdown in boilers, there is a saving of 1.5 kg/hr of bagasse. These figures may vary according to boiler parameters. The above details will emphasize the need for maintaining optimum operational conditions required for efficient performance of mills and boilers.

In one of the recent energy audits in a 4000 TCD sugar factory, it was found that the average moisture % bagasse was 53% and the fluctuation was between 51.5% to 55%. The factory was quite old but with modern facilities in a number of areas. The boilers (4 nos.) were also old and of low pressure designs but retrofitted with system for efficiency improvement. Because of poor state of maintenance the boiler efficiencies recorded with the high moisture % in bagasse was ranging from 50% to 56%. The bagasse steam ratio was 1.85 only against the optimum of 2%. It was found that by correcting some minor problems of maintenance of boilers and by effecting some improvements like reduction in excess air level, reduction in back end gas temperature, provision of better bagasse feeding arrangement etc. the efficiencies could be improved to 60% and above, which could reduce the bagasse consumption by about 21,900 Tonnes for 200 days working in a season. Similarly the reduction of bagasse moisture from 53% to 50% can increase the saving of bagasse by another 19,848 Tonnes for 200 working days in a season. Thus the total saving of about 41,750 tonnes of bagasse annually at a conservative Rs.400/- per tonne of bagasse will yield an additional revenue of Rs.167 lakhs to the factory. The bagasse saving converted in terms of power production will yield a revenue of more than Rs. 400 lakhs per annum even at the rate of Rs. 2.50 per unit of power. The factory will be justified in spending even Rs.400 lakhs towards moisture reduction in bagasse and boiler efficiency improvement programmes as the pay back will be attractive. Otherwise the opportunity loss will go unnoticed year after year.

POWER GENERATION:

While dwelling on Energy audit, it will be relevant to highlight the importance of improving productivity of bagasse. The foregoing discussions and case study have established the fact that how moisture % in bagasse is a critical factor in enhancing the productivity of bagasse in addition to efficient boiler conditions. Modern high efficiency boilers of high pressure designs i.e. pressures upwards of 45kg/cm² aim at an efficiency of 70% plus for bagasse firing, and with these boilers productivity of bagasse is further increased with the increase of operating pressures. Adopting higher pressure power cycle will increase the power output from the same bagasse. For example 100 kg of bagasse can produce the following power output.

Steam cycle parameter	Power generation at
Ata / Deg. C	2.5 ata BP kW
45 / 440	32.8
67 / 480	37.8

87 / 515

40.0

Hence it is advisable to adopt 87 ata 515°C steam cycle for new full-fledged cogeneration systems. We find that the bagasse steam ratio which is a Layman's yardstick in sugar parlance improves to 1:2.45 for 87 ata steam pressure modern boilers. It is seen that the bagasse steam ratio which used to be of the order of 1:2.0 with old low pressure, low efficiency systems have improved to 1:2.45 in the modern cogeneration systems which is a clear improvement in the productivity of bagasse and a positive step in energy conservation through improved boiler designs for higher efficiency. Thus this promises to be the key area in sugar industry for future indexation of the statutory energy regulatory authority that has been formed to monitor energy conservation.

RAW WATER:

Utilisation of raw water in the factory ranges from 75% to 110% on cane as against the optimum of 25%. Two bore pumps of 30 kW capacity each, running at 70% loading continuously operate for meeting the water requirement of the factory. In addition to this 2 more similar pumps continuously operate to meet the distillery's requirements. The enormous wastage of water and power in this area can be successfully controlled by proper planning. There is potential to save at least 60 kW of power in this area, which will save a wastage of about Rs.7.2 lakhs per annum.

The power saving opportunities identified in the foregoing is tabulated below. Even if 600 kW of power is saved the power consumption per tonne of cane will be 18.34 units instead of 22.10 units. This will amount to an additional revenue of about Rs.72 lakhs per annum.

Sl. No.	Description	Power saving in KW	Investment Rs. In Lakhs	Saving / Yr Rs. In Lakhs
1	Cane carrier VFD	15	5.0	1.80
2	Strained juice pump VFD	9	2.5	1.08
3	Weighed Juice pump	40	6.0	4.80
4	Sulphited Juice pump VFD	15	2.5	1.80
5(a)	Conversion of V belt to flat belt drives	12	2.5	1.44
5(b)	VFD for Air compressors, vacuum pumps and bagacillo blower vacuum pump	25	10.0	3.00
6(a)	Crystalliser, magma minglers Etc. drives planetary gears and change of motors	50	40.0	6.00
6(b)	Crystalliser, magma minglers	10	1.0	1.20

	Etc. drives planetary gears and change of motors, star, DSCM mode of operation			
7	Condenser, Injection water, spray cooling system	400	300	48.00
8	A range centrifugals	13	60	1.56
9	Boiler ID fans	274	46	32.80
10	Raw water	60	2	7.2

STEAM CONSUMPTION:

Steam consumption of the factory including refinery and distillery is about 53.5% and for sugar factory alone it is around 49.5 to 50%. By introducing continuous pans for B and C-massecuite and completely avoiding the use of exhaust steam for pan boiling it is possible to reduce steam consumption by at least 2%, which will mean a direct saving of 1% of extra bagasse which will be equivalent to an additional revenue of about Rs.307.2 lakhs per annum. The investment on this will be about 200 lakhs which is paid back within a year.

TOTAL SAVING POTENTIAL: Total Savings envisaged		Rs. In L.
	2. Power saving in sugar factory	
1123.	Steam Saving	307
	1200	

Conclusion:

Energy audit is a very important tool in transforming the fortunes of any organisation. Norms should be set and continuously reviewed during the course of operations, just as any other financial or production or commercial parameters.

As seen in this write up, the huge potential for savings, if properly harnessed can take any organisation to the path of prosperity. Particularly where cogeneration of power is involved in a sugar industry, every unit of power saved and every ton of bagasse saved adds to the additional revenue of the organisation.

Potential for energy conservation in sugar industry is immense because of the fast developments that are taking place in the industry as well as the traditionally conservative outlook of the Industry in India and their present status. This paper highlights only a few important areas that has come to light during the audit of different factories. There may be many more areas uncovered by this report typical to individual units. That the potential for saving more than Rs.800 lakhs per annum in one factory has been identified does not reflect that the same state of affairs will exist in all. It will be different in different places and there are bound to be concern areas in all places if honestly looked into, since no one could claim to have reached the state of perfection.

Therefore it will be prudent for all organisations to set up energy committees within the organisation, identify lacuna dispassionately and rectify them immediately. Total commitment, involvement and guidance of top managements is essential for this and if

implemented effectively, it will usher in prosperity not only to the organisation but also to the Industry and the Nation at large.

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