

Options for Co-Generation in Sugar Industry

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India is currently the largest producer of cane sugar in the world, accounting for 10% of the world production. Sugar is growing industry with the cane area, yield and recovery of sugar increasing over the decades, though there are cyclical variations from years to year. Though the concept of bagasse-based co-generation has always been practiced by sugar mills, there has of late been growing awareness in the sugar industry of the advantages of installing 'High efficiency' bagasse based co-generation system.

What is Co-generation?

Co-generation is the simultaneous generation of two different forms of useful energy from a single primary source of energy. The two different forms of energy are:

- Electrical energy and Thermal energy
- Mechanical energy and Thermal energy

The sequence of generation is not fixed e.g., Electrical/Mechanical energy and thermal energy or thermal energy followed by the generation of electrical/mechanical energy. Co-generation takes place through thermodynamic degradation of a single medium, e.g. Expansion of steam in a steam turbine followed by condensation or cooling down of hot gases. A typical example of an industry where co-generation is already widely used is sugar production where both thermal and electrical energy are generated using bagasse as the main co-generation.

Why Co-generation?

The efficiency of conventional electricity generation using large scale centralized power plant scale centralized power plant is assumed at 35%. A typical medium pressure boiler operates at an efficiency of about 85%. Assuming that an industrial process needs both heat and power in a ratio 1.5:1, the overall energy generation efficiency will thus be about 54%.

In case the same thermal and electrical energy would be supplied using a suitable co-generation system, the overall efficiency could range from 65 to 95% assuming an efficiency of 75% the total primary fuel savings would be about 28%.

Whereas in the case of separate boiler (with an efficiency of 85%) 1.76 units of fuel are required to supply 1.5 units of heat, in the case of co-generation the total fuel input would be 3.33. The fuel chargeable to power for supplying the extra unit of electricity is thus only 1.57 units compared to 2.86 for the conventional option. This is a reduction 45%.

If transmission/grid losses are taken into account, the picture becomes even more favourable. Assuming the transmission/grid losses to be 15% FcP for separate power generation would be 3.36. The total primary fuel savings would thus be in the order of 35% while the fuel saving related to electricity production would be about 53%.

Types of Co-generation

Depending on the quality of process heat required, co-generation may be based on topping cycle or on bottoming cycle.

In bottoming cycle systems, heat is required for the process at high temperature and hence power is generated through a suitable waste heat recovery system.

On the other hand, in the topping cycle system, heat is required for the process at low temperatures and therefore power generation is taken up first.

Requirement of Sugar Industries

The process of manufacturing crystal sugar requires steam. In existing co-generation systems steam is generated in low – pressure boilers by using bagasse-the woody fibrous residue of crushed cane, as fuel. This system was developed when possibility of exporting power to the grid was not envisaged. Further, since the storage of large quantities of combustible bagasse in the premises of the sugar mill was not an advisable option, most of the boilers were designed so as to use almost the entire quantity of bagasse produced. By upgrading the steam parameters, the sugar industry can produce electricity far in excess of their own requirement and sell the surplus power to the grid.

Benefits of adopting Co-generation systems in Sugar Industries

- Not depending on external power to all, sugar plants can be located nearer the sugar nearer the sugar growing areas, thereby saving on transportation cost of sugarcane.
- An efficient and sustained co-generation enables the plant to isolate itself from the vagaries of power.
- Power generation using bagasse is environmentally cleaner as bagasse produces very little fly ash and no Sulphur.
- Net contribution to greenhouse effect from the bagasse based co-generating plant is zero, since the carbon-di-oxide absorbed by the sugar cane grown is more than the one emitted by the co-generating plant.
- Low capital investment. Recurring costs are also lower compared to fossil fuel based power plants.
- Use of totally renewable source of energy. Total saving in the mining, extraction and long distance transportation expenses of fossil fuels.
- Rural location of sugar mills enables co-generated power to be directly fed to the local substation, consequently minimizing T & D losses and the requirement of long feeder lines.
- Saves the expenditure on safe storage and disposal of bagasse.
- A co-generation plant places no financial or administrative burden on the utility as it is executed and managed by the sugar factory.
- Power is generated at a lower cost in co-generating systems and pay back periods are shorter.
- Provides an initiative to sugar mills to concentrate more on conservation of energy and reduction of steam consumption thereby improving their profitability of operation.
- Surplus power generation in sugar factory is ideally suited for rural electrification and for energizing irrigation pumps and industrial and agro-based units in the villages.

Conclusion

Several studies carried out have established that significant potential exists in India for Bagasse based co-generation. Further, the interest shown by the government of India, the State Governments and international funding agencies have provided the necessary thrust to encourage sugar mills to become more and more conscious for energy conservation and venture into the area of high efficiency co-generation leading to export of surplus power. As one of the largest processors of cane sugar, Indian sugar industry is on the threshold of making a visible penetration in power generation sector.

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