COGENERATION TECHNOLOGY: CLEANER AND ENVIRONMENT FRIENDLY

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ABSTRACT

The increasing demand, growing prices and depleting resources of fossil fuels were diverting the attention towards the alternate energy source. The scenario of Pakistani sugar industries were presented in this research paper specially the bagasse production and their usa for cogeneration. The bagasse content moisture 53%, dissolved substance 2-5% and fiber content 47-56%. The bulk density of bagasse in sugarcane was 45kg/L. The bagasse content in sugarcane was 24-28%. The bagasse cogeneration was the prominent and suitable option against the fossil fuels because of emission free burning, viable for energy generation in sugar mill and surplus to sell.

Key words: *Fossil fuel, industries, sugar, cogeneration, suitable*

1. INTRODUCTION:

Sugar industry was the leading industry of Pakistan. It produces sugar as a major item with baggage and molasses as the residue. The molasses further processed for the production of ethanol in distilleries [1]. The juice free sugarcane was the bagasse. It was completely fibrous material. Around 80% sugars producing countries had better use and potential to utilize the bagasse effectively [2]. One of most useful use was the steam generation in sugar mills. The process by which the two forms of energy were produces as heat and electricity was known as cogeneration. In well designed cogeneration system the fully equipped boilers can generate the high pressure steam which was proceed for electricity by rotating the turbo generator blades (Fig 1).

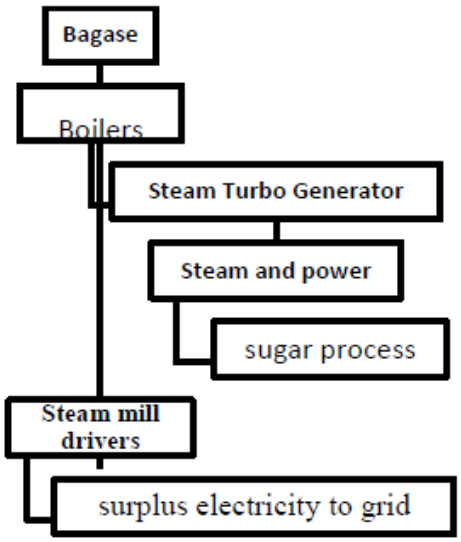

Figure-1: The simplified cogeneration Process

The cogeneration was popular in sense that sugarcane industry waste not only produces the power to meet the requirement but also surplus can be supplied to the grid stations. The cogeneration was used in wide spectrum in various industries like paper and pulp industry, petrochemical and textile and others. It significantly reduces the power consumption and in some cases the energy efficiency on cogeneration mode was up to 85% [3]. The energy sector authority's emphases the stack holders to generate the alternative fuels instead of fossil fuels because their prices were rising up, consequently the product cost increased and became unaffordable to common man. Also their deposits were depleting day by day and with passage of time they may be finished. Further the fossil fuel burning causes the green house gas emission and was the serious environmental concerned. That was why the need was to introduce the cogeneration to save the energy and control the emission. The lower energy-related emissions were the eutrophication potentials, acidification and global warning. So prevent the human from toxic effect of lead enriched oxygenates.

Cogeneration from bagasse was the feasible as it were the low cost, efficient and socially beneficent. It had provision to provide the renewable and clean energy source. Especially at the configurations where high pressure and temperature were maintained the cogeneration were the more efficient resources and ensuring widespread access to electricity services [4]

The bagasse was the lignocelluloses residue and was the byproduct of sugar industries used for various agricultural activities [5]. The sugarcane was content 20-30 bagasse. The 235-250kg bagasse was obtained from one ton of sugarcane [6].The India generated 40 million tons annually and was diverting from conventional fuels to

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bagasse cogeneration. The cost was cut down to half to one liter petrol [7].

The sugarcane was fifth largest crop of Pakistan in terms of area. It positioned at eleventh by production and sixtieth by yield in the world. In the list of agro based industry the sugar industry was at the second positioned and consists of seventy seven sugar mills. Those sugar mills had annual capacity over 6.1 million tones [8]. The motivated government policies and incentives of sugar mills owners encourage the growers. The sugar industry improves the energy efficiency by "green cogeneration" or ethanol production. The ethanol produced by fermentation of cellulose hydrolysis. In Pakistani economy the sugar industries and sugarcane growers were played important role in national economy. In Pakistan the seventy-one sugar mills were operational, two under construction and four completed (Table 1).

Table 1: The overview of sugar industries of Pakistan (ref 3)

Contribution to Economy	6.1 Million tones
Crushing capacity	3.0-4.0 Million tones
Share in GDP	1.9%
Employment	1.5 million(directly and indirectly)
Total investment	PKR 100 Billion (Approx)
Average Yield Per Hector	45.0-55.0 Million tones
Per Capita Consumption	25.8 kg per capita
Contribution to exchanger	Billion Rs.12.16

The sugar mills designed in the way to utilize the bagasse to meet their energy requirement. The alcohol and sugar were the energy intensive process. Some sugar mills established various downstream producing plants as biogas ethanol, effluent treatment chemical and paper plants (Table 2). The one -third of the bagasse was sufficient for generation of electricity and steam produced in sugar mill [9].

Table 2: The products of sugar mill (Crushing capacity 3,000 tonnes /day) (ref 3)

Item	Refined Sugar	Yeast	Potash Fertilizer	Pulp	Wax	Press-Mud
Tone	345	03	15	25	15	150

This research paper focused the cogeneration through bagasse in sugar industries. Also discovered their associated problems and economical, socio - environmental advantages.

2. COMPOSITION OF BAGASSE:

The composition of bagasse varies depends preliminary on climatical condition, soil nutrient content, sugarcane harvesting methods and finally the efficient sugarcane handling method in sugar mills. The sugarcane from ten different locations were analyzed in quality assurance laboratory Sakrand sugar mill and their mean were tabulated (Table 3).

Table 3: The composition of bagasse originated in sindh region

Moisture content (%)	Dissolved substance (%)	Fiber content (%)	Bagasse content in sugarcane (%)	Bulk density (Kg/L)
53	2-5	47-56	24-28	45

The Moisture content was most important from steam generation point of view. The other important properties were the dissolved substance and fiber content. The dissolved substances were the substances in aqueous solution and were originating in the juice consisting of sugar and of impurities. These dissolved substances were in small quantities ranging from 2 to 5%. Insoluble materials consisting mainly of cellulose part of bagasse. Quantity of bagasse varies between 24 - 28% by weight of sugarcane, or approximately one quarter [10].

3. CHEMICAL COMPOSITION:

The elemental analysis of bagasse was done in Hitech laboratory, SU by Energy Dispersive X-Ray Spectroscopy (table 4)

Table 4: The chemical composition of bagasse

Carbon (%)	Hydrogen (%)	Oxygen (%)	Ash (%)
47	6.5	44	2.5

4. BENEFITS OF BAGASSE COGENERATION:

The sugar industry viability was increased by generating the energy from their waste material at zero cost. This was the best option to utilize the waste (bagasse) usefully. The cogeneration not only fulfills the energy requirement indigenously at low operating and transmission cost but also provides the option to sell the surplus electricity to consumers.

The bagasse cogeneration opens the doors towards the natural, clean, renewable energy and safe biomass disposal.

CONCLUSION:

The enhancement of power generation from bagasse cogeneration was important especially in sugar mills. The cogeneration plant must be designed and optimized. The boilers capacity, turbo generator and power cycles operated appropriately. Technically the selection of cogeneration technology, the bagasse quality and quantity, handling operation and number of processing units were important factor. The bagasse cogeneration was the highly efficient energy conversion process and yield more electricity and heat then conventional combustion process.

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