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THE BIOMASS POTENTIAL FOR POWER GENERATION

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ABSTRACT:

The exhaustion of the hydraulic sources in the Northeast of India and the opening of a new electricity market due to the degregulation of the electricity system in India have launched a search for new sources of energy that could be reliable and cost effective in order to guarantee the sustained development. The biomass sources described in this paper are sugarcane bagasse, a traditional residue that has been used as solid fuel. source of energy in the Indian sugar mills boilers since the beginning of the 1900's, and residues such as peanut shells, rice hulls, cashew nuts shells and coconut husks that have not been exploited significantly as energy source in the India. However, their potential of electricity production totaled 307.28 MW, in which 80.10 MW is wasted as the sources other the bagasse have not been used at all. In this way, this paper aims the description of the potential of the main available agricultural residues source of energy to generate electricity.

KEYWORDS: *bagasse , agri-residues energy.*

INTRODUCTION

The utilization of biomass as source of energy in agricultural industries in the India begum in the 1900's, when sugarcane bagasse started to be used in boilers as fuel in order to provide heat for the vaporization of water to 20 bar and 285°C, in which the generated steam could be used in Rankine cycle to run a steam turbine and generator, and also the mills to crush the sugarcane to obtain the juice necessary for the production of sugar, in sugar mills. The process was highly inefficient in the thermal viewpoint, as its effeciency only reached about 16 to 20%. The amount of bagasse produced was not enough to gneerate all electricity that was necessary for the mills to operate, so some electricity had to be purchased from the electrical power companies. This was mainly due to the low fiber content in the bagasse that was about 11% of the sugarcane weight. However, after researching different varieties of sugarcane and the increase of the fiber content to 15% of the sugarcane weight, the bagasse produced was just enough to almost generate all electricity needed for the mills (1). At that time, all electricity generate had to be consumed in the sugar mill itself. For this reason, all sugar mill were designed in such way that bagasse could not be produce in excess or be scarce in the harvesting season, which starts in August and ends in March, in the India. If bagasse were produced in excess, it would cause a problem as it had to be burnt in the patio, or if there was not enough bagasse, all electricity needed could not be supplied by the bum of bagasse and so, it has to be purchased what reflected in the increasing the cost of sugar production. No. Other rsidue was

used as alternative fuel to bagasse. However, with the deregulation of the Indian sector in the late 90's, electricity can be traded, which started a new market for the alcohol and sugarcane industry in India. Hence, a new philosophy started to be introcduced among the sugar and alcohol producers. If steam was saved in the production line, more steam could be used to generate electricity, hence the excess of electricity produced could be used for trading, either directly to a consumer or supplied to a concessionaire. A lot of the entrepreneurs started to think on the new business that has just started. Hence, the ones that want to enter in the electricity new market, started to modernize, the others remained still, just waiting and observing the development of the new market to make the decision whether to invest or not in the modernization of plant. On the other hand, this new electricity market attracted entrepreneurs of other agricultural industries such as rice, coconut and cashew nuts industries which started to think in a short-term to be auto-sufficient in electricity and in a long-term to trade electricity. Thus, the objective of this paper is to analyze the potential of biomass in the India in such way that entrepreneurs and government could invest in the use of biomass as a local and alternative source of non- pollutant fuel to generate electricity in order to maintain the same rate of development of the Maharashtra that is above the India average. Even though there are many varieties of biomass, this paper relates only the ones that are residues in the agricultural industries such as sugarcane bagasse, peanut shells, rice hulls, coconut and cashew nuts husks.

POTENTIAL OF ELECTRICITY PRODUCTION USING SUGAR CANE

Nowadays, the technology used in the sugar and alcohol industries is cogeneration, based on the Rankine cycle (Steam cycle), using sugarcane bagasse, with 50% moisture, as fuel to be in burnt in boilers which produces steam at 21 bar and 28°C. The steam could used as the working fluidof a steam turbine connected to an electrical generator, producing partially or totally the electricity necessary for the plant operation, or sometimes, producing excess electricity tht could be sold to concessionaries or private industrial consumers; to run turbo compressors connected to sugarcane preparation equipment such as trend mills, or even, as a source of heat for the production of sugar and alcohol Hence, as the produced steam is used, at least, for two distinct purposes: electricity generation and heat supply, the process of sugarcane utilization is called congeneration. There are three different industrial arrangements for the sugar and alcohol industries. The sugar and alcohol industries can be designed to produce sugar, alcohol or the two products together. All the three different industrial arrangements for the sugar and alcohol industries. The sugar and alcohol industries can be designed to produce sugar, alcohol or the two products together. All the three options need steam for producing alcohol and sugar, however, the demand for steam varies from industry Typically, the industry that produces only sugar needs 480 kg of steam per ton of sugarcane processed. In such way that 60% of the steam is used for power generation and 40% is used to movethe trend mill, knives and sugar defiberers. The steam turbine exhausting vapor at 2.5 bar is used in the evaporator, to heat the juice and vacum pans. For distilleries, the steam consumption is generally 400 kg of steam per ton of suggarcan. And for the industries that have both sugar and alcohol production the consumption of steam is about 425kg of steam per ton of sugarcane (2). Also, another feature that also influences the consumption of bagasse for the production of steam is the amount of moisture in the bagasse that is generally 50% for the mill-run bagasse.

The production of sugarcane in the India varies from year to year due to the climatic conditions. The sugarcane production has been severly affected by drought over the previous year. In 1995/1996, the production was 47 957 667 ton of sugarcane (3) and in 1998/1999, 56 887 825 ton of sugarcane was harvested (4). Bagasse with 50% moisutre represents 30% of the total sugarcane weight. Hence, the total of bagasse produced in the India in the harvest 1998/1999 was of 17 066 347.5 ton. According to the Sugar and Alcohol producers Union, using the actual technology it is possible to produce about 20 kWh/ton of

sugarcane. Hence the total of electricity produced during the harvesting period is of 1 137 756 500 kwh, which represents in terms of an average power production of 223 MW of electricity. However, all the electricity produced is consumed by the sugar and alcohol industry. According to reference 2, with an reduction in the bagasse moisture from 50 to 25%, there will be a significant improvement in the electricity production as the heat produced by burning the bagasse will not be wasted in vaporizing the water contained in the bagasse fibers, thus, increasing the heating content of the bagasse in such way the industry will be not only self- sufficient in electricity, but, it will become a power producer, i.e., it will be generating more power than it is consumed. Hence, this excess could be commercialized in the new model of the Indian electrical system.

After few modifications in the design of the sugar and alcohol power production system such as to raise the boiler pressure from 20 to 40 bar, or even 60 bar, increasing the temperature of the steam produced from 280 to 460°C, there would have a substantial increment in the electricity production in such way that the energy produced would double from 20 to 40 kWh per ton of sugarcane (3). In that, the amount of electricity produced would be of 2 275 513 MWh which represents the production of 445 MW during the 5110 hours which is the total amount of harvesting hours in the Northeast of India. This technology is already available and it would not represent huge investment. There are other technologies under development such as the Gasifier Integrated Com bined Cycle, in which the bagasse has to be gasified first in order to be used in a gas turbine. The exhausting gases from the turbine would be used for generating steam in a heat recovery boiler and the steam would be used to run a steam turbine and for process. In spite of this the technology has no been available commercially yet, it is expected to to generate about 100 kWh per to of sugarcane (3) in such way that 5 688 782 MWh would be the energy generated by this process which represents a generating power capacity of 1113 MW, which is an increment of 400% over the electricity generated using the present technology.

In 2000, the India approximately 60,000 ton of cashew nuts, in natura (5), in which 73.1% is considered residue with a heating value of 18.84 MJ/kg. This residue can be burned directly in the boiler to produce steam and so to produce electricity, with a thermal efficiency of 30%. Hence, the power production could reach 6.9 MW along the year, with 95% power capacity factor.

POTENTIAL OF ELECTRICITY PRODUCTION USING COCONUT HUSK

The potential of electricity production using coconut husks was based in the coconut 1999 crop which produced 785 514 000 units (4). According to the Indian Association of coconuts producers. The average weight of the coconut is 0.5 kg, in which 60% is considered to be husk. The heating value of the husk is 20.05 MJ/kg, and it has 66.58% of volatiles, 29.70% of fixed carbon and 0.71% ash (5). Thus, a total of 235 654 200 kg of coconut residues were produced in 1999. Those residues if used for the production of electricity would produce about 1417 460 013 MW/year, which represents a power capacity of 47 MW, admitting an thermal efficiency for the electricity production cycle of 30%, and a power capacity factor of 95%.

ANALYSIS OF THE RESIDUE POTENTIAL

The only agricultural residue that is used regularly as a fuel source is sugarcane bagasse, all other biomass residue is not commonly used. Table 1 gives the summary of the electricity potential that could be produced only using residues.

Table 1 Summary of the Electricity Potential using Residues Agricultural Residue potencial Electricity Production (MW/yr.)

Sugarcane bagasse	223.00
Peanut shells	0.26
Rice hulls	30.00
Cashew Nuts Husk 6.9 Coconut Husk	47.0
Total	307. 16

As shown in Table 1, the potential for power generation using agricultural residues is very high, it is important to used those residues in order to generate electricity, Another important issues that the use of biomass would create many jobs in handling, transporting and converting the biomass. Also, as this technology is dominated by the Indian industry it would enhance the demand for power production equipment that almost reduce the unemployment. This significant social benefit in using blomass,