Natural gas utilization as complementary fuel in BIG GT systems for cogeneration in the sugar and alcohol Brazilian sector

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Increase power utilities in Brazil is, nowadays, an emergency to avoid black outs in the next years. High potential of power production exists in the sugar and alcohol Brazilian sector, particularly in the São Paulo state, were is concentrated both, the highest power demand of the country with the offer of natural gas from Bolívia and the majority of sugar cane mills.

Today, the power schemes installed use, basically, Back Pressure Steam Turbines (BPST) operating with relatively low steam parameters, generating, in the most of the cases, just the consumed power during the season. For the large increase of power generation in the sugar and alcohol sector the advanced technology implementation is necessary. BIG GT (Biomass Integrated Gasification Gas Turbine) more than CEST (Condensing Extraction Steam Turbine at high steam parameters) systems are interesting for this application.

The implementation of BIG GT systems in the sugar and alcohol sector is conditioned to the following factors: (i) the present status of the technology development; (ii) sugar cane biomass availability for the whole year operation and (iii) electricity generation cost at competitive market price. At commercial status of BIG GT technology, biomass availability is a serious problem for its implementation. Unfortunately, sugar cane bagasse is not enough for the whole year operation at the current steam consumption in process (500 kg_v/t_c) without use an auxiliary fuel. Here is that the present natural gas offer, existing in the energetic Brazilian sector, plays an important role.
The idea of natural gas use as off-season complementary fuel is possible, considering its high cost, only when advanced high efficiency technologies as BIG GT are used.

For the analysis of natural gas utilization as complementary fuel in BIG GT systems for cogeneration in the sugar and alcohol Brazilian sector, sugar cane mills capacity of 150, 300 and 800 t_c/h were considered from COPERSUCAR data with the main purpose of compute the electricity generation cost. Were considered also, values of steam consumption in process of 500, 340 and 280 kg_v/t_c computing the necessary investment to its reduction.

The integration concept of BIG GT systems with the sugar cane mills is studied from the installation of one, or more than one, ABB GT10 BIG GT unit in dependence of the following factors: (i) mill capacity, (ii) steam consumption in process and (iii) Natural gas – Bagasse power ratio ($kWt_{NG}/kWt_{Bagasse}$). The last is defined by the natural gas mass flow consumed in the BIG GT unit, which is restricted to the values: 'zero', just bagasse is use; '1.24', is equivalent to 13 MJ/kg of LHV, that is the minimal value of the fuel gas feed to the gas turbine that allows to avoid the gas turbine reconstruction; and '3.08', is equivalent to 20 MJ/kg of LHV for fuel gas feed to the gas turbine. In all cases was suppose the operation during 7446 h/year without additional sugar cane bagasse.

A computational code was use to simulate the BIG GT systems integration with the sugar cane mill. The main conclusions of the numerical results are: (i) with the natural gas utilization could be avoid the investment for reduce the steam consumption in process, at the same time that the power generation is done for the whole year; (ii) in dependence of the mill capacity, the steam consumption in process and the used Natural gas – Bagasse power ratio, the amount of power to the grid is between 27 – 83 MW at the generation cost of 31 – 67 US$/MWh.