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Biomass quality in a thermoelectric plant along one year

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1. Introduction

The biomass quality is an important issue for the operation of a thermoelectric plant. Independently of the combustion technology, the biomass fuels and its characteristics are responsible for some operating problems during the thermochemical conversion of the biomass in thermal energy. These operation problems are related to the boiler and heat exchangers, dedusting technologies (e.g., electrostatic precipitator). Some studies show the phenomena of corrosion and incrustation on the walls of the boiler (named as fouling phenomenon) and on the walls of superheater, economizer, and equipments for flue gas treatment (named as slag phenomenon). When the biomass presents high levels of alkaline metals, like herbaceous and agro-industrial residues, these problems will be intensified. For example, the potassium and sodium decrease the melting point of the ashes, causing the incrustations and slag formation. On the other hand, magnesium and calcium in the biomass lead to the increase of the melting point of the ashes.
The influence of the biomass quality on the bottom and fly ashes properties is related with the quantity of inert material, unburned carbon content and chemical composition. Thus, the main goal of this research work is focused on the characteristics of the forest biomass residues used as fuel in a Portuguese thermoelectric plant equipped with grate furnace technology. The results obtained allow the evaluation of the influence of some physical-chemical characteristics of the biomass on the produced ashes, and in the overall power plant performance.

2. Experimental

Biomass samples were collected in a Portuguese thermoelectric plant with grate furnace technology. This power plant consumes about 115 kton/year of forest biomass residues (with about 35% of moisture content) and has an electric power capacity installed of 9 MWe, develiring about 63 GWh/year to the national electric grid. In the plant, the biomass is transported from a ditch to the boiler feeder by a claw system.
About 20 kg of biomass sample was collected from the biomass ditch, using a bimonthly sampling campaign during one year. This biomass was characterized according to some parameters: proximate analysis (moisture, ash, volatile matter and fixed carbon contents), ultimate analysis (CHNOS contents), fine and inert contents, and heating value (lower and higher). All experimental procedures are normalized through European Norms.

3. Results and discussion

The results do not show significant variations between the six samples of biomass in terms of elementary composition (CHNOS), ash and volatile matter content. The lower heating value (LHV) in dry or wet basis varies between the different sampled biomasses, while the higher heating value does not show significant variation over a year. The fine and inert contents are an important indicator about the quality of biomass and its consequence on the conversion process and on the amount of produced ashes and its characteristics (the LHV was correlated with other parameters). The biomass quality is influenced by other contaminant materials accompanying the biomass. Through some treatments (e.g. sieving) can be removed inert materials (different solid wastes, soil, sands, etc), improving its quality and minimizing negative impacts on the environment and industry.

4. Conclusions

These results can give a relevant contribution for the biomass quality improvement in order to avoid some problems on the boiler operating conditions and heat recovering systems and flue gas treatment. The influence of biomass on the ash characteristics and produced amounts are other important issues to account for, namely considering the associated costs of its environmental management.