EXPERIMENTAL ASSESSMENT OF THE CONTINUOUS PNEUMATIC CLASSIFICATION PROCESS OF SUGARCANE BAGASSE

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Introduction

It is presented a new technological concept for the handling and treatment of solid particulate of biomass from sugarcane mills mainly sugarcane bagasse, which consisted through project development, construction, assembly and operation of an experimental installation in pilot plant scale to carry out the continuous pneumatic classification process of sugarcane bagasse, separating this biomass in three well-defined fractions, within certain controlled ranges of flow of bagasse and classification agent (air), called fine, medium and coarse.

In a first moment was performed the calculations that allowed the development of the pneumatic classification equipment. The calculations were based on physical and fluid-dynamics sugarcane bagasse properties, as well as constructive criteria, scale relations, project and operational parameters.

The operate principle of the pneumatic classifier is based on solid particles fluidization, elutriation and pneumatic transport principles within an air column. The fine particles are dragged and collected in a cyclone at the top of the equipment, the medium particles circulating in the column are collected through an opening next to the middle of this and the coarse particles, heavy enough to not be either dragged or put into lifting, fall by gravity action into an opening at the end lower of the air column. The feeding of the equipment is carried out by a rotative valve, projected to operate between 5 to 30kg/h with nominal value considered of 20kg/h. The air flow obtained into the column is produced by a centrifugal fan.

In a subsequent step was defined a set of basic experiments planned taking account three physical conditions of the sugarcane bagasse, obtained before feeding the classifier equipment. The physical conditions were sugarcane bagasse at equilibrium moisture (8% to 10% wet basis), bagasse at 50% moisture (condition of the bagasse used in Brazilian sugarcane mills boilers), and milled bagasse at equilibrium moisture with particle diameter size control at milling process of 5 and 10mm.

The experiments were divided in two blocks, in first one, integral sugarcane bagasse at equilibrium moisture was used in order to study the pneumatic classifying in a special condition that excluded the bagasse moisture effect. Thus, it was elaborated an experimental design at two levels, varying bagasse feeding rate and air flow, with a middle point and three replicates of this.

In the case of the second block of experiments were studied milled bagasse and bagasse at 50% of moisture. The planning chosen taking account to fix the feeding rate factor and to vary the classification agent rate factor. This is the traditional experimental design type with a change at each time.

Results and conclusions

The analysis of the first experiments block showed that higher rates were obtained independents of the bagasse feeding. About the air flow this varies causes higher or lower on classified fraction dispersion. To fine fraction the particle dispersion was low to the three air flow used, approximately 0,750mm to particle mean diameter, but when more increased the air flow more varied the particle diameter in the fraction, for example, using air flow of 108m^3/h (higher value) was observed lower dispersion with particles diameters varying between 0,130 to 0,750mm.

With respect medium fraction the lower degree of dispersion was observed when the air flow were 88 (mean value) and 108m^3/h respectively, observing 75% of mass fraction of classified bagasse with particle diameter greater than 0,380mm and 80% of mass fraction of classified bagasse with particle diameter greater than 0,750mm respectively.

To coarse fraction the lower dispersion was obtained when 108m^3/h air flow was applied with 60% of mass fraction of classified bagasse with particle diameter greater than 9,08mm.

The experimental results of the second block of experiments showed that it is possible to pneumatically classify sugarcane bagasse with 50% of moisture content (wet basis). It was observed that the separation of the coarse, medium and fine fractions, for all tested samples, in both cases of sugarcane bagasse at 50% moisture and milled sugarcane bagasse, there was a repeatable aerodynamic behavior. It is noticed that in the case of previously milling of the sugarcane bagasse, it was possible to classify into more homogeneous fractions with respect to the moisture and less moisture bagasse (50% and at equilibrium moisture respectively). The explanation for this behavior is based on the fact that milling itself is a process of pre-homogenization.

Likewise, it was shown that the dispersion of sizes in each separated fraction depends on the diameter of each fraction and operation conditions of the classifier. It was observed an increase in the dispersion (heterogeneity) with the increase of the average diameter of the fraction. Thus, the heterogeneity of the separated fractions increases from the fine to the coarse one. It was also observed that the air flow shows a determining factor for controlling the degree of dispersion of particle sizes in the different fractions of bagasse.

These results are significantly important considering that in some technological processes which use polydisperse biomass as raw material, especially biochemical processes of conversion, the physical homogeneity of the material, based on the distribution of sizes and shapes of particles, in addition to its inorganic material content, are necessary criteria to achieve a high performance and energy efficiency in the processes.

Supported by FAPESP – Fundação de Amparo à Pesquisa do Estado de São Paulo, Brazil

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