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Indeks podatności przemiałowej biomasy

Praca doktorska

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SUMMARY

One of the most frequently used forms of energy production from solid biomass fuels is the combustion and co-combustion of biomass in pulverized fuel fired boilers. Therefore some problems may arise with regard to the proper powdering system capacity, the required pulverized particle size distribution and the proper operation of the boiler, which are related to the quality of utilized biomass type. One of the main parameters determining the quality of milling and the maximum capacity of the mill is material grindability. Grindability of materials is defined as the ratio of the energy spent during grinding to the resulting effect of this process, determined by values such as cumulative sieve residue for specific mesh size, surface growth of material particles or increase in specific fraction content. At present, there is no standard procedure to assess the grindability of biomass. Therefore it is impossible to predict correctly the yield of mill during solid biomass fuels comminution, as well as biomass usefulness for fragmentation in pulverized boiler`s fuel preparation installations.

The main objective of the dissertation research was to develop a method of biomass grindability determination (Biomass Grindability Index), which would allow for a clear classification of different types of solid biofuels in terms of their milling properties. Because of the widespread tendency to comminute biomass in beater mills, the research was conducted in a beater tester (utilizing the same grinding mechanism as industrial beater mills).

The objective of the research included also assessment of possibility of adaptation of the existing coal grindability determination methods for evaluation of biomass milling. The initial research was based on the Czech *VUK* method, which utilizes beater tester and is based on the grinding theory defined by Bond. In the course of research, the biomass grindability determination method was modified to obtain the highest possible reliability of the developed index, with the scope of laboratory and industrial tests being:

- study of the effect of circumferential speed of test mill beaters on the sample fragmentation and energy consumption during the test,

- biomass grindability tests with constant sample weight and varying test duration,
- determination of the influence of selected biomass moisture content on grindability, at constant sample weight,
- biomass grindability tests at constant volume of the samples,
- determination of the influence of feed particles size distribution on biomass grindability, for selected biomass types and at constant volume of sample,
- comparative tests of selected biomass grindability (at constant sample volume) between specified amount of energy consumed by the test mill motor approach versus constant test duration approach,
- industrial tests of the biomass milling plant, equipped with beater mills, which have been used to determine specific grinding energy for three types of pelletized biomass, and thus to verify the adequacy of developed biomass grindability index.

The results of laboratory and industrial tests have shown that the grindability of different types of biomass, comminuted in beater mills, can be clearly determined by the I_E index (the higher the value of the index, the worse is the milling behavior of the biomass), expressed as the ratio of energy consumption during the test to the mass of product fraction <0.5 mm (0-0.5 mm grain class):

$$I_E = \frac{E_{1-2}}{m_L \cdot D_{0.5}}$$

Studies have shown that the optimum test parameters are as follows: particle size distribution of the feed 0.5-2 mm, circumferential speed of the beaters w_L = 35 m/s, test time t_L = 3 min and constant sample volumetric size v_L = 90 cm^3.

The developed method is intended to serve as the basis for the development of a standard method for biomass grindability determination. The widespread of biomass grindability standard could improve the process of fuel preparation (for pulverized boilers) and biomass production (for power applications).