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Bark Screening and its Effect On Bark Quality

Bark is an important byproduct for energy production at the pulp and sawmill industry. However, bark is heterogeneous material with uneven particle size distribution and high levels of contamination. Screening bark can improve the fuel quality by removing fine and oversize particles, as well as gravel and stones. In order to find out the potential quality gains of bark and a system productivity, a Backers 3mal star screen was studied in Sweden. Screening reduced the fine particles from the medium fraction (accepts) by 50% and eliminated all oversized particles (>150 mm). Overall, screening did not reduce the moisture content.

Bark from sawmills and pulp mills contains a high proportion of fine particles and contaminants (e.g. stones), coupled with irregular particle size distribution. These characteristics make bark a problematic fuel since they adversely affect storage capability, effective heating value and ash melting behavior. Screening forest biomass can improve the fuel quality by removing fine and oversize particles, gravel and stones.

AIM OF THE STUDY

The aim of this study was to analyze the performance of a star screen operating on bark. Machine productivity was assessed and the moisture content and particle size distribution of each fraction were analyzed.

MATERIALS AND METHODS

The study took place in Kilafors, central Sweden (61°12’54.3”N, 16°37’13.2”E). The bark used in the study was a by-product of sawmills and pulp mills in the region. The screened bark will be used as fuel in heating plants.

Figure 1. Backers star screen setup for screening bark.

The system consisted of a star screen (model Backers 3mal, 130 kW), two windshifters (model VS1200, 20 kW) to remove gravel and stones from the medium and oversize fractions, and a Volvo L90F front-end loader with 5 m³ bucket capacity (Figs. 1 and 2). The whole system was operated by one operator who also drove the loader. The space required for the system was approximately 1 500 m² including travel routes for the front-end loader.

Figure 2. Volvo L90F front-end loader loading bark into the screen.

The star screen was set up to produce a medium size fraction from 5 to 150 mm. The initial bark was separated into five different piles after screening: medium size fraction (5 – 150 mm), fine fraction (<5 mm), oversize fraction (>150 mm), contaminants in the medium size fraction, and contaminants in the oversize fraction. The oversize fraction pile without contaminants was then ready to be crushed and re-enter the screening process.

The time study was carried out using an Allegro MX field computer. A continuous timing method was applied over 2.3 hours. No delays or interruptions were observed during this time, therefore all the working time was considered effective working time.

Fourteen samples of the different screened fractions and initial bark were taken for moisture content and particle size distribution analysis. Samples that included large pieces of bark (initial bark and oversize fraction) were stored in plastic bags. The medium and fine fraction samples were stored in buckets. All samples were sealed to minimize the risk of evaporation. The samples were collected from several locations in the piles using a small shovel. It was possible to collect samples from the medium size fraction directly from the material flow. The samples were weighed, oven-dried for 16 hours and weighed again in order to determine their wet basis moisture content. The particle size distribution of each oven-dried fraction was carried out using a horizontal sieve shaker. The following sieves were used to categorize the material: 63 mm, 45 mm, 31.5 mm, 16 mm, 8 mm, 5 mm, 3 mm, and <3mm. Particles bigger than 150 mm were separated manually.

RESULTS

The results indicated that screening of bark with a star screen reduces the fine content (particles <3 mm) of the screened medium fraction by 50% and eliminates the oversize particles (>150 mm) (Fig. 3). However, the moisture content of the medium fraction was not reduced when compared to the initial material (Fig. 4).

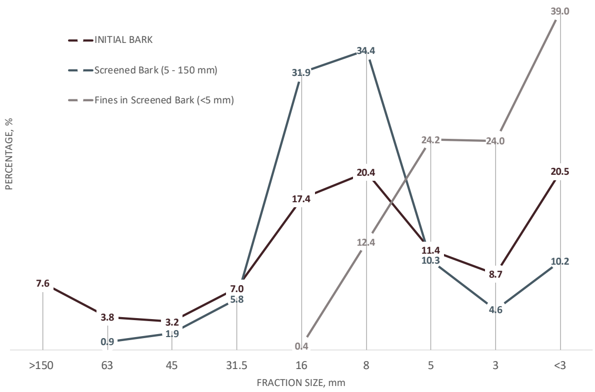

Figure 3. Particle size distribution of unscreened and screened bark.

The productivity of the star screen during the working time observed was 17.8 ODt/PM0h. The mass flow of each fraction could not be measured by weight, but an approximate measurement by volume was carried out. After screening, the volume of the medium fraction was 55.8% of the initial material, with 32.6% corresponding

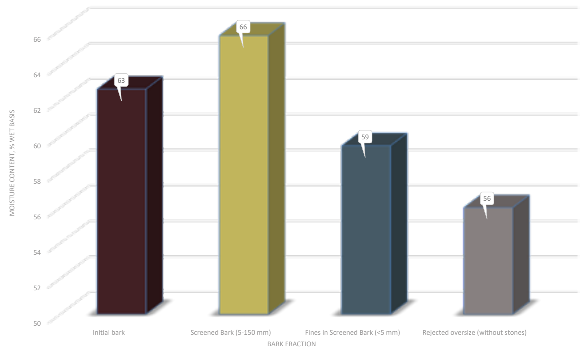

Figure 4. Moisture content of the different bark fractions before and after screening.

to the fine fraction, 4.7% to the clean oversize fraction, 2.3% to the rejected oversize fraction, and 4.7% to the rejected medium fraction.

DISCUSSION

Particle size distribution is an important parameter defining fuel quality, especially for small heating plants that can be negatively affected by fine and oversize particles (Huber et al., 2017). In addition, fine particles smaller than 3 mm reduce air circulation during storage which can increase the risk of self-ignition in the storage piles (Jirjis, 2005). The screening of bark has an positive influence over particle size distribution and is an effective method to improve the fuel properties of bark. The fine fraction was reduced and the oversize fraction was eliminated. A reduction in ash content is also expected. Furthermore, the use of a windshifter on the medium fraction ensures that no gravel or stones are delivered to the plants. The windshifter on the oversize fraction facilitates subsequent crushing of this material.

The star screen productivity measured in this study refers to effective screening time. Machinery relocation and possible delays would reduce this figure. However, the actual speed of the star screen was adjusted to match the windshifter speed. This means that if more powerful windshifters were used, the operational speed of the star screen could be increased.

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