

STUMP CRUSHING AND FUEL QUALITY

In early February 2013 three stump assortments were crushed at a forest fuel terminal managed by Skellefteå Kraft AB. Two of the assortments were ordinary stumps from clear cuts, while the third assortment was extracted from clear cut peat land. The productivity of the crusher, in terms of OD t PW h⁻¹, had high variation due to high variation of moisture contents between the materials, from 33 % to 68 % (wet basis). High variation in ash content was also found between all three assortments, where the highest ash content (6.1 %) was for the stumps from peat land. On average 43.6 % of crushed particles were with a range of 16 – 31.5 mm. Stumps from the peat land had the highest amount of particles under 16 mm, reaching 56 % of the total volume. To improve fuel quality from stumps pre-drying and sieving is recommended in order to reduce moisture, ash and contamination content.

MATERIALS AND METHODS

Crushing of three stump assortments was carried out at a terminal of Skellefteå Kraft AB at Hedensbyn in the community of Skellefteå. Stump assortment 1 was extracted in autumn 2009 and spring of year 2010 and then forwarded to a road side at year 2012. Stump assortment 2 was extracted in 2010 and forwarded to a road side year 2011. Stump assortment 3 was extracted from peat land. Crushing of all three stump assortments was performed in early February 2013. The used crusher was a CBI Magnum Force Series 8400 Hz Hog with 1000 Hp. Feeding of the crusher was made with a wheel based crane loader (CAT M322C) equipped with timber log grapple. A frequency time study, with 10 sec intervals, was performed for about 90 min of productive working time (PW) per assortment. The mass of each assortment was scaled after being crushed. Samples of crushed material were taken for analyses of moisture and ash content, heating values and for determination of the crushed particles size distribution. Analyses were performed according to the following Swedish standards; for sieving SS-EN 14918, heating value SS-EN 14918, moisture content SIS-CEN/TS 14774-3:2004 and ash content SS-EN 14775. Additionally only the fuel consumption of the crusher per assortment was measured where assumed heating value for the diesel fuel was 35.3 MJ per l.

RESULTS

The productivity of the crusher for assortment 1, 2 and 3 was 48.9, 62.4 and 28.6 OD t PW hour⁻¹ (Table 1). The high variation in productivity of the crusher was due to the high variation in moisture content, which was 41 % for assortment 1, 33 % for assortment 2 and 68 % for assortment 3. The measured heating values varied between 18.79 – 19.47 MJ/OD kg. The heating values as delivered range between from 3.96 MWh per fresh tonne for assortment 3 to 4.96 MWh per fresh tonne for assortment 2. (Table 1).



Figure 1. Stump crushing at a terminal.

Table 1. Productivity of the crusher and wood fuel properties for the different assortments. The energy balance is calculated as the energy return over energy invested.

	Assortment 1	Assortment 2	Assortment 3
Total mass OD t	48.9	62.4	28.6
Moisture content, %	41	33	68
Ash content, %	3.7	2.3	6.1
Effective heating value, MJ / OD kg	18.79	19.06	19.47
Energy content, as delivered, MWh/OD t	4.75	4.96	3.96
Crusher's Productivity OD t h ⁻¹	32.3	41.1	18.9
Fuel consumption l/OD t	3.6	2.9	4.2
Energy return on energy invested	135	173	97

There was also high variation in ash content between all three assortments (Table 1). The lowest ash content was for assortment 2, 2.3 %, while the highest was for assortment 3, where the ash content reached 6.1 %. Assortment 3 also had the highest share of finer particles, 56 % (less than 16 mm) when compared with the other two assortments which were more similar to each other in their particle size distribution. The high amount of fine particles for assortment 3 can be explained by the fact that these were partly decomposed stumps from peat land. On average for all three assortments 43.6 % of particles fell within dimensions of 16 to 31.5 mm.

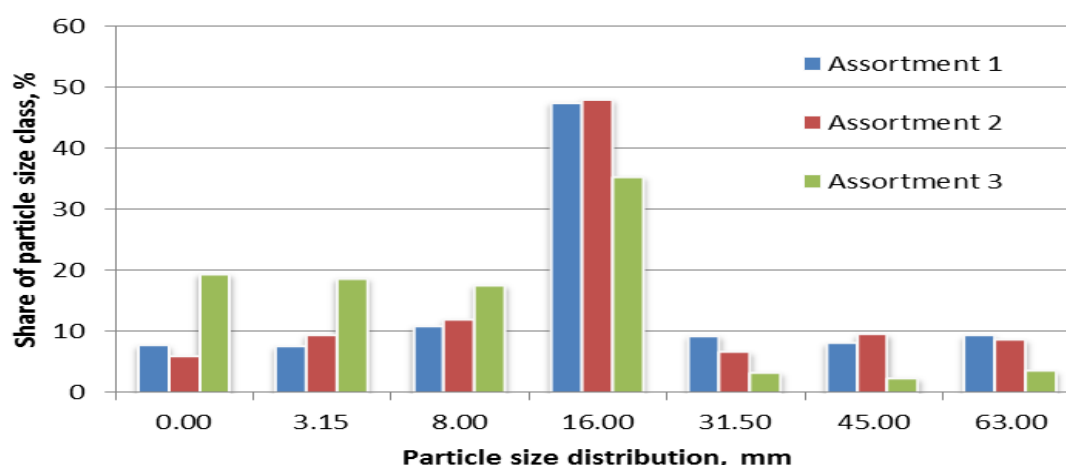


Figure 2. Particle size distribution of the crushed stump assortments.

Even though assortment 3 had the highest energy content, the high moisture and ash content dramatically lowered its fuel quality for combustion. To improve the fuel quality pre-drying and sieving has to be done to lower the moisture content and amount of fine particles and contamination in the crushed material.

KEYWORDS

Forest residues, comminution, ash content, heating value, particle size distribution, fuel quality

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