bio hub INFOSHEET

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Sampling with chainsaw

- for determination of moisture content of loose forest fuels

We aimed to develop an effective method that meets the requirements for timber measurement act for sampling of loose piled forest fuels. This infosheet is based on a master thesis project (Engman 2017) conducted within the BioHub project.

QUALITY PARAMETERS WHEN TRADING FOREST FUELS

Moisture content (MC), heating value, ash content and particle size distribution are important quality parameters when trading forest fuels. In general, the MC dictates the value, normally traded in MWh, as affects the effective heating value greatly – the lower MC the higher prize!

MC is the property that fluctuates most in the supply chain and thus is the main property to keep track of. The timber measurement act for forest fuels in Sweden give different threshold of measurement precision dependent of size of deliveries (Table 1).

Table 1. The requirements of for timber measurement act for forest fuels in Sweden. ODt=oven-dry t

Size of delivery (OD t)	Maximum deviation of MC (%)
<25	18.0
25-50	13.5
>50	9.0

METHODS TO MEASURE

In order to measure the MC, representative sampling of the delivery/batch must be taken. If the material is comminuted the sampling procedure is quite easy, but difficult/complicated for loose materials. One method is then to transport the loose material to a measuring station were sampling is done by drilling out materials with a drill of at least 1m long with a diameter of 5cm.

The drill must be able to be places at any position above the load to sample for representative sampling. The most common method is however to comminute the material and then sample. Comminuted biomass degrades however rapidly giving value losses, and therefore an ability to keep the biomass loose until combustion is warranted.

MOISTURE CONTENT

Freshly cut conifer logging residues have a MC of 50-55%, and broadleaves ca 10 %-units lower. Piled stacks dry during the summer and starting to re-moist during autumn. Rain and humidity affects the re-moistening process and covering the pile during storage can render ca 10%-units lower MC and more homogeneous MC-distribution in the pile compared to uncovered piles.

Figure 1. Dåva heat and power plant in Umeå.

SAMPLING WITH CHAINSAW

Trials were performed at fuel terminal of Dåva heat and power plant in Umeå (Fig. 1). For sampling, a chainsaw equipped with a saw dust collector was used and the saw dust were then analyzed of MC (Fig. 2).

The method is standardized for MC sampling of pulpwood in Austria and have also been tested on pulpwood and energy wood in Sweden. In our study, the sampling was performed in eight different longitude cut sections (Fig. 3) on a large pile of loose conifer logging residues (Fig. 4), including reference sampling for comparison (Fig. 5). An excavator was used to split the pile in eight sections (Fig. 6). In each cross section, samples were taken in three different horizontal layers, vertical/intersecting layers and in the surface layer in the center of nine equal sized areas (Fig. 7).

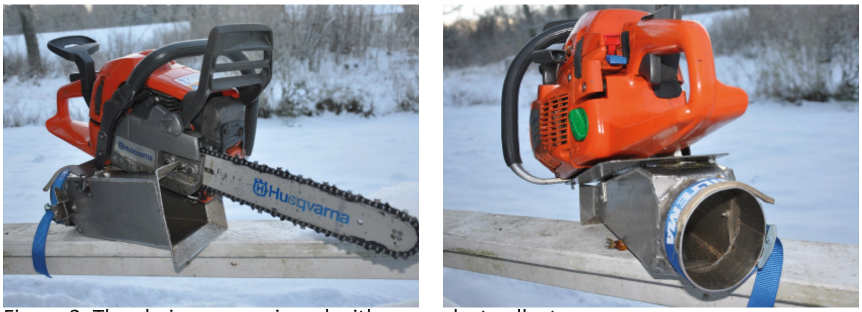

Figure 2. The chain-saw equipped with a saw-dust collector.

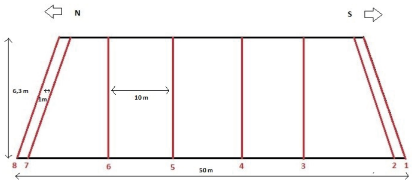

Figure 3. The “schematic pile” observed from the long side. The red lines indicate cut sections made by an excavator.

Figure 4. The sampled pile of loose conifer logging residues.

Figure 5.a Reference sample.

Figure 5b “Saw-dust” sample in paper bag.

Figure 6. To left, the excavator equipped with a grip and to right, a section cut from the excavator.

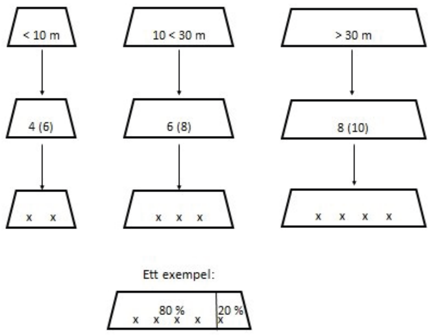

Figure 7. The sample points of samples were both sawdust samples and reference samples was taken from. Each cross represents a sample point. N=north, M=center, S=south, W=west, 0=east and U=up. Each square has the same area. All these points of samples were taken in cut sections 2-7 (Figure 3). In cut section 1 and 8 were the sample points V, U and O excluded.

THE PILE

The pile was on average 50 m long, 5.7 m wide and 6.3 m high. It had been stored for ca 1 year since delivered as fresh materials. The chain saw were equipped with a saw dust collector (Fig. 1) to which a paper bag (width 110 x length 180 x height 260 mm) were mounted.

When sampling (cutting) the blade were kept in a 90 degree position. In total, 90 sawdust samples and 90 reference samples were taken.

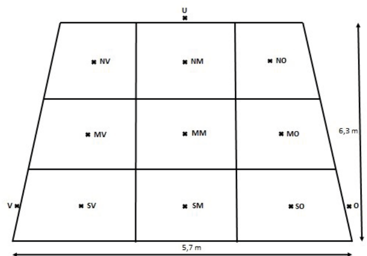

Figure 8. A suggestion of a method for determination of MC of loose forest fuels in piles using a chain saw with collector. Based on the length of the pile a number of samples should be taken, the number in brackets applies if the pile is heterogeneous. The crosses are the position of the samples in the pile and the location of these are selected arbitrarily with respect to how much they will be affected by the effects of the weather on the end sides. At the bottom of the figure show an example if the material is heterogeneous horizontally where the material is divided into two groups.

CONCLUSIONS

On average, based on reference samples, the pile had an MC of 32.4 % (sd 6.1 %-units). The by-volume-weighted MC was 30.8 %. There were no significant difference in MC between layers on a vertical direction, which also have been shown in previous studies. There were however significant differences between sections, which likely is due to that the pile constituted of different deliveries of materials (see Fig. 4). The MC in the lowest vertical layer 1m into the pile did not differ to the MC on the surface layer, which differ to findings in literature were differences have been found.

There were a 1.4%-unit (sd 3.5%-units) and significant difference between saw-dust samples and reference samples, were saw dust gave an over-estimation. The magnitude of difference seem to increase with samples particle sizes; the smaller pieces collected the higher overestimation.

SUGGESTED SAMPLING PROCEDURE

Based on this study and previous knowledge we suggest the following sampling procedure (Fig. 8) in order to meet the precision requirements (see Table 1):

1. Measure the length of the pile (your delivery/batch)
2. By visual inspection you estimate if the pile is homogeneous or not in a length-wise direction.
3. If the pile is heterogeneous one should divide the pile in sections and distribute sample points on basis of their share of the pile length.

With increased pile length, sample points should be moved in from the end-sides in order to minimize influence of the common high MCs on the side parts, which otherwise will give un-proportional high weights in calculations. Samples should be taken 1m into the pile on a height corresponding to ca 1/3 of the pile height from ground.

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