

RESEARCH INTO THE USE OVERSIZE FRACTION OF COMPOSTING

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Abstract: Research into the use oversize fraction of composting based on the requirements of legislation to reduce the total amount of biodegradable municipal waste going to landfills and current aid of composting. Prior to shipment of finished compost from the composting facility is required, this compost is supersaturated. Oversize fraction arises, which contains large lumps of compost, composted fraction of biodegradable municipal waste (mainly wood), aggregates and impurities (plastic, glass, metals, etc.). Part of this fraction is re-used in the composting process as inoculum and carbon source, excess oversize fraction is at best used as a technological material to secure landfills, or worse landfilled as waste is stabilized. Such handling oversize component of composting is highly uneconomic and in the future will be illegal, because most components of the oversize fraction are also useable. The biggest potential of oversize fraction for further utilization offers composted wood, which can be separated from the oversize fraction and further processed for commercial purposes. The possibility of separation of wood (and other components) from the oversize fraction is wet and the dry method. These methods have been validated in the determination of the individual material components of oversize fraction, which was collected from the Company Central Composting Brno. Work drafts the technological processes of separation of wood (and other components) from the oversize fraction and discusses their potentials, barriers, advantages and disadvantages. The work suggests other (commercial) use for each of separate material components (wood) from the oversize fraction.

Key Words: compost, separation of timber, dry method, wet method, the use of material components

INTRODUCTION

According to data from the Czech Statistical Office in the Czech Republic every year produced approx. 3.3 million tons of municipal waste (MW). This means that every one of the Czech population produces less than 320 kg of waste per year. Biodegradable municipal waste (BDMW) is about 40–50% by weight of the total amount of mixed municipal waste (MMW is part of MW that remains usable after sorting, and other hazardous components from MW (Pliva 2009, Zemanek 2010).

Landfill is currently the most common way of removing MW. Negligible component MW - BDMW in landfills causes the production of landfill gas, landfill instability, and early fulfilment of its capacity. According to an amendment to the Waste Act, which came into effect on 1st of January 2015, is implemented across the board BDMW landfill ban and mandatory collection of biodegradable waste. Such action leads to the necessity BDMW not just sorting but also processed at composting or biogas plants, especially if we take into account the preference of material recovery before energy recovery and disposal of waste resulting from the waste management hierarchy.

Composting is a biochemical process converting various components in organic waste into relatively stable humus (Zhentong, et al. 2013). The final product of composting is mature compost and its qualitative characteristics can be evaluated by Act no. 156/1998 Coll. on fertilizers, as amended by subsequent legislation (Decree 474/2000 Coll., establishing requirements for fertilizers, as amended by subsequent legislation, which is based on the ČSN 46 5735/1991).

Compost must meet certain parameters, such as: moisture 40–65%, the total content of combustible (organic) substances min. 25% remaining org. substances are poorly degradable

(humus), nitrogen 0.6% min, C: N 30: 1, neutral pH, does not contain any bacteria of the genus *Salmonella*, coliforms and enterococci in the content of max 103 CFU g compost, brown or dark gray color, without identifiable original structure (Tesarova, Szostkova 2010, Yumna, Tjalfe, Kai 2014).

Company Central Composting Brno states that it is an important facility for the use of bio waste for South Moravia with a capacity of 70,000 Mg of waste per year and a total area of 18,000 square meters.

SITA CZ as is the operator of the composting plant since 2009. Waste utilization is realized by means of composting gutters. 12 self-ventilated trays 6 x 36 m is in operation, runners are always running 1 hour a day. It is a controlled composting process with intensive aeration. Aeration facilitates and accelerates the process of metabolism. Thanks to the active access of air at this method does not require mixing. Composting plant has the technological equipment: mobile equipment for crushing biomass (shredders, chippers), loaders, homogenizer, drum sieve, tractors. Certified composts have the name Black Dragon (part of the pile as well as sludge from wastewater treatment plants), Green Dragon (part of the pile are the only vegetable waste) and Grey Dragon (substrate after mixing compost and soil).

Besides compost there is composted product also oversize fraction. Oversize fraction is an integral part of the process and waste resulting from the screening of the resulting compost, which is performed to separate the final compost from impurities by means of sieves. Its production is highly dependent on weather conditions. Ing. Jaromir Punčochář from central composting Brno as It notes that under unfavorable climatic conditions oversize fraction may represent up to 40% by volume of the total no sieved the finished compost.

The Central Composting Plant Brno removes this waste in landfills (a negligible amount is returned back into the composting process as inoculum). Landfill costs are reflected in cost of producing compost. Oversize fraction is no longer classified as waste under the Waste Catalogue (Annex no. 1 to the Decree 381/2001 Coll. Waste Catalogue, as amended, applicable legislation) between 19 05 Wastes from aerobic treatment of solid wastes. This waste usually contains no composted fraction of municipal biodegradable waste; no composted fraction of animal and vegetable origin waste, unsatisfactory quality compost, wood, stone, plastic and other additives.

Therefore worth considering whether in terms of environmental legislation and funding composting was possible individual components oversize fraction to separate and dispose of them separately. No composted wood from oversize fraction should be separated from the compost and process it for other commercial purposes. The Central Composting Brno has included among its products except compost also fuel wood chips, pulpwood for the furniture industry and mulch chips and bark. A sale of such products is financially attractive for the company.

MATERIAL AND METHODS

Sampling

All measurement based on sampling oversize fraction to the central composting plant Brno as Sampling was conducted from November 2014 to March 2015. It collected a total of 10 samples oversize fraction. When samples were used plastic containers with a volume of 13 dm³, which served for transport of samples and the determination of the total volume of the samples. The weight of the samples was determined using a digital balance. Samples were taken by means of blades from a pile stored oversize fraction into a plastic container, which was placed on digital weight. The required weight of the sample was always 10 kg. Vane sample was taken from different parts of the pile from the edge to the center and at different heights of the pile. The samples were transported to the Mendel University, Institute of Applied and Landscape Ecology, Room Q 4.02 (oven). There were successively tested two methods for grading oversize fraction (separation timber). Always used of protective work aids (gloves) (Horackova 2015).

Dry method

The dry method consists in manually sorting the samples. Grading was held in plastic containers of known volume and the ingredients: earth, wood, stone, other (metal, glass, plastic, etc.). After sorting was determined by the weight of components using digital scales and their volume was

determined by means of lines on plastic containers. The sample oversize fraction was always totally sorting. Finally, it was determined percentage of individual sorted components of the oversize fraction (Horackova 2015).

Wet method

The wet method is based on the physics of the various components of the oversize fraction. This method can also be called as a method voyage. Sample oversize fraction was placed into the tub with a volume of 80 dm³ and mixed with water. This suspension was allowed to stand for 10 minutes. There occurred separating components in the oversize fraction and the blood may then be removed through pieces of wood. Thus obtained timber was weighed on a digital scale, and its volume was determined using plastic containers of known volume (Horackova 2015).

Evaluation

Subsequently, all the measured results of both methods were evaluated and compared. Grading methods were discussed, identified their advantages and disadvantages. It was carried out recommendations for further usage thus obtained (assorted) material components of the samples oversize fraction (Horackova 2015).

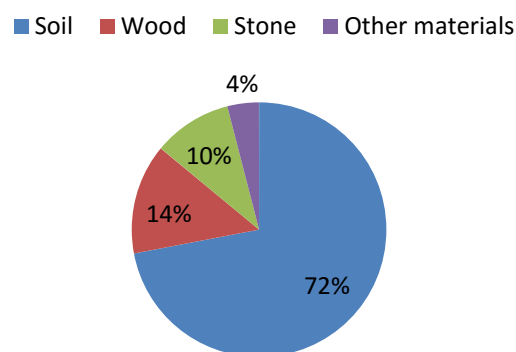
RESULTS AND DISCUSSION

Dry method

The dry method represented the manual sorting of samples oversize fraction to soil, wood, stone and other materials. It was therefore possible to determine the composition of the oversize fraction and the percentage of individual material components in it.

The volumes of individual samples of oversize fraction varied and depend primarily on the moisture content and the composition of the oversize fraction. In total, 100 kg were taken of the oversize fraction and there was separated out by this method 13.573 kg timber with a volume of 30.6 dm³. Wood constituted 13.7% by weight (Figure 1). The Figure 1 shows average proportion by weight of material components in the oversize fraction (Horackova 2015).

Figure 1 The average proportion by weight of material components in the oversize fraction (Horackova 2015)



Wet method

Wet method is based on the separation timber float. In the timber there was weight and volume determined. In this method, the same samples were used as in the dry method. Experiment results are therefore readily comparable.

In total there were 100 kg samples of oversize fraction processed, of which 15.250 kg of wood with a volume of 33 dm³. The amount of wood in the oversize fraction is 15%. We can see mass fraction of wood in the oversize fraction in the Figure 2 and timer volume fraction of oversize fraction in the Figure 3 (Horackova 2015).

Figure 2 Mass fraction of wood in the oversize fraction (Horackova 2015)

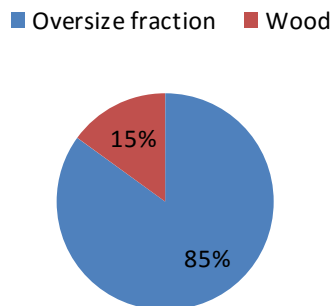
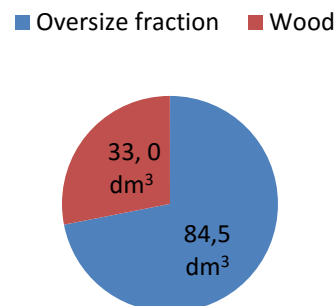


Figure 3 Timber volume fraction of oversize fraction (Horackova 2015)



Comparison of the methods

A total of 100 kg samples oversize fraction was separated out by using both methods. Dry method yielded 13.6 kg timber with a volume of 30.6 dm³ and wet method 15.3 kg timber with a volume of 33 dm³. The larger mass of separated wood at a wet method is explained by the presence of water in the timber material. Therefore, it was preferable to compare the volume of separated wood from both methods and the weight used only as a control value. By wet method yielded 2.4 dm³ more wood than by the dry one (Horackova 2015).

Table 1 Comparison of dry and wet method (Horackova 2015)

Aspect	Dry Method	Wet method
Time demands	✓	✗
The effectiveness of sorting oversize fraction	✓	✗
Changing the properties of separated materials	✗	✓
Demands on equipment	✗	✓
Separation efficiency of timber	✗	✓
Labour intensity	✓	✗
The possibility of further use of material	✓	✗

The table 1 shows a corporation of aspects of both methods. From the measurement results, the dry method is more suitable for smaller composting facility for its time and organizational demands. The advantage is certainly gain (sorting) of all material components of the oversize fraction and the possibility of subsequent further use. May give rise to waste-free process.

A water source is required for the realization of the wet method. In this method, it is preferable to complete drying wood and after sort. After sorting remainder of the oversize fraction after separation of the timber would also be suitable. Used water after separation timber can be used for irrigation compost fillings. For installations with a capacity we were recommended to use a combination of both methods (Horackova 2015).

Utilization of separated material components

Should the oversize fraction graded into individual material components (earth, wood, stone, others: metals, glass, plastics), they could be further exploited these materials. Composting facility could thus save financial resources on disposal (landfill) oversize fraction and vice versa could

potentially increase revenues. Separated soil can be rolled back into the pile of compost as a source of microorganisms, used in reclamation, or put into mature compost. Wood can be chipped and used as fuel used in horticulture, used as particleboard, a substrate for mushroom cultivation. Aggregates can be used in land reclamation, construction, compaction of the subsoil, in horticulture. Glass, metals and plastics can be recycled (Horackova 2015).

Using the method of separation in practice

For comparison experiment, we did not find any similar study, that's why the paper provides a method for separating oversize fraction implemented in terms of Central Composting Plant Brno. Because the composting plant does not have a suitable source of water, separation of wood components of the dry method has been tested, specifically, by using a drum sorter Doppstadt SM 518. The separation herein occurs by means of a rotating cylindrical screen. The sieve is slanting, material is driven to a certain height around the perimeter of the screen, and then falls by gravity. Grading was possible into several factions. Sieving of each sample of oversize fraction was total of 3 times. This led to the separation of stones and wood of larger sizes. Smaller pieces of material to remain in the oversize fraction and were returned back to the composting process, which have been decomposed. Composting plant does not use this process of separation, it is expensive. The ideal would be as follows sieving oversize component still hand aftersort and use all of its material components. This would reduce the cost of composting plant on landfilling (disposal) of waste (Horackova 2015).

CONCLUSION

Realized research involved assessing the possibility of separation of wood (or other material components) from the oversize fraction that results in a final sieving of the resulting compost in composting plants. Two methods of separation of oversize fractions were checked, dry one and wet one. Using the wet method has been separated out of 2.4 dm³ more wood than the dry method. 10 measurements were performed on the total sample mass of 100 kg oversize fraction. The dry method made it possible to separate out 13.6 kg timber with a volume of 30.6 dm³. Wet method allowed separation timber weighing 15.3 kg with a volume of 33 dm³. When implementing the wet method wood soaked in water, it is possible to explain the greater weight of separated wood opposite of the dry method. For comparison of these methods is therefore more appropriate to compare the volume of the separated material. Research suggests that the effectiveness of both methods under defined conditions is not much different. Each method has its advantages and disadvantages. Generally, the wet method is more suitable for composting with a plurality of the processed biological material. Conversely, a dry method can be recommended for smaller composting facility. Ideally, it would be possible to merge the two methods, and thus reduce time-consuming methods of dry and allow sorting all material components of the oversize fraction. If you would ideally leading to the recovery of sorted material components of the oversize fraction could be reduced the cost of composting to remove oversize fraction or income funds (Horackova 2015).

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