

RATE OF NON-BIODEGRADABLE GRAVEYARD WASTE FRACTION

Miroslav RUSKO, Bohdan STEJSKAL

Abstract

An analysis of graveyard waste composition has been carried out, where, by repeated measurements of samples weighing more than 500 kg (the total amount of analyzed waste was 3107 kg), it was found that the graveyard waste consists of almost 77 % of bio-degradable matter. It is operationally impossible to separate bio-degradable matter from non-biodegradable materials. It is desirable to collect compostable graveyard green waste separately from the waste coming from the decoration of gravestones that may be energetically utilized.

Key words

biodegradable waste, graveyard waste

Introduction

Landfilling is the most common method of municipal waste disposal in the Czech Republic. The percentage of biodegradable waste (biowaste) in municipal waste is in the range of 40 - 47% [1], [2], [3]. Garden and park waste, including graveyard waste, belongs to the category of municipal waste [4].

Effective management and rational utilization of biodegradable municipal waste is still a subject of much discussion. The most serious problems are caused by the heterogeneous biodegradable wastes which contain too many biodegradable components to be landfilled, but also contain too many non-biodegradable components and foreign materials to be composted. The typical example of such waste is cemetery waste.

The Czech Republic must comply with the legislative requirements set for waste management. In this particular case that means the EU Council Directive 1999/31/EC "On the

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Waste Landfills". The Directive requires EU member states to limit the amount of BRW in landfills. The main purpose of this restriction is to reduce the amount of emitted gases, particularly methane as a greenhouse gas, into the atmosphere. Therefore, the Plan of Waste Management of the Czech Republic includes the requirement to reduce the quantity of biodegradable waste deposited into landfills to (at least) 75 %_{weight} in 2010, to 50 %_{weight} in 2013, and to 35 %_{weight} in 2020 as compared to 1995 [5]. These objectives are not able to be reached, and it is clear that there will be a lot of biodegradable waste deposited into landfills.

To achieve the above-mentioned objectives, various methods have been proposed. Prior to the waste processing, it is necessary to know the waste material's composition, and after that to select the most appropriate method and procedure for waste utilization or disposal. The aim of this project was to determine the ratio of the biodegradable fraction and non-biodegradable fraction of graveyard waste and, on the basis of this analysis, to find an optimal method for utilization of such waste.

In both Czech and foreign publications, similar data have not been published yet; therefore it is not possible to compare the results obtained in the project with other studies.

Materials and methods

The analysed graveyard waste was collected from the Central Cemetery in Brno. The analysis itself was carried out at the temporary dump very close to the Central Cemetery. Large quantities of the graveyard waste are stored there for a long time. The samples were always collected from the newly deposited waste. For practical reasons the waste from other cemeteries was not analysed, but we do not expect big differences (i.e. differences in the tens of percent) in the waste composition coming from different cemeteries.

The sample was at first sorted in accordance with the Waste Catalogue, i.e. to 20 02 01 "Biodegradable Waste" and 20 02 03 "Other Non-biodegradable Waste". The waste 20 02 02 "Soil and Stones" was rarely found in the samples (<2%) and therefore it was not taken into consideration.

The sorted ingredients were then put into bags of the volume of 0.16 m³ and weighed by mechanical weight hanging (steelyard). In this way the approximate volume ratio of the particular graveyard waste components was simultaneously recorded.

The measurements were repeated six times. The size of each analysed sample was at least 500 kg.

Due to the climatic conditions immediately preceding some of the measurements, the weight of such components was slightly affected by the presence of precipitation water. The measured values proved them to be irrelevant for the objective of this project.

Measurement results and comments

The aim of this project was to determine the proportion of biodegradable fraction and non-biodegradable fraction of graveyard waste in regard to its further utilization. Due to the research methodology, the mass analysis has a higher value; the measured and calculated values of the mass analysis are shown both in tabular and graphical form for better clarity.

The volumetric analysis may be flawed, as just *an approximate* volume of waste bulk has been measured. Therefore, the results of volumetric analysis are expressed only in tabular form. For a more precise assessment and elimination of differences in the sample size for each measurement of the mass and volume analysis, the data results were converted into weight and volume percentages (%_w, %_v) of the particular components.

It is apparent that the particular measurements show only small differences in composition, with the unmatched content to biowaste variability in mixed municipal waste. For measurement II, i.e. on April 3, 2009, there was a greater proportion of green waste from the cemetery maintenance in the sample; the other samples were very well balanced. It appeared that the proportion of biowaste and non-biowaste does not depend on weather conditions or the season (winter - spring).

Biodegradable wastes (Cat. No 20 02 01) are largely made up of branches from conifer trees and cones; composting is possible though difficult and lengthy. Another waste component is flowers, where composting is smooth.

All non-biodegradable waste fractions come from the city residents - from the decoration and maintenance of graves, and the minimum degree is made up of mixed municipal waste, i.e. non-graveyard waste. The largest portion is made up of plastic materials while pieces of paraffin, glass, and metal represent only a small part of it. Other components of non-biodegradable fraction (such as ceramic pots) are negligible. There is no possibility for efficient material utilization of non-biodegradable graveyard waste, but it can be used to produce energy.

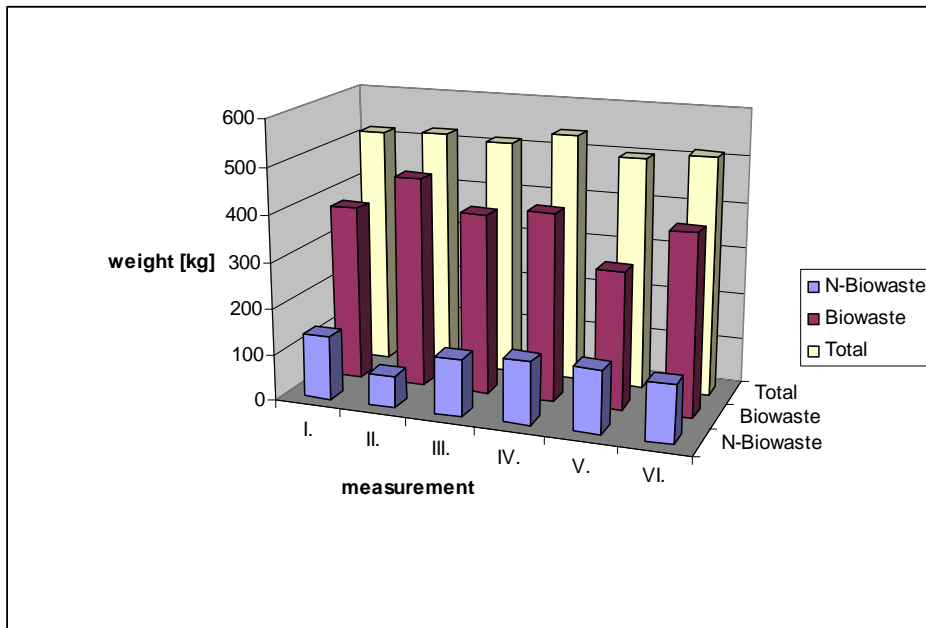
In some cases, the biodegradable and non-biodegradable wastes make up a unit which is difficult to disconnect (e.g. funeral wreaths). Such waste is only suitable for producing energy.

The measured values from particular measurements and conversion of them to volume percentage are listed in Table No. 1 and Table No 2. Relevant graphs correspond to the results of the mass analysis.

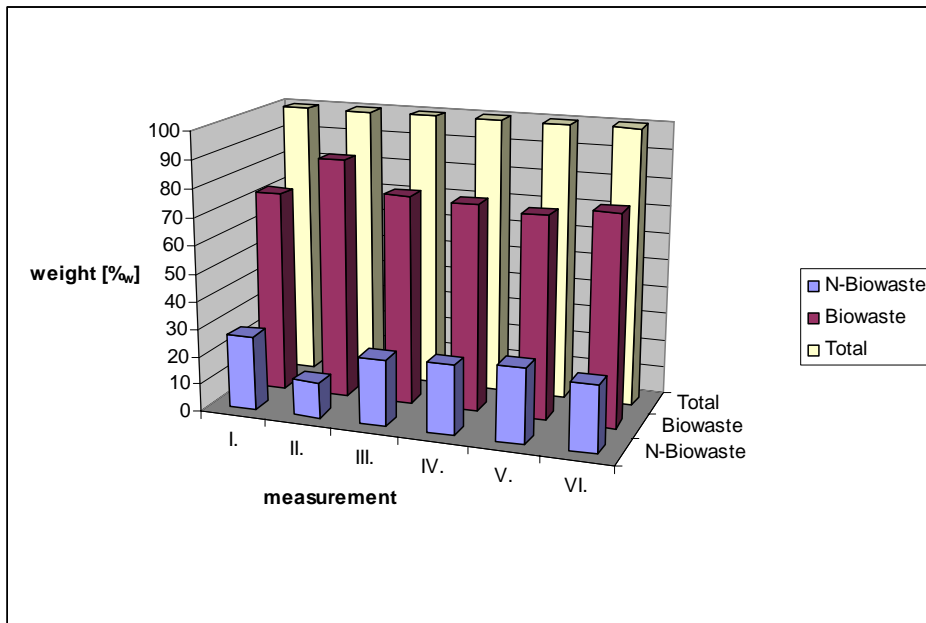
MASS OF GRAVEYARD WASTE COMPONENTS

Table 1

Measurement/ Date	Non-biowaste [kg]	Biowaste [kg]	In total [kg]	Non-biowaste [% w]	Biowaste [% w]
I/11 Mar	138	379,5	517,5	27	73
II/3 Apr	68,5	454,5	523	13	87
III/21 Apr	122,5	390	512,5	24	76
IV/30 Apr	135	405	540	25	75
V/4 May	136	297	500	27	73
VI/7 May	123	391	514	24	76



Graph 1a. Weight of graveyard waste portions



Graph 1b. Percentage of weight of graveyard waste portions

Measurement/ date	Non-biowaste [m ³]	Biowaste [m ³]	In total [m ³]	Non-biowaste [% v]	Biowaste [% v]
I/11 Mar	1,01	2,67	3,68	28	72
II/3 Apr	0,64	4,27	4,91	13	87
III/21 Apr	1,2	3,36	4,56	26	74
IV/30 Apr	1,28	4,12	5,4	24	76
V/4 May	1,12	3,2	4,32	26	74
VI/7 May	1,04	352	4,56	23	77

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Conclusion

The analysis of graveyard waste composition was carried out with regard to its further processing and utilization, especially composting.

The graveyard waste (mixed) contains approximately 26% of the non-biodegradable component which does not allow use of the waste as a raw material for composting or in biogas stations for biogas production.

For better utilization of graveyard waste, the most appropriate way is to introduce sorting of the waste generated by the citizens as well as the waste that comes from the maintenance of cemetery green (this waste is less contaminated by litter than the city maintenance green waste). The separated waste from the cemetery green maintenance can be composted; the waste generated by the citizens in untreated form can only be used as an alternative fuel. Another possibility for its disposal is composting and then landfilling as stabilized waste.

Owing to the difficulty of sorting graveyard waste and poor economic performance of its incineration, it can be expected that graveyard waste will mostly be deposited into landfills.

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