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BIO-WASTE COMPOSTING AS A PART OF RURAL DEVELOPMENT

Summary

One of the most serious problems of waste management in Czech Republic is the useful treatment of biodegradable municipal waste because EU Council Directive 1999/31/EC requires of member states to limit the amount of biodegradable waste deposited into landfill. Composting of biodegradable municipal waste can be a solution of this problem but there are many operational and economic problems.

This article describes advantages and problems of bio-waste composting in rural conditions (of Czech Republic) at all parts of composting process, i.e. from bio-waste sorting and collection through bio-waste composting to utilization and sale of compost.

Bio-waste composting in countryside brings many benefits. The waste is treated at the place of origin and it is possible to get the organic mass of compost back to the field with minimal transport distances. Decentralized waste treatment brings jobs to regions of a small rate of employment.

It is necessary to solve many problems related to the process of composting. Quality of input raw material is the first of them. It was found that the amount of undesirable impurities in separately collected biodegradable municipal waste depends on the type of building density and the settlement size. By the measurement of 200 kg samples of sorted bio-waste it was showed that purity of waste sorting is much better in small villages than in rather big cities.

Right size of composting plant is another question to discussion. A lot of small composting plants built for several villages allow waste treatment in the place of origin but just a big composting plant is rich enough to have adequate machine equipment. Of course, in this case transport distances are long.

Compost selling is connected with other problems. Farmers usually do not want even high-quality compost because of the costs of compost application to the field (although missing of organic mass in the soil). Lots of low-quality compost is used as a reclaim material.

Key words: biowaste, composting, sorting, waste utilization, rural development

INTRODUCTION

One of the most serious problems of waste management in Czech Republic is the useful treatment of biodegradable municipal waste because EU Council Directive 1999/31/EC requires of member states to limit the amount of biodegradable waste into landfill. In Czech legislation it is set forth by the Act No. 185/2001 Coll. on Waste, and amendments to other Acts [Zákon…, 2001], and also in the objectives of the Waste Management Plan of the Czech Republic [Nařízení vlády..., 2003]. Just this requirement is one of the aims of Plan of Waste Management of Czech Republic that is not fulfilled. Composting of biodegradable municipal waste can be a solution of this problem but there are many operational and economic problems

Biowaste composting in countryside brings many benefits. The first is the moving biodegradable waste away from the landfills. The waste is treated at the place of origin and it is possible to get the organic mass of compost back to the field (or the soil) with minimal transport distances. Decentralized waste treatment brings jobs to regions of a small rate of employment.

In order to meet the aim there were realized several pilot projects of sorting, collection and utilization of biodegradable municipal waste. Through these pilot projects the major operational problems of the composting system, described in this paper, were identified. These problems can be divided into three groups: 1) Quality of input raw material (depending on the system of biowaste sorting and collection), 2) Right size of composting plant and necessary machine equipment and 3) Compost selling and utilization.

SORTING OF BIODEGRADABLE MUNICIPAL WASTE

The quantity of biodegradable waste in municipal waste is from 40 to 50% [Mužík &, Hutla, 2005; Slejška, 2004; Slejška & Váňa, 2004]. The first operational problem is, consequently, sorting of biodegradable municipal waste by citizens and getting the input raw material into the composting plant. Right and correct grading of the system of sorting and collection of biodegradable municipal waste and the purity of sorted waste are key factors for further processing and waste utilization.

Within the field measurements there has been monitored the quality of sorted waste in the cities of Kroměříž (with population of more than 29 000 inhabitants) and Náměšť nad Oslavou (about 5 000 inhabitants), and in the villages of Březník (about 630 inhabitants), Jinošov (about 310 inhabitants) and Naloučany (about 175 inhabitants).

MATERIALS AND METHODS

For operational reasons, separate waste was analysed after its collection in the area of a waste treatment facility. Individual samples were collected within two days of separate waste delivery, without any modifications (scattering, compaction). The sample size was at least 200 kg, the sample was manually sorted to components according to the Waste catalogue at first, it means to the 200201 Biodegradable waste and to the 200203 Other non-biodegradable waste (impurities including biodegradable waste unsuitable for composting, e.g., animal by-products [Vyhláška..., 2001]. Individual fractions were placed in containers with a capacity of 20 litres and then weighed on mechanical scales (spring scale).

The recorded values were used to determine unacceptable impurities by weight in the sorted biodegradable municipal waste.

RESULTS AND COMMENT

In the following tables measured values are shown. In graphs weight percentage representation of specific fractions is shown. Unacceptable impurities were either small objects (such plastic, glass or metal pieces, exceptionally animal remains), or bags of mixed household waste.

Table 1. Measured values of sorted biodegradable municipal waste in Kroměříž [Stejskál, 2010b]

Date of collection	Sample weight [kg]	Biowaste weight [kg]	Impurities weight [kg]
28.04.2009	206	190.5	15.5
12.05.2009	205	191	14
26.05.2009	212	196	16
9.06.2009	201	183	18
23.06.2009	211	204	7
7.07.2009	208	200	8
15.07.2009	212	204	8
21.07.2009	213.5	206.5	7
29.07.2009	205	203	2
4.08.2009	224.5	206	18.5

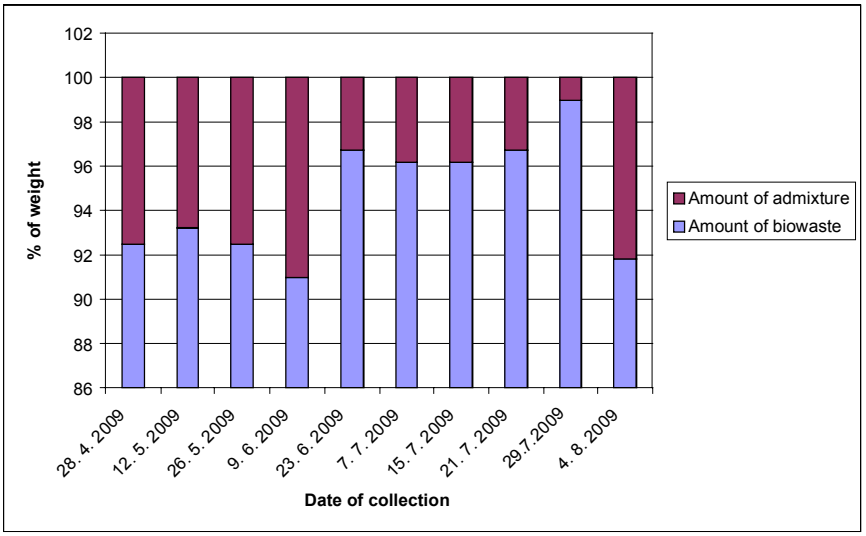

Figure 1. Rate of admixture at sorted biodegradable municipal waste in Kroměříž

Table 2. Measured values of sorted biodegradable municipal waste in Náměšť nad Oslavou [Stejskál, 2010a]

Date of collection	Sample weight [kg]	Biowaste weight [kg]	Impurities weight [kg]
23.09.2009	210	209	1
23.09.2009	223	222	1
6.10.2009	235	231	4
6.10.2009	224.5	220.5	4
5.05.2010	207.7	207.4	0.3
5.05.2010	206.9	206.1	0.8
19.05.2010	214.8	213.4	1.4
19.05.2010	208.2	207.8	0.4
2.06.2010	210.4	207.5	2.9
2.06.2010	207.2	205.6	1.6

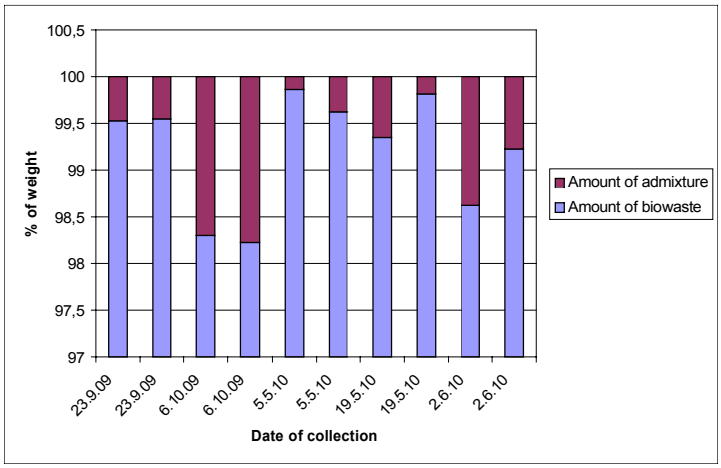

Figure 2. Rate of admixture at sorted biodegradable municipal waste in Náměšť nad Oslavou

Table 3. Measured values of sorted biodegradable municipal waste in Březník, Jinošov and Naloučany [Stejskál, 2010a]

Date of collection	Sample weight [kg]	Biowaste weight [kg]	Impurities weight [kg]
23.09.2009	205	203	2
23.09.2009	214	211	3
6.10.2009	212.5	212.5	0
6.10.2009	213	211	2
5.05.2010	217.3	215.5	1.8
5.05.2010	210.5	210.5	0
19.05.2010	218.3	217.9	0.4
19.05.2010	225.3	225	0.3
2.06.2010	207	204.1	2.9
2.06.2010	203	203	0

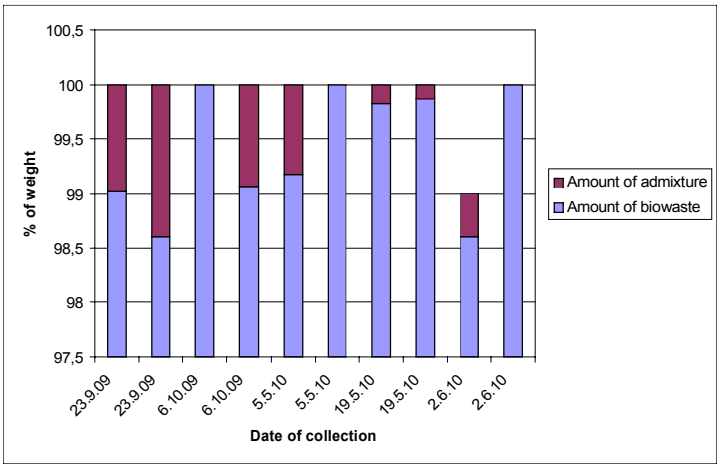

Figure 3. Rate of admixture at sorted biodegradable municipal waste in Březník, Jinošov and Naloučany

As evident from the measured values, the amount of unacceptable impurities in separate biodegradable waste varies depending on the size of the city or village. It is probably caused by the anonymity during sorting and collection in big cities. In Annex 5 to Decree No. 341/2008 Sb. [Vyhláška..., 2008] those permitted additives for composting rate is a maximum of 2%$_{wt.}$ and operators of composting plants, depending on technological equipment, require 1-2%$_{wt.}$ of impurities in the input raw material. [Roy et al, 2007]

In practice this means that sorted biodegradable municipal waste from Kroměříž city is unusable for composting because the amount of impurities varies from 1 to 9 %$_{wt.}$.

Quite different is the situation in small towns and villages. Degree of impurity in sorted waste in Náměšť nad Oslavou varies from 0.14 to 1.78 %$_{wt.}$ and in villages Březník, Jinošov and Naloučany varies from 0 to 1.4%$_{wt.}$.

The system of biodegradable municipal waste sorting is almost perfect and allows the production of high quality compost. Some samples from small villages were completely free of unwanted impurities. In the case of samples from small villages, the rate of impurities exceeding 1%$_{wt.}$ was recorded only once.

SIZE OF COMPOSTING PLANT AND ITS TECHNICAL EQUIPMENT

In rural conditions of Czech Republic it is not easy to design a composting plant. Of all the possible technologies of composting we think only about heap composting but there are still several problems to be confronted. It is better to build smaller composting plants, but it is a big composting plant that is rich enough to have necessary technical equipment that includes:

a) energy resources - tractors, front loaders, tool carriers. In practice it appeared that the tractor must be equipped with additional gear box reductor with the gear ratio i = 18 to slow (the ground speed is 0.1 – 2 km per hour) because of the use of the tractor as a energy source for the compost turner. Otherwise, the clutch will be destroyed very soon. [Plíva et al, 2005]

b) preparation of raw materials into compost - crushers , chippers. The main function of crushers and chippers are
   - volume reduction (economically efficient);
   - enlargement of the surface of composted materials (great area because of microbiological action);
   - ensuring the homogeneity of composted materials.

   Crushers cannot provide compliance with any requirements of the particle size of output; depending on the type of work system prevalent in the process of disintegration impact crusher, quarry and smearing.

   Chippers operating mechanism has a fixed blade; it means that chipper „planes" the raw material. The main type of stress is shear (cut). For this reason the chippers are suitable only for wood without additives and they are highly susceptible to damage! Plíva et al, 2005]

c) aeration and mixing of compost - compost turner. Redigging of compost is the most important operation during the process of composting. The compost turner is irreplaceable by any technique equipment (for example, front loader). The main required features and functions of a turner are:
   - good aeration and mixing of raw materials in the whole area of heap profile;
   - low ground speed and possibility of its regulation in range from 0,1 to 1,0 km per hour;
   - partial crushing of raw materials;
   - forming of materials into a pile of specified profile;
   - good manoeuvrability and sliding properties. Plíva et al, 2005]

d) sieving of finished compost - screening equipment. Unsifted compost is unmarketable, sifted is irresistible. The main required features and functions of a screen are:
   - sorting of finished compost from unwanted impurities;
   - possibility of using of sieves with different mesh sizes (15, 20, 40 mm);
   - the screen is equipped with a cleaning brush. Plíva et al, 2005].

COMPOST SELLING AND UTILIZATION

Sale of compost is the most serious problem of biodegradable municipal waste composting (in conditions of Czech Republic). Many farmers do not want to use compost, even if the comost is free. Compost with the addition of sludge of wastewater treatment plant is unmarketable. The composting plant can be build with the support of subsidies (fprom EU) but composting plant operation must be funded by self-earned money. Main income comes from payments for waste but the income from sale of compost is irreplaceable.

For these reasons it can be expected that composting plants will produce several types of product:

1. compost or garden substrates of carefully chosen raw materials;
2. substrates for the maintenance of urban green;
3. substrates for the reclamation of landfills.

CONCLUSION

In this paper the problems of biodegradable municipal waste utilization in rural conditions of Czech Republic are described.

Purity and quality of input waste (into composting plant) are key factors of compost quality. As is shown, the problem arises of too large amount of admixture in selected biowaste related to the size of the city. In rural areas the problem is not so serious because of small amount of impurities in sorted biowaste.

In practice it appears that it is impossible to operate the composting plant without basic technical equipment. The composting plant can be build with the support of subsidies (from EU) (including necessary technical equipment) but composting plant operation must be funded by self-earned money. Main income comes from payments for waste but the income from sale of compost is irreplaceable. It is unwise to start the project of composting plant building without solved problem of compost sale.

Concrete project has to be based on local (rural) conditions, especially on the mass of biodegradable waste and on the waste take-away route. It is better to build a composting plant with a small possibility of capacity increase (if you are successful, other villages want to participate).

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