ANALYSIS OF BIODEGRADABLE WASTE TREATMENT IN ORDER TO REDUCE QUANTITY OF DISPOSED WASTE

Bojana Tot[1] , Svjetlana Jokanović[1] , Goran Vujic[1] , Bojan Batinić[1], Nemanja Stanisavljević[1], Bojana Beronja[1], Dejan Ubavin[1]

[1] *Department of Environmental Engineering and Occupational Safety and Health, Faculty of Technical Sciences, University of Novi Sad, Serbia*

ABSTRACT

According to data obtained by analysis of quantity and composition of municipal solid waste in Republic of Serbia, the most significant waste fraction 40% represents organic waste, and roughly can be divided into food waste and garden or yard waste. In Serbia, practically all biodegradable waste ends up on non sanitary landfills, contributing to a large negative impact due to high production of methane, one of the most significant greenhouse gases (GHG). In order to comply with increasing national and international requirements, one of the main objectives is the reduction to 75% (by weight) of the total quantities of biodegradable municipal solid waste which ends up at landfill until 2016 a the first step to accomplish this requirements. This paper analyzes possible ways for the treatment of biodegradable waste from households in Serbian municipalities in order to achieve this goal. Therefore, in this paper, flows of garden and other biodegradable waste in municipal solid waste are analyzed by MFA (Material Flow Analysis) and two scenarios are presented. For decision makers in the field of waste management, the obtained information will be of great importance in order to develop an appropriate waste management system and to achieve specific targets for biodegradable waste treatment according to national and EU Directives.

1. INTRODUCION

Organic waste can represent 20 to 80% of total municipal solid waste (MSW) stream, depending on the country economic development level. Approximately 25-35 million tones of biodegradable waste is produced in the EU every year, and nearly 50% of that amount includes green waste from public places and parks, and garden waste from households [1], [2].

In Serbia in contrast to most European countries, currently almost all amount of organics waste ends up usually on non sanitary landfills. Consequently, and in accordance with waste hierarchy, landfills are the last options for organic waste.

EU Directive (2008/98/EC) sets objectives to reduce the amount of biodegradable waste, through separate collection, composting, biogas production or materials/energy recovery and recycling [3]. According to this, a Serbian Landfill Directive was adopted in 2010. Its main objectives are:

- Not later than 2016 reduction to **75%** of the total quantities (by weight) of biodegradable municipal waste.
- Not later than 2019 reduction to **50%** of the total quantities (by weight) of biodegradable municipal waste.
- Not later than 2026 reduction to **35%** of the total quantities (by weight) of biodegradable municipal waste [4].

2. BIODEGRADABLE WASTE

According to data obtained by analysis of quantity and composition of municipal solid waste in Republic of Serbia, the most significant waste fraction represents organic waste which takes more than 40% of total amount, and roughly can be divided into food waste and garden or yard waste.

The estimation of the amount of food and garden waste is one of first steps and it is necessary for determination of the size and type of treatment.

In most cases garden waste from household in Novi Sad is collected together with other municipal waste. In most municipalities of Serbia the total amount of garden waste is unknown. Novi Sad is one of municipalities where data exist about generation of garden waste. Part of this fraction of waste is generated in public places and parks and the other part is garden waste generated within households. According to data from the public company responsible for the green waste collection and transport in Novi Sad, about 15,000 tons were collected from public areas and parks in 2009. Also, based on a municipal study on waste quantification and characterization conducted for Novi Sad, it was shown that garden waste from households represents 9.13% of all MSW, or 11,000 tons per year. The total of garden waste from public areas and households collected in Novi Sad is about 26,000 t [5]. According to the same study, percentage of food waste in MSW in 2008 was 40.73% [5] and the total amount of food waste collected in Novi Sad was about 50,000 tons.

Total municipal waste generated in Novi Sad in 2008 was 120,773 tons. According to the composition study of municipal waste in Novi Sad (Table 1), the estimated amount of biodegradable waste (including paper and cardboard) that was sent to landfill is approximately to 78,000 t per year [5]. If we include garden waste generated in public places and parks, the total amount of biodegradable waste disposed in landfill was 92.000 tons. Proper treatment of this waste is necessary in the waste management system in order to fulfill landfill targets.

Table 1: Morphological composition of municipal waste in Novi Sad in 2008[5]

Waste category	%	t
Garden waste	9,13	11027
Other biodegradable waste	40,73	49191
Paper	8,57	10350
Glass	11,19	13514
Cardboard	6,06	7319
Waxed cardboard	0,72	870
Al-coated cardboard	0,91	1099
Metal- packaging and other	0,98	1184
Metal-Al cans	0,43	519
Plastic- packaging	4,57	5519
Plastic bags	3,85	4650
Hard plastic	3,66	4420
Textile	3,09	3732
Leather	0,03	36
Nappies	1,29	1558
Fine waste particles	4,73	5713

3. TREATMENT OF BIODEGRADABLE WASTE

Considering the mentioned quantities and targets defined in the Serbian Landfill Directive, this paper points out options for the treatment of garden waste from household and public places and options for the treatment of food waste from households in Novi Sad municipality.

3.1. Windrow composting of garden waste

Composting is an effective biological treatment used to reduce organic material volume and weight, which also converts it into a valuable product (compost) for soil protection and crop growth [6].

Composting in low-technology plants like windrow composting plants is the most common management garden waste in Europe in general [7].

Green waste from public places and parks waste, which includes grass clippings, hedge cuttings, tree pruning, small branches, leaves, and wood debris, can be easily composted in centralized composting operations, and that option can be a low-effort, cost-effective and environmentally sound method to reuse yard waste. Landfill space in that way is conserved, disposal costs are reduced and a useful end product is produced with composting.

Generally, the efficiency of composting stages depends on a variety of parameters, such as aeration, temperature, moisture, pH and material for composting [7].

The advantage of composting is related to the fact that the compost and the digested material can be used as a soil improver because the majority of the nutrients, contained in the source materials, are preserved during the process. As such, it can be used as a substitute for mineral fertilizers. [8].

The environmental assessment indicates that current practices for garden waste management could be made more environmentally sound if composting operations were optimized [9].

3.2. Anaerobic digestion (AD) of food waste

This segment would involve the introduction of primary separation of food waste from households and waste stream is considered to be will be treated by anaerobic digestion. This reduces the volume of waste and makes it biologically inactive so it can be taken to a landfill without releasing methane. AD also produces less air and solid emissions than incineration, landfill and pyrolysis and gasification.

The quality and quantity of the input material are the only real changing factors in the anaerobic digestion process, which are otherwise kept as constant as possible [10]. If the residue is clean enough it can also be used for land sites, landfill restoration and as a soil additive.

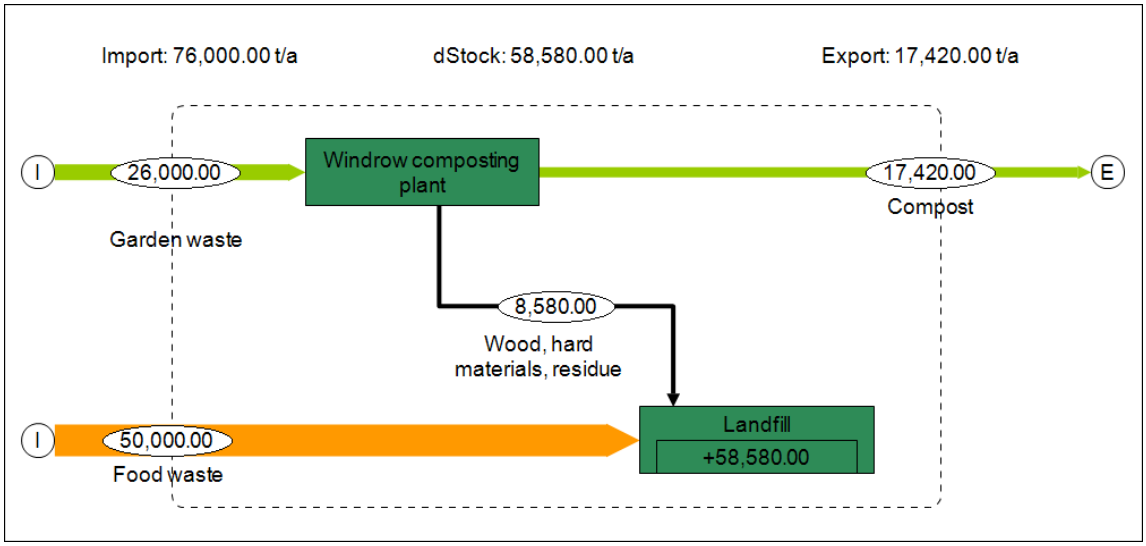
4. MFA OF TWO SCENARIOS

Material Flow Analysis (MFA) has become a reliable instrument to describe material flows and stocks within various systems [11, 12].

Flows of garden and other biodegradable waste in municipal solid waste are analyzed by MFA and two scenarios are presented. For decision makers in the field of waste management, the obtained information will be of a great importance in order to develop an appropriate waste management system and to achieve specific targets for biodegradable waste according to national and EU Directives.

4.1. Scenario 1

In Scenario 1, two streams are showed: garden and food waste. In a compositing facility, 26,000 tons of garden waste, originated from public collection of garden waste from a household (42%) and green waste from public areas and parks (58%), will be treated. Food waste will not be treated, and it will be disposed to landfill.

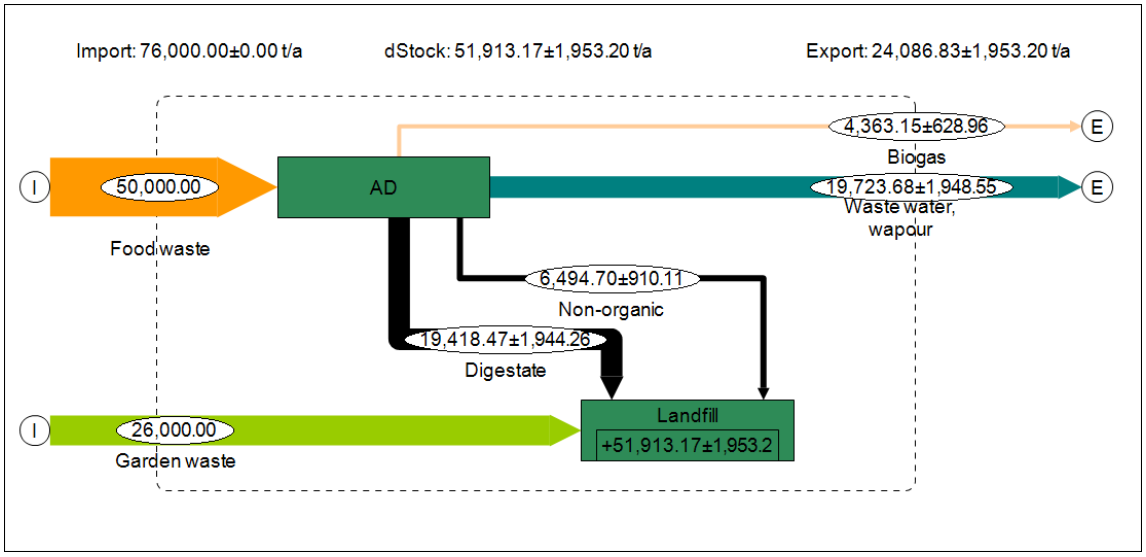


Picture 1: Scenario 1 - Treatment of Garden waste

The total amount of biodegradable waste is reduced by about 17,500 tons. A large amount of this waste, ca. 58,500 tons (without paper and cardboard) is still disposed to landfill.

4.2. Scenario 2

In Scenario 2, also two streams are showed: garden and food waste. The 50,000 tons of food waste from household will be treated with anaerobic digestion. Garden waste will not be treated and it will be disposed to landfill.



Picture 2: Scenario 2 - Treatment of Food waste

The total amount of biodegradable waste is reduced by about 30,000 tons but still 46,000 tons of biodegradable waste (without paper and cardboard) are disposed to landfill.

5. CONCLUSION

The EU Directive (2008/98/EC) sets objectives to reduce the amount of biodegradable waste, through separate collection, composting, biogas production or materials/energy recovery and recycling.

This paper describes two possible scenarios for the treatment of waste in order to achieve specific targets for management of biodegradable waste according to the Serbian and EU Directives which define targets for decreasing disposal rate on landfills.

In scenario 1, the treatment of garden waste through windrow composting is analyzed, and the total amount of biodegradable waste is reduced to 81% (by weight). With this scenario the target for 2016 will not be achieved.

In scenario 2, the treatment of food waste trough anaerobic digestion is analyzed, and the total amount of biodegradable waste is reduced to 67% (by weight). With this scenario the target for 2016 will be achieved.

Only if both scenarios are applied, the target for 2019 will be achieved. For fulfilling the target for 2026 some other treatments must be included, for example: paper and cardboard recycling, incineration of residue from composting.

REFERENCES

[1] B. K. Adhikari, A. Trémier, J. Martinez and S. Barrington, “Home and community composting for on-site treatment of urban organic waste: perspective for Europe and Canada”, Waste Management & Research, 2010, Vol. 28, pp. 1039–1053.

[2] G. Palacios, R. Apodaca, C. Rebollo, J. Azcárate, “European policy on biodegradable waste: a management perspective”, 2009.

[3] Directive 2008/98/EC of the European Parliament and of the Council on waste and repealing certain Directives, Official Journal of the European Union, (2008) 312/3-312/30.

[4] Waste Management Law, Official Gazette of the Republic of Serbia, RS-36/09 (2009).

[5] Vujić, G., Jovičić, N., Redžić, N., Jovičič, G., Batinić, B., Stanisavljević, N., Abuhress, O.A. (2010) A fast method for the analysis of municipal solid waste in developing countries - case study of Serbia. Environmental Engineering and Management Journal, 9, 8, 1021-1029

[6] Marga López Montserrat Soliva, F. Xavier Martínez-Farré, Mónica Fernández, Oscar Huerta-Pujol, “Evaluation of MSW organic fraction for composting: Separate collection or mechanical sorting” Resources, Conservation and Recycling 54 (2010) 222–228

[7] Karolina Marešová, Mária Kollárová, “Influence of compost covers on the efficiency of biowaste composting process” Waste Management 30 (2010) 2469–2474

[8] Dawn Stretton-Maycock, Graham Merrington, The use and application to land of MBT compost-like output - review of current European practice in relation to environmental protection Environment Agency – January 2009, 978-1-84432-973-1

[9] Alessio Boldrin “Environmental Assessment of Garden Waste Management”, Technical University of Denmark Department of Environmental Engineering, September 2009

[10] P. Illmer, G. Gstraunthaler, “Effect of seasonal changes in quantities of biowaste on full scale anaerobic digester performance” Waste Management 29 (2009) 162–167

[11] O. Cencic, H. Rechberger, “Material flow analysis with software STAN” J. Environ. Eng. Manage., 18(1), 3-7 (2008)

[12] Paul H. Brunner, Helmut Recheberger., Practical Handbook of Material Flow Analysis, Lewis Publishers, USA, 2004.