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[1.]Tamás MOLNÁR, [2.]Ferenc FARKAS

THE EXAMINATION OF THE COMPOSITION OF WASTE TAKEN TO THE REFUSE DUMP

[1-2.] University of Szeged, Faculty of Engineering, Szeged, HUNGARY

Abstract: The communal solid waste refuse dump of the „A·S·A Hódmezővásárhely Köztisztasági Ltd." Is located on the outskirts of Hódmezővásárhely on the area No. 01957/1. The refuse dump is situated south of Hodmezovasarhely, west of no. 4414 road, about 5-6 kilometres from the centre. In terms of public service obligation the communal solid waste of Hódmezővásárhely and six other settlements is taken to the refuse dump (Csanytelek, Mindszent, Mártély, Földeák, Békéssámson, Makó, Nagyér), its area of responsibility is 200.000 people. It is operating in accordance with the Waste Management Law of 2000 No. XLIII and the related legislation and the public service contracts signed with the municipalities. The refuse dump and its facilities are built on the basis of an impact assessment of 1994. The refuse dump of Hódmezővásárhely is situated on 20 ha of land and the top height of the landfill is 30m. The refuse dump can store 3,9 million m3 of refuse and will provide environment friendly storage for the refuse of Hódmezővásárhely and its environs for 50 years. The refuse dump is provided with technical protection, leachate collection system and landfill gas drainage system constructed on the base of Austrian standards. Its cultivation is done by heapmaking technology. Based on the permission of ATIKÖFE the waste that may be delivered to the refuse dump are the following: household waste, not hazardous industrial waste, sewage sludges, debris and soil.
Keywords: landfill gas, alternative energy, environmental conditions, EWC codes, waste composition

INTRODUCTION

The The examination was carried out on the A.S.A. Hódmezővásárhely refuse Ltd.'s second and third landfill sites where I analysed the unloaded waste. When laying down the boundaries of the areas for the surveys it had to be taken into consideration where the waste is produced. The areas covered in the examination are the following:

- Hódmezővásárhely public domain,
- Hódmezővásárhely downtown,
- Hódmezővásárhely suburb.

This method represents the waste composition for the entire landfill site. During the examination I examined the first loads which arrived each day. On the basis of the entire daily delivery the composition of the total amount of waste can be concluded. Due to this the waste delivered within a day is aggregated by EWC codes. A.S.A. Hódmezővásárhely Ltd. carried out the compulsory winter, sping, summer and autumn monitoring provided in the standard environmental performance permissions by the notice of the Environmental inspectorates (Table 1). Waste composition examination was made by MSZ 21420-28 and MSZ 21420-29 standards where I divided the total waste into 13 fractions and their sub fractions and from these I specified biodegradable proportion in the refuse dump.

Table 1. The amount of waste covered in the examination of waste composition in 2007

		winter 3. site	spring 2. site	summer 3. site	autumn 1. site
A	Gross mass of the collecting vehicle [kg]	11540 kg	28220 kg	11540 kg	28220 kg
B	Raw nett mass [kg]	1040 kg	11740 kg	1040 kg	11740 kg
C	Mass of average sample [kg]	504,7kg	499,57kg	501,5kg	503,5kg

WASTE POTENTIAL GENERATED IN THE REGION OF HÓDMEZŐVÁSÁRHELY

As the result of the waste analysis by MSZ 21976 standard to determine the biodegradable organic matter content of municipal waste it can be stated that 53% of the total collected amount (19.322.24

tons) of solid municipal waste (EWC 200301), that is 10240.78 tons can be considered biodegradable and it can be considered as biomass potential. (Table 2) Usable biomass potential and speculative landfill gas yields produced from municipal waste from Hódmezővásárhely and its region for 2007 are shown in table 3.

Table 2. Amount of municipal waste by A.S.A. weight data

Year	Household waste (t)	Industrial waste(t)	Construction waste (t)
2005	31 071,33	13 516,56	11 414,32
2006	28 203,54	14 517,83	19 355,94
2007	19 322,24	21 201,81	36 599,36
2008	19 253,24	20 930,55	14 192,47
2009	20 974,66	17 403,90	12 479,42
2010	36 646,02	21 364,48	12 982,00
	Sewage sludge (t)	Oily waste(t)	All (t)
2005	3 209,93	11 970,97	71 183,11
2006	4 691,90	10 796,56	77 565,77
2007	3 396,94	10 481,13	91 001,48
2008	2 565,82	10 334,30	67 276,38
2009	2 984,42	6 888,89	60 731,29
2010	2 452,29	11 423,96	84 868,75

Table 3. Produced municipal waste by areas and energy recovery

Area	Biomass potential [t]	Landfill gas recovery [m³/t]	Landfill gas produced [m³]	Landfill gas caloric value [MJ/m³]
Hmvhely	7574,94t	256	1.939.184	21
Mindszent	826,36t	256	211.456	21
Mártély	151,04t	256	38.666	21
Székkutas	188,34t	256	48.215	21
Green waste	1500t	190	285.000	21
Sewage sludge	713,16t	310	221.079	21
Oily waste	524t	190	99.560	21
All	11477,94t		2.843.160	21

Speculative amount of landfill gas produced from municipal waste is 2,244,424 m³. During my calculations I considered the most favorable yield, which are the following: municipal waste 256m³/t, sewage sludge 310m³/t, oily waste 190m³/t, green wastes 190 m³/t. The amount of landfill gas produced depends on the composition of the waste and is 40-300m³/t (by organic content of waste), by practical experience the actual amount of landfill gas that can be produced is 2-3 m³/t annually. It has to be considered that depending on the gas convey system and its operation only 30-50% of the total amount of landfill gas can be utilized. Differences between theoretical and practical amounts can be because of the changes of the environmental parameters, the organic matter content of waste, the type and composition of the waste and its physical characteristics, degradation conditions and the consistency of waste.

Amount of landfill gas generated in Hódmezővásárhely refuse dump: V_t [m³/t waste] according to Tabasaran/Rettenberge formula:

$$V_t = 1.868 \cdot Co \cdot (0{,}014 \cdot T + 0{,}28) \cdot (1-10^{-kt})$$

[Tabasaran/ Rettenberger, 1987]

C_o: proportion of organic carbin of waste [kg/t waste], 1.868: gas production of organic matter [m³/kg],

T: waste temperature [°C], k[-]: degradation constant, t: time [year]

EXAMINATION RESULTS OF THE ORGANIC MATTER CONTENT OF THE DELIVERED WASTE

≡ Composition of waste in 2007 winter

The mass of the waste at the primary sorting was 504,7 kg, the weight of waste remaining on the upper sieve (D>100) was 146,2 kg, the weight of biodegradable waste was 5,4 kg (3.7%) and there was 31,5 kg paper (21,5%) (Diagram 1).At the secondary sorting the mass of waste was 358,5 kg, the weight of waste remaining on the middle sieve (20<D<100) was 42,55 kg, the sample diminution ratio is 8,425. During secondary sorting the weight of biodegradable waste was 22,1 kg (51.9%) and the weight of paper was 1,5 kg (3.5%).

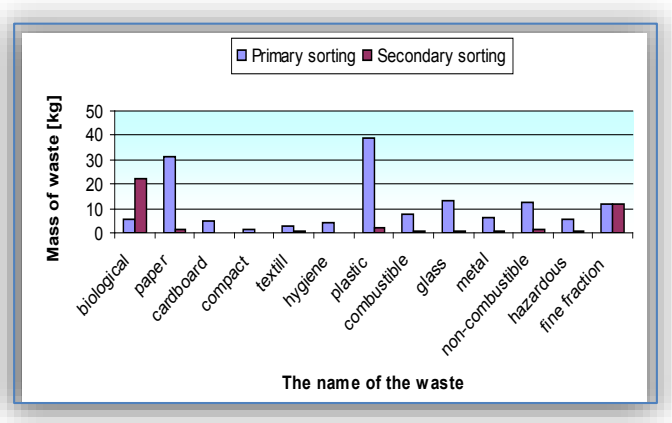

Diagram 1. Composition of remaining waste on the upper and middle sieve examination results

≡ Composition of waste in 2007 spring

The mass of waste at the primary sorting was 499,5 kg, the weight of waste remaining on the upper sieve (D>100) was 196,35 kg, the weight of biodegradable waste was 22,6 kg (11,5%) and there was 48,5 kg paper (24,7%) (Diagram 2). At the secondary sorting the mass of waste was 303,5 kg, the weight of waste remaining on the middle sieve (20<D<100) was 40,1 kg, the sample diminution ratio is 7,56. During secondary sorting the weight of biodegradable waste was 6,9 kg (17.2%) and the weight of paper was 8,2 kg (20.6%).

≡ Composition of waste in 2007 summer

The mass of waste at the primary sorting was 501,5 kg, the weight of waste remaining on the upper

sieve (D>100) was 160,5 kg, the weight of biodegradable waste was 16,8 kg (10,5%) and there was 36,1 kg paper (22,5%) (Diagram 3).
At the secondary sorting the mass of waste was 341 kg, the weight of waste remaining on the middle sieve (20<D<100) was 41,5 kg, the sample diminution ratio is 8,21. During secondary sorting the weight of biodegradable waste was 11,62 kg (28,1%) and the weight of paper was 7,4 kg (18%).

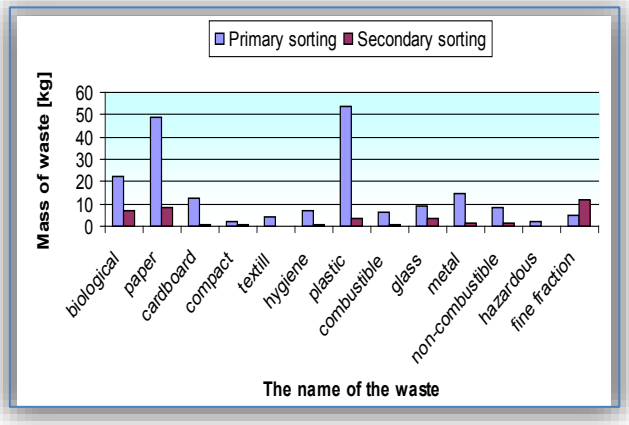

Diagram 2. Composition of remaining waste on the upper and middle sieve examination results

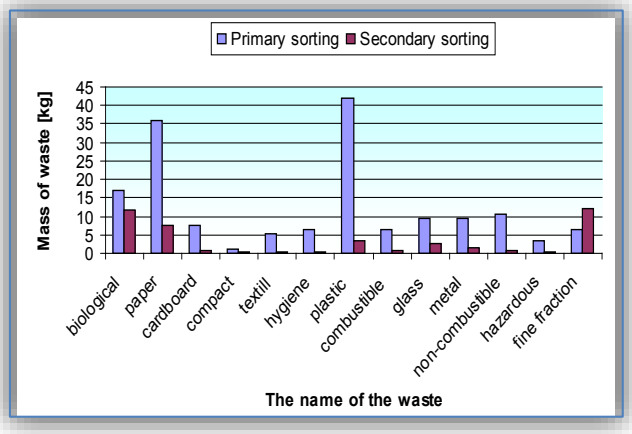

Diagram 3. Composition of remaining waste on the upper and middle sieve examination results

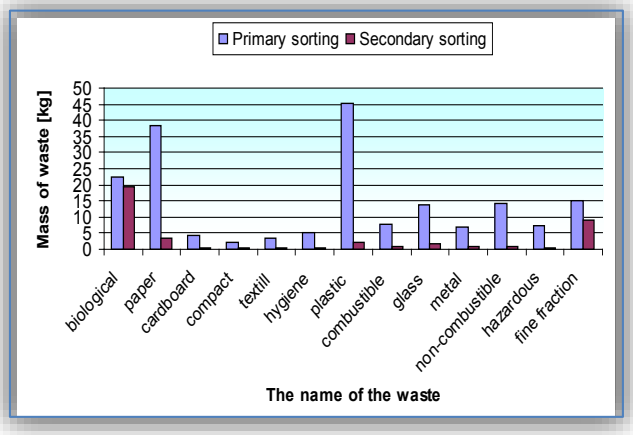

Diagram 4. Composition of remaining waste on the upper and middle sieve examination results

≡ Composition of waste in 2007 autumn

The mass of waste at the primary sorting was 503,5 kg, the weight of waste remaining on the upper sieve (D>100) was 186,5 kg, the weight of biodegradable waste was 22,5 kg (12,1%) and there was 38,24 kg paper (20,5%) (diagram 4). At the secondary sorting the mass of waste was 317 kg, the weight of waste remaining on the middle sieve (20<D<100) was 40,6 kg, the sample diminution ratio is 7,80. During secondary sorting the weight of biodegradable waste was 19.4 kg (48%) and the weight of paper was 3,37 kg (8,3%).
The determining factor of the biodegradable waste is the household waste and the green waste. Sewage sludge contains 30% of degradable organic matter, but municipal waste contains only 3-4% so it does not change significantly the organic matter concentration. Oily waste does not change the organic matter concentration either, as it can cause only about 1.5% concentration rise with the permitted oil concentration by the Environment Performance permission.

DISCUSSION

In our country and world-wide the amount of waste is growing rapidly due to economic development. It is true that the amount of selectively collected waste is also increasing and also the quantities of secondary materials as recycled materials quantities - so they can get back into the manufacturing process – however it is an important task to dispose of the waste at an up-to-date and environmentally friendly location. The other aspect is to protect the environment, and therefore use measures and technologies, which provide possibility for minimizing the potential environmental problems during the placement and disposal of waste.

CONCLUSIONS

In the recent years in Hungary the continuous increase of solid waste, as a result of private consumption, has become a serious issue. In Hungary currently about 23 million m^3 solid urban waste is formed annually. Sixty-two percent (62%) of this waste is household waste and the remaining is waste produced at institutions or service providers which can be treated together with the household waste. Waste management plays a key role in the quality of environment, protecting natural resources and developing environmental security. There can be two basic environmentally harmful effects of waste disposal. One of them is leachate, which percolates through the deposited waste and pollutes ground water, the other is the landfill gas from decomposed organic materials. Landfill sites should have deponia gas discharge duct system in order to comply with the environmental standards. Overall, in a particular

landfill, the meteorological parameters are always changing; the organic matter input parameters are characteristic of the region therefore the extraction efficiency can only be changed by the control of the exhaust capacity. Therefore, research has great importance in this area of research to show which landfill gas parameters are generated with the climatic parameters and organic matter intake.

Note

This paper is based on the paper presented at International Conference on Science and Technique based on Applied and Fundamental Research – ICoSTAF 2016, organized by University of Szeged, Faculty of Engineering, in Szeged, HUNGARY, 2 June 2016

References

[1] BAI, A.(2007): A biogáz; Száz Magyar Falu Könyvesháza Kht., Budapest
[2] CHRISTENSEN, TH.H -KJELDSEN, P. (1989):Basic biochemical process in landfills Sanitary Landfilling (ed.: CHRISTENSEN, TH.H.-COSSU, R.-STEGMANN, R.) Academic Press, pp. 29-48.)
[3] Molnár T. (2007): Quantitative and qualitive analysis of the biogas production from the municipal solid waste, Hungarian Agricultural Engineering N0 20/2007, pp. 20-22, HU ISSN 0864-7410.
[4] Molnár T. (2009) The impact of the weather conditions for the parameter of the production of landfillgas, Hungarian Agricultural Engineering N0 22/2009, pp. 91-94, HU ISSN 0864-7410.
[5] Molnár T. (2015) Changes of methane content of landfill gas with regard to different wind speed interval, Hungarian Agricultural Engineering N0 27/2015, pp. 20-23-94, HU ISSN 0864-7410.
[6] STACHOWITZ, W. H. (2004): „Berechnung“ oder Abschätzungen von Gasproduktionsmengen Gasprognose
[7] SVÁB, J. (1981): Biometriai módszerek a kutatásban, Mezőgazdasági Kiadó, ISBN 9632310136, p.50-51., Budapest
[8] TABASARAN, O. (1981):Gas production from landfill. In: Bridgewater AV, Lidgren K, editors. Household waste management in Europe, economics and techniques. New York: Van Nostrand Reinhold Co.; 1981. p. 159–75.

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