

**POSTĘPY W INŻYNIERII MECHANICZNEJ  
DEVELOPMENTS IN MECHANICAL ENGINEERING**

7(4)/2016, 87-93

Czasopismo naukowo-techniczne – Scientific-Technical Journal

---

Marietta MARKIEWICZ-PATALON, Jerzy KASZKOWIAK

**NEW SYSTEMS OF MUNICIPAL WASTE'S MANAGEMENT  
ILLUSTRATED WITH AN EXAMPLE OF SELECTED  
DISTRICTS**

**Summary:** The problems of generation and management of municipal wastes generated by households are presented in this article. The numeric data concerning the volumes of generated municipal wastes, their processing and costs related to their storage in two, independent of each other districts are presented here. The obtained results were compared with assumptions established by these districts when the act came into effect. The quantity of waste per capita varies from 0.13 to 0.30 Mg/year.

**Key words:** wastes management, volumes of generated wastes, Environmental Protection Law, local self-government, wastes' recovery problem

## **1. INTRODUCTION**

The problem of municipal wastes segregation has, according to literature, been noticed already since XIX century. The first documents confirming the waste collection and segregation as well as establishment of the first municipal waste incineration plant have been preserved from that period of time. According to the act as of April 27, 2001 Environmental Protection Law considers all the materials and fluid substances from which a considerable volume may be used as a secondary materials [1], to be waste. In their general division, there may be distinguished municipal and industrial wastes. In Poland, in spite of legal conditions, there still are being formed the so-called illegal dumps, with not control and supervision, the consequences of existence of which shall be noticeable for the next years.

Harmfulness of wastes for the natural environment is the essential criterion of wastes division. The mentioned wastes, pursuant to the European Directive, are being classified as: wastes from households, large wastes, craft wastes and wastes from trade of the character of wastes from households, garden and parkland wastes, from market places, street sweepings, construction wastes, sewage sludge, fecal matter, fecal sediments, leavings formed in the course of waste water treatment and water conditioning [4].

---

mgr inż. Marietta MARKIEWICZ-PATALON, Uniwersytet Technologiczno-Przyrodniczy,  
Wydział Inżynierii Mechanicznej, Al. prof. S. Kaliskiego 7, 85-796 Bydgoszcz,  
e-mail: marietta.markiewicz@utp.edu.pl

dr inż. Jerzy KASZKOWIAK, Uniwersytet Technologiczno-Przyrodniczy, Wydział Inżynierii  
Mechanicznej, Al. prof. S. Kaliskiego 7, 85-796 Bydgoszcz, e-mail: jerzy.kaszковиak@utp.edu.pl

Legal changes in the manner of management of wastes generated by households took place in July 2013, when there started to bind the Act on the change of the act on maintaining cleanness and order in districts [2]. It shifted the obligation of management of wastes generated by households to local self-governments. Prior to the Law's amendment, management of wastes in Poland was not arranged and it was the owner of a real estate who decided on what company and for what amount shall collect municipal wastes. From the date of coming into force of the law, a new obligation of the district is conducting an annual analysis of the state of municipal wastes' management in order to verify its technical and organizational possibilities within the scope of municipal wastes' processing, investment needs, costs of the municipal wastes' management system [9]. Each holder of wastes, understood according to the Law on wastes of April 27, 2001 (Journal of Laws of June 20, 2001) as a physical or legal person factually managing the wastes, (owner of the property that the earlier mentioned wastes is stored), should get appropriate containers for selective collection of wastes. Selective collection of wastes means separate collection of fractions of: paper, metal, plastics, glass, large multi-material packages, bio-degradable municipal wastes including bio-degradable package wastes and used electric and electronic equipment [3].



Fig. 1. Municipal wastes at households (own study)

The inhabitants of districts have been obliged to lodge declarations governing the type of collection (selective or non-selective) and incurring costs of wastes' collection from households. The reason of such changes' introduction was the state of the natural environment, polluted by mass storage of non-degradable wastes or wastes putrefying over a longer time period. The areas where wastes are being stored, commonly called dumps, result in considerable threat to the natural environment and generate mounting costs, what results from the increase of wastes' generation at households for at least 1% per year.



Fig. 2. Municipal wastes dump (own study)

Revisions have, to a small degree, improved functioning of wastes' turnover and wastes in Poland have been all the time been considered as a needless ballast, and their storage on dumps far from a city has been considered to be the best solutions. Meanwhile up-to-date methods make it possible not only to eliminate a harmful impact of wastes on environment but also to obtain considerable economical profits [7]. A household generates annually about 300-500 kg of wastes, what in the scale of the whole country gives about 10-11 million tons per year (on the basis of data on volumes of wastes registered on dumps) [10]. Moreover, a considerable volume of wastes is stored on illegal dumps.

The changes resulting from the adjustment of the Polish law to the European law result not only segregation and storage of wastes, but most of all their processing. As far as recycling is considered, as compared to the western European countries, Poland has been using its potential possibilities in less than 10%. For example, in Germany only 20% of wastes are sent at dumps due to impossibility of their re-use. The remaining part is re-used or processed into energy. Production of alternative fuels may be the example of plastics' processing. Establishment of industrial plants dealing with wastes' incineration, professionally called Thermal Municipal Wastes' Conversion Installations has become the most popular method among the recycling method of wastes' use in Poland. This process is not the only method of their utilization, an incineration plant is the solution of the problem of these wastes which give in to other utilization methods, it does not fill in for recycling, composting or other methods, it is only supplementation of recycling methods. Annually in Poland 9473830,98 Mg of wastes are generated, that is why up-to-date technological solutions of their utilization and recovery are such an important aspect. The share of individual provinces in the total volume of generated municipal wastes in Poland is differentiated both in absolute values as well as expressed per

capita. The highest volume of municipal wastes is generated in the Silesian and Mazovian provinces. In the Mazovian province it is 0,25 Mg per capita while in Silesian province 0,29 Mg per capita.

Table 1. The volumes of generated wastes in provinces per year (own study on the basis of [5])

Province	Volume of wastes during a year, Mg	Volume of wastes during a year per capita, Mg
ŁÓDZ	575 752,71	0,22
MAZOVIAN	1 331 624,24	0,25
LITTLE POLAND	702 040,46	0,20
SILESIA	1 347 843,98	0,29
LUBLIN	348 423,88	0,16
SUBCARPATHIAN	357 579,09	0,16
PODLASKIE	251 713,85	0,20
ŚWIĘTOKRZYSKIE	169 697,12	0,13
LUBUSZ	313 098,11	0,30
GREAT POLAND	949 771,12	0,27
WEST POMERANIAN	519 510,71	0,30
LOWER SILESIA	853 739,49	0,29
OPOLE	247 976,68	0,24
KUYAVIAN-POMERANIAN	514 951,87	0,24
POMERANIAN	644 789,71	0,28
WARMIAN-MAZURIAN	345 317,96	0,23

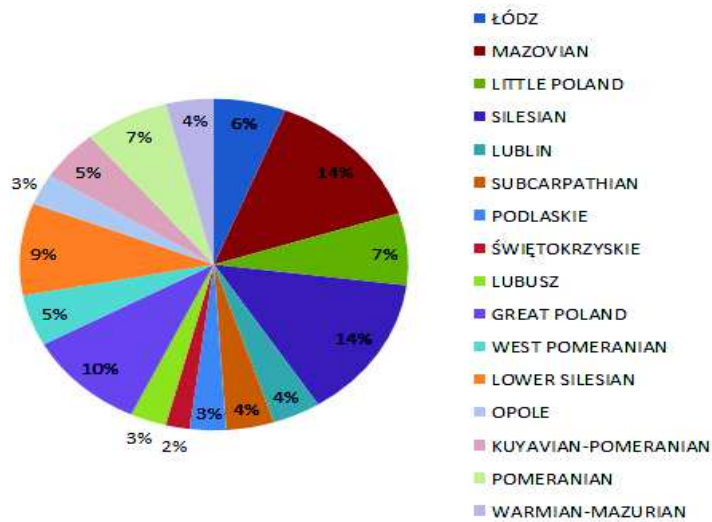


Fig. 3. The percentage share of generated wastes in individual provinces within a year (own study on the basis of [5])

## 2. PURPOSE OF THE STUDY

The purpose of the study is to establish the volume of municipal wastes generated by one inhabitant and comparison of the above mentioned wastes' generation in two unrelated districts and the analysis of wastes' management manner.

## 3. RESULTS OF THE STUDIES

The volume of wastes generated by households in selected districts, in two separated provinces (district A – Mazovian province, district B – Warmian-Mazurian province) were analysed. The volumes of generated wastes per capita and the ratio of the volume of wastes recovered for storage at dumps and the costs of their storage were compared.

Table 2. Comparison of the volumes of the generated wastes (own study on the basis of literature [6, 8])

	District A	District B
Number of inhabitants	4866 inhabitants	8697 inhabitants
Volume of municipal wastes	1147,7 [Mg/year]	1478,0 [Mg/year]
Volume of municipal wastes per capita	0,24 [Mg/year]	0,17 [Mg/year]
Volume of wastes subject to recovery	140,7 [Mg/year]	221,0 [Mg/year]
Volume of wastes stored at dumps	1007,0 [Mg/year]	1257,0 [Mg/year]
Costs connected with storage of wastes not subject to recovery (110,6 PLN/t)	111374,2 [PLN/year]	139024,2 [PLN/year]
Cost of wastes' storage per capita	22,9 [PLN/t]	15,9 [PLN/t]

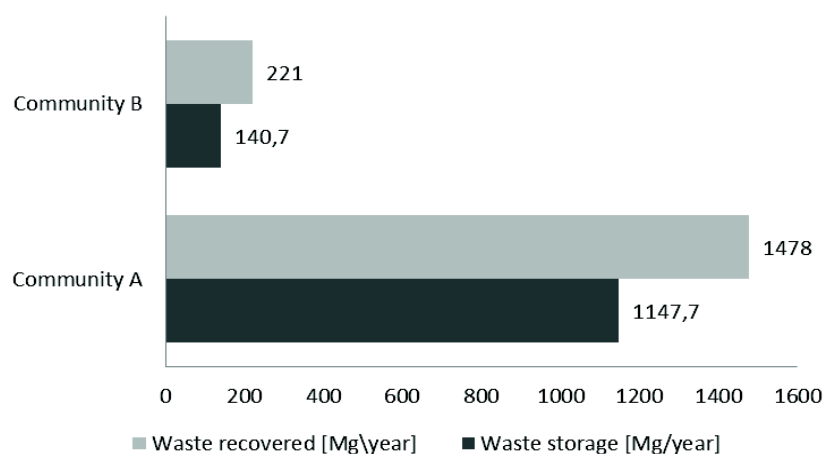


Fig. 4. Ratio of wastes recovered to stored (on study)

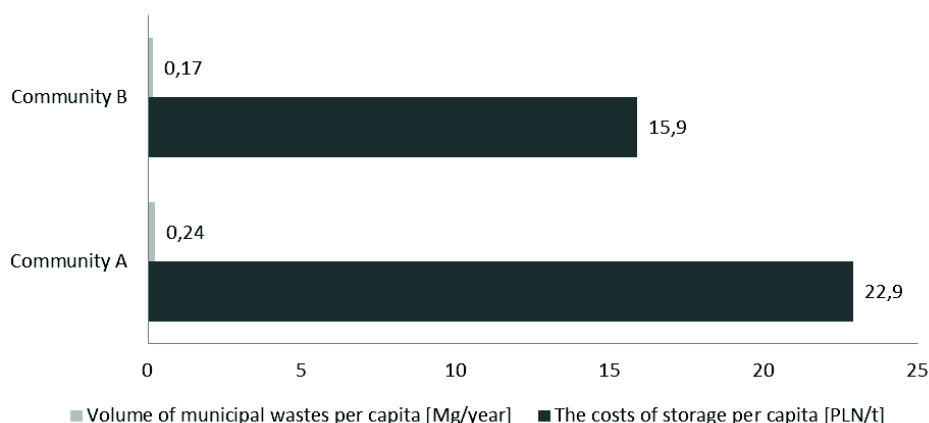


Fig. 5. Comparison of the costs of storage and volumes of wastes' generation per capita (own study on the basis of literature [6, 8])

At the chart 4 the ratio of the volume of wastes subject to recovery and the volume of wastes stored at dumps. These volumes are similar in both the districts. The district A has been recovering 13% of wastes while 87% is transported on dumpsites, analogously in district B – 15% of wastes is subject to recovery while 85% is stored on dumpsites. From the presented data (chart 4 and 5) it results, that the district A, in spite of a lower number of inhabitants generates for 0,07 [Mg/year] more of municipal wastes than the district B, and what's connected with that, the cost of storage of wastes not subject to recovery per capita is for 7 PLN higher than in the district B.

#### 4. CONCLUSIONS

Wastes and threats connected with them are a growing problem in the environment protection. However, last years showed an increased interest of the State authorities in wastes management and minimization of their generation in individual districts, but also introduction of new technologies connected with rendering harmless and recycling of wastes. Within the scope of wastes' management since 1997 many legal conditionings which set down the mode of wastes' handling have been established, however these were the revisions from 2013 which forced the local self-governments to organize the manner of the wastes management. The presented districts located in the Mazovian and Warmian-Mazurian province have been gradually implementing the provisions of the Law since 2013. The so-far changes concern imposing upon inhabitants of the terms of a municipal company collecting wastes from households and impose an obligation of wastes' segregation and bearing costs connected with their storage at dumpsites. A gradual increase of the volume of wastes subject to recovery and substitution of storage with management is being observed. However, there is no correlation between enterprises offering wastes processing services and legal conditionings and expenses for raw materials' recovery, what

constitutes an issue not settled yet. Undoubtedly, apart from further legal and organizational changes, necessary are actions encouraging inhabitants to segregate wastes and fully legal their storage. So far there are still more wastes stored on dumpsites than recovered or utilized.

## REFERENCES

- [1] Act as of April 27, 2001, Law on Environmental Protection (Journal of Laws no 62 item 627).
- [2] Act as of July 1, 2011 on the change of the act on cleanness and order maintenance in districts and some other acts (Journal of Laws from July 25, 2011 item 897).
- [3] Act as of September 13, 1996 on cleanness and order maintenance in districts.
- [4] Directives of the European Parliament and the Council 2009/98/CE dated November 19, 2008 on wastes (Journal of Laws L312 from 22 XI 2008).
- [5] [stat.gov.pl/obszary-tematyczne/infrastruktura-komunalna-nieruchomosci/nieruchomosci-budynki-infrastruktura-komunalna/infrastruktura-komunalna](http://stat.gov.pl/obszary-tematyczne/infrastruktura-komunalna-nieruchomosci/nieruchomosci-budynki-infrastruktura-komunalna/infrastruktura-komunalna).
- [6] [www.brodnica.net.pl/asp/pliki/download/pgo.pdf](http://www.brodnica.net.pl/asp/pliki/download/pgo.pdf).
- [7] [www.egospodarka.pl](http://www.egospodarka.pl), Wysypiska śmieci rosnącym problemem. Regina Anam, poradnik internetowy eGospodarka.
- [8] [www.milakowo-umig.bip-wm.pl/public](http://www.milakowo-umig.bip-wm.pl/public).
- [9] [www.mos.gov.pl](http://www.mos.gov.pl), Ministerstwo Środowiska, Departament Gospodarki Odpadami, Nowy system gospodarki odpadami komunalnymi, Emilia Kołaczek, Warszawa.
- [10] [www.mos.gov.pl](http://www.mos.gov.pl), Ministerstwo Środowiska, Rzeczpospolita Polska.
- [11] [www.spalarnie-odpadow.pl/technologie-spalania](http://www.spalarnie-odpadow.pl/technologie-spalania).