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ANALYSIS OF MUNICIPAL WASTE COLLECTED BY THE SELECTED WASTE MANAGEMENT ESTABLISHMENTS

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ABSTRACT

From the moment of Poland's accession to the EU, we have been obliged to adjust the waste management system to directives issued by the European Community Council. Our waste management has been adjusted to the requirements of the European Union directives. The objective of the paper was to determine: firstly, the amount of the produced mixed municipal waste; secondly the amount of municipal waste collected in a selective manner with the use of collection methods through segregation in the place of their production using two containers located next to each other – one for collective collection of paper, cardboard and plastic and the second for collection of glass; thirdly, the size of recovered secondary raw material such as glass, plastic and paper from mixed municipal waste; fourthly, the amount of containers or plastic bags designated for selective waste collection. For execution of this objective, two establishments using various waste management systems were selected. Research was carried out in Firma Usług Komunalnych [Municiapl Services Company] "Wodnik" in Trzebnica and in Zakład Gospodarki Komunalnej [Municipal Management Establishment] in Gać, which have dealt with municipal waste sorting for many years. The research proved that the plastic bag method is more effective than segregation with the use of containers located in the neighbourhood.

Introduction and the objective of the paper

The increasing amount of municipal waste produced in households, production establishments and other economic establishments inflicts natural environment pollution and its degradation. The increasing costs of municipal waste disposal and their management influenced formation of illegal rubbish dumps. From the moment of Poland's accession to the EU, we have been obliged to adjust the waste management system to directives issued by

the European Community Council. Directives should be transformed to suit the state law by statutory laws and other normative acts (Kozłowska, 2006; Jurasz, 1998; Żurek, Zarokiewicz, 1992). Council Resolution of 24th February 1997 set forth the Community strategy in waste management. The frame directive which determines basic requirements concerning dealing with waste is of basic significance in the normative acts systems (Górski, 2006).

The most important European legal acts on waste are Directive 2008/98/EC and 99/31/EC of the Parliament and the European Council which determine the main requirements concerning waste management in the Community and waste disposal. The EU strategy in waste management accepts principles, which assume protection against waste production due to the use of the so-called clean production technologies, recycling and re-use of waste, optimal management, waste disposal and their appropriate transport (Directive 2008/98/EC).

The most important document in Poland, which introduces guidelines of the EU is a National Cohesion Strategy adopted for 2007-2013 (Kulczycka and Pietrzyk-Sokulska, 2009). Basic legal regulations on waste management comprise the Polish law in statutory laws, as follows: Act of 13th September 1996 on maintaining cleanness and order in municipalities (Dz. U. [Journal of Laws] 2005 no 236 as amended in 2011), the National Plan of Waste Management of 2010 (KPGO 2014, www.sejm.gov.pl, Ustawa o odpadach).

The following constitute objectives of the ecological politics of the country: maintaining the increase of selective collection, recycling along with the economic growth, increase of ecologically safe waste combustion, liquidation of dumping grounds which fail to meet the requirements of environmental protection and their reclamation, appropriate management of hazardous waste and particularly selective management of at least 50% of waste which are produced in households (Kulczycka and Pietrzyk-Sokulska, 2009).

Main advantages following from selective collection of municipal waste are following (KPGO 2014):

– decrease of the mass and volume of waste transferred to be deposited on a landfill,
– selection of hazardous substances from waste and transferring them to a suitable establishment, which deals with their neutralization,
– decrease of original raw material and energy consumption for production of new products as a result of the use of segregated waste,
– financial profits from selling selected raw material as well as lower charges for waste disposal on a landfill (Kozłowska, 2006).

Selective selection of secondary raw material assumes the following waste collection systems: containers located in the neighbourhood, collective points of selective collection, selective collection "at the source of formation", district waste collection centres (Hryb, 2010, 2011; Żygadło, 2001).

The objective of the paper was determination of the following changes for the period from 2007 to 2010:

– the amount of produced mixed municipal waste,
– the amount of municipal waste collected selectively at the place of their production (two containers located next to each other, one for a joint paper, cardboard and plastic collection and the other for collection of glass),
– the amount of secondary raw material, such as: glass, plastic, paper and cardboard from mixed municipal waste,
– the number of containers or plastic bags designated for selective waste collection.

A facility and methodology of research

The research was carried out on the territory of Dolnośląskie voivodeship in Zakład Usług Komunalnych "Wodnik" [Municipal Services Establishment] which is located in Trzebnica and in Zakład Gospodarki Komunalnej [Municipal Management Establishment] in Gać. These establishments have been dealing with collection and segregation of municipal waste for many years.

The company ***Usługi Komunalne „Wodnik" in Trzebnica*** collected mixed municipal waste in the investigated period from the territory of the following communes: Trzebnica, Zawonia, Krośnice, Wisznia Mała, Długołęka, Prusice. On the territory of communes: Trzebnica, Krośnice, Zawonia and Prusice it carried out a selective collection of the used packages with a container method and with the use of plastic bags. It also carried out waste paper collection by collecting three times a week from collection points and waste paper establishments. Moreover, it collected waste paper from schools, which joined in collecting waste paper on the territory of a commune.

The establishment owns two sorting lines, one designated for processing of mixed municipal waste and the other for waste collected selectively. Sorting lines are constructed of the following devices: trough conveyor ascendant, a sorting sieve, horizontal conveyor, a sorting tribune, a waste packing press. The collected raw material was collected on the territory of an establishment in Trzebnica, where on a sorting line they were divided into appropriate fractions, which are compressed by baling and in this form they are prepared for further transport (Grabowski and Spalińska, 2008).

Zakład Gospodarki Odpadami in Gać is Ekologiczny Związek Gospodarki Odpadami Komunalnymi „EKOGOK" [Ecological Association of Municipal Waste Collection] with its registered office in Oława. The following communes have been served by the establishment since 2002: Skarbimierz, Lubaszka, Oława as well as cities of Oława and Brzeg. The establishment carries out selective collection system which consists in joint collection of plastic, metal as well as paper and cardboard to one container. Glass is collected in a separate container. This system of waste segregation was accepted in the establishment since it obtains higher and higher social acceptance on account of their simplified collection and decrease of their transport costs because majority of waste is collected during a single crossing of a transport mean. Mechanical sorting of non-segregated municipal waste as well as waste from selective collection is carried out in the Establishment. Waste recovery is carried out at the sorting hall equipped with mechanical waste segregation line, composed of a drum sieve, an electromagnetic separator of ferrous metals, a non-ferrous metals separator, two optical-pneumatic separators and a baling press for sorted secondary raw material. A sorting plant operates in a two-shift system and the maximum performance of a sorting line is 100 600 $Mg \cdot year^{-1}$ (Pozwolenie zintegrowane ZGO Gać, 2007, Prezentacja ZGO Gać).

Results of research and their analysis

Mixed municipal waste and selectively collected waste were collected by ***Firma Usługi Komunalne „Wodnik"*** from households, from municipal services establishments, trading, small business establishments and offices. Waste was collected from 100 000 citizens.

When analysing the size of the mass of the obtained waste (fig. 1), the highest share in the total mass comprised of household waste which amounted to approximately 300, 000 Mg and from establishments which run business activity, which was approximately 200, 000 Mg. Considerably lower number of waste was from municipal services and was within 35 000 Mg to 55, 000 Mg. In case of total municipal waste, this number increased by over 260 000 Mg from 2007 to 2010.

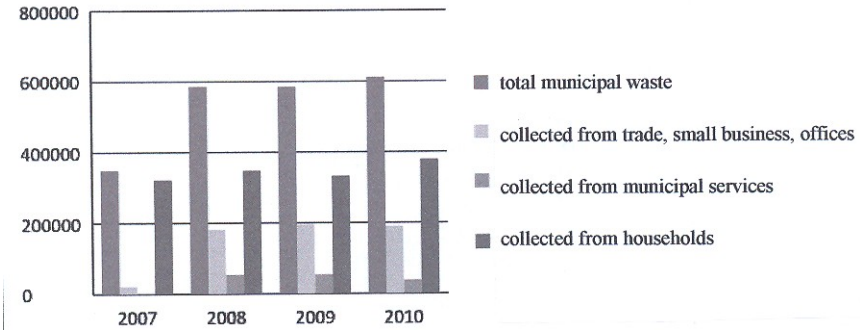

Figure 1. Collected municipal waste M_k in Mg by company Usługi Komunalne "Wodnik" in Trzebnica (author's own study based on data obtained from FUK „Wodnik" in Trzebnica)

Total recovery of paper, cardboard, glass and plastic from total mass of mixed waste was within 3.5% in 2007 to 2.5% in 2010 and in the remaining years was 2% of waste mass. It should be emphasised that in the analysed period the amount of secondary raw material separated on the waste segregation line decreased. Within 2007-2010 the mass of waste processed on a sorting line was lower by 28, 455 Mg. Considerable differences in the amount of collected waste obtained at their segregation occurred. Mass of selectively collected paper and cardboard increased almost by 500 Mg (fig. 2). In case of glass containers the biggest recovery of them took place in 2008 and it was over 7,000 Mg. Between 2008 and 2009 a decrease of the obtained mass took place and it was approx. 1,500 Mg. In 2007 the highest number of plastic containers was selectively collected – it was over 3,600 Mg and in 2010 almost 3,200 Mg.

A sorting facility owned by the Establishment served 22.2 thousand citizens in 2010. The mass of waste accepted to a sorting facility in 2010 was 5, 567 Mg and was higher in comparison to 2006 by approx. 2,000 Mg. 23% of raw material were recovered for recycling in 2010. In 2010 selective waste such as cullet was collected from 17 thousand citizens, plastic from 22.1 thousand citizens, whereas paper scrap from 12.1 thousand of citizens. Plastic and glass was collected to containers of "Iglo" type of 2.5 m^3, PCV 240 l, and to plastic bags of 240 l and 110 l volume. At the average approximately 60, 000 thousand plastic bags are used to collect secondary raw material every year. In 2010, 444 containers for glass, the same number for plastics and 424 for paper scrap were used for selective waste collection.

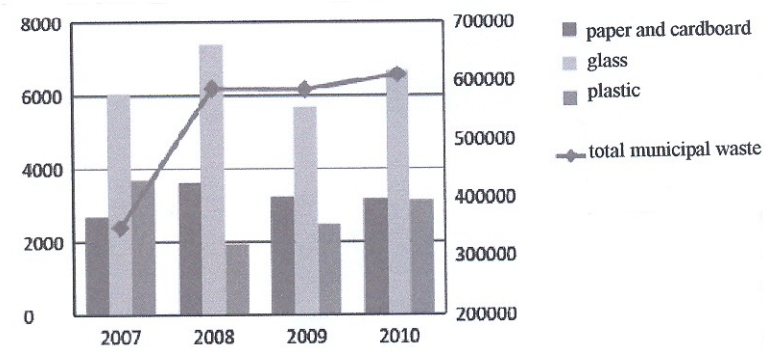

Figure 2. Waste collected selectively M_s in Mg and municipal waste M_k in Mg by Firma Usługi Komunalne "Wodnik" in Trzebnica (author's own study based on data obtained from FUK "Wodnik" in Trzebnica)

Due to cooperation with a local society, ecological education of citizens and constant investment inputs increase Firma Usługi Komunalne "Wodnik" in Trzebnica obtained a high level of recovered secondary raw material.

The other analysed establishment is ***Zakład Gospodarki Odpadami in Gać***, which from 2007 to 2010 increased the amount of the accepted non-segregated municipal waste by 16, 000 Mg (fig. 3) which constitutes the increase by 30%.

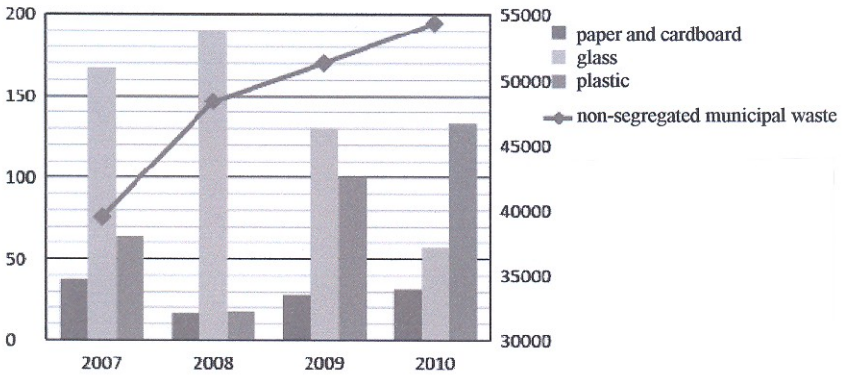

Figure 3. Municipal waste segregated in M_s in Mg and municipal waste M_k in Mg collected by ZGO Gać in Trzebnica (*author's own study based on data obtained from Zakład Gospodarki Komunalnej Gać)*

Taking into consideration municipal waste collected selectively in ZGO "Gać", in 2007 they amounted to 7.08% and in 2010 to 7.75%. The difference resulted from the increase of

the mass of mixed waste accepted and segregated, which increased by approximately 18, 000 Mg. In 2007, a mass of sorted raw material was 2, 983 Mg and in 2010 4, 694 Mg. In case of a selective collection of all types of secondary raw material, we may notice an upward tendency of the recovered mass not earlier than since 2006.

When analysing data on segregation of mixed packages waste, which was carried out on the territory served by ZGO "Gać", one may state that the system of such integration is effective and allowed separation of 2, 708 Mg raw material in 2010. Separate segregation of glass was 1, 029 Mg and decreased in comparison to 2009 by 300 Mg (fig. 4).

In 2004, 92 Mg of this waste was separated and in 2010 only 31 Mg. Glass is segregated in a lower amount, at the level of 57 Mg, when in 2006 it reached the level of 235 Mg. 133 Mg of plastics were obtained in 2010. The lowest number of this material was separated in 2008 and was at the level of 18 Mg. ZGO "Gać" earned PLN 1, 815, 279 from sale of secondary raw material in 2010, which means a unit profit at the level of 512.50 PLN·Mg^{-1} of waste.

Mass of waste transferred to repeated use from the beginning of operation of the Establishment was 33, 236 Mg. In 2004, 1,899 Mg was recovered and in 2010 4, 693 Mg. The increase of the obtained mass of selective waste follows from the increase of the number of containers for segregation, from ecological education of citizens and from modernization of the waste segregation line.

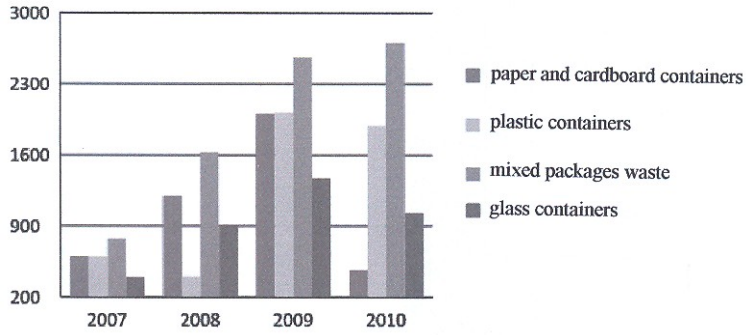

Figure 4. Packages waste M_s in Mg accepted by ZGO Gać [author's own study based on the data obtained from Zakład Gospodarki Komunalnej Gać]

Conclusions

Based on the research, one may make the following conclusions:

1. Within 2007 to 2010 Firma Usług Komunalnych "Wodnik" in Trzebnica recovered in total on the entire served area approximately 560 Mg more waste collected selectively which constitutes an increase by 4.3%.
2. An increase of the amount of waste collected selectively was reported in Zakład Gospodarki Odpadami in Gać. It followed from modernization of an establishment and the increase of the scope of segregation system with the use of two containers. In 2004, 1, 899

Mg of waste was collected and in 2010 4, 693 Mg which constituted an increase by 60%.

3. Research of two different methods of selective collection of municipal waste proved that the use of segregation at the source with a plastic bags method is more effective than segragaton with the use of containers located in the neighbourhood.

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ANALIZA ODPADÓW KOMUNALNYCH ZBIERANYCH PRZEZ WYBRANE ZAKŁADY ZAGOSPODAROWANIA ODPADÓW

Streszczenie. Od momentu wejścia Polski do UE zobowiązani jesteśmy do dostosowania systemu gospodarki odpadami do dyrektyw wydawanych przez Radę Wspólnoty Europejskiej. Nasza gospodarka odpadami została dostosowana do wymogów dyrektyw Unii Europejskiej. Celem pracy było określenie: po pierwsze ilości wytwarzanych odpadów komunalnych zmieszanych, po drugie ilości odpadów komunalnych gromadzonych selektywnie przy wykorzystaniu metod zbiórki poprzez segregację w miejscu ich powstawania stosując dwa kontenery ustawione obok siebie – jeden do łącznego gromadzenia papieru, tektury oraz tworzywa sztucznego a drugi do gromadzenia szkła, po trzecie wielkości odzyskanych surowców wtórnych takich jak szkło, tworzywo sztuczne oraz papier z odpadów komunalnych zmieszanych, po czwarte ilości pojemników lub worków przeznaczonych do selektywnej zbiórki odpadów. Do zrealizowania tego celu wybrano dwa zakłady stosujące różne systemy zagospodarowania odpadów. Badania zostały przeprowadzone w Firmie Usług Komunalnych „Wodnik" w Trzebnicy oraz w Zakładzie Gospodarki Komunalnej w Gaci, które od wielu lat zajmują się sortowaniem odpadów komunalnych. Badania dowiodły, że metoda workowa jest efektywniejsza od segregacji za pomocą kontenerów ustawionych w „sąsiedztwie".

Słowa kluczowe: odpady, segregacja, zakład gospodarki odpadami