Effective Municipal Waste Management as a Challenge for Self-Government Municipalities

Joanna Bril, Edward Rydygier

Abstract **− The article presents the problems of municipal waste management by local self-governments in Poland. Municipal waste in Poland constitutes a number of problems for the local authorities of both small communities and large municipalities, which force the use of new efficient organizational solutions and the need to make costly investments in infrastructure. Waste management is not only a technical problem, but it is also an area which involves various actors throughout society. The need of application of logistics solutions to the effective management of municipal waste is pointed. As an example of municipal waste management system it was considered the waste management plan for the Capital City of Warsaw. This plan was assessed in terms of respecting the principles of sustainable development and the requirements of the logistics system. Proposals of amendments to the Law on Waste developed by self-government organizations are presented.**

Index Terms **− environment protection, municipal waste, logistics system, waste management, sustainable development**

I. Introduction

The importance of waste management since Polish accession to the EU has increased significantly due to the need to adapt the requirements of EU standards in the field of cleanliness of the environment. In the face of strong economic growth of Western European countries in the early 70-ies of XX century, under the conditions of the intensification of the industry and the growth of private consumption, excess of waste has led to the so-called 'Avalanche of waste', which forced the introduction of new regulations and the need to develop innovative waste treatment technology. While Poland only after the change of regime began intensively to overcome the backlog and catch up the delay in modern waste management. It should also be pointed that the current regulations of the European Union are directed to respect the principles of sustainable development, which translates into the need to develop new logistics solutions and the use of innovative waste disposal technologies.

Municipal waste in Poland constitutes a number of problems for the local authorities of both small communities and large municipalities, which force the use of new efficient organizational solutions and the need to make costly investments in infrastructure.

According to Polish regulations Waste is defined in Law on Waste of 14 December 2012 [18]. This Law replaced the former Law on Waste of 27 April 2001. Amendment was made in order to adapt to EU rules on waste management to Polish law. According to the provisions, substances or objects considered as waste are unsuitable in a given place or time. Regulated in the amended procedures are designed to protect human life and health and the environment in accordance with the principles of sustainable development. Recommended waste management is prevention, limiting waste production, preparation for re-use and reducing the negative impact on the environment.

Law on Waste of 14 December 2012 is also included provisions on the general principles of waste management, waste management plans, principles of registers entities distributing products, products in packages and waste managing entities, as well as the principles of keeping records of waste treatment. In addition, pursuant to the provisions of the new law is to be created database of products and packages and waste recycle objects, which will replace the current base − Integrated Waste System.

II. Waste: Definition and Classification

Waste classification can be made according to different criteria, such as:

- chemical composition,
- physical properties,
- the place of their formation,
- the manner of their disposal or re-use,
- environmental hazard.

Considering the organic fraction, the waste is divided into:

- mineral waste, containing minor amounts (up to 1%) of organic matter,
- organic-mineral waste, containing 5-50% organic matter,
- organic waste, containing organic substances more than 50%.

Generally the waste can be divided into:

- municipal waste − generated by households but also from other sources generated waste which has nature or composition similar to waste from households,
- industrial waste – it means by-products created in the production process, i.e. solid and liquid substances and useless products without additional technological processing.

Amount of industrial waste is dependent on the degree of civilization development, industry structure, and process technology. In Poland, the industrial waste represents more than 90% of the total amount of waste.

In business practice it is used classification by which waste is treated as a potential source of secondary raw materials [17]. This classification has multilevel structure and uses different division criteria, is quite detailed and reasonably comprehensive.

In the first stage of this comprehensive classification the waste is divided into 5 basic types:

- metallic,
- non-metallic,

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- mineral,
- municipal,
- converted into heat.

In the second stage, a basis for the distribution of the different types of recyclable materials is a place of generation. In the third stage, there are used non-uniform criteria for different types of recyclable materials. With respect to the metallic, non-metallic and converted to heat waste it is used material criterion, for the mineral waste − the place of generation, while for municipal waste − criterion of the state of aggregation. In the fourth degree classification as the basis of criterion are the physical, chemical and technological properties. Waste collected in landfills is important for the national economics as potential secondary raw materials, the value of which is estimated at several hundred million dollars. Approximately 25% of the amount recovered secondary raw materials is carbon, 35% − zinc, lead, iron and other metals, and the remaining 40% consists of components such as: clay, ash, slag, crushed rock, gravel, etc. The nature, size and nuisance of waste reflected the applied technology, resource management and consumption of material goods. The formation of excessive amounts of waste is a sign of improper economy and points to the need to counter this tendency which causes degradation of the environment in the future.

III. Municipal waste management

The municipal waste generated in the municipalities consists waste from households, as well as public and services facilities. Among the municipal waste one can find many ingredients that are hazardous waste containing toxic, flammable, explosive substances or pathogenic micro-organisms (including used batteries, rechargeable batteries, fluorescent lamps, mercury thermometers, packaging of paints, solvents, varnishes, lubricants, used oils, unused medications, and packing of chemicals and fertilizers used in agriculture). Municipal waste constitutes a potential source of secondary raw materials, therefore requires a well-organized selection [7].

Municipal waste can be divided into several groups [17]:

- household waste, i.e. waste associated with being human in the place of residence (food scraps, packaging, used household items),
- large size waste, i.e. car wrecks, furniture, televisions, washing machines, refrigerators,
- waste from public facilities, i.e. educational, cultural, sporting, administrative and clerical institutions,
- green or biological waste from the care of urban green areas and kitchen gardens,
- street waste collected in baskets and street sweepings from the streets and squares,
- debris from apartments renovations and construction sites,
- snow and ice removed from the streets and squares in the winter.

Quantitative composition of municipal waste depends on the type of area (urban, rural, low, high), technical and sanitary equipment of buildings (especially when it comes to heating method), the amount of service facilities and other non-residential buildings (schools, offices, parks), recovery of secondary raw materials as well as the conditions of personal wealth, possession of backyard gardens, and even the season.

Law on Waste of 14 December 2012 implements into the Polish legal system the recently introduced EU rules in the field of waste managing, in particular: European Parliament and the European Council Directive no. 2008/98/EC of 19 November 2008 on waste and European Parliament and the European Council Directive no. 2010/75/EC of 24 November 2010 on industrial emissions, integrated pollution prevention and control [9].

The adjustment of Polish law on waste management to the EU requirements results in incurring certain costs and the necessity of preparing a suitable set of economic and legal means. Proper waste management, including hazardous waste, is an important element of the environmental policy of the European Union aimed at respecting the principles of sustainable development. Under this policy, the strategic goals have been considered as: eliminating waste at the source of generation, promotion recycling and reuse of waste and reduction of pollution caused by the burning of waste. Eliminating waste at the source results taking over responsibility for waste management by producers (e.g. cars). The European Union is a signatory to the Basel Convention on the control of cross-border movements and disposal of hazardous waste together with the adopted amendment to prohibit the export of hazardous waste. European Union Strategy for Waste Management was formulated in the document entitled ‘Communication from the Commission to the Council and the European Parliament on a Community strategy for waste management’ published in 1989. Prior the general environmental protection principles have been formulated in the following five action programs of the European Community, taking for periods of 5 years, starting from 1973.

These programs have been consistently defined common tasks in the field of waste management, such as:

- prevention of waste,
- recycling and re-use of waste,
- safe disposal of residues not for recovery.

EU Strategy for Municipal Solid Waste Management promotes [11]:

- reduction of waste unfit for reuse,
- elimination of toxic waste,
- reuse as much of the waste,
- safe disposal of residues not for recovery.

The EU requirement according waste reuse results in the implementation of many, constantly modernized waste treatment technology. Waste disposal is a challenge for researchers who are looking for effective, low-cost and environmentally safe ways of disposing of the products of human activity.The most common method of waste disposal is combustion using different processes such as:

- direct burning in furnace with fixed, moving, and rotating grate,
- fluidized combustion,
- combustion in rotary furnaces.

In the world the alternative technologies of combustion are developed, for example gasification and pyrolysis, which are popular in Japan and North America.

Waste combustion can be a kind of recycling, if will be used to generate energy, indirectly by alternative fuels produced from solid waste or directly to generate heat. In

Europe the largest producers of alternative fuels from waste are Germany and Italy, which have a production capacity in excess of 1 million tons/year. In contrast, waste burning in boiler installations provides heat that can be used to produce electricity. For example, in the United States in 2003, operated 102 power plants based on technologies WTE (Waste-To-Energy, which means converting waste to electricity). The share of waste combustion in many boiler installations increased from 9% in 1980 to 14% in 2002 (for comparison, in the same time, the amount of waste recycled increased from 10% to 28%). The United States generated annually waste in the amount of nearly a quarter billion tons, and from this amount about 30 million tons is burned giving a 2800 MW of electrical power. For comparison, in the EU countries in 2004 worked 370 incineration installations. They were capable to transform energy 43 million tons of municipal waste [6].

Another kind of waste processing technology is composting, i.e. biological method based on the decomposition of organic matter by microorganisms. Almost 40% of the mass flow of waste permitted for this process is municipal waste. Susceptible to composting organic waste derived primarily from gardens and farms (leftover fruits, vegetables, or other foods). On average over the year organic waste constitutes about 30% of municipal waste mass stream. However, not all organic waste suitable for composting can be composed. In recent years, it was noted that the composition of the compostable waste changes by increasing the proportion of toxic substances. Also increases the content of heavy metals [2].

IV. Logistics in Waste Management

The implementation of sustainable development principles in waste management necessitates the use of logistics solutions. For this reason it has developed a new branch of logistics that was called the logistics of waste. In the specialist literature logistics of waste is also known under the term of reverse logistics, logistics of return, logistics of recycling, and ecological logistics.

The goal of logistics of waste is to seek the most convenient organizational and cost solutions, taking into account the waste transport and storage, as well as removal and disposal of waste. Logistics of waste involves management of flows of waste (including full blown or damaged products but recognized by their administrators for waste) and information management associated with these flows from places of waste generation to places of destination (where waste will be designed for reuse, processed, disposed or prepared for long-term storage). Flows of waste should be cost-effective while minimizing the negative impact on the human environment.

Important tasks of the logistics of waste is a solving organizational, technical and economical problems to deal with the remains after waste recycling and waste not suitable for the destruction required long-term storage under conditions which do not endanger the environment [3].

The scope of the logistics of waste is relatively broad and includes

- public education on issues of sustainable development,
- organization of segregated waste collection,
- regular removal of collected waste,
- delivery of waste to rendering plants that have previously concluded relevant,
- concern for the technical condition of and aesthetics of waste collection infrastructure,
- investing in landfill waste unfit for recycling,
- special treatment of hazardous waste.

The simplest activity from the point of view of the logistical operations would be directing all waste for long-term storage. However, to respect the principles of sustainable development, waste flows must be so organized to maintain a hierarchy of values, as illustrated in Fig. 1 .

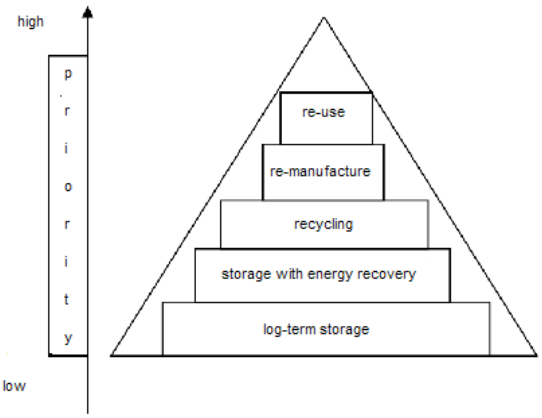

Fig. 1. The value hierarchy of waste recovery

The inclusion of an appropriate hierarchy of values for the recovery of raw materials and energy from waste determines the following logistical tasks [10]:

- design of the returnable packaging systems and management systems withdrawn flows in channels of distribution of finished products due to their unsuitability time in individual cells: retail, wholesale (reuse level),
- development of efficient logistics chains to obtain secondary raw materials for re-produce items (re-manufacture level),
- creating a system of sorting, collecting and receiving of goods consumed and their commutation of the disposal installations (recycling level),
- creating a system of sorting, collecting and receiving of goods consumed and their commutation to incineration or landfill (storage with energy recovery level, long-term storage level).

V. Logistics Systems for Waste Management

Condition for the application of logistics in waste management is to develop an appropriate logistics system [4]. Logistics system can operate in a spatial, organizational or information level. Logistically integrated waste management system should be constructed taking into account the functional areas. Functional areas stand out due to activities related to the generation of waste, their transport to disposal facilities and landfills (field of the real economy) and activities involving the regulation and control (field of the rules).

The main determinants of the logistically integrated waste management system are:

- amount, nature and spatial distribution of waste,

• degree of regularity and dynamics of the production of waste,
• principles of environmental protection,
• spatial and urban factors such as structure and shape of the settlement of the region,
• possibility of the location of objects, routes of communication, spatial structure of economic activity,
• universal standards as well as local (national, regional) requirements for acceptable environmental pollution.

Above group of factors (defined in a descriptive or parametric form) is a set of external constraints and conditions. The second group of factors concludes internal conditions closely related to the level of technology in the field of transport, storage and processing of waste, as:

• method of waste collection,
• selection of the location and size of facilities,
• efficiency of facilities,
• routes selection and gathering the appropriate means of transport.

Logistic system can be described by a static model − the description of its operation relates to a specific point in time. Logistic system can also be described using the dynamic model − in this case changes in the factors over time are taken into account. The dynamic model should take into account:

• frequency of waste,
• ability to locate objects in stages,
• restrictions on the functioning of objects related to their capacity and absorption,
• ability to launch new processes for recycling of waste,
• existence of numerous and easily accessible sites for the location of new facilities.

Constructing an integrated logistic system of waste management the distribution of towns and villages in the region should be taken into account, as well as the location of industrial plants. Planning new facilities transportation of the target should be based on an analysis which takes in the account [1]:

• existing facilities,
  it is necessary to evaluate existing objects with particular emphasis on their technical conditions, the possibility of modernizing and expansion with locating obstacles associated with the place and access to the landfill,
• driving conditions,
  providing access roads to the new object with the determination of the amount needed funding and ensure traffic safety,
• geotechnical conditions,
  determining the type of substrate and wicking soil, groundwater level, drainage conditions at the area of the future facility,
• the environmental conditions,
  include health risks, pollution of soil, air and water,
• urban conditions,
  include geographic location, height of the object, the object nuisance to the environment, the possibility of further expansion, appearance, etc.,
• operating conditions of cooperating objects,
  concerning the assessment of the amount of waste which can accommodate up in the facility and the time of use landfill,
• disruption of the system,
  predicting emergency response, planning up landfills or additional means of transport,
• plans of development,
  predicting objects possible to modernize, plan up landfills or additional means of transport.

VI. Waste Management in Large Municipality

As an example of municipal waste management system in Poland there is presented the waste management system of the Capital City of Warsaw, and then the attitude of this system has done. Guidelines for waste management have been developed in the document 'Waste Management Plan for the City of Warsaw for 2008-2011 taking into account the years 2012-2015 [8]. This is a plan for the district and municipality, due to the fact that Capital City of Warsaw is in accordance with Art. 1 (paragraph 1) of the Act of 15 March 2002 on the polity of Capital City of Warsaw, the municipality has the status of city and district.

The scope of the Waste Management Plan includes:

• analysis and evaluation of the current state of municipal waste management with the identification of problems,
• predicted changes in waste management,
• targets for waste management,
• measures to improve the situation in the field of waste management,
• instruments and financial resources for implementation of the plan,
• estimate the costs of the waste management system,
• monitoring and evaluating the implementation of the objectives pursued.

The Plan includes all types of waste produced and imported into the city, especially with regard to municipal waste, as biodegradable waste and packaging waste, construction waste, tires and hazardous waste, including medical and veterinary waste, waste oil, batteries and accumulators, end of life vehicles, waste containing PCBs/PCTs, electrical and electronic waste, waste containing asbestos, pesticides.

Warsaw is the largest Polish city, located in the central-eastern part of the country, on the river Vistula. The extent of the city from south to north is 30 km, and from east to west 29 km. City of Warsaw is divided into 18 districts.

The largest district representing 15.4% of the entire city is Wawer, then Bialoleka (14.1%), Ursynow (8.5%), Wilanow (7.1%), Mokotow (6.9%), Bielany (6, 3%), Wlochy (5.5%), Bemowo (4.8%), Targowek (4.7%), Wesola (4.4%), Praga-Poludnie (4.3%), Wawer (3.7 %), Rembertow (3.7%), Srodmiescie (3.0%), Praga-Polnoc (2.2%), Ochota (1.9%), Ursus (1.8%) and Zoliborz (1.6%).

In terms of morphological composition of municipal waste in the City of Warsaw includes mainly:

• organic waste (vegetable, animal, and others)
• paper and paperboard,
• plastics,
• textiles,
• glass,
• metals,
• mineral waste,
• minor fraction of ash,
• hazardous waste contained in waste stream.

Moreover, the municipal waste stream contents waste requiring different treatment, i. e. bulky waste and waste from repairs.

Studies on the morphology of waste have been carried out using a uniform methodology for representative routes. It should be noted, however, that these studies mainly comprise unsorted municipal waste from households. There were not included in the study of the years 2006 and 2007 separately collected waste and municipal waste from other sources − the infrastructure (retail outlets, schools, offices, etc.). Environmental Protection Bureau has obtained data on the number of received waste from the reports of entrepreneurs operating in the Capital City of Warsaw and authorized the Mayor Warsaw to operate in the waste collection from property owners.

For comparison are summarized amount of waste received in the years 2005-2007 (Table I). The difference between the official national statistics and the data of the City Warsaw in 2005 and 2006 may be due to the fact that businesses pass on the report regarding the weight of municipal waste received at the request of the City Warsaw. In 2007, under the amended Act of 13 September 1996 on the maintenance cleanliness and order in communities all entrepreneurs licensed to receive municipal waste were obliged to transmit annual reports. On the basis of data for 2007 can be seen that the amount of waste collected for the year 2006 decreased slightly and amounted to 752 600 Mg.

Table I. The amounts received municipal waste from the area of the City of Warsaw for the period from 2005-2007

	The amount of waste [Mg] for the years 2005-2007		
Year	2005	2006	2007
Municipal Office of Warsaw	677084	836404*	752600
Main Statistical Office	827725**	871003**	no data

Source: Bureau of Environmental Protection of Municipal Office of Warsaw
* corrected value (of the waste from construction and demolition of buildings)
** data does not include municipal waste collected separately

Planning waste management system and its efficient operation is based on the determination of future changes in the composition and quantity of waste. When planning took into account the analysis of the economic situation of Polish and assumed that the economic development of the country will run without any major breakdowns, and the structure of the economy will be approaching the economies of Western Europe. Consequently, it was assumed that in the Capital City of Warsaw during the period of foresight, i.e. in 2008-2015 will dominate the continuous urbanization of the city, constant development of the sphere of business infrastructure and a wide range of catering services, hospitality and tourism, and consumer attitudes will be characterized by the generation of more waste. On the basis of the morphology of the waste and the index for the capital accumulation it was rated that the total flow stream contains approx. 65% waste from residents, and 35% waste from infrastructure. Projected amount and qualitative composition of municipal solid waste, which provide produce about 830 061 ton of waste in 2009 and gradually increase to 883 343 Mg in 2015 indicates that it is necessary to install an integrated system of recovery and disposal of municipal waste, which will drastically reduce the storage of untreated waste and increase the recovery and recycling of materials from selective collection. Planned waste management system takes into account such features as 'Regionality' and 'Prospectivity', which allows for future municipal waste management not only of the City of Warsaw, but as well as neighboring municipalities forming the urban agglomeration.

The waste management plan for Warsaw includes the following tasks:

1. Organizational tasks:

a) development of selective collection by:

- intensifying the collection of 'at source' and 'containers set in the neighborhood,
- district voluntary waste collection points,
- mobile waste collection points.

2. Investment tasks:

a) facilities for material recovery from selective waste collection:

- 8 district voluntary waste collection points,
- two waste sorting plant for raw materials selectively collected with a capacity of 20000 Mg/year expandable to 30000 Mg/year; in addition there will be sorting waste of raw materials belonging to private entrepreneurs,
- installation for composting green waste with a capacity of 20 000 Mg/year,
- installation of anaerobic treatment of biodegradable waste with a capacity of 10 000 Mg/year,
- installations for removing bulky waste, including waste electrical part of the performance target approx. 10 000 Mg/year,
- waste processing plants with a capacity of 8000 Mg/year,

b) installations for the disposal of mixed municipal waste with energy recovery by heat and electricity:

- modernization and expansion of existing waste treatment plants - support right-bank part of Warsaw agglomeration of performance target 312 000 Mg/year,
- take action to build a 2nd disposal installations - supports left-bank part of Warsaw agglomeration 390 000 Mg/year (taking into account the forecast amount of waste by 2025 and the ability to service the surrounding communities).

c) landfills:

- landfills building for non-hazardous and inert waste with a capacity of 400 000 Mg in 2009, 300 000 Mg in 2011, and then 190 000 Mg in 2013. The amount of waste going to landfill will gradually decrease due to the requirement to reduce the amount of biodegradable.

3. Education:

a) educational program for residents in the goal to explain the ways of dealing with waste and principles of sustainable development.

The functioning of the proposed system:

1. Mixed municipal waste will be directed to waste incineration with energy recovery of heat and electricity.
2. Expansion of the system of selective collection and recovery of waste:

a) selective collection will cover the following types of waste: packaging waste, waste paper and cardboard, waste plastics, metals, hazardous waste, bulky waste, construction waste, green waste, kitchen waste, biodegradable (restaurants, hotels, canteens) and waste consumed electrical and electronic equipment,

b) waste of second raw materials will be collected 'at source' of one-family housing areas, using containers positioned

'in the vicinity' of the multifamily housing and in district voluntary collection points and will be directed to the sorting plant,

c) household waste and other biodegradable waste will be collected selectively 'at source' near one-family and multifamily buildings,
d) green waste will be collected selectively 'at source' and through the district points of waste collection,
e) separately collected biodegradable waste will be processed in composting installations and fermentation plants for methanation,
f) hazardous waste will be collected in the district waste collection points and specially designated areas (e. g. pharmacies, schools, shopping centers, etc.) besides, the company authorized to receive waste, according to the rules are required to receive, i. a., separately collected hazardous by property owners,
g) hazardous waste will be disposed of in specialist facilities for the disposal of hazardous waste outside of the city,
h) large size (bulky) waste will be collected as part of the periodic collection and district waste collection points; besides, the company authorized to receive waste, according to the rules are required to collect bulky waste collected separately from the municipal waste stream by property owners,
i) large size waste will be subject to recovery in installations to dismantling large size objects,
j) waste from renovation and demolition will be collected in the district waste collection points and recovered in the plant processing debris, besides, the company authorized to receive waste, according to the rules are required to receive selectively collected waste from demolition by the property owners. Ballast waste from the waste sorting plants and recovering second raw materials will be directed to waste incinerations and landfills, depending on the type of waste.

In the assessment of the system of waste management it should be emphasized the complexity of issues.

Since the Law on Waste corresponding EU regulations therefore community authorities planning waste management system must take into account the principles of sustainable development by giving priority to the issues of waste recycling. In the field of municipal waste management is a broad spectrum of various issues, including legislative, organizational, economic, technical and technological problems. Efficient waste management in municipalities requires the development of an integrated logistics system. Logistics tasks are waste collection, their efficient and effective transportation and storage of.

VII. Rating Waste Management plan for Warsaw

In assessing waste management plan for the City of Warsaw for the implementation of logistical tasks should be emphasized that it has features of logistically oriented management system [5]. External and internal factors are listed. Directions of development of the waste management system are indicated. All the activities have been grouped into legislative, organizational, investment and education tasks. The plan includes a forecast of waste management by 2015.

Unfortunately, implementation of the plan has experienced unexpected difficulties. For example, Forest Service indicates that the waste is still thrown into the woods. The plenipotentiaries of the boards of Warsaw districts explained that littering the forest takes place, because a lot of people successfully avoid fees. These are the residents who withheld the actual number of household members to pay less, and those who do not report their homes. According to the new contracts with garbage collection companies, waste is received once every two weeks, which is not enough for some residents. In suburban forests less were thrown out scraps of food, used container, but there is observed more waste after repairs, used car parts and rubbish from allotments, when people come back from the weekend to the city. Also, hazardous waste is thrown into the woods, because the new law limits what can be disposed of in containers. Such waste as light bulbs, paint cans, oil bottles, automotive and construction waste and old furniture should be put into district selective collection points. People who throw waste in the forest can punish mandate, but it can be applied only when the perpetrator will be caught in the act. Ministry of the Environment announced that the second half of the year will amend the law on waste. The amendment provides, among other things, that companies have to receive waste at least once every two weeks [12].

Also in Warsaw a negative impact on the implementation waste management had a conflict of city authorities with the companies, which acceded to tender for waste collection. National Board of Appeal on April 10, 2014, dismissed the complaint private companies and concluded that the rates proposed by the Warsaw Cleaning Company are sufficient to cover the cost of ecological waste management. According to this provision, from August 1, 2014 Warsaw Cleaning Company supports as many as 10 of the 18 districts. This is a giant market: more than a million inhabitants and approx. 1.36 million tones of waste to waste to collect and process, and is a large and complicated logistical operation too. Warsaw Bureau for Environmental Protection informed that pre-picked waste will be exported to the modern landfill near Warsaw, where it will be stored and composted. Unfortunately, this type of waste management methods is not compatible with EU standards, which prefer recycling of waste. Warsaw authorities decided to store the waste but in many cities in Poland local governments invest in modern waste incineration plants using the EU funds, for example Poznan, Bialystok, Bydgoszcz, Konin, Krakow and Szczecin [13].

In Warsaw there is observed a problem with green waste, i.e. grass clippings, branches and leaves of trees, which, according to the amended law on waste can not be burned by the houses in urban areas. This type of waste can be composted, but many property owners can not compost the waste near their homes. Controversy concerns the interpretation of contracts in the case of residents of one-family houses. When it came time mowing and raking, residents learned that the green waste will be received, but only from designated places. The 'Lekaro' Company does not want to receive grass clippings from every real estate and designated places for collecting green waste − ten in Wesola district, four on the Praga-Poludnie and only one in Rembertow, Praga-Polnoc and Wawer (Fig. 2).

Fig. 2. Garbage truck 'Lekaro' at work (source: press release)

When the matter became loud, the company had set more containers in Wawer (today there are 13). The 'Sita Poland' Company also compels owners of one-family homes to drive with grass to eight places on Ursynow and six in Wilanow. Only Warsaw Clearing Company is ready to receive waste from the gates [13].

Start of construction of the planned investments by the Board of Warsaw is extended in time. Currently used technology waste disposal requires long storage before they are fit for further processing. By the time the waste is a nuisance for local residents because of the odor. Before the local elections in Warsaw in November 2014 the city authorities have promised to move this nuisance disposal plant from the Wola district outside the city. In the new plant it was to be constructed the modern incinerator for waste imported from Warsaw and surrounding areas. After the local elections the new government changed the location of the capital. Currently, it is planned to expand waste treatment plant in the Targowek district on the right side of the Vistula river, far from the city center, situated on the left bank of the city (Fig. 3).

Fig. 3. Waste disposal plant in Warsaw (source: press release)

On-site municipal waste disposal plant in the Targowek district, the garbage incinerator has been operating since 2000. This incinerator was already outdated when you start, because the city authorities decided to cheaper technology from the 80s. Therefore from the beginning it was planned modernization of this plant, which today utilizes approx. 10 percent municipal waste and approx. 70 thousand tons per year. The remaining waste is disposed of in overflowing landfills. Unfortunately, building a new incinerator delayed in time, mainly due to lack of an agreed position on financing. Installation was to be initially financed with city funds, then from EU funds, and finally by a private investor. When it turned out that the plant will generate big profits (to produce electricity and heat i.e. eco-energy which is valuable in the EU), the city once again changed their minds. In December 2015 the Board of Warsaw decided that the expansion of the incinerator, which will be disposed of even 320 thousand tons of garbage a year, will be financed by the town hall. The installation has to take over the Municipal Cleaning Office.

Also a program of education for the residents of Warsaw is not properly implemented. People have difficulty in getting rid of hazardous waste, for example broken mercury thermometer. Warsaw local press described the case of resident who tried to get rid of the broken thermometer in a pharmacy. Pharmacy refused and the private waste disposal company recommended by the Municipal Office requested service charge. Fire Brigade only neutralized place spreading of mercury with sulphur, but the thermometer did not take. It turns out that in each district have been designated pharmacy receiving expired drugs and mercury thermometers, but the information about the list of those pharmacies is only on the website of the city. In Warsaw, for a long time have been no points for separate collection of municipal waste, where residents could leave hazardous household waste such as expired drugs, paints, oils, electronic equipment, light bulbs, batteries, carpets and rubble. Although according to the Low on Waste municipalities are responsible for organizing selective waste collection points, has not been legally determined number, or date of their creation. What's more, the rules (not only in the Law on Waste, but also in the Act on maintaining cleanliness and order in municipalities) do not provide for sanctions for failure to hold these points. Regional governor as supervisor could impose sanctions on the municipality for not implementing statutory tasks, but Mazowsze Region Governor (supervisor of the authorities of Warsaw) has difficulty in determining the amount of penalties which prevents him from intervening. After the intervention of the Warsaw journalists from the local newspaper 'Metro' enjoyed a positive effect, the Press Office of the City of Warsaw has ensured that the points of selective waste collection are planned for autumn 2014 [14]. Really, these points (only two stationary and mobiles in each of district) were organized in October, 2015. While self-government activists want the amendment to the rules, the experts of the National Fund for Environmental Protection and Water Management believe that in such major changes as the reallocation of waste management for municipalities require a change in mentality, and this is a long process. According to environmental experts, even the best of the Act does not settle anything if their contents do not reach conscious consumers and responsible partners [16]. Principles of waste separation, very different from the previous ones, have been developed late. In mid-2014, together with the setting of special containers in the streets, the city government conducted an information campaign involving the hanging posters and distributing leaflets containing a description of the types of segregated waste. Waste has been divided into three groups: dry waste (red containers), glass packaging (green containers) and mixed waste (black containers). As an example the original informational leaflet is shown in Fig. 4.

Fig. 4. The leaflet with information of waste segregation

However, despite the clear drawings of objects thrown into the garbage, residents of Warsaw still have difficulties with the correct segregation of waste. Residents have become accustomed to the old classification of the waste were divided on the paper, plastic and metals.

In summary assessment of the waste management plan in Warsaw and its implementation it should be emphasized that, although it contains many elements of the logistics waste management system lacks developed an effective strategy and a detailed timetable for implementation. Planned investments are delayed in time, the executive tasks are not carried out comprehensively in many aspects. Especially overlooked is the social factor, hence protests from residents. Warsaw authorities as well as the boards of many municipalities in Poland do not accept some of the laws and their interpretation by the Ministry of Environment. Waiting for subsequent amendments causes delays in the implementation of the action plan.

VIII. Conclusions

Municipal waste management in Poland is carried out by the municipalities. The new Law on Waste corresponding EU regulations taking into account the principles of sustainable development, unfortunately the law implementation of local governments encounters difficulties. Difficulties in law implementation concern both small communities and large urban municipalities. For now, in order to improve the functioning of the management of waste in the municipalities special parliamentary committee develops changes in two acts: on maintaining cleanliness and order in municipalities and on ownership of properties. It turns out, however, that the Parliamentary projects are good for the welfare of the residents, but not to be accepted by local governments represented by the Municipal Association of Cities [15]. Local governments are protesting against the stationary points of the selective collection of municipal waste or becoming too stiffening waste collection frequency. Local authorities cite the examples of municipalities which have adopted mobile solutions, regardless of the stationary and the proposed provision will prevent their functioning, thus unreasonably restrict the independence of municipalities in this regard. Moreover, the local government would resign from tenders to their own companies. This is an important postulate, as foreign companies increasingly dictate higher prices for garbage collection. Minister of the Environment recognized the justice of such a solution. Unfortunately, this type of amendment may be taken only by Parliament as the amendment to Law of Waste, and this amendment is still being developed by the Ministry.

The tendency to constantly changing regulations and legal amendments stems from deeper sources. The commitment of municipalities to waste management and enforcement of EU regulations has caused many problems for local government. Waste management is not only a technical problem, but it is also an area which involves various actors throughout society. The most important actors are municipal local governments, the ministry of the environment, business organizations engaged in waste management and scientific specialists and local government experts. Then there are the mental problems associated with environmental awareness and understanding of the principles of sustainable development. Besides taking into account the specific socio-political situation, it should take into account political divisions of society affecting the management of municipalities. In Poland every four years, the local elections are carried out in which electoral establish parliamentary parties in terms of political affiliation rather than apolitical activities for residents. In this context, even the technical problems associated with waste utilization and their recycling as well as plant construction take on a political character.

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