

Dariusz STARKOWSKI • Paweł BARDZIŃSKI

ROAD TRANSPORT PROCESS ANALYSIS, OF MUNICIPAL WASTE, ON THE BASIS OF A CHOSEN SERVICE COMPANY. CLASSIFICATION AND IDENTIFICATION OF WASTE

Dariusz **Starkowski**, PhD, Eng. Senior Lecturer – *Poznan School of Logistics,
Chair of Logistics Bases*

Paweł **Bardziński**, MSc, Eng., Head of Logistics Division – *Altwater Piła Sp. z o.o. –
ENERIS Ochrona Środowiska*

Correspondence address:

Poznan School of Logistics, Chair of Logistics Bases
ul. E. Estkowskiego 6, 61-755 Poznań, Poland
e mail: dariusz.starkowski@wsl.com.pl

ABSTRACT: The article discussed the process of road transport operation planning connected with municipal waste transport and the organization of mixed waste collection on the example of shipping routes analysis carried out by means of transport of a service company in Wałcz commune in West Pomeranian voivodship. The article consists of seven parts, all of which present elements of a planning and transport process connected with municipal waste in road transport from legal, technical and economic perspective. Legal information concerning a road transport of goods was provided along with conditions that have to be met in order to perform this kind of transport and business activity. Moreover, technical and legal aspects of municipal waste transport vehicles were approached. The article covered as well the characteristics of: transport process, transport technologies, transport systems, the analysis of work capacity on the basis of drivers' working time and a description of optimal routes for providing services in the commune taking into consideration a technological process of municipal waste transport step by step. The aim of the article is to show the most significant definitions of this field, identification, classification and packaging labeling used in waste management.

KEY WORDS: road transport, municipal waste, provisions of law, transport centre, legislative directive, transport operation

Introduction

As for the costs of waste management system in Poland, over 70% constitute waste collection and transport to waste treatment plants or recovery in further use in national economy. The said costs are connected with growing petrol prices, higher drivers' and loaders' salaries and create a need of a transport logistic system optimization in utility companies (Eco-companies). In order to rationalize the transport system there are several commonly accessible programs used that optimize shipment routes, technical condition of vehicle fleet and RFID system created to analyze the location of waste containers. Such solutions are implemented in many undertakings due to more dynamic and competitive market. The transport operation needs to be planned with a number of activities taken into consideration such as relocation of a load treated in terms of technology and logistics. The first thing to consider is to choose proper means of transport. Then, appropriate fixing devices are to be picked that come along with a certain type of cargo. Rules and methods of choosing proper means of transport during a transport operation planning play an important role in the whole process. Planning and implementation of the said issues is a key element of waste delivery to the receiver in accordance with his/her individual conditions of the contract and transport.

The notion of municipal waste and its classification

Each transport of a load concerns a specific cargo. Apart from determining its specificity it is also important to set the character and the course of a transport operation. Various waste demand certain requirements to be met in compliance with its character. Exact knowledge of the load is a key to implement proper activities that are complimentary to the transport process. In order to analyze municipal waste it should be defined what municipal waste is.

Waste management itself aims to obtaining, transportation, recovery and performing activities that dispose of waste. The terms connected with this issue are:

- municipal waste – the definition of municipal waste is included in article 3, paragraph 1 point 7 of the Act on Waste, which states that it is the “waste that originates from households with end-of life vehicles excluded, and waste that does not contain hazardous waste originating from other waste producers, which due to its character and composition resemble household waste; mixed municipal waste remain mixed even if process-

ing took place which did not significantly affect its character.” (Regulation..... 2014);

- municipal sewage sludge-means residues accruing from sewage treatment plants in fermentation chambers;
- medical waste – is created by healthcare activities or after scientific connected with medicine;
- waste storage – all activities aiming at waste storing prior to its further transport, disposal or recovery;
- veterinary waste – created by veterinary healthcare activities or the ones connected with health related research;
- biodegradable waste – waste that is degraded through microorganisms;
- inert waste – waste that is insignificant to the environment, people and animals.

Classification of municipal waste is depicted in (figure 1), (Kozlak, 2009). Conducting transport activities entails production of various kinds of waste. Waste production therefore, is a feature of business activity and waste management has become a problem of all societies and economies. Waste can be divided into two basic types: municipal solid waste (classified as a group 20 in accordance with waste catalogue) originating from households, which is not discussed in the article, and business activity related waste (there are 19 waste groups in accordance with waste catalogue) (Regulation 2014). It should be remembered that there exists an official waste classification depicted in waste catalogue – currently Regulation of the Minister of Environment of 9 December 2014 on waste catalogues applies (Journal of Laws of 2014, item 1923). Waste is divided into groups, subgroups and types of waste depending on its source, qualities determining waste as hazardous and components which if exceeded in terms of limit substance values, make waste hazardous.

The division is related to waste record – keeping and reporting. Waste that is created in production companies and households is:

- Transport related and load securing waste, e.g. packaging and securities of goods such as paper, cardboard, foil and plastic, used wooden pallets etc. including waste coming from damage of transported goods;
- Waste that is related to maintenance of vehicles in the garage [used operational fluids of vehicles, oil and air filters, used tyres, lining and brake pads, dampers, partly used airbag bellows, metal scraps, operating fluids packaging, empty pressurized canisters, cupboard and paper and plastic packaging etc. (Starkowski, Bienczak, Zwierzycki, 2011).

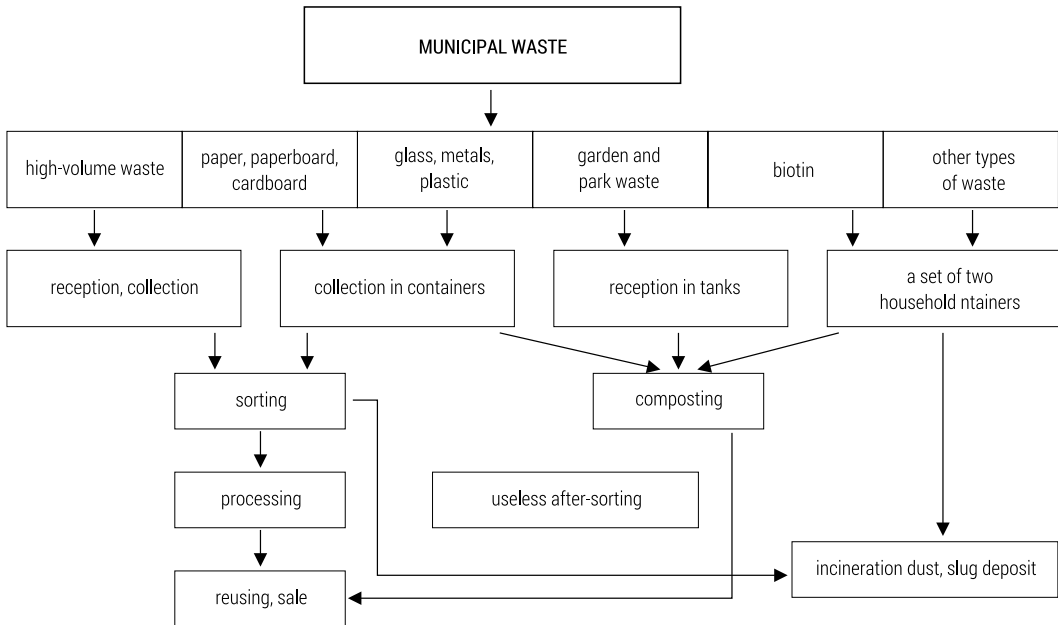


Figure 1. Classification of municipal waste

Source: authors' own work.

Rules of waste classification

Waste catalogue has groups, subgroups and their codes. Hazardous waste is marked with an asterisk*. Every type of waste was given a six digit code, which consists of two digits that define the group, next two digits specifying subgroups and the last two digits defining a type of waste. Waste catalogue which was determined in Regulation of Minister of Environment of 9 December 2014, should be presented in accordance with rules – First: Classification in relation to source generating the of waste – groups 01 to 12 or 17 to 20. Next a six digit code has to be ascribed. Classification of waste from specific branches of industry is an exception. This type of waste can be divided into several groups (table 1), (Kozlak, 2009):

First: If packaging waste that is communal waste but collected during selective collection

- First: If packaging waste is municipal waste but collected separately – it is classified directly in the group 15 01, not 20 01.
- Second: If an appropriate item was not found among groups 01 to 12 or 17 to 20, then the waste is classified in groups 13 – 15.

- Third: If the item is still unfound in the above mentioned groups, it should be covered by group 16.
- Fourth: if waste does not match group 16, it should be classified in a group of waste origin and ascribe a code 99 at the end – wastes not otherwise specified.

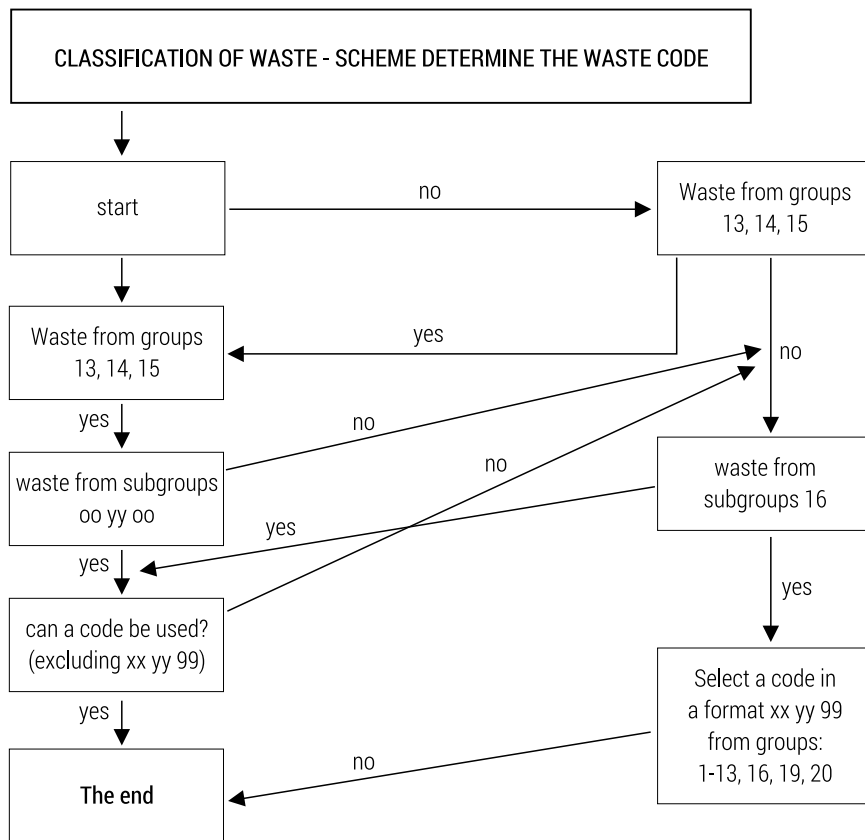


Figure 2. Municipal waste and its identification

Source: authors' own work.

The scheme below depicts phases of an appropriate waste classification (figure 2), (Teodorowicz, 2010):

- waste organic solvents, refrigerants and propellants (except groups 7 and 8) – 14;
- waste packaging, absorbents, wiping clothes, filter materials and protective clothing not otherwise specified – 15;
- waste not otherwise specified – 16;

- construction, demolition and road infrastructure waste (including excavated soil from contaminated sites) – 17;
- waste from human or animal health care or related research (except kitchen and restaurants waste not arising from immediate health care) – 18;
- waste from waste management facilities, off-site waste water treatment plants and the preparation of water intended for human consumption and water for industrial– 19;
- municipal waste including separately collected fractions – 20.

Table 1. Proper waste classification

Group	15	Waste packaging, absorbents, wiping clothes, filter materials and protective clothing not otherwise specified
Subgroup	15 01	Waste packaging (including municipal packaging waste collected separately)
Type of waste other than hazardous	15 01 01	Paper and cardboard packaging
Type of hazardous waste	15 01 10	Packaging containing residues of or contaminated by dangerous substances (e.g plant protection products toxicity class I and II – very toxic and toxic)

Source: authors' own work.

Municipal waste is classified into group Q14 as substances or objects that cannot be used by the holder any longer. Municipal waste belongs to group (table 2), (Regulation... 2014).

Table 2. Place of municipal waste in waste catalogue

Code	Groups, subgroups and types of waste
20	municipal waste including separately collected fractions
20 01	Separately collected fractions (except 15 01)
20 01 01	Paper and cardboard
20 01 02	Glass
20 01 08	Biodegradable kitchen and canteen waste
20 01 10	Clothes
20 01 11	Textiles
20 01 13*	Solvents

20 01 14*	Acids
20 01 15*	Alkalines
20 01 17*	Photochemicals
20 01 19*	Pesticides
20 01 21*	Fluorescent tubes and other mercury-containing waste
20 01 23*	Discarded equipment containing chlorofluorocarbons
20 01 25	Edible oil and fat
20 01 26*	Oil and fat other than those mentioned in 20 01 25
20 01 27*	Paint, inks, adhesives and resins containing dangerous substances
20 01 28	Paint, inks, adhesives and resins other than those mentioned in 20 01 27
20 01 29*	Detergents containing dangerous substances
20 01 30	Detergents other than those mentioned in 20 01 29
20 01 31*	Cytotoxic and cytostatic medicines
20 01 32	Medicines other than those mentioned in 20 01 31
20 01 33*	Batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries
20 01 34	Batteries and accumulators other than those mentioned in 20 01 33

Explanations:

* Hazardous waste is marked with an asterix in waste catalogue „*“ Current classification of the Polish Classification of Goods and Services (pl. PKWiU) is given below. The classification was introduced through the Regulation of Council of Ministers of 4 September 2015 (Journal of Laws of 2015 item 1676) for application as of 1 January 2016, in statistics, record, documents, accounts official registers and information systems of public administration (Act on keeping of the commune in a clean and orderly condition2015).

Group	20	Municipal waste including separately collected fractions
Subgroup	20 03	Other municipal waste
Type of waste	20 03 01	Mixed municipal waste

Place in PKWiU / 2015:

Section E WATER SUPPLY; SEWAGE AND WASTE TOGETHER WITH RELATED SERVICES
Chapter 38 Services related to collection, reusing and waste disposal

PKWiU symbol:

P38.11.31 Municipal, non-recyclable non-hazardous waste

Identification and packaging labeling

It is very important for the municipal management to know the informative function of labeling. In the process of waste collection and sorting it is significant to know the labeling system inter alia in terms of recycling – waste reusing. There are certain materials that can undergo this process. It is the producer or importer that should label the packaging (Mendyk, 2012). Labels were determined in an Act of 13 July 2013 on management of packaging and packaging waste. That constitutes a change as the former Act of 2004 stipulated that it was the producer who had to label the packaging with recycling symbols. Labeling that can be found on the packaging needs to be clear, visible and legible. It should contain (Starkowski, Bienczak, 2012; Zwierzycki et al., 2012):

- type of material used for production;
- reuse labeling (in case of reusable packaging);
- recycling labeling (in case of recyclable packaging).

Labeling may take the form of a package label. The package leaflet has to be attached in case when the size does not allow to label the package. The Act does not lay down minimal size of labeling. All patterns are shown in the Regulation of the Minister of Environment of 3 September 2014 on specimen of package labeling. The specimen indicate type of material that packaging is made of. Here are the following types of packaging (Starkowski, Bienczak, Zwierzycki et al., 2011):

- made of plastic;
- made of paper and cardboard;
- made of steel and aluminum;
- made of wood including cork;
- made of cotton and jute;
- made of glass;
- multi-material.

Characteristics of a logistic process

The term **logistic process** is an orderly sequence of operations that aims to provide flow of information and materials. A set of processes creates a logistic system which is understood as a coherent configuration of elements.

The system comprises: production, transport, storage and receiver. What should be taken into account are relations between the particular elements. It concerns the flow of finance, information and goods. A logistic process is a part of (Starkowski, Bienczak, Zwierzycki et al., 2011):

- supply logistics which covers movement of goods, raw materials, intermediate products from suppliers to production companies. Placing a proper order and stock keeping is an important thing to remember in relation to logistics;
- production logistics which main aim is to transfer products during the process of production and effective management of finished products that go to the warehouse;
- distribution logistics deals with delivery of ordered products to the receiver. The most significant factor in this case is low cost and short period of execution of the supply. Such factors affect market competitiveness of the company (Regulation..., 2014).

The logistic process entails the following processes (Poskrobko, Poskrobko, 2012):

- communication, which is a factor that the process could not exist without. Communication and therefore information is a basic element of the process – working on clients' orders needs to be done diligently so that the order complies with the client's needs. Every mistake done in this matter may influence company's image;
- flow of materials management, is a process which aims at defining an accurate number of materials and good timing of the delivery;
- management of stocks, deals with the storage of Raw materials, finished products or intermediate products which will be used;
- storage, is a chain of activities which are directed at stock keeping in specified conditions at a given time;
- transport, consists in transfer of goods and people. The term is also used in relation to information flow (Ficon, 2008).

What a company gains by implementing this rule is not only customer's satisfaction but also a stronger position in the market and in turn competitiveness. Applying the principle demands better warehouse management, faster and flexible reaction to clients' needs (Ficon, 2008).

When we talk about logistic processes it should be remembered that logistics has its origins in an ancient civilization (Janiak, 2008). Treated as an area of management, logistics is a set of aims and activities that aims at accomplishment of the task using own resources. Moreover, we should also add activities that support transfer of goods and people. The activities are the flow of information, money but also other material resources such as vehicles used in performance of the task. The scope of logistics is very extensive and includes (Skowronek, 2012):

- information management which plays a key role in logistics. Information has an impact on supply, transport, the handling of orders in the company;

- materials management, has a function of defined materials delivery and simple access to the goods during storage;
- transport management, it should be pointed out that freight forwarding has a primary function in this case, as the route has to be planned in such a way that cargo goes into the right place in a good, time and condition;
- storage management, includes all warehouse tasks such as record keeping, keeping goods in required conditions and informing about possible shortcomings;
- safety management is the most significant as it is directly responsible for human security. What matters is a proper packaging labeling especially during hazardous waste transport;
- packaging management consists in providing a proper product security through packaging.

The packaging is designed to protect the product, inform the client about the contents and it can also be a promotional element. The analysis of logistic waste management should also define that the above mentioned rules pertain to service companies that municipal company undoubtedly is. In respect of the article, we can say that the company is a business entity that conducts its activity for commercial purposes. It is entered into the Commercial Register and it obtains remuneration for performed services.

Review

The problem of appropriate logistic processes management in the premises of a municipal company is tightly connected with a proper identification of the sorted and transported waste including municipal waste. Hence, subject knowledge is related mainly to knowledge of proper legal provisions and abiding by the current rules. Municipal waste transport is a demanding task as when the carrier plans it many factors such as type of waste, packaging labeling, waste classification, transport duration, appropriate vehicle, natural environment safety and security of other participants of supply chain need to be considered. Failure to comply with at least one of the guidelines may lead to financial loss, sanctions and penalties.

The contribution of the authors

Dariusz Starkowski – 90%

Paweł Bardziński – 10%

Literature

- Act of 13 September 1996 on keeping the commune in orderly condition (Journal of Laws 2015 item 87)
- Ficoń K. (2008), *Logistyka ekonomiczna. Procesy logistyczne*, Warszawa
- Janiak T. (2006), *Słownik terminologii logistycznej*, Poznań
- Koźlak A. (2009), *Transport w logistyce a logistyka w transporcie*, „Czasopismo Logistyka” No. 2
- Mendyk E. (2012), *Ekonomika transportu*, Poznań
- Poskrobko B., Poskrobko T. (2012), *Zarządzanie środowiskiem w Polsce*, Warszawa
- Regulation of the Minister of Environment of 9 December 2014 on specimen of packaging labeling (Journal of Laws 2014 item. 1298)
- Regulation of the Minister of Environment of 9 December 2014 on waste catalogue (Journal of Laws 2014 item. 1923)
- Skowronek C. (2012), *Logistyka w przedsiębiorstwie*, Warszawa
- Starkowski D., Bieńczak K., Zwierzycki W., *Samochodowy transport krajowy i międzynarodowy. Przepisy prawne*, Vol. 2, Systherm 2011
- Starkowski D., Bieńczak K., Zwierzycki W., *Samochodowy transport krajowy i międzynarodowy. Środowisko pracy kierowcy i logistyka*, Vol. 3, Systherm 2011
- Starkowski D., Bieńczak K., Zwierzycki W., *Samochodowy transport krajowy i międzynarodowy. Przepisy w transporcie drogowym*, Vol. 4, Systherm 2011
- Starkowski D., Bieńczak K., Zwierzycki W., *Samochodowy transport krajowy i międzynarodowy. Transport kołowo – drogowy*, Vol. 5, Systherm 2012
- Teodorowicz H. (2010), *Gospodarka odpadami w przedsiębiorstwie*, Warszawa