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The Characteristics of Transport Process, of System and Transport Technology of Municipal Waste on the Example of the Village of Wałcz

Charakterystyka procesu transportowego, systemu i technologii transportowej odpadów komunalnych na przykładzie gminy Wałcz

The article discusses the planning process for road transport operation connected with the carriage of municipal waste and also presents the organization of mixed municipal waste collection on the example of the analysis of travelled transport routes performed in specific means of transport owned by a service company in Wałcz Commune in West Pomeranian Voivodeship (województwo zachodniomorskie). Presented elements of planning process and of the carriage of municipal waste in road transport in legal, technical and economic aspects. It also includes all legal information relating to the road carriage of goods as well as the conditions that must be met by the service company while executing this kind of carriage and economic business. The characteristics of the transport process, the transport technology, the transport systems were made, too. The purpose of this article is to present the transport process and transport system of municipal waste.

Keywords: road transport, municipal waste, means of transport, transport operation

Introduction

Almost any type of activities carried out by a individual person results in the formation of municipal waste. This refers both to everyday life and vocational life. Waste administration rules, in particular municipal one are directly related to logistics conditions and processes connected with waste prevention rules or minimizing its quantities, its removal from the places of formation, and also waste utilisation or disposal in a way that ensures protection for human life and health as well as the protection of the environment which are set forth in the Act on municipal waste. The amounts of produced municipal waste are increasing along with the country's

economic growth and the growing demand for all material commodities and better living standard of households. The treatment of the increasing amount of waste will make particular local authorities to create technical and economic conditions for the appropriate treatment of waste to allow its reuse in whole or in part, or its disposal in the case when its utilisation is impossible, inappropriate or economically unjustified.

1. The characteristics of the process and transport system

1.1. Transport process

Carrying out one transport operation by any way linked to the movement of commodities by appropriate means of transport requires respective organizational and executive activities as well as trade service. The transport process is called a series of defined achievements mutually correlated as a result of which cargo will be delivered to a recipient. The correct transport process [1] consists of three basic operations: organizational, executive and trading ones. Through organizational operations one should understand the planning of carriage routes as well as the preparation of transport documents. The executive operations include the carriage itself, that is everything related to the carriage process which means at least: the cargo loading, carriage, unloading, simultaneously being the operations which involve a vehicle directly. The last group of operations are trade ones which relate to financial questions - more precisely to a transport fee for the carriage of goods or persons [2]. Road transport of waste in the field of waste collection and waste transport is a specific type of transport. In the case of municipal waste carriage the very basic transport process remains unchanged but the characteristics of such goods presented in the previous parts of the article make the road carrier to plan and execute the transport process more carefully. Entrepreneurs that conduct this type of economic activity, as waste purchasers, perform the activity in the scope of road transport for their own needs. Waste transport process is called a string of activities and tasks which are aimed at creating a certain entirety. Transport process is aimed at carrying the waste to final location in a fast and quick manner. Owing to the transport processes we know where the cargo is located all the time. In waste transport the very essential information is the type of waste in the transport process (Fig. 1) [3]. Depending on the fact whether the waste is mixed or segregated the operations connected with it will be lengthened or shortened.

The sample transport process realized in the Municipal Community Plant is presented in Figure 2 [1], in which the process of mixed municipal waste is shown where the refuse is sorted.

While analysing the above specifications [1, 4], which show transport processes one can notice a distinct difference between the transport of mixed waste and the transport of segregated one. While mixed waste conveyance which is executed by the Municipal Community Plant all waste collected from inhabitants is transported directly to a landfill.

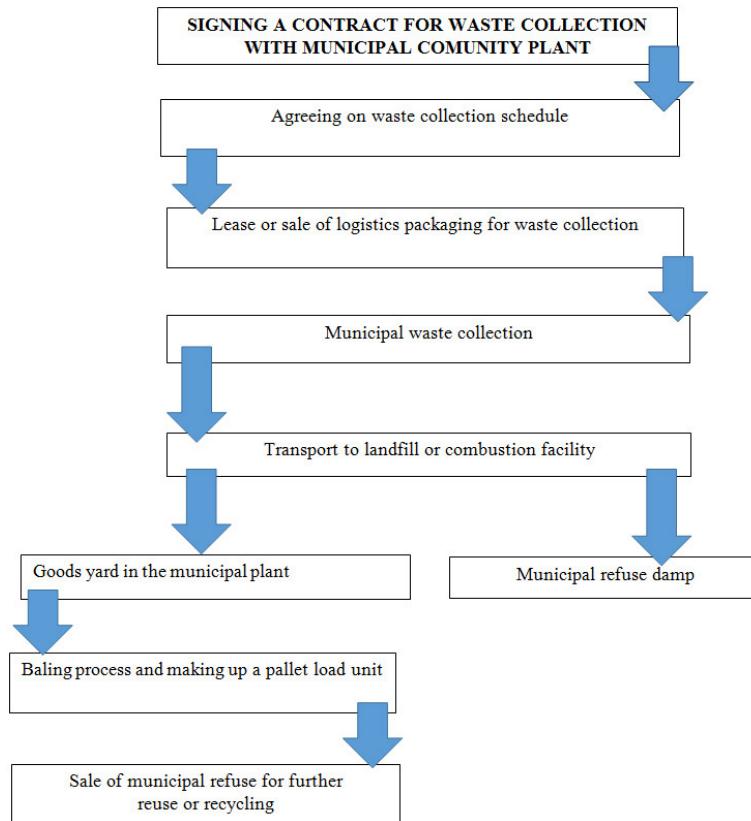


Fig. 1. The sample transport process of municipal waste [3]

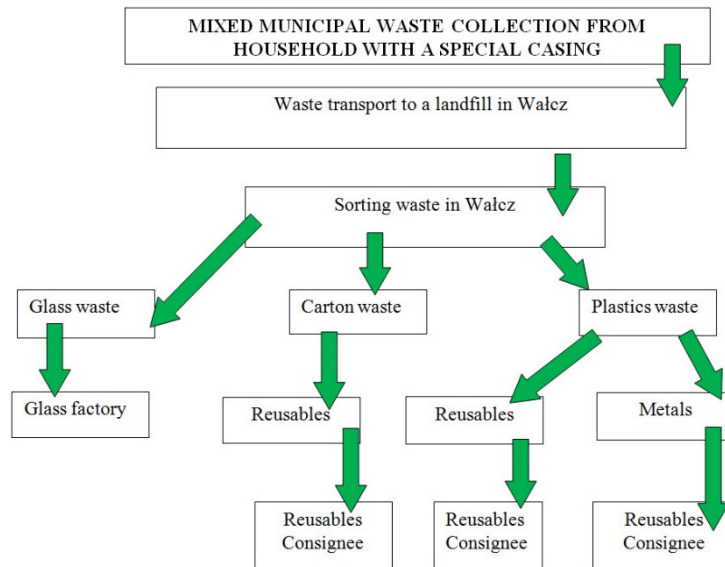


Fig. 2. The transport process of mixed waste [1]

Yet in the transport process of segregated waste a part of the waste, which is produced in a household, is transported directly to waste landfill, and the rest of waste which undergoes segregation, e.g. paper, glass, plastic and metals is transported to the dump site in the Municipal Community Plant. The works like wastepaper or plastic baling are performed in the goods yard. After the baling process the obtained cubes are stored in a warehouse where they remain until sold further on. All metals are searched for in the plastic waste and given away to a scrap metal lump store. Thanks to the activities related with searching and storing metals and their further sale the Municipal Community Plant may assign financial sources to its investments e.g. the purchase of new means of transport. The glass, which is recovered from bins and bags taken from inhabitants as well as companies, is collected and transported to glass factory where it is sold. The Municipal Community Plant on its own seeks for recipients of its waste which may be sold in the aftermarket.

1.2. Transport technology

While choosing the technology of transport process we base upon a decisive factor which is transportability of cargo. Transportability of cargo is divided into: transportability of carriage, transportability of load and economical transportability. The transportability of carriage is related to cargo resistance to damage which may occur while conveyance. The transportability of carriage is affected by: material transportability of cargo which is directly connected with chemical as well as biological features of cargo. The technical transportability of carriage is dependant on the form of cargo, its mass, shape and volume. The economical transportability of cargo arises from the relations between the transport cost and cargo value. The transportability of load determines the resistance to piling. It demonstrates to what extent the area of transport vehicle and storing area are utilised. Thanks to the transportability the cargo may be divided into two groups: those unsusceptible to piling which indicates poor transportability of cargo and the other group of susceptible ones which indicates that the cargo possesses a high transportability of cargo as well as economical one [3].

While choosing the technology we do not do it freely but what we take into consideration is the mass of cargo, type of cargo, and technical equipment of a carrier and other participants of the process, that is, consignors and recipients of the cargo [3]. The type and the form of cargo that we deal with is decisively influential on the selection of certain technical measures. Each of the two parties wants the cargo to reach a recipient from a consignor in an intact condition, unchanged and in a specified period of time. To transport municipal waste a specialized technology, manual or automated one, is used [5].

1.3. The transport system for municipal waste

Transport system refers to the organisation of waste transport on a specified area. Such an area may be for instance a town or a region. For waste in the Municipal

Community Plant a circuit system has been applied [4]. The system is characterised by the fact that it is performed on a specified route, where the waste is collected in particular places. Their locations are determined along a continued and planned route [3].

1.4. Procedure concerning preparations (planning) for municipal waste transport

A very crucial element of a safe transport process is to execute its proper planning using adequate procedure. It is essential not only because of transport costs but most of all because of safety for other traffic participants and for natural environment. The description of such a procedure is as follows:

The purpose of procedure

The purpose of procedure must display the range of duties and principles of conduct which refer to the preparation and transport of municipal waste.

The scope of procedure

The scope of procedure includes activities ranging from obtaining waste transport permit, through other activities and obligations of an entity that transports such waste - to it is passed over to a landfill.

The detailed description

A waste holder that runs business in collecting or transporting waste is obliged to obtain permit to run such a business. The permit to conduct business activity in the field of waste carriage is issued by Starosta (County Mayor), proper in the respect of the seat of or the residence of a waste holder - after consulting a relevant vögt, an alderman or a mayor.

The petition for the conduct of business activity in the field of waste collection or waste conveyance should include [6-10]:

- 1) specification of waste types to be collected or conveyed, in the event when determining waste type is not sufficient enough to define threat which this waste type may cause for the environment, a proper authority can summon the petitioner to give basic chemical waste composition and its properties,
- 2) marking the area of the business operations,
- 3) indicating place and manner of waste storing,
- 4) indicating manner and means of waste transport,
- 5) presenting technical and organizational possibilities which allow to execute waste collecting and transport operations properly,
- 6) estimated period of waste collection and conveyance operations.

Passing over a batch of municipal waste by a waste producer to another waste holder, for example for further conveyance, takes place with the use of „Waste Transfer Notes” - made up by the waste producer. The duties of the waste holder, that conducts business activity, exclusively in the field of transport to a landfill, include [6-10]:

- holding a “Waste Transfer Notes” with a confirmation of waste receipt,
- holding a transportation document with the description of hazardous goods (wastes),
- holding a circulation permit for the vehicle to convey hazardous waste,
- holding ADR licence, by a driver, certifying the graduation from Improvement course for the drivers carrying hazardous waste,
- putting on a vehicle fluorescent warning plates,
- maintaining cleanliness of load box on a vehicle,
- inspection of packaging condition and its marking with letter “A”,
- inspection of waste load safety fixing on a vehicle.

Before each loading of waste the load box of the vehicle should be thoroughly cleaned, particularly of sharp and hard objects (e.g. nails, screws) which do not constitute an integral part of the vehicle body. It is advisable to cover the floor with foil to prevent damage to the packaging. The waste loading and unloading (pallets, containers of big-bag types) should be carried out with the use of a crane or a hoist. The one who conveys waste should refuse to accept the shipment of waste which does not have the marking of products or waste, and also in the case where the packaging has been damaged while loading. Units of shipment should be arranged and fixed on the vehicle so that they cannot move and they are not exposed to friction, shock, overturning or falling out of the vehicle during transportation. While being transported the cargo should be carefully covered with foil or tarpaulin to prevent damage. After each unloading of waste off the vehicle, it is necessary to check carefully whether there is any remains of the transported waste on the surface of the load box. Should any remains be found, they ought to be removed immediately, and the vehicle and its equipment thoroughly cleaned, in accordance with the rules for the disposal of municipal waste [6-10].

2. The characteristics of the collection and transport of municipal waste on the example of the community of Wałcz serviced by the company of Altvater - Eneris

2.1. The characteristics of the municipal company

The study was carried out on the basis of one of the largest municipal companies in Wielkopolskie Province (województwo wielkopolskie). The company is currently dealing with comprehensive waste management services which include among others the collection and transport of municipal and electrical and electronic waste as well as large-scale one. The company also conducts selective collection of packaging waste in the source of their formation, then segregates it and later on passes it over to recycling companies. It also provides year-round cleaning services for roads, streets and sidewalks. The area of business operations includes poviats (counties) located in the 3 provinces in the north-west of Poland. The company provides services to the poviats (counties) of: pilskie, chodzieskie, czarnkowsko-

-trzcianeckie, człuchowskie, wałeckie, wągrowieckie and gdańskie. Owing to its selective collection activities, the company has its own sorting facility. The waste is systematically sorted immediately after collection and then sorted into particular kinds and colours:

- plastic: white, blue, green, mix,
- glass: white, brown, mix,
- waste paper: cardboard, “newspaper wastes”, mixed paper.

The segregated waste, collected with separation into fractions, is sorted and stored in the storage - transport facilities of the company. The municipal waste collected in the area of the Wielkopolska Province (województwo wielkopolskie) is transported to a landfill. The company also provides services in the West Pomeranian Province region (województwo zachodniopomorskie). The waste collected from this region of municipal waste management is deposited in the Wardyń Górny Landfill. These actions are due to the Act's restrictions that determine that waste collected from a certain economic region cannot be moved to another. The company operates in the region in Wielkopolska Province and Szczecin region in West Pomeranian Province (województwo zachodniopomorskie). The division of Wielkopolskie and Zachodniopomorskie Provinces (voivodships) into municipal waste management regions is as follows [11].

2.2. The characteristics and organization of the municipal waste management system in the commune of Wałcz

The principles of municipal waste management in the area of the Wałcz commune were elaborated in the document of RESOLUTION No. 2177/11 of the Zachodniopomorskie Province Board dated 30th December 2011 on the opinion on the draft Waste Management Plan for the Town of Wałcz for the years of 2010-2013 with the prospect for the year of 2017. The basis of this plan is Article 14 item 7 pt. 4 of the Waste Act of 27 April 2001 (The Journal of Laws of 2007, No. 39, item 251, as amended). The commune of Wałcz belongs to the Wałeckie county and is located in the Zachodniopomorskie Province. The service for the commune is executed owing to winning a tender which takes place every year. In this area it serves about 3500 inhabitants, including private companies located in the town of Wałcz. The commune of Wałcz belongs to the Szczecinek region in the scope of waste management in Zachodniopomorskie Province.

The waste collected in the rural commune of Wałcz is dumped in the Wardynia Górny landfill. The studies on the optimizing the transportability of vehicles and time of transport operations were planned and determined on the basis of service in the entire rural commune of Wałcz in the system of 10 working days. The collection of mixed municipal waste takes place within 9 days and one day is dedicated to the selective waste collection. Every day the collection from 350 places on average is done. The detailed service plan and field of coverage of the commune is presented in Tables 1 and 2 and in Figure 3.

Table 1. The system of service in the rural commune of Walcz - odd week

Collection day	Area serviced	Number of collection points	
Monday	Karsibór	241	489
	Rudnica	13	
	Golce	83	
	Dobrzyca Walecka	34	
	Rudki	94	
	Glinki	17	
	Dobrogoszcz	7	
Tuesday	Selective waste collection - sector 1: Wiesiółka, Czapla, Bukowa Góra, Dobrzyca Leśna, Czechyń, Głowaczewo, Nowa Szwecja, Ostrowiec, Szwecja, Zdbice, Golce, Dobrzyca, Rudki, Dębołęka, Kłosowo, Boguszyn, Kolno, Karsibór, Dobrogoszcz, Jarogniewo, Glinki, Kłębowiec, Rudnica, Górnica, Świętosław, Laski, Lipie, Jeziorko		
	Selective waste collection - sector 2: Różewo, Popowo, Gostomia, Łąki, Dzikowo, Brzezinki, Ługi Waleckie, Papowo, Prusinowo, Prusinówko, Chwiram, Strączno, Nakielno, Nagórze, Rutwica, Piława, Omulno, Lubno, Kołatnik, Przybkowo, Dobino, Smoąg, Wałcz Pierwszy, Pluskota, Wałcz Drugi, Witankowo, Sitowo, Chude, Rusinowo Leśniczówka		
Wednesday	Strączno	184	434
	Szwecja	200	
	Zdbice	44	
	Nowa Szwecja	6	
Thursday	Companies - Walcz		
	Kołatnik	40	54
	Pluskota	4	
	Wałcz Pierwszy	10	
Friday	Dzikowo	88	353
	Łąki	32	
	Ługi Waleckie	23	
	Papowo	9	
	Brzezinki	40	
	Lubno	140	
	Omulno	13	
	Piława	8	
Drzewoszewo - a company, the period of summer			
Monday	Karsibór	241	489
	Rudnica	13	
	Golce	83	
	Dobrzyca Walecka	34	
	Rudki	94	
	Glinki	17	
	Dobrogoszcz	7	

Table 2. The system of service in the rural commune of Wałcz - even week

Collection day	Area serviced	Number of collection points	
Monday	Nagórze	4	481
	Nakielno	92	
	Górnica	75	
	Laski Wałeckie	13	
	Lipie	8	
	Kłosowo	31	
	Dębołęka	79	
	Świętosław	14	
	Kolno	29	
	Jeziorko	16	
	Boguszyn	23	
	Rutwica	97	
	Tuesday	Popowo	
Przybkowo		31	
Różewo		243	
Chwiram		209	
Gostomia		107	
Wednesday	Dobino	99	393
	Wiesiółka	58	
	Czechyń	32	
	Głowaczewo	7	
	Bukowa Góra	1	
	Kłębowiec	135	
	Czapla	26	
Dobrzyca Leśna	5		
Thursday	Companies - Wałcz		
	Witankowo	99	108
	Sitowo	9	
Friday	Wałcz Drugi	61	311
	Chude	48	
	Prusinowo Wałeckie	18	
	Prusinówko	34	
	Ostrowiec	150	
Monday	Nagórze	4	481
	Nakielno	92	
	Górnica	75	
	Laski Wałeckie	13	
	Lipie	8	
	Kłosowo	31	
	Dębołęka	79	
	Świętosław	14	
	Kolno	29	
	Jeziorko	16	
	Boguszyn	23	
	Rutwica	97	

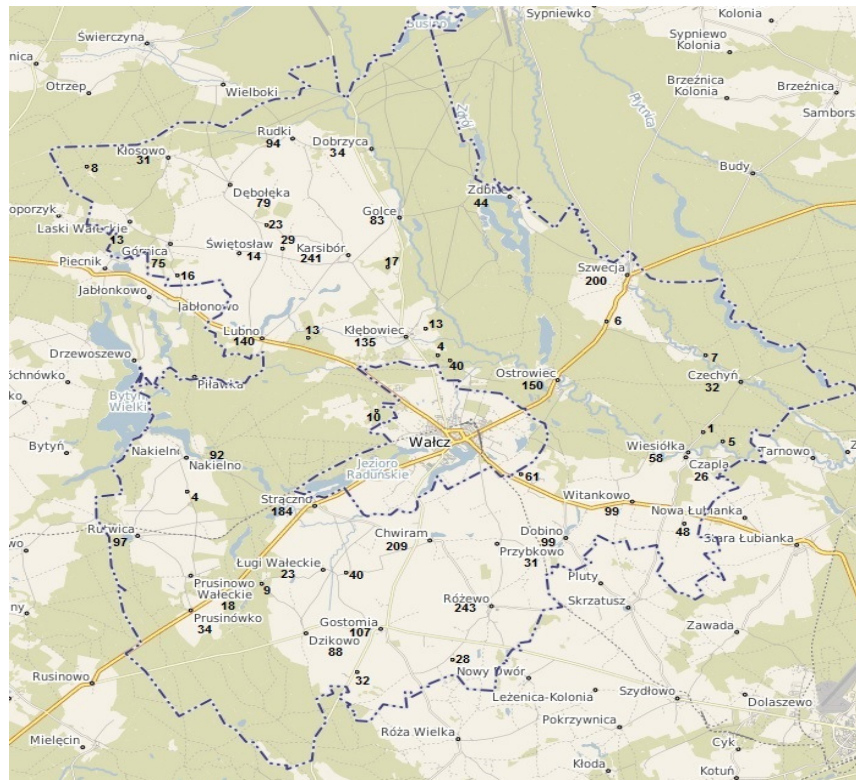



Fig. 3. The map of serviced area in the rural commune of Walcz:  - borders of the commune of Walcz, **32** - number of collection points and village location

A very important element of the municipal waste collection logistics system is that the municipal company which collects waste from property owners is subject to registration in the given community office. The commune of Walcz is located, on average, 35 km away from the municipal utility. Each day a driver is obliged to take about half an hour to reach the area of work. The areas are varied in terms of village locations as well as the number of collection points. The average daily quantity of containers is 350 bins. The number of containers is not constant. Due to the changing seasons of the year - seasonality - the number of bins, emptied at private customers who run their own businesses, is increasing or decreasing. The total number of recovery point in the municipality of Walcz is about 3,500. The distance between the transport depot of the municipal company and the waste landfill in Wardyń Górny is shown in Figure 4.

At this point, attention should be paid to the similarity of the work involved in the collection and transport of mixed municipal waste and the work carried out in typical transport and forwarding companies. The execution of a forwarding order is usually based on the following operations:

- receipt of documents,
- leaving the depot,

- loading in the place specified by a client,
- carriage and unload of the cargo in a specified place,
- return to the depot.

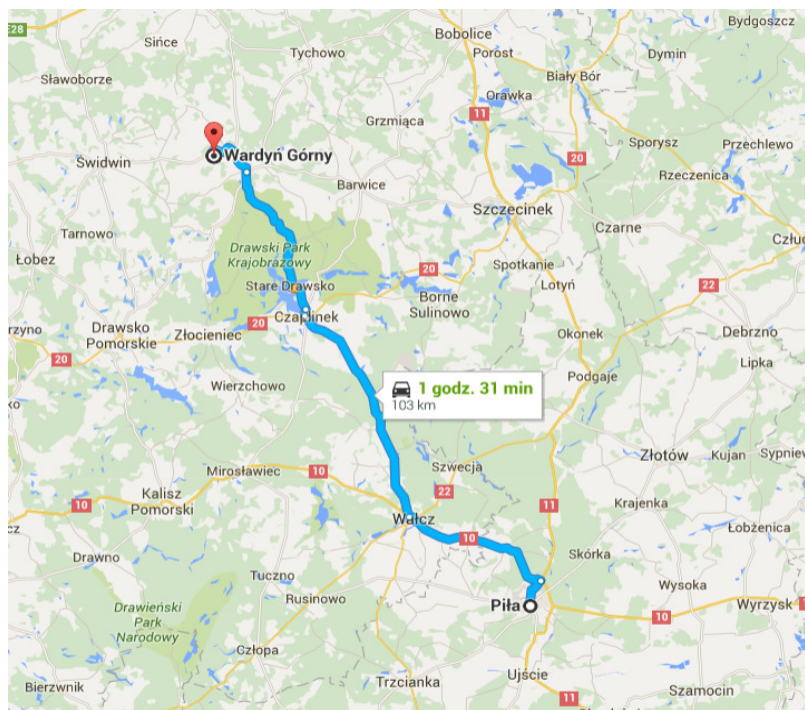


Fig. 4. The presentation of location and distance between the landfill in Wardyń Górny and the transport depot of a municipal company of Altwater Eneris

The course of work of a driver of the vehicle, intended for waste collection, is similar. The workday begins with the receipt of documents and departure from the depot to the area indicated for a certain day. Then the driver goes to the scheduled waste collection sites. Each point of emptying waste bin can be defined as the place of loading the cargo. Unlike a typical transport operation, there are many places for loading waste (depending on how many bins are to be emptied on a certain day) and they are small in tonnage, but the total weight of the cargo is comparable to the typical gainful carriage. Upon collection from all the scheduled sites, the waste is transported to a landfill - the place where the cargo is unloaded. Then the vehicle with emptied cargo space travels back to the depot. The whole process of collecting and transporting municipal waste is shown in the (Fig. 5).

For the analysis of the optimization of the logistics system, the measurements of the course of each working day were made and are presented in the form of reports. An exemplary map of the course of the Monday's area in the odd week is shown in (Fig. 6) while the plan (the map) of the course of Monday's in the even week is shown in (Fig. 7).

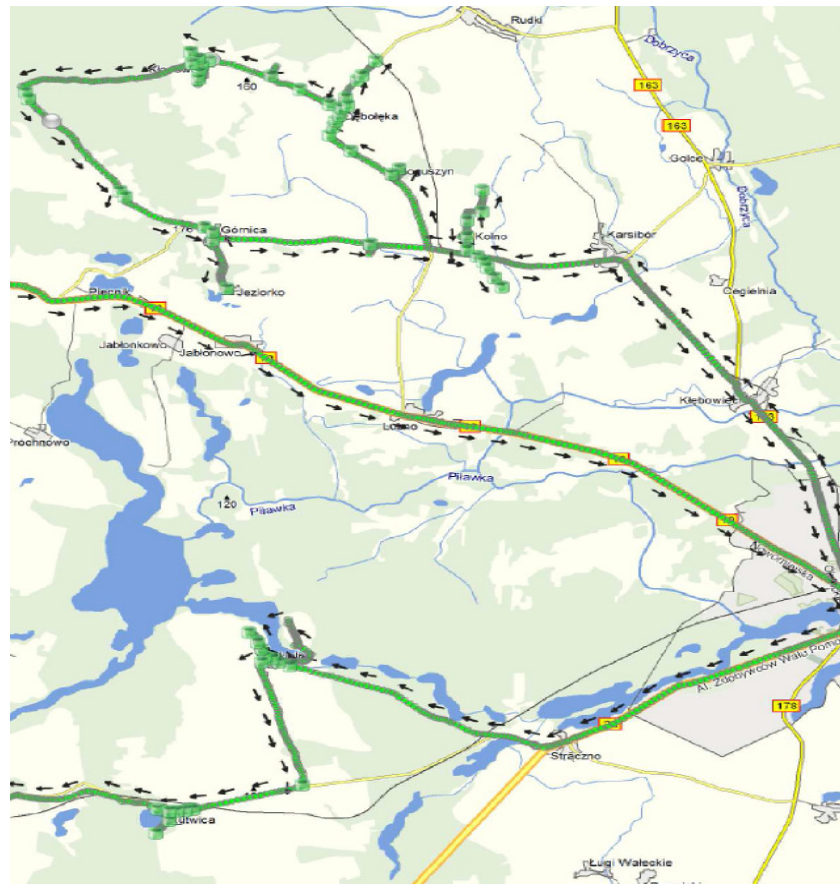





Fig. 7. The map of route of Monday's area in an even week:  - the place of employment of bin emptying device,  - the direction of a vehicle travel,  - the vehicle route based on location data from the GPS transmitter

Conclusions

Managing the transport process in a municipal community plant requires vast legal knowledge and knowing logistics matters in the area of optimizing the supply chain. However the effect did not prove to be influential and spectacular enough to use the proposal of optimization of this kind. The key to effective performance of collection process and transport of municipal waste are reductions arising from rational route planning. Route optimization are connected with savings. The results of the exam/test confirm the reduction of time and distance, which is connected with savings of travel to places of storing municipal waste and justifiable amendments in routes of municipal company.

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Streszczenie

Omówiono proces planowania drogowej operacji transportowej związanej z transportem odpadów komunalnych. Dodatkowo przedstawiono organizację zbiórki zmieszanych odpadów komunalnych na przykładzie analizy wykonywanych tras przewozowych przy pomocy specjalistycznych środków transportowych przedsiębiorstwa usługowego znajdującego się w gminie Walcz w województwie zachodniopomorskim. Przedstawiono elementy procesu planistycznego i przewozowego odpadów komunalnych w transporcie drogowym pod względem prawnym, technicznym oraz ekonomicznym. Podano informacje prawne dotyczące przewozu drogowego rzeczy oraz warunki, jakie musi spełniać przedsiębiorstwo usługowe, wykonując tego rodzaju przewóz i działalność gospodarczą. Celem tego artykułu jest przedstawienie procesu i systemu transportowego odpadów komunalnych.

Słowa kluczowe: transport drogowy, odpad komunalny, środek transportowy, operacja transportowa