

Waste from Cemetery Adornment of Graves – Management and Minimization

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ABSTRACT

Cemetery waste accounts for only a small amount of municipal waste, but its collection and inadequate management are problematic. The purpose of this study was to identify problems in the operation and logistics of the waste management system through the eyes of the cemetery user and the bodies responsible for collecting this type of waste. The tradition of caring for and decorating gravestones is significant in the production of cemetery waste. Most waste is generated during the holiday of the dead. The problem is the lack of adequate regulations and a permanent system of cemetery waste management throughout Europe and, for example, Poland. These issues affect both visitors and cemetery managers. Success in logistics of sustainable cemetery waste management can come from canvassing the opinions of cemetery visitors and managers and dissemination of the principles of minimalism.

Keywords: cemetery waste, logistics, waste management, waste generator, cemetery manager.

INTRODUCTION

Waste production is increasing annually in many countries. Everyday waste (municipal waste) is collected and processed by municipalities and produced mainly in households. In the European Union, for example, the generation of this waste (average 530 kg per person in 2021) and its recycling (average 50%) differ. The countries producing the most municipal waste include Austria, Luxembourg, Denmark, Belgium and Germany (834, 793, 786, 759, 646 kg per person, respectively), and the share of recycling and composting of municipal waste in 2021 in these countries was respectively 62, 55, 34, 53 and 71% [Waste management in the EU...].

Against this background, in 2021, for example, the average Pole generated 358 kg, an increase of 16 kg compared to 2020 (this figure was 409 kg per person in the UK in 2021 [Statistica, 2024]). Unfortunately, data from the Central Statistical

Office show that only 25.7% of all garbage was recycled, as in the previous year [Poles are producing more and more...]. In the UK, 44.6% of waste from households was recycled in 2021, slightly up from 44.4% in the previous year [Statistica, 2024]. All countries in the EU face great challenges in improving the organization of waste management. By 2030, 60% reuse and recycling of municipal waste should be achieved, and landfilling reduced to 10% by 2035 [Waste management in the EU...].

Promotion of actions toward waste avoidance, further minimization if not avoided, and finally returning it to circulation as widely as possible in the form of properly segregated secondary raw materials is an integral part of the current strategy of broadly protecting the environment from waste. This line of thinking is the basis for construction of a closed-loop economy. Among waste, cemetery waste is worth noting. In Polish law, cemetery waste is included in municipal waste. Although it constitutes only approximately

1%, it is a significant problem for the municipal management system due to its high diversity and poor quality (usually mixed and highly polluted) [Jaworska-Szott and Marcinkowski, 2014].

Much of this waste seems unrecyclable because cemetery visitors do not segregate it. Even biodegradable waste (e.g., live flowers and soil from the contents of pots, flowers from wreaths) very often contains harmful substances (e.g., varnish residues, plastic elements, wires, etc.), so segregation requires the involvement of waste generators in conscious separation into a clean bio fraction and polluted fraction, which can also be further segregated. The lack of a permanent waste management system for cemeteries throughout Poland is also a problem [Janda and Marcinkowski, 2021]. The key to success in cemetery waste management is appropriate organization of waste collection and reduction of waste generation. In the abovementioned elements, public participation, i.e., the informed participation of citizens in the system and even its cocreation, plays an important role, and participation can take various forms [Wójcicki, 2018].

A vital role in cemetery waste generation is played by the Polish tradition of caring for and decoration of graves, by loved ones of the deceased, burning candles, and a funeral ceremony richly decorated with flowers. These phenomena and accepted customs affect the quantity and quality of waste generated in cemeteries. In the past, the cemetery was where one could also rest in the shade of trees. Trees of native species were, therefore, an integral part of old cemeteries, but they have become a problem over the years. For the sake of keeping tombstones clean, they began to be cut en masse, replaced by trees that are at least somewhat “maintenance-free” (e.g., cypresses, junipers) [Rudnicki, 2022]. Such actions reduced biodegradable waste, e.g., leaves and branches generated during the maintenance and cleaning of cemetery areas. However, numerous plastic, glass, and mixed (problematic) wastes have appeared.

Today’s society still attaches great importance to the appearance and decoration of gravestones. It does not think about the consequences, leading to much cemetery waste. It seems that decorating graves alone is not the only problem; the problem is also what the average person will do with the waste when cleaning the grave. If s/he had the ability and the conviction to segregate this waste on the spot, the nuisance of waste management could become less. This publication describes research on the issue of cemetery waste management. The

study aimed to identify selected operational problems of the cemetery waste management system at five municipal cemeteries and two parish cemeteries in Poland. The problems were also studied through the eyes of the cemetery users and the bodies responsible for collection of this type of waste.

MATERIALS AND METHODS

The research was conducted in southeastern Poland, in Rzeszów and surrounding areas. Elements of the logistics of cemetery waste management at the selected sites were evaluated based on observations (including all photographs, taken by A. Pieczonka). Materials provided by the companies listed below were also used [MZK Leżajsk 2022, ŁZK Łańcut 2022, MPGK Rzeszów 2022]. Municipal cemeteries were selected for evaluation: (1) in the city of Leżajsk (cc L), (2) in the city of Łańcut (cc Ł), (3) in the city of Rzeszów; with cemeteries Wilkowyja (cc RZW), Pobitno (cc RZP) and Zalesie (cc RZZ), and parish cemeteries in the village of Rakszawa (pc R) and the village of Dąbrówki, Czarna commune (pc D).

A SWOT analysis was used to assess strengths, weaknesses, opportunities, and threats [Nowicki 2015] in the logistics of the observed systems.

Two surveys were prepared to verify the evaluation of the state of cemetery waste management through the eyes of cemetery users and the municipal cemetery manager of the surveyed enterprises. The first survey was addressed to cemetery users. The survey contained 17 closed questions and a metric. Its compilation and analysis allowed verification of the hypotheses (Table 1). The second questionnaire was prepared for the body responsible for organizing the collection of cemetery waste. It contained four closed questions and two open questions. It was conducted using the contact method. Its design and analysis verified the following hypotheses (Table 2).

RESULTS AND DISCUSSION

Elements of cemetery waste management logistics at selected facilities

The formation of cemetery waste

Two fundamental causes of cemetery waste can be distinguished. The first is related to care and maintenance work. This results in waste such as

Table 1. Hypotheses in the study of cemetery users

Research hypotheses	Questions to verify the validity of the hypotheses
a) The respondent is satisfied with the organization of the cemetery waste management system	<ul style="list-style-type: none"> - Is your locality's current cemetery waste management system correct? - What could be segregated in the cemetery you use? - What do you like best about the cemetery waste management system?
b) The respondent notes inadequacies and sees risks associated with the current cemetery waste management system	<ul style="list-style-type: none"> - Did you see overflowing cemetery containers? - Did you see abandoned cemetery waste? - Does cemetery waste harm the environment? - What negative impact does cemetery waste cause?
c) The respondent knows the type of waste most often collected	<ul style="list-style-type: none"> - What type of waste is found most in cemetery containers? - At what time of the year does the most waste accumulate?
d) The respondent could use green waste management solutions	<ul style="list-style-type: none"> - Do you have the ability to segregate cemetery waste at the cemetery? - Have you ever had the opportunity to use candle racks? - What function do candle racks serve? - Can cemetery waste be recycled? - Can you get compost from biodegradable waste? - Can alternative fuel be obtained from cemetery waste?
e) The respondent has ideas for changes in the organization of the cemetery waste management system	<ul style="list-style-type: none"> - What is the biggest problem in the cemetery waste management system? - Is there anything you want to change about the cemetery waste management system?

Table 2. Hypotheses in the study of the body responsible for collecting cemetery waste

Research hypotheses	Questions to verify the validity of the hypotheses
a) The respondent accepts the organization of the cemetery waste management system in his company	<ul style="list-style-type: none"> - Are you satisfied with your company's cemetery waste management system?
b) The respondent expects the participation of cemetery users in the cemetery waste management system	<ul style="list-style-type: none"> - Do you know what public participation in problem-solving is? - Participation is: (choose from the given definitions) - What do you expect from users of the cemetery waste management system?
c) The respondent has an idea for reorganizing the cemetery waste management system in his company	<ul style="list-style-type: none"> - Is there anything you would like to change about the waste management system at the cemetery where you work? If so, list the changes you would like to make

Note: The survey data obtained were analyzed within a Microsoft Excel spreadsheet.

grass and weeds, branches, leaves of deciduous trees, and needles. These belong to the group of biodegradable waste. The second type of waste generated here is the remains of ornaments brought by cemetery visitors. This group includes live and artificial bouquets, live and artificial flowers, candles and refills, various types of packaging, and textile waste. Fragments of gravestone decorations quickly become unwanted waste, which the owner wants to eliminate. This group of waste also contains a bio fraction.

The Law on Waste and the Law on Maintaining Cleanliness and Order in Municipalities [Law of December 14, 2012..., Law of August 11, 2021...] mandate the collection of municipal waste selectively. Cemetery waste belongs to the municipal waste group, so by correctly understanding the law, it should also be collected selectively. The categorization of waste can be shown according to various requirements. First, qualitative characteristics include the chemical composition, state of

aggregation, and degree of suitability of the waste for reprocessing and use. The determinant can also be the environmental nuisance or the place where the waste is generated. Most often, the origin of the waste is considered a criterion for a particular group [Burzyńska, 2016]. According to Rosik-Dulewska [2020] "to organize resource management and environmental protection, it is necessary to have a classification that reflects the genesis of waste, its properties, ecological harmfulness, usefulness, and mass production". Thus, an appropriate classification is necessary here.

According to the Waste Catalogue Ordinance [Ordinance of the Minister of Climate of January 2, 2020...], depending on the source of their generation, cemetery waste is classified in group "20" as municipal waste, including fractions collected selectively. The various codes classify waste in detail, dividing it into specific groups and subgroups. Cemetery waste has code 20 02 – from gardens and parks (including cemeteries) (Table 3).

Table 3. Separation of municipal waste codes, including cemetery waste

Code	Groups, subgroups, and types of waste
20	Municipal waste, including fractions collected selectively
20 01 01	Paper and cardboard
20 01 02	Glass
20 02	Waste from gardens and parks (including cemeteries)
20 02 01	Biodegradable waste
20 02 02	Soil and earth, including stones
20 02 03	Other nonbiodegradable waste
20 03	Other municipal waste
20 03 01	Non segregated (mixed) municipal waste

Note: Based on the waste catalogue compiled by the Ministry of Climate as of January 2, 2020.

The largest problem for cemetery waste managers is the lack of detailed discussion of this type of waste in the specialized literature. How they are collected and how often they are disposed of is decided by the person who manages the cemetery [Law on Cemeteries and Burial of the Dead...]. Article 2 of this law describes who the cemetery manager is depending on the type of cemetery. "Art. 2.1. Maintenance and management of municipal cemeteries is the responsibility of the competent mayors (mayors, city presidents) in whose territory the cemetery is located. 2. maintenance and management of religious cemeteries belong to religious associations".

Currently, no generally accepted system applies to every municipal or religious cemetery. The cemetery waste management system is handled by each municipality, which has its own Waste Management Plan and municipal cleanliness and order regulations. Poland's primary obligations in the field of municipal waste management (including cemetery waste) resulting from EU membership include the following:

- preparation of a waste management plan;
- achievement of set levels: collection, recovery, and recycling (also a reduction in quantity) of waste that is biodegradable;
- meeting requirements for construction and operation of waste recovery and disposal facilities; controlling compliance with regulations [Teodorowicz, 2013].

With the current organizational and legal status, a group of cemetery waste is not subject to segregation. This category should be listed:

candle holders; artificial flowers and bouquets; broken glass; soiled miscellaneous waste; and all other waste not listed below.

The following are considered suitable for segregation: bio waste (grass, leaves and branches, cut and potted flowers without pots, natural wreaths without artificial flowers and sashes), glass (clear glass candles, not stained with paraffin and without plastic elements, glass bottles, vases), paper and cardboard, metals and plastics (emptied PET packaging, emptied plastic flower pots, packaging films, emptied cleaning product packaging, plastic bags, buckets).

Methods of collecting cemetery waste

The Law on Maintaining Cleanliness and Order in Municipalities includes norms for collecting municipal waste from unoccupied properties, such as cemeteries. However, each municipality independently determines the form of collection and municipal waste collection systems in its territory, considering its capabilities and the most beneficial solution to residents [Saj, 2016]. The first element of the municipal waste management system (if it cannot be avoided and minimized) is waste collection. Waste can be collected in chutes, in separate rubbish enclosures with containers, or containers. One should be careful when choosing waste collection equipment. The quality of the containers or bins is essential, and there is a need to check that they provide the following requirements:

- protection of users and collectors from injury by sharp edges;
- sustainability;
- easy maintenance;
- reducing noise during emptying;
- ease of opening and closing and the close-fitting of the lid [Skalmowski and Dindorf, 1995, Ledoba and Oleszczuk, 2002].
- The most common cemetery waste collection system is used:
- containers with a capacity of 6 to 7 m³ (KP-7) (e.g., Fig. 2);
- PA-1.1 containers with a capacity of 1.1 m³ (e.g., Fig. 8);
- POK-2.2 containers with a capacity of 2.2 m³ (e.g., Fig. 9).

KP-7 containers are designed for the collection of solid waste. They are characterized by a capacity of 6 to 7 m³. The waste can be put through the upper openings, which are provided with closing flaps.

Leżajsk City

The owner of this cemetery is the Municipality of Leżajsk. The cemetery covers approximately 7 hectares, and approximately 7 thousand people are buried here. The cemetery is divided into 25 sectors and includes a columbarium. According to the Resolution of the Municipal Council of Leżajsk, the administrator's duties include taking care of the appearance and functionality of the cemetery, as well as handling all matters related to its operation. The fees collected for providing access to the burial place of a deceased person (one time) are also used for the maintenance of the cemetery, including a waste management system. The cemetery has eighteen 1100-litre containers (Fig. 1) and 6 KP-7 containers (Fig. 2). There is no waste segregation system at the cemetery, and all waste is dumped here together (Fig. 3 and 4). Employees of the Municipal Department in Leżajsk collect the waste. After waste collection, employees segregate and recover, if possible, biodegradable waste (wilted flowers, live Christmas tree bases) and clean white glass not soiled with paraffin. Waste removal is carried out after notification by the person managing the cemetery if there is such a need [MZK Leżajsk, 2022].

Łańcut City

The Municipal Cemetery in Łańcut is, at the same time, a parish cemetery listed in the register of monuments. The cemetery was opened in 1862, and in 1881 and 1969, it was expanded with additional quarters. The cemetery covers an area of approximately 5 hectares, and by 2022, approximately 30,000 people were buried there in about 5 thousand of graves. All municipal waste generated in the cemetery is disposed of in containers located along the main alleys (24 containers with a capacity of 1,100 litres (Fig. 5). Users of the system are not allowed to segregate waste (Fig. 6). However, there is a rack (Fig. 7) that allows the user to leave reusable candles. A candle machine is next to the rack (Fig. 7), allowing users to purchase a new candle refill or a new candle [ŁZK Łańcut 2022] on site.

Rzeszów City

The Wilkowyja Communal Cemetery in Rzeszów is currently the largest in the city and the surrounding area [Terczyńska, 2022]. It covers an area of nearly 28 hectares and contains approximately 33,000 graves. In Rzeszów, municipal and parish cemeteries are excluded from the municipal waste management system. Waste collection from parish cemeteries is based on individual



Fig. 1. The 1100-litre containers with a lid to close the container at the Leżajsk cemetery



Fig. 2. The KP-7 container at the Leżajsk cemetery

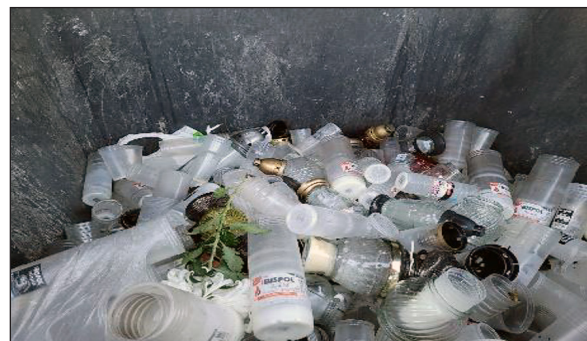


Fig. 3. Contents of the 1100-litre container at the Leżajsk cemetery



Fig. 4. Contents of KP-7 container at the Leżajsk cemetery



Fig. 5. The 1100 litre containers at the cemetery in Łańcut

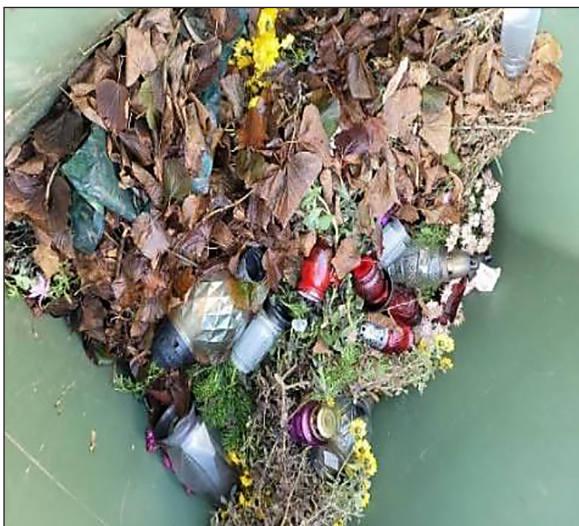


Fig. 6. Contents of the 1100 litre container at the cemetery in Łańcut



Fig. 7. Left, a rack for reusing candles; right, a candle machine in Łańcut

agreements between the cemetery manager and the disposal company. In the case of a municipal cemetery, waste collection is part of the implementation of the contract between the municipality and the company selected in a public tender, which is Miejskie Przedsiębiorstwo Gospodarki Komunalnej Sp. z o.o. Rzeszów.

Under the contract, MPGK – Rzeszów Sp. z o.o. performs tasks such as:

- maintenance of cemeteries (e.g., collecting soil, sweeping path, collecting contents from solid waste containers, winter maintenance of alleys, mowing and weeding, cutting down trees and shrubs);
- cemetery management (including but not limited to maintaining cemetery books, collecting cemetery fees on behalf of the municipality of Rzeszów, providing cemetery quarters, providing cemetery equipment, etc.) [Miąsik, 2020].

All municipal waste generated in the cemetery is disposed of in containers located by the paths. The waste management system at the Wilkowyja cemetery includes the following: 87 containers with a capacity of 1.1 m³ (Fig. 8); 29 containers with a capacity of 2.2 m³ (Fig. 9); 1 KP-7 container. In the new part of the cemetery, by the main path, there are containers for segregation: one container of 1.1 m³ intended for waste such as metals and plastics (Fig. 10) and six containers intended for biodegradable waste (Fig. 11) [MPGK Rzeszów, 2022]. Cemetery users must search for these containers away from the graves they visit if they want to segregate waste.

Pobitno Communal Cemetery (opened January 1, 1910, entered in the register of monuments) is now a closed cemetery and covers



Fig. 8. The 1100 litre container at Wilkowyja cemetery



Fig. 9. The 2200 litre container at Wilkowyja cemetery



Fig. 10. Wilkowyja – the 1100 litre container for metals and plastics



Fig. 11. The 1100 litre container for biodegradable waste at Wilkowyja cemetery



Fig. 12. Empty containers (1100 litre) located by the central alley at Pobitno

an area of approximately 7 hectares (40,000 graves). The cemetery also has a historic stand of trees. All waste generated at this cemetery is disposed of in containers along the main paths. It facilitates the operation of MPGK workers. A vehicle can quickly be driven here to empty the bins. The system includes 31 containers with a capacity of 1.1 m³ (Fig. 12), but they are inadequately arranged. During documentation of the organization of the cemetery area, it was noted that the greater half of some of the containers were empty or half full, but the waste was spilling out of several other containers (Fig. 13 and 14), polluting the cemetery area [MPGK Rzeszów, 2022].

The Zalesie Municipal Cemetery covers an area of 0.85 hectares (with over a thousand graves). All waste generated in the cemetery is disposed of in one KP-7 container (Fig. 15). Although there is no possibility of segregating various wastes in this cemetery, there is a rack for reusing candles (Fig. 16) [MPGK Rzeszów, 2022].

Rakszawa village

Rakszawa Parish Cemetery is adjacent to the church and covers approximately 1.5 hectares (including over 700 graves, with about 4,000 buried). The parish priest manages the cemetery. The system has concreted quarters where waste is segregated into organic and glass (Fig. 17–18). There is also a 1100-liter container for plastic



Fig. 13. Pobitno – an overflowing container with a capacity of 1100 litre



Fig. 14. Pobitno – another overflowing container with a capacity of 1100 litre



Fig. 15. The KP-7 container at Zalesie cemetery



Fig. 16. The rack for candles at the Zalesie cemetery



Fig. 17. Rakszawa – organic waste quarters

(Fig. 18–20). The concrete quarters are open and unsecured, so waste cannot escape them. Although system users are allowed to segregate waste, they do not and litter the area (Fig. 19–20). Waste is scattered by the wind, threatening the environment and poses a threat to animals.



Fig. 18. Rakszawa – back quarters for glass, front 1,100 l container, for plastic



Fig. 19. Rakszawa – scattered pots and other plastic waste outside the quarters



Fig. 20. Rakszawa – overflowing container, waste scattered around, used candle refills



Fig. 21. Information on the prohibition of littering at the Dąbrówki cemetery

Unfortunately, no information was obtained on how this cemetery disposed of its waste.

Dąbrówki Village

This parish cemetery is smaller than Rakszawa (700 burials), but the cemetery manager is also the parish priest. The cemetery displays a notice that prohibits the dumping of waste by visitors to the cemetery (Fig. 21). Such a system is based on civic responsibility. After taking the rubbish away, the citizen can segregate it within personal household waste. This system seems most conducive to reducing the mass of mixed waste, as it gives rise to resource recovery, saving ecosystems, and has positive social and economic effects.

SWOT analysis of the operation of cemetery waste management at the analyzed cemeteries

SWOT analysis is a technique for organizing and analyzing information. Its consideration aims to state an object's most important internal strengths and weaknesses, considering the threats

and opportunities inherent in its environment and itself [Nowicki, 2015]. This analysis of the operation of cemetery waste management at the surveyed cemetery facilities was conducted and presented at Table 4.

Survey results

Results of survey for cemetery users

This study included 100 respondents. They were selected randomly, irrespective of where they lived. The group represented was primarily women (63%). Representatives of the 18–30 age group and those living in rural areas answered the questions in the most significant numbers.

"Satisfaction with the organization of the cemetery waste management system"; the statement that the current system of cemetery waste management in your locality is correct disagreed with 63% of respondents (39% of respondents said "definitely not" and 24% said "no"). "I do not know if the system is correct," stated 17% (including a large group of men – 35%). Only 6% of women showed such a lack of interest.

The next question sought to determine what respondents could segregate waste at the cemetery they visited. Most people (64%) said they would manage to segregate glass. Twice as many women (64%) chose to try to segregate previously unsegregated waste. Interestingly, only 9% of the respondents were willing to segregate paper (Table 5).

Most respondents said they approved of high-capacity containers at the cemetery (68%, including 70% of female respondents). Fewer

Table 4. Results of the SWOT analysis concerning the operation of the waste management system at the surveyed cemeteries

Strengths (S)	Weaknesses (W)
<ul style="list-style-type: none"> - Frequency of waste removal reported by the cemetery administrator. The administrator reports that when he recognizes the need that the containers should be emptied, by doing so, there is a chance to clean up the cemetery and reduce the negative impact of cemetery waste on the environment. Thus, the condition of the containers and the frequency of removal is controlled (1); - Frequency of waste collection, once a week and as needed on request for larger cemeteries (2); - Thoughtful placement of bins along paths allows easy access to the container for cemetery users and relevant cleaning services (3); - The reusable candle rack allows waste reduction (4). 	<ul style="list-style-type: none"> - Lack of ability to segregate waste by the discarder (3); - Failure to admonish and punish those who do not keep order around containers when dumping waste (5); - No possibility of leaving waste in the cemetery; for example, after funeral ceremonies, where many wreaths remain, it is difficult to take them as waste (8).
Opportunities (O)	Threats (T)
<ul style="list-style-type: none"> - Segregation of waste by employees allows recovery of biodegradable waste and clean glass (6); - Biodegradable waste bins enable segregation and promote green recycling (7); - Using a reusable candle rack reduces the amount of waste generated and allows you to replace the candles according to your preferences (4); - Banning the dumping of waste in the cemetery. This system is based on civic responsibility, as everyone can appropriately segregate waste after taking it home (8). 	<ul style="list-style-type: none"> - Not keeping containers tidy by people dumping waste poses a threat to the environment, people, and biodiversity (5); - An open, unprotected chamber causes the release of odours, and climatic factors can create risks such as moving waste to places not intended for it (9); - Containers with a 2.2 m³ capacity do not contain a closure flap, thus increasing odour emissions. Climatic factors can cause wind-blown waste (7).

Note: 1 – cemetery Leżajsk ccL, Łañcut ccL, Zalesie ccRZZ; 2 – Wilkowyja cemetery ccRZW and Pobitno ccRZP; 3 – Wilkowyja cemetery ccRZW, Pobitno ccRZP, Leżajsk ccL, Łañcut ccL; 4 – Cemetery Łañcut ccL, Zalesie ccRZZ; 5 – Wilkowyja cemetery ccRZW, Pobitno ccRZP, Rakszawa pcR; 6 – Leżajsk cemetery ccL; 7 – Wilkowyja cemetery ccRZW; 8 – Dabrowki cemetery pcD; 9 – Cemetery Rakszawa pcR.

Table 5. Responses to the question: mark what could be segregated in the cemetery you use (multiple choice)

GlasS		Biodegradable waste		Metals and plastics		Paper		Mixed waste other	
64%		38%		47%		9%		58%	
W	M	W	M	W	M	W	M	W	M
61%	39%	68%	32%	62%	38%	55%	44%	64%	36%

Note: W – women, M – men (compiled from survey results).

respondents (19%) approved of the frequency of removal and the number of containers.

Based on the survey results, hypothesis a: “Respondents are satisfied with the organization of the current cemetery waste management system” (Table 1) was verified negatively. More than half of the respondents do not like the observed system. They see the possibility of segregating glass, metals, plastics, and even more accurate segregation of mixed waste. Respondents accept high-capacity containers.

"Knowledge of the risks associated with the cemetery waste management system"; most respondents (92%) happened to see overflowing cemetery containers. It was noted by both men and women. It was also checked whether respondents happened to see cemetery waste dumped outside the collection system. This fact was indicated by

88% of respondents (40% answered “definitely yes,” 48% answered “yes”). There were both men and women.

Another survey question verified the problem “whether respondents are aware of the danger that cemetery waste can cause”. Eighty-six percent of respondents were aware of this (51% answered “definitely yes”, 35% “yes”). Only 9% of respondents do not know the subject, including more men (11%). Relatively few (5%) did not see the danger of cemetery waste (more men).

In a question about the dangers that waste can cause, respondents marked many examples. As many as 73% of women and 70% of men believe cemetery waste threatens the soil. In descending order, they then noted the danger to animals (62%) and the negative impact of cemetery waste

as a fire hazard. Sixty percent of women and 49% of men knew this (Table 6).

The survey results verified hypothesis b: “Knowledge of the risks of the cemetery waste management system” (Table 1) was positive verification. Most people surveyed knew the dangers of cemetery waste to the environment and human health. They also observed the environment around the cemetery containers, and an extensive group was paying attention to overflowing containers and abandoned waste.

“Knowledge of the type of waste most commonly collected”; respondents most frequently noted used plastic candle refills (89%). They also singled out glass candles, artificial flowers, live bouquets, and especially chrysanthemums (Fig. 22).

The next question was to determine familiarity with the time when most waste accumulates. It was noted that it is autumn (86% of respondents, both men and women). It is related to the Polish tradition of the Day of the Dead – November 1. The hypothesis c: if respondents know the type of waste most often collected (Table 1) was verified positively. The respondents also identified the time when the most cemetery waste was collected.

“Assessing the feasibility of using ecological solutions in cemetery waste management”; most respondents said there was no possibility of using the waste segregation system at the cemetery (55%). Interestingly, 5% of women and men did not know whether they had the option of waste segregation at the cemetery. Participants of the survey were asked whether they could use the candle racks. As many as 81% of respondents

do not have such an opportunity (65% answered “no”, 16% “definitely not”). Seven percent of respondents (significantly more men) knew nothing about the indicated topic.

When asked what function the candle racks serve, 58% of respondents marked the answer “they give a second life to objects” and 53% stated that they “reduce the amount of waste generated”. Some respondents also believe they give “saving money” (42%) and “the possibility of replacing a candle” (38%).

The majority (80%) of respondents believe it is possible to recycle cemetery waste. Twice as many men (27%) do not consider this subject.

Regarding the question: “Is it possible to obtain compost from biodegradable waste?” thirty percent of both female and male respondents did not know. The possibility of obtaining compost was confirmed by 69% of respondents (21% answered “definitely yes,” 48% “yes”). Only 1% of respondents said it was impossible to obtain compost from biodegradable waste.

The last question concerned the possibility of obtaining alternative fuel from cemetery waste. Lack of knowledge on this subject was demonstrated by as many as 72% of respondents, including men and women alike (Table 7).

Hypothesis d: “respondents have the opportunity to use green solutions in cemetery waste management” (Table 1) was verified negatively. Although most respondents know the function that candle racks perform for reuse and have knowledge of the possibility of obtaining compost from biodegradable waste, they do not have the opportunity to use ecological solutions in

Table 6. Responses to the question: what negative impact does cemetery waste cause? (multiple choice) [%]

Are a threat to water		Are a threat to the soil		Are a threat to plants		Are a threat to animals		Pollute the air		Harm health		May cause fire hazards		Other	
W	M	W	M	W	M	W	M	W	M	W	M	W	M	W	M
52%		72%		51%		62%		26%		31%		56%		3%	
56%	46%	73%	70%	54%	46%	63%	59%	32%	16%	35%	24%	60%	49%	2%	5%

Note: W – women, M – men (compiled from survey results).

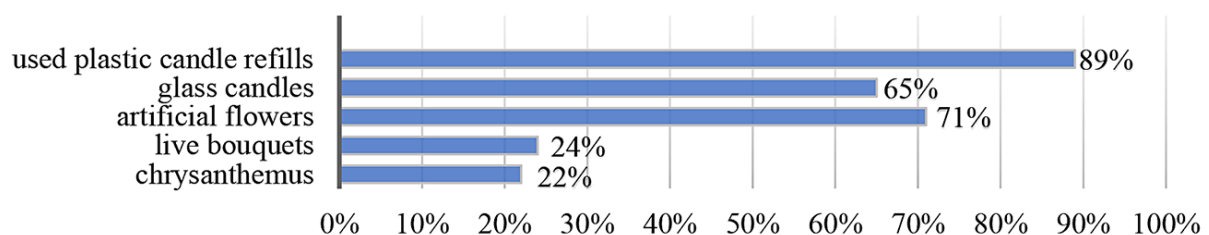


Fig. 22. Question: what type of waste is found most in cemetery containers? (multiple choice) [%]

their cemeteries. Only 12% of respondents had ever had the opportunity to use candle racks.

"Survey respondents' ideas for changes to the cemetery waste management system"; the desire to change the cemetery waste management system by making segregation mandatory was chosen by 63% of the women surveyed. Many saw the need for more frequent waste collection (49%). Numerous (50%) also wanted to change the number of containers. Only 9% of respondents saw no need for change. Proposals to introduce a system of reusing glass candles and artificial flowers to share these resources and to ban waste dumping in the cemetery were suggested by 3% of women.

According to the answer to the question "What is the biggest problem in the operation of the cemetery waste management system?", "neglect and unwillingness of the public" was considered the most significant (58%). Additionally, there was a significant lack of containers/containers (52%) and a lack of waste segregation (44%). One person (3%) expressed the opinion that candle manufacturers are the problem. They should increase the amount of biodegradable products available, such as candle holders or artificial wreaths made of biodegradable plastic, to strive for sustainable waste management (Table 8).

Hypothesis e: "survey respondents have ideas for making changes to the cemetery waste management system" (Table 1) was verified positively. Survey respondents were eager to mark many possible solutions, including introducing mandatory segregation. They claimed that the biggest

problem is neglect and reluctance of the public, which means they are aware of the mistakes made and see the dangers of bad habits.

Summary and conclusions of survey for cemetery users; with the survey results, it can be argued that the people surveyed usually cannot use environmentally friendly solutions for cemetery waste management. They know the risks associated with the environmental impact of this waste. They note the period in which the most waste accumulates, and the type of waste generated the most. Most respondents pointed to the organization's negligence and the public's unwillingness as problems.

Results of survey for the entity responsible for collecting this type of waste

Four people from the companies discussed above took part in the survey. Two women and two men answered the questions. The survey was conducted in a contact form. Three of the respondents are managers, managers of the funeral and cemetery services department (they take care of the appearance and maintenance of the cemetery), and one of the respondents is involved in the management of stone companies and cemetery planning. When asked about their satisfaction with the waste management system at managed cemeteries, all responded that they were satisfied with the system they ran.

The assumption that the cemetery manager is satisfied with the system run by his company (Table 2) was verified positively. One hundred percent of respondents gave a confirming answer.

Table 7. Responses to the question: can alternative fuel be obtained from cemetery waste?

Definitely yes		Yes		I do not know		Not		Definitely not	
11%		14%		72%		2%		1%	
W	M	W	M	W	M	W	M	W	M
16%	3%	11%	19%	70%	76%	3%	0%	0%	3%

Note: W – women, M – men (compiled from survey results).

Table 8. Question: what is the biggest problem in the cemetery waste management system?

Lack of an adequate number of containers/containers		Export frequency		Neglect and resentment of society		Lack of funds		Lack of waste segregation		Bad organizational system of authorities		Other	
52%		36%		58%		15%		44%		37%		1%	
W	M	W	M	W	M	W	M	W	M	W	M	W	M
56%	46%	38%	32%	68%	41%	17%	11%	46%	41%	43%	27%	-	3%

Note: W – women, M – men (compiled from survey results).

To the question: “do you know what is public participation in problem solving?”, seventy-five percent of respondents gave an affirmative answer. The next question verified the answers and was concerned with the definition of participation. All 4 of respondents chose the correct answer: “active participation in solving social problems and issues.

In terms of the expectations of those involved in the waste management system, for the person who uses the system (i.e., the average Mr. Kowalski), segregation, a change of mentality, and keeping the containers tidy were needed. Half of the respondents did not give a broader answer. They claimed that they had no opinion on the given topic. The next question very much linked to the previous question, and concerned the cooperation that managers expect from users of the system. Again, waste segregation was expected, significantly reducing waste management costs (you pay less for segregated waste). Attention was given to maintaining order around containers and bins. Complaints were made about inappropriate human behavior, such as importing and leaving waste from one’s household and disorder around containers. Some respondents had no comments on the users of the cemetery waste management system.

All surveyed representatives of the entity responsible for collecting cemetery waste were familiar with the principle of public participation. Half were interested in the waste management problems in their enterprise, observed the associated problems, and tried to solve them. They also desired participation from those using the system (Table 2).

Regarding the introduction of changes to the cemetery waste management system, half of the respondents didn’t know whether they would like to apply any changes to the system. The others had such an intention. One suggestion was to make segregation mandatory, but the respondent indicated that such an attempt had already been made and had failed. Visitors to cemeteries have not implemented waste segregation. The managers of the cemetery in Leżajsk want to make another attempt soon to recycle glass, biodegradable waste, and plastic.

Half of the survey respondents described their initiatives for changing the cemetery waste management system. Thus, the last hypothesis of this part of the survey can be positively verified.

Summary and conclusions of survey for the entity responsible for collecting this type of waste; only half of those willing to complete this survey wanted to make changes in their enterprise’s system of organization and operation because they are facing problems regarding its proper operation. Changes should improve the cemetery waste management system.

Although cemetery waste accounts for approximately 1% of waste in Poland [Jaworska-Szott and Marcinkowski, 2014], it should be given more attention than before because its collection and inadequate management cause increasing problems. Cemetery managers are grappling with the rising costs of paying for the disposal of this waste, causing them to increasingly call on grave owners to limit the decorations and candles they bring or to take the waste home with them [Kapczyńska, 2020].

A 2013 study at a cemetery in Brno confirmed (through biodegradation) a decrease in the weight of waste (approximately 71% on average) during long-term storage in containers there [Stejskal, 2014], but does long-lying cemetery waste in containers meet the standards of sustainable waste management? Larger-scale studies are needed in this regard, as municipal governments can use the results to reduce costs associated with cemetery waste management. Additionally, the pro-environmental prospects for integrating cemetery biofraction into Europe’s existing green recycling system are essential.

The lack of a permanent waste management system for cemeteries nationwide is a problem. In the seven cemeteries analyzed above, the systems varied significantly. It should be noted, however, that system users most often cannot conveniently segregate the waste generated. Thus, there were situations where they collected waste inappropriately. As Survey II showed, cemetery managers complained about the improper behavior of people disposing of waste. Problems thus affect both cemetery visitors and managers. Managers often do not allow users to segregate their waste. They see this as an unjustified and costly effort that will not yield results. For administrators, introducing changes such as monitoring, more frequent waste collection, and an increased number of bins or containers allowing segregation entails higher costs and often lacks the financial means to do so. It often applies to parish cemeteries, where unusual

practices are sometimes used. These can be seen at the cemetery in Dąbrówki, where the parish priest orders garbage to be taken outside the cemetery grounds. Such a system can be convenient for cemetery staff, as it redirects responsibility for waste to visitors. Some waste can be taken home without a problem. However, waste of a larger volume (such as funeral wreaths) is a problem. This is because not everyone can manage or dispose of them at home. In addition, this is where a conflict of interest arises. To change the system to something more appropriate, civic participation and good communication between the system's manager and user are needed.

Notably, the Polish tradition of remembering the dead is important in the issue of cemetery waste generated, with Poland being one of the world's largest producers and the largest consumer of candles. The sale of candles in Europe exceeds the value of 600 million euros per year, while in Poland, approximately 300 million candles are produced and sold annually, the most in all of Europe [Maciejewski, 2022]. The environmental organization "Eneris" reports that every year, 3 to 9 kg of waste (including reeds, artificial flowers, and candles) are removed from one grave after All Saints' Day. Poles burn candles worth 700 million zlotys every year [Eneris, 2022].

Plastic, disposable candles are bought reflexively because of their low price and convenience; once they are used up, they must be thrown away. Flowers made of plastic, from which bouquets are made, only occasionally contain more easily decomposed silk. Even live chrysanthemums, which are mass-produced, are grown in greenhouses using pesticides, and their environmental impact, as measured, for example, by Life Cycle Assessment (LCA), is not at all indifferent. Therefore, cemetery ornaments are now readily available to everyone, but the result is several hundred tons of usually unsegregated cemetery waste. It should also be noted that waste, such as disposable candles and refills, is soiled with paraffin and unfortunately cannot be recycled [Obluska, 2020]. Cemetery waste is not the only nuisance to the broader environment. According to a study conducted in 2013, during the holiday of the dead period, significant increases in the concentrations of benzene (by 200% and 114%) and toluene (by 366% and 324%, respectively) were noticed at cemeteries in Opole and Grodkow during the burning of candles. The composition

of this emission can be compared with transport and communication emissions, which significantly impact the level of air pollution around cemeteries [Olszowski and Kłós, 2013].

As seen, several changes are required to reduce the nuisance that common funerary customs represent and the associated generation of cemetery waste. These should concern how the spaces occupied by cemeteries are organized, the burial itself, and the care of graves [Kasprzak, 2023]. Once again, it is easy to link these problems to the need for widespread education for sustainability [Kostecka *et al.*, 2016, Wąglorz, 2020], which requires good organization, time, and money.

The results of survey for cemetery users and earlier studies described in publications, including Kostecka and Kielbasa [2009], Kostecka and Kwolek [2010], Korab and Jacejko [2020], and Śliwa and Miazga [2020], indicate that women tend to be more involved in caring for numerous elements of the environment. The current survey also shows that, first, more women were involved in completing the survey themselves. More men than women do not see the dangers of cemetery waste and show a lack of interest in properly operating the cemetery waste management system. In proposals to improve the system, twice as many women chose the difficulty of waste segregation. It is important because women are more likely to be involved in decorating and cleaning tombstones. Women saw the actual quantity and quality of waste generated. They also noticed errors in the cemetery waste management system.

Struggling with the constant increase in cemetery waste, their managers often look for innovative solutions. In Poznan, for example, the first "forest of remembrance" was created in the Junikowo cemetery, where the dead are buried among the trees without decorating the burial site. Nature, trees, and falling leaves serve as decorations. However, benches for visitors are located between trees [Kasprzak, 2023]. One obvious way forwards may be to consider composting or even vermicomposting of the biodegradable (organic) components of cemetery waste. Recent thinking [From death comes life'...2023], beyond the scope of this work, might even consider that human bodies themselves might be composted to save cemetery space. Perhaps the public must be persuaded to accept some of these measures.

CONCLUSIONS

Although cemetery waste accounts for approximately 1% of municipal waste, it requires increasing attention to organize sustainable management and update legal regulations.

Improvement of the waste management system should be carried out at the source. Studies of the attitude of cemetery users toward the production of cemetery waste and ways of collecting it are essential. They allow us to find important elements for improving the logistics of the current system. The survey may indicate greater involvement of women in pro-environmental activities in this plane. Similar surveys are also worth conducting in communication with bodies responsible for collecting this type of waste.

Successes on the road to sustainable logistics of cemetery waste management can be achieved by organizing and enforcing selective collection of cemetery waste. In doing so, the organizers of selective collection and the users who visit cemeteries must work together. Avoidance and minimization of cemetery waste should become critical to the conduct of future generations, resulting from environmental concerns. New ideas for achieving this should be constantly sought, with everyone able to play a part.

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