

STUDY ON WASTE COLLECTION IN URBAN AREAS USING SELECTIVE COLLECTION WITH UNDERGROUND PLATFORMS

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Abstract: The problem of waste collection is and will be a long-held debate. Due to the increase in living standards, the amount of waste also increases, so other methods of collecting this waste are needed than usual ones. A method that seems to catch up lately is collecting them in platforms that include underground containers. Thus, in response to the increased demand for storage of the increasing amount of waste, many sub-litter containers have been installed in many areas of the world. Romania is also trying to keep up, so some projects have appeared and are in the process of finalizing such projects by which a part of city waste is selectively selected with the help of underground platforms.

Keywords: waste management, aerobic digestion, underground containers, biodegradable waste

1. INTRODUCTION

Waste is not only an environmental problem but also an economic loss. On average, Europeans produce 481 kilograms of municipal waste per year. An increasing proportion of this amount is recycled or transformed into compost, while a smaller portion reaches the landfill. How can we change the way we produce and consume so that we produce less and less waste while using all the waste as a resource?

The amount of waste we generate is closely linked to our patterns of consumption and production. The very large number of products entering the market is another challenge. Demographic changes, such as an increase in the number of households made up of one person, also affect the amount of waste we generate (packing products in smaller packages) [1].

Transformation with regard to waste management is closely linked to EU waste legislation. The main legislative instrument in this area is the Waste Framework Directive. It presents a waste management hierarchy: starts with prevention, followed by preparation for reuse, recycling and recovery and ends with disposal. The directive aims to prevent as much as possible the generation of waste, the use of waste generated as a resource and the minimization of the amount of waste going to landfills.

The Waste Framework Directive [2], together

with other EU waste directives (on waste disposal, end-of-life vehicles, electronic waste, batteries, packaging waste, etc.), includes specific objectives. For example, by 2020, each EU country must recycle half of its municipal waste; by 2016, 45% of the batteries need to be collected; by 2020, 70% of non-hazardous construction and demolition waste (from the mass) should be recycled or recovered.

2. NEGATIVE EFFECTS OF THE UNDESPECTED WASTE MANAGEMENT

Mismanagement waste management contributes to climate change and atmospheric pollution and directly affects many ecosystems and species.

Landfills, considered being the last resort method in the waste hierarchy, release methane, a very powerful greenhouse gas that is associated with climate change. Methane is formed by microorganisms present in landfills because of biodegradable waste such as food, paper and garden waste. Depending on how they are built, landfills could also contaminate soil and water.

Once collected, the waste is transported and treated. Carbon dioxide - the most common greenhouse gas - and air pollutants, including particles [1], are released into the atmosphere by the transport process.

Some of the waste could be incinerated or recycled. Energy from waste can be used to produce heat or electricity that could replace the energy produced by the use of coal or other fuels. The recovery of waste for energy production could thus contribute to reducing greenhouse gas emissions [3].

Recycling can further contribute to lowering greenhouse gas emissions and other emissions. When recycled materials replace new materials, the need for extraction or production of new materials decreases.

3. WASTES AS A RESOURCE

How would we be able to use waste as a resource and reduce the need to extract new resources? Extracting less material and using existing resources

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could help to avoid part of the impact created along the chain. In this context, unused waste is also a potential loss.

Turning waste into a resource by 2020 is one of the main objectives of the EU Roadmap towards an Energy-Efficient Europe [2]. The Roadmap also highlights the need to ensure high-quality recycling, waste disposal, limiting energy recovery to non-recyclable materials and stopping illegal shipments of waste.

These objectives can be met. In many countries, kitchen and gardening waste accounts for the bulk of solid municipal waste. Waste of this type, when collected separately, can be converted into a source of energy or fertilizer. Anaerobic digestion is a method of waste treatment involving the passage of biodegradable waste through a biological decomposition process similar to that of landfills but under controlled conditions. Anaerobic digestion produces biogas and residual materials which in turn can be used as fertilizers such as compost.

If, by 2020, all countries fully meet their waste avoidance targets set out in the Landfill Directive, there could be a further reduction in life-cycle greenhouse gas emissions of 62 million tonnes CO₂ equivalent - which would be a significant contribution to the EU's climate change mitigation efforts.

Getting on the scale of the waste hierarchy requires a joint effort of all stakeholders: consumers, manufacturers, decision-makers, local authorities, waste treatment plants, and so on. Consumers willing to sort waste from their own households can only recycle if the waste collection infrastructure they create is created. The reverse is also valid; municipalities can only recycle a larger proportion if households sort their own waste [4].

Ultimately, waste can only be a problem or a resource depending on how we handle it.

4. WASTE PREVENTION / COLLECTION

4.1 Advantages of urban comfort

Advantages of urban comfort:

- Significant space efficiency;
- Optimization of location;-
- Removal of smells;
- Significant limitation of the presence of insects;
- Elimination of the presence of stray animals and rodents;
- Protecting the health of the population and animals;
- Limit additional amenities.

Pre-collection / collection of municipal waste on underground platforms has many advantages, including: eliminating unpleasant smells, eliminating outbreaks of infection, eliminating dirt around waste disposal sites, accessing containers only to authorized persons, aesthetically improved appearance, emptying is easily accomplished by waste collection utility vehicles.

The visible part of the underground platforms are shown in Figure 1.



Figure 1. The visible part of the underground platforms

The dimensions of the underground platforms are shown in Figure 2

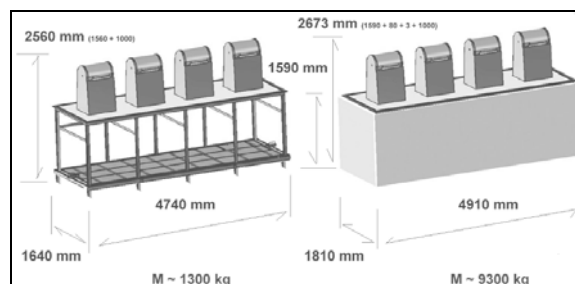


Figure 2. The dimensions of the underground platforms

4.2 Investment and operational advantages

Removing sewer connection

- Eliminating vandalism and theft
- Platforms do not require special collection machines
- Eliminate pest control operations
- Limitation of disinfection operations
- Limiting cleaning operations
- Elimination of daily container check operations
- Complete elimination of human access - protect the health of the population
- Complete elimination of animal access - protecting animal health and eliminating the risk of disease spreading.

4.3 Legal advantages

Underground platforms fully comply with the applicable Environmental and Population Health legislation:

Obligation to engrave - it is marked with the name of the authority / operator as well as the area served / the owners' association;

- Labelling of waste types - inserts can be labelled and / or dyed in the colours of the waste fraction codes;

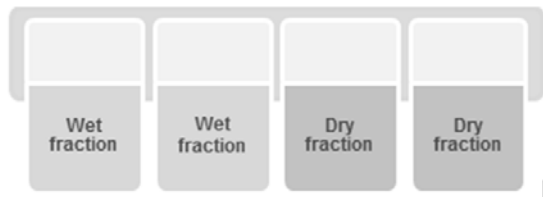
- Duct connection requirement - does not require connection to the sewage system;

- Obligation of controlled access - there is no human or animal access to waste;

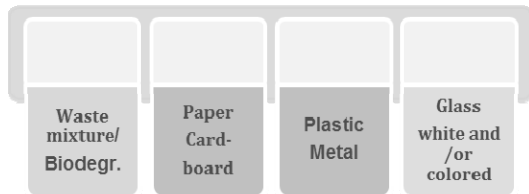
- The selective access obligation - the platform can only be accessed by the operator and / or the owner of the hydraulic device. On request, such mobile devices can be delivered to municipal inspectors, police, local police, etc [5].

5. PROPOSED VARIANTS

- Application model 1 with four inserts



- Application model 2 with four inserts



6. TECHNICAL DESCRIPTION OF SUBTERRANEAN PLATFORMS

Underground waste collection platforms are an alternative to classic platforms, represented by pens where containers/bins are placed (Figure 3).

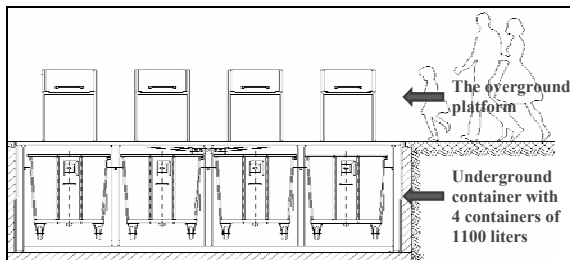


Figure 3 Underground waste collection platforms

Underground platforms are composed of:

- in the underground - the impermeable concrete tank and the metallic elevator structure (provided with hydraulic system), in which are placed 4 waste collection containers of 1.1 mc);
- in the above-ground - metal platform provided with 4 waste baskets, stainless steel with lid folding system.

7. SMART MONITORING AND WARNING SYSTEM

7.1 DESCRIPTION OF THE MONITORING AND WARNING SYSTEM

Underground garbage collection platforms can be equipped with a monitoring and warning system where platform containers are loaded to capacity. This system provides the following facilities:

- access to waste storage is based on the access card, being allowed only to persons assigned to the respective underground platform
- monitors container filling and warns the sanitation company when any of the containers have been filled.

Compilation of the monitoring and warning system for filling

The monitoring and warning system for filling is made up of two components:

- data acquisition system - underground platform equipment
- data processing - software, processing data from underground platforms

Data acquisition system

The data acquisition system for a 4-container underground platform contains:

- the command system
- 4 card readers, 4 electromagnetic yarns, 4 fill sensors
- a number of access cards (RFID proximity tag) depending on the number of users assigned to the platform

The electrical power required to supply the equipment is supplied by a photovoltaic panel and is stored in a battery.

Data transmission system

Data transmission from the underground platform to the data processing system is done with a GSM / GPRS modem and a data subscription (2G / 3G) SIM card.

The data processing system is a software hosted on a web site capable of collecting, storing and processing data received from underground platforms (Figure. 4).

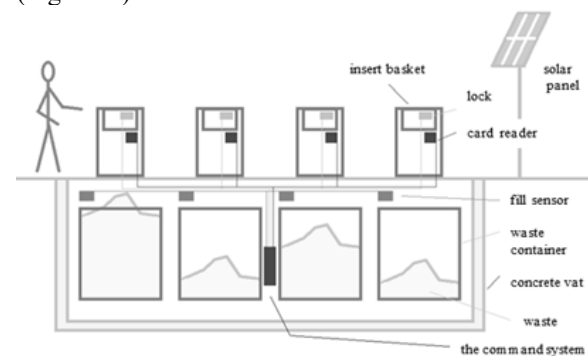


Figure 4. Underground platform with container monitoring and warning system

7.2. MODE OF OPERATION

User access to waste storage is based on an access card. In order to be able to store the waste in underground containers, the user approaches the card reader located near the platform basket insertion cover, corresponding to the type of waste.

If the underground container is not full, the system will signal by a short acoustic signal and allow the user to open the lid, which will be able to throw the waste into the underground container beneath the respective insertion basket.

If the underground container is full, the system will alert the user through a long acoustic signal, the insertion basket cover will be locked, and the user will use the next available insertion basket allocated

to the same type of waste. Locking the lid will prevent overflow of the container.

Platform equipment - the data acquisition system - will send a message to the data processing system if any of the underground containers have been filled. The sanitation company has a situation of full containers from each platform and can decide when to send the picking machine.

If a single container for each type of waste is allocated on the platform - the 4-fracture collection - the system can be configured as after filling a container do not block the opening of the insert basket cover to allow it to be dumped in the container yet some waste, but in this case the sanitation company will have to ensure that the container is emptied as soon as possible in order not to store waste on the surface of the underground platform (Figures 5, 6).



Figure 5. Underground platform with container monitoring and warning system



Figure 6. Oriented images for underground platform with container monitoring and warning system

7. 3 DESIGN REQUIREMENTS

The main requirements taken into account when designing the container monitoring and warning system in the underground platform are as follows:

- a) the access of persons to the storage of waste will be allowed on the basis of the card;
- b) detection of filling of each container will be done with optical sensors;
- c) the equipment on the platform will be powered by a photovoltaic panel;
- d) the data transmission to the server will be done via the GSM network and internet connection;
- e) data will be transmitted if a container is filled or emptied;
- f) Data will be stored on a web server for a minimum of 12 months;
- g) for each platform, the container filling data as well as identification data and technical data (serial number, address, geographic coordinates, temperature, battery voltage, etc.) will be stored on the server;
- h) The system will allow the positioning of the platforms to be displayed on the map;
- i) the system will allow the operator to generate various reports on platform filling status, activity history, operating problems (lack of communication, low voltage);
- j) acts to the system will be done on several levels (administrator, user);
- k) the system will offer the operator a route to empty the containers;

8. CONCLUSIONS

The introduction of the new European waste collection system into underground platforms is a modern solution for the management and collection of municipal waste and recyclable waste. Thus, the new underground waste collection system will replace the traditional underground waste collection system where the containers were located on the surface.

The underground waste collection system is an innovative way to collect waste. Due to the sealing of containers at a depth of 1.80 m, this system makes it possible to collect waste in humid and environmental conditions. The system prevents people climbing through containers from recyclable materials, is protected from the presence of rodents, street animals, bad weather, and the scent from waste.

In addition to the advantages mentioned above, the system benefits from a design that fits perfectly into the landscape of any city.

REFERENCES

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