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EVALUATION OF THE WASTE MANAGEMENT ACTIVITY IN THE IMPLEMENTATION PROCESS OF THE WASTE TRANSFER STATIONS IN ROMANIA

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Abstract: Transfer stations are used for the short-term transfer or storage of waste, for loading and pressing in large pre-containers (36-40 m³), and their transport to sorting stations or ecological landfills. The design and construction of transfer stations is carried out in accordance with the requirements of the waste management plans, and their operation will be carried out by operators only after obtaining the permits and authorizations required by the regulations in force.

The authorization and regulatory procedures from the legislative point of view are harmonized with the subsequent legislation at European level and imply an approach to the management of wastewater generated from the site so that the impact on environmental factors is minimal. The paper presents models of good practices from the situations encountered in the implementation of the transfer stations in Romania in accordance with the waste management plans.

Keywords: groundwater transfer stations, water bodies, monitoring, water and soil pollution, MSW transfer station; Municipal solid waste (MSW); Secondary pollutants; Transfer.

1. INTRODUCTION

Municipal waste management involves their collection, transport, recovery and disposal, including the supervision of these operations and the subsequent maintenance of landfills. Municipal waste management is the responsibility of municipalities, which can perform these tasks either directly (through specialized services within the Local Councils) or indirectly (by delegating this responsibility on a contract basis to specialized and authorized companies for sanitation services).

Waste management services have evolved from simple labor-intensive blue-collar activities, mostly focused on garbage collection and urban cleaning, towards industrially complex capital-intensive services. This evolution takes place in parallel with the emergence of environmental policy as a key driver of demand. Besides the more traditional "urban hygiene" waste management needs to deliver security of supply, environmental protection and "circular economy" [1].

The transfer stations are designed to streamline the transportation of residual waste from the collection areas to the local ecological landfill. Waste transfer stations play an important role in waste disposal [2].

2. MATERIALS AND METHODS

A pilot source transfer station was observed at the county level in selected cities and locality for collection of data on composition, generation rate and compliance level of separation of the transferred waste [3, 1].

The transfer stations comprise a series of reception and service spaces which are described below. The transport of waste will be done by compacting them in 30 m^3 containers in which the waste will be compacted, the containers having a useful weight between 20-21 tons, respectively open containers with a volume of 40 m^3 with a payload between 7 and 8 tons.

The administrative area of the transfer station consists of:

- scales for vehicles and waste reception booth
- area of bulky waste
- garage with mechanical workshop
- rainwater decanter
- treatment plant
- drilled well
- car parks
- the TRAFO post

Figure 1. Weighing booth

The locker room consists of a Eurocontainer that

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is equipped with a bathroom, is supplied to the water network on the premises, to the sewerage network and to the electricity network.

The container washing area consists of a platform with flat dimensions on which empty containers are positioned and washed before being reused.

The garage and the mechanical workshop represent a construction with a metal structure connected to the water, sewerage and electrical networks.

Figure 2. Garage and mechanical workshop

The transfer station is designed to streamline the transportation of residual waste from the collection area to the zonal landfill. The waste will be transported by compacting them in 30 m^3 containers in which the waste will be compacted, the containers having a useful weight between 20-21 tons, respectively open containers with a volume of 40 m^3 with a useful weight between 7 and 8 tons.

The containers are lifted/placed on the platform of the transport vehicle by means of a lifting hook and conical sliding rollers.

Using the transfer stations in the household waste management activity, is saving of fuel, labor, technological equipment is achieved, and equipment wear is reduced by about 6 times compared to the conventional transport of this waste to the existing landfill.

For the development of technological operations, which mainly involve the unloading of garbage cans in 30 m3 containers, followed by their transport to the landfill of non-hazardous waste, two separate operational areas are required. On one, the displacements of the waste trucks are carried out, which bring the household waste collected by the authorized operator, to be unloaded in the containers with compaction, and in which the waste will be pressed, on the other the activity is carried out in the containers without compaction of 40 m^3.

Figure 3. Transfer area

With the help of the hydraulic arm on the transport vehicle, the full container is lifted to fix it on the platform of the means of transport. As vehicles move in a permanent flow on these surfaces, the variant of a road concrete platform is chosen.

Figure 4. Maneuvering area

Open containers will be covered by a tarpaulin during transport. While the transport vehicle is in the race, the handling of the containers in the station will be done with the help of the front loader.

The stations are equipped with open containers of 40 m^3 and 30 m^3 containers, respectively. Their number depends on the area served

The main parameters that were used to design the transfer station are:

- total number of station operating days per year: 312 days;
- average station charging level: 80%;
- average station operating capacity 8375 to/year;
- maximum capacity per working day 32 to/day;
- personal service number 6 workers;
- container capacity with compaction 30 m^3;
- density of waste loaded into the container 30 m^3: 500 kg/m^3;
- theoretical container capacity 30 m^3: 15.0 to;
- degree of container loading 30 m^3: 90%;
- container capacity 30 m^3: 13,5 tons;
- density of waste loaded into the container 40 m^3: 250 kg/m^3;
- theoretical container capacity 40: m^3 8,0 to;
- degree of container loading 40 m^3: 90%;
- container capacity: 7,2 tons;

The input data that were used to design the utilities within the transfer station were the following:

- total area of the transfer station: 15 877 m^2;
- area for unloading garbage trucks: 679 m^2;

- the surface for manipulating the transport vehicle: 1126 m^2;

- number of container transport vehicles of 30 m^3: 1 piece;

- required number of closed containers of 30 m^3: 3 pieces;

- required number of open containers of 40 m^3: 4 pieces;

- number of front loaders: 1 piece;

- maximum capacity period: 9: 00÷11: 00, 15: 00÷17: 00;

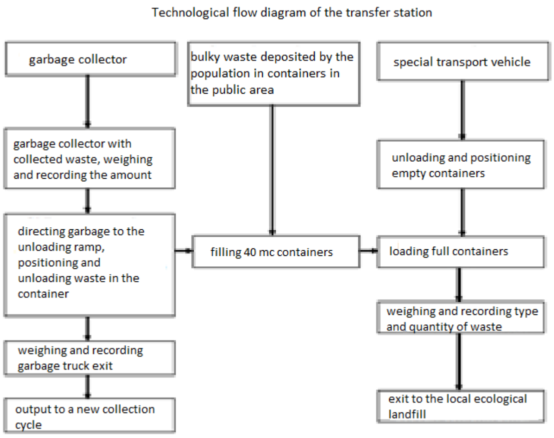

Figure 5. Technological flow transfer station

Technological flow transfer station

Waste flow (bringing waste)

A. Entry of machines for the transport of residual waste from municipal waste collected separately. The garbage trucks enter the enclosure and are positioned on the scales intended for motor vehicles.

The automatic card-based electronic system records the number and weight of the machine.

B. After being weighed at the entrance (having the waste table), the garbage trucks go to the unloading platform where the movements of the waste trucks carrying the collected household waste are carried out. The waste is unloaded in the feed hopper of the press, and then by pressing it is introduced in the 30 m^3 containers of the press. Also on this platform is the transport of waste from garbage cans directly to containers without press compaction.

A. After tipping, the waste trucks head to the scales to be weighed again (without the waste table this time), after which they leave the premises. The difference between the weight at the entrance and the one at the exit represents the weight of the waste brought and unloaded in the counters of 30/40 m^3.

Waste flow (waste collection)

A. Entry of machines transporting full containers. The special vehicles enter the premises and are positioned on the scale intended for motor vehicles. The automatic card-based electronic system records the number and weight of the machine.

C. Movements for positioning empty containers instead of full ones.

Loading full containers.

A. The truck is positioned on the weighing scale for motor vehicles. The automatic card-based electronic system records the number and weight of the machine. Leaving the truck with the full container from the station.

Transfer station flow

D. Once a container has been filled from the press, it must be replaced with another empty one. The translation system allows the exchange of the full container next to the press with another empty one, by operating the container exchange system. The full container will be moved sideways, and another empty one will take its place. The full container will be loaded on the platform of the special transport vehicle (with hook-lift system) and will be transported to the landfill of non-hazardous waste to empty it. While the truck is running, the containers will be handled with the help of the loader.

E. Once a 40 m^3 container has been filled, it is pulled out of its place and placed in the waiting position, and another empty container is to be placed in its place. This operation is done with the help of transport vehicles. After placing the empty container in position, the full one is climbed with the help of the hook on the platform of the transport vehicle and will move to the landfill.

F. Once every 3-4 weeks the empty containers that arrive at the station, instead of being positioned in the waiting place will be positioned on the container washing platform.

G. Bulky waste such as any waste electrical and electronic equipment, batteries, accumulators, used tires; ferrous waste, furniture or construction and demolition waste is not allowed to end up in the zonal landfill and will therefore be stored in containers. Specially designated, located in an area specific to these types of waste within the transfer station.

3. RESULTS AND DISCUSSIONS

The generation and seasonal variations of secondary pollutants were investigated during the municipal solid waste transfer station.

Wastewater generated on site in transfer stations pose a serious problem for soil and water protection and consists of:

- domestic wastewater from the toilets in the locker room in the reception area and inside the garage;
- technological wastewater from the mechanical workshop;
- technological wastewater resulting from washing containers;
- technological wastewater from washing the transfer area;

These wastewater must be collected through two distinct circuits:

- domestic wastewater is collected by the wastewater collection network and directed to the containerized treatment plant and then discharged into a natural outfall;
- rainwater from the site will be collected through open concrete gutters and PVC pipes, pass through hydrocarbon separators then through a decanter and then discharged into a natural outfall.

The effluent resulting from the treatment plant shall not exceed the loading limits provided in H.G.

no. 188/2002, and H.G. no. 352/2005, NTPA 001/2002 [4, 5, 6].

The results conducted in similar studies [7] showed that the raw wastewater generated from three municipal solid waste transfer stations indicate a pH value that ranged from 4,2-6,0, a chemical oxygen demand of 40,000-70,000 mg/l, biochemical oxygen demand of 15,000-25,000 mg/l, ammonia nitrogen 400-700 mg/l, total nitrogen 600-1500 mg/l, total phosphorus 50-200 mg/l and suspended solids 1000-80,000 mg/l.

Most of the numbers mentioned above showed an irregular variation depending on the waste composition, while the values for total nitrogen, total phosphorus and suspended solids were higher in summer and autumn influenced probably by temperature.

The wastewater generation observed shows different variation comprising values form 2÷8 % from the waste quantity. Regarding the air pollution the Hydrogen sulfide and Ammoniac were shown during investigation, however there was no change within the composition due to season variation.

Similar problems are posed by the leachate collected inside the containers with variation of a pH value that ranged from 5,0-6,0, a chemical oxygen demand of 42,000-89,000 mg/l, biochemical oxygen demand of 18,000-34,000 mg/l, ammonia nitrogen 587-1422 mg/l and total phosphorus 80-216 mg/l.

The analysis conducted over the environmental factors affected have shown that secondary pollutants production is closely related to temperature raise especially regarding the gaseous pollutants. And above all else, refuse classification in source, deodorization and anti-acid corrosion are the important processes to control the secondary pollutants during compression and transfer of MSW [7].

Shortcomings of existing waste management practices are highlighted and a conceptual framework for a centralized waste management system is proposed, where three interconnected elements are discussed:

(1) an infrastructure for proper collection of product lifecycle data to facilitate full visibility throughout the entire lifespan of a product,

(2) a set of new business models relied on product lifecycle data to prevent waste generation, and

(3) an intelligent sensor-based infrastructure for proper upstream waste separation and on-time collection [8,9].

By implementing 100% of the Integrated waste management system project, the entire population is served at one time by sanitation services. Malfunctions of the system exist ant they are generated by the interruption of the waste collection and transport activity by the sanitation operator were noticed, by affecting the health of the population and the excessive pollution of the environment [10].

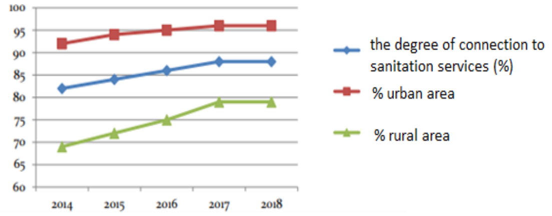

Figure 6. The degree of connection to sanitation services in Romania

The indicator on municipal waste generation is important in assessing the required tools to address waste management and was calculated as the ratio between the sum of the quantities of household waste collected, the quantities of waste electrical and electronic equipment from the population (specific flow), the amount of waste from municipal services, the amount of waste from collectors collected from the population (by flows waste: paper/cardboard, metals, plastics, glass, wood, biodegradable, textiles), waste batteries from the population and generating economic operators (expressed in tons/year) and the total number of inhabitants in the county, multiplied by 1000.

The evolution of the waste generation indicator at national level is presented in the chart below. Starting with 2015, it shows an upward trend.

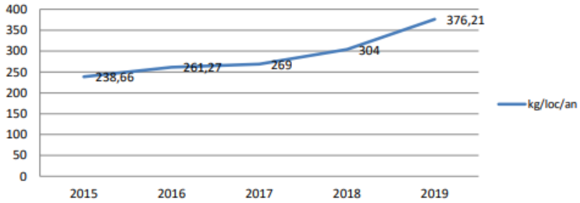

Figure 7. Evolution of the waste generation indicator

The quantities of production waste generated vary from year to year, due to the variation of waste generating activities, refurbishment, the growing concern to minimize the amount of waste generated, but also the growing number of operators who report the quantities generated in the electronic application. The quantities of production waste generated annually are registered and reported by the economic operators, based on the statistical survey questionnaires.

The collection of data and their verification in the electronic application Waste Statistics developed within the Integrated waste management system project is handled by the County Agencies for Environmental Protection, and the analysis and processing of these data is handled by the National Agency for Environmental Protection.

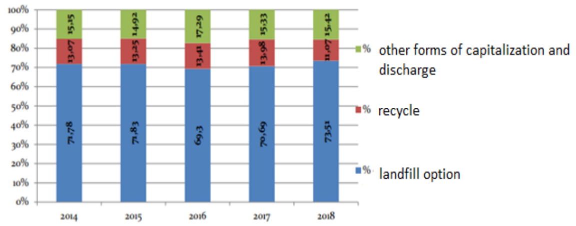

Figure 8. Share of the main municipal waste management activities, related to the amount of waste generated in the period 2014 – 2018

From the above it is observed that starting with 2016 the amount of waste stored has an increasing trend, which is inconsistent with the principles and objectives adopted by the EU through the legislative package on the circular economy.

The main causes that increase the quantities of waste stored are:

• waste management facilities developed under integrated waste management systems are not operational or do not operate at the planned capacity and efficiency;

• lack of infrastructure for separate waste collection or its faulty operation, non-implementation of the "pay for what you throw away" system, poor involvement of sanitation operators and local public administration in separate waste collection and transport to treatment facilities for recovery.

For the projection of the amount of municipal waste generated in the period 2016-2025 are used the following assumptions:

• the indicators for generating household waste in both urban and rural areas remain at the values from 2015 in the first two years of the forecast (2016, 2017), after which, starting with 2018, there is a decrease. This decrease is estimated on the basis of the implementation of measures to prevent waste generation (increasing the individual composting of biowaste in rural areas, the application of measures to prevent food waste, streamlining the economic instrument on the eco-tax for plastic bags and implementing the instrument), economically pays for how much you throw away);

• regarding the degree of connection of the population to the sanitation service, it is assumed that in 2016 it was 95% in urban areas and 85% in rural areas, and in 2017 100% in urban areas and 95% in rural areas [11]. Starting with 2018, the entire population of the country will be served with a sanitation service. The evolution of the degree of connection of the population to the sanitation service is related to the implementation of Integrated waste management system projects that ensure the separate collection of the entire amount of waste generated;

• similar waste represents 25% of municipal waste for the entire planning period;

• waste from parks and gardens, waste from markets and street waste remain constant, at the estimated value for 2015. During the planning period there is a decrease in the amount of municipal waste generated (the amount of municipal waste estimated for 2025 is about 12% lower than estimated for 2015).

As illustrated in the previous section, turning wastes to non-wastes involved a number of applicable waste management actions. As it has been put forward earlier, waste management also entails strategic planning, prescribing options, prevention of the contamination of environment and conservation of resources, minimizing the amount and toxicity of waste creation, choosing the best treatment option, with taking into consideration legislation, assessing effects and consequences and decision making [12]

To be able to design the most appropriate waste management system, the proper theoretical background has to be established. Waste management will have to be built, such that embraces the following notions [12]:

- Waste management is to prevent waste causing harm to human health and the environment.

- The primary aim of waste management is the conservation of resources.

- We shall avoid waste creation by creating useful objects primarily.

- Waste management is to encompass the goal of turning waste into nonwaste.

It is concluded that there is a need for more theoretical research to be made in the waste management domain, and to offer a scientifically founded and optimal choice of waste management options [13]:

Waste management activity raises a significant number of challenges and a necessity for a sustainable research techniques development. It is highly important not only to have a specific legislation applicable but also the means to follow the best strategies. Along with implementing landfill as a final option for waste management and equal importance should have selective collection of waste, recycling and monitoring activities for a complete image and according to a circular economy demands.

4. CONCLUSIONS

As a result of the implementation of measures to prevent waste generation and preparation for reuse, in the waste generation forecast was considered a decrease in the indicator of household waste generation in urban areas from 0,66 kg/inhabitant x day in 2015 to 0,6 kg / inhabitant x day in 2025, and in rural areas from 0,31 kg / inhabitant x day to 0.27 kg / inhabitant x day. This leads to the reduction of the municipal waste generation indicator from 228 kg / place / year in 2017 to 204 kg / place / year in 2025.

When making the projection on the composition of municipal waste is taken into account considers the following hypotheses:

• household and similar waste:

 in the period 2015-2017 the composition remains constant, being equal to the average values related to the period 2010-2014;

 in the period 2018-2025:

- the percentage of plastic waste will decrease by up to 10% as a result of the reduction in the consumption of plastic bags and plastic packaging, which will gradually be replaced by glass and paper packaging;

- the percentage of glass waste will decrease to 4.5% as a result of the introduction of the storage system for reusable packaging;

- the percentage of biowaste will decrease by up to 55% as a result of the implementation of measures to prevent the generation of food waste;

- the percentage of paper / cardboard waste will show a staged increase up to 13.5%; - the percentage of scrap metal will show a phased increase of up to 3.5%;

- the percentage of wood waste will show a staged increase up to 2.7%;

- the percentage of textile waste will remain at a constant value of 1%

• waste from public services (parks and gardens, markets and streets) during the planning period the composition remains constant at the average values for the period 2010-2014.

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