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The Safety Situation of Municipal Solid Waste Landfills in Hungary from a Disaster Management Perspective – Part 1

Today, nearly seventy municipal solid waste landfills in Hungary fully comply with European Union directives. Experience has shown that some sites have not yet been recultivated and that there are several illegal landfills. Waste fires are a special area within disaster management that have not yet been legally regulated nor intervention procedures have been established. In the first part of the series of articles I will present the key aspects that should be taken into account when defining a possible legal regulation. In addition, I plan to evaluate the prevention and response measures to hazards that are specific to landfills.

Keywords: **waste management, resource management, extinguishing water management, fire safety, industrial safety**

1. Introduction

The issue of fire safety and emergency planning of landfills in Hungary is a less scientifically researched topic. Waste is inherent in human life. No waste is generated in nature, as any residue is recovered in the form of food or humus. In some cases, it can also serve as a habitat for smaller organisms. However, mankind has been producing unusable materials since the beginning of his evolutionary development.

There are several definitions for waste. Among them, it is worth looking at Act CLXXXV of 2012 on Waste (hereinafter: the Waste Act), which is worded as follows in § 2 (23): "Waste: any substance or object which the holder discards or intends or is required to discard."

We must therefore take two official aspects into account when defining waste as a concept. On the one hand, it is a substance we want to get rid of, and on the

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other hand, an unused residue. In addition to the comprehensive definition of waste, it is necessary to mention three subcategories.

The first group is *bio-waste,* which includes garden waste, also known as green waste, and food waste. During their natural decomposition, green waste forms, among other things, combustible and greenhouse gases.

The second category is *construction and demolition waste.* The vast majority of construction debris is inert waste. Inert wastes are non-combustible and do not oxidise. In addition, they do not emit environmentally hazardous compounds and do not undergo biodegradation.

The third group can be identified as *household waste,* which is commonly referred to as municipal or household waste. Thus, any waste that is generated in everyday life can also contain degradable, inert and small amounts of hazardous waste.

Based on the composition of municipal waste, it consists on average of 40–50% organic matter,[2] and the content of hazardous waste ranges from about 0.5 to 0.7%.[3]

In order to significantly reduce the amount of waste in our environment, in my opinion, it is necessary to change our approach to public waste management in the first place. Public education can play a key role in developing an environmentally conscious approach. For example, it is important to teach children that it is not only necessary to collect waste selectively, but also to understand the process that takes place with the recycled material during waste treatment. In addition to the selective collection of materials belonging to the already mentioned waste categories, information on the afterlife of waste can also be an important aspect. In the case of decomposing waste, recycling can take place as compost,[4] or biomass.[5] In addition, the utilisation of construction and demolition debris as a road base can reduce the amount of waste going to landfill.

One of the biggest problems regarding the safety of the environment[6] is waste that cannot be monitored by monitoring systems. For example the microplastics.[7]

Non-recyclable waste typically comes from a variety of packaging materials. Within the European Union, nation states use different methods to reduce landfilling and increase the spread of recyclable materials. An example is the deposit fee. Another method could be the banded garbage collection system prevalent in Germany.[8]

It can be seen from the above that waste that is neither reused nor recovered for energy is landfilled in a municipal landfill. A landfill is a facility with specific technical

[2] József Hajdú: *Biogáz üzemek működése és biogáz üzemi technológiák.* Gödöllő, Szent István Egyetemi Kiadó, 2009. 13.

[3] Lajos Kátai-Urbán: *Veszélyes üzemekkel kapcsolatos iparbiztonsági jog-, intézmény- és eszközrendszer fejlesztése Magyarországon.* Budapest, Nemzeti Közszolgálati Egyetem, 2015. 34.

[4] Tamás Trenyik: *A települési hulladék begyűjtés és a kapcsolódó elválasztási láncok folyamatmodell bázisú értékelése.* PhD thesis, University of Kaposvár, Faculty of Economics, 2019. 3.

[5] Nemzeti Energia- és Klímaterv [National Energy and Climate Plan]. Ministry for Innovation and Technology, 2019. 41.

[6] Lajos Kátai-Urbán et al.: Veszélyes tevékenységek biztonsága a fenntarthatóság jegyében. *Védelem Tudomány,* 5, no. 1 (2020). 140.

[7] Lajos Kátai-Urbán – Tamás Parrag: *Szennyvizek mikroszennyező és mikroműanyag tartalma.* Iparbiztonsági és Hatósági Szakmai Nap, 2020. 104–113.

[8] Júlia Hornyacsek – Erika László: A hulladéklerakás adaptálható tapasztalatai Ausztriában és Németországban. *Bolyai Szemle,* 25, no. 3 (2016). 92.

protection where waste is stored on and off the surface for at least one year for non-recycling purposes.

The aim of this article is to present the general Hungarian safety regulatory environment, the most important safety factors, the sources of danger and the possible answers to the possible events of solid waste landfills in Hungary. In the course of my work, I used the sources of the European Union and domestic law as a basis. In addition, I analysed the scientific literature of both Hungary and abroad and compared it with a critical approach.

2. Evaluation of legislation

2.1. Examination of the international legal environment

The Council of the European Union, Directive 1999/31/EC on the landfill of waste lists, among the general requirements for action on landfills in point 5 of Annex I, an incident which has an adverse effect or a hazard on the installation.

It is unfortunate to note that the landfill regulations of the European Union basically set standards for the landfill and acceptance of waste, but this legislation does not deal with aspects of disaster prevention or fire protection.

2.2. Examination of the domestic legal environment

In Hungary, the general regulation of waste management is provided by the Waste Act, the authorising provision of which provides for the decree 20/2006 on certain rules and conditions related to landfilling (IV. 5.). The Ministry of Environment and Water defines the exact rules for the establishment and operation of the depository. That legislation does not deal with the safety aspects of the installations in a separate provision. However, Act CXXVIII of 2011 on Disaster Management Section 4 of the Act only establishes the *non-scope* of the Act in relation to waste landfills.

Decree 219/2011 (X. 20.) on the prevention of major accidents involving dangerous substances, formulates criteria only for hazardous waste, as solid hazardous waste is typically disposed of by incineration.[9] In addition, it is important to note that Decree 6/2016 (VI. 24.) on Firefighting Tactics Regulations and Technical Rescue Regulations BM OKF instruction does not contain any special provisions related to waste fires.

Establishment criteria are met only by Decree 54/2014 (XII. 5.) on National Fire Protection Regulations, introduced by the Decree of the Ministry of the Interior, § 72 (6), according to which "an extinguishing water intensity of 1,800 litres/minute shall be provided for one and a half hours in the open-air storage area of a municipal waste landfill". The law gives a free hand here as to whether this amount is provided

[9] Cintia Morvai: Veszélyes hulladékok keletkezésének és ártalmatlanításának vizsgálata. *Védelem Tudomány,* 2, no. 3 (2017). 136.

by the landfill operator from a hydrant or a firefighting reservoir. For most facilities, the plant has its own fire safety policy drawn up by its own or a qualified fire engineer. The instructions of which must be followed by the workers. These usually only provide instructions on how to place and keep fire extinguishers on standby.[10]

3. Assessment of the technical possibilities of waste management

3.1. Waste management activities in Hungary

Most of the waste generated by the population can be processed in three different ways:

- solid waste can be recycled or reused, as is the case with deposit products or paper
- energy use, i.e. the conversion of waste energy into thermal and electrical energy in incinerators, is also a significant form of recovery
- ultimately, depositing can be the right solution[11]

In terms of waste management, the ideal would be for the population not to produce waste. This way, all products would be made exclusively of recyclable or reusable material. This is especially true for the packaging of food or household products. The extraction of disposable plastics and the use of degradable materials would still be feasible. However, this solution would entail significant additional costs for both the manufacturer and the consumer. In the long run, therefore, the aim is to completely restructure the industry and consumer habits, i.e. to minimise the production of waste. In the short term, however, it is necessary to ensure that the waste generated so far is properly treated.

Figure 1 shows the levels of waste management, which can also be referred to as a waste pyramid.

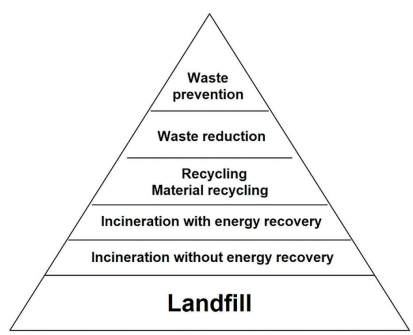

Figure 1: Levels of waste management, i.e. the "waste pyramid"

Source: Anikó Horváth – József Stipta: Csomagolóanyagok környezeti hatásvizsgálata. Műszaki Szemle, 10, nos. 39–40 (2007). 26.

[10] Barnabás Csőke: *Hulladékgazdálkodás.* Veszprém, Pannon Egyetem, 2011. 65.
[11] Géza Károly Kiss Leizer: Környezetbiztonság a hulladékok hasznosításában. *Hadmérnök,* 10, no. 3 (2015). 112.

In Hungary, the collection and removal of waste from residential areas is a key task in society. According to Decree 292/2013 (VII. 26.) on the rules of non-regular waste shipments and the designation of state bodies acting in this process, if the company providing public services in the area of competence is unable to transport the waste, the disaster management authority shall designate another economic organisation providing public services that carries out the transport of waste from the underserved area.

This regulation prevents emergency situations like the one that happened in Naples[12] in the early 2010s, or is still going on in Rome.[13] An important problem in these areas is the public protest against the establishment of new landfills. Municipal waste generated locally must be transported by the city administration to sites significantly further away. This causes supply problems and public health problems in cities due to additional costs and distance.

According to a 2014 survey, there are more than 2,500 public landfills in Hungary.[14] Of these, 70 have landfills that fully comply with EU standards.[15] Among the 2,500, however, there are some that have been illegally designed.

According to 2016 data, 65% of the waste generated in Hungary is landfilled.[16] The EU average for landfilling is 63%.[17] Of the remaining 35%, 9% will be recovered for energy through incineration and the other 26% will be recycled.[18] It is worth noting here that the selective collection and transport of paper and plastic waste and the disposal of green waste have significantly contributed to the development of good waste management practices.

3.2. Municipal solid waste landfills

The disadvantage of landfills is that the waste is not recovered materially or energetically. Bio-waste, such as green waste or food waste, forms various gases during natural decomposition (combustion), among which methane can also be identified. These gases are uniformly called landfill gas.[19] Methane is known primarily from mining as the cause of the blast. It can be seen, therefore, that the depositor can also be a serious source of danger. It is not possible to ventilate the waste, as in the vast majority of cases it is compacted by a so-called compactor with claw wheels.

[12] Christian Fraser: Naples: A City Swimming in Filth. *BBC News,* 28 May 2008.
[13] Giorgia Orlandi: Évek óta tart a hulladékválság az olasz fővárosban. *Euronews,* 13 July 2021.
[14] BME ABÉT: *Kommunális szilárd hulladéklerakók Magyarországon* [Municipal Solid Waste Landfills in Hungary]. s. a.
[15] Ákos Grecmájer: *Magyarország hulladékgazdálkodási adatainak földrajzi megjelenítése és elemzése.* Budapest, ELTE–TTK, 2014. 10.
[16] Képviselői Információs Szolgálat [Representative Information Service]: Hulladékerőművek, hulladékégetés [Waste-to-Energy Plants, Waste Incineration]. *Infojegyzet,* 2016/23. 3.
[17] Angéla Pál: A kommunális hulladékok környezeti hatásai, a hulladékgazdálkodás, mint ellenhatás. *Hadmérnök,* 11, no. 2 (2016). 96.
[18] Hornyacsek–László (2016): op. cit. 87.
[19] Imre Szabó: *Hulladéklerakók tervezése, üzemeltetése I.* Miskolc, Miskolci Egyetem, 2011.

Figure 2: Caterpillar 826C compactor at an Australian landfill
Source: Picture of a Caterpillar 826C landfill compactor being used at an Australian landfill site. s. a.

As a result, landfill gas must be drained. The extraction of the gases is carried out by means of perforated so-called drain pipes, which are placed horizontally in layers. Drain pipes are already introduced out of the ground into solid polyethylene pipes that branch into gas pumps. Geotextiles are then spread on the drain pipes. This releases the waste into an anaerobic environment, i.e. if possible, all the gas formed escapes into the pipes. Thus, the landfill gases can only have minimal contact with the outside air. Vertical piping can also be used for landfill gas discharge, but only in the case of abandoned landfills, as in this case landfill activity on the surface cannot be ensured. The methane formed so far is released into the air, which is not beneficial due to its greenhouse effect.[20] At the same time, the advantage of piping penetrating the layers is that the concentration of evaporating gases can also be measured. Despite the anaerobic environment, leakage occurs through capillary passages.

Methane in landfill gas can also be dangerous to the environment, as if an inclusion is formed or gas pumping stops, it can already cause an explosion. The amount of methane produced can be said to be energetically insignificant. Most typically, a boiler is set up in the landfill area itself, where it can generate hot water and/or electricity by burning it. The methane content of the landfill gas varies greatly from 30 to 70%, which may be responsible for the odour in the area. The other materials in the landfill gas can typically be carbon dioxide, which can make it difficult to burn methane as

[20] Pál (2016): op. cit. 96.

a perfect combustion product. This gas also has an ozone depleting effect. The energy generated here usually only serves the landfill's own energy needs.[21]

4. Resources in the field of solid landfills

One of the main problems of operating municipal waste landfills is that the composition of waste is considered to be significantly heterogeneous. Combustible and non-combustible waste can also include small amounts of hazardous waste, such as chemicals, infectious substances classified as hospital waste, and so on. In addition to the previously mentioned degradable waste, self-reactive substances can also be identified. In the latter category, lithium-ion batteries play a prominent role in which, if the separator membrane is damaged, a self-reactive process can occur during the reaction of the anode and cathode fluids. The cell is first physically deformed and then, by perforating the outer shell, the material is in contact with the oxygen in the ambient air during a severe and short-term refractive action. The flame is unquenchable because when the process starts, oxygen is released during the reaction, which fuels the combustion. For this reason, a burning fuel cell can burn even when submerged. This phenomenon can occur without an external heat source, merely due to mechanical damage.[22] In this way, conscious public waste management has a key role to play in order to avoid fires in landfills. Another important aspect is that collection machines typically dispose of waste uncontrolled, which makes it impossible to recycle waste in advance. Injury can often occur during the operation of compactors and grabs. At the same time, there is a greater burden on workers, as it is important to recycle the waste around the cell for post-processing. Monitoring and detecting sweats or the spread of fire is also a separate task.

We know from the work of researchers in the field that "74% of fires in waste management were caused by spontaneous combustion, 11% by other known causes and 15% by unknown causes".[23] In the event of a fire in the landfill, the fire brigade must be notified immediately. Experience shows that this is not always clear to those who work there.

For the most part, due to a lack of knowledge of the legal regulatory obligation, security guards are often wary of signalling the incident to the emergency services on duty during working hours and outside of working hours during the night shift, for fear of possible legal retaliation. Thus, unfortunately, a large proportion of fire alarms only reach disaster protection when the public also announces extensive smoke or light exposure at night.

In the migration area, the competent intervention staff must be trained and practiced to work in accordance with local conditions. Such is the case with the densely changing surface, as uncompressed waste is looser in some areas due to

[21] Hajdú (2009): op. cit. 13.
[22] Qingsong Wang et al.: Thermal Runaway Caused Fire and Explosion of Lithium Ion Battery. *Journal of Power Sources,* 208 (2012). 210–224.
[23] Imre Antal – Rudolf Nagy: A települési hulladékkezelés tűzbiztonságának munkavédelmi szempontú vizsgálata. *Védelem Tudomány,* 6, no. 4 (2021). 61.

continuous dumping, so accidents can occur due to the swampy nature of the soil. Elsewhere, chippings, subsidence and water washes may occur. However, compaction with compactors is not common in all landfills. The compactors use their claw wheels to compact the material to a workable density. However, in landfills where only wheeled excavators or grabs are available, no such work process takes place. This can also cause subsidence, which can lead to serious accidents. In poor visibility conditions such as night, fog, heavy smoke or snow cover, this can be an additional source of danger for the intervention fire brigade.

5. Conclusions

The facts presented in the present study show that there is room for improvement in the legal regulation of solid waste landfills in Hungary from a disaster management perspective. We can see that there are effective international and domestic initiatives to reduce the amount of waste generated. It can be said, however, that until the guidelines for the circular economy come into force in the European Union, we will have to deal with the solid waste generated by households. Non-recoverable waste can pose significant hazards to both the public and workers, and to our environment as a whole. It is clear that a number of events stem from landfill activities that cannot be prevented by primary interveners. An excellent example of this is self-inflammation.

In my opinion, conscious waste management and the prevention of major fires must be an important requirement for disaster protection. Further attention should be paid to the activities of on-site workers, as their responsibilities will be significantly increased in curbing initial fires over time and preventing their spread.

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