



PUSZTAZÁMOR REGIONAL LANDFILL



FKF





THE WASTE HIERARCHY

In a consumer society, people are continuously urged to buy more. With the accumulation of goods, more and more waste is generated, placing a huge burden on the environment. The negative impact of waste on the environment can be reduced significantly if waste is treated with the right processes.

Waste is a material or an object that is or is to be discarded by its owner. Waste is different from garbage as – although it becomes useless where it was generated (households, factories, agriculture, institutions, etc.) - it can be used as secondary raw material if collected separately according to different material types.

Garbage, however, is a material or object that becomes useless and cannot be used further, thus it is removed from the cycle of economy.

Waste procession, disposal and recycling is a complex task since the different types cannot be treated in a unified way. Waste hierarchy which is defined in 5 steps provides help concerning the proper order in which waste should be treated.



PREVENTION

REUSE

RECYCLING

ENERGY
RECOVERY

DISPOSAL

FKF Nonprofit Zrt. (FKF Nonprofit Pte.) takes a responsible role in waste management, i.e.: the collection, transport, reuse and recycling as well as the disposal of waste generated in Budapest. The Company owns Pusztazámor Regional Landfill which is the most up-to-date and safest sanitary landfill in the region. This publication provides detailed information on the operation of the facility and explains how non-recyclable and non-reusable municipal solid waste get disposed of in an eco-friendly way.

Municipal Solid Waste Generated in Hungary (thousand tons)

| 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|-------|-------|-------|-------|-------|-------|-------|
| 4,553 | 4,312 | 4,033 | 3,809 | 3,987 | 3,738 | 3,712 |

Source: Hungarian Central Statistical Office



1. The first and most important element of the hierarchy is prevention. Everyone should strive to minimise waste production. Nowadays it is a challenging task as almost every product one buys is pre-packed. Nevertheless, a conscious consumer does have a possibility to purchase goods with little or recyclable or reusable packaging.



2. The second step of waste hierarchy covers the preparation for reuse. It means that not every object which seems useless should be thrown out. These can be reused in their original forms after cleaning and repair. A machine part, for example, can function in another machine as well, or an outgrown piece of clothing can be given away or sold, and recyclable plastic bottles can be refilled after cleaning or used as an ornament.



3. The third step includes the recycling of waste materials. It makes separate waste collection inevitable. In the course of this process, materials sorted get reprocessed and resold.



4. The fourth step of waste hierarchy is energy recovery. Waste is incinerated in Budapest Waste-to-Energy Plant where district heating and electric energy is produced out of it. There are waste types from materials not to be recycled but their energy content can still be utilised in this plant.



5. The fifth and least environment-friendly solution is waste disposal in landfills. In the course of this process, waste is disposed of in a landfill site meeting environmental and environmental health regulations. Waste loses significant material and energy contents here. Efforts should be made so that only those waste types get disposed of in landfills which can be utilised in neither of the abovementioned steps of the hierarchy.

INTRODUCTION OF PUSZTAZÁMOR REGIONAL LANDFILL



Approximately 700,000 tons of municipal solid waste is generated in Budapest a year, nearly 420,000 tons of which is thermally utilised. The rest is disposed of in Pusztazámor Regional Landfill. The construction of the landfill was started in April 1999 and was finished in August 2000. An interesting piece of information is that in the course of the construction works, an Avaric era cemetery was discovered with 1247 tombs and a great number of archaeological objects from the era. The area of the landfill is located near the motorway M7 within the administrative boundaries of the settlement Pusztazámor. Pusztazámor and the neighbouring settlements: Sósokút, Tárnok, Gyúró and Tordas are relatively far (3-5 km) from the landfill. The waste collection vehicles approach the landfill site from the motorway avoiding residential areas.

The landfill covers a 91 ha area and is equipped with a full range of technical protection, a leachate collection and treatment system with leachate system cleaning as well as an air-injection treatment system. The environmental control of the landfill is guaranteed by 19 ground water monitoring wells, surface water sampling, noise and vibration protection and soil protection as well as air quality check points.

The landfill in Pusztazámor receives and disposes of around 35% of the municipal solid waste generated in Budapest and the nearby settlements belonging to Pest County and also performs waste collection and transport in these neighbouring settlements as part of public services or with separate contract.

There is a waste yard operated within the landfill which enables the separate collection of both recyclable waste and domestic hazardous waste brought in by residents. In 2005 a composting site was also put into operation to utilise green waste collected separately. Its capacity has been expanded to 30,000 ton/year since 2014. The compost produced here is used in the course of the continuous rehabilitation* of the landfill and it is also a commercially valuable product. After the arriving waste is identified, checked, weighed and recorded electronically, it is unloaded in the working face of the landfill. Covering the landfill is performed by means of soil continuously excavated from the expansion area. In line with the strictest environmental regula-

tions of the European Union, Pusztazámor Regional Landfill gets constantly rehabilitated, covered with the specified soil layers and planted to regain an aesthetic landscape.

FKF Nonprofit Zrt. is committed to environmental protection. The development and expansion of Pusztazámor Regional Landfill is being realized by taking the principle of sustainable development into consideration. The Company's target is to make the landfill in Pusztazámor capable of treating waste generated in Budapest and its surroundings for quite a long time.

*rehabilitation: restoration of the environment destroyed due to human intervention focusing on planting and vegetation



FACILITIES OF THE LANDFILL

The area of the landfill is 91 ha. This is where Phase I and the expansion areas of the landfill space, the composting site, the reception terminal with the control and office buildings, the environmental laboratory, several sets of equipment and also a waste yard can be found.

The area is suitable to give place in five phases to a landfill with the following size and capacity, equipped with a technical protection compliant with national regulations including standards and requirements reconciling relevant EU policies.

Capacity and expected operating time of Pusztazámor Regional Landfill (in case of disposal of an expected 350,000 compacted m³/year)

| | | Phase I | Phase II | Phase III | Phase IV | Phase V | Total |
|-------------------------------|-----------------|---------|----------|-----------|----------|---------|-------|
| Area of landfill | ha | 18.3 | 15.8 | 12.4 | 8.9 | 6.9 | 62.3 |
| Volume of deposited waste | Mm ³ | 3.8 | 3.5 | 3.6 | 2.5 | 6.1 | 19.5 |
| Operating time | year | 12 | 10 | 10 | 7 | 17 | 56 |
| Starting operations (planned) | year | 2000 | 2012 | 2022 | 2032 | 2039 | |

The technically protected part of Phase I. built within the frameworks of this project covers an area of 18.3 ha. The topsoil was removed and deposited for continuous rehabilitation nearby. The bottom liner of the landfill was built in a sawtooth design from 12 slopes, the total slope of the ditches is 2%, and the cross-slope between the ditches and the backbone lines is 3%. Slopes provide leachate drainage even in case the bottom liner sinks.

Soil from cuts was used to the construction of the 1,600 m long leachate dam with an inner slope of 1:1.5 and an outer slope of 1:3, surrounding the working face. The outer slope was mounted with soil and topsoil according to the layer structure required for rehabilitation and planting was also completed.

In 2012 Phase I of the landfill was filled. The next 2 ha area for Phase II was put into operation in December 2012. Within the frameworks of the expansion of Phase II, a 15 ha landfill space integrally connected to Phase I was created, which provides an additional 3.5 million m³ landfill capacity. It guarantees landfilling on the spot for another 17 years.

In addition, the composting site within Pusztazámor Regional Landfill also managed to be expanded to a capacity of 30,000 ton/year. A reverse osmosis technology based sewage treatment facility is used to clean the leachate from the already filled and still operating landfill spaces.

TECHNICAL PROTECTION

A number of environmental and health regulations must be observed in a landfill. A safe landfill site typically has a bottom liner system and sets of equipment for leachate and landfill gas collection. Pusztazámor Regional Landfill fully complies with all environmental regulations. Technical protection consists of double layer sealing: a mineral layer and HDPE lining as well.

Mineral sealing layer

Under the landfill's bottom liner, there is the bentonite conditioned 0.5 m thick upper layer of a tens of meters thick clay soil layer.

The currently operating Phase II was equipped with an additional impermeable bentonite layer.

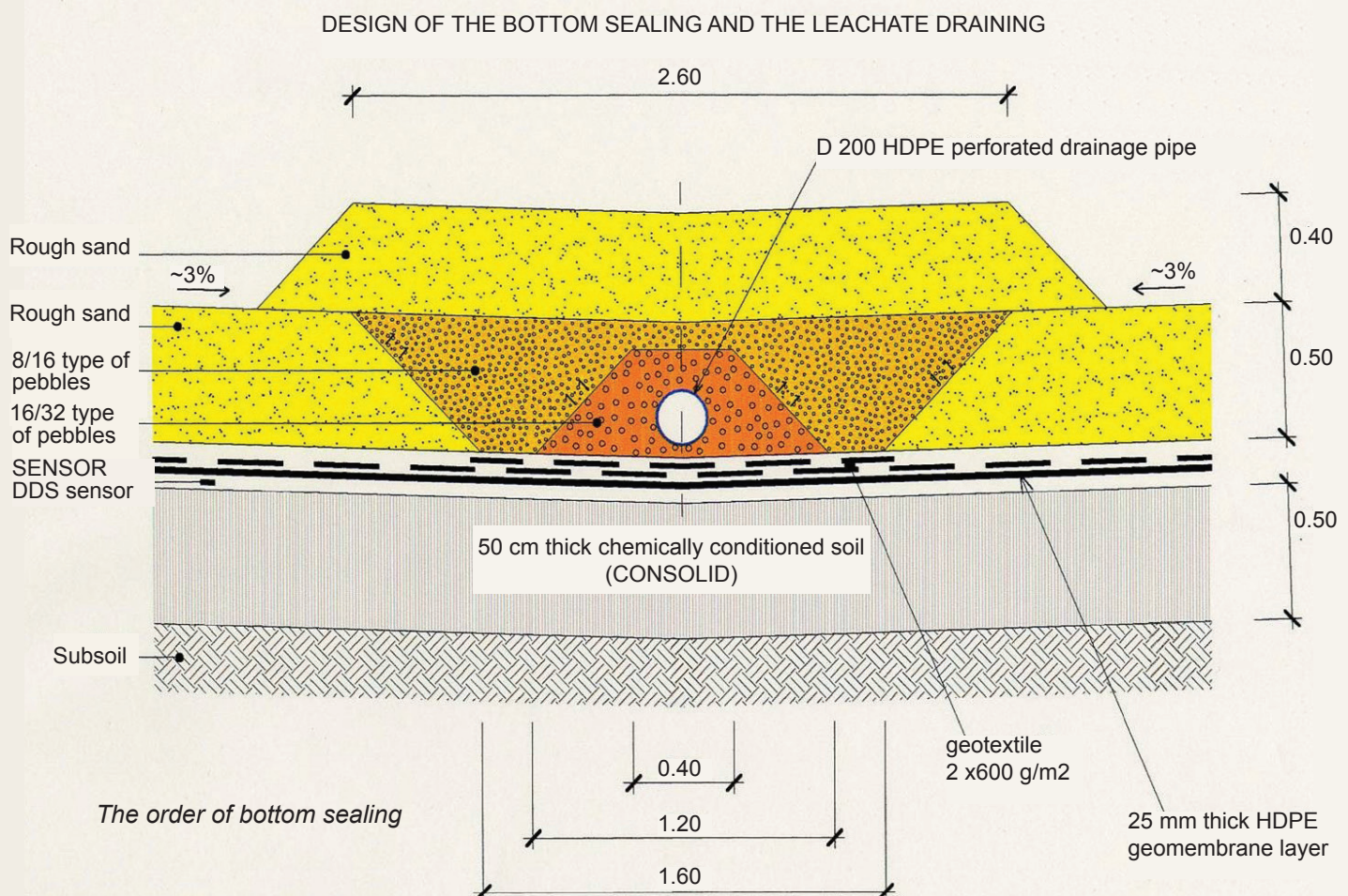
A grid of 6,000 geophysical sensors was installed in the entire area of the landfill under the mineral sealing to check the HDPE geomembrane lining.

Geomembrane lining

There is a 2.5 mm thick HDPE geomembrane lining covering both the bottom of the pit and the walls of the landfill dam.

The geomembranes were joined by double seam welding.

A geotextile layer was put above the geomembrane lining. In case of Phase I, a 0.5 m thick coarse sand drainage layer covered this geotextile layer, while in case of Phase II it was a 16/32 gravel drainage layer. The functioning of the sealing is monitored continuously by a monitoring system of a grid of sensors and groundwater monitoring well manholes even for decades after the landfill becomes full.



LANDFILL TECHNOLOGY

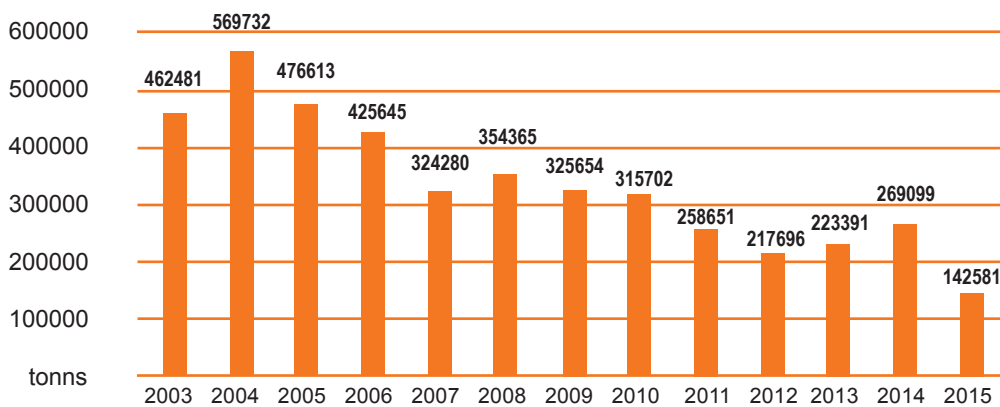
A daily average of 150-300 vehicles transports 1000-2000 tons of waste to Pusttazámor Regional Landfill. The great incoming amounts of waste are measured on a weighbridge, then checked and recorded, thus all data are documented precisely. Monitoring is completed by visual inspection, random sampling and laboratory testing on the spot. Waste received is compressed and ordered in 2-3 m thick horizontal prism by landfill compactors. The geometry of filling and checking its actual level is completed by continuous GPS geodesic monitoring.

Did you know that the compressed volume of waste is only 1/7th of the volume measured in the container?

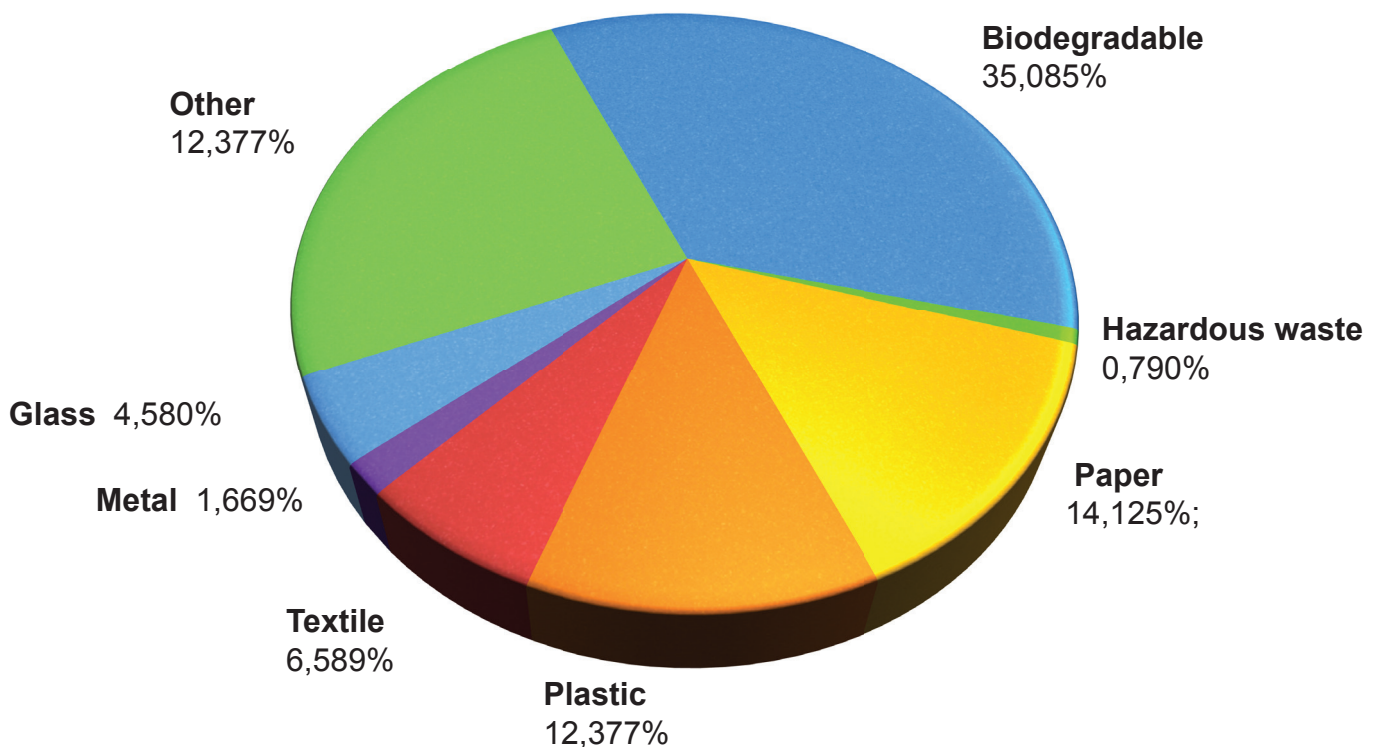
As part of landfill technology, a cover (cap) is put on top of waste at the end of every working day. The covering material is excavated from the expansion area, simultaneously preparing the pit for the next phases.

Did you know that an average of 250,000 tons of waste is disposed of in the landfill annually, but if necessary, nearly double the amount can be treated there?

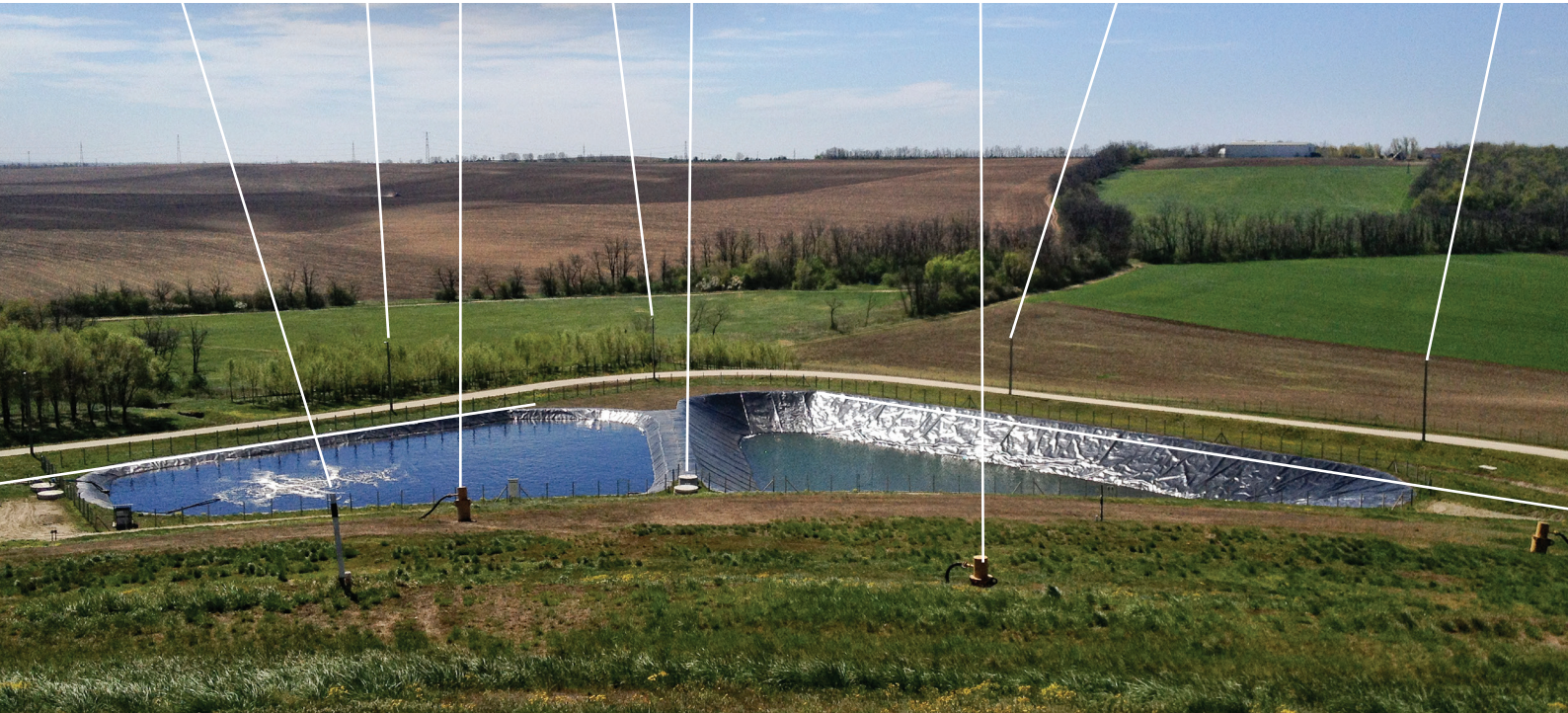
Waste received for disposal between 2003 and 2015



Composition of the municipal solid waste of Budapest, m/m% 2015.



LEACHATE COLLECTION SYSTEM



Contaminated rainwater fallen on the surface of the landfill space and percolated through waste is collected as part of the technical protection by a system of drainage pipes of 12 independent arms. Drainage pipes carry leachate through manholes on the ditches located on the outside wall of the dam into the pump-well put next to the leachate pond where level control pumps lift it to the divided pond area.

Did you know that the leachate drainage system in Pusztazámor Regional Landfill has the length of 7,000 m?

Did you know that the sealed pond has a 6 m deep, 0.8 ha and 24,000 m³ divided pool area?

The leachate stored and aerated as necessary by the three aerating ejectors is carried to the cleaning equipment operating based on reverse osmosis by pumps. Within the cleaning device, a daily 100 m³ leachate is pushed through 57 PTFE membrane filters organised in columns, in three stages with 60-120 bar pressure. The 90 m³/day clean water which got through the membranes is driven into a living aquatic recipient. The thickened 10 m³/d concentrate gets transported for further treatment. The cleaning device works automatically and is subject to 24-hour remote monitoring.

In the course of reverse osmosis, more pressure affects a concentrated aqueous solution separated from a more dilute solution by a semi-permeable and mechanically strong membrane than the osmotic pressure. In this case, the water molecules flow in the dilute solution and the concentration of the concentrated solution increases.



ENVIRONMENTAL MONITORING SYSTEM



The environmental monitoring system is overseen by the accredited laboratory of the Quality and Environmental Management Department of FKF Non-profit Zrt.

The following areas are examined:

- groundwater monitoring by 19 monitoring wells
- surface water monitoring at 4 points
- air-borne particles and settled dust control at 4 points
- soil monitoring at 5 points
- noise and vibration control at 5 points
- as part of the environmental monitoring system, 6,000 geophysical sensors check the HDPE geomembrane liner as well as a meteorological station examines and records weather data.

Facilities of the Reception Terminal

a waste yard, a laboratory, a control building, 2 public road weighbridges with a measuring limit of 60 tons, a welfare and office building for 50 people with dressing room, a building for subcontractors, a maintenance building, a storage and boiler building, a PB gas bottle site, a vehicle maintenance building with 2-2 repair bays, a crane and repair pits, a patrol station with a 30 m³ diesel refuelling machine, a vehicle and machinery wash with 2-2 high-pressure washers, a fire-water and industrial water reservoir as well as industrial water producing wells.



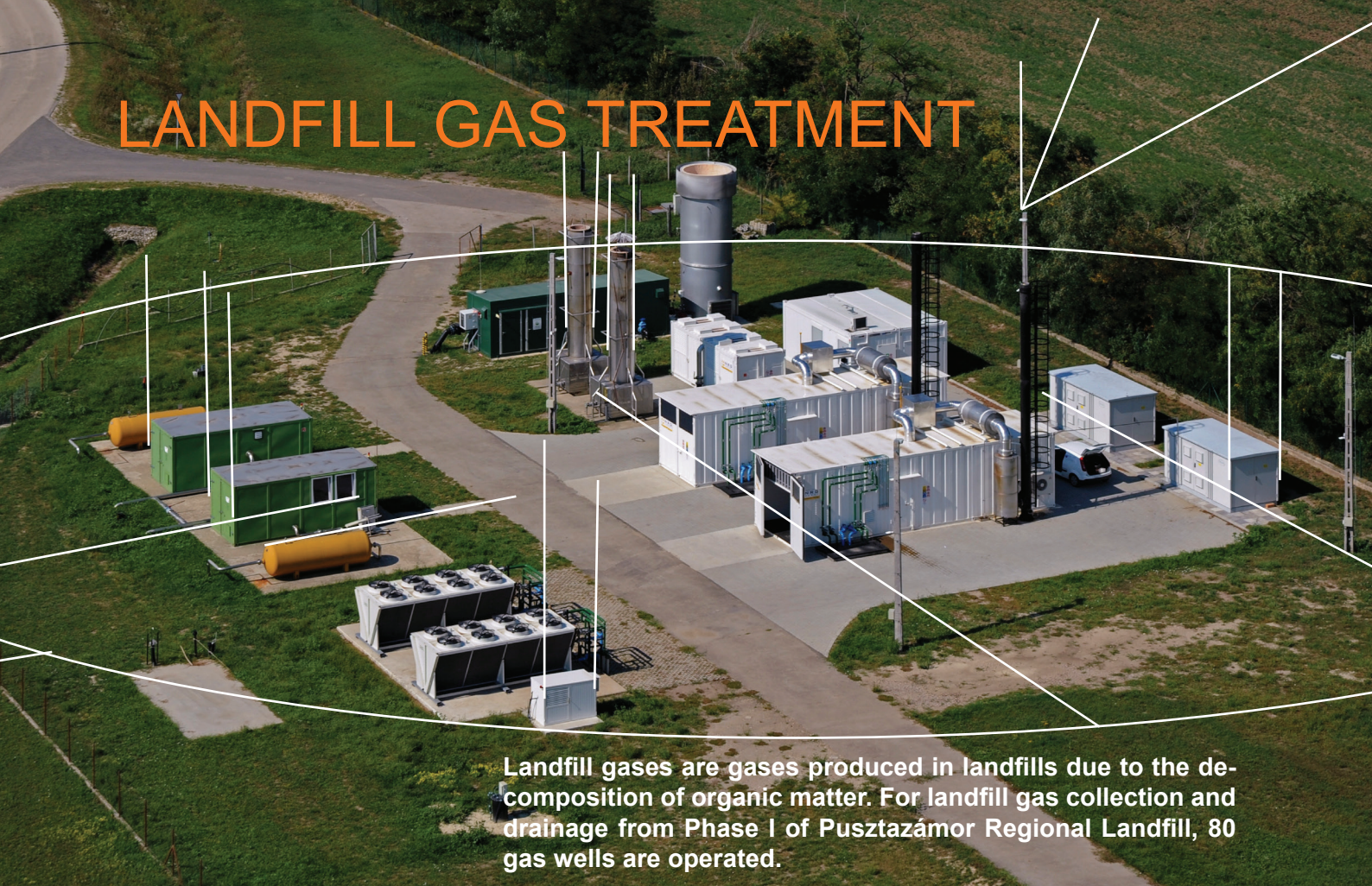
Infrastructure and Utility Networks - Road Network Utilities

water and sewage networks, electric networks, IT networks, technological equipment control and monitoring network

IT and Spatial Information Technology Systems

Online recording of the entry of incoming waste is carried out in the central data registration system of the Company. There are 25 industrial surveillance cameras monitoring site operations.

LANDFILL GAS TREATMENT



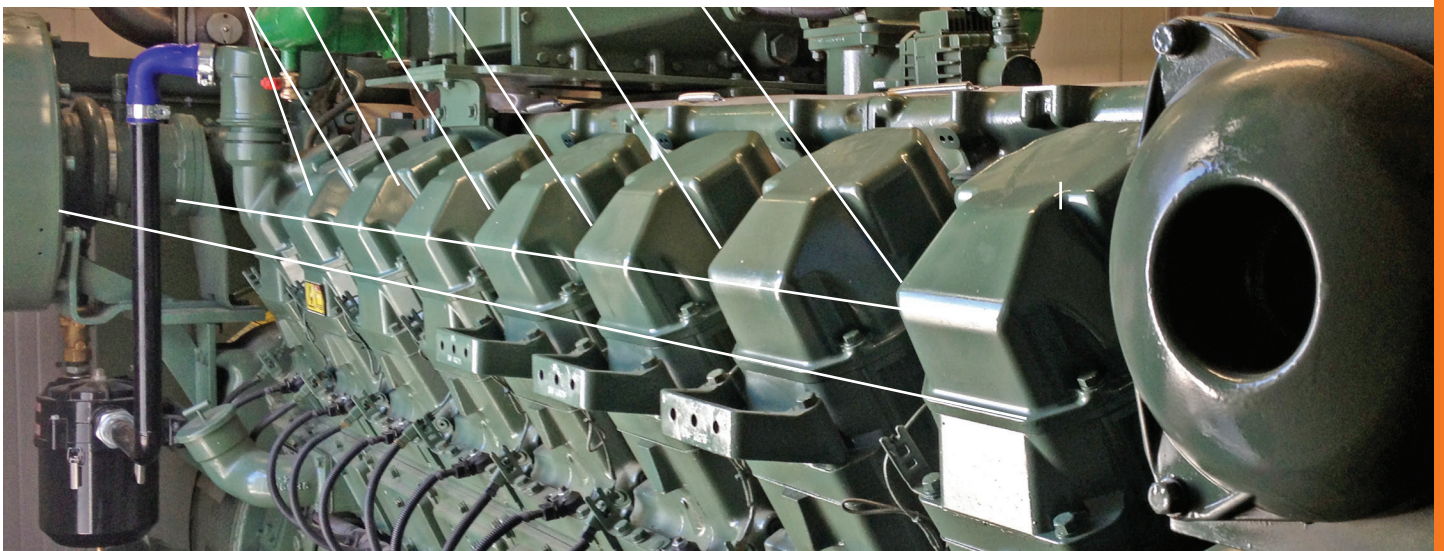
Landfill gases are gases produced in landfills due to the decomposition of organic matter. For landfill gas collection and drainage from Phase I of Pusztazámor Regional Landfill, 80 gas wells are operated.

Did you know that the methane concentration of landfill gases is 55%.

As preparation for landfill gas utilization, a flare of a capacity of 500 m³/h was installed in the summer of 2006 which was used to extract some of the landfill gas and, in the meantime, the boiler providing heat energy was transformed into one operated by landfill gas. By the end of 2009 the extraction was expanded to 1000 m³/h, by 2013 to 2000 m³/h, and in 2015 landfill gas utilization was started by means of the installation of a small energy plant.

Did you know that power generation from landfill gas by gas engines can satisfy the electricity needs of 5,000 households?

Landfill gas utilization is provided by 2 Caterpillar G3516 A+ gas engines with 16 cylinders and the capacity of 1.1 MW each. Energy produced here is sold at 20 kV through the city network. The hot water and heating supply of the plant is also guaranteed by landfill gas.



REHABILITATION

A composting site was put into operation within the territory of Pusztazámor Regional Landfill in 2005. It has already been expanded to a 2 ha area with the primary function to treat municipal-type, biodegradable waste collected separately from gardens and parks in the capital city (green waste). Almost 10,000 tons of high quality compost product authorized for marketing by NÉBIH can be produced from the incoming green waste by means of the utilization system of 30,000 tons annual capacity operating 8 compost prisms with aeration control and semi-permeable covering.

Did you know that compost is an excellent soil conditioner which can replace manure and provide nutrients up to three years? By composting nutrient leaching, soil erosion and soil degradation is reduced, the biological activity of the soil increases and its structure improves. 1 ton of compost can consist of 300 kg organic humic substances.

Compost made in Pusztazámor can be bought in bulk in the landfill.

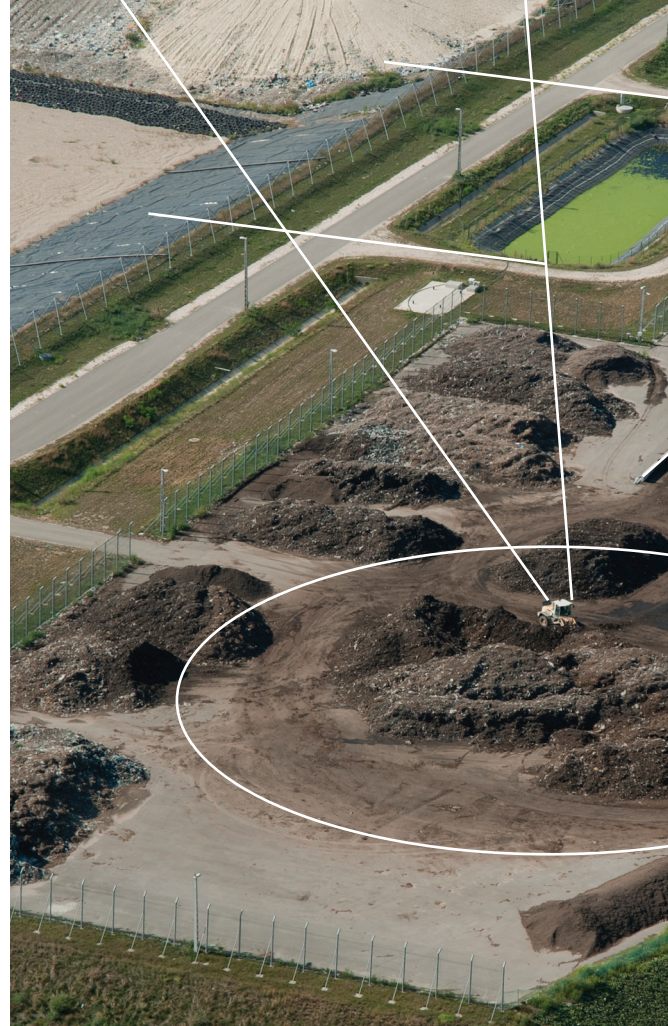
The produced compost is also used in the course of the rehabilitation of the landfill.

Pusztazámor Regional Landfill pays special attention to restore the outer surface of the landfill by rehabilitating the environment that had been damaged by the excavation works during the construction of the landfill. Accordingly, the temporary rehabilitation of Phase I was finished in an approximately 200,000 m² area in 2013. Its final rehabilitation is planned in the near future.

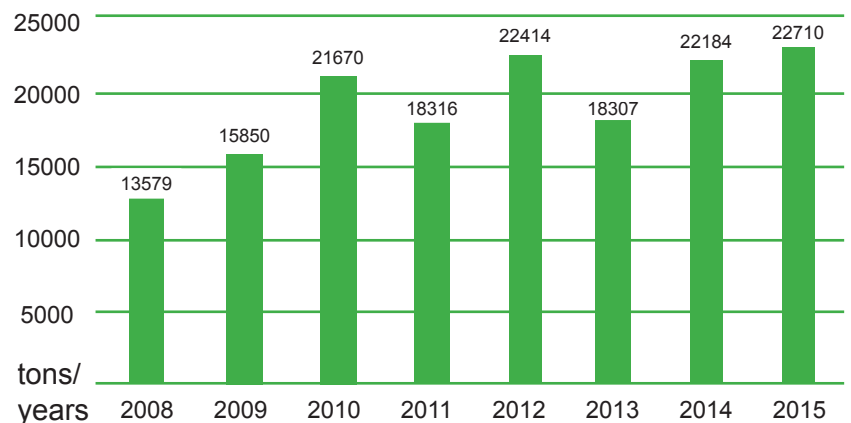
Layer Order of Temporary Rehabilitation:

- equalizer layer
- 30 cm thick clay layer
- 40 cm thick soil mixture
- covering by lawn

Did you know that Pusztazámor Regional Landfill has a stock of game? Mostly deer can be seen in the area of the landfill.



Green Waste Received





SITE VISITS

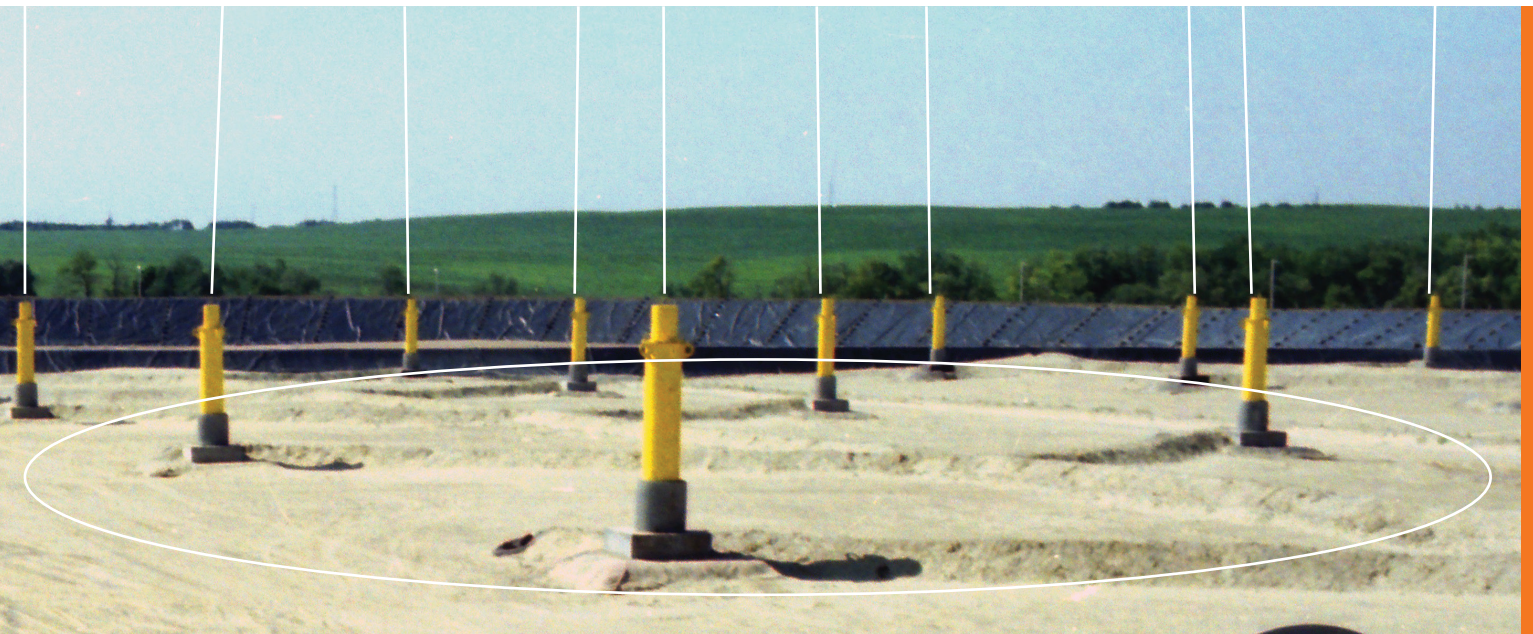
email: mileg@fkf.hu

The request for site visit only can be regarded as accepted after our confirmation of a site visit form sent to us. (It can be downloaded from our website: www.fkf.hu)

How to reach the plant?

The landfill is located in a 90 ha agricultural area without any infrastructure relatively far – 3-4 km far – from the neighbouring settlements (Pusztázámor, Sósút, Tárnok, Tordas, Gyúró). The area which is around 25 km far from the capital can be reached on motorway M7 from the direction of Budapest (motorway exit Tárnok).

Coordinates: 47°22'39"N 18°47'53"E



IMPRINT

Published by: FKF Nonprofit Zrt.

Address: 1081 Budapest, Alföldi u. 7.

Telephone: 06 40 353 353

Website: www.fkf.hu

Publisher: István Csontos,

CEO of FKF Nonprofit Zrt.

Graphics: Bertold Bolla

Printed by: Grafit Pencil Nyomda Kft.

Budapest, 2016



BUDAPEST

