Use of geosynthetics in landfills. Case studies from Romania

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ABSTRACT: The continuous growth of waste quantity, as well as the recent preoccupation for the environment protection led to the necessity to build new ecologic landfills in Romania. For these new landfills, geosynthetic materials are widely used for various functions: as hydraulic barrier, for drainage, filtration or reinforcing. The main geosynthetics used in landfills are the geomembranes and Geosynthetic Clay Liners as hydraulic barrier, the geotextiles for separation and filtration, the geogrids for reinforcing and geocomposites for drainage. The paper presents case studies of some landfills from Romania for different types of waste (municipal, organics, from petroleum industry) built in Romania in the last 2 years: the municipal landfill of the Sighisoara town, the organic waste landfill from Vasilati, the hydrocarbons residues landfill Videle and the municipal landfill of Bucharest.

1 INTRODUCTION

The controlled or “ecologic” landfills are supposed to use complex systems in order to protect the soil. Lately, these systems have largely used geosynthetics, which offer many advantages: homogeneity of their properties for the whole surface, easy to install, superior qualities comparing to the natural materials, speed of installation etc.

The landfills, by their complex structure and technical requirements, represent works that adopted very fast the new geosynthetic materials . Moreover, this kind of work contributed to the widening of the possible applications and made possible the research in this field.

The main geosynthetics used in landfills are (Gazdaru et al., 1992, 1999):

- geomembranes, used alone or in association with compacted clay liners (CCL) or other synthetic barriers, which allow better performances for the assembly;
- Geosynthetic Clay Liners (GCL), composed of a bentonite layer sandwiched between two geotextiles and/or geomembranes. They can be used in the liner or cover systems, alone or in association with CCLs or geomembranes
- for the drainage, leachate collection and removal and leak detection systems, the geonets and geocomposites for drainage are replacing more and more often the traditional gravel layer. They are offering better in-plane transmissivity, small thickness, easy and fast installation;
- geotextiles are the most used geosynthetics and they have a large place in landfills as separation layer, filtration, protection of the geomembrane against puncture, erosion protection in capping systems etc.
- geogrids are used for reinforcing the soft ground, for increasing the bearing capacity, for steep slopes or veneer cover soils reinforcement. One of the newest solutions of reinforcing soft soils is represented by geocells.

Figure 1 presents after Koerner (1994) the place of various geosynthetics in landfills.

The paper presents some landfills designed and built in Romania in the last 2 years in Romania using different types of geosynthetics with various functions.

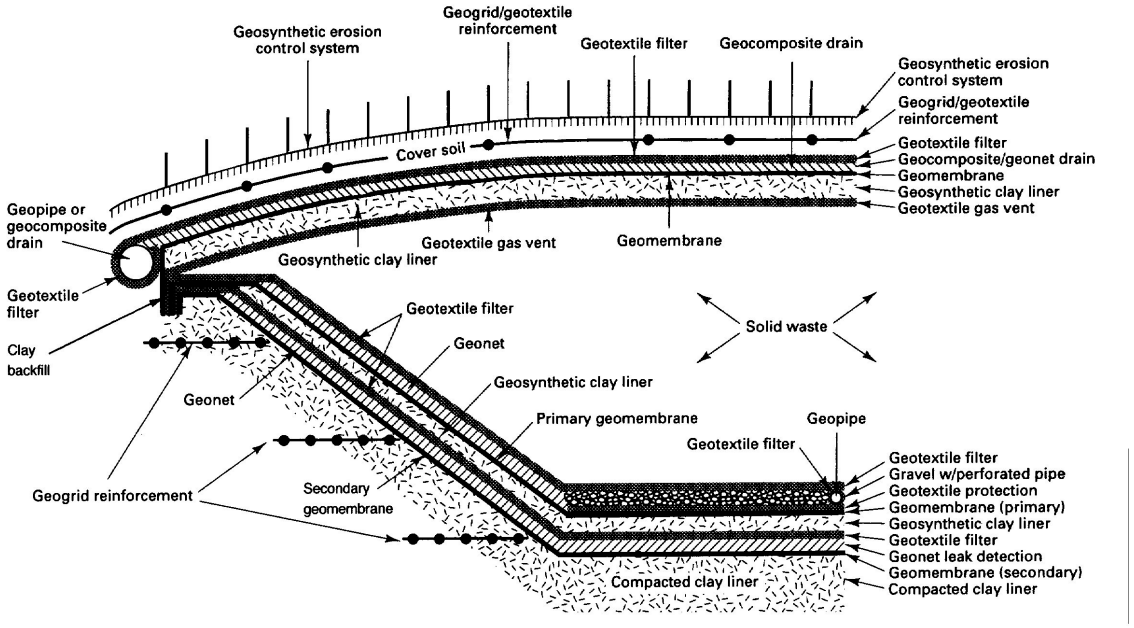

Figure 1. Use of geosynthetics in landfills (Koerner, 1994)

2 THE MUNICIPAL LANDFILL IN SIGHISOARA

The Sighisoara town (center of Transylvania) has 40 000 inhabitants and, before 1998, disposed of an uncontrolled landfill with a surface of 3.8 ha, located 1.5 km away from the town, in an abandoned backwater of the Tarnava Mare river. The waste deposit was 15 – 16 years old and 3 – 8 m thick.

Due to local constraints, the adopted solution was to extend and to surelevate the existing deposit for at least 20 years (Figure 2).

The new landfill, which is in operation at present, has an area of 60 000 m^2, 17 000 m^2 being the extension of the old deposit and 43 000 m^2 being built on the natural ground.

The capacity of the landfill is 232 000 m^3.

The ground is composed of 0.8 – 1.0 m fine silty sand, followed by a layer of silty sandy clays of about 8 m thickness, a thin layer of fine marl sand in which the groundwater level was located and below –9.60 m a marl clay layer.

For the liner system two solutions were adopted: one for the extension on the natural ground and another one for the area located on the old deposit (Figure 3).

For the landfill area situated on natural ground:

- a 1.5 mm thick HDPE geomembrane was installed on the natural clay barrier;
- a nonwoven protection geotextile, 1500 g/m^2
- a gravel drainage layer, 16/30 mm, 50 cm thick.

For the old deposit area, in order to provide the required bearing capacity, a reinforcement of a granular layer with two layers of geogrids was installed. Above this reinforced layer, a 25 cm thick compacted clay liner was laid out, followed by a Geosynthetic Clay Liner (composed of a HDPE geomembrane + a bentonite layer). The GCL was installed bentonite face down and the geomembrane of the GCL was protected against puncture with a thick nonwoven geotextile (15000 g/m^2).

The 25 cm thick clay layer is meant to avoid the migration of the GCL bentonite into the reinforced granular layer.

The drainage layer consists of rounded gravel 16/30 mm, 40 cm thick and HDPE pipes for collecting and transporting the leachate to the adjacent pond.

These solutions were adopted after a comparison study between the compacted clay liner and the geomembrane liner. The study led to the conclusion that it is impossible to meet the required specifications if the on-site clay is used (Manea et al., 1998).

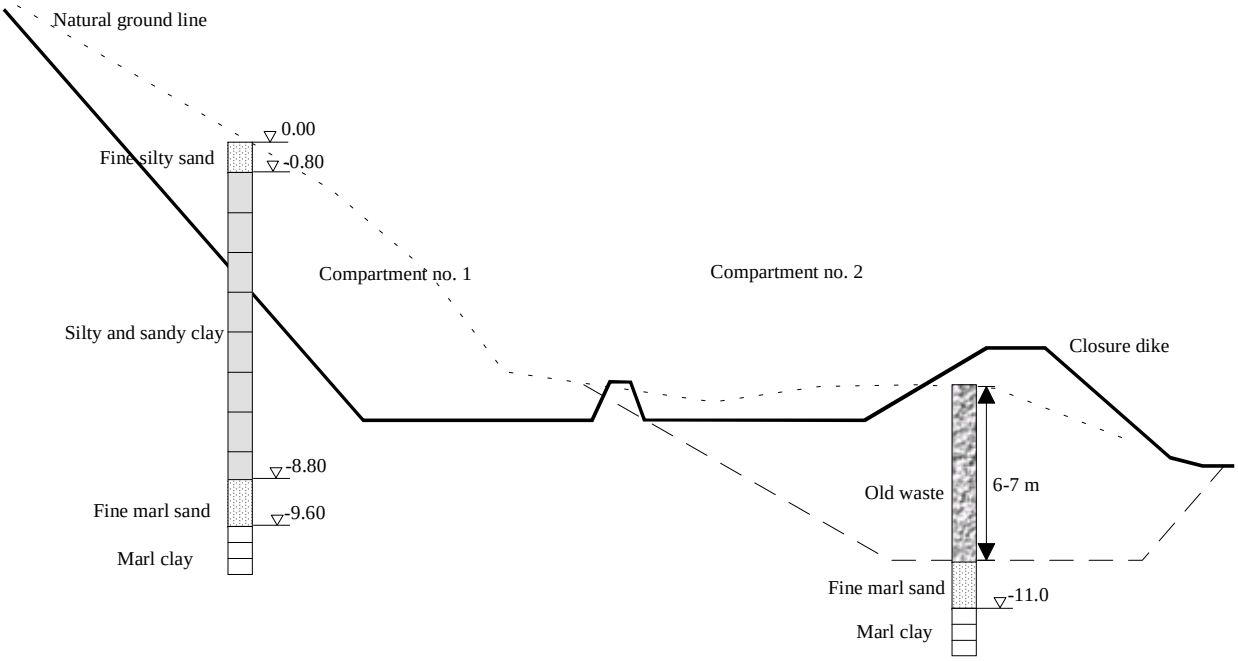

Figure 2. The municipal landfill of the Sighisoara town

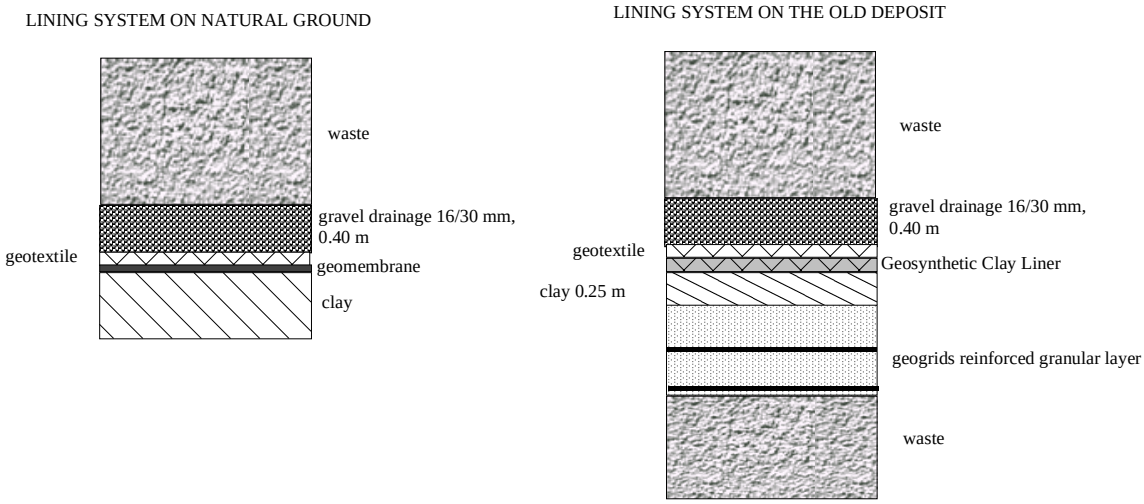

Figure 3. Liner and drainage systems adopted for the municipal landfill in Sighisoara

Because the old deposit area was very compressible on about 4 m depth (the waste being relatively "fresh"), the bearing capacity was not enough to support the containment dike. A geocell mattress was then built with geogrids in order to solve this problem (Figure 4).

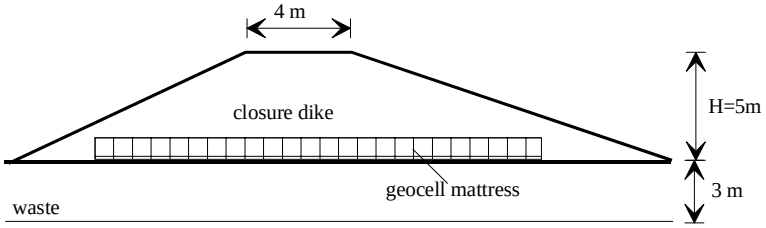

Figure 4. Containment dike on geocell mattress for the municipal landfill in Sighisoara

The use of conventional methods, such as removing the existent waste and replacing it with a good material or to schedule the execution on large periods of time in order to allow a natural consolidation of the wastes were considered not to be practical and economic. The geocell mattress solution presents the following advantages:
- a rigid platform was created, providing a uniform distribution of the contact pressures on the ground;
- no excavations or preliminary works were needed;
- the supplementary costs for the temporary occupation of the land were eliminated;
- the execution could be carried out by rainy or cold weather;
- the execution is faster;
- no special technologies or installations are needed;
- the geocells being located directly on the old wastes, a good aeration of the biogas is possible.

This is the first geocell mattress installed in Romania and it is successful.

3 THE MUNICIPAL LANDFILL OF BUCHAREST

The new municipal landfill of Bucharest is located in Chiajna, about 20 km away from Bucharest and has a surface of 16.5 ha, with possibility of extension on another 10 ha. The landfill will have 5 compartments, the first and the second one being built on the natural ground, the fifth on the existing deposit and the other two compartments in an area where nowadays there is a slough.

The landfill capacity is 4 000 000 tones and it can be increased to 4 500 000 tones by building 2 other compartments on natural ground.

At the present time, the first compartment is completely filled, the second one partially filled and the work for the extension of the first compartment is in progress.

The liner consists of a 1.5 mm thick HDPE geomembrane, protected against puncture with two geotextile layers of 800 g/m2 each (Figure 5).

Above the geotextiles, a drainage layer of 16/30 mm rounded gravel, 40 cm thick was installed. The leachate is collected by HDPE collectors DN 200 and DN 250 respectively and transported to a leachate pond lined also with a HDPE geomembrane of 2 mm thickness.

4 ORGANIC WASTE LANDFILL FOR A PIG FARM IN VASILATI

At the pig farm in Vasilati, the environment impact study showed a hazardous potential of the dejections resulted from this activity. According to the Romanian legislation in this field, in order to meet the specifications, a geomembrane liner was needed (2 mm thick – see Figure 6).

The pond is a parallelepiped, 70 m $\times$ 40 m at the upper part and 55 $\times$ 25 m at the base and it is 4 m deep.

The waste quantity to be stored is about 35.71 l/day.

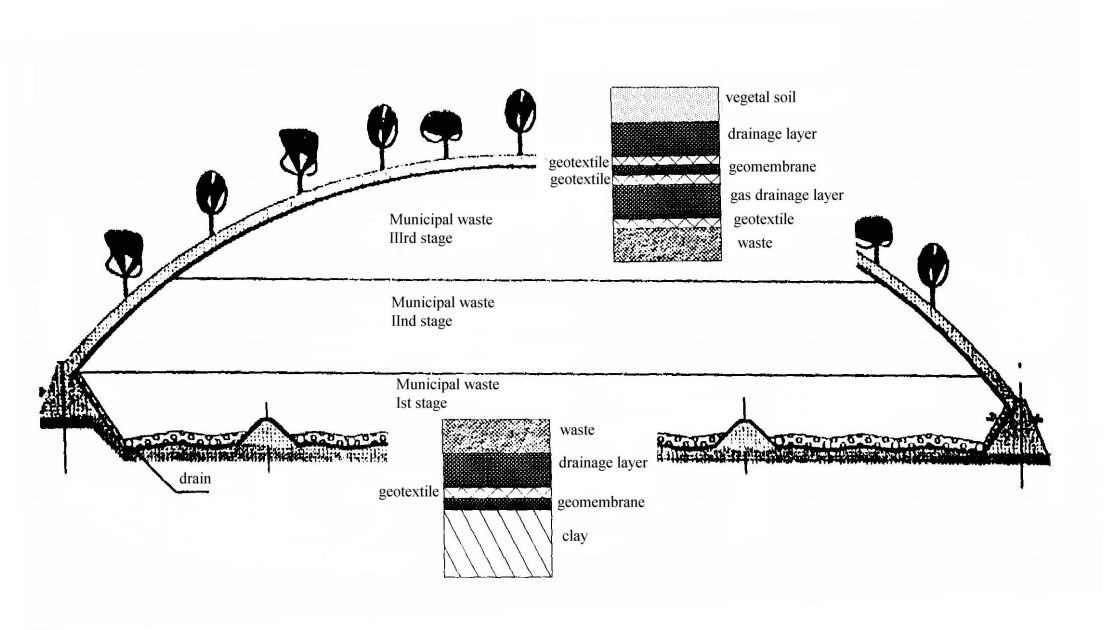

Figure 5. The municipal waste disposal Bucharest – Chiajna

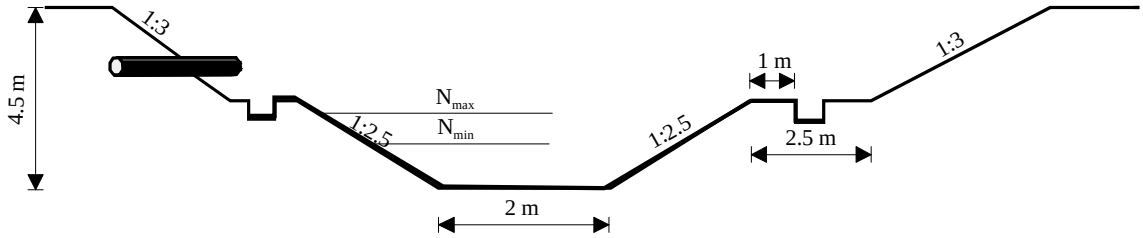

Figure 6. The Vasilati pond

5 THE WASTE LANDFILL FOR OIL PRODUCTS AT VIDELE

After the check-ups carried out at the Poieni shell (parks Butesti and Vatasi), it was concluded that the walls of the decantation ponds and the clay based hydraulic barrier exhibit cracks and it was necessary to restore the liner.

A 2 mm HDPE geomembrane was used on the existing concrete walls, after a pre-treatment of the cracks. Each geomembrane pan was fixed on the concrete walls using a mechanical connection and the seams were welded.

Figure 7 shows a cross section, a detail of the connection between the geomembrane and the concrete wall and the treatment of the singular point created by a pipe passing over the pond.

6 CONCLUSIONS

By presenting different types of landfills for various types of waste, it can be noted that in Romania, in the last few years, the previously theoretical preoccupation for environment protection led to the design and execution by Romanian engineers, of modern ecologic landfills using technical so-

lutions adapted to the local conditions. For these works, the theoretical and practical experience of Romanian specialists was used, by means of state-of-the-art solutions based on geosynthetics. The geomembranes, Geosynthetic Clay Liners, geogrids, geocells provided efficient, economic and durable solutions.

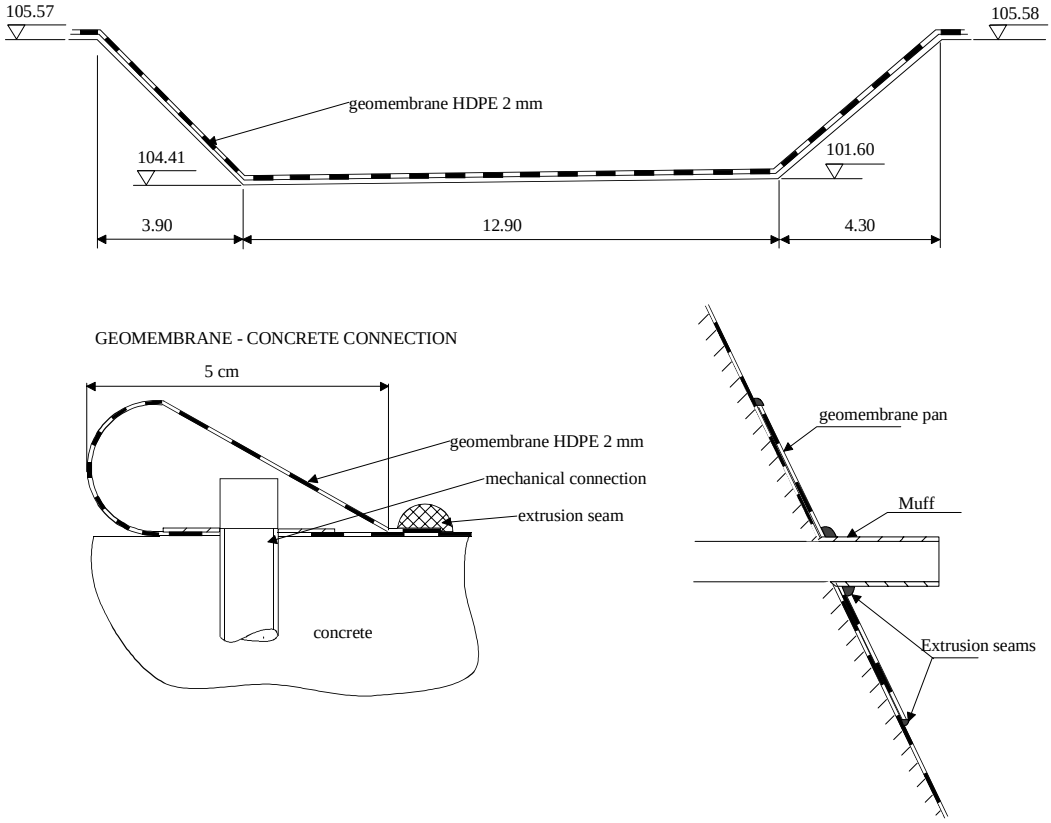

Figure 7. The petroleum industry waste landfill in Videle

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