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MSW issues in Portugal – The Seixal sanitary landfill

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ABSTRACT: A sanitary landfill for municipal solid waste (MSW), generated in the Seixal and Almada municipalities, has been constructed. It is being developed in phases, covering an area of 14 ha, which will serve the region sufficiently for about 11 years. This paper describes some considerations on the liner system, and presents the main aspects related to the design and operation of the sanitary landfill.

1 INTRODUCTION

In Portugal, about 2,95 x 10^6 t of municipal solid waste (MSW) is produced per year, according to data from 1993. Of this, 38% is being treated, and, from this treated part, only 26,1% has had an adequate final destination (in sanitary landfills or by composting). These data show that Portugal is far behind, compared with other European countries (QUERCUS, 1995). The same source reports that, in 1993, only 7 sanitary landfills were really controlled (one of them being inactive). All together, they serve 18 municipalities from the 273 existing in the country (Fig. 1).

Regarding this situation, an important effort has been made to implement a legislative framework to support an adequate waste management policy, which not only must guarantee the protection of the environment and public health, but also be in agreement with the European legislation (CEC, 1994).

2 PORTUGUESE LEGISLATION ON MSW

In Portugal, the bases of the waste management have been established by a law (Decreto-Lei n°488/85), which stated that the Municipal Councils should organize and keep an updated file on the quantity, nature, and final destination of the gathered waste (LNEC/DGQA, 1992). Later on, a decree (Portaria n°768/88) ruled on the execution of those inventories, through the creation of the MSW Registration Form, in which a detailed description of the waste must be given.

Concerning the sanitary landfill construction requirements, after the site selection, the Municipal Council must ask the DGRN (General Directorate of Environmental Quality) and the DGOT (General Directorate of Land Ordering and Urban

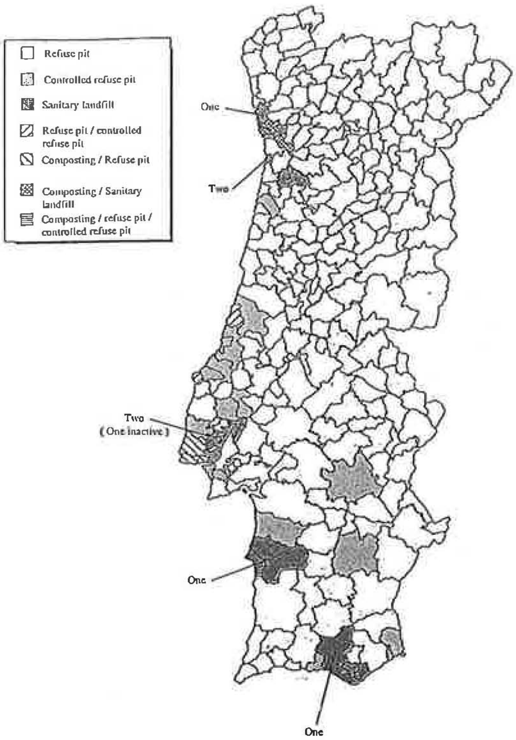

Fig. 1. Final destination of the Portuguese MSW, by municipalities (QUERCUS, 1995).

Development) to pronounce themselves, in their sphere of competence, about the aptness of the site for the installation of a landfill. If these two entities agree with the chosen site, then the Municipal Council must promote all studies and investigations necessary for the execution project of the sanitary landfill.

The project should include all infrastructures, equipment, and operation measures necessary for the correct performance of the landfill, and, at same time, must assure the environmental and public health protection. The project is then submitted to the DGQA (General Directorate of Environmental Quality) for appreciation. If DGQA express a favourable opinion, the Municipal Council will finally promote the landfill execution (LNEC/DGQA,1992).

The case history which will be presented in what follows will show the effort that Portugal has been doing, since 1993, to improve the solid waste management.

3 SEIXAL SANITARY LANDFILL-CASE HISTORY

In the Seixal and Almada municipalities, about 300 t of MSW is produced per day. Until 1995, the MSW was placed in two sanitary landfills in the Seixal municipality. As they have reached their full capacity, and also due to the increase of environmental awareness, a new sanitary landfill was constructed. This landfill has been built with an improved design and operation procedure, in order to ensure a safer and more adequate management of MSW the produced.

Before the design, an Environmental Impact Assessment (EIA) was carried out, which was submitted to public appreciation and DGQA approval.

The landfill was constructed in agreement with the legislation in force at that time, namely with the Commission of the European Council Directive (CEC,1991), and has been supported by European Communities under the Cohesion Fund of the 2nd Framework Programme.

4 SITE CONSIDERATIONS

The preliminary planning began with searching for potential sites for a long-term disposal of MSW. An old sand pit was selected, located at Amora county (Seixal municipality).

Concerning the selected site, the following positive aspects were found: the landfill has generally a good access, and does not interfere with the existing traffic; the morphology is the one corresponding to an old sand pit, with an available area of approximately 14 ha; the haul distances are smaller than 25 km, and the nearest residential area is situated at a distance larger than the minimum legal requirements. There is a sufficient volume of material suitable for covering each and all individual waste layers, and the climatologic conditions are favourable.

The geological survey made for the area of the landfill, indicates the presence of sedimentary formations (Plio-Pleistocene), lithologically formed by sand, gravel, clayey sandstone, and clay.

From a hydrogeologic point of view, although the permeability of the underlying strata is high ($10^{-6}<K<10^{-4}$ cm/s), and several aquifer layers (productivity of 2 to 20 l/s) occur at a depth between 60 m to 200 m, it was possible to build and operate the landfill, because the required sealing systems were installed. Their function is to ensure that the quality of the local groundwater and underlying soils is not affected.

Furthermore, after the landfill closure, the site will be fitted into the surrounding landscape, and restored with vegetation.

5 TECHNICAL SOLUTION

On the area available (14 ha), it was proposed to build two main cells (cells 1 and 2), each one occupying 5,5 ha, and having an average depth of 22 m. This procedure takes advantage of the existing morphology, namely the depressions resulting from the operation of the old sand pit.

The landfill has been developed by phases, beginning with the construction of cell 1. The soil excavated for modelling cell 1, was placed temporally in depression reserved for cell 2, and will be used for the daily cover. Cell 1 has a capacity to hold the community waste for about 4 years. Its closure will determine the time to build cell 2. This methodology allows the distribution, in time, of the costs necessary for the landfill completion.

A disposal of inert waste has also been forcasted, and, for this effect, an area of 2 ha (cell 3) has been reserved.

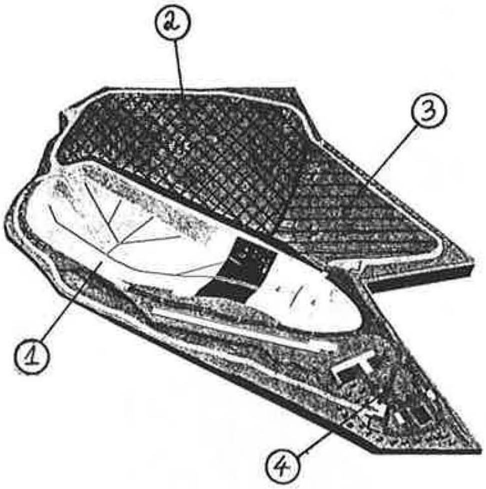

Fig. 2. Layout of the Seixal sanitary landfill: (1) active filling area (cell 1); (2) and (3) future filling areas (cell 2 and 3); (4) infrastructures (administration, vehicle, machine and wheel cleaning, stores, weighbridge, scrap area, recycling area, etc.).

The reminding area of 1,5 ha was used for the infrastructures and services necessary to the landfill operation (Fig. 2).

For security, a metal fence, surrounded by trees, was installed around the site.

6 CONSTRUCTION

The construction of cell 1 (Fig. 3) began in 1995 February and finished in July of the same year. The cell is presently in operation, and will be the object of the following description.

6.1 Site preparation

After clearing the site, the slopes of the depression were adjusted, to the final slope angle of 60°. In order to complete the depression contour in the area of the old roadway, built to serve the sand pit operation, an embankment was constructed (with a slope of 1V:2H), using properly compacted local soils.

6.2 Liner system

After preparation and acceptance of the soil subgrade, the construction of the cell proceeded

Fig. 3. General view of the landfill.

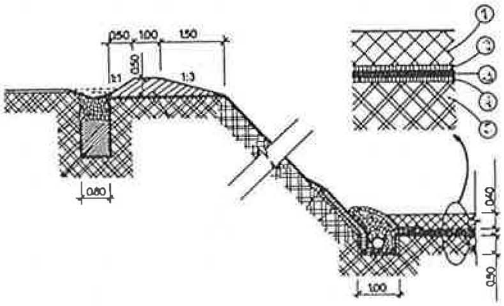

Fig. 4. Liner system: (1) subgrade; (2) geotextile; (3) geomembrane; (4) geotextile; (5) sand.

with the installation of the liner system. The technical and ecological solution, selected for the impermeabilization of this waste disposal facility, took into consideration the previously enhanced geological, hidrogeological, and geotechnical characteristics, as well as the existing legislation.

The liner system consists of the following (Fig. 4):

- a first layer of a needle punched, non-woven, polypropylene geotextile, with 140g/m^2, installed over the grading;
- a smooth geomembrane of high density polyethylene (HDPE), with 1,5 mm thick;
- a second geotextile layer, with the same features of the first layer;
- a sand layer, with 0,4 m.

The use of the most adequate materials, and a correct installation are paramount to the performance of any liner system, and, from this point of view, a Quality Control Programme had been presented and implemented by the installation company.

At the planning stage, the geometrical shape of the landfill had been taken into consideration in order to avoid the possibility of causing any distortion in the geomembrane.

A panel layout had been prepared and is essential to show how the rolls or packages of geomembrane shall be assembled and joined by welding, to form the finished liner. This is of the utmost importance when dealing with 52 m high slopes, dipping 60°. Particular precautions had also been taken with the anchor trenches at the crown of the slopes.

The geomembrane seam welding had been accomplished by double fusion welding with an air channel (hot wedge welding).

The repairs and some needed patches had been performed with a new piece of geomembrane from the same batch as the one used for the prime work, and by means of an extrusion welding machine with a welding rod.

Over the years, Construction Quality Assurance has evolved from a simple process of observing and recording data, to a complex interrelated process of inspection and physical testing, both at the place of manufacture and at the site of the installation.

The geomembrane quality control implemented for this landfill took the following aspects into consideration:

- conformance testing of the raw materials and finished products;
- inspection upon the arrival on site;
- trial seam welding with destructive testing (peel, shear);
- non destructive testing of all field weldings (visual inspection, vacuum testing, air-pressure testing);
- monitoring of the welding;
- destructive testing of the field welds.

6.3 Drainage systems

The drainage systems basically comprise the peripheral ditches to divert the surface runoff, the bottom collection channels to convey the leachates to the location from which they are removed for treatment, and the gas control system. The last one (Fig. 5), has been constructed in such a way that its development, in height, follows the waste landfill process.

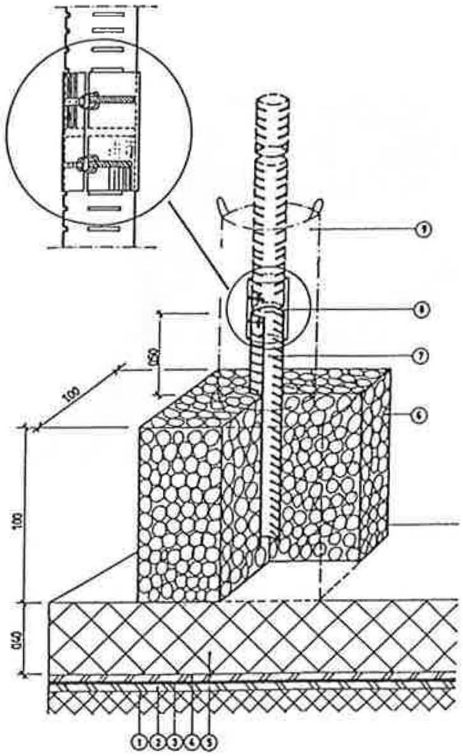

Fig. 5. Landfill gas vent: (1) subgrade; (2) geotextile; (3) geomembrane; (4) geotextile; (5) sand; (6) gabion (10x10x10 m); (7) perforated HDPE pipe (ϕ=160 mm, h=15 m); (8) telescopic joint; (9) guide pipe.

7 OPERATION

Considering the morphologic features of the site, the characteristics of the cover soil, the climatologic conditions, and the quantity and nature of the produced MSW, the filling process of the landfill is being developed by placing the waste in layers. The waste deposited in each operating period, usually one day, forms a daily cell. The waste deposited by the collection vehicles is spread out in 0,5 m layers and compacted to a density of 0,8 t/m^3. The typical dimensions of a daily cell are: 1 m height, 25 m width, and 15 m length. However these dimensions depend on the volume of waste, on geometric restrictions of the landfill area, and on weather condition.

The exposed face of the cell is covered, at the end of each operating period, with about 0,2 m of local soil.

To protect the geomembrane, installed over the side slopes, a layer of soil is placed against it, and only there after the waste is placed.

In order to detect any leakage of leachates from the bottom of the landfill, a groundwater monitoring plan has been made. It consists in the collection of water samples from boreholes, and their analysis at an offsite laboratory.

8 FINAL REMARKS

The application in Portugal of the 1991 CEC Directive on Landfill Waste resulted in an enormous adaptation effort of the local and regional governments, not only at the technical and administrative level, but also from an economic point of view (LNEC/DGQA, 1992).

This landfill, built in agreement with the aforementioned Directive, has been claimed to have improved the solid waste management situation in the Seixal and Almada municipalities, insuring a better protection of the environment and public health.

Although some controversy still exists about which is the best technical solution: the compacted clay liners or the geomembrane liners, in the described landfill, the geomembrane resulted in a better price-benefit relation.

9 ACKNOWLEDGMENTS

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