Creation of a New Storage Cell in the Wauthier-Braine Waste Disposal

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ABSTRACT : The Wauthier-Braine (20 km South of Brussels) disposal site has been selected to dispose non-toxic industrial wastes. It is located in a former sand quarry that have already been partially filled with inert and non-toxic waste.
The lining system has been engineered in order to take into consideration important settlements. This disposal site is the first one in Wallonia where geosynthetics and mineral materials were used together for the lining systems.

1 INTRODUCTION

Belgium like many other developed countries is confronted to the elimination of industrial wastes.
The experts of the BIFFA Waste Services Company decided to open a disposal for non-toxic industrial wastes like cardboard, plastics,... These wastes are constitued of a substantial organic part and will be subjected to biological degradation.

Located at about 20 km South of Brussels, the Wauthier-Braine Waste disposal is using a former sand quarry. The local geological and hydrogeological situations requested a particular attention related to potential pollutions.
For Wallonia, one of the three regions in Belgium, and up to now, regulations are mostly covering waste classification, how to organize the site study,...
A general requirement related to the global permeability of the cell has been stated : $k \leq 10^{-9}$ m/sec which correspond to the clay permeability. Since a very long time, clay has been considered by the local engineers and geologist as the unic waterproofing material for waste disposals.
By the way this regulation has been published in 1987 but was not applied on site. This situation changed after a few major pollutions and a maximum security has then be requested : optimal performances for 50 to 100 years...
The preparation of Wauthier-Braine site took place at this period.

Considering the situation, Monjoie, Rigo and Polo-Chiapolini (1992) prepared a vade-mecum for the realization of artificial waterproofing systems for landfills in Wallonia, including analysis on the site selection, the lining materials selection, the basic principles on which the design must be based, the design methods, the placement of each componants and the QC/QA procedures.

2 WAUTHIER-BRAINE SITE DESCRIPTION

The Wauthier-Braine site is located in a former sand quarry. Figure 1 gives a general view of this site. The total area is 400.000 m².
Cell 0 has been filled with ashes. Cell 1 has been filled with non-toxic industrial wastes.

The hereby described plannings involved cell 3. As indicated on the Figure 1, cell 3 is constitued by 3 slopes and a bottom lining.
Celles 4 will be prepared later.
Below the cells bottom one can find 10 meters sand and then clay on about 25 meters. The watertable is at 3 meters below the cells bottom.

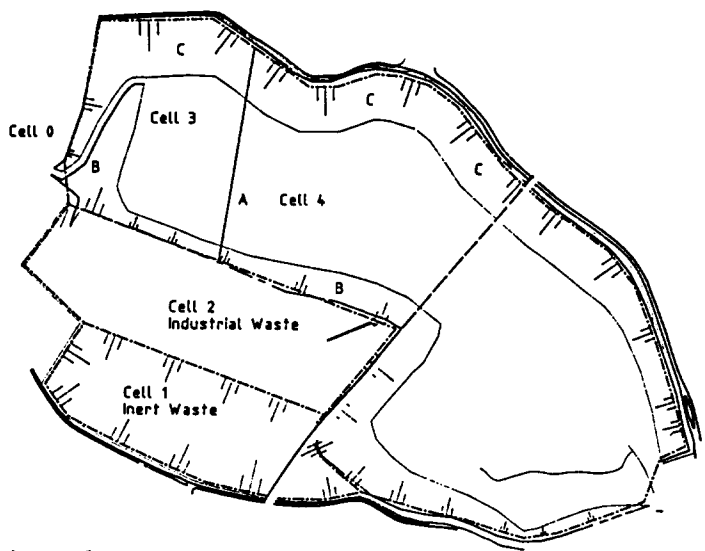

Fig. 1

As indicated on this Figure the 3 slopes of cell 3 are constitued of different materials :
- between cells 3 and 2 : non-toxic industrial wastes (very young wastes);
- between cells 3 and 0 : ashes (very old and stabilized);
- slope c : natural soil (sand).
This specific situations will create settlements problems at the junctions of the 3 slopes. This has been taken into consideration during the design and a technical solution has been developed.

The total area to be covered in cell 3 was 60.000 m² (24.000 m² bottom and 36.000 m² slopes).
The slopes angle is 26°. The slopes lengths are ranging between 50 and 70 m.
The bottom dimensions are 200 m x 120 m.
More details have been published before on this site (Canivet Ph., 1992).

3 BASIC PRINCIPLES FOR THE DESIGN OF THE LINING SYSTEM

The bottom lining system has been designed on the basis of a double lining : waste/leachate collection and removal drainage layer/a 2,0 mm HDPE geomembrane/secondary drainage layer/a 60 cm compacted clay layer.
The slopes lining is more critical because of the expected settlements of :
- the stored wastes;
- the slopes supporting soils (or waste).

Important differential settlements are expected at the slopes junctions as said before. For these reasons, the principle of the zero stress in the slopes geomembranes has been used. A geotextile has been placed on top of the geomembrane creating a low friction interface where movements are allowed. The leachate collection and removal layers were made of a cement stabilized sand on which gabions were anchored. This drainage layer is self-supporting. This requested a particular attention from the contractor for the placement of this drainage layer. This will be described hereafter.

4 TYPICAL CROSS-SECTIONS

4.1 Bqttom lining

Figure 2 shows a typical cross-section of the lining system (bottom and slope). The various components of the bottom lining system are as follow (from bottom to the top) :
- 10 cm gravel between two geotextiles for drainage and anticontamination;
- 60 cm compacted clay ($k_{max} = 10^{-9}$ m/sec) as a first waterproofing layer;
- 30 cm drainage sand layer, collecting pipes with a geotextile as a separator between sand and clay.

- a 2 mm thick HDPE geomembrane, smooth on both sides as the primary waterproofing layer;
- a protection layer made of a 10 cm sand layer and a geotextile as separation between this sand layer and the leachate drainage system;
- a 40 cm gravel layer (56/120) including drainage pipes as a leachate collection and removal system;
- a geotextile as separator and filter between the waste and the leachate drainage layer.

. mechanical support of the top drainage layer (gabions). For this purpose, an important risberm has been realized on top of the hole lining system at the foot of the slopes in order to stabilize mechanically this supporting layers.;
. deformation absorber : under the action of the acid leachates the stabilizing cement is supposed to be dissolved.

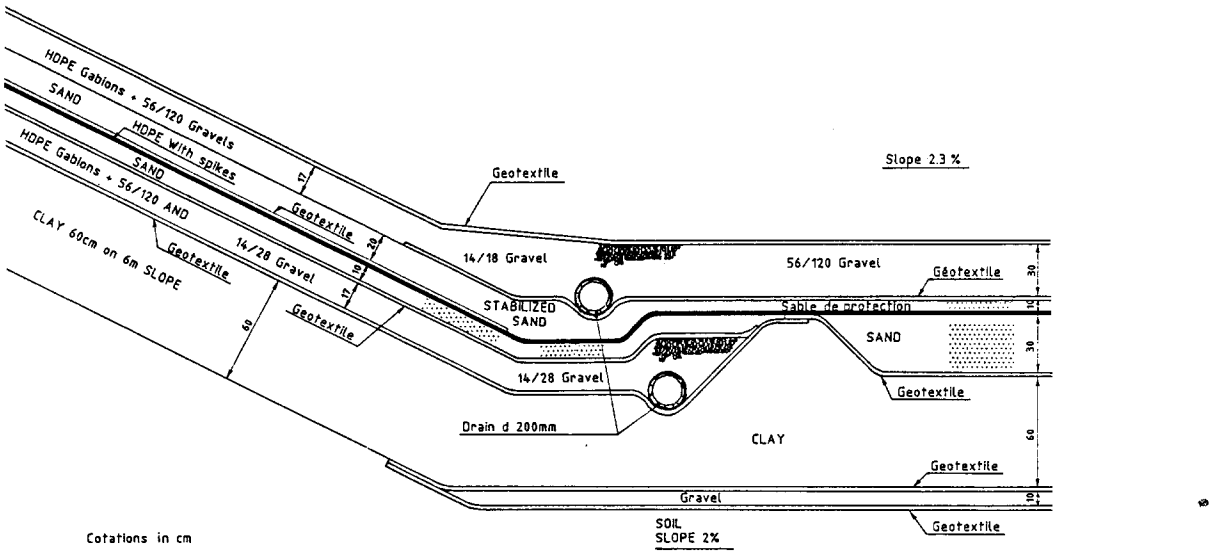

Fig. 2

4.2 The slopes

For the slopes located on wastes, the lining system are constitued of the following components (see also on Figure 2) :
- a 60 cm compacted clay (kmax = 10^{-9} m/sec) on 13,4 meters along the slopes;
- 17 cm HDPE gabions with 56/120 drainage gravels as a :
. stabilization of the existing waste slopes;
. mechanical support of the lining system;
. drainage of the leachate generated by the existing wastes;
. drainage of leakages passing through the HDPE geomembrane;
- a protection layer made of a geotextile and a 10 cm sand layer;
- a 2 mm HDPE geomembranes with spikes (4 mm) on the bottom side and cuspated on the top;
- a geotextile with low friction angle on the geomembrane;
- a 30 cm of cement stabilized sand layer as :
. protection for the geomembrane;

The sand layer is then loosing its rigidity allowing deformations and an efficient geomembrane protection;
- gabions drainage lines were then anchored in the stabilized sand layer (as showed on Figure 3) in order to collect the leachates along the slopes. The gabions lines were organized as spur drains.

More details were published before on this (Tcherniaeff M., 1992):

4.3 Lining systems at the slopes junctions

As presented before, the slopes junctions are supposed to be stressed and strained under the action of the settlements. In order to insure the durability of the geomembrane under these very severe conditions, the junction of the slopes geomembranes has been realized in fan as showed on Figure 3.

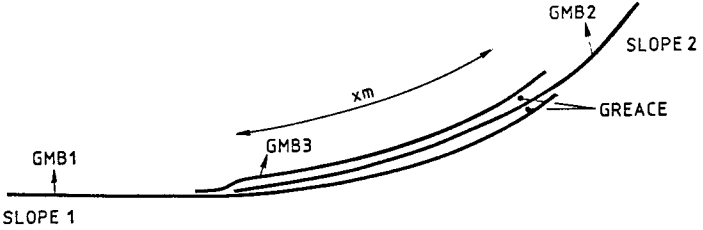

Fig. 3 Junction (in fan) at the cell corner between the slopes geomembranes

GMB1: geomembrane on slope 1 (with spikes)
GMB2: geomembrane on slope 2 (partially with spikes)
GMB3: geomembrane element (smooth) reduced on geomembrane 1

A total movements of about 7 meters is expected at the top of the junction. This movement is near to be zero at the bottom. Some greace has been placed between the membranes in order to decrease the friction angle and to help to the waterproofing function after the geomembranes movements.

5 PLACEMENT AND QUALITY CONTROL

All the operations, from design until placement, have been reviewed and controlled by an independent quality office.
A particular attention has been placed on the clay compaction and on the geomembranes seaming operations.

The 60 cm compacted clay layer has been placed in 3 steps (3 layers of 20 cm each). The clay has been controlled :
- at the extraction;
- during the laying down;
- after the placement.

Various tests have been done: granulometry, Atterberg limits; volumic weight, voids index and water content.

The permeability has been obtained by means of laboratory tests.
More details on all this procedure have been published by Hilde J.L. (1992).

The geomembranes seaming operations were subjected to a QC/QA procedure as described by Rigo and all (1992). Destructive and non-destructive tests were performed following the ASTM standards.

6 CONCLUSIONS

The Wauthier-Braine disposal site was the first engineered lining system using both geosynthetics and natural material in Wallonia (Belgium). This site is located in a former sand quarry. The pollution risk was high.
Engineers were faced with particularly high settlements. For this reason practical solutions were developed in order to reduce at maximum the stresses in the geomembrane.

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