Landfill Drainage Systems

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ABSTRACT: The authors present two waste landfill (WL) drainage systems using a geocomposite. The first is used for surface water drainage to limit the volume of water entering the landfill. The second is used for drainage of leachates.

1 DRAINAGE OF SURFACE WATER OF THE LANDFILL WASTE IN LAUZIERES

The operator has chosen not to use a geomembrane or Geosynthetic Clay Liner (GCL) to seal the landfill. In order to limit the infiltration of water inside the landfill the solution retained was the DRAINTUBE system, a drainage geocomposite composed of a filter, a drain core and regularly spaced mini-pipes (figure 1). These elements are assembled by needle-punching. The mini-pipes enable fast, mono-directional evacuation towards the collector trenches.

Figure 1. Structure of the geocomposite.

For drainage of the dome area, the geocomposite is placed on a 30 cm thick closing material. The considerable flow-off length (200 m) and low slope angle (3%) required the creation of intermediary collectors every 60 m in order to evacuate the excess storm rain water with an intensity of 100 mm per day.

The system is dimensioned to obtain a maximum pressure between mini-pipes of less than 1 cm (figure 2).

Figure 2. Diagram of pressure between mini-drains

This very low water pressure does not affect the top soil to geocomposite layer interface characteristics (figure 3) and therefore guarantees the correct hold of the top soil.

The following factors are taken into account when calculating the percentage of water infiltrating inside the landfill:
- the flow of the geocomposite drainage layer,
- the perpendicular permeability of the geocomposite,
- the permeability of the surface sealing material.

An infiltration percentage of around 4% is thus obtained, which enables correct decomposition of waste while limiting the volume of leachate.

The problem with draining embankments with a slope of 3H/2V is the same as for the surface cover. However, in order to get the top soil layer with a thickness of 0.10 m to hold over a slope distance of 20 m required special measures. Two test sections were created (figures 4a and 4b).

Figure 3. View of the surface covering and drainage system.

Figure 4a. Test section n°1
The test procedure employed was to lay out the materials as indicated in figures 4a and 4b by securing the head of the geosynthetic materials (drainage geocomposite and geogrid) in a traditional anchor trench (figure 5).

Figure 4b. Test section n°2

The cocoa matting is fastened to the embankment at regular intervals (pins), in order to resist the force of the wind.

These test sections were completed in May 2000. Over a year later, the following points were noted:

- section n° 1 (figure 6), good hold of top soil and sufficient vegetation which favours evapotranspiration

- section n° 2 (figure 7), partial vegetation coverage due to instability of the top-soil.

Figure 5. Anchor trench

Figure 7. State of section n° 2 over a year later

Removal of part of section n°1 enabled observation of the following:

- the geogrid is in a perfect state and presents a certain level of tension. This fact confirms that it accomplishes its task of retaining the top soil (figure 8).

- the geocomposite drainage layer is humid and thus favours the growth of vegetation.

- cutting the geocomposite drainage layer indicated that it was not polluted by the top soil.

Figure 6. State of section n° 1 over a year later.

Figure 8. State of the top soil securing geogrid

Tests were carried out on these test sections to measure the geogrid head tension (figure 9).

A dynamometer of 25 kN was placed between the geogrid and a concrete test block.
The careful and progressive application of 0.10 m of top soil on the geogrid enabled measurement of a force of 4 kN over a width of 5 m.

The theoretic calculations taking into account the soil-geogrid friction forces provided a traction value of 10 kN/m.

The considerable difference between these two values (theoretic and true) is mainly due to partial friction caused by the anchor beam (figure 10).

In order to counter this problem and preserve the functional characteristics of the filter, we have developed a mechanically bonded, non-woven geotextile composed of black fibres on a stabilising layer, guaranteed anti-UV for two years (figure 12).

When the geocomposite drainage is to be used on embankments, the same anchor trench system is used as for geomembrane liners (figure 13).
To guarantee continuation of the drainage and mechanical protection functions during filling of the landfill, the geocomposite sheets are welded together (figure 14).

Figure 14. Covering and fastening of sheets.

3 CONCLUSION

These applications have enable:

- the development of protective drainage geocomposite resistant to UV rays,
- the successful efficiency geogrid retainment top soil on slopes,
- the limitation of water infiltration into the cell.

4 REFERENCES
