Table of contents Search Author index

Geosynthetics - 7th ICG - Delmas, Gourc & Girard (eds) © 2002 Swets & Zeitlinger, Lisse ISBN 90 5809 523 1

Landfill Drainage Systems

R. ARAB & Y. DURKHEIM, AFITEX, France
P. GENDRIN, GEOROUTE Ingenierie, France

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.

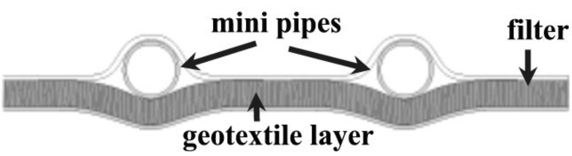

Figure 1. Structure of the geocomposite.

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 60m 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).

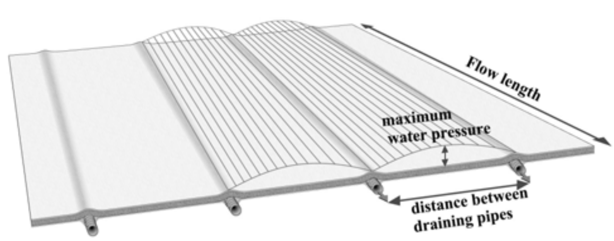

Figure 2. Diagram of pressure between mini-drains

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.

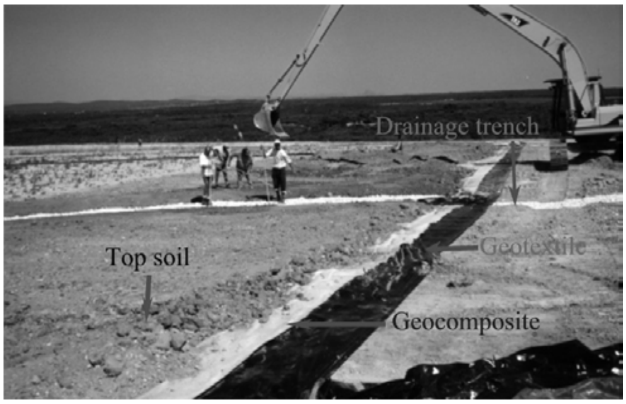

Figure 3. View of the surface covering and drainage system.

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).

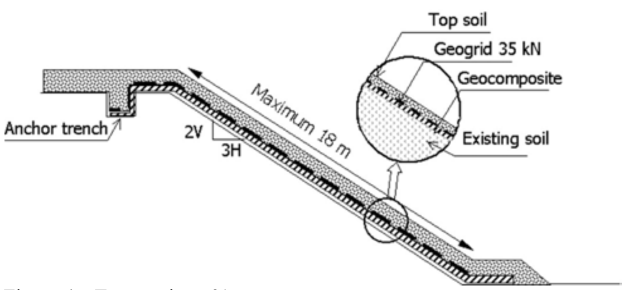

Figure 4a. Test section n°1

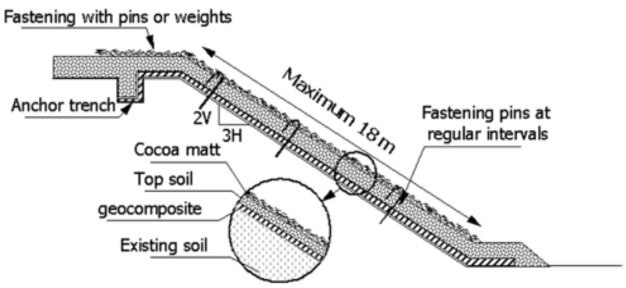

Figure 4b. Test section n°2

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 5. Anchor trench

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

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

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

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 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

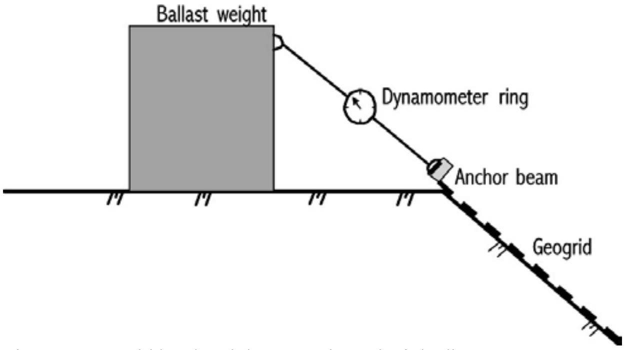

Figure 9. Geogrid head-weight measuring principle diagram.

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)

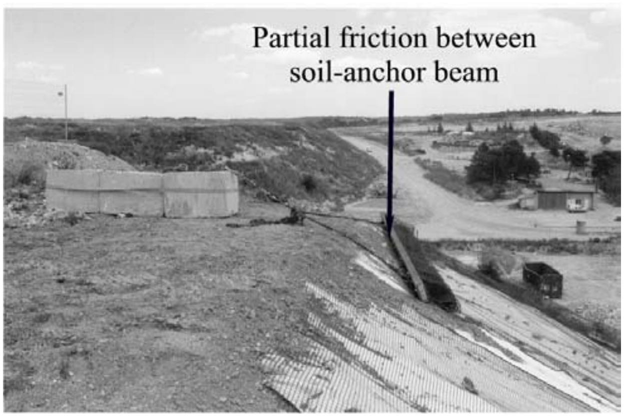

Figure 10. View of soil-anchor beam

2 DRAINAGE OF LEACHATE IN THE LANDFILL WASTE IN DOMERAT

When operating a domestic waste landfill, a leachate drainage system is obligatory before their treatment. Drainage generally takes place in the sump of the landfill via a 30 to 50 cm thick layer composed of granular material.

The use of a drainage geocomposite on the embankments enables fast drainage to the sump with a drainage layer gain in storage volume.

In the case of leachate drainage, the flow volume may be estimated according to the rainfall volume provoking fermentation of the waste.

The geocomposite drainage layer used contains one mini-drain per metre which enables evacuation of a flow volume corresponding to a rainfall of 138 mm/day. The drainage layer has a surface of mass 800 g/m² and the filter layer a surface mass of 200 g/m² which also fulfils the role of an anti-puncture protection for the geomembrane liner for a waste depth of around 10 m.

As the time required to fill the landfill is around two years, an Ultra Violet (UV) ray resistant geotextile filter must be included as the geosynthetic liners are extremely sensitive to these rays (figure 11)

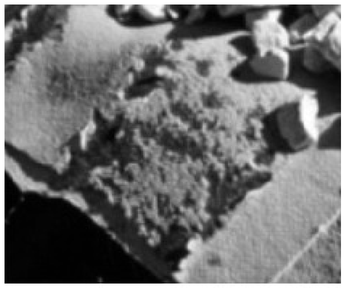

Figure 11. Damage to the geotextile filter caused by UV rays

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).

Figure 12. Geocomposite drainage layer with filter guaranteed anti-UV for two years

When the geocomposite drainage is to be used on embankments, the same anchor trench system is used as for geomembrane liners (figure 13).

Figure 13. Fastening of a geocomposite drainage layer at the head of the embankment

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

Durkheim Y. & Gendrin P. 2000. Drainage Design in a Landfill Lining System at the Saint Sylvestre Bas Le Roc (Creuse france). *Second European Geosynthetics Conference, Vol. 2, pp. 505-507.*

Faure Y.H., Auvin G. 1994. Performance and Design of Geocomposites for Drainage of Gaz. *Fifth International Conference on Geotextiles, Geomembranes and Related Products, pp. 833-836.*