Long-term performance of geosynthetic drainage elements

Comportement de long durée des elements geosynthetiques pour le drainage

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ABSTRACT: Six landfill covers of 2 to 12 years of service life were opened, samples of random wire drainage composites exhumed. Tests on pristine and exhumed specimen show

- no measurable changes of the polymer;
- soil embedment in the nonwoven filter causing the permittivity to be halved;
- no drain flow reduction by roots or soil embedment

RÉSUMÉ: Six couvertures des décharge pour ordures avec une durée de vie entre 2 et 12 ans étaient ouvertes; echantillons des geosynthetics pour drainage ont été prelevés. Essais hydrauliques et mecaniques avec les echantillons exhumés et a l'etat vierge conduisent à les conclusions suivantes:

- aucune dégradation des polymers n'est mesurable ;
- intrusion des particules de terre penêtre dans le filtre diminue la pérméabilité de moitier ;
- le transmissivité n'est pas influencé par racines ou intrusion des particules de terre entre le corps de drainage

1 INTRODUCTION

Laboratory tests on drain composites give reliable data on deformation and water flow without soil particles. Reality in soil may change these values. Therefore a exhumation program of geosynthetic drainage composites was started, executed by the accredited laboratory tBU and sponsored by the producer.

2 EXHUMATION AND TEST PROGRAM

Six landfills in Germany and one river amelioration were chosen. Their service life was up to 12 years (landfill) and 20 years (river). Figure 1 shows the general location in Germany.

Figure 1. Locations of exhumation in Germany

The exhumed specimen were tested on

- hydraulic properties
  permittivity of the nonwoven filter (with soil/without soil)
  transmissivity of the composite
- mechanical properties
  shear
  creep
- durability
  DSC of polymers
- optical (Scanning Electron Microscope – SEM)
  soil in filter
  surface of wires
  degradation of surface
- rain events before exhumation were registered.

An accompanying test program by ICP and TUM dealt with the soil properties.

3 RESULTS

3.1 *Soil embedment*

The soil embedment is mainly a phenomenon in the upper filter, the bottom filter got some intrusions in case of clay liners underneath. In the drain core very little soil was found (see figure 2).

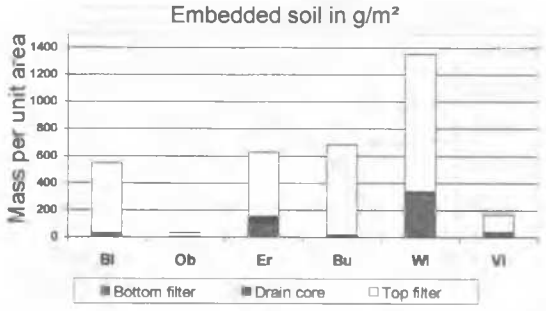

Figure 2. Soil embedment in the layers of a drain composite

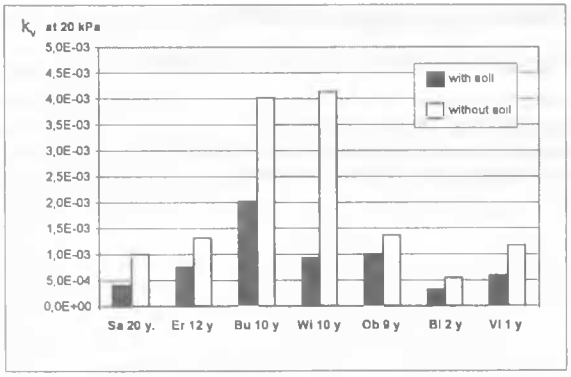

Figure 3. Permittivity of filter with and without soil embedded

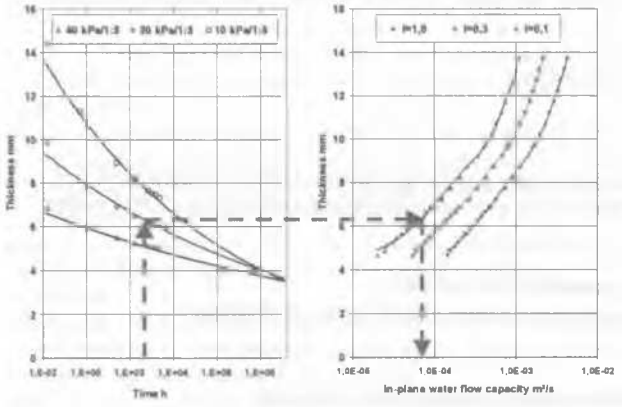

Figure 4. Creep time and thickness/flow curves

3.2 *Hydraulic properties*

The flow through the geofilter was lower with soil embedment. On average the value of k_v is half of the new material (see figure 3).

The core material showed the same values versus thickness as the pristine material. The values fit into the design-nomogram figure 4.

3.3 *Mechanical properties*

The tests in progress show no difference in comparison to new material: no shear rupture, no stiffness change.

3.4 *Durability*

The Arrhenius plot of the PP-material for the random wires is given in figure 5; it is to be seen that after up to 20 years at ca 10 °C no change will be measurable.

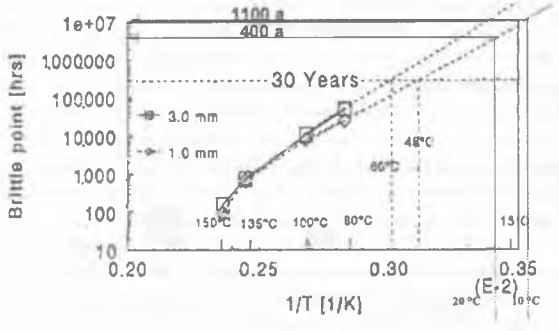

Figure 5. Arrhenius-plot of PP wires

3.5 *Optical impressions*

Some example pictures show the exhumation. The top soil was removed with excavators, the last 10 cm by hand. Some specimen were extracted with 10 cm of contact soil

The exhumation 3 days after a 100 y rain event showed a only humid drainage composite. Roots were found in a depth of 1.4 m in the top filter (vegetation bushes and trees on the cover) and some very fine in the compacted clay liner

Polymer degradation was not to be observed. The figures 12 and 13 show the joint of the random wire core after exhumation. The rough surface at the joint is also seen in pristine samples.

Figure 6. Exhumation Erbenschwang

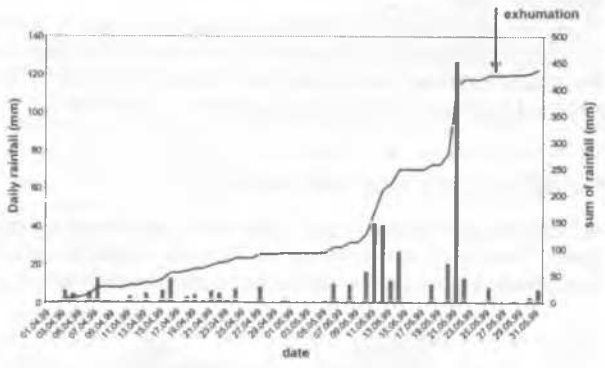

Figure 7. Rain events Erbenschwang

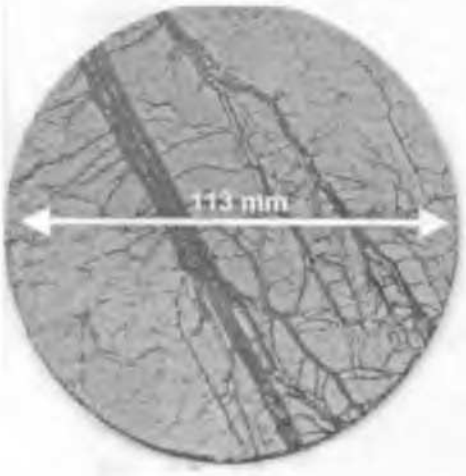

Figure 8. Roots in top filter joint

Figure 9. Roots in top filter (SEM)

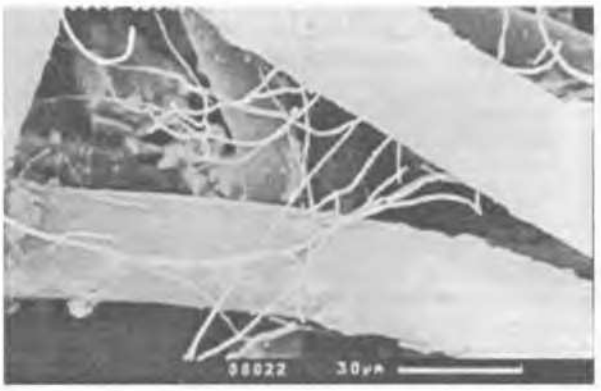

Figure 10. Roots in drain core (SEM)

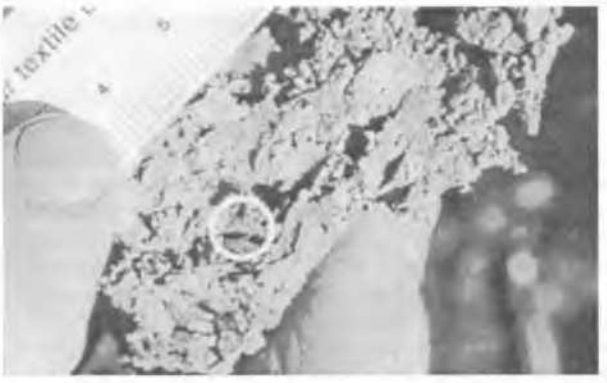

Figure 11. Roots in compacted clay liner

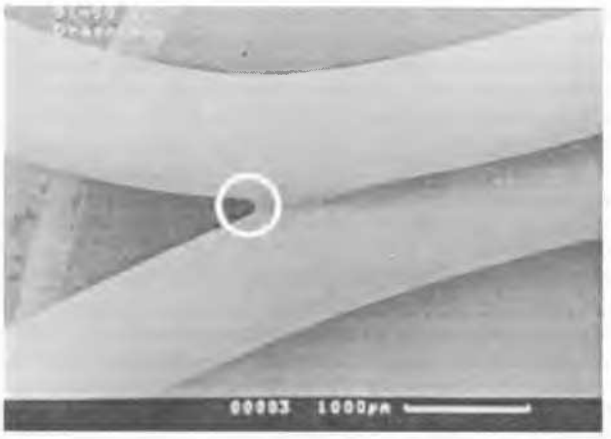

Figure 12. Wire of drain core (SEM)

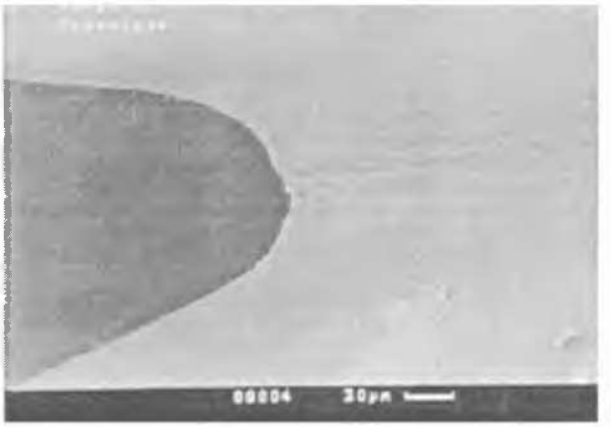

Figure 13. Joint of wires of drain core (SEM)

4 CONCLUSION

The exhumation of products after up to 20 years of service life showed

- well functioning systems
- no polymer degradation
- no essential clogging or blocking of the filter.

Geosynthetic drainage elements are
effective
reliable
durable geotechnical products.

5 REFERENCES

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