European Recommandations on Geotextiles and Geomembranes in Landfills

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ABSTRACT : Geosynthetics are nowadays of common use in landfills. Two European organisations are now working on this topic : the CEN Technical Committee TC 189 for the standardization level, and the ESSMFE Technical Committee 8 for the Technical Recommendations about Geotechnics of Landfill Design and Remedial Work. The ETC 8 is working on a broader geotechnical approach of landfill geotechnics, but, to cope with geosynthetics it has agreed to take into account the general approach of the CEN TC 189.

1. INTRODUCTION

As a consequence of the European unification process, the free circulation of goods (including geosynthetics) and persons, will be a reality. This will also mean the unification of basic requirements, design and testing methods. The CEN was officially appointed to achieve the standardization work. The CEN Technical Committee 189 is in charge of the area of geotextiles and related products. It also deals with geomembranes applications through the Joint Working Group with CEN TC 254 (flexible sheetings for water proofing) (Rigo and Delmas, 1993). In the organisation of CEN TC 189, the Working Group 1 deals with general and specific requirements, performance criteria in different applications such as landfills.
The European Technical Committee 8 (ETC 8), founded at the ICSMFE 1989 in Rio de Janeiro, aims at providing the engineering practice with recommendations for its work. The work of this Committee comprises the major geotechnical aspects in landfill design and remedial works. In its second edition of Recommendations published in 1993 (GLR, 1993), the ETC 8 has included the already discussed work made in CEN TC 189 WG1 and has added under "appendix" status additional country-specific proposals (Jessberger et al., 1993).

2. GEOTEXTILES AND RELATED PRODUCTS

Geotextiles and related products (geogrids, geonets,...) are dealt with in the following GLR Recommendations :
R 2-9 Principles for the Use of Geotextiles and Related Products;
R 3-9 Suitability Tests for Geotextiles and Related Products;
R 5-5 Quality Assurance for Geotextiles;
A 2-9 Geotextiles in Lining Systems (French proposal);
A 5-5 French Certification Procedure for Geotextiles.
The main point in recommendation R 2-9 is the analysis of the functions of geotextiles in lining systems :
- drainage of fluids (liquid and/or gases);
- filtration in drainage systems;
- protection of geomembranes and other liners;
- reinforcement (soils or waste)

To fulfil the design requirements, geotextiles and related products have to be carefully selected. There is a need to guarantee the satisfactory long term performance of the products, especially at the base of a landfill where no access for maintenance and remediation can be provided once waste is deposited.
Table 1 is listing the suitability tests that are either necessary (N) or applicable (A), from a French point of view, for the selection of products (or combined products), for each of four functions indicated here above. This proposal is a landfill related modification of the CEN TC 189 WG1 N48E official document issued for the general applications of geotextiles and related products in lining systems.
In recommendation R3-9 testing procedures that can be adopted to perform the tests listed in Table 1 are summarised.
Recommendation R 5-5 deals with quality assurance for geotextiles in landfill applications; the proposed quality assurance procedure classically covers :

Table 1 : Geotextiles in lining systems of wastes disposals

This table modified from the CEN TC 189 WG1 N48E corresponds to a French proposal to present teh tests to be specified in regard of the wanted function of the geotextile.
(N) Results of the correponding test to be given in any case for all the projects;
(A) Results of the correponding test to be given if required according to the specifities of the projects;
(1) Geomembrane hydraulic performance to be tested after performing the test;
(2) Tested in association with the associated geomembrane.

Function	Filtration	Reinforcement	Drainage	Protection
Performance tests	long term filter stability static puncture resistance resistance to chemical degradation (A)	friction (inclined plane)(A) in soil creep test (A) in soil tensile test (A) resistance to chemical degradation (A)	long term drainage (biological clogging) (A) resistance to chemical degradation (A)	long term puncture resistance (A) (1,2) resistance to chemical degradation (A) burst test (A)
Index tests	opening size (N) permittivity (N) resistance to chemical degradation (A) thickness at specified pres. (N)	tensile test (N) friction (direct shear test)(N) tensile for joints or seams (A) tensile creep behaviour (A)	transmissivity (N) water penetration resistance (A)	static puncture test (see Gmb) (N) (1,2)
Installation test	tensile test (N) construction damage (N) thermal oxidation (A) temperature (junction of gmb)(A) tensile for joints or seams (A) dynamic perforation test (A) identification of roll (N) mass per unit area (A) thickness at specified pres. (A)	tensile test (N) construction damage (N) dynamic perforation test(N) thermal oxidation (A) identification of roll (N) mass per unit area (A) thickness at specified pres. (A)	tensile test (N) construction damage (N) identification of roll (N) mass per unit area (A) thickness at specified pres. (A)	tensile test (N) construction damage (N)(2) thermal oxidation (A) dynamic perforation test (A) (2) identification of roll (N) mass per unit area (A) thickness at specified pres. (A)

Table 2 : Geomembranes in landfill lining systems.
This table modified from the CEN TC 189 WG1 N48E corresponds to a French proposal to present teh tests to be specified in regard of the wanted function of the geotextile.
(N) Results of the correponding test to be given in any case for all the projects;
(A) Results of the correponding test to be given if required according to the specifities of the projects;
(1) Fluid, e.i. liquids and gases; (2) Wheathering, chemical, biological, permanent elongation; (3) Strain stress behaviour; static & cyclic;
(4) Tested on the system geotextiles and geomembranes

Function	Fluid barriers (1)
Performance tests	chemical gas permeation (A) (2) long term liquid "permeability" (N) resistance to chemical degradation(2) friction properties (anchorage, slope,..) (N) (4) tensile test (performance) (A) (3) tensile test on joints (performance) (N) hydrostatic puncture resistance (4)(A) static puncture resistance (4)(A) burst creep / relaxation behaviour (A) bursting (large diameter) (4) (A) resistance to chemical degradation, biological, UV, Oz, water, roots tested on gmb and joints (A)
Index tests	water vapour transmission (A) thickness at specified pressure (N) stress crack (A) carbon black (content, dispersion) (A) tensile test (performance) (N)
Installation test	tensile test (performance) (N) impact test : gmb, joints (4) (A) construction damage (4) (N) straightness flatness (A) low T° folding (N) high T° stability (N) coefficient of linear expansion (A) identification of roll (N) mass per unit area (A) thickness at specified pressure (A) joints: peel test (A),and tensile shear test (A), vacuum box (N), sparkle test (A) and dual seams test (A), air lance test (A)

- the manufactures of the product (product quality);
- its acceptance as a possible component of a landfill;
- quality assurance on site.

It must be pointed out that the recommendations clearly make a distinction between :

- "certified geotextiles for which the performance characteristics are certified by an external independent party and;
- "non-certified" geotextiles.

As an example, Appendix A 5-5 of the GLR Recommendations describes the French certification procedure is fully effective in France.

3. GEOMEMBRANES

The recommendations R 2-10, R 3-10 and R 5-6 are dedicated to geomembranes either synthetic or bituminous. Geosynthetics clay liners have not been introduced in the recommendations because they can be considered as relatively new materials for which more experience is needed before any extensive use in landfill applications.

Recommendation R 2-10 "Principles for the use of geomembranes" is completed by Appendix A 2-10 which lists the tests, also (N) or (A), that, from a French point of view, have to or can be done for a proper selection of geomembranes as fluid barriers. Table 2, where possible testing procedures for the suitability tests are listed, is also a modification of the more general CEN document, where other applications of geomembranes are considered.

In R 5-6 of the GLR-Recommandations quality assurance of geomembranes in landfill applications is considered. Similar to geotextiles the quality assurance of geomembranes comprises :

- product quality;
- acceptance of the product as a possible landfill component;
- quality assurance on site.

Reference is made to the German certification procedure of geomembranes (BAM, 1992).

4. CONCLUSION

Dealing with geosynthetics in landfills, ETC 8 GLR Recommendations, provide and up-to-date check-list of general principles and subsequent testing procedures and/or requirements in order to avoid basic mistakes in the design and acceptance in landfill applications.

It must be pointed out that the GLR document is already based on the CEN principles that should be expressed in the corresponding standards in a near future.

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