THE ROLE OF GEOSYNTHETICS IN U.S.A. WASTE MANAGEMENT FACILITIES

Gregory N. Richardson, Ph.D., P.E.
Westinghouse Environmental and Geotechnical Services, Inc.

1. Introduction

Waste management facilities within the United States are regulated by the Environmental Protection Agency (EPA), under the authority of the Resource Conservation and Recovery Act (RCRA) of 1984. Such facilities include hazardous waste landfills or surface impoundments, and municipal waste landfills. More recently, EPA's authority has been broadened to include nuclear waste repositories and military storage facilities.

Within the authority established by RCRA, EPA has conducted a significant research program into the technologies of waste containment. This program has resulted in Minimum Technology Guidelines (MTG) for these facilities. The MTG establish primary components that must be used in hazardous waste facilities and minimum physical standards for each component. Currently attention is focused on municipal landfills and it is anticipated that similiar MTG criteria will be issued for such facilities. In the interim, many states have enacted local regulations for municipal landfills that are based on existing MTG criteria.

This paper summarizes the MTG criteria and reviews the increasing role played by geosynthetics within these facilities.

2. Liquids Containment

The initial focus of EPA's effort and of the first MTG issued (1) was to prevent the migration of liquids within the waste facility to the outside environment. This effort led to a ban on the placement of liquid wastes within the landfills and to the requirement that the integrity of liner be

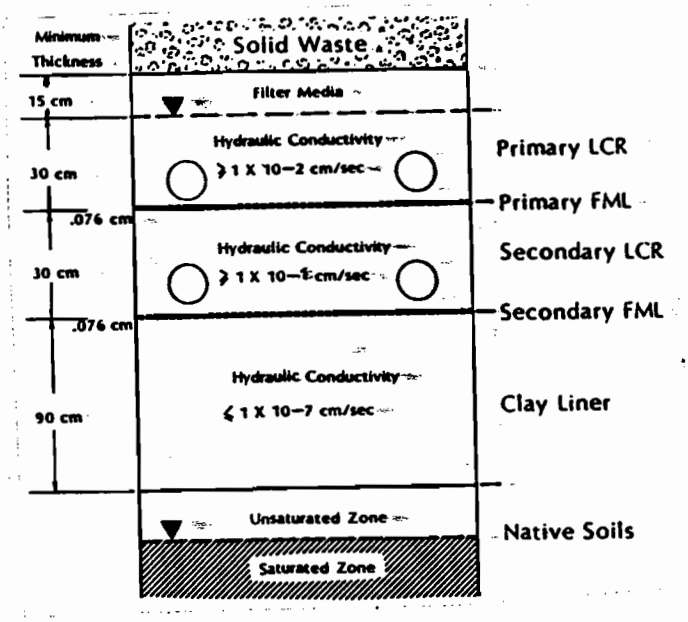

Figure 1 Profile of MTG Double Liner System

verified during the operational life of the facility and for a 30-year post-closure monitoring period. The requirement that the integrity of the liner be verified led to the MTG specified double-liner system. The profile of this double-liner system is shown on Figure 1 and consists of the following components;

- Leachate Collection/Removal (LCR) drainage layer that must be designed to remove both leachate and storm water so that less than 1-foot (30 cm) of hydraulic head acts on the primary liner.

- Primary Flexible Membrane Liner (FML) consisting of a minimum 30-mil (.75 mm) thickness for landfills and 45-mil (1.1 mm) thickness for surface impoundments.

- Leak Detection System (LDS) that functions to rapidly detect leaks in the primary FML liner.

- Secondary Composite Liner consisting of an additional FML and a minimum 3-feet (1 m) of

clay having a hydraulic conductivity less than $1x10^{-7}$ cm/sec.

In reality, a majority of Hazardous waste facilities are being constructed with a composite primary liner that includes an 18-inch (45 cm) layer of clay between the Primary FML and the LDS system. The reasons for this are explained in this paper.

Within the MTG liner configuration geosynthetics play the following roles:

- Filters: geotextiles separate the LCR from the waste mass or operational soil cover,
- Cushion: geotextiles protect the primary FML from the overlying granular drainage media,
- Moisture Barrier: two geomembranes prevent the flow of leachate from the landfill, and
- Drainage: geonets are well suited for use as the LDS layer.

The drainage appplication of geonets has in fact been driven by EPA's goal for rapid detection of leaks in the primary system. This rapid detection criteria prevents the use of a geotextile cushion over the secondary FML and requires a minimal capillary driven storage capacity within the LDS. A geonet provides a better solution to these criteria than natural sands or gravels.

Significant design problems that are encountered when applying the MTG liner system to an actual landfill geometry are as follows:

- <u>Sideslope Stability</u> of the layered components on sidewalls having a typical slope of 3 (horizontal) to 1 (vertical),
- <u>Leachate Sump Access</u> without penetration of an FML below the waste, and
- <u>Access Ramp Stability</u> for the ramps that carry vehicles in and out of the landfill.

The author has recently completed a design manual (2) for EPA that established design principles for these facilities. Again the MTG criteria has fathered another geosynthetic component; textured HPDE has been developed to improve the sideslope and ramp stability problems. Such textured FML's offer significantly higher coefficients of friction (<20°) with adjacent soils than smooth HDPE (13-16°)

The most important concept in the MTG system is the value of a composite liner. The use of an FML overlying a clay layer provides a superior containment system. With the weight of overlying waste forcing the FML into intimate contact with the clay liner a symbiotic relationship is formed. The FML protects the clay from direct chemical exposure and the hydraulic head of overlying leachate. Conversely, the underlying clay significantly reduces the leakage impact of penetrations in the FML. Proposed regulations will control the amount of liquids allowed in the LDS system. For this reason many landfill owners use a composite primary liner instead of only an FML as recommended by MTG.

3. Landfill Closure

The MTG liner system described above results in the landfill functioning as a "bath tub." That is, the landfill will fill with liquids if the drainage sumps are not continually pumped. Concerned about the long-term performance of these landfills, EPA has recently established a MTG profile for the covers of such facilities. The MTG profile for the covers of such facilities. The MTG cover system is shown on Figure 2, and consists of the following components:

- An erosion control layer consisting of a vegetated or armored surface and a soil layer having a minimum thickness of 24-inches (60 cm) and a slope of 3 to 5 percent,

- A drainage layer consisting of 12-inch (30 cm) of clean sands or gravels, and

- A barrier layer consisting of a 20-mil (.5 mm) FML and 2-feet (60 cm) of 1 x 10^{-7} cm/sec hydraulic conductivity clay.

Optional layers include a gas vent layer to remove gases produced within the wastes and a biotic barrier to limit plant or animal intrusion.

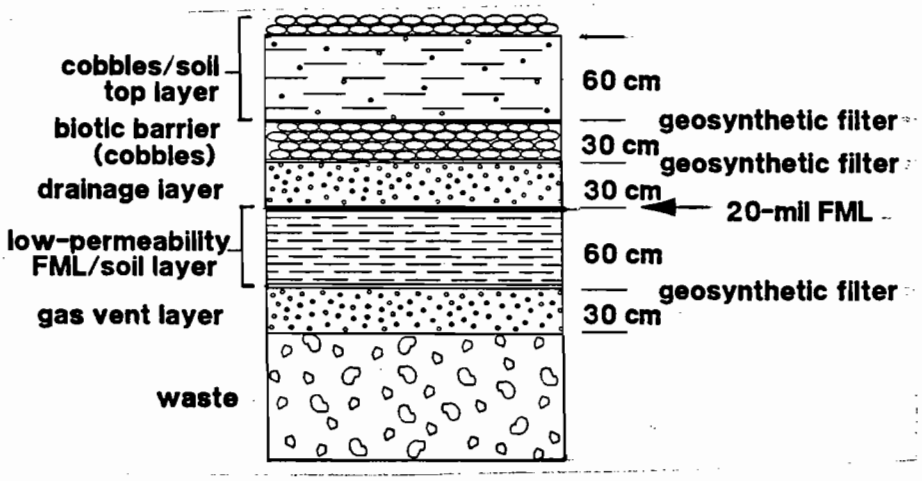

Figure 2 MTG Cover Design with Optional Layers

Within the MTG cover system, geosynthetics used include a geotextile as a filter between the erosion control layer and the drainage layer, and the FML component of the composite barrier layer. While a geonet could be used for the drainage layer, this is seldom done because of the desire to protect the FML and clay layer from frost exposure. This thickness of a conventional sand or gravel drainage layer aids in protecting the barrier layer from frost action.

Many arid regions of the U.S.A. are not able to vegetate the MTG cover due to its poor water storage capability. By placing a drainage layer beneath the top erosion control layer, moisture is removed from the root zone of many plants. Thus periods of drought will kill the vegetation. In these cases an armored surface of stone or asphalt is used.

4. Summary

Modern landfills require geosynthetic components to act as filters, drainage layers, cushions, and moisture barriers. The relative recent introduction of geosynthetics and the critical nature of landfills has concerned many environmental groups. Current EPA research is looking at the chemical compatibility of all geosynthetic components and attempting to define the impact of biological growth on all components. Thus the regulatory community has accepted the role of geosynthetics and are now simply fine tuning their application.

5. References

1. EPA, Minimum Technology Guidance on Double Liner Systems for landfills and Surface Impoundments, 2nd Version, May 24, 1985.

2. Richardson, G.N. and R. M. Koerner, Geosynthetic Design Guidance for Hazardous Waste Landfill Cells and Surface Impoundments, EPA/600/52-87/097, February, 1988.

3. EPA, Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments, EPA/530-SW-89-047, July, 1989.