Geosynthetics: Applications, Design and Construction, De Groot, Den Hoedt & Termaat (eds)
© 1996 Balkema, Rotterdam. ISBN 90 5410 836 3

Case histories of landfills and role of geosynthetics, in Greece

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ABSTRACT: The use of geotextiles, geonets, geomembranes and geocomposites for the waterproofing of the soil in which waste has to be contained or for the capping of the old landfills becomes a standard procedure which offers to the engineer a safe and long term, low cost solution. The last 3 years all the designs for the new landfills are based for the waterproofing on the use of geosynthetics. The basic design and the material specification for these landfills are presented in this paper.

1. ALREADY BUILT NEW LANDFILLS

The waterproofing of the new landfills is based on the use of geosynthetics.

In Greece 6 of the new landfills in provinces are already waterproofed with geomembranes.

The design and the use of geosynthetics follow the sequence geotextile - geomembrane - geotextile and in some cases a geogrid is placed under the goemembrane to face the high pressure of underground water.

The final design is submitted by the contractors which passed the prequalification stage.

The prequalification requirments demand for a Joint -Venture with an experienced contractor from an EU country or in other cases for a declaration from an experienced foreign firm that the specialised works (eg. the waterproofing or the biogas treatment) will be executed by them.

Up to now the waste disposal that have already been built using goesynthetics are in provincial towns with budgets up to 2.000.000 D.M.

The design of the waterproofing follows the sequence geotextile - geomembrane - geotextile with no special calculations.

As these is no official specification for the geosynthetics the consultant proposes through the final design, which the contractor submits, the type and the method of waterpoofing to be applied.The certain material specification is based on the following.

a. Geotextile

A nonwoven geotextile of 300 gr/m^2 is usually used with any other specification. That means that the contractor buys the cheapest possible geotextile. Specifications based on the existing international documents must be issued in order to have a protection layer and not just another layer in the waste landfill.

b. Geomembranes

A geomembrane of HDPE is used with a thickness 1,5 to 2,00 mm. This is included in the design with no special consideration as no calculation of the local geological condition has been made.

The tender documents demand for a pre-agreement between the contractor, the supplier and the installer as an effort to control the proper use of a good quality material through an authorised installer.

AGRU, SLT, GUNDLE, NSC, PLIFLEX participate usually in the tender through this pre-agreement with local contractors.

c. Geogrids, Geocomposites.

These are some cases in which a geocomposite is used as a drainage layer.

The use of the geocomposite is proposed by the contractor as it is cheaper than any other solution in the area of the landfill (high transportation cost for crushed material etc.).

It is obvious that no design exists and the proposal is based on the suppliers recomentation for the certain material.

2. LANDFILLS UNDER TENDER

The landfills already built in provincial towns are app. 20.000-30.000m

Such landfills are under tender for a number of towns all over Greece and the above mentioned design is considered as the proper one.

In those tenders mainly local contructors participate.

Apart form that a huge program for ATTICA region is under design or under tender.

The 2 landfills which have been used in the past are almost closed.

The announcement of the design of the new ones is under discussion for over 2 years with the local authorities as the NIMBY syndrom is very strong. Demonstrations, stikes, fights, occupation of highways are the result of this syndrome that seams to be reaching its peak point this period.

To cover the need of keeping disposing of the waste of 3.000.000 people the goverment announced a tender for the extention of one old landfill.
The tenders will be under prequalification this summer for a project of 25 million D.M. 13 J/V are been selected to submit a final design and a financial offer by July 1. 1996.

3. CAPPING OF THE OLD LANDFILLS

The 2 landfills which have been acceping the waste of greater Athens area during the last 30 years are under restoration : 50 million D.M. project (20 million D.M. for SHISTOS restoration and 30 million for LIOSSIA restoration has been announced and the contractor are already on site.

The problems that all the consultants and experienced foreign companies are conforted with at the landfills are very particular and very difficult. The main points of these problems for the design are:

1. Dry and hot climate
2. Smaller ammount of raifall
3. Lack of water within the landfill
4. Very high inhomogenity within the landfill
5. Compaction while dumping waste was insufficient

Because of those five main reasons it is very difficult to make any kind of serious calculations for the settlements, especially those due to bio-chemical reactions.
Bio-chemical processes as these is gasproduction are only possible as long as there is water available.

One has to emphasize that great gas exploitation needs continous supply of water. It will go along with strong settlements. Higher gasproduction therefore means a greater danger of damaging the top-cover.
Due to the damage , gasmigration may occur and high costs of repairing and maintainign are expected.

The top-cover-system would be destroyed partly and a use of the surface as a recreation area would be impossible or at least very dangerous.

Therefore the design tried to find a solution which prefers the use of the surface as a recreation area. This would mean to minimize expected settlements due to gas production. Indirectly, the cost for an expensive gas-collection-system would be reduced.
But also for this kind of construction, there remains a potential danger that gas and lechate may penetrate the surface.

No guarantee for a perfect impermeabel cover system can be offered because of the unknown quality and consistency of the waste and its chemical processes.
But it is pointed out, that a construction, based on experience, will in any case minimize the problems in accordance with a minimum cost.

A good functioning and controlled gas collection has a direct dependency on an impermeable top cover system.

Despite the expected settlements, the greatest aim has to be to find a top-cover-system which helps to avoid or minimize cracks due to settlements.
This function is supposed to use special geotextiles and - limited to the upper area- a special treatmend by means of dynamic compction.
For the main area- however (slopes) the design relies on the correct choice of geotextiles.

The proposal is based on following technical demands:

a. Production of a mineralic mixtute in different qualities which can be used as mineralic liner ($k<1x10^{-5}$ cm/s) and a protection layer ($k<1<10^{-5}$ cm/s). The mixture should be of a quality which offers rather smaller kf-values.
Besides the impermeability, it should possess a relatively high elasticity and plastic behavior, which should enable to diminish or even avoid cracks.

b. To cope with greater settlements and to avoid cracks the consultant only finds a possibility to use special geotextiles or geogrids with high tension capacity.
This is going to be proposed especially for the slopes which comprise the greatest part of the area.
On the upper plateau, where various recreation facilities are going to be located, the ground is partially treated by dynamic compaction.

c. The upper plateau has a combination-lining-system, where a geomembrane is going to be used. A relatively new product of geomembranes is developed as "Very Low Density" Polyethylen (VLDPE) contrary to the "High Density"PE (HDPE). VLDPE offers as the main advantage a better elasticity and therefore an additional means to enlarge the security against potential cracks.

d. The demands stated at point a,b and c should offer an utmost security for achieving an

impermeable surface.
Only an impermeable cover allows to suck off biogas by means of an underpressure. Only an underpressure makes it possible for the regulation of the quantity of gas to be sucked off.

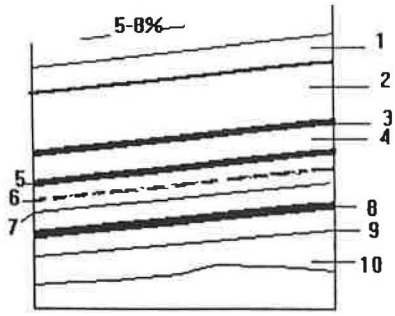
A surface cover demolished by cracks due to settlements establishes no underpressure. Air can penetrate and besides the gas is spoiled by oxygen. To avoid explosions of the mixture of oxygen (air) and biogas the quantity of gas sucked off has to be reduced. So the underpressure becomes smaller.

As a result of these circumstances biogas can penetrate the surface. It will become dangerous to use it as a recreation area.

e. This description reveals a direct connection between the top cover system and the gas collecting system.
Only a controllable gas collection allows taking out good quality gas.

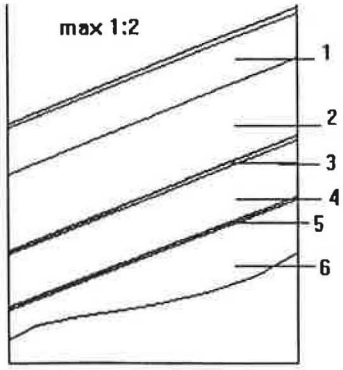
4. SECTIONS FOR THE CAPPING:

UPPER CAP



1. 30-150 CM HUMUS
2. 100 CM PROTECTION LAYER
1x10-4 bis 1x10-5 cm/sec
3. GEOTEXTILE
4. 30 CM RUNOFF DRAINAGE 8/32 MM
5. PROTECTION GEOTEXTILE
6. 1MM GEOMEMRANE
7. 2x25 MINERAL LINER 1x10-6 cm/sec
8. GEOTEXTILE
9. 30 CM BIOGAS-LEACHATE COLLECTION LAYER
10.PROFING LAYER, 1,00 - 1,5 m, COMPACTED

SLOPES



1. 30-150 CM HUMUS
2. 100 CM PROTECTION LAYER,
Kf<1x10-5 1x10-6 cm
(UPPER STRUCT.WITH SHEEPFOOT ROLLER)
3. GEOTEXTILE
4. 30 CM BIOGAS-LEACHATE COLLECTION LAYER
5. REINFORCED GEOTEXTILE
6. PROFILING LAYER, 1,00-1,50m, COMPACTED

CONCLUSIONS

The waste disposal project in Greece offer a great new potential for consultants, suppliers, contractors and specialized installers to design and high quality materials and techniques in order to combine the protection of the environments and the progress of the people.

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