

Diversification and innovation in environmental industry.

Environmental science/industry in Belgium

- In Belgium : environmental science is dominated by **bio-engineers** (formerly called agricultural engineers).
- They have made a very large contribution to this field, especially related to **biofuel, biogenetics and remediation.**
- They represent the **vast majority of technical experts** in research, industry and government agencies related to environmental problems. (Smaller percentage of chemists and biologists.)
- Civil and geotechnical engineers are almost completely missing in areas like environmental protection.

Geotechnical practice in environmental legislation

- Environmental experts consider soil as
 - **worst case : a chemical ingredient**
 - **best case : similar to steel or concrete (uniform, fixed in norms and standards)**
 - not our problem : contractor's responsibility
- Legislation is based on this principle. Result :
 - **CMA : 1071 pages**
 - **no technical requirements for geotechnical aspects** (well ok, 1.5 pages in the CMA on watercontent)

Flemish legislation on landfill liners

VLAREM II Environmental Safety

- Part 5. Sectoral environmental conditions for classified establishments
 - **Chapter 5.2. Waste Treatment Plants**
 - Section 5.2.4. Sites where waste materials are deposited in or on the soil
 - Subsection 5.2.4.3. Design and infrastructure of the landfill site
 - » Article 5.2.4.3.3. bottom liner (cat 1 and 2)
 - Subsection 5.2.4.5. Closure procedures and aftercare
 - » Article 5.2.4.5.2. top liner

Flemish legislation on landfill liners (cont.)

- Top liners
 - can consist of a homogenous layer of quasi-impermeable ground material covered with a synthetic liner of welded foil sheets placed between adapted protective layers.
 - permeability : equivalent to a 0.5 metre-thick layer with a k-value smaller than or equal to $1 \cdot 10^{-9}$ m/s.
 - the foil used must at least be equivalent to a 2.5 mm-thick HDPE-foil.

Flemish legislation on landfill liners (cont.)

- Top liners
 - “may be realised using other methods and forms of construction, for which the approval of the supervisory authority is required. The applicant must prove the soundness of the method or construction he proposes. Any other form of construction proposed must at least be equivalent to the double top liner described in point above”

Flemish legislation on landfill liners (cont.)

- Flemish regulations are prescriptive, based on double liner system.
- The mineral liner needs to fulfill requirements on thickness and hydraulic permeability.
- The geomembrane should be 2.5 mm HDPE.
- “alternative” solutions must be equivalent ... but equivalency can only be related to hydraulic aspects (in some way or another...)

Role of the environmental contractor

- Even knowledgeable environmental contractors adapt their working method in order to be competitive : no additional testing, no test field, no QA/QC.
- No drive to innovate : any liner technology which is superior to the GM/CCL would probably be more expensive, but would still be considered only “equivalent”.
 - alternative systems are less cost-efficient

How to get involved

Finding new areas to co-operate with other environmental professions can broaden the contact between the current environmental experts and the geotechnical engineering profession. This could be our 'way in'.

This should be limited to topics where we can make a significant contribution. Geotechnics would be the main key.

Research funded by environmental contractors

AMORAS project funded by the Flemish government.



Research funded by environmental contractors (cont.)

MIP research project on sludge dewatering using flocculating agents

- optimize dewatering by selection of polymer type, concentration, mixing method, draining method,...
- effect of flocculating agent on (long term) geotechnical behaviour of the treated soil.

Research funded by environmental contractors (cont.)

Preliminary results:

- polymer creates substructure within the soil
- substructure is not very sensitive (i.e. is not easily destroyed by remoulding) and exists up to large stress levels
- treated soil shows higher C_{α} , higher c_v at same stress levels
- treated soil has similar shear strength but exhibits drained behaviour at higher strain rates than untreated soil