gigsa

The South African Chapter of the International Geosynthetics Society

Dedicated to the Scientific and Engineering Development of Geosynthetics and Associated Technologies

A newsletter of the Geosynthetics Interest Group of South Africa
In Association with the South African Institution of Civil Engineering

June 2003

Where people or company or product names are underlined, these are Internet and e-mail links in the electronic version of this newsletter.

President's Comment

One of the reasons that I stood for election to the GIGSA committee was to be able to represent an unbiased professional voice in GIGSA. Judging by some recent comments made, there is still a perception in the geosynthetics industry that GIGSA is controlled by a few geosynthetics suppliers whose agenda is to further their own commercial interests. Our past president Kelvin Legge has previously referred to instances of suppliers "sledging" their competition, and I will not address that issue again. I do want to emphasize however, that GIGSA is a professional organization that was established to promote the science and practice of the geosynthetics industry for the benefit of all, and not any particular individuals, companies or organizations. It is for this reason that the president of GIGSA may not be from any commercial geosynthetics supplier or contracting company, but from an academic institution, regulatory authority or a consulting practice.

I therefore want to assure members that as long as I am president, I will do my utmost to ensure the impartiality of the GIGSA committee and uphold the ethics of our constitution. I welcome anybody who has concerns in this regard to contact me. I also want to suggest that, rather than sitting on the sidelines and criticizing the motives of some of the GIGSA committee members, get actively involved to ensure that your voice is heard on committee.

This newsletter is once again a bumper issue with news of various events and seminars. I commend the organizers of the training seminars on Geosynthetic Reinforced Soils (BS 8006), and encourage you to attend. As discussed in the previous newsletter, GIGSA is planning to arrange similar training seminars on other geosynthetic materials, such as geomembranes, GCLs, geofilters, etc. Once again, we would welcome input from any members with specialist geosynthetic expertise or knowledge, who would like to participate in such seminars.

Another initiative being undertaken by your committee is the development of a "GIGSA" standard code of practice for the selection and installation of GCLs. I often refer to the GCL as a "magic" lining/capping material that is generally installed as simply as laying a carpet. There is however, a danger with such a simplistic approach, and there is definitely a need in South Africa for a GCL Standard. Anybody who would like to participate in or contribute towards the development of such a standard is welcome to contact me.

News of other events and projects being undertaken by GIGSA are discussed elsewhere in this newsletter. Enjoy!

Kind regards,

Peter Legg..... peter@jbawaste.co.za

Remember: Amateurs built the Ark, but professionals built the Titanic . . .

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Engineered Linings • Kaytech • Aquatan • DuPont SA • Geotextiles Africa • SRK Consulting • Jones & Wagener • Gundle Geosynthetics • Botank Construction • Amalgamated Packaging Industries • Land Rehabilitation Systems I-Corp International • Gast International SA

Separation: An Interesting New Technique

A new housing development in Hillcrest, KwaZulu-Natal, was faced with the problem that the only access point was over a marsh wetland directly above a conservation area that included a dam. The sensitivities associated with a protected environment necessitated an innovative approach that would have minimum invasive effect on the environment.

Raudig Civils approached Moore, Spence & Jones in Durban to assess the requirements that would provide a stable access point to the housing development. Of primary concern was the need for the roadway to withstand the weight of the heavy-duty trucks that would be servicing the building site.

Lionel Moore of Moore, Spence and Jones says " The wetland material consisted of a silty sand which was very soft and loose. On inspection, we found that a DCP or DPL probe could penetrate as deep as 3 meters in this soft environment. After consultation with Maccaferri / African Gabions we agreed that *Flexmesh* would provide the basal reinforcement and separation functions required by the proposed fill that would form the new access road to the proposed housing development".

Flexmesh being laid over the wetland, before placing of dumprock

Flexmesh is a multipurpose geocomposite made of 8x10 type hexagonal double twisted wire mesh reinforced with transverse steel rods coupled with a geotextile attached to one side of the wire mesh fabric.

The geotextile is ***AG 300***®, a compact needle punched nonwoven polyester fabric with a weight of 250 g/m². This fabric has high resistance to installation damage and was ideal for the application. The primary function of the geotextile was to separate the wetland soil below the Flexmesh from the coarse rock above and so prevent the contamination of the coarse rock layer. To resist the stresses imposed by the construction machinery, *AG 300* has a minimum energy absorption of 10 kN/m and a tensile strength of 22 kN/m. The geotextile is overlapped and stapled to one side of the mesh around the perimeter of each panel. The added strength required for basal reinforcement and separation function was provided by the wire mesh fabric that has a tensile strength of 50 kN/m at a strain of 2%.

Coarse rockfill with a mass of 3.6 tons per square metre was placed over the Flexmesh, and the access road was constructed over this.

Fixing panels of *Flexmesh* over the wetland. Note wire mesh and transverse steel rods over the geotextile.

Lionel Moore comments, "This structure has provided an appropriate and efficient solution to ensuring a sustainable and maintenance free access road through soft and loose wetland soils. The expected settlement occurred during the construction phase, and immediate access to the building site by the heavy-duty construction vehicles was enabled."

Assmosis: The process by which some people seem to absorb success and advancement by sucking up to the boss.

Technical Note From Kelvin Legge

The paper "*An Appraisal of the Performance of Geosynthetic Materials Used in Waste Disposal Facilities in South Africa*" by K R Legge and P L Davies which was presented at Wastecon 2002 in Durban in October 2002 has attracted a lot of discussion in the industry, and some concern from manufacturers.

In response to appeals for further information on the subject of the composite liner / leak detection layer, the following notes are provided:

- While the individual geosynthetic materials' performance are critical design features, so too are the interactions between various materials.
- This paper referred in particular to the interaction between a composite (geomembrane and geosynthetic clay liner (GCL)) primary liner and geosynthetic drainage layers (geodrains). The test series described was undertaken in an apparatus having a rigid flat top loading platen, and a rigid flat receiving surface that the materials being tested lie on. This type of apparatus is typically used for evaluating transmissivity (horizontal flow through the thickness of pervious geosynthetics). While the normal load was varied, the loading platens do not simulate the in-situ distribution of loading variations (stress concentrations or undulations) in the adjacent soils.
- The test results show that as the normal perpendicular load increases on a composite liner / geodrain system, the geodrain transmissivity reduces. In one arrangement where a GCL over drainage net was not separated by a high modulus geotextile or other similar quasi-rigid material, the transmissivity of the system reduced to zero after 14 hours of load at 400 kPa. It should be noted that all the geodrain systems tested show a reduction in transmissivity, albeit to various extents, with increasing load.
- The extent of reduction that is allowable / acceptable is the design engineer's decision. While the authors do refer to significant intrusion of an unsupported GCL into a geonet, the mechanism of drainage flow reduction is not described in detail. The major contribution to the effect appears to be GCL intrusion. However, there is also a reduction due to deformation in the drainage medium itself, which was shown in the paper (see figures 3a and 3b).
- The authors also caution designers to consider the effects of heat and compressive creep that may further aggravate the reduction in transmissivity in site-specific applications. Yet another factor to consider is the "softness" of the underlying geomembrane, which may intrude into the drainage material from beneath.
- With site-specific loading conditions (pressure, temperature, performance life required etc.) in mind, the design engineer, as the responsible person, has to assess the whole-liner performance, recognising the variations in geosynthetic materials constituents, and their mutual interactions.
- Thus, it is recommended that appropriate testing be done to simulate the expected conditions, to support design assumptions.
- The authors have subsequently investigated the effect of heat on geodrain structures, and hope to publish this data in the near future.

For further information, contact Kelvin Legge at leggek@dwaf.gov.za

Salmon Day: The experience of spending entire day swimming upstream only to get screwed and die in the end.

Australasian Technology Exchange

"Our Australian and New Zealand peers are good sports not only on the field – but beneath it, around it and away from the playing fields as well".

So says Kelvin Legge of the Department of Water Affairs and Forestry. He and Peter Davies of Kaytech recently joined three other invited international guest speakers to present a one-day geosynthetic seminar series in Auckland; Brisbane; Sydney and Melbourne.

Kelvin and Peter spoke on "The development and use of geosynthetics in landfill lining systems" and "The use and abuse of GCL's" respectively.

The lecture team. Clockwise: Dr Michael Heibaum, Kent von Maubeuge, Kelvin Legge, Peter Davies and NZ host Chris Brockliss. (Absent: John Cowland)

Other speakers included **Dr Michael Heibaum** of the German Bundesanstalt für Wasserbau (Federal Waterways Engineering and Research Institute) who spoke on the use of geosynthetics in waterways, including the placement of GCL's in a canal while in use, and sea revetment works. **John Cowland** a consulting engineer from Hong Kong spoke on geomembrane lining of landfills and **Kent von Mauberge** of Naue Fasertechnik Germany

spoke in detail on geosynthetic clay liner performance.

The seminar concept was the brainchild of Matt Eberle of Geotextiles Australasia who many readers will remember as a visitor to SA and presenter on GCL's at a Gigsa event some two years ago.

In addition to the four one-day seminars, the South Africans were provided the opportunity to meet regulators and contractors in Perth and Adelaide. The interactions were fruitful, with discussion on polymer type suitable for various uses (including in the mining industry), construction methods - particularly in abandoned quarries and discussions on the process of regulating industry performance.

Says Kelvin: "Clearly, with all the travelling being undertaken in two weeks there was not much time for sightseeing, however our hosts were extremely polite, cordial and considerate. We got to see a lot of beautiful Auckland, including its extinct volcanoes and the amazing yacht basin with the craft readying for the America's Cup. We even got taken to the All Blacks "World of Champions" shop where I purchased a rugby jersey for my wife – they had no green and gold so she had to settle for black with a silver fern!

The SA team sampling some of Australia's finest in the vinyards near Adelaide. The Sheila serving the wine was a cracker (the wine was good too!)

We also have to admit that the wine farms in the Adelaide area produce superb goods despite names like "Broken Fishplate".

Geofabrics Australasia and Maccaferri New Zealand sponsored the entire trip in the interests of geosynthetic awareness and development of the industry. Both thanks and congratulations are due to those companies! Judging by the subsequent communications received from engineers in particular it seems that the exchange of ideas was well received and will develop further.

Kelvin reports that it was a tremendous privilege being able to meet consulting engineers, material suppliers and contractors to discuss particular problems associated with geosynthetics and the waste industry in so many locations, particularly as the local conditions varied widely. It was interesting to note amongst other things that in some areas, geomembrane sheets are not welded but merely overlapped in lining systems and that extensive use is made of silt curtains around construction sites. The regulatory system varies between states but relies heavily on self-regulation. However, heaven forbid if an operator/owner performs outside of the standards set – the legal enforcement and prosecution is extremely efficient!

For further information on antipodean geosynthetic usage and regulations, contact Kelvin Legge at leggek@dwaf.gov.za or Peter Davies at ktechpld@kaymac.co.za.

Percussive Maintenance: The fine art of whacking the crap out of an electronic device to get it to work.

Geotextiles as Filters: Why Do They Work?

This, the first in a series of articles on geosynthetic matters, does not look at the "if" and "buts" rather at components of how geotextiles *do* perform. For very many decades, engineers have used granular filters in various civil engineering applications with growing confidence. While the filter criteria for sand and gravels are well established it was the advancement by Sherard (who further developed criteria for silts and clays in the mid 80's) that has established the basic principles of granular filter criteria used today.

Irrespective of the base soil to be drained, the opposing principles with which the granular filter needs to comply are:

1. The pore sizes between the filter particulate medium must be coarse enough to allow the seepage water to drain away freely, and
2. The pore openings between the filter particulate medium must be small enough to retain the coarse fraction of the base soil (which in turn will retain the remainder of the base soil).

This is done by setting a limit to the ratio between the fine (D15) fraction of the filter material and the coarse (d85) particle range of the base soil. While this works well for sand and gravels, it was found that for fine-grained base soils having between 40% and 85% passing the 0,075mm sieve, other factors

such as cohesion in the base soil allow us to place a limit to the D15 of the filter at 0,7mm.

Typically, this would mean that for draining fine materials the D15 of a filter having a requirement of being less than 0,7mm nominal diameter would have pore spaces controlling piping less than 0,116mm. (This can be shown by using Pythagoras to ascertain that the diameter of a sphere, which will just pass between three equal spheres of diameter D, is D/6). The rest of the granular filters characteristic pore spaces are larger.

work as filters, in particular in re-establishing a transition zone. . Although a non-woven is often considered two-dimensional it actually behaves as a three dimensional filter. Provided the fine fraction of the base soil (which controls its permeability) does not build up at the interface of the soil and geotextile filter but passes beyond that interface, the geotextile will work as a filter to that soil. Thus in the case of non-wovens the fine fraction typically passes beyond that interface and is often trapped within the geotextile where the flow paths narrow. Nevertheless, water finds its way through the more

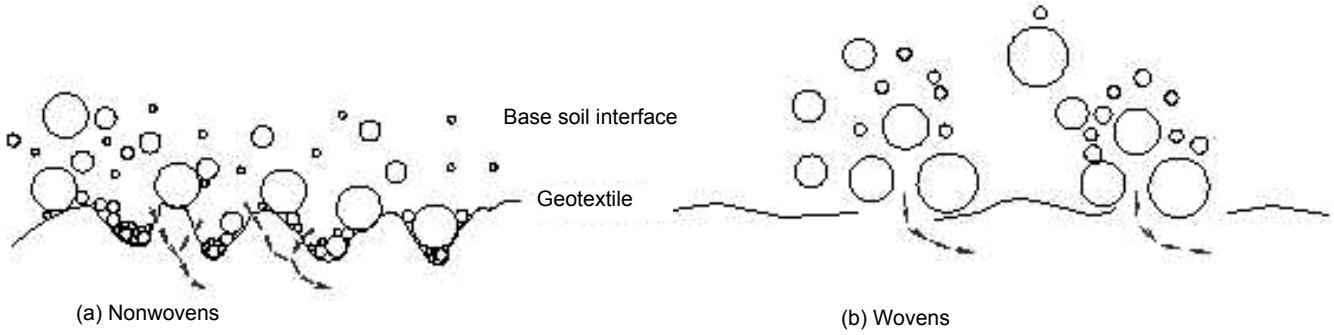


Figure 1: Diagrammatic presentation of (a) Nonwoven geotextile filter, (b) Woven mechanisms.

However, for the same base soils there is often a question as to whether a non-woven or woven geotextile could or should be used *in unidirectional flow applications*.

Typically, nonwoven geotextiles have operative pore sizes well below 100 microns, let alone their minimum characteristic pore size that is much less. Their maximum opening size measured in dynamic testing is however much larger. On the other hand (and I did not get that quote from Naas) the characteristic pore size for woven tape products is typically 300 microns and larger.

So too is there a distinct difference in other characteristics of the two generic geotextile types, such as the non-wovens have a far larger percentage open area; higher porosity and are usually thicker than woven tape geotextiles. But experience has shown us that both types of geotextiles do work as filters in particular applications. So why is this?

Well it is quite simple really, provided one recognises the mechanism by which the products

permeable interface zone (where the fine fraction of soil is now depleted) into the geotextile structure and around the trapped fine fraction, to exit into the drainage medium.

Similarly, for woven tape geotextiles the fine fraction departs from the base soil at the interface zone around openings and passes through the geotextile with very little entrapment taking place between tapes. Because the pores are usually relatively large compared to the base soil, the medium fraction also passes through the geotextile. A cone of coarse particles is thus established around each opening in the woven material and the base soil drains the permiant through this pervious cone.

The inverse is found in non-woven filter applications where the interface becomes pervious and the permiant finds its way around the inverted less permeable entrapped fine fraction material. See figure 1a and b.

With this understanding of the geotextile filter mechanism, designers can not only determine whether a particular geotextile will work as a filter for

a particular base soil, but they can also assess what precautionary measures need to be employed during the construction and operational phase to minimise risks of piping, clogging or blocking.

Technical note by Kelvin Legge. Contact:
leggek@dwaf.gov.za

PS: The 4th International Geofilter Conference is scheduled for October 2004, in Stellenbosch, Western Cape.

Stress Puppy: A person who seems to thrive on being stressed out and whiny.

Designing with Geosynthetic Clay Liners

By Scott Lucas, Vice President of Bentofix Technologies Inc, Barrie, Canada. A presentation given at the SAGEOS 2003 Seminar, Toronto, Canada, 26 March 2003.

Geosynthetic Clay Liners [GCL's] are the newest of geosynthetics, having been around in the North American market for approximately twelve [12] years. GCL acceptance has only become widely used in applications for the past seven [7] years. The Engineer's perceptions of GCL properties vary. Due to these varying approaches, the manufacturer has had to develop over the years seventeen [17] variations of the GCL to meet the engineer's requirement.

GCL use in Canada: Rennie Street Landfill, in Hamilton City, on Lake Ontario. Composite liner using a GCL to line a waterway through the landfill.

This talk will explain the designing of GCL's from a manufacturer's perspective.

GCL's are today commonly used in landfill liners, landfill covers, liquid impoundments, canal liners, secondary containment, heap leach pads and several transportation uses. Of course, for each application, specifications of how the GCL is to perform are different. GCL's were designed to replace two to three feet of compacted clay. In landfill applications, this of course saves valuable air space.

GCL's are also easier to deploy than compacted clay, saving time in deployment, money, and are backed up by a manufacturer's quality control documentation.

As the years of acceptance have gone along, testing methods and tests on the GCL have changed. The product has also developed and changed, driven by further knowledge of the GCL's performance.

Most in the civil engineering community, however, have not kept up with the changes to the product and the changes to the testing and test methods. They are therefore looking at old standards to qualify a GCL. We in manufacturing, when qualifying a GCL to a certain specification, have to spend the time taking exceptions to various requirements, as those tests are either no longer performed or another test has superseded the old test method.

Just this year we received a specification from an Engineer based in the United States, looking for product for a site in the United States. Following are exceptions that we had to take to his specification.

1. He asked for a certain thickness, thickness is no longer performed on GCLs, as it is irrelevant.
2. He requested Index Flux according to ASTM D 5891. The test method for Index Flux is ASTM D 5887. Standard test D 5891 is for determining GCL bentonite fluid loss.
3. He requested certain permeability to local storm water. We had no storm water from this area to test that the permeability would be correct.
4. He wanted bentonite moisture content tested according to D 2216, which utilizes an oven and is typically used for drying plastics. However, moisture content of standard fabric encased GCLs is tested in accordance with D 4643 which uses a microwave in the drying process.
5. He wanted the mass per unit area of the bentonite tested in accordance with ASTM D 5261, however bentonite mass in GCLs is tested in accordance with ASTM D 5993
6. He wanted an interface shear value, tested in accordance with ASTM D 5993, however test

method ASTM D 5321 is used to test the interface, ASTM D 5993 is the mass per unit area.

7. Then he wanted the internal friction angle of the GCL tested in accordance with ASTM D 5993, however this is done in accordance with ASTM D 6243. D 5993 is for bentonite mass, as stated before.

This engineer was either in a real hurry to write this specification or perhaps the person who typed up the specification was unfamiliar with geosynthetics.

As more than half of all GCL's are sold into the North American market place, standards are most commonly written up according to ASTM International methods. Therefore, a GCL manufacturer follows these methods throughout the manufacturing process.

There have not been any Canadian standards written on GCL's, probably because we ship our solid waste to the United States and therefore our use of containment liners is minimal.

Some test methods that have been written are fine for an independent laboratory; however, for a manufacturer they can be quite difficult. Due to this, we have to adapt and find means to comply with the required test. Some tests do not have any defined basis of reporting and because of this, the reported values vary at an extremely high rate from one laboratory to the next.

Other standards that have been written do not define fully in detail the apparatus; therefore, there is once again a high variability from one lab to the next. However, as we progress, these test methods will be refined to assure that the test results can be duplicated.

Today the following test methods are in place to qualify a GCL's properties. However, be on guard; these could change after my talk:

- Clay Swell Index in accordance with ASTM D 5890
- Clay Fluid Loss in accordance with ASTM D 5891
- Geotextiles, Mass per Unit Area ASTM D 5261
- Mass of GCL – ASTM D 5993
- Mass of bentonite – ASTM D 5993
- Moisture Content – ASTM D 5993 or D 4643
- Tensile strength – ASTM D 6768
- Peel Strength – ASTM D 6496 or D 4632
- Permeability – ASTM D 5887 or D 5084
- Index Flux – ASTM D 5887
- Internal Shear – ASTM D 6243
- Interface Shear – ASTM D 5321

Any other ASTM test method that may be still out there is outdated and should not be used. However, because the market place still requires some of the old test methods, we as a manufacturer will comply and test to those methods. So, as you may guess, our lab is the largest facility within our manufacturing plant.

As stated, we now have seventeen variations of the original two types of GCL's to meet the markets requirements, as engineers look at the performance of a GCL with different views. We have within this category reinforced and unreinforced GCL's.

For a reinforced GCL the textiles are bonded together either by needle punching through the top to the bottom or by stitching the textiles together. An unreinforced GCL is one where the top and bottom textiles are not bonded. Unreinforced GCL's are typically recommended for slopes less than 10 (h): 1 (v).

Now, it is when we come to the reinforced GCL that the GCL becomes extremely variable.

To aid in giving a particular GCL to the marketplace, we have designed GCL's for situations that we know can or will happen. Our greatest failure area has typically been when GCL's are installed for ponds, lakes, etc. It is important that the subsoil is prepared properly to prevent any failure. Knowing that in a lot of cases the subsoil is not going to be the best, we have designed a GCL which has a polypropylene coating applied to one side, to form and an impermeable membrane. This will prevent any disturbance of the clay within the GCL.

Rennie Street Landfill. A later view

For slopes of 2:1 or steeper, we have designed GCLs that have incredible internal peak shear values. And we have had to go one step further and design a GCL that has a high residual shear value at a certain displacement, as we have engineers designing slopes steeper than certain failure. We also have the Department of the Environment Protection agencies in certain States and Provinces asking for this. Why? – Because they do not understand the properties of a GCL. An interface will fail long before the GCL does internally. However, we have to provide a GCL that will meet this failure requirement.

We have designed GCL's which will have chemicals mixed into the clay. These chemicals have either been placed within the clay to protect the bentonite from saline conditions or obtain a lower permeability at higher confining stresses.

We have designed GCL's with various loadings of clay. Sites have different licensing agreements with the Regulatory Agencies of their State/Province. The bentonite content at given moisture content is typically one of those. Kentucky has the highest requirement for the GCL bentonite loading of all the States.

We have designed GCL's with different textiles, as various engineers have asked for properties that the standard textiles cannot achieve. We also will use different textiles in accordance to slope conditions and interfaces.

Sometimes when a specification arrives, we just scratch our heads and wonder what type of Geosynthetic Clay Liner will be used to meet the specifications that this Engineer wants?

There are volumes of papers written on the testing of GCL's, the performance of a GCL, the long-term viability of a GCL and these papers continue to be published, with another GCL seminar scheduled in June 2003 at the ASTM meetings in Denver. I do not profess to have read all these papers, even though I have been associated with GCL's since their introduction to North America. We even have books devoted only to GCL's, the latest of which is from the GCL seminar in Nuremberg Germany, last October.

In closing, when designing with GCL's make sure that you use the latest test methods and know what you are trying to achieve in the design. Remember that in a landfill the Geosynthetic Clay Liner is but one component within the system and that there are other areas within the system where failure will occur before there is any failure in the GCL.

For more information, contact Scott Lucas. slucas@gseworld.com

You are a Professional Engineer. Do you *really* know as much as you should, about the geosynthetic product and the application you are considering it for? *Geosynthetica* can help:

http://www.geosynthetica.net/

Some Technical Documents you can download at Geosynthetica ... (Many more)

Costs and Benefits of Geomembrane Liner Installation CQA, written by G.T. Darilek and D.L. Laine, published in the Geosynthetics 2001 Conference Proceedings. full document 06/11/03

Mobile Geoelectric Liner Integrity Surveys: Planning Ahead, written by Ian Peggs, published in the Geosynthetics '99 Conference Proceedings, "Specifying Geosynthetics and Developing Design Details." full document 06/10/03

Some Documents Available From GIGSA

The next GIGSA Committee Meeting will be held on 6 August. If any GIGSA member has something they would like placed on the agenda, please contact Peter Legge on peter@jbawaste.co.za to discuss.

- EU Council Directive 1993/31/EC of 26 April 1999: *"On The Landfill of Waste".* A 110 kb pdf file. The EU's approach to landfill.
- The USA *"Geosynthetic Manufacturer's Handbook"*. An excellent introduction to all geosynthetics, types, terminology, applications etc. Perfect for students or those new to geosynthetics. No commercialism! A 1 727 kb pdf file.
- *GRI-GM13*. The Geosynthetics Research Institute of America's geomembrane specification on which the SANS (formerly SABS) South African geomembrane specification (currently in draft form) is to be based. A 157 kb pdf file.
- The state of Victoria's (Australia) landfill legislation " The Siting, Design, Operation and Rehabilitation of Landfills. A 831 kb pdf file.

Want any of these? Contact Peter Davies on ktechpld@kaymac.co.za for an e-mail copy.

This newsletter is produced and edited by Peter Davies on behalf of GIGSA. Opinions advanced do not necessarily reflect the views of GIGSA. Contributions, compliments, comments and constructive suggestions are always welcome. Reactions to criticism may take some time . . .

Some Upcoming Events

"Two Rivers Conference".
North American Geosynthetics Society Conference in conjunction with the 56th national conference of the Canadian Geotechnical Society. 26 Sept. to 1 October, Winnipeg, Manitoba, Canada. More information at:
http://home.cc.umanitoba.ca/~cgsman/cgs2003/

"Sardinia 2003" Ninth International Waste Management And Landfill Symposium.
S. Margherita di Pula, Cagliari, Italy. 6 to10 October, 2003. More information at www.sardiniasymposium.it

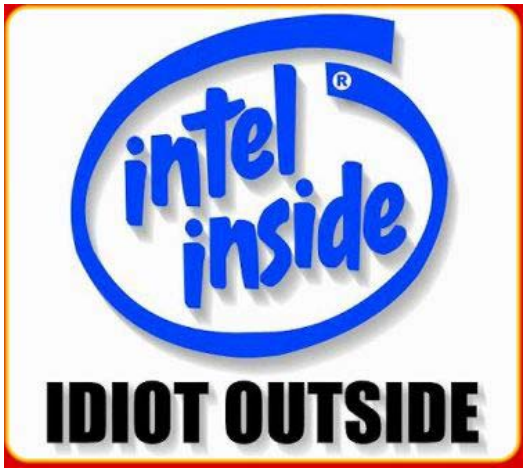
"*The Involvement Of Geotechnical Engineering In Infrastructure Development In Africa"*
ISSMGE 13th African Regional Conference Marrakech, Morocco December 8-11, 2003. Organised by: Comité Marocain de Mécanique des Sols et des Roches. Local contact: Peter Day day@jaws.co.za / http://www.emi.ac.ma/~13CRA

3rd International Mining and Industrial Waste Management Conference.
17 – 19 February 2004. Under the auspices of the Geotechnical and Environmental Engineering Divisions of the South African Institution of Civil Engineering.
Contact: Leslie Stephenson l.stephenson@ee.wits.ac.za
"Geotechnical Engineering with Geosynthetics"

"EuroGeo 3". 3rd European Geosynthetics Conference.
Munich, 01-04 March 2004. Organised by the German Society of Geotechnics (DGGT) under the auspices of the International Geosynthetics Society (IGS). Munich, Germany. 1-4 March 2004. Contact: General Secretariat: Technische Universität München. eurogeo3@bv.tum.de / www.gb.bv.tum.de/eurogeo3

"GeoAsia 2004". Asian Regional Conference on Geosynthetics".
21 – 23 June 2004. Organised by Korean Chapter of the IGS, under the auspices of the IGS. Visit the web site at
http://www.kgss.or.kr/geoasia2004/index_e.htm

"8ICG-Yokohama". The *8th Quadrennial International Conference on Geosynthetics*. 18 – 22 September 2006. Organised by Japanese Chapter of the IGS, under the auspices of the IGS. Contact: Mr. Nobuo Kiyokawa at info@8icg-yokohama.org and visit the web site at http://www.8icg-yokohama.org/.



(So? - I ran out of serious material – Ed,)