Issue 41 · June 2013 · 18th year [25th English translation]

The latest news magazine from the NAUE Group

NAUE NEWS

Cold Start, Climate Protection, Scour Protection

In 2010, NAUE News opened with the headline “A Cold Start”, and we complained about how the long winter had lasted well into March, had featured many below-zero temperatures, and had brought construction activity in Europe to a halt. The situation this year is virtually identical; the main difference is that the long, cold winter lasted until April and caused many construction projects to be put, quite literally, on ice. These whims of the weather cannot, of course, be planned for, so it is no surprise that we were unable to meet our budget figures for the first quarter. But there is still a chance of making good the first-quarter shortfall during the coming (hopefully summer-like!) months.

Savings in CO_2 equate to 3.2 million automobile kilometres

The EAGM (European Association of Geosynthetic product Manufacturers) charged the ETH University in Zurich and ESU-services Ltd. with the preparation of a report comparing the environmental balance of construction materials used in civil engineering structures. The study investigated conventional materials and construction methods using concrete, cement, lime and aggregate and compared these to applications using geosynthetics. In all the applications studied, the report shows that construction methods using geosynthetics are significantly less harmful to the climate.

The comparison of a reinforced-concrete retaining structure with a geosynthetic-reinforced retaining wall documented a reduction of 85% in greenhouse-gas emissions. The construction of a conventional road with frost-resistant gravel and sand layers emits 800 tonnes more CO_2 per 10km length than the same road constructed using a geogrid-reinforced sub-base. In other words: The use of a 10km-long, geogrid-reinforced base layer saves the same amount of CO_2 as an automobile emits over a distance of 3.2 million kilometers - and that equates to 80 times round the world.

These impressive figures document the enormous ecological potential in geosynthetics. But this potential can only be realized if future tenders take account of the impact of the different construction methods on the climate. Then, civil engineering will be able to make a significant contribution to major government targets. For example, the goal in Germany is to reduce CO_2 emissions by 80% by the year 2050.

First wind farm with geotextile scour protection

Measurements made at the offshore wind-farm test field Alpha Ventus were alarming. In the space of only one year, scour holes with depths of up to 6m had developed in the bed of the wind-energy installation. These problems were nothing new for us. Back in 2005 we had already delivered geotextile sand containers to protect a measurement platform in the North Sea against scour.

Inspection of this project after 5 years showed that the sand containers had completely fulfilled their task and no scouring had occurred. Subsequently, numerous trials were carried out in the large wave tank in Hanover to obtain more knowledge on the design, arrangement, and degree of filling of these sand containers.

After this extensive preparatory work we can state with pride that NAUE has supplied the first geotextile sand containers used as a scour-protection system for an offshore wind farm. The Amrumbank West offshore wind farm is being constructed over an area of 32km², 35km to the north of Heligoland and around 37km west of the North Frisian island of Amrum in water depths of 20 to 25m.

Amrumbank West GmbH in Munich, a wholly owned subsidiary of E.ON AG, is planning to operate 80 individual wind-energy devices to supply energy to 300,000 households.

The contract to install the scour-protection system was awarded to the Danish company Peter Madsen Rederi A/S. We are very glad to be part of this interesting project; this will certainly not be our last report on it.

CONTENT

Further information:
www.naue.com

Recreation Island in Tidal Mudflats Adds Lagoon for the Whole Family

Terrafix® and Secutex® protect and raise Perlebucht dikes off Büsum

In the 1970s, an artificial island was constructed in the Perlebucht Bay on the tidal mudflats off Büsum, a popular seaside travel destination in Germany's Schleswig-Holstein state. The island is situated to the seaward side of the coastal dike. Now, a new promenade has been constructed and the asphalted dike raised. The causeway revetment has been renewed as well. Terrafix® separation nonwovens and Secutex® sand containers have played an important part in protecting the new shoreline against erosion.

Until now, a 3.6m high asphalt dike protected the shore on the island's west side. To the east, a 200m long causeway led from the mainland to the island. This causeway divided the Perlebucht Bay into two major zones: a relaxed bathing area in the southern basin, and an active water sports area in the northern basin. The whole construction area thus lay in the tidal mudflats, with a tidal range of ± 1.62m. The asphalt dike with its promenade needed to be raised and protected against erosion, and the causeway revetment had to be renewed. These upgrades have created the framework for a new family lagoon due to open in the summer of 2013.


(Picture: KED Ingenieure)

Raised by up to 1.6m on the seaward side

Dark-grey asphalt dikes no longer feature in the new family lagoon. Natural-stone riprap now protects the seaward side of the new promenade and the causeway; this was applied on top of the existing asphalt revetment. Since the dike and the causeway are subjected to different sea loading, they are designed differently.

On the outer crest of the dike, the asphalt was cut through at a height of 3.1m and broken open to the landward side enough to allow the new revetment to be brought up vertically between these. The overlap is a minimum of 500mm. 200mm of crushed aggregate (30/60mm) and 500mm of riprap stone (LMB 5/40) were placed and subsequently grouted with colloidal cement.

The newly protected dike is 4.2m high at its northern end, and 5.2m high at the south.

Thinner construction on causeway

The new causeway revetment was also constructed on the existing dike. The construction (bottom to top) was somewhat thinner, as there is less tide in the bay.

- Terrafix® 813 filter fabric
- 150mm aggregate 30/60mm
- 400mm riprap CP 90/250
- Colloidal concrete grouting

A total of 7,000m² of NAUE's Terrafix® 813 was installed.

3,600 containers protect against erosion

The promenade on the top of the dike was completely redesigned. Optical highlights are the “objets d'art” in the shape of a stylised wave marking flood- and storm-tide levels. Under the dike, NAUE geotextiles protect the whole length of the island against retrogressive erosion.

Construction started with 9,000m² of Terrafix® 813 being installed; this was anchored using precast-concrete L-shaped units. In combination with cast-in-place concrete, the geotextile fabric was anchored and the edges of the promenade were constructed. 3,600 Secutex® R601 sand containers were then placed on the filter fabric. Secutex® is a needle-punched staple-fibre nonwoven which can also be sewn to form containers. These were filled, and subsequently covered, with locally available sand. Construction lasted from April 2012 until May 2013. The revetment- and erosion-protection structures were completed in late summer, well before the beginning of the storm-tide season.

The client was the community of Büsum. Seebauer, Wefers & Partner served as landscape architects and KED Ingenieure GmbH (Hamburg) provided the hydraulic engineering support for the project.


(Picture: KED Ingenieure)

The Future Requires a Stable Foundation

Secugrid® and Combigrid® make the biogas plant in Wölfersheim-Berstadt (Germany) possible

The OVAG Group planned a large-scale plant at Wölfersheim-Berstadt in Upper Hesse. However, the soft soils were not suitable to support the planned construction. The salvation: NAUE Secugrid® and Combigrid® geogrids to stabilise the foundation. The inauguration of the 15 million Euro plant took place in September 2012.

The energy market has been in transition: Germany, for example, would like to move away from electricity generated by nuclear power and too great dependence on imported natural gas. Sustainable solutions are in demand, and locally produced biogas is one of the most attractive options - one that provides new growth for agriculture and energy.

With this opportunity in sight, the OVAG Group banded together with a supplier association comprised of 70 agricultural operations from the Wetterau district.

OVAG is a regional power company in Upper Hesse, and one that has advanced steadily with new power opportunities throughout its history. Its first power plant had been fired with lignite (brown coal) and had gone online in Wölfersheim 100 years before the biogas plant's construction. The addition of biogas was seen as a natural extension of the company's ever-growing sustainability portfolio, which already has incorporated wind and water energy.

However: The foundation of the planned biogas plant in Wölfersheim-Berstadt was not going to work. Boreholes and soil samples taken in the spring of 2010 showed that the foundation consisted of a mineral infill layer of up to 40m thick. The layer stemmed from former open-cast mining operations, containing coal components and fly ash from power plants. Also, loess loam and clays in weak to stiff condition were present. According to the mining stratification, these loess loams reached the planned foundations of the buildings. The material was too soft to carry the expected site loads.

Coarse gravel alone would not have been of any use, since the stone simply would have "sunk" into the soft soil. The solution: Secugrid® designed in accordance to EBGEO design recommendations.

Secugrid® is a soil reinforcing geogrid made of stretched, monolithic flat bars with welded junctions. The grid is particularly suited for the reinforcement of soils that possess poor bearing capacities. From September 2010 onward, a total of 32,000m² of Secugrid® 80/80 Q6 were installed across the zone to make

it possible to site the biogas plant there. Installed within a 450mm thick crushed rock subbase (200mm and 250mm) underneath a 650mm thick superstructure, the geogrid reinforcement contributed significantly to the fact that the foundation became a real load-bearing layer.

Two reinforcement layers were required

Emphasising just how poor the soils were, the reinforcement performance of Secugrid® did not provide sufficient bearing capacity everywhere. Some areas had soils so weak (CBR ≤ 3%) that it was necessary to have a more complex reinforced soil structure. In these instances, NAUE Combigrid® 40/40 Q1 151 GRK 3 was specified. Combigrid® is a unique composite reinforcement material composed of a Secutex® nonwoven geotextile embedded within a Secugrid® geogrid. The combination of geogrid and nonwoven provides multiple, key geosynthetic functions in a single rolled product: Combigrid® reinforces, separates and filters. Each of these functions was needed to guarantee enough soil stability that the biogas plant could be safely constructed and operated.

The Combigrid® installation began in April, and by the time the foundation-related works were completed, a total of 8,550m² were installed. The reinforced system, from bottom to top, included:

- Coarse stone
- Secugrid® for reinforcement
- Lime/Cement stabilised soil
- Crushed stone base course

The combination of Secugrid® and Combigrid® forms the foundation, so that the entire plant with storage, tanks and traffic areas could be constructed in time for a 10 September 2012 inauguration.

For the participating partners, the biogas plant is a sustainable investment in the future energy field. And the area's farmers have a new, guaranteed customer for a portion of their production. The community of Wölfersheim also benefits by way of tax revenue from the sale of gas and new source for employment. Perhaps best of all, the community receives a modern and future-oriented energy site. For the OVAG Group, it ensures the power supply and in the process of doing so, makes itself a bit more independent of other suppliers of electricity and gas. The annual output of bio-methane gas corresponds to roughly 41 million kWh. Ultimately, biogas contributes to the protection of the environment and the climate, in accordance with the motto: "Energy from the region for the region."

Did you know...?

NAUE TV releases 4 new films

Powerhouse construction with Secugrid® - The construction of the hydroelectric power plant and the supporting walls for the powerhouse in Arkun, Turkey is shown step by step and how you can achieve substantial savings by utilising NAUE Geosynthetics versus conventional construction methods in large-scale projects.

2012 Bentofix® X.F, Advanced safety with Bentofix® X.F: A serial story – A tutorial referring to our Bentofix® X.F campaign with the Bentofix® kit. See how you can use the components and create your own geosynthetic clay liner. Learn how the needling-process works and test it yourself.

The Safe Wall – Geosysnthetics in environmental protection. The Hannover Landfill demanded a retaining wall to protect the neighbouring landscape. This was realised with a mechanically stalibised earth (MSE) wall with a gabion facing. See the step-by-step construction and how the wall blends into the surrounding area.

Secutex® EDF, the new dimension in railways – This film illustrates the various functions of our new geocomposite Secutex® EDF. The several applications and the advantages of this brand new type of multi-component system are shown and explained. Providing long-term vibration cushioning, filtration and drainage performance are the main objectives of this geocomposite that is already successfully used in railway construction.

You can find our films at www.naue.com or directly at www.naue.tv.

Protecting the Environment in the EU's Newest Countries

When new member states join the European Union, bringing their environmental regulations into harmony with EU codes can be one of the hardest challenges.

Harmonisation requires not just substantial knowledge exchange for effective and consistent adoption of new practices but considerable remediation of old works.

The large prospect of new members from Eastern and Central Europe in the 2000s was particularly challenging in regards to creating consistency across the waste management industry in these states to guarantee both compliance and environmental protection.

An early example of the work required at landfills in the new EU states is the Dâmbovița County work near Bucharest, the capital of Romania. There, beginning in 2007, two new landfills needed to be constructed in Aninoasa and Titu and five closed (Aninoasa, Titu, Moreni, Pucioasa and Fieni).

The initial technical solution for closure included a landfill capping system (from bottom up) consisting of:

- Gas drainage layer, 0.5m of gravel
- 800g/m² protection geotextile
- 2.0mm textured HDPE geomembrane
- Drainage geocomposite for rainfall water
- Top soil, 30cm

For the gas drainage layer, the design specified 0.5m of 16/32mm gravel or recycled material from demolition. For rainwater drainage layer, gravel was requested.

Suitable fill material, however, was not available in the immediate area, and transporting a large amount of special aggregate to these many waste sites was deemed prohibitively expensive.

NAUE proposed a more modern, economical design that consisted of (from bottom up):

- Leveling layer of 20cm of crushed recycled materials (e.g., demolition)
- Secudrain® 151 WD 451 151 geocomposite for gas drainage layer
- Carbofol® 406 GM 13 MF/MF 2mm HDPE geomembrane
- Secudrain® 151 WD 451 151 geocomposite for rainwater management
- 0.3m cover soil

In addition to exceptional gas/liquid drainage performance, the NAUE Secudrain® geocomposites possessed a high puncture resistance value. This meant that Secudrain® could also function as protection for the Carbofol® HDPE geomembrane.

The originally specified protection geotextile layer would no longer be needed under the geomembrane, and furthermore the Secudrain® would provide an equivalent or greater level of gas management while avoiding the need to transport so much expensive special fill to the sites.

The use of geosynthetics at these locations also meant that the risk and potential impact of closure system settlement was reduced substantially without the mineral material layer loads.

In total, 110,000m² of Secudrain® was installed in Dâmbovița County. The capping systems were installed in half the time of the originally specified systems and the total cost of the project was lowered.

Polyethylene Coating Separates Concrete and Bentonite

Basin sealing at the A9 Lederhose motorway junction: Bentofix® X allows direct concrete application on geosynthetic clay liners (GCLs)

Concrete and bentonite are actually quite incompatible: concrete reduces the sealing effect of bentonite and bentonite reduces the strength of concrete. Now NAUE has a solution: Bentofix® X – a polyethylene-coated bentonite sealing mat, also called a geosynthetic clay liner (GCL). At the A9 Lederhose motorway junction near Triptis, the basin sealing allowed a direct application of concrete onto the bentonite mat.

The A9 is internationally significant. Not only does it connect Berlin and Munich but it continues on to Austria and Italy. The 46.5km extension in Thuringia is the final A9 extension project to be completed of the works that emerged with German reunification in 1990. Of note, this final A9 extension is actually being financed privately as part of a new financing model.

Refinancing according to availability

Via Gateway Thüringen GmbH & Co. KG is the private consortium that is orchestrating the financing, planning, building and operating of the A9 from Lederhose to the Thuringia border. The group's contract is for 20 years.

It gets state money for this, but unlike the previous public-private models in which the private management company was paid based upon traffic volume this new scheme is based on roadway "availability." If the route is not accessible or accessible only to a limited extent, the consortium is paid less. The base sealing system designed into the Lederhose motorway junction is also innovative.

The NAUE Team recommended the Bentofix® X for installation underneath the concrete layer and the paving.

Concrete paving makes cleaning easier

The project team accepted the recommendation and decided to utilize the special coating on Bentofix® X. Subsequently, the construction of the flood control basin was implemented in October 2012, with the system containing (from top to bottom):

- Concrete block paving (joints filled with concrete mortar)
- 22cm concrete bedding
- Bentofix® X2 BFG 5300, installed with the coated side facing up (4,300m²)
- Formation

The concrete paving surface plays a very functional role in this design, including for protection. With regular cleaning and potential desludging maintenance needed, the concrete prevents those operations from threatening the integrity of the bentonite mat or its coating.

The GCL is engineered as a highly effective liquid barrier only. Hence, actions upon the basin, even for cleaning and desludging, are not appropriate for the GCL and can potentially impair how effective the barrier system can perform over the long-term. Protected by concrete, however, the bentonite mat is ready to provide significant long-term barrier security.

As noted earlier, bentonite and concrete are not directly compatible (according to the EAG-GTD technical guideline: Recommendations for Application of Geosynthetic Clay Liners).

Direct contact between the two materials impairs the performance of both layers. The bentonite mat removes liquid from the concrete, which impairs the setting process. On the other hand, the alkaline concrete slurry from the concrete prevents the expansion of the bentonite. Concrete and bentonite are thus not an ideal combination.

This is why Bentofix® X, with its special polyethylene coating, needed to be selected.

Coating separates and ensures functionality

Bentofix® X2 BFG 5300 corresponds to the proven NAUE Bentofix®: a highly expandable layer of sodium bentonite powder that is encased between two geotextile layers and is erosion-resistant due to the special needlepunch manufacturing process. The additional polyethylene coating is then extruded on one side for this new Bentofix® X2 material.

For the Lederhose project, the coating prevents the concrete slurry and bentonite powder from reciprocally influencing each other.

Additional advantages to the use of this coating include: protection against desiccation, increased root protection and resistance to damage from burrowing rodents, a stronger seal (a de facto "double seal"), and even less water permeability than the already exceptional performance of non-coated bentonite mats.

Bentofix® X takes the long-term barrier characteristics for which bentonite mats are already renowned and multiplies them.

Outer layer options and reinforcement

Bentofix® X mats can also be flexibly outfitted with different material outer layer surfaces (e.g., smooth or structured), which increases the range of applications and design configurations in which these bentonite mats may be utilised. For the A9 project, a smooth-surfaced Bentofix® X2 BFG 5300 was installed.

An additional Secugrid® 30/30 Q1 geogrid was placed in all sloped areas and back-anchored on the slope crest in a statically dimensioned anchor trench so that the concrete couldn't slip prior to setting.

The back-anchoring is only required for the grid, not for the Bentofix®. The GCL is only fitted in the trench, whereas the geogrid is installed through the entire trench cross section.

Thin Combigrid® Platforms Carry Heavy Loads

Harvey Norman Site in Maroochydore, Australia

In the construction of heavily trafficked areas such as working platforms, a stable subgrade with sufficient bearing capacity is required. Economical and environmental advantages of construction methods with geosynthetics, especially on soft soils are already well known. Soil masses that need to be excavated, transported and installed can be dramatically reduced by the inclusion of geosynthetics. The best example is the improvement of soft subgrades with geogrids or geocomposite products. Geotextiles are normally required to separate a granular platform from a cohesive subgrade and to act as a filter.

In 2011, it was planned to build granular piling rig access platforms to facilitate the installation of piles for support of the new Harvey Norman bulky goods project in Maroochydore, Queensland, Australia, to increase the low subgrade strength and to provide sufficient bearing capacity for the imposed loads of the cranes.

After site investigations, the consultant confirmed that the current condition of the site surface would not be satisfactory for the safe operation of the proposed precast piling rig imposed load of 280kPa. It was also advised that the grey clay exposed on the surface of the site had been badly affected through saturation as a result of the 2011 Queensland floods. Subsequent wet weather was not allowing the perched groundwater to drain away, leaving the platform saturated. These surface soils alone were not capable of supporting the required 280kPa bearing capacity required for the pile rig. A further constraint was that the platform thickness was limited to 350mm above the existing subgrade elevation to avoid interference with the intended levels of the proposed basement car park.

Global Synthetics were asked to provide a geosynthetic alternative design to provide a suitable (i.e. safe and stable) working platform for the piling rig. The original design proposal was to excavate 200mm and construct a 500mm thick platform consisting of good quality unbound pavement gravel. As the subgrade was weak, and the thickness of the platform was limited, the geosynthetic reinforced platform on existing subgrade was chosen as the preferred solution. With reference to the information given, a subgrade CBR value of minimum 1% (equal to cu > 30kN/m²) had to be considered as the existing bearing capacity of the in-situ soft subgrade. The design by BBG Bauberatung Geokunststoffe GmbH & Co. KG focused on the specific machine type to be used with a total mass of 77 tonne. The design of the reinforced working platform was carried out in accordance with the BRE (Building Research Establishment, UK 2004) design manual and the design principles defined in DIN 4017:2006 to achieve an adequate safety factor against bearing failure.

Upon final approval, some 50,000m² of Combigrid® geocomposite was installed successfully on site beneath the crane platform. The material was placed directly on the subgrade to improve the bearing capacity and to prevent fines from migrating into the platform materials. The appropriate strength of geogrid was selected according to appropriate stress and strain properties required and the subgrade bearing capacity. A 350mm thick granular working platform was then constructed on top of the Combigrid®.

Combigrid® consists of a Secugrid® geogrid as the reinforcement component; combined with a needle-punched nonwoven geotextile firmly welded between the reinforcement bars offering separation and filtration in one single layer. It offers the functions of two different materials with the simplicity of installing a single product.

The use of Combigrid® made the construction of a thin granular platform layer on the very soft subgrade possible, reducing construction costs and construction time for the client. By omitting the 200mm subgrade excavation and removal procedure, and reducing the platform thickness from 500mm to 350mm substantially reduced the number of truck movements to and from site ensuring significant additional environmental benefits as a result. The contractor, client and pile rig operator were extremely happy with the results and reported that the final solution exceeded their expectations.

For more information, contact info@globalsynthetics.com.au.

Soft Rock Protects Thorpeness

Emergency Response: the Suffolk Coast's Erosion

The seasonally harsh conditions along England's Suffolk coastline present a steady threat of erosion. In the 1970s, a gabion structure was installed along a sensitive stretch in Thorpeness to defend against localised erosion.

The 200m long structure protected cliff-side residential homes. Over time, however, even this strong structure began to succumb to the constant wave attack. Heavy storms in April and May 2010 caused a failure of many gabion mats.

Differential settlement of the gabions stressed and parted the binding ties that hold the wire baskets together. Geotextile underlay beneath the gabions also tore.

The Suffolk Coastal District Council plotted a two-phase erosion correction with Phase 1 addressing the emergency protection works and Phase 2 providing long-term site correction and stability. They found that to defend the coastline and communities they needed a seemingly softer solution: geotextile bags and local fill.

NAUE to the Rescue

The Council considered three site management options.

First, they questioned whether correcting the site would be economically feasible in the short term and a viable erosion prevention solution long term. They needed to understand the full risk: whether it could be halted and whether it might stabilise on its own. So the Council reserved the first option for doing nothing at all.

Analysis, however, showed that erosion would continue and that inaction would leave the cliff side prone to rapid erosion as the slope re-profiled to a stable angle. All the while, the beach's drawdown would reduce wave dissipation. The cliff line was on pace to recede at around 1.0m/yr for 5 to 10 years.

Option 2 was identified as the "minimum" work solution and focused on securing the existing gabion defense line, ideally to minimise damage under a 1:5 year storm event with depth-limited waves. The slope toe would need to be repaired along most of the structure length to reduce the wash-out risk.

Where the gabions had been damaged, cutting, reprofiling and replacement of material would be needed. Up to 75% of the structure's length was thought to be in need of repairs. Essentially, new geotextile underlay and new gabions would be needed.

Option 3 focused on improving the design life of the site with the use of geotextile bags, either building up the current defense with them or improving the toe with them. This option would extend the gabion structure's design life to at least 25 years and defend the beach frontage against erosion while new sediment deposits could build.

When all costs were compared and design life was weighed against the options, the Council chose the geotextile bag solution. NAUE Soft Rock geobags, made with highly durable Terrafix® geotextile, were specified.

Excavating the slope toe on the beach front down to the clay, the construction team - led by J Breheny Contractors Ltd - built geobag berms on a slope of 1:4. Each bag was 2.4 x 1.2 x 0.4m when filled with the on-site material. This Soft Rock approach has been used at similar sites around the world, and in each instance the utilisation of geotextile containers or tubes has both defended against erosion and allowed for beach rebuilding.

As waves strike the rebuilt slope, the wave energy is diffused and the sand carried in the water is able to be left behind. Where water filters into the structure, the geotextile bags prevent sediment from being pulled out but allow the water to filter away.

The Thorpeness frontage is now being restored with the help of the needlepunched nonwoven geotextile-based geobag berm. The bags are being laid eight to ten layers deep over 1.5 miles of geotextile underlay.

In addition to the revetment support and erosion control protection offered by this approach, the use of local fill in the bags has greatly improved the economics of the construction and reduced the environmental pollution normally associated with the transport of significant quantities of heavier erosion protection solutions (such as heavy riprap).

Did you know...?

We issued a flyer on our new product development Secutex® EDF, a new type of geocomposite specifically for use in railway constructions.

The functions and the advantages of this new development are explained in detail.

"On track with Secutex® EDF"

Secutex® EDF ensures long-term elasticity as well as the drainage and vibration cushioning of the track bed. It reduces gravel abrasion and extensive wear on wheels and rails. These functions increase the track service life and reduce maintenance costs.

For more information please contact us at info@naue.com and order your copy of this flyer.

Exhibition and seminar schedules

June		
17. - 21.06.13	*Exponor Chile 2013*	*Antofagasta, Chile*
September		
02. - 06.09.13	*ICSMGE Paris 2013*	*Paris, France*
18. - 20.09.13	*ICE Coasts, Marine Structures and Breakwaters 2013*	*Edinburgh, GB*
30.09. - 02.10.13	*INFRA Oman*	*Oman*
October		
14. - 16.10.13	*Bologna 2013 - International Symposium on Design and Practice of Geosynthetic-Reinforced Soil Structures*	*Bologna, Italy*
November		
07. - 08.11.13	*Landfillworkshop Zittau-Liberec 2013*	*Zittau, Germany*
18. - 20.11.13	*GEOAFRICA 2013*	*Accra, Ghana*
27. - 29.11.13	*STUVA conference 2013*	*Stuttgart, Germany*
28. - 29.11.13	*GEOTEC Hanoi 2013*	*Hanoi, Vietnam*

Editor: Management. Implementation: Department for Marketing. Circulation: 2,000, Design/Production: TwoTypes². Alsweder Straße 19, 32312 Lübbecke, Germany. Reproduction, including extracts, may only be made with the prior permission of the publisher.