NAUE

NEWS

The latest news magazine from the NAUE Group

Issue 24 - June 2005

Introduction

The year 2005 began with a special highlight - our 4th German Geosynthetics Colloquium. Approximately 200 people accepted our invitation this year to come along to Garmisch-Partenkirchen where a wintry landscape, deep in snow, with brilliant blue skies provided the perfect backdrop for our Geosynthetics Colloqium and its illustrious guests.

The Chairman of the DGGT, the Deutsche Gesellschaft für Geotechnik and Chairman of the Board Management of Züblin AG, Prof. Dr.-Ing. Manfred Nußbaumer, held a speech in honor of Univ.-Prof. Dr.-Ing. Dr.-Ing. E. h. Rudolf Floss who celebrated his 70th birthday this year.

Professor Floss was among those who were "in at the birth" of the geosynthetic industry. He founded and led in a variety of functions as Chairman, the department of the DGGT and the German Chapter of the IGS or the International Geosynthetics Society. Professor Floss must take the credit for the fact that today the performance and acceptance of geosynthetics is so wide-spread and as an alternative to conventional building materials are being used in increasingly more frequent applications. We would like to take this opportunity to wish Univ.-Prof. Dr.-Ing. Dr.-Ing. E. h. Floss all the best for his 70th birthday with the hope that he has many full years of activity in good health ahead of him.

Just a few days later, we received the news that the Walter Bau AG, the third largest German construction company was going the same way as Holzmann AG and had declared insolvency. The many cases of companies going to the wall reflect the current desolate situation on the German construction market. The German construction industry has been fighting declining turnovers for quite a few years now but nevertheless, against the background of significant events - the World Football Championships in 2006 and the successful introduction of the toll collect system on German autobahns - we can see positive signs for 2005, even in Germany, that construction works are beginning to pick up again, particularly in the infrastructure sector. However, due to an unexpected late and unusually long winter, this trend cannot be supported by figures in the first quarter of the year but our sales team is optimistic for the rest of the year.

Exports continued in the same successful lane as in 2004 and provided the Group with developments in the first quarter of 2005 which exceeded our targets.

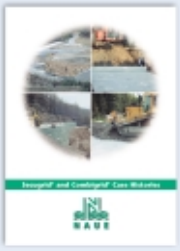
As we have announced in the previous editions of the NAUE News, March and April 2005 saw the completion of our new extended office facility and the move from the Lübbecke and Lemfoerde sites to this new administration headquarters in Fiestel. We are full of praise for all those involved in the change-over as the whole operation was carried out on time without causing any problems or hiccups in our daily business activities. Many of our employees sacrificed their weekends in order to speed up the relocation and so ensure that work could begin again as soon as possible. We would like to extend our sincere thanks to all of our staff for their help.

May 18, 2005 was again a red-letter day for our site in Adorf, Saxony. The District Administrator in the Vogtland County, Dr. Tassilo Lenk and the major of Adorf, Ms. Mariechen Bang, placed the second geogrid plant in Adorf on stream and thus officially gave the go-ahead for production to begin. The team around Volkhard Müller and Werner Guether succeeded - as they said they would - in getting the second geogrid plant ready for production on time. This is even more worthy of praise as the patented Secugrid®-welding plant is a one-off-the-kind construction, which was for the most part carried out by our own workforce. To have this production and plant know-how within our own company is a decisive factor when it comes to remaining competitive and ensuring the future of our company.

Personnel-wise, there have been changes in the NAUE group in 2005 as we have welcomed an old friend back into the company, Dipl.-Ing. Norbert Vissing, who was responsible for production at the Tönisberg site from 1996 to 2002 and is now taking over as head of the complete production sectors for all of the NAUE production sites. We would like to wish him success in his challenging tasks.

The NAUE group is looking optimistically to the construction season in 2005. As the world's only manufacturer of the complete range of geosynthetics in its own plants, we can pass on cutting-edge advantages to our customers. Continuous high quality products, harmonizing with one another and just one contact person for each customer - simply one-stop shopping! We are well-prepared to meet any challenges which come our way in the future.

Did you know ...?



...that NAUE has designed an interesting flyer about the benefits of Secugrid® reinforcement, "Secugrid® and Combigrid® Case Histories" which clearly illustrate the enormous potential provided in this innovative product. Have we aroused your curiosity? Then simply contact Ms. Walz:

telephone +49 (0) 57 43 / 41 - 5 70,
fax +49 (0) 57 43 / 41 - 2 94 or
e-mail swalz@naue.com!

Special forum Geotechnics

We reported briefly in our last edition of the NAUE News on the appointment of our managing partner Dr.-Ing. Georg Heerten as an honorary professor at the RWTH or Rheinisch-Westfälische Technische Hochschule (Rheinisch-Westfalian Institute of Technology) in Aachen; an event which was afforded a special honor by the chair and institute of "Geotechnic in the Building sector" on December 2, 2004 in the form of a special forum on "Building with Geosynthetics" at the RWTH in Aachen.

Following official words of welcome given by the provost of the faculty for structural engineering, Univ.-Prof. Dr.-Ing. W. Benning, the chairman of the department for "Geosynthetics in Geotechnics" of the DGGT, Deutsche Gesellschaft für Geotechnik e. V. (German Association of Geotechnics) Univ.-Prof. em. Dr.-Ing. Dr.-Ing. E.h. Rudolf Floss also extended a warm welcome and was joined by the provost Univ.-Prof. Dr.-Ing. W. Benning and the chair and director of the DGGT Univ.-Prof. Dr.-Ing. Martin Ziegler in recognizing Prof. Dr.-Ing. G. Heerten's ten years plus of work as a lecturer on the subject of "Geosynthetics in Geotechnics". The engineering and technical side of the special geotechnic forum "Building with Geosynthetics" offered a wide and international spectrum with lectures held by

- *Prof. Dr.-Ing. Georg Heerten: "The century of geosynthetics has only just begun",*
- *Univ.-Prof. Dr.-Ing. M. Ziegler: "The use of geogrids as reinforcement elements in geotechnics - interaction geogrids and soil",*
- *Prof. Dr. R. M. Koerner: "Cost Savings and Technical Challenges by Designing with Geosynthetics in North America".*

A tour of the institute for "Geosynthetics in Structural Engineering" provided an insight into the institute's facilities. One main feature were the testing facilities for geosynthetic research where Prof. Alan McGown from Strathclyde University presented the instruments and devices he had taken over since his retirement, for the first time to the public - all shiny and new and ready to go! Thus conditions have been created at the Institute "Geosynthetics in Structural engineering" at the RWTH Aachen for future intensified research and development work, regarding the reinforcement of earthworks with geosynthetics.

The special forum on geotechnics also provided an opportunity to involve the presence of guests from Europe and the USA in a workshop on December 3rd, 2004 on the subject of "Junction Strength and Biaxial Geogrid Properties" in a discussion at an international level and gave us a platform on which to present our successful reinforcement product Secugrid®. The discussion - which in the opinion of the participants from Germany, Europe and the USA was a fruitful exchange of ideas and information - focused on the following topics:

- Description of the product properties of geosynthetic reinforcement products in deformations within the range of the serviceability of synthetically reinforced earthworks (deformation < 2%),
- The considerably increased rigidity and lower creep properties of bi-axial load-elongation behavior, particularly in PET (polyester) Secugrid®,
- The effects of reinforcements in road base courses on long-term deformation and service behavior.

NAUE would like to extend its gratitude to all those who contributed in making this event such a success.

national projects

Nordenham, Northseacenter - on a safe foundation [Marc Iken]

The construction of local supply centers on green-field sites outside of the cities pose planners and the construction companies with difficult and complex tasks especially when the foundations do not have the required bearing capacity. Since November 2004, a shopping mall with several businesses, outdoor installations and access roads has been under construction in Nordenham. A survey of the subsoil showed that one could expect under the top surface a base of silt in varying thicknesses and a consistency classified as being between a plastic and liquid state. In addition, the number of hammer blows per minute during the drop-penetration tests showed that one would have to reckon with loose to very loose unconsolidated deposits at depths of 5 to 6 metres below the top. It would also have been nearly impossible to drive directly over the ground after rainfall. Proposals for the foundation put forward by the consultant Ingenieurgesellschaft Dr.-Ing. Beuße & Dr. Schmidt mbH, Tostedt, in agreement with the designer suggested "floating" foundations using geogrids for the whole area (including the buildings). In order to ensure a high enough degree of stiffness of the floating foundation, it was necessary to use reinforcing products which absorb the highest possible strength at the lowest possible level of elongation. Because of the optimum in strength-elongation behavior, it was decided to install a double layered Secugrid® solution. Prior to the commencement work, various areas of the site were prepared for the construction works. Below the areas of the buildings, the following set-up was installed as a foundation bolster over a 10 cm thick sand leveling course (from top to bottom):

- 40 cm base course, coarse gravel (0/45 mm)
- Secugrid® 40/40 Q6
- 45 cm base course, coarse gravel (0/45 mm)
- Combigrid® 60/60 Q6/R 156

The lower layer of Combigrid® 60/60 Q6/R 156 is a composite material comprising a Secugrid® geogrid with a Secutex® separating and filter nonwoven geotextile firmly welded between the lengthwise and crosswise flat reinforcing bars. This special composite product ensures with one installation process the reinforcement as well as the long-term filter stability of the base course. During the course of construction plate loading pressure tests were carried out which showed that the required bearing load values (of > 120 MN/m²), approx. 12.5 % CBR, were exceeded at the upper edge of the base surface in all cases so that it was possible to carry out the construction work on the buildings and their enlarged foundation blocks in varying dimensions (depending on the requirements specified by the designer). The areas next to the buildings were made on sand (70 cm) and a base course of coarse gravel (30 cm). A Secutex® separating and filter nonwoven formed a secure separation between the construction and the foundation layer over the whole of the area. A concrete brick paving was used for the surface layer of the parking lots. In the area of the main access roads an additional geogrid reinforcement layer of Secugrid® 40/40 Q6 was installed beneath a 30 cm thick base course because of the high stress expected from vehicles and freight traffic. The road surface will be constructed in asphalt.

Double layer construction using Combigrid® 60/60 Q6 / R156 and Secugrid® 40/40 Q6

In total, approximately 13,000 m² Combigrid®, 17,300 m² Secugrid® and around 22,000 m² Secutex® were installed. The company Depenbrock Bau GmbH & Co. from Stemwede was engaged as general contractors for the whole of the project (civil engineering). Date of completion is planned for the end of June 2005 in spite of the having to carry out works in the wet spring season. Ultimately, this could only be done thanks to the use of NAUE geosynthetics as the reinforced areas withstood the construction phases without any problems and no additional site roads had to be built. So thanks to NAUE geosynthetics, the Nordenham Nordseecenter will soon be firmly on its feet!

international projects

Design of a Secugrid® reinforced wall in the Czech Republic [Hana Rousková]

The investor of the project in the lime mine in Tman u Berouna in the Czech Republic, Vapenka Certovy Schody a.s., decided to build a reinforced wall in order to widen the existing road used for transporting stone to the crushing mill. The planners provided for a reinforced wall construction in the form of steel gabions filled with coarse gravel whereby the front side of the reinforced wall was to be set back every second layer by 0.5 m. Local conditions showed that the steep face would require cages to be

Front view of the access ramps reinforced with Secugrid®

stacked one on top of the other to a height of up to 12 m. The selected method of offsetting resulted in a maximum incline of 84°. The planned widening of the road also required that the earth thrusts on the cage wall will not cause any shifting or deformations so the cages had to be back-anchored by means of geogrids. In cooperation with the geosynthetic consultant Bauberatung Geokunststoffe (BBG), NAUE GmbH & Co. KG worked on a proposed solution using Secugrid® geogrids. It was decided to use Secugrid® 200/40 Q6 between each of the gabions. A connection between the geogrids and the gabions was ensured by friction from the resulting weight from the filling material. Furthermore, the BBG calculations on Secugrid® showed that the length of anchorage of the 10 reinforcement layers was only 4 to 7 m, depending on the position of the geogrid so that the contractor ZS Brno was able to install shorter lengths than the originally planned 10 m anchorages. This, in turn, meant lower construction costs and quicker installation. The construction of the steep face resulted not only in a wider access road but also in an additional area in which trucks and other vehicles have sufficient room to maneuver and reverse (minimum radius of 20.5 m).

Lovanja land-fill site - construction of the landfill in Montenegro, Yugosalvia [Armin Leue]

The Republic of Montenegro has been pursuing plans since 1995 to establish a waste disposal system since the Waste Management Law from 1975 was revised and newly passed in 2000. Funded by the European Union, the order was commissioned in 2001 to set up a strategic master plan (an EU plan regarding the setting up of landfill sites in Montenegro) which was published on October 5, 2004.

The strategy comprised the planning of three sites on the Adriatic coast, in order to protect the sensitive environment there from 2004. In order to ensure an environmentally-friendly method of disposing of the quantities of waste which would be involved until the building of the main landfill, a small landfill in Lovanja near Kotor was planned and implemented within just one year.

According to statements made by government officials, this landfill is the first to be planned and constructed in accordance with international guidelines (composite lining sealing) in Montenegro. GKW Mannheim, Germany, the company commissioned with the planning of this landfill, changed the original design which included a base sealing system of a 1.5 m thick compacted clay liner, a 1.5 mm thick PVC liner and a 30 cm thick sand protection layer into one which took into consideration the composite lining required under EU regulations; whereby Getoari (Prizaren, Kosovo) were responsible for installing the geosynthetic liners.

The Lovanja landfill also features a waste water collecting system and a waste water treatment plant.

Installing Secutex® on the Carbofol® geomembrane, and the placement of a mineral drainage layer

The following materials were selected for the construction of the landfill (from top to bottom):

- 30 cm thick gravel leachate collection system, grain size 8/16 mm
- Geotextile protection layer Secutex® R 504
- 1.5 mm thick HDPE Carbofol® geomembrane
- 1 m thick compacted clay liner - 4 layers, each of 25 cm

The selected geosynthetic solution manufactured by NAUE combined with quick and professional installation allowed the construction's owner to start up operations right on schedule. Furthermore, considerable cost-savings were achieved in comparison with the conventional system. By saving around 80 cm of mineral material, additional landfill volumes were created and together with the installation of NAUE geosynthetic components, a cost-favorable package was selected. In selecting this system, the construction's owner opted for the cost-efficient alternative and permanent solution provided in particular by Carbofol® liners made of HDPE.

Did you know ...?

...that NAUE has issued a number of **project videos** which demonstrate the applications of geosynthetics. The videos allow a real insight into the world of geo-synthetics produced by NAUE. If you are interested in a demonstration, please address your requests to Ms. Walz: telephone +49 (0) 57 43 / 41 - 5 70, fax +49 (0) 57 43 / 41 - 2 94 or e-mail swalz@naue.com.

...that the German FGSV - **"Forschungsgesellschaft für Straßen- und Verkehrswesen"** (a research association for roads, transport and communications) working group Earthworks and Foundations, has republished the new "technical terms of delivery for geosynthetics in road construction - TL GeoK E-StB 05" (in German language) which will surely prove to be of invaluable assistance for your area of work. If you are interested, please contact the publishers direct under: info@fgsv-verlag.de.

...that NAUE has released new interesting case studies? Furthermore, an informative profile of our company appeared in the journal TIS (Tiefbau, Ingenieurbau, Straßenbau, issue 4/2005 in German language) and will be translated shortly. We would be pleased to let you have further information, contact Ms. Walz: telephone +49 (0) 57 43 / 41 - 5 70, fax +49 (0) 57 43 / 41 - 2 94 or e-mail swalz@naue.com

Products

Long-term Service Lifetime of Bentofix® GCLs [Kent von Maubeuge]

Bentofix® Geosynthetic Clay Liners (GCLs) are commonly reinforced with polypropylene (PP) fibres to improve their resistance to shear loads. Since the shear resistance is often used in the design of slopes, the long-term properties of the reinforcement can be the determining factor affecting the service lifetime of the slope. Therefore, it is important to understand the long-term behaviour of reinforced GCLs. Two possible failure mechanisms for the reinforcing fibres are creep rupture and oxidation. For this reason NAUE started a research program in 1999 to investigate these issues. One research part was carried out by the BAM (Bundesanstalt für Materialforschung und -prüfung [Federal Institute

for Materials Research and Testing]). The results from the BAM experiments on the > 200 year functional lifetime of Bentofix discussed in the NAUE News issue No. 22 were independently complimented by a series of oven-aging experiments designed to measure the oxidation rates of the fibres when exposed to air in a simulated landfill environment. The second research project was carried out at TRI, a testing and research institute in Austin/Texas. This study involved using Arrhenius extrapolation methods to determine the oxidation rate of fibres when exposed to air at temperatures of 100°, 90°, 80°, 70°, and 60°C. The material tested was a needle-punched, nonwoven polypropylene Secutex® geotextile made from fibres used in the Bentofix® GCL. The specimens for oven exposure were approximately 5 cm x 15 cm. Over 500 specimens were cut and then were shuffled to try to minimize the effect of thickness variations in the material. Test specimens were exposed in forced-air ovens at temperatures of 100°C, 90°C, 80°C, and 70°C. The specimens were hung under racks with unfolded steel paper clips. The specimens were spread out evenly around the oven and they were not touching each other. Three different ovens were used to perform the four sets of exposures. The unexposed and exposed test specimens were evaluated by a strip tensile test. The test grips were 2.5 cm x 10 cm, the strain rate was 10 cm/min, and the initial gage length was 7.5 cm. All tests were taken to failure and the maximum load and the strain at the maximum load were recorded. The aim of the study was to propose a generally accepted requirement that the tested geotextile should maintain over 50 % of its strength when exposed to the tested condition, which was also the basis for the extrapolation. When these data were used to extrapolate, it was found that if the textiles were continuously exposed to fresh air in a high air-flow environment, the predicted service lifetime would be about 17.8 years at 15°C. However, since these were extreme and not realistic conditions the results were compared to oxidation rates found in 8 % oxygen, which is believed to be the maximum concentration one would find in a buried application. In this case, the oxidation rate was 21 times slower than the rate found in air (21 % oxygen). This means that the 17.8 year service lifetime would actually be 373 years in a buried application; agreeing very well with the results from the BAM. The results for these two independent studies clearly show the long term performance capabilities of Bentofix® GCLs. However, one can be less conservative and assume that a remaining long-term tensile strength of 25 % or even 10 % would be sufficient. In this case the lifetime prediction for Bentofix® would increase to 560 years, resp. 672 years. The full study will conclude shortly.

Please contact Kent von Maubeuge:
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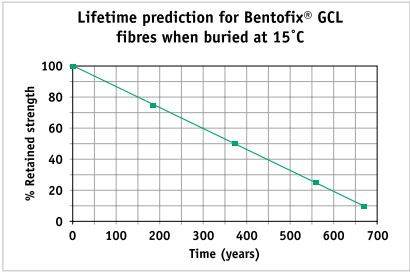


Secugrid® reinforced soils

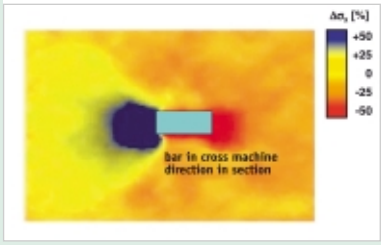
[Univ.-Prof Dr.-Ing. Martin Ziegler, Dipl.-Ing. Volker Timmers]

At the RWTH - the Rheinisch-Westfälsiche Technische Hochschule - in Aachen, studies are being carried out in numerous laboratory tests and numerical calculations regarding the material properties of geogrids and their effect on soil reinforcement.

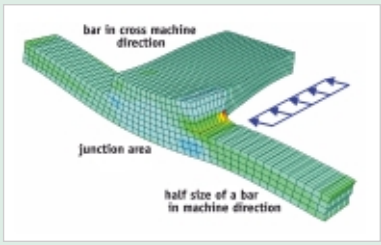
The extent of the effects (stress) absorbed by the geogrid bars - in practice, usually caused at minor deformations in the construction by means of friction and interlocking between the geogrid and the soil material - depend on both the geogrid rigidity and on the density of the soil layer and the grain shape of the soil material. Numerical calculations using the particle size method reflect the soil material as aggregate particles, allowing that these properties can be taken into consideration.

As the effects (stress) on the cross bars must be transferred into the longitudinal bars via the junctions, junction resistance is of significance for the material resistance of geogrids as well as their tensile strength. The actual complex stress situation in the junctions can only be measured e.g. with the help of the Finite Element Method using suitable material models.

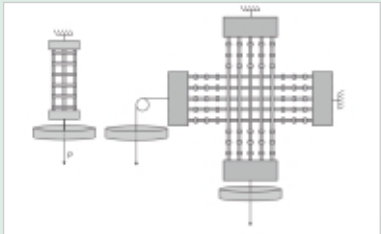
As a result of the extruded polymer structure, the material behavior of geogrids is time-dependent and anisotropic therefore tensile stress leads to elastic, and prominently visco-elastic and visco-plastic deformations. Based on tension-elongation isochrones resulting from uni-axial and bi-axial creep tests on Secugrid® made of polyester, studies are being made on the extent of expected less creep elongations under bi-axial stress compared to the uni-axial stress and to what extent this effect can be considered when dimensioning Secugrid® reinforced construction. For further information:
Univ.-Prof. Dr.-Ing. M. Ziegler und Dipl.-Ing. V. Timmers, Geotechnik im Bauwesen, RWTH Aachen, www.geotechnik.rwth-aachen.de



Pull-out test: Changes of horizontal tensions in a Secugrid® bar



Junction deformation resulting from cross stress on the bar



Schematic of creep tests

Impressum

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Schedule of shows and conferences

13./14.06.05	*10th Research days on ground water, Dresden/Germany (in German)*
14.-17.06.05	*CIWM Annual Conference & Exhibition, Torbay/UK*
05.-07.07.05	*40th Defra Flood and Coastal Management Conference 2005 York/UK*
12.07.05	*IGS UK Chapter Symposium Geosynthetics in Hydraulic Engineering Nottingham7UK*
14./15.09.05	*4th International Underground and Tunnel Fair, Sargans/Switzerland*
14.-17.09.05	*HTG Congress, Bremen/Germany (in German)*
20.09.05	*5th Landfill seminar, Mainz/Germany (in German)*
28.09.-01.10.05	*Enviro-Tech Philippines 2005, Manila/Philippines*
29./30.09.05	*2nd Symposium Environmental geo-engineering, Freiberg/Germany*
06./07.10.05	*Closure and Recultivation of landfills (ICP), Karlsruhe/Germany, (in German)*
12.-16.10.05	*SAIE 2005, Bologna/Italy*