

Keeping on the right side of Health & Safety Law

A look at CDM 2015 following a Health and Safety Seminar held by Equipe in March 2015



Seismic Cone Penetration Testing
Improvements to aid investigations on rail sites

Geotechnica 2011 - A Retrospective
A look back at the third Geotechnica as we build towards 2015's show

Ammonia and Ammonium
Methods of analysis in water and soils

Sustainable geo-engineering
Maccaferri look at construction sustainability

GEOTECHNICAL COURSE DATES:
Rock Description Workshop
17th June 2015, 12th August 2015
In Situ Testing
20th May 2015
Lab Testing
26th May 2015

GEOTECHNICAL COURSE DATES:
Geotechnical Foundation Design - 3rd June 2015, 16th July 2015
Soil Description Workshop
4th June 2015, 15th July 2015

H&S COURSE DATES:
IOSH Avoiding Danger from Underground Services
24th April 2015, 26th June 2015
IOSH Safe Supervision of Geotechnical Sites:
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NEXT COURSE DATES: 24th April 2015
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IOSH Working Safely (on Geotechnical Sites)

This one day geotechnically focussed health and safety course has been developed by industry specialists as a foundation to site safety for all personnel involved in projects in the drilling and geotechnical industry. Its aim is to impart the core safety skills required of those working on geotechnical sites by building on their existing specialist technical skills and making it relevant to their place of work.

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GEOTECHNICAL COURSES

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Welcome

Welcome to the 39th Edition of **theGeotechnica** - the UK's fastest growing online geotechnically focussed e-magazine.

This month, once again, we have a fantastic line-up of insightful and informative articles that make for a must-read.

The first article of this month's issue comes from Chris Dimelow, projects manager for Lankelma. In this article Chris talks about how improved seismic cone penetration testing will bring benefits to rail site investigations.

The second article of this month's issue is also the cover article. The article comes from Julian Lovell, Managing Director at the Equipe Group. This month Julian continues to discuss Health and Safety Law, with a focus on CDM 2015 following a Health and Safety Seminar held by Equipe in March 2015.

The third article comes from Calum Spires of the Equipe Group. This month is the third in a series of articles from Calum that will take a look back at previous Geotechnica events in the build-up to this year's event in July. This month Calum takes a look at Geotechnica 2011 - the third event in Geotechnica's history.

Our fourth article this month comes from Hazel Davidson of Derwentside Environmental Testing Services. In this excellently informative article, Hazel discusses the methods of analysis of ammonia and ammonium in waters and soils.

The final article this month comes from geotechnical and civil engineering specialists Maccaferri provide a look at construction sustainability, where the principles of reclamation and recycling of site won materials have been raised significantly.






As with every new edition of the magazine, the Editorial Team here at **theGeotechnica** will be on the lookout for even more new, original and interesting content from all corners of the sector, and would actively encourage all readers to come forward with any appropriate and relevant content - whether it be a small news item or a detailed case study of works recently completed or being undertaken. If this content is media rich and interactive, then all the better. We are looking to increase the already large readership of the magazine through better social media integration and promotion, as well as improving content month on month.

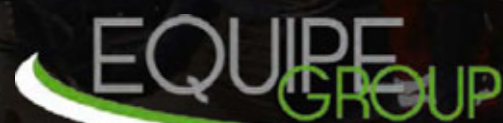
Finally, for any content that is submitted we will ensure that an advertising space, proportionate to the quality of content provided, is reserved should you wish to place an advert in that single edition of the magazine. We hope you enjoy this month's edition of the magazine and are inspired to contribute your own content for the coming editions of **theGeotechnica**.

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theGeotechnica

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SEISMIC CONE PENETRATION TESTING TO IMPROVE RAIL INVESTIGATIONS

Writing for **theGeotechnica** this month is Chris Dimelow, projects manager for [Lankelma](#). In this article Chris talks about how improved seismic cone penetration testing will bring benefits to rail site investigations.

Site investigations on the railway are often challenging, with tight timescales – mainly during night-time and weekend possessions – on sites with difficult access and tight working space. Then there is the challenge of data quality and timely access to results.

Cone Penetration Testing (CPT)

is an ideal technique for site investigations on the railway because it is fast, quiet and clean, producing no spoil, and can often achieve deeper penetration than dynamic probing and window sampling.

A major advantage for railway investigations is CPT's speed. Typically, a 15m deep CPT takes

about 40 minutes, so between four and five tests (producing 7,500 data points) can be carried out in a six hour night-time possession including the time for getting on and off site (depending on how far test positions are from the site access point).

CPT delivers high quality data which can be used to determine soil parameters, including soil type, relative density, insitu stress conditions and shear strength, for use in

geotechnical design. Results are also available in real time, which allows engineers to take decisions on site during the investigation. This is particularly useful when identifying the best locations for further testing, sampling and monitoring.

The seismic cone is a particularly useful tool for railway site investigations. The test measures the insitu shear wave velocity, which allows the small strain shear modulus and the stiffness of the ground

to be calculated. Small strain shear modulus is essential to understand the dynamic properties of the soil and can be used for calculating settlement and dynamic loading effects, such as those experienced by railway earth structures.

“Lankelma recently refined the seismic cone test by developing a new seismic wave generator positioned next to the CPT rig...”

Lankelma recently refined the seismic cone test by developing a new seismic wave generator positioned next to the CPT rig (on the railway this can be a road rail vehicle (RRV) rig or one attached to a rail excavator arm).

Seismic beams are typically a wooden block with a metal face but this creates a disjointed source – the shear wave generated from the wood is not consistent and the integrity of the wood can deteriorate quickly after multiple strikes.

Lankelma's seismic wave generator, on the other hand, comprises a nylon block with ground anchors that produces a cleaner seismic shear wave.

“The nylon produces fewer harmonics, so dampening provides a clearer, repeatable shear wave signal.”

The nylon produces fewer harmonics, so dampening provides a clearer, repeatable shear wave signal. Anchors and teeth help secure to the ground, restricting horizontal

movement. This means the force of the strike is better transmitted into a shear wave and not dispersed through surface movement.

The 15cm² seismic cone comprises a piezocone unit with a seismometer above, which is pushed into the ground and stopped at 1m intervals to measure shear wave velocity and build-up a seismic profile. The cone is an accelerometer-based seismometer, rather than a more conventional geophone system. This has a higher sensitivity, with a larger frequency response and less noise than a geophone system, delivering better quality data and to considerably greater depths. Higher data quality ultimately means that interpretations are far more accurate, which in turn means design can be improved.

“Because it can be used with most CPT equipment developed for the railway, seismic cone testing is suitable for investigating a wide range of railway environments...”

Because it can be used with most CPT equipment developed for the railway, seismic cone testing is suitable for investigating a wide range of railway environments, including the track bed, embankments, tunnels and stations. This versatility, together with improved data quality, means it is a great addition to the site investigation contractor's armoury on the railway. ■

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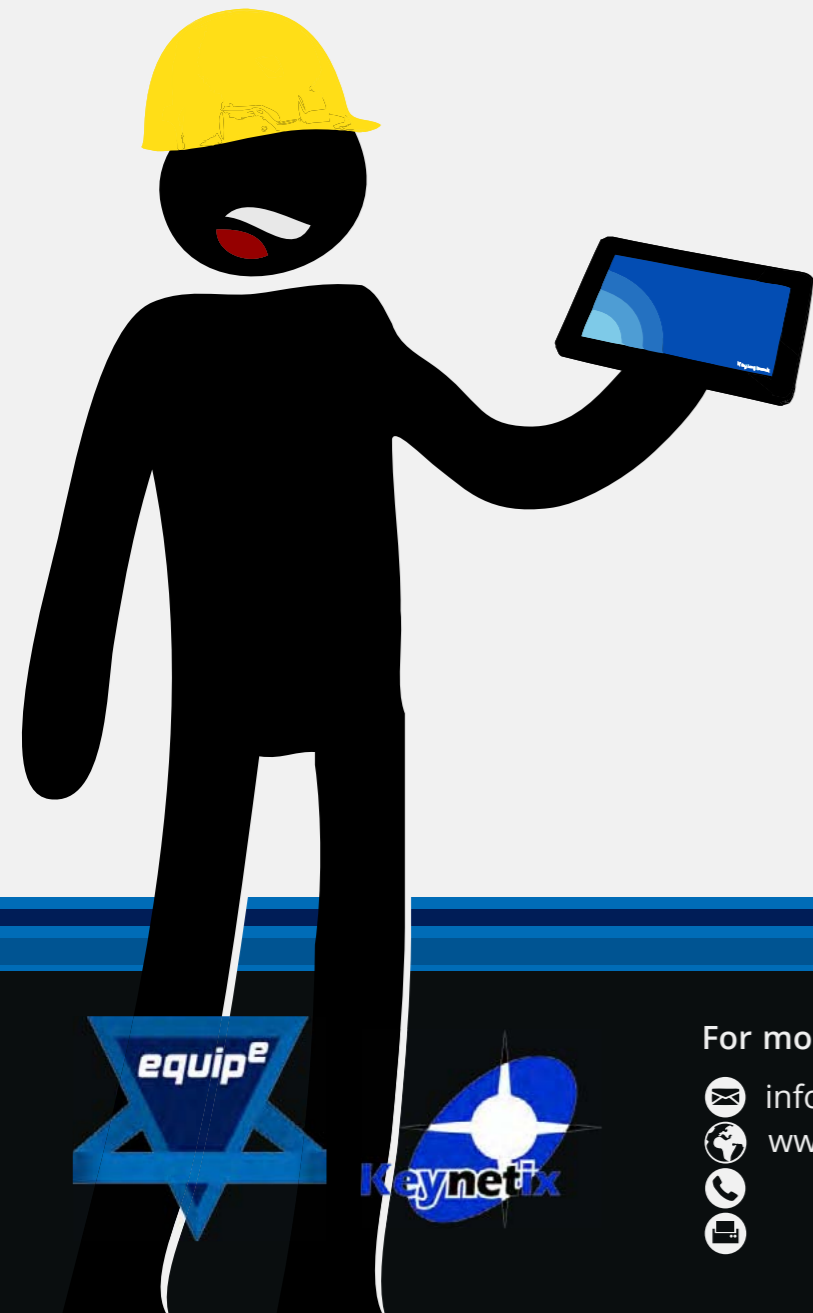
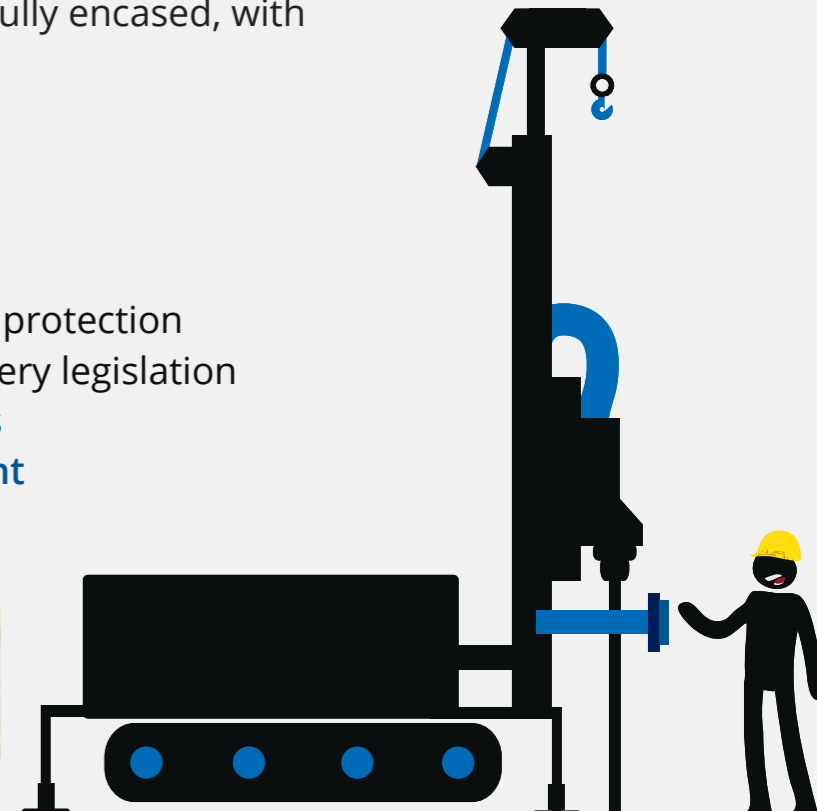


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KEEPING ON THE RIGHT SIDE OF HEALTH AND SAFETY LAW

CDM 2015 – INDUSTRY HEALTH AND SAFETY FORUM REPORT

Writing for **theGeotechnica** this month is Julian Lovell, Managing Director at the [Equipe Group](#). This month Julian continues to discuss Health and Safety Law, with a focus on CDM 2015 following a Health and Safety Seminar held by Equipe in March 2015.

The Construction (Design and Management) Regulations 2015 (CDM 2015) will come into force on 6th April 2015 and the geotechnical and drilling industry is currently trying to work out how or if the changes will make an impact. As with most legislation and guidance, organisations have to interpret how this may affect or be applied to their business, understand their obligations and manage their work to enable compliance. **“On 4th March 2015, Equipe facilitated the first geotechnical and drilling Industry Health and Safety Forum to establish an industry wide interpretation of CDM 2015.”**

On 4th March 2015, Equipe

facilitated the first geotechnical and drilling Industry Health and Safety Forum to establish an industry wide interpretation of CDM 2015.

The Regulations are subject to certain transitional provisions to cover projects which recognise there will be projects that started before CDM 2015 comes into force. All new projects must comply with CDM 2015 from the 6th of April and all existing projects must comply within 6 months.

The main principals of CDM are upheld within CDM 2015 which is good communication, engaging at the right level, employing competent individuals and organisations and doing the job right. Yes, there are identified duty holders with roles and responsibilities and CDM 2015 appears to outline more clearly and more



robustly the obligations of the Client but it is still about eliminating, minimising and controlling the risk. Clients are required to provide pre construction information; Designers must eliminate risk through design; Designers must inform contractors about remaining risks that cannot be eliminated and Contractors must manage the remaining risk in accordance with accepted principles.

The subject and full understanding of CDM 2015 is too large for one article and will arguably evolve as organisations start to implement the new

requirements for their projects. This article discusses two aspects of the new Regulations; Additional Requirements and the Construction Phase Plan and then provides three industry scenarios for consideration.

Additional Requirements of CDM 2015

CDM 2015 has removed the CDM Coordinator and amended the role which now requires the appointment of a Principal Designer. All projects independent of duration will now require a Construction Phase Plan. Domestic work

which was previously not notifiable and therefore had no requirement for a CDMC or Principal Contractor will now be covered by all areas of CDM. In addition, the notification threshold will change, but not noticeably. Those jobs where more than 1 contractor is involved, will require the Client to appoint in writing (regardless of site notification status) a Principal Contractor and a Principal Designer.

Construction Phase Plan

What will the Construction Phase Plan look like and what must it contain? Now there is

no longer a CDMC to approve the Construction Phase Plan, the hope is that this will reduce the paperwork developed to satisfy the clearly detailed areas of an ACoP, without adding to **“The HSE are keen to ensure the Construction Phase Plan does not become a repository for generic method statements and risk assessments.”**

the safety of the project. The HSE are keen to ensure the Construction Phase Plan does not become a repository for generic method statements and risk assessments.

The Regulations state that:

A construction phase plan is a document that must record the following:

a) health and safety arrangements for the construction phase;

b) site rules; and

c) where relevant, specific measures concerning work that falls within one or more of the categories listed in Schedule 3

The plan should not include documents that get in the way of a clear understanding of what is needed to manage the construction phase, such as generic risk assessments, records of how decisions were reached or detailed safety method statements.

Therefore, the Construction Phase Plan should be produced as a high level document outlining how the Principal Contractor will manage ►►

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Speakers: Dr John Powell - GEOLABS Ltd, Tom Lunne

NEXT SEMINAR DATE: 23rd - 24th June 2015

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“Risk Assessments and Method Statements should be used, not as a measure of competence as they often are at the moment... but as a management tool.”

the health and safety aspects of the construction. Risk Assessments and Method Statements should be used, not as a measure of competence as they often are at the moment (competence should already have been established before appointments are made), but as a management tool to identify and advise the site teams and workers how this will be controlled. Interestingly a template has been produced by CITB for small builders to produce a Construction Phase Plan using an on-line App. This provides a useful insight as to what is expected to be included and does not prompt for any Method Statements or Risk Assessments. The leading question would be if a template based approach could be suitable for small or simple geotechnical and drilling projects?

Scenario 1

A consultancy employing geotechnical specialists is contracted by a housing association to carry out a ground investigation and report the findings. The consultancy employs the ground investigation contractor, designs the ground investigation and provides a ground investigation report for the housing association.

Question: Is the Consulting

Engineer the Client, Designer, Principal Designer, Contractor or Principal Contractor?

Considerations: The consultancy is not the Client under CDM although he may pay for the ground investigation contractor. The housing association is the influencing organisation for the project, would ultimately pay for the project including the ground investigation and would be regarded as the Client. The consultancy, if they are not directly involved with the design of the structure (the house), should not be appointed as Principal Designer and would not even be considered as a Designer by CDM.

“The Client should therefore look to appoint the Principal Designer from the design team...”

The Client should therefore look to appoint the Principal Designer from the design team which would probably be a Structural Engineer, Architect or an in-house specialist if they are part of the design team. The Consulting Engineer should be appointed as Principal Contractor as the design of the ground investigation is a construction phase activity and is not design of the structure.

Scenario 2

A multi-disciplinary consultancy is asked to identify a contractor to carry out a three day trial pitting ground investigation for a development which will be constructed in a couple of years' time. The ground investigation contractor is employed by the developer, finds a local JCB driver, manages the work and produces a ground investigation report.

Questions: Does the project fall under CDM 2015 and should a Construction Phase Plan be produced?

Considerations: Ground investigation is classified by CDM as construction and so will fall under CDM 2015. The developer is the Client as he has ultimate control of the project.

“Assuming the multi-disciplinary consultancy is part of or is the design team then they will be Designer and possibly the Principal Designer...”

Assuming the multi-disciplinary consultancy is part of or is the design team then they will be Designer and possibly the Principal Designer but the client, as a developer, could equally carry out the PD role to cover the whole of the project at the earliest stage, even though there is a delay anticipated. The ground investigation will be carried out by more than one Contractor; the ground investigation contractor and the JCB provider. In a project set up correctly by the Client, the main contractor responsible for the build of the development would be the Principal Contractor. However, it is likely that they would not be appointed at this stage and therefore the ground investigation would be appointed as the Principal Contractor.

Scenario 3

A private house owner requires an extension and employs a ground investigation contractor to dig some hand pits and carry out



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some shallow boreholes to satisfy building control. The ground investigation contractor carries out the work and provides a ground investigation report with recommendations to the home owner.

Question: Does the project fall under CDM 2015, is a Construction Phase Plan required who are the duty holders?

Considerations: The project is for a domestic client and therefore falls under CDM 2015. The Client is the home owner but as a domestic client, their duties under CDM will automatically pass to the Principal Contractor, unless the client has a written agreement with the Principal Designer that the designer coordinates and manages the

project.

The Principal Contractor will be the builder responsible for building the extension. The ground investigation contractor will therefore be a Contractor. Yes a Construction Phase Plan is required and in this scenario the builder could use the on-line App but the GI contractor will still need to produce their own risk assessments, taking into account the contents of the CPP.

The scenarios above are observations made by the authors and not all of the Geotechnica readership may agree which is why the formation of an Industry Health and Safety Forum is so important. Clearly, the industry interpretation of CDM 2015 is work in progress

“...the Industry H&S Forum will seek advice and input from the geotechnical and drilling industry...”

and the Industry H&S Forum will seek advice and input from the geotechnical and drilling industry with a view to publishing guidance. This guidance in the first instance is likely to include: A Client's guide to CDM 2015 for geotechnical and drilling projects which clearly defines the Clients requirements, obligations and information to be provided; and a series of examples of typical contract and project situations where an interpretation of the duty holders and CDM 2015 requirements are provided.

Watch this space. ■



CPD Approved Courses for Geotechnical Academy Alumni

Specifying Site Investigations

This one day course will look at the various methods available to carry out intrusive and non intrusive investigation. Whilst the course will concentrate on geotechnical methods some geo-environmental methods will be briefly discussed. The course will look at the aims of SI and categorise the various stages in an investigation.

Soil Description Workshop

From 2007 new European Standards have started replacing the British Standards (Codes) under which investigations in the UK have been carried out. UK working practice will have to change to meet these new requirements but few practitioners are aware of the changes or the timetable. The workshop will comprise a series of lectures on the changes, and lectures on soil description followed by practical sessions describing soil samples.

Rock Description Workshop

From 2007 new European Standards have started replacing the British Standards (Codes) under which investigations in the UK have been carried out. UK working practice will have to change to meet these new requirements but few practitioners are aware of the changes or the timetable. The workshop will comprise a series of lectures on the changes, and lectures on rock description followed by practical sessions describing rock and compiling mechanical logs of rock core.

In Situ Testing

The course will cover both the theory and the practice of various In Situ Testing techniques used on typical geotechnical projects. In addition the courses will consider the effect that Eurocodes will have on the UK's current practice. This course provides an overview of in situ tests used in common practice and some of the more specialist tests together with their advantages and limitations.

Field Instrumentation and Monitoring

The course comprises a comprehensive one day appreciation of the complete process involved in Instrumentation and Monitoring in the geotechnical environment. The course provides an overview of the current guidance documents and their requirements. The course will consider the design of both individual installations and the installation of suites of instruments in the wider site context.

Geotechnical Foundation Design

This one day course will provide a general overview of foundation design. It will include an assessment of the use and choice of shallow foundations and piles. It will cover the derivation of bearing capacity formula and their use. Exercises will be carried out to calculate the working loads and settlement of simple foundations. The methods used to calculate these will be in accordance with those described in Eurocode.

IOSH Working Safely (on Geotechnical Sites)

This one day course is developed by industry specialists within RPA Safety Services and Equipe Training as a foundation to site safety. Its aim is to impart the core safety skills required of those working on geotechnical sites by building on their existing specialist technical skills. After attending the course, candidates should be able to identify hazards on site, understand basic safety legislation, participate fully and confidently in site safety consultation and manage priority risks to a sufficient standard.

IOSH Avoiding Danger from Underground Services

Partnering with RPA Safety Services once again, Equipe provide another IOSH certified health and safety course. This one day course is aimed at anybody involved in specifying, instructing, managing, supervising or actually breaking ground and really addresses the problems and risks related to underground services, which may be encountered during both planning and execution of geotechnical projects.

IOSH Safe Supervision of Geotechnical Sites

Equipe has partnered with RPA Safety Services, an independent occupational health and safety specialist, to provide a unique IOSH certified course for the Drilling and Geotechnics industry. The three day course is certified by IOSH, is specifically focussed on the geotechnical industry and provides a totally unique and relevant Health and Safety course for managers and supervisors.

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GEOTECHNICA 2011

A RETROSPECTIVE

Writing for **theGeotechnica** this month is Calum Spires of the [Equipe Group](#). This month is the third in a series of articles from Calum that will take a look back at previous Geotechnica events in the build-up to this year's event in July. This month Calum takes a look back at Geotechnica 2011.

Eddy Grant, Billy-Ray Cyrus, Dexy's Midnight Runners, Soft Cell even the Baha Men – everyone remembers the One-Hit-Wonders of this world. The Beatles, Queen, Take That, Beyonce – everyone always remembers the multi-hit artists as well – but does anyone ever remember a Two-Hit-Wonder? After two highly acclaimed and successful years, Geotechnica was striving not to be forgotten, not to fall away into obscurity after a couple of hits. Instead Geotechnica was looking to come back for a third time and cement its place as the premier geotechnical conference and

exhibition in the UK. 2011 had already been a big year for the world, let alone the UK geotechnical industry, with the Egyptian revolution, the Royal Wedding and the fall of Osama Bin Laden, but for the Equipe Group, Geotechnica was the primary focus.

Managing Director of Equipe, Julian Lovell was all too aware that Geotechnica had to deliver for a third successive year, so as to avoid the scrapheap of Two-Hit-Wonders: “Geotechnica had done fantastically well in its first two years, and word-of-mouth recommendations were

starting to grow – we needed to keep that ball rolling and not get stuck in a rut. Growth was actually the primary theme of Geotechnica for 2011's event, both in terms of attendance and participation for the event, but also for the Geotechnical Conference.”

2010 was a year of foundations being laid and targets being set – the economy had taken a beating at the back-end of the 2000's, but 2011 was seen as the first real year where realistic goals for growth could be outlined and achieved. The geotechnical and land drilling industries had a major role to play in this establishment, and Geotechnica was seen by Equipe as the perfect base from which to promote this growth.

Operations Director at Equipe, Keith Spires explained the need for efficiency and innovation to drive the industry growth: “For 2011's event, we focussed on introducing our visitors to the concept of ‘Engineering Efficiencies for Sustainable Growth’ – the ‘title’ if you will of the Conference that year.

“Essentially we wanted to ask questions as to how we as an industry were planning on increasing the rate of growth for our sector...”

Essentially we wanted to ask questions as to how we as an industry were planning on increasing the rate of growth



for our sector and then sustain that growth through the coming years. In 2010 we had increased the level of networking and opportunities for communication at Geotechnica, but in 2011 we wanted to utilise that higher level of discussion to achieve a higher level of understanding.”

“...we needed to ask serious questions as to where the industry was going and saw itself in five or so years.”

Julian continued: “Not only that, but we needed to ask serious questions as to where the industry was going and saw itself in five or so years. We felt that innovation within the industry was the only way to realistically and efficiently maintain a sustainable growth. The knowledge-base and technology-base in the late 2000's was not going to be sufficient to kick-start the industry, let alone maintain the necessary growth. Projects like HS2 and the upgrading of a number of motorways

throughout the UK meant that there was plenty of work coming up, but the technology to increase efficiency on the projects was not necessarily up to scratch. We knew that Geotechnica could be a platform to promote these efficiencies.”

Again set on the beautiful backdrop of Edge Hill, just outside of Banbury in Oxfordshire, Geotechnica 2011 opened on Wednesday the 6th of July and attracted over 75 exhibitors, keen to display their latest products, create new relationships and drum up new business for the coming year. Sponsorship came from all areas of the industry, with Geotechnical Engineering and Geotechnical Observations being joined by Drillwell as the mainsponsors, however Rockbit UK, DuraDeck, Atlas Copco and MuoviTech also supported the exhibition, much to Equipe's delight. The layout was slightly tweaked for 2011, with one larger marquee replacing the previously separated smaller ones in order to bring everyone under one roof to encourage communication and networking between all



visitors and exhibitors.

“The single, larger marquee was a ploy by us to bring everyone together under one roof – we felt that the separate marquees made the whole

“We did however decide to continue with the food court, as well as introducing a fully licensed bar...”

thing slightly disjointed. We did however decide to continue with the food court, as well as introducing a fully licensed bar that would serve soft drinks in the daytime and then a selection of local craft beers for the evening networking event which was greatly appreciated by all that attended.” continued Keith.

Julian added: “I did however

decline to invite The Mangled Wurzels back for another year – I think once may have been enough for that!”

With the focus on increasing awareness of innovations and sustaining the initial growth of the industry, the Technical Conference (or ‘Geotechnical Symposium’ as it was titled for the year) was once again massively popular, with a great number of attendees commenting on the high calibre of presentation speakers. The conference was split into 4 sessions: Session 1- How do clients view innovative design? Session 2 – Are the new codes and guidance helping or hindering growth? Session 3 – Producing efficiencies with the use of innovative management and smart data systems; and Session 4 – Where has all the geotechnical innovation gone?

Session 1 was kicked off by

Professor Quentin Leiper, Group Engineer at Carillion. Professor Leiper focussed the session on delivering sustainability from all areas of the industry, from client down to contractor and back again.

“Alex Kidd from the Highways Agency then outlined the future of the UK Motorway network, and how clients receptiveness to new ideas, innovations and cost effective solutions would help to deliver these projects.”

Alex Kidd from the Highways Agency then outlined the future of the UK Motorway network, and how clients receptiveness to new ideas, innovations

and cost effective solutions would help to deliver these projects. Ivan Hodgson of URS/ Scott Wilson then introduced a study of one such case of innovation with the use of tyre bales to provide lightweight embankments using waste materials. Dinesh Patel of Arup Consulting followed this up with a look at the use of re-used foundations in The Pinnacle Building project. Session 1 was closed by Andrew Milne who gave a contractor’s perspective, demonstrating the innovations that Geotechnical Engineering were producing to provide cost-effective solutions for various upcoming projects.

“Session 2 placed the latest Eurocodes and Guidance under scrutiny.”

Session 2 placed the latest Eurocodes and Guidance under scrutiny. Lead by Andrew Howley of Loopmaster Europe introducing the Ground Source codes of practice, Dr Andrew Bond of Geocentric then focussed specifically on the future of Eurocodes and the development of pre-existing codes. Derek Smith of Coffey then outlined the Site Investigation Steering Group’s take on the redrafted documents. Following this Paul Maliphant of Halcrow/ EGGs introduced the attending delegates to the UK’s Register of Geotechnical Engineering Professionals (RoGEP) – created to confirm an individual’s technical competence, professional attitude and experience in ground engineering. Following Paul, Professor Barry Clarke of The University of Leeds returned

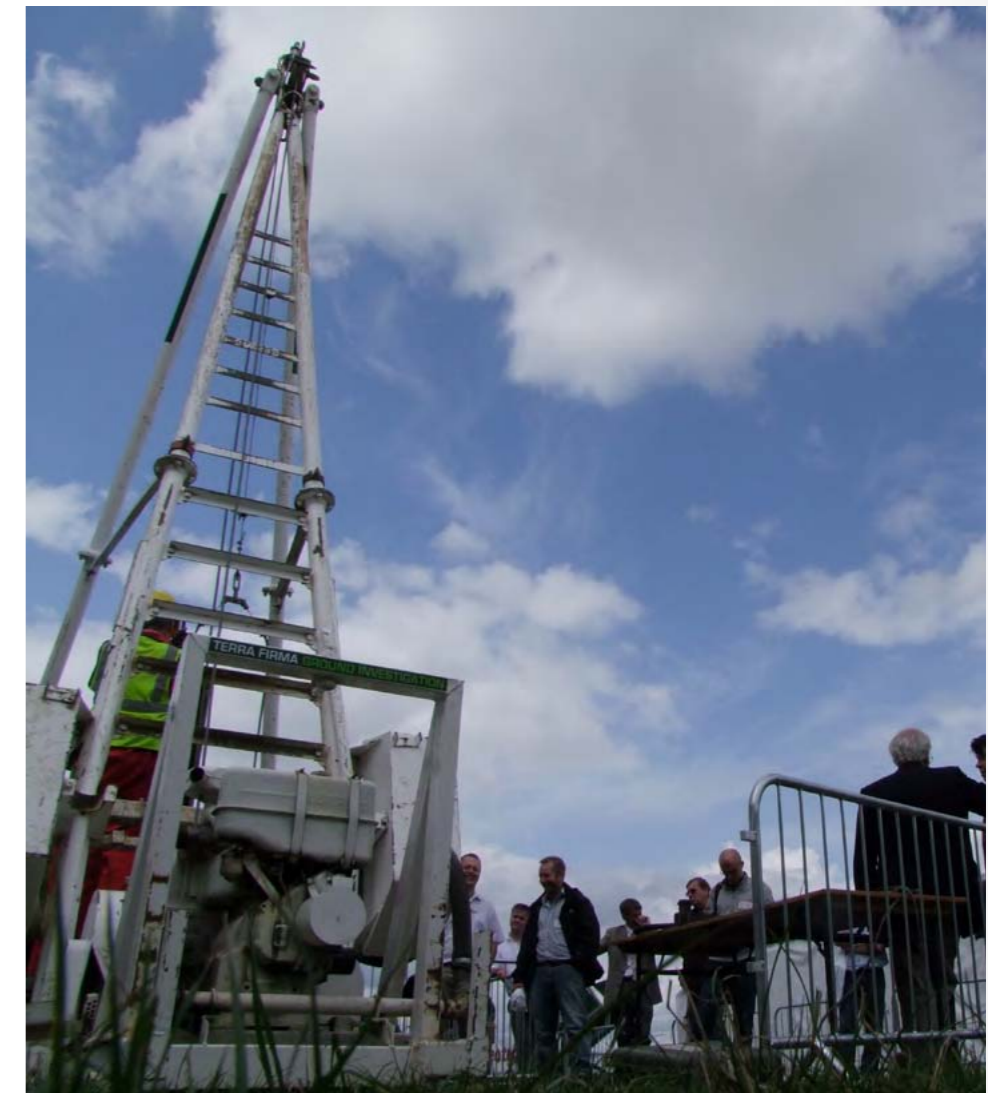
to focus on the Eurocodes, and posed the controversial question of whether the new codes and specification would help or hinder growth.

Innovation was the primary focus of the conference on the Thursday. Peter Turner of the Environment Agency focussed his talk on the client’s perspective on Health and Safety, asking if what they expect and what they actually get are the same thing. Following Peter was Digby Harman of Soil Engineering who introduced drilling parameter recording, offering it as a cost-effective provision of better data management from boreholes. Professor John Reynolds of Reynolds International discussed near-surface geophysical surveys and how you can maximise the

results obtained, before David Whitaker of Arup explained the importance of getting the design right in ground source projects. The efficiency of environmental data interpretation was then discussed by Professor Paul Nathanail of Nottingham University, before Clive Dalton of Cambridge Insitu introduced the self-boring Pressuremeter and the best ways to interpret the data obtained for design.

“The final session of the day focussed purely on geotechnical innovation...”

The final session of the day focussed purely on geotechnical innovation and how it would be necessary to enable the construction ▶▶





industry to grow out of its then poor position, asking where that innovation would come from. The ever popular Professor Eddie Bromhead of Kingston University posed the initial session question to the attendees: "Is there any innovation left to drive a recovery?". Dr Andrew Ridley of Geotechnical Observations built on this, emphasising the need to branch out and develop more innovations, offering a compelling case that technical and vocational innovation was the only way forward for "Neil Smith of the BGA and Applied Geotechnical Engineering then offered the stance that the innovation for the future of the industry had its roots in training..."

recovery. Neil Smith of the BGA and Applied Geotechnical

Engineering then offered the stance that the innovation for the future of the industry had its roots in training – arguing that increasing the knowledge base would help to kick-start the development of the necessary innovations.

Julian Lovell again offered his summary of the conference, emphasising the content as an essential as a call-to-arms: "We were determined to ask searching and leading questions with the 2011 conference, and laid down a challenge to the industry to not only sustain the growth achieved the previous year, but the innovate and drive the industry upwards towards even greater levels of prosperity. Speakers such as Eddie Bromhead and Barry Clarke didn't mince their words when discussing the future and whether we as an industry were ready to rise to tackle the challenges on the horizon, and we felt that the delegates left the conference inspired to innovate and reach heights that the geotechnical industry

had never seen before."

2011 was an extremely important year for continued growth in the geotechnical and drilling industries, with a number of new challenges arising and the demand for new methods and systems to be put in place to ensure efficient and continued development.

"Geotechnica played an essential role in promoting discussion that would lead to further innovations..."

Geotechnica played an essential role in promoting discussion that would lead to further innovations that would help to sustain this growth across the coming years. It can certainly be said that Geotechnica 2011 was Equipe's third hit, ensuring that the event would only go from strength to strength in the coming years, and wouldn't be ranked alongside Men Without Hats and Marky Mark as eternal Two-Hit-Wonders. ■

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Geotechnical Conference

Wednesday 8th July 2015

Morning Session
Keeping on the right side of Health and Safety legislation

Session sponsored by:



A series of short presentations from the HSE and industry leaders to update the community on Health and Safety topics and concerns. Topics covered will include an update from HSE, Asbestos in Soil, new BDA audit and CDM 2015.

Speakers include:
John Underwood, Construction Inspector - Construction Sector Safety Team, **Health and Safety Executive**
Hamish Campbell, British Drilling Association
Seamus Lefroy-Brooks, Managing Director, LBH Wembley

Afternoon Session
How AGS data makes organisations more efficient

Session sponsored by:



A series of short presentations about advances in the use of capturing and using Geotechnical Data from site, through the laboratories to report and beyond. The talks will discuss the use of AGS through the process and will include a number of case studies to show how it works for real projects.

Speakers include:
Ben Armstrong, General Manager, **Ground Technology Services**
Simon Miles, Principal Geotechnical Engineer, **Atkins**
Dr Roger Chandler, Managing Director, **Keynetix**

Thursday 9th July 2015

Morning Session
Can the geotechnical industry fulfil the Client's requirements?

A series of presentations from leading procurers of geotechnical work including HS2 and Network Rail, in which they outline their requirements and expectations from the geotechnical and drilling community. The talks will not only outline current requirements but the Client's will also discuss future requirements and aspirations and ask how the Community can meet these.

Speakers include:
Jonathan Gammon, HS2
Mike Brown, Senior Engineer, Network Rail

Afternoon Session
Advances in Remote Monitoring of geotechnical structures

A series of presentations looking at how the use of field instruments and technologies have advanced and how they can be used to efficiently monitor geotechnical structures remotely. The session will look at a few of these technologies but also discuss how the data can be used more efficiently and possibly in the future be shared with the Community.

Speakers include:
Dr Andrew Ridley, Managing Director, **Geotechnical Observations**
Prof. Neil Dixon, Professor of Geotechnical Engineering, **Loughborough University**
Dr David Gunn and Dr Jonathan Chambers, **British Geological Survey**

Geotechnica



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THE ANALYSIS OF AMMONIA AND AMMONIUM IN WATERS AND SOILS

Writing for **theGeotechnica** this month is Hazel Davidson of [Derwentside Environmental Testing Services](#). In this excellently informative article, Hazel discusses the methods of analysis of ammonia and ammonium in waters and soils.

Ammonia is a ubiquitous contaminant of soils and surface waters, entering water courses from a variety of single point and diffuse sources. Ammonia (NH₃) and ammonium (NH₄) are an integral part of the nitrogen cycle (Fig. 1) and are present naturally in soil and surface or waste waters. They help to indicate the quality of water bodies or effluent streams. At its simplest, the natural processes include the following:

- Atmospheric nitrogen is converted to nitrate compounds by nitrogen fixing bacteria or industrial processes, and these can be used by plants to form proteins
- Plants are eaten by animals and form animal proteins, and the waste products are egested as solids or excreted as urea (both containing nitrogen)
- Urea, egested material and dead organisms are broken

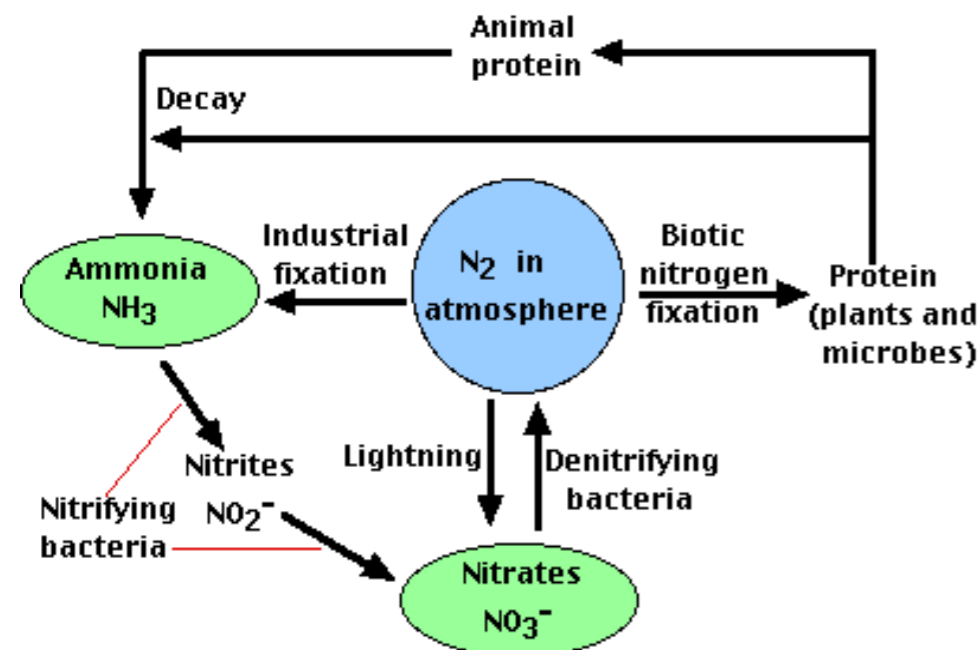


Fig. 1 The Nitrogen Cycle

down in soil by decomposing bacteria, producing ammonia

- Nitrifying bacteria use the ammonia to form nitrites, nitrates, and finally, nitrogen (back into the atmosphere)

Laboratory Analysis

It is helpful to clarify what exactly is measured in laboratory methods for nitrogen analysis:

- Organic nitrogen – bound organic material such as proteins, urea, nucleic acids
- Kjeldahl nitrogen (the name of a method) – the sum of organic nitrogen and ammoniacal nitrogen

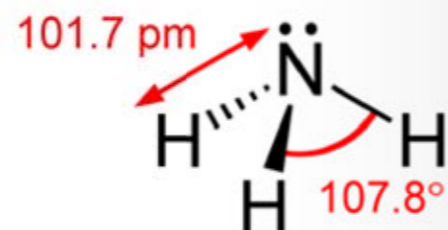


Fig. 2 Ammonia (un-ionised)

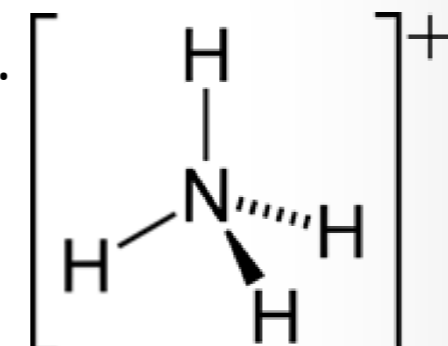
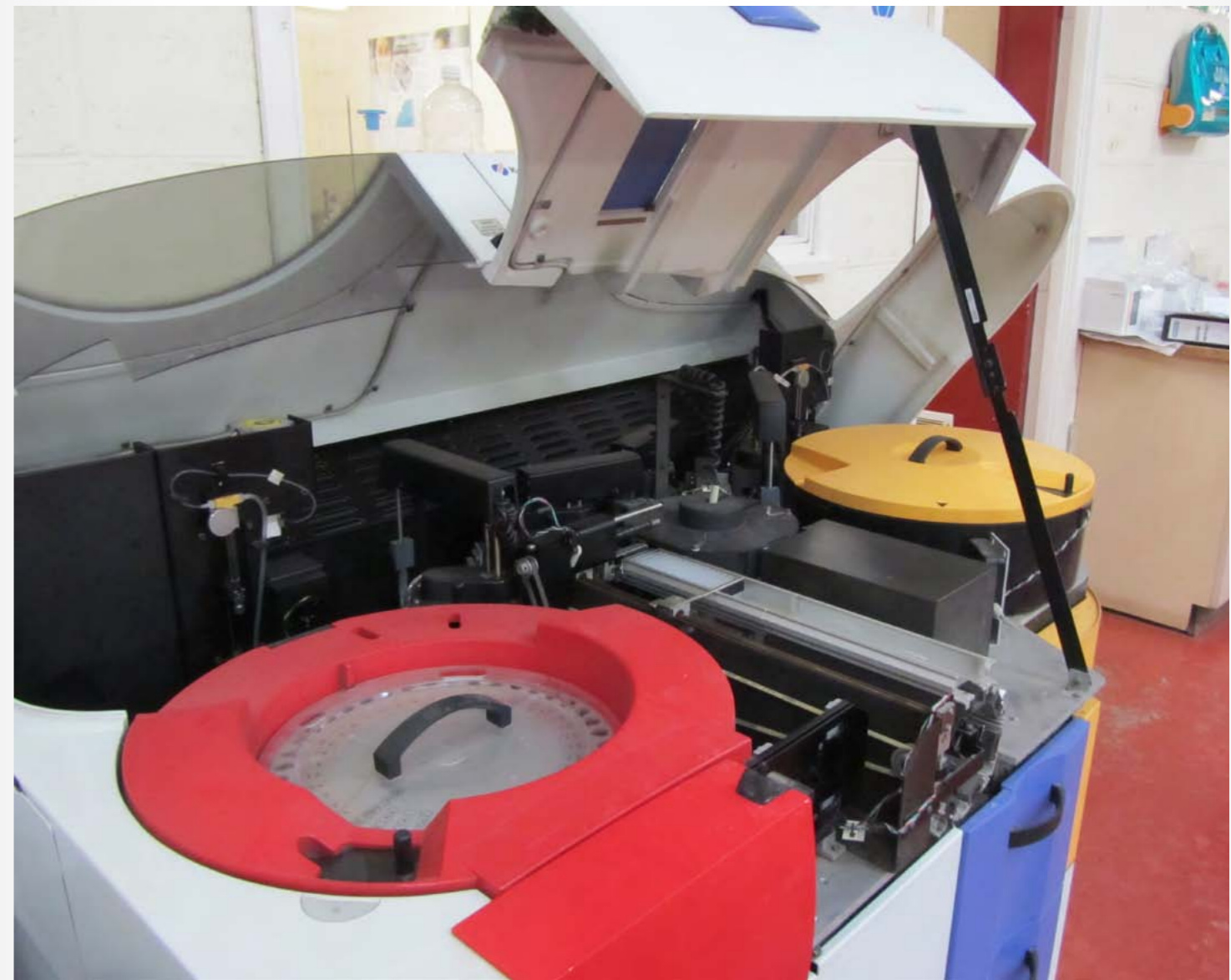


Fig. 3 Ammonium (positively charged ion)



Ammoniacal nitrogen – the sum of nitrogen in ammonia and ammonium, measured as ammonium, NH₄

- Ammonia – un-ionised ammonia, measured as NH₃
- Oxidised nitrogen – the sum of nitrogen in nitrates and nitrites
- Total nitrogen – all of the above

The structure of ammonia is

Example:

pH	6.3	7.0	7.5	8.0	8.5	8.7	9.0	11.0
% un-ionised ammonia	0.11	0.56	1.77	5.38	15.2	22.2	36.3	98.2

All measurements reported for 25°C

“It is very soluble in water, with a solubility of 31%... but it can be lost easily to the atmosphere if the water sample is heated or over agitated.”

NH₃, it is fairly volatile and can exist as a gas (B. Pt. -33.34), and this is the un-ionised form. It is very soluble in water, with a solubility of 31% (maximum concentration of 0.880g/ml), but it can be lost easily to the

atmosphere if the water sample is heated or over agitated.

Ammonium (NH₄⁺), is the reduced, ionised form and carries a positive charge. It often exists as ammonium hydroxide (a weak alkali) in water, but can form ammonium chloride or ammonium nitrate, or ammonium sulphate – it is quite reactive. These salts are more stable than the un-ionised ammonia, as they are not volatile. The relationship between ammonia and ammonium in water is in

equilibrium, highly dependent upon the pH (and temperature) of the water:

At pH 8.5, the proportion of un-ionised ammonia is approximately ten times that at pH 7.5, and, for every 9°C increase in temperature, the proportion of un-ionised ammonia approximately doubles.

Methods of Analysis

Water samples are filtered prior to analysis, to remove sediment which may interfere with the analysis.

Soil samples are usually extracted with water, as the ammonia/ammonium are so soluble in water, and then filtered.

There are several methods for measuring ammonia and ammonium, but two of the most common are ion selective electrode and spectrophotometry.

Ion selective electrode – this instrument uses a hydrophobic gas-permeable membrane to separate the sample from an electrode internal solution of ammonium chloride. Ammonia

in the sample diffuses through the membrane and changes the pH of the internal solution, which is sensed by the electrode. In order to measure ammoniacal nitrogen (ammonia and ammonium), a strong alkali is added to the sample, raising the pH above 11, and converting the ammonium to ammonia.

The ion selective method can detect ammonia in the range

0.03 to 1400 mg/l, but the response is slow below 1 mg/l. Spectrophotometry – an intensely blue compound, indophenol, is formed by the reaction of ammonia, hypochlorite and phenol, using nitroprusside as a catalyst, in a strongly alkaline matrix, and this method can either be used manually, or applied to an automated spectrophotometer (continuous flow or discrete

“Standards of varying concentrations are analysed, the software constructs a calibration curve, and then the sample concentration is read off from this calibration curve.”

flow analysis). Standards of varying concentrations are analysed, the software constructs a calibration curve, and then the sample concentration is read off from this calibration curve.

The spectrophotometric method can detect ammoniacal nitrogen in the range 0.02 to 40 mg/l – the system is more sensitive to low levels, but samples with higher concentrations will require dilution before analysis.

It is possible to simply measure the ammoniacal nitrogen, and then to calculate the ammonia, as long as the pH and temperature of the sample were measured at source, when the sample was collected, using tables prepared by the USEPA or similar (some examples are given in the preceding section).

Sampling and Preservation

Because of the volatility of ammonia, the action of nitrifying bacteria, and the changing equilibrium between ammonia and ammonium, it is imperative that water samples are collected and stored in the correct manner, and preferably preserved chemically with sulphuric acid to fix the ammoniacal compounds to prevent further change. All samples should be stored at 5 +/- 3°C, both during transportation and at the laboratory.

Unpreserved samples should be analysed within 24 hours of collection, and as this is frequently not possible, it is more usual for samples to be collected in acidified bottles (supplied by the laboratory). The acid will convert all ammonia to ammonium, and therefore the result is reported as ammoniacal nitrogen, either as NH₄ or as NH₄-N. Preserved samples are stable for four weeks if stored cold.

“Soil samples are not chemically preserved, but samples should be kept cold and analysed as soon as possible...”

Soil samples are not chemically preserved, but samples should be kept cold and analysed as soon as possible – the microbial population and the pH of the soil will affect the equilibrium and concentration of ammonia/ammonium.

Ammonia/Nitrate Stripping

For wastewater treatment, ►►



it is important to reduce the level of nitrogenous compounds before discharge to a water course. There are a number of methods for achieving this:

- Ion exchange – the wastewater can be passed through a column or bed of ion exchange/mineral resin to preferentially remove the nitrate/ammonia compounds.
- Air stripping – the pH of the wastewater is increased to convert ammonium to ammonia, and by agitation and/or heat, the ammonia is released as a gas, which can be trapped and used as fertiliser.
- Biological nitrification – two types of aerobic bacteria are used – nitrosomonas to convert ammonia to nitrite, and then nitrobacter to

“Recent advances now use a fixed film system, which has a high surface area for contact with the bacteria...”

convert nitrite to nitrate. Recent advances now use a fixed film system, which has a high surface area for contact with the bacteria, and is much more efficient at removing the ammonia/nitrite.

- Membrane separation – a process of membrane electrolysis (ME), allowing ammonia to be continuously removed by passing across the membrane where it is then trapped and can be used as a fertiliser. Electrodialysis regenerates the salt solution so

the process is continuous.

For all of these methods, the concentration of ammonia in the wastewater can be analysed in situ, using probes, to ensure the system is monitored until the process is complete.

Water Quality and the Water Framework Directive (WFD)

Levels of ammonia/ammonium are usually low in surface waters (from 10 microgram/litre) up to much higher levels in sewage effluents and waste waters (commonly up to 50 milligrams/litre).

Background levels in soil are commonly 1 – 5 mg/kg, but organic rich soils are higher, and application of fertiliser can give rise to levels of 3000 mg/kg. Currently, there are no

guideline values for soils, due to the number of pathways for the removal of ammonia:

- Volatilisation into air
- Adsorption onto soil particles
- Transformation by microbial activity
- Uptake by plants
- Leaching into the groundwater

Environmental Quality Standards (EQS values) for waters are set by the regulators, based on compliance with the Water Framework Directive (2000/60/EC). An Environment Agency Science Report (40038/SR2) was published in 2007 and discussed the use of predicted

no-effect concentrations (PNECs) for setting EQS values for ammonia. Toxicity to freshwater fauna is attributable mainly to the un-ionised ammonia, which increases with temperature and pH, as discussed earlier in this article.

The current European EQS for un-ionised ammonia is 15 micrograms/litre (0.015 mg/l), which is about the limit of the current methodology. **“The proposed value is 1.1 micrograms/litre, based on PNEC values, which will cause issues until technology is available to meet this limit...”**

The proposed value is 1.1

micrograms/litre, based on PNEC values, which will cause issues until technology is available to meet this limit, and this is not in place as yet.

Current regulation (Groundwater Directive 2006/118/EC), and the EA publication H1 Annex D Surface Water v.2.2 (December 2011) state that ammoniacal nitrogen in groundwater should be within the range 0.3 – 1.73 milligrams/litre, depending on location and typology, and for lakes the range is 0.2 – 0.6 milligrams/litre.

At DETS, we use two methods, a standard test with a range of 0.2 – 1400 milligrams/litre, and a low level method, with a range of 0.015 – 0.8 milligrams/litre. ■



Derwentside Environmental Testing Services (DETS)

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At Glencorse, the buildings were effectively “buried” into a carefully re-profiled landscape behind massive retaining walls, up to 9.0m high in places. [Glencorse Water Treatment Works. Edinburgh]



THE CONTINUED RISE OF SUSTAINABLE GEO-ENGINEERING

In this month's article for **theGeotechnica**, geotechnical and civil engineering specialists [Maccaferri](#) provide a look at construction sustainability, where the principles of reclamation and recycling of site won materials have been raised significantly.

There are scores of brown-field site redevelopment projects under way throughout the country where site won soils, which are costly to dig, costly to shift and costly to dispose of, especially if they are of questionable provenance, need to be dealt with.

The construction industry has made huge progress in its approach to the management

and reuse of site won soils and one company at the forefront is geotechnical specialists, Maccaferri. Their approach is simple and straightforward and has led to the successful completion of a host of high profile projects.

Maccaferri specialises in slope stabilisation and retaining wall design and construction and in this niche area of expertise

they are frequently called on to advise on the most cost effective means of re-using the thousands of tonnes of site reclaimed soil and fill materials generated during the redevelopment of old construction sites.

As we know, every household in the UK is constantly being urged to minimise waste by re-using everyday consumables and, wherever possible, recycling waste. The same is happening in the world of construction.

Developers often have to work

within strict planning guidelines which require them to recycle and re-use site won materials. Where dig-out and dump was the norm of years gone by, this casual approach to gobbling up of natural resources has been replaced by the goal of “Site Sustainability”.

In the following examples, we are able to see where the principles of sustainable geo-engineering have been employed.

Glencorse, Edinburgh.

At the recently commissioned



At Gatwick Airport, a 350m long, 16m high reinforced soil bund was constructed to screen nearby villages from new aircraft stands and taxi-way.

Glencorse Water Treatment Works in Scotland, Design and Build Contractors, Black & Veatch used elaborate camouflage techniques in their quest to hide the 10 hectare site in the Pentland Hills above Edinburgh.

The treatment plant's setting, next to the Pentlands Regional Park, required careful design and planning to reconcile the very large buildings and reservoir with the surrounding landscape... “The solution was to effectively “bury” the works into a carefully re-profiled landscape...”

area. The solution was to effectively “bury” the works into a carefully re-profiled landscape, created by placing thousands of cubic metres of excavated material behind massive retaining walls, up to 9.0m high in places.

For these structures, Maccaferri Construction was brought in to provide design and installation

expertise.

Maccaferri designed and built a network of mass-gravity and reinforced soil structures comprising their stone filled Gabion Terramesh units in combination with high strength geogrids sandwiched between layers of compacted back fill. “The Geogrid acts as a reinforcement medium which causes the wall and the retained material to work as a single physical mass with immense strength and durability.”

The Geogrid acts as a reinforcement medium which causes the wall and the retained material to work as a single physical mass with immense strength and durability.

At the time, the £130m scheme was completed it was the largest capital project commissioned by Scottish Water and



The steeply sloping face of the Gatwick screening bund required specialist reinforcement geogrids and Scott Wilson brought in Maccaferri to produce detailed proposal.

was described by Professor Paul Jowett, Chairman of the Institution of Civil Engineers, as being “not only an exemplary project in terms of critical infrastructure but also in terms of sustainable development and carbon reduction”

Gatwick Airport

At Gatwick Airport, a giant bund, 350m long and 16m high was constructed using recycled site won materials, to screen nearby villages from new aircraft stands and taxi-ways being built as part of a £43m improvement scheme.

The stands provide remote parking for aircraft and include two areas capable of housing the Airbus A380 – the world’s largest commercial passenger airliner.

Consultants, Scott Wilson, conceived a structure which would, from the village perspective, be as natural in appearance as practicable,

with a varied profile and heavily vegetated to blend in with the local woodland setting.

“At 3:1, the steeply sloping face required specialist reinforcement geogrids...”

At 3:1, the steeply sloping face required specialist reinforcement geogrids and Scott Wilson brought in Maccaferri to produce detailed proposal.

Their solution was a reinforced soil structure comprising 97,000sqm Paragrid reinforcement geogrid in combination with over 180,000 tonnes of back fill, the majority of which was recycled granular materials and site won clay, reclaimed from other areas of the airport site.

Paragrid is a biaxial grid comprising composite

geosynthetic straps with a polyester core within a protective polyethylene sheath. The grid is placed horizontally between layers of compacted structural back-fill, nominally 600mm in thickness.

Biomac, a bio-degradable erosion protection blanket also from Maccaferri, was used to face the sloped surface of the geogrid wrap. This allowed the inclusion and retention of a face layer of compacted top-soil which was later hydro-seeded to promote rapid establishment of vegetative cover.

Bell Green, Sydenham

More recently, the commercial redevelopment of an old gas works site at Bell Green, Sydenham in South London, set the sustainability bar at an even higher level.

Here, Contractors Gallagher Construction were faced with a complex, brown field

site redevelopment on poor/contaminated ground with cost and planning restrictions that required the exclusive re-use of site won material rather than importation of new. Nothing to leave the site –nothing to be taken in.

Again, Maccaferri was brought in for expert design advice, this time for the construction of two retaining walls required for a heavy vehicle access ramp.

“Maccaferri concluded that a mass gravity structures would not be possible because of the poor ground conditions and the strong probability of settlement.”

Maccaferri concluded that a mass gravity structures would not be possible because of the poor ground conditions and the strong probability of



For the redevelopment work at Bell Green in South London, Paradrain and Green Terramesh creates a steep, vegetated-faced wall as part of a reinforced soil, slope construction.

settlement.

Also, the impermeable nature of the fill material meant it was highly susceptible to volume change due to retained moisture content. Because of this, adequate compaction would be hard to achieve.

Maccaferri’s solution was the introduction of Paradrain, a geo-composite reinforcement grid which has integral drainage capability. Paradrain – manufactured by Linear Composites, a Maccaferri Company - not only provides the required structural reinforcement but also allows relief of pore water pressure within the compacted material. Paradrain - was used in combination with Maccaferri Green Terramesh, a modular formwork system designed to produce a steeply sloping vegetated-faced wall as part of a reinforced soil, slope construction.

A single length of double twist

wire mesh forms the base and upper reinforcing panels and the Green Terramesh facing unit. A bio-degradable blanket behind the sloping faces of the unit retains topsoil, controls erosion and promotes rapid vegetation establishment, leading to an overall “green” aspect.

Conclusion

As social, political and environmental pressures continue to grow, the demand for cost efficient, sustainable solutions to geo-engineering challenges will increase.

In the cost conscious world of civil engineering, we can no longer dig-and-dump and ignore the consequences. A new culture of retain, recycle and re-use is permeating the industry, leading to the construction of spectacular new buildings that can justifiably claim to be sustainable. ■

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