theGeotechnica

equip

inside this edition...

season's greetings
to all of our readers
from all of us at theGeotechnica

also included...

- an update on eurocode 7
- launch of the Federation of Drilling Specialists
- more on drilling fluids improving productivity

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issue no. 7
december 2011

Equipe Geotechnical Symposia

Awareness - Applications - Advances

Field Instrumentation in Geotechnics

11th and 12th January 2012

at The Drilling Academy, nr. Banbury

FREE TO ATTEND

Programme

Day 1

08:45 – 09:15	Registration and Coffee
09:15 – 09:30	*Welcome and Introductions* – **Pete Reading *et al***
09:30 – 09:50	*Introduction of Participants* (audience participation)
09:50 – 10:05	*Engineering is a Risky Business* – **Pete Reading**
10:05 – 11:20	*Systematic Approach to Planning Monitoring Programmes*, **John Dunnicliff**
11:20 – 11:35	Morning Break
11:30 – 11:45	MOGE & *GIN*, **John Dunnicliff**
11:45 – 12:45	*Overview of Hardware – Part 1*, **John Dunnicliff**
12:45 – 13:15	*Monitoring the Performance of Infrastructure Embankments*, **Dr Andrew Ridley**
13:15 – 14:00	Lunch Break
14:00 – 14:45	*Use of InSAR as a Field Instrument*, **Kevin Banks**
14:45 – 15:15	*When, where and how to specify vibrating wires + Case Study*, **Rory O'Rourke**
15:15 – 15:30	Afternoon Break
15:30 – 16:00	*Ensuring appropriate monitoring specifications*
16:00 – 16:30	*Training and Competence*, **Nick Slater**
16:30 – 16:45	Summing Up and Close

Day 2

08:45 – 09:00	Coffee
09:00 – 10:00	*Overview of Hardware – Part 2*, **John Dunnicliff**
10:00 – 10:30	*Tottenham Court Road / The Shard*, **Aidan Laimbeer**
10:30 – 10:45	SAA Demonstration
10:45 – 11:00	Morning Break
11:00 – 12:00	*Workshop - Planning a Monitoring Programme for an Embankment on Soft Clay* **John Dunnicliff**
12:00 – 12:30	*Use of Robotic Total Stations in Geotechnical Applications*, **Nick Russill**
12:30 – 13:30	Lunch and Equipment demonstrations
13:30 – 14:35	*Load, strain and stress applied + Blackfriars Case Study*, **James Gale**
14:35 – 15:05	*Wireless technologies moving forward*, **Grant Taylor**
15:05 – 15:20	Afternoon Break
15:20 – 16:10	*Fibre Optics*
16:10 – 16:40	*Data handling, storage and web based monitoring Systems,* **Dr Roger Chandler**
16:40 – 17:00	Summing up and close

Speakers

John Dunnicliff, Independent Instrumentation Consultant
Dr Andrew Ridley, Managing Director, Geotechnical Observations
Tony Simmonds, International Projects Manager, Geokon Inc.
Rory O'Rourke, Managing Director, Datum Monitoring
Kevin Banks, IDS UK
Nick Slater, Business Development Manager, ITMSoil
Nick Russill, Managing Director, TerraDat
Aidan Laimbeer, Commercial Manager, Sol Data
James Gale, Strainstall
Grant Taylor, Geosense Division Manager, MGS
Dr Roger Chandler, Managing Director, Keynetix

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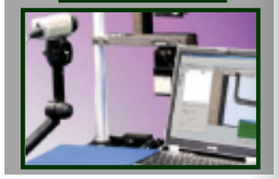

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an introduction

Welcome to the seventh edition of **theGeotechnica**.

With this issue we would like to wish all of our readers, contributors and advertisers our warmest Season's Greetings and of course a Happy and Prosperous New Year. We hope that we will all be able to put the difficulties of the last year behind us and start to rebuild a vibrant and healthy future for the geotechnical industry.

In this month's edition once again carries a number of interesting articles. In the Drilling Section we have the second in our series on drilling muds and borehole stabilisation. This complex and fascinating science can mean the success or failure of a borehole and James Mansell imparts his knowledge on this very important subject.

In the Eurocode Section, we have the views of Card Geotechnical on the interpretation of how skills and competency should be viewed in terms of the codes. This has been the subject of debate over the last few weeks and this article goes some way in trying to clarify how the codes should be interpreted.

In the Geotechnical Section we are publishing a case study written by Ben Armstrong of Ground Technology. In the study he demonstrates that with an intelligent use of techniques it is possible to carry out Eurocode compliant site investigation without costing the client a fortune or throwing away all of our traditional methods. In fact Ben shows that by the use of the borehole vane it is possible to obtain high quality results from which the upshot is significant cost savings in the design of wind turbine bases.

The article in the Safety Issues Section comes from Emma Betts, an independent Health and Safety Consultant. Emma focuses on the "High Five" - the top five causes of accidents which will be the areas which the HSE will be concentrating in the coming months.

In the Innovations Section we have an article introducing the Federation of Drilling Specialists (FDS). The Federation will be launching in January and the article provides you with everything you need to know.

Again this month's issue has some great job opportunities, both at home and overseas. So if you fancy a change or wish to progress your career, take a look in the jobs section. If on the other hand you are looking for staff then why not place your advert here with us in our jobs section, our rates are very competitive and we circulate to a large cross section of the Geotechnical community.

Here in the editorial office we are always on the lookout for interesting articles, so if you want to tell the world about something you have done or are passionate about why not write an article. **theGeotechnica** is read by in excess of 5000 workers in the geotechnical industry and in many countries around the world. Our readership is growing all the time so it makes **theGeotechnica** a great place to showcase your work or advertise your products and services to a most receptive audience. Send your contribution or ask for more information at magazine@geotechnica.co.uk or call 01295 670990 for more information.

Editoral Board, theGeotechnica

Contents: What's in this issue?

geotechnical

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Eurocode 7 has recieved thorough coverage from **the-Geotechnica**, and this month's issue is no exception. This month Ben Armstrong of Groud Technology takes a look at its influence on site investigation, focussing on a case study involving the design and construction of several wind turbines in Cambridgeshire.

Much has been written regarding the application of the Eurocode 7 documents and their influence on SI practice. Though many advocate the necessary changes, the evidence continues to suggest that much of the Site Investigation work carried out is not of sufficient quality, quantity and relevance to comply with the codes. If the quality and relevance of site investigation data received by the designer is not sufficient, excessive conservatism at the design stage is likely, inevitably leading to increased construction costs. Non compliance also increases the likelihood that geotechnical and environmental risks are not adequately investigated and defined.

"These outcomes are the fundamental problem that poorly considered or low quality site investigation creates."

These outcomes are the fundamental problem that poorly considered or low quality site investigation creates. This is worrying, considering EC7 essentially makes mandatory what our industry has long recognised as best practice. To avoid these outcomes, we should be continually asking ourselves: how do we obtain the best, most reliable and relevant soil properties from our ground investigation considering the nature of the development? This question certainly embraces the ethos of EC7, and also leads to the conclusion that better planning and full consideration of the overall scheme are required if we are to provide the highest quality information and data.

A recent project, undertaken by Ground Technology Services (GTS), illustrates how a flexible approach, good planning and collaborative working combined with an EC7 compliant ground investigation resulted in leaner construction costs for a wind farm project.

GTS were commissioned to carry out site investigation works for the design and construction of foundations and temporary works for seven 2 Megawatt wind turbines, on a site in Cambridgeshire. The temporary works included the design and construction of access roads and hard standings for the large mobile cranes required to lift the turbine masts.

Lifting wind turbine blades into place.

An initial desk study and geotechnical risk assessment highlighted the presence of thick sequences of low strength and highly compressible Flandrian sedi-

"Locally available borehole records indicated these materials to be locally firm to very soft extremely low to low strength cohesive deposits..."

ments immediately beneath the site. Locally available borehole records indicated these materials to be locally firm to very soft extremely low to low strength cohesive deposits, with bands of peat and very loose granular deposits to depths between 4.80m and 9.10m. These were shown to be underlain by a mixture of medium dense to dense March Gravels (marine beach deposits) and dense granular Glaciofluvial Deposits. Glacial Till was also shown either directly underlying the Fladrian Deposits, or underlying the March Gravels and Glaciofluvial Deposits. The Glacial Till comprised high strength cohesive soils. The solid geology of Ampthill Clay was shown to be present from between 12.00m and 13.90m, which consisted of very stiff high to very high strength, locally extremely high strength cohesive soils.

"The preliminary information indicated a piled solution for the turbine foundations would be required..."

The preliminary information indicated a piled solution for the turbine foundations would be required, for which more routine investigation techniques would be sufficient. It was also considered that either a piled or ground improvement solution would be needed beneath the temporary crane hard standing to mitigate the risk of unacceptable levels of ground deformation beneath the cranes during construction.

However, the project team wanted to minimise the construction costs for temporary crane hard standing and access roads as far as possible. GTS worked very closely with the engineering team in order to develop and design a suitable ground investigation to sufficiently characterise the likely behaviour of the Flandrian sediments under the loads likely to be imposed by the crane outrigger pads. The ground investigation information was also needed to confirm pile design parameters for the turbine foundations.

Due to the highly variable geological sequence, a series of techniques were utilised to adequately characterize each soil layer and provide high quality and reliable parameters for design. A phased investigation approach was used in order to develop the ground model and techniques to be employed as the inves-

"This approach allowed the identification of sensitive zones and high quality targeted sampling and compressibility testing to be undertaken..."

tigation proceeded. This approach allowed the identification of sensitive zones and high quality targeted sampling and compressibility testing to be undertaken while keeping costs to a minimum. The investigation needed to provide high quality information of the softer cohesive layers to determine the short term stability of the crane footings.

The initial phase of investigation comprised of a series of CPTu (piezocone) tests to 18m depth at 3 locations beneath each proposed turbine. The CPTu tests were able to provide real time data, reducing the time

"The initial data was provided in AGS format, enabling a rapid assessment of normalised derived soil parameters to be carried out."

required to provide preliminary design information. The initial data was provided in AGS format, enabling

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a rapid assessment of normalised derived soil parameters to be carried out. Derived soil parameters were calculated from the raw AGS data using the methods and techniques outlined in Cone Testing in Geotechnical Practice, Lunne et al. (1997). This enabled an assessment of the soil behaviour type and also a relevant range of derived parameters to be made. However, the correlation equations recommended in Lunne et al provide a range of results for both undrained shear strength (Cu) and one dimensional compressibility

"Site specific correlations were required to confirm the factors for use in the derived parameter equations for each of the soil layers encountered."

(Mv). Site specific correlations were required to confirm the factors for use in the derived parameter equations for each of the soil layers encountered. Based on these results, further targeted intrusive exploratory holes were designed and appropriate sampling and in-situ testing methods were selected to optimise sample quality and parameter derivation.

Borehole Vane Testing.

Cable percussive boreholes were selected as a reliable method to provide soil samples for engineering description, and also to confirm the soil behaviour and type descriptions derived from the CPT profiles. This drilling method also enables high quality sampling and in-situ testing to be carried out economically, providing the correct equipment used and the drilling team are trained in its use.

High quality thin walled piston sampling and in-situ vane shear strength testing were undertaken through the full thickness of the marine alluvial layers. It is rather unfortunate that borehole vane testing and thin walled piston sampling have seldom been specified in the investigations we have been involved in over the last 10 years. In order to ensure the tests were carried out adequately, all equipment had to be checked thoroughly, and the vane equipment calibrated prior to use. We also provided a training day in our yard to ensure all drilling staff was able to carry out the tests appropriately. The training was organised and coordinated by our field manager and Senior Engineer, who both have over 25 years experience in site investigation.

"The use of the vane test was decided upon to provide in-situ Cu values..."

The use of the vane test was decided upon to provide in-situ Cu values to derive site specific correlations for use with the CPTu data, enabling a continuous strength profile to be determined. A further benefit was that possible errors in strength testing results due to disturbances caused by sampling, transportation and handling in the laboratory were removed. The results (uncorrected) were also instant, which limited any possible further errors caused by changes in the sample during the inevitable time delay between sampling and lab testing.

Based on the CPTu data, specific depths for the vane tests and piston samples were decided upon before the drilling was carried out. This allowed a minimum number of samples to be taken, but enabled the most sensitive and critical layers to be targeted. Each borehole was drilled 2m away from a CPTu test to ensure that the relevant layers of interest were being tested and sampled, whilst being outside the zone of influence of the earlier CPTu tests. Based on the textbook correlations reported for undrained shear strength in soft normally consolidated deposits, Cu values as low as 8kPa would have been assumed. The in-situ vane testing of the weakest layers yielded worst case corrected results of 17kPa. This allowed a significant increase in the characteristic value to be used for design. The results of remoulded tests indicated a sensitivity of about 4, demonstrating that the loss of strength upon disturbance would have been significant, further validating the selection of in-situ testing in this case.

"The piston samples were taken for detailed logging and also to take high quality sub samples for laboratory compressibility testing. "

The piston samples were taken for detailed logging and also to take high quality sub samples for laboratory compressibility testing. The piston samples were transported to the lab on the same day. This enabled selected sub samples to be taken for oedometer testing, but also allowed simultaneous soil description of the whole sample. This dramatically improved the engineering description of this layer, allowing relevant fabric and laminated layers to be recorded. These can have an important controlling effect on the settlement

behaviour, enabling a greater degree of consolidation to occur by reducing drainage path lengths. These effects are not usually apparent in the small samples used in oedometer tests, leading to under-estimations of the rate of consolidation.

In order to help confirm the short term load/settlement behaviour of the softer clays, several large plate diameter tests were also undertaken at selected depths in the ground. These tests helped confirm parameter selection for the designer's settlement calculations.

"Routine standard penetration testing was utilised in the underlying granular strata."

Routine standard penetration testing was utilised in the underlying granular strata. All SPT's were undertaken with GTS's fully calibrated hammers in accordance with EC7. The results of the SPT's generally agreed with the densities obtained from the CPTu tests. However, the latter clearly showed significant variations in density in relatively thin layers. SPT's are too insensitive to pick these variations up, and depending on the spacing of testing, could miss less dense layers potentially significant to the engineering problem.

Sampling and strength testing of the stiff Glacial Till and Ampthill Clay strata raised some interesting points with respect to sample quality and BS EN ISO 22475. The code requires class 1 samples for strength and compressibility testing. These materials are too stiff for piston sampling, and despite recent improvements in driven open tube sampler design (UT100), it is doubtful that a class 1 sample would be obtained due to the sustained driving effort required, even if the tube and cutting shoe remained fully intact. Therefore, traditional U100's using the aluminium tube were taken at appropriate intervals, with SPT's performed immediately after each tube sample. The samples were dispatched to the lab on the same day for quick undrained triaxial testing. Quick turnaround was essential to reduce the effects of moisture changes across the sample on the results, which arguably has a greater impact than mechanical disturbance on materials of this type. The results of the tests were used for confirming site specific correlations with the CPTu and SPT data to confirm undrained strength profiles. As the data was required for routine pile design (which has used these methods over a number of years), arguably obtaining a class 1 sample was not necessary. However, this is a grey area, but choice can depend on the sensitivity of the problem, where increased costs to obtain high quality samples will be less important and justifiable.

"The results of the tests were used for confirming site specific correlations with the CPTu and SPT data..."

Using a collaborative phased approach while utilising a variety of techniques suited to the soil profile enabled high quality data to be provided to the designers without increasing cost. This resulted in costly temporary works solutions for the crane pads to be avoided. Using the results of the investigation, a stiffened platform for the temporary crane locations was designed to limit the stresses imposed on the softer critical layer identified to acceptable levels in the temporary case. The design was developed further and validated by undertaking additional plate bearing tests. The works were subsequently carried out successfully.

"It doesn't necessarily have to cost more and may even save significant sums of money..."

By spending more time considering the rationale behind the investigation, it is far more likely that a well considered high quality investigation will be undertaken. It doesn't necessarily have to cost more and may even save significant sums of money, as risks should be better defined and understood and greater reliance can be placed upon the accuracy and representativeness of the parameters provided for the design. ■

Once again **theGeotechnica** is striving to keep you updated with the influence and implimentation into the geotechnical and drilling industries. Here Nick Langdon, Director of Card Geotechnics and Ian Marychurch, Owner of the company, discuss EC7 and how it will effect engineers. The views in this article are of the authors and do not necessarily reflect those of the Editoral Board.

In a recent presentation to the CIRIA Conference on Geotechnical Issues in Construction one speaker

"... a major consultant appears to have suggested that EC7 might require engineers to have a broad knowledge and not be too specialised..."

from a major consultant appears to have suggested that EC7 might require engineers to have a broad knowledge and not be too specialised, and that too often the investigation is undertaken by the geologist and the analysis by the engineer. To us at CGL these seemed an extraordinary set of statements to make in 2011. We have written as experienced professionals in the industry who started out as engineer and geologist but through our careers have developed our knowledge and been recognised for our contributions in the complementary field.

Firstly, let's explore the view that EC7 requires the engineer to have broad as opposed to specialist knowledge. EC7 in common with its structural equivalents EC2 and EC3 on structural concrete and steel, looks to the extensive use of partial safety factors on soil strength and material parameters and introduces the concept of Serviceability Limit States and Ultimate Limit States in a formalised manner across the broad spectrum of geotechnical design for the first time. As a direct result designs are being driven from the viewpoint of what movements or deflections might be allowed if they are to be EC7 compliant. The geotechnical engineer or engineering geologist will be asking of their structural or civil engineering counterparts what movements can be accepted and what the structure is to be designed for.

"...experience tells us there are many traps for the non specialist."

Even if the process is to be simplified to that which a broad based engineer might understand, the choice of Young's Modulus from which much in future may be determined and relied upon, experience tells us there are many traps for the non specialist. Thinking the choice is merely a variation of steel and concrete deflection calculations may be the assumption of the generalist. Sadly as those of us who are specialists know only too well deciding on drained or undrained parameters and the rate of change with depth are critical in the deriving of realistic deflection or movement predictions. Of course it gets more detailed and more specific but what is clear is that far from requiring the engineer to become more broad based, the geotechnical engineer and the engineering geologist will likely have to become more specialist in the derivation of fundamental soil parameters and the prediction of ground movements. Additionally the structural engineer will need to acquire a far greater understanding of the implications of these geotechnical serviceability criteria and the specialist soil structure interaction knowledge to provide the "how" to the original question "why are we limiting movements? "

The second implied outcome from EC7, as to the expectation that there will be less demarcation between geologists doing investigation and engineers doing sums, is even more surprising. Thirty years ago this was the rather artificial division that big international consultancies tried to instil. In the more enlightened consultancies it was recognised there were highly numerate geologists with capability to be chartered professional civil engineers, and competent to design more than a site investigation. Equally there were civil engineers capable of understanding the influence geology and geomorphology could have on both the establishment of a ground model and the testing and

"After all both Terzaghi and Skempton and others demonstrated this affinity with the science of geology on repeated occasions..."

parameters that supported it. After all both Terzaghi and Skempton and others demonstrated this affinity with the science of geology on repeated occasions in formulating much of what underwrites today's engineering discipline. To recognise that the successful resolution of ground based risk and providing solutions required both the focus of the engineer and the broad sweep of the geologist was an axiom of these design teams which we at CGL carry forward today with others who are similarly enlightened. To suggest that this might be a new development from adopting EC7 is surprising we suspect to many in the industry but might explain some of the issues we face in value engineering the arcane, illuminating the confused and simplifying the needlessly complex.

In conclusion, EC7 presents challenges and changes but these are of the specialist team coming together to provide more sophisticated levels of serviceability prediction in response to more enlightened enquiries from more geotechnical aware generalists. ■

environmental

contents

Writing for **theGeotechnica** once more is Hazel Davidson, Technical Marketing Manager of ALcontrol-Laboratories. Here, Hazel talks about methods of soil analysis.

Soils are an extremely complex matrix to analyse, particularly on contaminated sites – the actual soil matrix can vary from a sand (silica) to limestone (calcium carbonate) to clay (complexed minerals), or a mixture of many. In addition to this, the range of contaminants varies from fairly innocuous construction materials to toxic gasworks waste to highly toxic pharmaceutical waste/mercury/explosives, etc.

Methods of chemical analysis need to cope with this very wide range of materials and compounds, which is difficult, and the introduction of MCERTS (the Environment Agency's Monitoring Certification Scheme) has raised awareness of the issues associated with reliable testing over such diverse matrices.

Preparation of Soil Samples

This is an absolutely critical step, and tends to be overlooked in a review of methods, but if the preparation is not carefully done, then no amount of sophisticated instrumentation will improve the result.

"Many tests cannot be performed on a dried and crushed sample..."

Many tests cannot be performed on a dried and crushed sample, as some of the parameter of interest will be lost, so soils must be initially mixed (and tested) in a wet, as received state, and these include:

Volatiles, leachate testing, phenols, ammoniacal nitrogen, sulphides, cyanides, most organics, hexavalent chromium

Homogenisation can be done by a classic cone & quartering technique, or using a jaw crusher to break up larger chunks, or kneading clay type samples. Fibrous material may need to be cut up or shredded. If a subsample can be dried, this is usually at a temperature of 35 – 40oC, or 105oC if a moisture content is required. Moisture contents will be needed for all testing performed on as received soils, as these must be adjusted back to a dry weight basis for reporting purposes. For contaminated soils, it is not regarded as advisable to remove anything from the sample, as potential hazardous material may coat the lumps (e.g. paint, electroplating fluids), or constitute the whole lump (e.g. tar), but if any component is removed, this must be noted on the final report to comply with MCERTS requirements.

Filtration of soil samples

Once a subsample of soil is weighed out, then for most methods, some form of liquid is added to the soil to extract the required parameter of interest. For example, anions and pH require a 2:1 water extraction, metals use an acidic digest, cyanides need an alkaline extraction, phenols use a methanol/water mix, and most organics need a solvent extraction. Samples must be shaken, refluxed, or digested for specific periods of time, then filtered or centrifuged, and the liquid extract then analysed by an instrument specific for the analyte in question.

End over end shakers

During the validation of a method, the robustness and applicability over a range of matrices must be determined, and this is usually done by using Certified Reference Materials (CRMs) or spike and recovery (spiking a range of soils with a known amount of a standard and then testing to see how much is recovered). The validation must cover the preparative stages of a method, as well as the instrumental analysis.

Analytical Methods

Calibration

All analytical instruments require calibration, and this is usually performed by preparing a range of standards (five or six is common) at increasing concentrations, putting these through the instrument, which will then construct a calibration curve or graph. Samples, when run through the instrument, are read off this graph to give the concentration of the analyte within the

"Alternatively, internal standards of a known concentration are added to the sample..."

sample. Alternatively, internal standards of a known concentration are added to the sample, and the concentration of compounds within the sample are calculated according to their response measured against that of the internal standard – this is more common in organic methods.

Methods fall into two main groups: spectroscopic methods for most inorganic analytes, and chromatographic methods for organic compounds.

Inorganic Compounds

"One of the most basic (and traditional) methods is colourimetric spectroscopy."

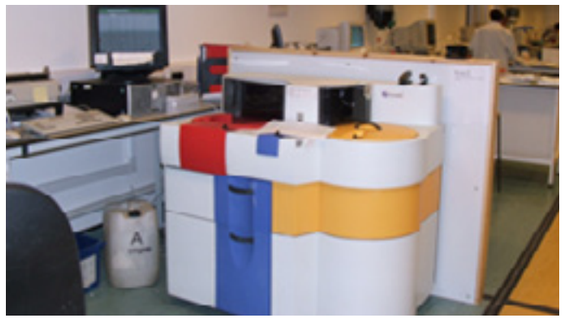
Anions

One of the most basic (and traditional) methods is colourimetric spectroscopy. This has been used by chemists for hundreds of years, although instrumentation is much more automated nowadays. This chemistry lends itself well to anions (compounds which are negatively charged and therefore attracted to an anode), and examples are:

Chloride, nitrate, nitrite, sulphate, phosphate, sulphide, ammoniacal nitrogen

Most laboratories will use some form of automated spectrophotometer, such as a Kone or an Aqua. They are multi element analysers, so more than one compound can be determined in one run. All instruments will have an autosampler, and a system for sequentially adding the appropriate chemicals to develop the colour. The final solution then passes into the spec-

trophotometer part of the system. The general rule (the Beer-Lambert Law) is that: 'the absorbance of light at a given wavelength is directly proportional to the concentration of the absorbing species', or in simpler words, the more intense the colour, the greater the concentration. These automated analysers are very efficient and can run up to two hundred samples per hour.



Kone Spectrophotometer

Distillation for acid soluble sulphide

Metals

Metals comprise one of the most commonly requested groups of analytes in environmental analysis, and these are usually measured by an Inductively Coupled Plasma Optical Emission Spectroscopy (ICP - OES). The dried and crushed soil is weighed out (usually 5 g of sample), and then digested on a hot block with aqua regia (a 3:1 mix of concentrated hydrochloric and nitric acids) for up to two hours. The acid extract is filtered and then loaded into the autosampler rack on the ICP – OES, where it will be aspirated and pumped into the plasma (a very hot, ionised gas at 10,000oC). Here, energy causes electron excitation, and then as the sample passes out of the plasma, this energy will be emitted as the electrons return to their ground state. The energy emitted will be at specific wavelengths, according to the metals present in the sample, and this energy is detected by the spectrophotometer.

"The acid extract is filtered and then loaded into the autosampler rack on the ICP – OES..."

Plasma in an ICP

"The beauty of the ICP is that it will measure several wavelengths at once..."

The beauty of the ICP is that it will measure several wavelengths at once, so over 20 metals can be analysed in about 4 minutes, ensuring this is a very efficient method.

ICPMS can be used instead of ICPOES, but the samples require large dilutions due to the sensitivity of the instrument to the high acidic and dissolved solids content in the digests.

An alternative method of metals analysis is atomic absorption, and there are several forms of this, but the downside is that only one element can be measured at once.

Sulphur compounds

There are several forms of sulphur containing compounds, and these have differing levels of importance in environmental analysis.

- Total sulphur can be measured using an induction furnace, but as sulphur can exist in many forms, it will not give much information regarding risks on site.

"Elemental (or free) sulphur is analysed using a solvent extraction..."

- Elemental (or free) sulphur is analysed using a solvent extraction, followed by HPLC (an organic method described later in this article). This is present on many ex gasworks sites and can cause a dermatitis like skin reaction.

- Total sulphides can be analysed by acid digestion and ICP, but many of these are insoluble and relatively inert, so do not constitute an environmental hazard.

- Acid Soluble Sulphide is considered more of an environmental risk, as if these compounds are present on a site with acid rain or groundwater, then hydrogen sulphide can be formed, which is highly toxic at low levels. These are analysed either by ion selective electrode, or acid digestion followed by colourimetric analysis of the impinger solution (which traps the evolved hydrogen sulphide).

"Acid Soluble Sulphate, sometimes referred to as total sulphate, is analysed using an acid digestion..."

- Acid Soluble Sulphate, sometimes referred to as total sulphate (which may not be strictly equivalent), is analysed using an acid digestion followed by ICP-OES. A value of 0.24% is considered a potential risk for concrete attack.

- Water Soluble Sulphate, from a 2:1 water extract, is analysed either by ICP-OES or colourimetric spectrophotometry. This will determine if sulphate resisting cement is required by the construction company.

Nitrogenous compounds

The interrelationship of nitrogen compounds can be confusing, and these are defined as follows:

- Nitrate and nitrite (total oxidised nitrogen) – these will be analysed on a 2:1 water extract of the soil by colourimetric spectroscopy.

- Ammoniacal nitrogen – this will include both ammonia (NH3) and ammonium (NH4), and again is either a water extract, or distilled as exchangeable ammonia.

- Kjeldahl nitrogen is a measure of the ammoniacal nitrogen and organic nitrogen, and is analysed by a distillation and titration method.

"Total nitrogen involves a stronger acid digestion, and includes all of the above."

- Total nitrogen involves a stronger acid digestion, and includes all of the above.

Cyanide compounds

- Free cyanide represents simple cyanide salts, such as potassium cyanide. These are very water soluble and extremely toxic, and are measured by a water extraction, followed by a specific, automated distillation/colorimetric analysis such as a Skalar.

- Easily liberated cyanide is still measuring free cyanide, but uses a more acidic digestion to cope with difficult matrices.

- Total cyanide requires a much more aggressive digestion, but this is also performed on the Skalar system. This will include the complex ferri and ferro cyanides.

"Thiocyanate is a separate colourimetric analysis, and is not included in the total cyanide, but again can be performed on the Skalar."

- Thiocyanate is a separate colourimetric analysis, and is not included in the total cyanide, but again can be performed on the Skalar.

Organic Methods

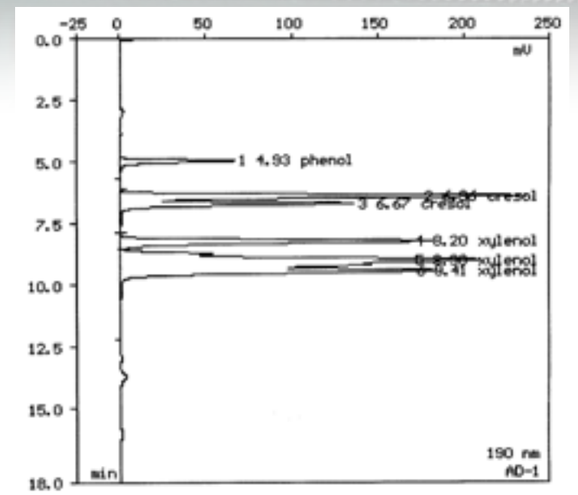
These are commonly based on some form of chromatography, with the usual methods including:

HPLC High performance (or high pressure liquid chromatography)
GCFIDGas chromatography with flame ionisation detection
GCMS Gas chromatography with mass spectroscopy detection

Chromatography is the separation of a complex mixture by the use of partitioning between a stationary phase (the column), and the mobile phase (a liquid or gas). The separation occurs because of different properties of the compounds – either their mass (so larger molecules take longer to pass through), or their polarity (the charge associated with a compound – the greater this is, the more reactive the compound will be and the more slowly it will move through the column).

High Performance Liquid Chromatography

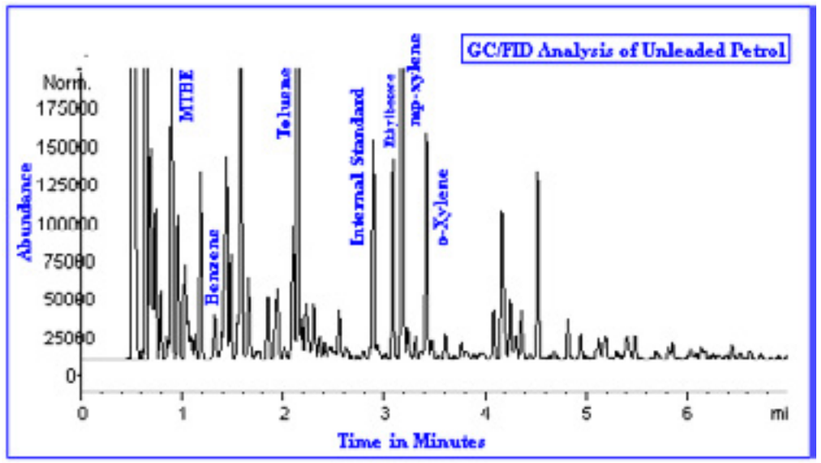
Speciated phenols are analysed by HPLC, and will give results for phenol itself, xylenols, cresols, resorcinols and napthols. Depending on the site, clients need to request just phenol, total phenols, or speciated phenols.



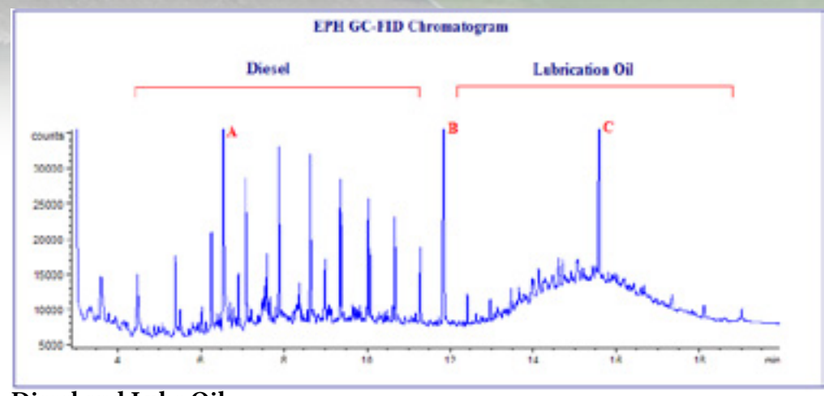
HPLC phenols chromatogram

Gas chromatography with FID

This method is mostly used for petroleum hydrocarbons, such as gasoline range organics (GRO) and extractable petroleum hydrocarbons (EPH). The pattern of the chromatogram enables the analyst to identify the type of product in the soil.



Gasoline

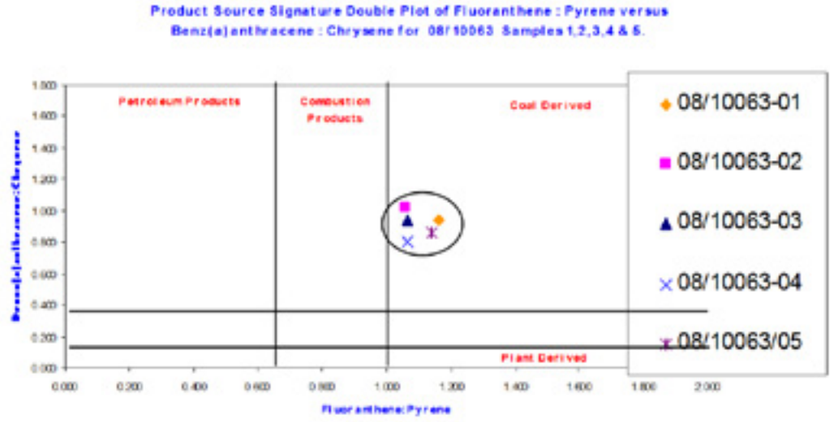


Diesel and Lube Oil

Gas chromatography with Mass Spectroscopy detection

This method is used for a very wide variety of compounds, some examples of which include:

Polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and pesticides (chlorinated and phosphorylated, plus many others)



PAH double plot to determine source of aromatics

A mass spec can be run in two ways, either in full scan, where the instrument is set to look at every peak, or in selected ion monitoring (SIM), where it will only look for specific target compounds and ignore anything else which may be present. If a client is not sure which compounds to request, then it is better to ask for a VOC and/or SVOC full scan plus TICs. Each of these will provide a target list of 60 + compounds plus up to ten Tentatively Identified Compounds. If the likely compounds are known, then it is better to use the methods run in SIM, as these will provide lower detection limits.

Summary

This review gives only a summary of some of the many methods of soil analysis, but these cover the more widely used techniques. All methods must be fully validated and proven to work across a range of matrices, and are monitored on a batch by batch basis with the use of blanks and Analytical Quality Control (AQC) samples. In addition, laboratories accredited to ISO 17025 (and MCERTS) must participate in proficiency testing schemes, where blind samples are tested at regular intervals to ensure the laboratory methods are fit for purpose. Environmental analysis today is complex, time consuming, and is subject to rigorous quality procedures. Over 30% of samples analysed are QC or validation samples, and this represents a heavy cost to the laboratory, but data must be defensible. Laboratories constantly seek to improve their methods and processes, and further developments/legislation will provide the impetus to continue with these improvements – this is an ever changing industry.

drilling

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This is the second in a series of articles on borehole stabilisation and the use of drilling fluids and muds. In this issue of **theGeotechnica**, James Mansell of Clear Solutions International Ltd. once again imparts his knowledge on this very important subject.

In this article we will look at the specifics of various different drilling fluid systems which are commonly used in the Geodrilling industry.

"...the ideal fluid enables the driller to cut a smooth, stable gauge hole through a range of formations..."

In the last article we discussed the ideal drilling fluid - the ideal fluid enables the driller to cut a smooth, stable gauge hole through a range of formations whilst balancing down hole pressures, optimising penetration rates and preventing formation damage. We will now go on to discuss how we achieve this in practice.

Pure-Bore® drilling fluid effectively stabilising and removing London clay and Lambeth Group cuttings from a geothermal borehole.

"Most of this talk is based on individual perceptions of a particular need and rarely on the total needs of the job..."

Types of Fluid - There are a large number of drilling fluid systems available on the market and we hear a lot of talk about bentonite systems and polymer systems with different camps promoting the benefits of their own particular favourite. Most of this talk is based on individual perceptions of a particular need and rarely on the total needs of the job and therefore we should carefully consider all of the different types of drilling fluid systems, which can be used in the Geodrilling Industry.

Pure Water - This is the simplest type of fluid and may work in hard rock drilling with foam or mist, but does not work in sedimentary formations because:

- It has very poor hole cleaning ability unless you are pumping sufficient volume to raise the annular velocity enough to carry cuttings.
- The water will run away into any porous/permeable formations such as sand and gravel which may then collapse.
- In clay formations it causes the clay to wash out and dissolve giving a very poor out of gauge hole whilst stiffer clays and shales swell and hydrate leading to sloughing back into the borehole.

"These are readily available and as such perform a much better job at holding holes open than plain water..."

Civil Engineering Grade Bentonite Based Mud Systems – These are readily available and as such perform a much better job at holding holes open than plain water with their main benefit being that they are much better at carrying cuttings out of hole. They also suspend cuttings when the fluid stops moving to help prevent them settling to the bottom of the hole. Bentonite also forms a filter cake on the sides of the hole (a plastering effect that prevents fluid loss into the formation) which stabilises the open hole and helps prevent wash out.

The negative aspects of a straight CE grade bentonite system is that it has to be mixed through a high shear mixer; needs clean fresh water with no contaminants (such as salt) in order to hydrate; large quantities are required to build viscosity; it takes a long time to fully hydrate; it does not provide a highly shear thinning drilling fluid; and it builds progressive pump pressures which generate high down hole surge pressures when circulation is restarted. In addition native clays readily disperse hydrate into the fluid system resulting in high pump pressures to circulate the drilling fluid and a fluid that becomes difficult to recycle without large dilution rates being required.

Ultra-Bore® bentonite drilling fluid in use showing exceptional high shear rheology for optimum hole cleaning whilst shearing back down for effective processing on surface.

High Yield Bentonite Based Mud Systems – More recent developments of high performance bentonite drilling fluid systems, such as Ultra-Bore®, have resulted in significant benefits over standard CE grade bentonite in that product consumption is typically reduced by more than 50%, hole cleaning is boosted and lower pump pressures are required to circulate the fluid. These products also mix more readily than CE grade bentonite, develop far better borehole stability and have a lower initial solids content making them more tolerant of drilled solids contamination. On the down side they still don't mix effectively and fail to prevent clays and shale hydrating, sloughing, sticking or dispersing back into the drilling fluid - without the addition of polymer additives they still rapidly build mud weight in fine formations requiring a dump and dilute solution.

"These products also mix more readily than CE grade bentonite..."

"...without the addition of polymer additives they still rapidly build mud weight in fine formations..."

Liquid Polymer Based Mud Systems – these are typically synthetic, polyacrylamide based drilling fluid systems and are sold under a range of brand names such as Liquimud®. They have been used for a number of years in the Geodrilling industry as a small quantity will mix easily in fresh or salt water to very quickly develop a simple high viscosity drilling fluid with good lubrication and clay encapsulation properties. On the down side, most of these products are suspended in a mineral oil carrier fluid so do not provide the most environmentally acceptable drilling fluid. In addition these additives fail to form a tight filter cake so can't

drilling

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effectively stabilise unconsolidated formations such as sand and gravel. They also fail to provide low shear viscosity or gel strength meaning that very high flow rates are required to clean the hole whilst the cuttings quickly settle back down the borehole when the mud pumps are turned off.

“They also fail to provide low shear viscosity or gel strength...”

Dry Polymer Based Mud Systems – there are a large number of dry polymer drilling fluid additives available on the market including products such as Clear Stabiliser® which provide fluid loss control, Drill-Sorb® which is a very effective loss circulation material and drilling fluid solidifier, and Clear-Gel™ which can be used to increase the carrying capacity and gel strength of the drilling fluid. The problem with many of these additives is that whilst they are very effective in building one or two mud properties on their own, to build all of the required drilling fluid functions for the given ground conditions, you need to develop a multi additive drilling fluid. This fluid then becomes both difficult and expensive to manage and maintain - drilling a hole in the ground is difficult enough in the first place without introducing additional variables.

As a result a dedicated research and development program was instigated a number of years ago to formulate and manufacture a high performance, one bag, biodegradable polymer drilling fluid that addressed most of the desirable properties of a drilling fluid. The result was a product called Pure-Bore® which not only mixes quickly and easily through a high shear mixer in fresh and salt water, but also builds effective low shear rheology for optimum hole cleaning, forms a tight firm filter cake to help stabilise unconsolidated formations such as sand and gravel and maintains the integrity of formation reservoirs. Pure-Bore® also provides excellent clay and shale inhibition/encapsulation to help prevent clays swelling and sloughing into the borehole and subsequently dispersing into the drilling fluid thus considerably reducing product and fluid consumption and disposal. As such Pure-Bore® has proven to be an effective product not only on numerous shallow boreholes throughout Europe but also on a large number of deep vertical wells and long, large diameter boreholes.

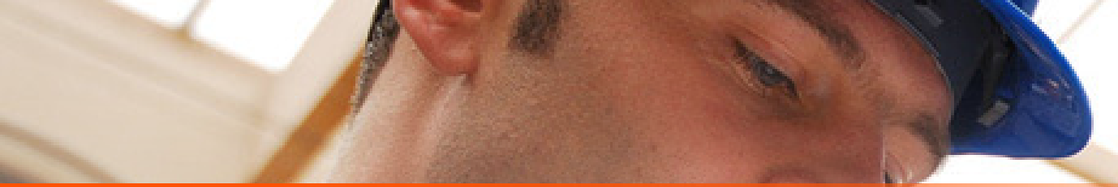
“Pure-Bore® also provides excellent clay and shale inhibition/encapsulation...”

“As highlighted there are many different drilling fluid types available to today’s driller.”

As highlighted there are many different drilling fluid types available to today’s driller. The decision that has to be made therefore, is which fluid type will be the easiest to use, the safest, the most environmentally acceptable and will provide the best possible drilling rate combined with final borehole productivity. By making calculated decisions about the type of drilling fluid and equipment utilised for each and every project, it is possible to significantly increase both productivity and performance. ■

Throughout our remaining drilling fluid articles we will expand on this one by looking at the following aspects of drilling fluids in more detail:

- The safe and effective mixing and use of different drilling fluid additives
- The importance of flow rate, annular velocity and drilling fluid rheology in the drilling fluid process
- The effective recycling, handling and disposal of used drilling fluids
- Minimising the risk of formation damage and optimising the productivity of production wells
- The effective sealing and grouting of boreholes for different applications



safely handing industry hazards

safety issues

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Writing for **theGeotechnica** for the first time, Emma Betts, an independant chartered occupational safety professional, discusses the various potential hazards that are present throughout the construction industry.

With so many potential hazards the construction industry is considered to be a high risk environment to work in. There are five key areas that account for most of the accidents and ill health reported on an annual basis. These are: falls from height, workplace transport, slips and trips, manual handling, and asbestos.

"Falls from height are still the most common cause of fatal and serious accidents in the construction industry..."

Falls from height are still the most common cause of fatal and serious accidents in the construction industry, accounting for 50% of all deaths. These include falls from roofs, through fragile materials and from ladders. By following some of these simple guidelines the risk of injury can be reduced:

- Always work from a safe and secure place with edge protection

Manual handling has always been an issue on geotechnical sites.

- Ensure scaffold towers are correctly erected by competent operatives
- Ensure leading edges and gaps are protected with guardrails and toe boards
- When using ladders, if there is no alternative, only work for short durations
- Always maintain 3 points of contact when climbing a rig mast, and use harnesses where appropriate
- Keep access points tidy and waste free
- Ensure any ladders used are properly positioned, at the correct angle (1:4) and secured
- Only use a ladder that is properly maintained

Even in the geotechnical sector where most of the work is concerned with excavating the ground, falls from height could still be a risk. Falling from ground level into an unprotected three or four metre deep trial pit is a very real hazard, but how many of us would include falls from height on a risk assessment? Here are some simple measures to adopt to reduce the risk of injury while trial pitting:

- Always work from a safe and secure place, avoid standing on the long side of a pit
- Ensure sidewall stability before approaching the side of the pit, approach from narrowest side.
- Never leave an open pit unattended
- Excavations left open overnight should be covered, fenced off and appropriate signage displayed
- Working areas should be kept tidy and walkways kept clear of tripping hazards
- Ensure stockpiles are stable and at a safe distance from the side of the pit to avoid possible pit collapse
- Do not enter any unstable excavation. Do not enter any unsupported excavation

"Workplace transport incidents are the second most common cause of fatalities on site."

Workplace transport incidents are the second most common cause of fatalities on site. The following can help prevent injury:

Traffic management can be challenging.

- Use barriers and warning signs to separate vehicles and people
- Be aware of traffic plans and routes on site
- Site speed limits should be adhered to
- Ensure a 'high viz' policy is followed by all workers
- Avoid reversing – if it can't be avoided use a trained banksman
- Don't use plant and vehicles on dangerous slopes
- Ensure that vehicles are properly maintained, correctly used and all plant operators are trained and competent.

"An untidy site is not only disorganised but will increase the risk of slips and trips."

Good housekeeping, tidy well organised sites and clean welfare facilities are essential for the running of a good site. An untidy site is not only disorganised but will increase the risk of slips and trips. Good housekeeping can be easily maintained by following these simple guidelines:

- Always consider the best location for welfare and office facilities
- Establish a dedicated materials storage area. Stack materials on firm, level ground
- Stack/store materials in an appropriate manner e.g. Chock pipes to stop rolling
- Keep storage areas tidy – place waste in skips
- Keep footpaths, emergency routes, points of access and scaffold platforms clear of materials and equipment

All sites should have decent welfare facilities, if the facilities are poor and not regularly cleaned this can lead to ill health. The minimum requirements for provision of welfare are:

- Clean toilets
- Hot and cold running water with soap and towels
- Basins large enough to immerse your arms to the elbows
- Drinking water
- Warm, dry and clean place to sit and eat

Manual Handling related injuries account for over a third of all over 3 day injuries and are one of the most common causes of people leaving the construction industry. The handling of heavy and awkward loads, repetitive handling and using a poor posture all contribute to injuries.

"The handling of heavy and awkward loads, repetitive handling and using a poor posture all contribute to injuries."

Follow these simple guidelines to reduce the likelihood of sustaining a manual handling injury:

- Be aware of musculoskeletal disorders, manual handling and how to avoid it through training and general awareness
- Avoid manual handling, use a forklift, dumper or other mechanical means wherever possible
- Ensure you follow an appropriate systems of work
- Break loads down into manageable sizes
- Avoid repetitive handling or awkward movements
- Always lift with your legs and not your back

safety issues

“Asbestos kills more people each year than any other single work-related cause.”

Asbestos kills more people each year than any other single work-related cause. The damage occurs when airborne fibres become inhaled into the lungs. The majority of exposure related diseases are mainly cancers of the chest (Mesothelioma) and lungs (Asbestosis). There can be a long delay between first exposure to asbestos and the start of the disease this can vary between 15 and 60 years.

Good housekeeping is not always easy.

“Asbestos is particularly associated with demolition and renovation of properties built between 1930’s and 1980’s.”

Asbestos is particularly associated with demolition and renovation of properties built between 1930’s and 1980’s. You are more likely to encounter asbestos as Cement-bound asbestos, asbestos coatings and asbestos bitumen products which have been widely used since the 1950’s.

There are three types of asbestos White (Chrysotile), Blue (Crocidolite) and Brown (Amosite). The last twoBlue and brown asbestos are considered to be more hazardous, however most asbestos looks colourless to the naked eye. When bound in a matrix it will have a generally grey appearance, and the fibres are contained. Most asbestos is not a hazard unless the material is broken, sawn, drilled or sanded. These activities cause fibrous asbestos to be disturbed releasing fibres into the air.

“Unless you are licensed to work with asbestos you should not disturb, break up or remove any materials you suspect to contain asbestos.”

Unless you are licensed to work with asbestos you should not disturb, break up or remove any materials you suspect to contain asbestos. Within the industry there is a real need to provide basic, general awareness training for anyone who may come into contact with possible asbestos materials in order to give them an understanding of the effects of exposure, where asbestos may be present, and how to protect themselves and others as well as what to do in an emergency, if asbestos is found during site work.

Before commencing any site investigation the site should be assessed for the risk of asbestos. If there is a risk of the presence of asbestos, an appropriate survey should be carried out, by a licensed company. If any material you suspect to be asbestos is found during an investigation, always stop work and check your company policy to ascertain safe practise.

Further information can be found at www.hse.gov.uk where there are leaflets available detailing the hazards discussed in this article. ■

Raising the Standards – Federation of Drilling Specialists is launched

products and innovations

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January 2012 will see the launch of the Federation of Drilling Specialists (FDS) and theGeotechnica is very pleased to be part of it.

In November, Equipe, who will operate as the Administration Team for FDS, consulted industry in an open pre-launch meeting and the overwhelming consensus was that if operated with integrity and independence

"Based upon the feedback and further consultation, the constitution was amended and the FDS is now ready to be launched."

should become a useful organisation. Based upon the feedback and further consultation, the constitution was amended and the FDS is now ready to be launched.

So what is the Federation of Drilling Specialists?

The Federation of Drilling Specialists is a group of like minded organisations who promote and deliver services and products of continually high standards to or within the drilling industry.

The drilling industry, in this context, comprises all drilling activities across the geotechnical, geothermal (ground source), water well, drilling and grouting, ground anchors, geotechnical processing, drainage and civil engineering sectors.

The Federation of Drilling Specialists and its membership represent a mark of quality and assurance of workmanship. It is an unashamedly elite of organisations and membership can only be obtained through successful completion of comprehensive annual audits.

"The purpose of membership to the Federation of Drilling Specialists is to create an interactive community where knowledge, both technical and safety, can be freely circulated..."

The purpose of membership to the Federation of Drilling Specialists is to create an interactive community where knowledge, both technical and safety, can be freely circulated for the benefit of all and where best practice and industry improvements are shared.

The Federation of Drilling Specialists (FDS) is an organisation which will promote the drilling industry, best practice, innovation and provide guidance and advice.

FDS Vision

A community with shared values, that delivers and promotes quality, innovation, new products and best practice in the drilling industry. A community that is rewarded for its endeavours and that strives to improve.

Aims
The Federation of Drilling Specialists aims to:

- Promote the drilling industry and those in it who meet the standards
- Raise awareness and promote best practice
- Promote and support innovation and new products to the drilling industry
- Promote, support and deliver training and education to all stakeholders in the drilling industry
- Improve health and safety awareness and standards in the industry through training, education and innovation
- Raise awareness of and promote Standards, Regulations and Codes of Practice which enhance and improve the drilling industry
- Work with other associations, federations, government or other official bodies in order to develop and maintain standards and promote the industry
- Partner with those bodies which are associated with the drilling industry and aligned with the federation's aims
- Collaborate and partner with UK and overseas bodies
- Disseminate information to all interested parties through training, seminars, symposia, magazines, guidance notes, bulletins and the website

Why is the FDS different?

"... an extremely important aspect to the FDS is that it is not governed by a committee but by a Board of Independent Trustees..."

Unlike trade associations and other clubs, an extremely important aspect to the FDS is that it is not governed by a committee but by a Board of Independent Trustees supported by a very strong Administration Team. The Trustees are highly respected and well known individuals who have worked within and around the drilling industry and have a reputation of high integrity. This allows the FDS to respond quickly and make independent decisions for the benefit of the entire membership.

"Membership to FDS has to be earnt through proven capability and compliance to the FDS Eligibility Criteria."

Membership is also not a given upon payment of fees. Membership to FDS has to be earnt through proven capability and compliance to the *FDS Eligibility Criteria* and once obtained can be lost if standards drop.

Membership to FDS will really mean something, be difficult to obtain and it is hoped that organisations will aspire to meet the grade.

Membership
Membership is available in the following categories:

Corporate Membership
Companies with a turnover >£3M

Corporate Membership
Companies with a turnover <£3M

Corporate Membership
Sole Trader / Owner Operator

Personal

Affiliate Member

Honorary Member

Corporate Membership is available to Public Liability Companies, Registered Limited, Limited Liability Partnerships, Sole Traders and Owner Operators. Corporate members can be from UK or European Union states as long as they meet the *FDS Eligibility Criteria*.[1]

Personal Membership is available to individual drill-

ing operatives who are employed by an FDS Corporate Member.

Affiliate Membership is available to companies associated with the drilling industry such as specialist contractors, consultants, suppliers, manufacturers, academic organisations, trade associations, other specialists and overseas corporate companies.

Honorary Membership is by invitation only and to individuals who have shown dedication to the drilling industry over a substantial number of years or who have made significant contributions to the advancement and promotion of the drilling industry.

Membership Audit
Initial Audit will comprise scrutinisation of the completed membership questionnaire followed by a Site Audit to ensure compliance against the criteria and company procedures. During each stage, FDS will work with the organisations and completion of satisfactory audits will be a collaborative approach. Where shortfalls are recognised, FDS will work, wherever possible, with the organisations to meet their obligations.

The audits will consist of documentation validation followed by a site audit and will encompass the requirements of BS 22475 Parts 2 & 3.

"The validation of the documentation will comprise checking of the submitted questionnaire and supporting documentation..."

The validation of the documentation will comprise checking of the submitted questionnaire and supporting documentation and requests for additional supporting information where required. The site audit will be based upon the requirements of BS 22475 Parts 2 & 3.

[1]The Federation of Drilling Specialists will only accept those companies and individuals who meet the *FDS Eligibility Criteria* for membership. Eligibility will be measured by the quality of the information provided, compliance to the criteria and annual audit.

"FDS Audits will be comprehensive and check that organisations have sufficient and suitable robust systems and procedures in place..."

FDS Audits will be comprehensive and check that organisations have sufficient and suitable robust systems and procedures in place to operate legally, safely and efficiently. The FDS Audits will assess the drilling aspects of the company in detail such as compliance to rig guarding requirements, LOLER and PUWER and buried services. When organisations have already obtained valid certification for management, safety and environmental systems such as ISO 9001, ISO 14001, OHSAS 18001, CHAS, Achilles Link Up, Achilles Verify, Construction Line then the FDS audit will accept this certification and concentrate on the aspects most relevant to drilling which are not robustly assessed in these.

What are the Membership Benefits?
The benefits for Corporate and Affiliate Members include a wide range of independent advice and information provided by the Administration Team (Equipe) and their network of drilling engineers and professionals.

In addition, full members also benefit from:

- FREE attendance at the FDS Annual Health and Safety Forum – 16th February 2012

- FREE members entry into theGeotechnica

- FREE members entry onto the FDS website with hyperlink to member's own website

- FREE copies of theGeotechnica

- 10% off Equipe services:
  - o NVQs
  - o LOLER Inspections
  - o Audits – Land Drilling / Health and Safety
  - o On Site Compliance Testing (Audit, LOLER & SPT Calibration)

- 10% off Equipe training courses:
  - o Drilling
  - o Technical
  - o Health & Safety
  - o Tachograph and Driver's Hours
  - o IOSH Safe Supervision of Geotechnical Sites
  - o IOSH Avoiding Danger from Underground Services

Advice includes:
Technical Specifications, Eurocode Compliance, Training & Competence, Health and Safety, Rig Guarding, Tachographs, Driver's Hours, LOLER, PUWER, NVQs and CSCS / CPCS

Membership to the Federation of Drilling Specialists will commence from January 2012 and it is hoped that it will quickly become recognised as a badge of quality and high standards of workmanship. Already, many of the leading geotechnical consultancies and clients are seeking to improve their supply chain and meet their own obligations and they see FDS membership as a big step to assisting their own requirements. No other drilling membership represents such a high level of integrity, quality and compliance and clients, consultants and practitioners should want to be part of it.

Further details and information regarding membership of the Federation of Drilling Specialists can be obtained from Equipe info@equipetraining.co.uk or from the FDS website www.fds.org.uk which will be launched in January 2012. ■

directory

To advertise in theGeotechnica could not be easier; just send us your advert in PDF format or in Microsoft Word and we will insert it into our advertisement places. Rates for advertising space are given below. All adverts placed by Drilling Academy™ members will benefit from discounted rates.

If you would like to book space for 3, 6 or 12 months or for more information please contact Equipe on Tel: 01295 670990 or Email us at magazine@geotechnica.co.uk

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Email: si@conceptconsultants.co.uk

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Email: info@dynamicsampling.co.uk

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RGI GEOTECHNICAL INVESTIGATION
Unit 37, Longfield Road, Sydenham Industrial Estate, Leamington Spa, Warwickshire, CV31 1XB
Tel/Fax: 01926 886329 **Mob:** 07748871546
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Email: sales@drillwell.co.uk

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Tel: 01983 203600 **Fax:** 01983 291335
E-mail: enquiries@strainstall.com

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Email: web@terradat.co.uk

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laboratory services

ALCONTROL Laboratories
Units 7 & 8 Hawarden Business Park, Manor Road, Hawarden, Deeside, Flintshire CH5 3US
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Email: hawarden.sales@alcontrol.com

CONCEPT
Unit 8 Warple Mews, Warple Way, London W3 0RF
Tel: 020 8811 2880 **Fax:** 020 8811 2881
Email: si@conceptconsultants.co.uk

GEOLABS
Bucknalls Lane, Garston, Watford, Hertfordshire, WD25 9XX
Tel: 01923 892 190 **Fax:** 01923 892 191
Email: admin@geolabs.co.uk

K4 SOILS LABORATORY
Unit 8, Olds Close, Watford, Hertfordshire, WD18 9RU
Tel: 01923 711288 **Fax:** 01923 711311
Email: office@k4soils.com

site investigation

CONCEPT
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Tel: 020 8811 2880 **Fax:** 020 8811 2881
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training and education

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Specific experience in the following is preferred:

- Engineered Fills – earthworks testing, design, specification and validation, assessment of embankment/fill settlements.
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- Knowledge of reinforced earth design and retaining walls preferred.

The successful candidates must be comfortable interfacing with clients, other professionals, contractors and regulators as the role will involve a mix of technical and project management skills as well as the preparation of proposals, overseeing reports and mentoring or more junior staff. The position can be based in either our Kenilworth or Newton-le-Willows and could also be offered as a part-time vacancy (subject to a minimum number of working hours to be agreed).

Please submit your CV and covering letter to John Cartwright, Applied Geology Limited, Unit 23 Abbey Park, Kenilworth, Warwickshire, CV8 2LY. Tel. 02476 511822. NO AGENCIES.
john.cartwright@appliedgeology.co.uk www.appliedgeology.co.uk

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paul.turnbull@geodrill-ltd.co.uk or karl.blanke@geodrill-ltd.co.uk
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