Down to *Earth* Solutions

Welcome to the Autumn 2002 edition of our newsletter. We're keeping you up-to-date on what's happening in our firm, contamination issues, new processes and technologies and the latest legislation.

Remediation technology leader

Remediation of PAH contaminated soil is promoted by aeriation with soil ameliorants, cotton trash and surfactant..

Over the last six months, the intensification of the research we began into remediation technologies in 1989, has been very exciting for the scientists at Environmental & Earth Sciences. As indicated in the last newsletter, we have already substantially improved the bioremediation of PAHs, which means that bioremediation is now a viable option for your gas works remediation.

In the coming newsletters we will document innovative technologies we have developed in the past as well as well as new technologies we are developing or trialing now. Remediation technologies we will discuss in forthcoming newsletters, including cut-off trenches instead of containment, immobilization instead of disposal and enhanced, monitored attenuation, all of which we have applied in real life situations.

We have recently bench tested a number of new treatments: these include the destruction of lindane by oxidation and alkaline chlorination—which has reached the stage where we have applied for a licence to undertake a field trial; Fenton's Reagent for in situ degradation of solvents in sand aquifers and phyto-remediation of nutrients in streams.

A cut-off trench is constructed to prevent contamination from an old gas works from reaching a river.

Because of these developments, Philip Mulvey will be travelling to Europe later this year to determine their application in Europe and to investigate ways of improving them.

This pursuit of scientific excellence in contamination assessment and remediation is resulting in the delivery of more economic solutions to our clients. As one of the few environmental companies that puts our money where our mouth is, we suggest you call for a FREE quote for the remediation of your site—you may be surprised with what we can achieve with these new technologies.

Equipment developments

New in house technologies and equipment enable Environmental & Earth Sciences to provide a better service for the same price as our competitors. In 1995, we developed a light weight push-tube drilling rig. These units have since been used mainly from our Melbourne and Sydney offices.

The Mark II light-weight, push-tube drilling rig in a tight spot.

Profile – Tom Knowles

Tom Knowles is the most recent addition to the Environmental and Earth Sciences team and joins the NSW office as our 2002 graduate. He completed his combined BA (Asian Studies)/BSc (Hons) degree at University of Sydney last year.

His Soil Science honours thesis was entitled, "Carbon storage in cotton soils of NNSW". The work involved quantifying the extent and spatial variability of the soil carbon pool of a cotton field and comparing the results to that of the surrounding soil under native vegetation. Based on the results, an estimate of the soil carbon pool of all similar soils within Australia was then calculated.

Tom is currently gaining further expertise in the company's established spheres of work in contaminated site characterisation and remediation. In line with the company's commitment to innovative enviromnental solutions, Tom is keen to further develop the work started in his thesis by exploring possibilities for carbon credits and carbon trading in relation to soil.

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The Rotocult is made in Australia and is used to mix soil as thoroughly as a pug mill for much less cost and at a greater through-put.

Equipment developments

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Constant modification during use in the field for several years has resulted in the development of a Mark II version of the drilling rig in 2000. Further improvements to the hydraulics and the drilling rods have been incorporated in a Mark III version which will be supplied to our Sydney office and the new Brisbane office, which opens in June.

Although light weight and maneouvreable, these diesel driven rigs can be used to drill up to 40 holes each to a depth of two metres in a day and can core through concrete. All our staff are trained in their operation.

Contaminant immobilization is often required before soil can be disposed off site. Rotocult is new piece of equipment, manufactured in Australia, that can mix soil as thoroughly as a pug mill for much less cost and at a greater through-put. We use the Rotocult for stabilization, bioremediation and chemical degradation. Use of the machine resulted in substantial savings for the stabilization of barium from contaminated soil at an industrial site in Melbourne, when 5 000 m^3 of material required treatment.

A Mark I light-weight drilling rig being used to core thrugh a concrete floor inside a warehouse.

Remember to check
www.groundscience.com
for updated information and
employment opportunities.

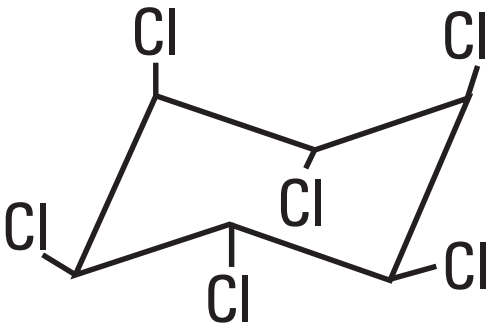
Lindane breakdown

by Sean Delonas
New York Post - Jan. 18, 1995

Lindane is an organochlorine pesticide which has been used as an insecticide and fumigant on numerous soil dwelling and phytophagous (plant eating) insects. Its common name is either hexachloro cyoctohexane (HCH) or benzene hexachloride (BHC), but there are more than 150 trade or other names for the compound. The empirical formula for lindane is $C_6H_6Cl_6$ with a cyclic structure as shown.

The observed health effects of lindane on human beings have largely occurred through accidental or intentional ingestion, although inhalation toxicity has occurred when used in vaporisers. Lotions (10% active ingredient) applied for scabies have resulted in severe intoxication of children and infants. The effects from these types of acute exposure are nervous system effects, high body temperature and pulmonary edema. Chronic effects may be liver and kidney damage. Laboratory studies have shown that it is moderately toxic to rats via oral and dermal (LD_{50}, 88 to 190 ppm oral, 500 to 1000 ppm dermal) exposure. However, some bird species have demonstrated a greater resilience to lindane exposure (LD_{50}, greater than 2000 ppm in mallard duck, LC_5 for Japanese quail). Eggshell thinning and reduced egg production has also be reported in birds exposed to lindane. It is very toxic to fish and aquatic species with 96 hour LC_{50} values from 1.7 to 90 mg/L in trout, coho salmon, carp, flathead minnow, bluegill, large mouth bass and yellow perch. The bio accumulation factor is 1400 times ambient water concentrations indicating significant bioaccumulation.

The effectiveness of lindane as an insecticide is its stability at temperatures less than 180°C and resistance to photodegradation. Given that it does not biodegrade or hydrolyse in either fresh or salt water environments, it is a chemical of potentially significant harm to aquatic or marine life. Notwithstanding its recalcitrance to chemical or physical decomposition, studies by Environmental & Earth Sciences have demonstrated that there are means by which this compound can be effectively broken down. We have applied to the NSW EPA to undertake a



trial to treat soils contaminated with this compound, following successful bench scale trials. Stay tuned for further details on this exciting development in further editions of *Solutions*.

For further information please call Andrew Kohlrusch at Environmental & Earth Sciences, Sydney office, on

Phone (02) 9922 1777

Vetiver grass for phyto-remediation

Urban wastes and the by-products of rural, industrial and mining industries are putting unprecedented stresses on natural environments. These potential environmental problems when coupled with the abundance of naturally occurring acid sulfate soils on Australia's coastal strip are creating a scenario of unsustainable growth. Existing and traditional treatment methods are expensive and often unsuitable for smaller communities and their industries.

Environmental & Earth Sciences is currently engaged in the promotion and use of a new phyto-technology nutrient scrubbing, vetiver grass. Vetiver grass is an adaptable remediation tool with a wide range of uses for environmental protection and remediation. Vetiver grass has been used in the treatment of eutrophic lakes, dams and waterways, for treating sewage effluent and leachate from landfill, as the vegetative component of artificial wetlands and in erosion and sediment control.

A sterile cultivar of vetiver grass (*Vetiveria zizaniodes*) has been developed in Queensland. Research in Queensland and Northern New South Wales by others has confirmed its effectiveness as a bioremediation tool. An erect perennial grass to 2 metres tall, it possesses a strong dense mainly vertical root system often greater than 3 metres in depth. The grass is by nature a hydrophyte, but also thrives under xerophytic conditions.

Vetiver grass grows most effectively in tropical and subtropical climates, but can also be effectively used in Mediterranean regions. In the coldest months where soil temperatures drop below 15 degrees centigrade, the grass goes into a dormant state. Grown in full sun, vetiver grass is frost and drought resistant, will grow on most soil types (with a pH range of 3 to 9.5) as well as on rubble, and is tolerant to high levels of mineral toxicities such as aluminium, zinc and lead. Therefore, vetiver is an excellent tool for the management of sodic and acidic scalds.

Research in China has shown that vetiver grass effectively removes soluble nitrogen (N) and phosphorous (P), key elements in blue green and other algal blooms. In trials, 98% of P and 74% of N was removed from a polluted river in five weeks. Vetiver can be planted on the banks of waterways, in shallow areas of lakes or can be grown hydroponically on floating platforms. An advantage of the floating platform is that the plant tops and roots can be easily harvested and the pontoons moved to the worst affected area.

A hydroponic trial run in northern NSW to determine the efficiency of vetiver in improving domestic effluent quality was conducted using a mixture of black waters (from toilet septic tank) and grey waters (from kitchen & bathroom). 94% of total N, 90% of total P, 91% of E. coli and 44% of total coliforms were removed from the effluent by vetiver, confirming the results of the Chinese research.

Vetiver can act as a corollary to the landfill bioreactor with its long and matting roots being used to control the bioreactor by containing and treating surface or underground egresses from the bioreactor system, either on the batters or at the toe of the landfill. This has been successfully demonstrated in the Wellington Point Landfill Case Study, situated near Brisbane.

On cotton farms in central Queensland, hedged vetiver was very effective in preventing herbicides (diuron, trifluralin, prometryn fluometuron), organochlorine pesticides and organophosphates from entering nearby aquatic ecosystems. In the first year of growth, vetiver hedges trapped 86% of total endosulfan in the sediment of runoff water and 67% of chlorpyrifos (organophosphate). The second year, 65% of total endosulfan was trapped.

The configuration of its root system makes Vetiver grass an excellent erosion control tool. Studies have shown that erosion rates can be as little as less than three tonnes/ha of soil loss per annum, a very acceptable rate, with runoff reducyion as much as 60-70% of recorded rainfall.

Environmental & Earth Sciences is now propagating Vetiver grass in northern NSW and Melbourne for use by our clients,

For more information on vetiver grass and your environmental problems, please contact Hugh McCaffery, Manager, Northern NSW office: Phone: 02 6687 4650

THMs may be in drinking water

Trihalomethanes (THMs) are the name given to a group of compounds that may be present in drinking water in Australia as the result of chlorination and were recently found in groundwater during one of our projects.

Commonly known THMs are trichloromethane (chloroform), bromodichloromethane and tribromomethane (bromoform). THMs are produced in drinking water when chlorine, which reacts with water to produce hypochlorous acid, reacts with naturally occurring organic material such as humic and fulvic acids. Hence the more naturally occurring organic material in the water source, the greater the concentration of THMs that may occur.

THMs can be removed from water by limiting the attributing elements, such as organic material, from the water source or by removing the THMs themselves after formation. Activated carbon is just one successful method for removing both the precursors and the THMs in drinking water.

THMs are rapidly and efficiently absorbed following ingestion. They are metabolised primarily to carbon dioxide (and/or carbon monoxide) and quickly exhaled. Being fat soluble, if accumulated, they store in tissues with the highest lipid content such as brain and kidney tissue and blood. Chloroform and bromoform are known to cause central nervous system depression in humans. THMs in drinking water, either individually or in total, should not exceed 0.25 mg/L (NHRMC/ARMCANZ (1996) *Australian Drinking Water Guidelines*) although rare fluctuations are unlikely to pose significant health risks. The World Health Organisation (WHO) has produced guideline values for chloroform of 0.2 mg/L and bromoform of 0.1 mg/L but recognises that toxicological effects of other THMs are similar.

New guidelines implications

In February and March of this year the Victorian division of the Australian Contaminated Land Consultants Association (ACLCA) in association with the Victorian EPA held an industry seminar on the implications of the new EPA Publication, Number 759, "*Environmental Auditor (Contaminated Land) Guidelines for issue of Certificates and Statements of Environmental Audit*" May 2001.

Key speakers at the seminar were Stuart McConnell (Manager, Land & Groundwater) and Darryl Strudwick (Project Manager, Groundwater) from the EPA, while a panel of environmental assessors and EPA accredited environmental auditors were also on hand to answer queries from the floor.

The event was well attended by people from local government, the property sector and the environmental industry. Some of the key points brought up at the seminar included:

—the previous auditor guidelines (May 1992) are now superseded;

—a certificate of audit *cannot* be issued if any beneficial use of the segment of the environment that is being audited is impacted;

—the auditor may have some involvement with the assessment of the site (and indeed can undertake the assessment on the proviso that he or she believes that no remedial works will be necessary), however the auditor should not have any direct involvement with the clean up of the site; and,

—assessment of ground-water conditions at a site being audited is required in all cases, and generally the installation of a *minimum* of three groundwater bores is necessary to establish site groundwater status.

The seminar was followed by a half day workshop at the EPA offices in Southbank, which involved groups of six people at tables working through a hypothetical contaminated site assessment and remediation. Stuart McConnell was on hand, with three auditors to answer questions about the hypothetical site and about assessment and remediation methodologies.

All attendees agreed that the afternoon was very useful in determining the EPA's and the environmental auditors' view points in regards to the future direction of environmental assessment and auditing in Victoria. The seminar and workshop should help to raise the standard of contaminated land assessment and remediation in Victoria

Due to the response to the workshop, more are being scheduled. However places are limited to those people that attended the initial seminar.

If you are interested in attending one of the future workshops, or have a query concerning the new auditor guidelines, please do not hesitate to contact Philip Mulvey, environmental auditor, in our Sydney office on (02) 9922 1777, or Ian Brookman in our Melbourne office, on (03) 9593 8770.

Ian is also the Treasurer of the Victorian branch of the ACLCA and can be contacted regarding ACLCA membership and forthcoming events.

Victorian goings on

On 7 February 2002, Ian Brookman, Market Development Manager for Environmental & Earth Sciences attended a Property Council of Australia luncheon at the Grand Hyatt, Melbourne, to accept the certificate of membership from the Property Council of Australia on behalf of Environmental & Earth Sciences. Environmental & Earth Sciences are very pleased to have become members and to be able to support such a prestigious organisation as the Property Council of Australia.

Positions vacant

Although the two senior positions in Melbourne and one in Sydney have been filled, we are still seeking an additional two senior people for Australia and one for New Zealand.

Please contact Tracey Bauer on 61 2 9922 1777

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