Emerging contaminants in waters and soils, practical considerations: -Sampling, analysis and consequences. To be held at The Source, Meadowhall, Sheffield on 4 March 2015

Main programme

Time	Author/Abstract
09.50 – 10.20	Registration and Refreshments
10.20 – 10.30	Chair: Welcome and Introduction
10.30 – 11.00	Rakesh Kanda, (Brunel University) Emerging and Priority Pollutants – the Need for Ultra-Low Trace Level Monitoring Water is under threat from our increasing use of chemicals and the rapid urbanisation of our cities. The Water Frame Work Directive aims to protect the water environment, restore aquatic ecosystems and ensure the long-term sustainable use of water via the key objective of attaining good status for all water bodies which comprise of good ecological and chemical status for surface waters and good chemical status for groundwater. The WFD uses environmental quality standards (EQS) for priority substances and priority hazardous substances as the criteria for the assessment of good chemical status. These substances present a substantial risk to aquatic ecosystems if they are allowed to accumulate without mitigation and the EC predicts that only half of European waters will meet the water quality objectives of WFD at present. Robust environmental monitoring is essential for the assessment of the chemical status of water bodies. Data reported to the EC shows that 40% of surface water bodies in the EU have unknown chemical status with many member states are not monitoring priority substances. Some of the reasons for a lack of monitoring are associated with analytical difficulties, such as meeting limits of detection or other performance targets. Other barriers include the high costs of meeting analytical requirements of ultra-low measurements. Furthermore, for some substances there is a need to develop national and European standards to allow robust and comparable data to be generated and there is a need to research into new cost effective methods to meet EQS requirements. Although ultra low level monitoring is expected to be high cost, these costs are much lower than the cost of inappropriate decisions.
11.00 – 11:30	Graham Mills (Portsmouth University) and Anthony Gravell (Natural Resources Wales) Comparison of Active and Passive Sampling in Relation to Contaminants of Emerging Concern Monitoring pollutants in the water column normally relies on the periodic collection of low volume (1-2 L) bottle (spot or grab) samples of water that are subsequently analysed in the laboratory. This is undertaken routinely in order to fulfil various statutory and regulatory (e.g. checking against environmental quality standards within the Water Framework Directive, WFD, 2000/60/EC) requirements. A limitation of this monitoring approach is that fluctuations in the concentrations of pollutants in between sampling events can be missed. The measurement of time-weighted average concentrations (TWA) concentrations over a period of several weeks by using passive samplers seems to be a promising approach in the assessment of representative pollutant concentrations in water bodies. It is also possible, at reasonable cost, to

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	measure much lower concentrations than is possible by using low volume spot sampling. This presentation will describe the different types of passive sampling device (e.g. Chemcatcher® and POCIS) that are currently used to monitor a range of contaminants of emerging concern (e.g. pharmaceuticals and personal care products) in various water systems and highlight their relevant advantages and disadvantages. It will discuss how the samplers can be calibrated in laboratory and in situ in the field and how environmental conditions (water temperature and turbulence, biofouling) affect compound uptake rates. Lastly, a number of field applications, where these samplers have been deployed in rivers and sewage influent/effluent channels to measure emerging pollutants will be shown.
11.30 – 12.00	Dr Maria Romero-Gonzalez (University of Sheffield) and Dr Peter Skipworth (Environmental Monitoring Solutions Ltd). Measuring Continuous Concentration of Mass Pollutants in the Aquatic Environment MultiMEMS is a novel micro-technology platform for the continuous monitoring of phosphates, nitrates and metaldehyde. It will give essential observability – which is currently absent – in monitoring the increasing problem of nutrients and pesticides in rivers. It is based on the principle of mass of analyte being accumulated over time on a poly-styrene based polymer functionalised with receptive molecules. The detection is provided by a change of polymer mass when complexed with nutrients. Preliminary results have shown that there is a linear relationship between the mass signal and concentration of ortho-phosphate at the range 0.5 – 10 mg PO43- L-1. The limit of detection and limit of quantification have been quantified as LOD = 0.150 mg PO43- L-1 and LOQ = 0.250 mg PO43- L-1. The polymer was found to be sensitive and selective towards phosphate in a solution that also contained sulphate, chloride and nitrate. The functionalised polymer was used to quantify phosphate in river water samples and was found to be comparable to the quantification using Ion Chromatography. Reliability and reproducibility were quantified via inter-laboratory analysis and phosphate concentration were comparable using this approach. Further validation using Certified Reference Materials as well as other techniques is currently on-going.
12.00 – 13.00	Lunch & poster viewing

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13.00 – 13.30	Marianne Stuart, (British Geological Survey) Emerging Contaminants in Groundwater in Urban Environments As techniques improve more microorganic compounds are emerging into the groundwater environment. These include pharmaceuticals and personal care products, lifestyle compounds and food additives and their metabolites. Few are at present considered under the WFD. Environment Agency data shows that some ECs are being frequently detected in groundwater. Sources in the urban environment include wastewater and industrial effluent leakage and landfills. Collecting good samples for these compounds is testing due to the wide range of potential sources, including sampling equipment and borehole casing. Results from contrasting urban areas will be presented. Groundwater from both Nottingham and Doncaster on the Sherwood Sandstone aquifer indicate that microorganics, including emerging contaminants are present at depth in the aquifer (>50 m). The number of compounds detected appears to be a useful tool and is consistent with chloride concentrations and earlier work on pathogens, suggesting a sewage source. For the Thames floodplain at Oxford the urban impact can be distinguished from a landfill plume using ECs. For the developing town of Kawbe in Zambia the pressures on the shallow groundwater system are from unsewered sanitation. We may see increasing PCPs and industrial chemicals as low income counties develop. Whilst some are probably no threat to drinking water at such µg/L concentrations, there is little information on their impact on other groundwater receptors in the environment.
13.30 – 14.00	Barbara Kasprzyk-Hordern (University of Bath) Stereochemistry of Pharmacologically Active Compounds: a New Paradigm in Environmental Analysis and Risk Assessment Chirality plays an important role in the life of plants and animals but it is also vital in the agricultural, pharmaceutical and chemical industries. The phenomenon of chirality is also of growing importance in the field of environmental pollution and its effects on human health. Chiral pharmacologically active compounds (PACs) are environmental pollutants. They enter the environment mainly through sewage, waste effluents from manufacturing processes, runoff and sludge. They are bioactive, ubiquitous and persistent with synergistic properties. Surprisingly, the environmental fate and effects of PACs are assessed without taking into consideration their enantiomeric forms. The European Medicines Agency (EMEA) guideline on the Environmental Risk Assessment (ERA) of Medicinal Products for Human Use [1] recommends the estimation of exposure and the prediction of risk calculation for the whole parent compounds only i.e. as a racemate if prescribed as such. Similarly, the EU Directive for ERA for Veterinary Medicinal Products [2] does not require enantiomer-specific tests to be undertaken for veterinary CMPs. Such an approach leads to an underestimation of toxicity of PACs, incorrect environmental risk assessment, and direct risk to the environment and human health, as PACs are likely to be present in the environment in their non-racemic forms.

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	This talk will introduce the phenomenon of chirality in the context of fate and effects of chiral PACs in the environment. Results from monitoring of several wastewater treatment plants and receiving waters will be presented and implications of enantiomer-dependant fate and ecotoxicity of PACs for procedures applied in environmental risk assessment will be explored. [1] Guideline on the ERA of medicinal products for human use; European Medicines Agency, Doc. Ref. MEA/CHMP/SWP/4447/00 [2] ERA for Veterinary Medicinal Products other than GMO containing and Immunological Products; EU Directive 81/852/EEC
14.00 – 14.30	Zulin Zhang, (James Hutton Institute) Short- and Long-term Temporal Trend of Organic Contaminants in Soils Following Single or Multiple Applications of Sewage Sludge to Pastures Zulin ZHANG[1], Morgane LE VELLY[1,3], Helen RUFFIE[1,3], Emma CALMETTES[1,3], Stewart M. RHIND[1], Carol E. KYLE[1], Rupert L. HOUGH[1], Elizabeth I DUFF[2], Craig MCKENZIE[3] [1]The James Hutton Institute, Craigiebuckler, Aberdeen AB15 8QH, UK [2]Biomathematics and Statistics Scotland, Craigiebuckler, Aberdeen AB15 8QH, UK [3]Robert Gordon University, Institute for Innovation Design and Sustainability (IDEAS), Riverside East, Garthdee, Aberdeen AB10 7GJ, UK Temporal concentration trends of selected organic contaminants (OCs: Bisphenol A (BPA), diethylhexyl phthalate (DEHP) polycyclic aromatic hydrocarbon (PAH), polychlorinated biphenyl (PCB) and polybrominated diphenyl ethers (PBDE)) in soils were investigated following sewage sludge application to pasture (short term single application and long term multiple applications over 13 years). The background concentrations of these contaminants in control soils were presented and the contamination levels were similar for these two different studies. Single application of sewage sludge can increase soil concentrations of some, but not all classes of OCs (e.g. soil PAH and PCB concentrations were not altered for short term application experiments). However, repeated treated soils contained consistently higher concentrations than controls, for the all target contaminants. In addition, the difference between treated and control soil concentration was much more significant in the repeated applications. This result indicates the long-term accumulation of multiple contaminants by multiple sewage sludge applications over a prolonged period although the effects of the presence of such contaminant mixtures have not yet been elucidated. Fugacity modelling was undertaken to estimate partitioning of selected organic contaminant (soil plus sewage: pore water: soil air partitioning) and potential uptake into a range of food crops. This work forms part of a larger program of research aimed at assessing the risks associated with the long-term application of sewage sludge to agricultural soils.
14.30 – 15.00	Refreshments and Poster Viewing

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15.00 – 15.30	Christine Switzer (University of Strathclyde) Emerging Contaminants in Soils: Challenges and Opportunities from Quantification to Remediation The phrase "emerging contaminants" is used to describe a wide range of substances that are not typically considered to be contaminants, including pharmaceuticals, personal care products, plastics additives, flame retardants, and other substances that may be released into the environment as diffuse or point source pollution. Three general factors affect the ability to control pollution caused by these substances effectively: detection and quantification in environmental samples; the diversity of release mechanisms into the environment; and limitations of existing contaminant remediation technologies that were designed to address traditional contaminant release scenarios. Substantial advances have been made in environmental analytical chemistry for emerging contaminants in environmental media, but these methods tend to be expensive, laborious, and may require specialist analytical equipment. The diversity of environmental release mechanisms, not all of which are known, has led to the detection of emerging contaminants in a wide range of locations, including parts of the world far away from any industrial activity. Finally, the diversity of contaminants and release mechanisms pose significant challenges to successful application of remediation technologies, most of which were developed with traditional contaminant release scenarios in mind.
15.30 – 16.00	Simon Parsons Royal Society of Chemistry Sustainable Water Prize Winner 2014 Sustainable Water Treatment
16.00 – 16.30	Discussion

Posters

Poster No.	Author/Abstract
1	Bruce Petrie
2	Dr. Maria Dolores Camacho-Muñoz
3	Timothy Dee WSP some recent investigations on Tributyl tin in soil and groundwater associated with timber treatment activities in Doncaster and Boston
4	Debbie White British Geological Survey (BGS) 'Concentrations of micro-pollutants in the groundwaters of the Sherwood sandstone aquifer below Doncaster were investigated using 3 multi-level piezometers. The multilevel piezometers used were installed in parks and green spaces within the

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	Bessacarr – Cantley area of Doncaster in 2003 as part of a previous project to look at the effect of the urban environment on groundwaters and as such were well characterized. In the study presented micropollutants were detected at depth (up to 60 m bgl) within the aquifer and legacy pesticide contaminants are clearly seen. The poster will detail sampling techniques as well as the study results.'
5	Kathy Ridgway*, Dan Carrier, Anaïs Maury, Anatune Ltd, Cambridgeshire, UK. * Corresponding author email kathy.ridgway@anatune.co.uk Determination of trace (pg/L) levels of Cypermethrin in water using Stir Bar Sorptive Extraction New limits for the levels of permitted pesticides in water present a challenge to the testing laboratories. For Cypermethrin, due to its high aquatic toxicity, a detection limit of 0.01 ng/L is proposed. A method is therefore required that provides a high level of enrichment, in order to achieve the low detection limits and avoid the need for large sample volumes using traditional liquid- liquid extraction approaches. The use of a selective GC-MS/MS method further enhances selectivity and hence sensitivity. The use of stir bar sorptive extraction (SBSE) using the Gerstel PDMS Twisters™ was investigated with selective detection using an Agilent 7000C GC-MS/MS. Just as in liquid-liquid extractions, analytes partition between the extraction phase, in this case PDMS, and the liquid sample phase (water). Analytes are then thermally desorbed directly into the GC inlet, enabling complete transfer of the extracted analytes. This poster presents data from the initial work which demonstrates the potential of this technique to achieve detection at the proposed limits. The technique is simple and avoids the use of large volume of sample or solvents, as in traditional liquid-liquid extractions
6	Zeid Oiaidha* and Gillian Greenway University of Hull Monitoring of a pollutants in the environment by using a portable system device Environment pollution is a wide-reaching problem and it is likely to influence the humans and organisms. Progesterone is a natural steroid hormone that plays vital roles in fertility and pregnancy and its uses in the industrial field in making drugs and cosmetics products. The effect of progesterone in the environment is receiving growing attention from the public at large, as there is a continuous spread of anthropogenic substances into the water environment. Even though it is present at very low levels (low 1 ng L-1 range) progesterone has a clear effect on the reproductive behaviours of fish and therefore needs to be monitored. Currently laboratory based method are required because of the high sensitivity and selectivity required but there is an urgent need for low cost screening methods. This work describes steps towards the development of a portable analysis system. This incorporates a preconcentration and purification step achieved using silica monolith prepared from tetramethyl orthosilicate (TMOS) and coated by C18. This is then

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	followed by a selective and sensitive immunoassay with chemiluminescence detection, the aim being to immobilise the antibody onto solid support surface (ITO electrode) by using electrochemistry technique. Then, combine the ITO electrode with a polymer microfluidic device to obtain rapid detection of chemiluminescence signal with a coupled charge device (CCD) camera. The final goal will be to combine all steps into an automated system for application in the environment. References: G. Plaza, K. Ulfig and A. J. Tien, Pol. J. Environ. Stud., 2000, 9, 231-236. N. Kishikawa, S. Higuchi, K. Ohyama, K. Nakashima and N. Kuroda, Forensic Toxicol., 2013, 31, 301-306 Y. H. Dou, S. J. Haswell, J. Greenman and J. Wadhawan, Electroanalysis, 2012, 24, 264-272.

This meeting is focussed on exploring the chemistry of Contaminants of Emerging Concern (emerging contaminants) which are those that have recently been discovered in soil and/or water environments and are considered to be a potential risk to the environment and/or and human health.

Registration

On-line registration is available at:

https://www.eventbrite.co.uk/e/emerging-contaminants-in-waters-and-soils-practical-considerations-sampling-analysis-and-tickets-13548480871

Delegate fess is: (£200 for RSC members, £250 non-members and £150 for RSC concession members (retired, student, unemployed etc.). An early bird discount is available for bookings made before the 17th February 2015.

Posters will be on display during the breaks for this meeting. The Water Science Forum is offering a £100 for the best poster.

If you wish to present a poster please contact Kevin Prior at kevin@thackie.co.uk

Venue

The Source, 300 Meadowhall Way, Sheffield, S9 1EA and directions can be found at:

http://www.thesourceacademy.co.uk/location/82/find-us

Programme

The programme is is available from:

http://www.rsc.org/events/detail/16644/emerging-contaminants-in-waters-and-soils-practical-considerations-sampling-analysis-and-consequences