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“Promoting the professional and scientific interests of members to safeguard the public interest in the application of chemical sciences in water-related industries.”

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Chemical and Environmental Policy RSC Workshop

The Royal Society of Chemistry hosted a workshop on the development of chemical and environmental policy at Burlington House on the 5th of July 2017. There were a range of stakeholders represented including MP Mary Creagh, 2015 Parliament Chair UK House of Commons Environmental Audit Committee; Robin Foster (Health & Safety Executive) Head of Policy, International Chemicals Unit; Kay Williams (Defra) Head of EU & International Chemicals Unit and Doug Wilson (Environment Agency) Director of Research, Analysis and Evaluation. Richard Allan represented the Water Science Forum and was an invited speaker. There were a range of presentations by the panel which covered current thinking about post Brexit environmental regulation. As part of this session, Richard presented on the role of science in the development of national and international standards. Richard presented two case studies, one on analytical method development and the other on the Circular Economy concepts.

The discussions during the day were informative and interesting, covering topics such as REACH; the interface between science and policy for the environment; and science, environmental policy and chemicals management for the UK exiting the EU. It was clear from the discussions that much more work needs to be done to fully understand the implications of possible Brexit outcomes. There was a particular focus on the possible cost implications and capacity building required for the effective management of regulations once the Brexit position is negotiated and moves into implementation. It was clear that to achieve the required policy outcomes and protect the environment it is critical to ensure funding for innovation, research and development. - *by Richard Allan*



From L-R: Dr Camilla Alexander-White (RSC), Robin Foster (Head of Policy, International Chemical Unit, HSE), Doug Wilson (Director of Research, Analysis and Evaluation, EA), Dr Richard Allan (Business Sector Lead: Environment, The James Hutton Institute and Water Science Forum Representative), Kay Williams (Head of EU & International Chemicals Unit, DEFRA)



Water Factoid—there are more than 663 million people in the world who have never tasted a glass of clean water

Recycling of alginate from immobilised algae beads and its applicability for phosphorus removal

Algae have been increasingly applied for phosphorus removal in wastewater treatment. Research has shown that immobilised algae may be a good alternative to the usual suspended algae systems. This is due to various advantages, such as simpler and more cost effective separation of algal biomass from wastewater, prevention of cross-contamination, shorter contact times and smaller footprint (Whitton et al. 2015; De-Bashan and Bashan 2010; Cai, Park, and Li 2013). Alginate, a polysaccharide derived from brown seaweed, which is used in a wide range of industries such as food and pharmaceuticals has shown to be effective for producing beads containing algae (De-Bashan and Bashan 2010; Bixler and Porse 2011).

The current demonstration scale study of this technology, and the first of its kind in collaboration with Severn Trent Water, has highlighted some key up-scaling challenges. These consist of maintaining the performance, producing large quantities of algae beads and economic hindrances due to the high cost of alginate which adds considerably to the operational costs.

The economic aspect was the main motivation behind this research in which we want to give a proof of concept for recycling and reuse of alginate from algae containing beads. The gelation of alginate involves an ion transfer reaction in which liquid sodium alginate reacts to form solid calcium alginate by addition of calcium chloride. This reaction can be reversed by immersing calcium alginate in a sodium salt solution.



Tri-sodium citrate was used for dissolution of algae containing beads and the recovered alginate was used for immobilisation of new algal cells. Beads made from recovered alginate were assessed for their physical properties and it was shown that beads made from the recovered alginate were more compressible and larger than those made from virgin alginate. Beads containing algae made from fresh and recovered (supplemented with alginate powder) alginate were used in phosphorus removal batch tests to assess their efficiency. The phosphorus removal rate was higher with virgin alginate beads, however the final phosphorus concentration was very low (<0.2 mg/L P) for both systems, confirming the potential of the technology for phosphorus removal from wastewater.

The main conclusions of this work can be summarised as follows:

- Dissolution of beads has been accomplished with minimal volumes of tri-sodium citrate at high concentration.
- Re-immobilization of recycled alginate is viable but addition of fresh alginate powder is necessary to maintain the bead strength.
- Adequate phosphorus removal was achieved with beads made from recovered alginate.
- Further experiments are needed to evaluate the feasibility of alginate recovery at larger scale.

This work was conducted to extend an on-going collaboration between Cranfield University (UK) and RMIT University (Australia) on algae-based wastewater treatment technologies. I would like to thank the RSC Water Science group for granting me the Alan Tetlow Bursary Award and hence giving me the opportunity to gain research experience abroad and to work in the group of Professor Felicity Roddick and Dr Linhua Fan. - by Olga Murujew

Passive sampling monitoring methods for detecting pollutants in surface waters in South Africa



A grant awarded to WSF committee member Professor Graham Mills has enabled researchers to undertake fieldwork in South Africa to monitor for key prescribed anti-retroviral drugs in surface waters. The Royal Society/Royal Society of Chemistry International Exchange Scheme was awarded to Graham Mills (University of Portsmouth [UoP], UK) and Professor Luke Chimuka (The University of the Witwatersrand [Wits], South Africa). In August 2017 two researchers from UoP travelled out to South Africa to collaborate with researchers from Wits and the Department of Water and Sanitation, Pretoria. The Chemcatcher®, a passive sampler device (developed at UoP) is now used worldwide for monitoring water quality. Here, it was deployed at ten sites in the Jukskei River catchment in the greater Johannesburg area (WITS).



The catchment covers a large region with a wide range of industrial and domestic inputs. The aim of the initial fieldwork was to monitor for key prescribed anti-retroviral drugs along with a range of polar organic contaminants, including pharmaceuticals and personal care products (PPCPs). After a two week deployment time, the devices were retrieved and shipped to the UK to undergo a screening and targeted analysis procedure at the Natural Resources Wales Laboratory in Swansea. It is hoped the results will provide information on the range and concentration of a suite of unregulated chemicals in water bodies around the Johannesburg region. In the longer term it is envisaged that passive sampling including Chemcatcher® can be used alongside spot sampling to aid in river catchment investigations in identifying sources, fluxes and fate of contaminants in South African surface waters. - **by Gary Fones**

Water and Health Workshop

31 January 2018, UWE Bristol

A joint workshop held with Sensors for Water Interest Group with a keynote talk from Public Health England on waterborne diseases, followed by presentations from companies and researchers showcasing the latest devices and sensor technologies that are able to rapidly detect microbiological and chemical contaminants.

Book your place here — <https://www.eventbrite.co.uk/e/water-health-workshop-tickets-36809531299>



WSF Inclusion and Diversity

When people first think of inclusion and diversity they inevitably think of the protected characteristics (age, disability, gender reassignment, race, religion or belief, sex, sexual orientation, marriage and civil partnership and pregnancy and maternity) under The Equality Act 2010. But for organisations such as ourselves it is more than that, we have to include students and retired individuals, people working in academia or industry, the waged and unwaged to truly represent all of our members.



So to enable us to do this early next year, we will be surveying our members to try and ascertain what are the barriers preventing our members taking part in our activities or becoming a member of our committee. This will assist us in planning our events and activities to continue to make our organisation truly representative of all our members.

We hope you will be able to take part in this survey and answer the questions you feel able to. This will help us include everyone from our diverse membership in all our activities.



In the News

The Moon's interior could contain lots of water, study shows— *Space*

Satellite data on lunar volcanic deposits suggest presence of substantial amounts of water.

Plastic fibres found in tap water around the World, study reveals— *The Guardian*

83% of tap water samples tested globally in a recent study show the presence of microplastics.

Fukushima's nuclear waste will be dumped into the ocean, Japanese plant owner says— *Newsweek*

Tokyo Electric Power Company announce tritium contaminated water from the 2011 incident will be dumped into the Pacific.

'Monster' fatberg: Museum makes bid to put giant lump of fat from London sewer on display — *The Telegraph*

The Museum of London express interest in displaying part on the 250m fatberg found in London sewers.

There's as much water in Earth's mantle as in all the oceans — *New Scientist*

Experiments on rocks typical of those in the mantle transition zone suggest there is more water beneath us than in oceans.

Chemists remove 99 per cent of BPA from water in 30 minutes — *Wired*

The use of TAML catalysts and hydrogen peroxide to heavily contaminated water coagulates BPA for easy filtration as demonstrated in laboratory studies.

Papers of Interest (RSC open access)

An academic researcher's guide to increased impact on regulatory assessment of chemicals

<http://pubs.rsc.org/en/content/articlelanding/2017/em/c7em00075h#!divAbstract>

A strategic screening approach to identify transformation products of organic micropollutants formed in natural waters

<http://pubs.rsc.org/en/content/articlelanding/2017/em/c6em00635c#!divAbstract>

WSF Newsletter— If you have any items of interest or stories for the newsletter please email us at—rscwsf@gmail.com

WSF Microplastic Pollution Event: Everyone's problem—but what can be done about it?

The Water Science Forum held a highly successful event on the topical issue of Microplastic Pollution at Burlington House on 16th October. Pollution of the aquatic environment by plastic waste, and the ecological consequences is increasingly under the spotlight from both a research focus and public concern. The workshop was fully subscribed attracting 75 delegates from a range of academia, industry, regulatory bodies and the press. Current understanding and research updates were covered by experts with both marine and freshwater backgrounds along with discussions around knowledge gaps and future requirements.



From L-R: Prof Richard Thompson, Dr Sabine Pahl, Adrian Clark, Dr Katie Whitlock, Dr Matt Hill, Dr Lucy Woodall, Alice Horton, Dr Dannielle Green, Dr Thomas Maes

Adrian Clark, WSF committee member and lead organiser opened the day welcoming delegates and speakers showing an opening video address from Defra's Dr Therese Coffrey MP, voicing governmental support on tackling the microplastic pollution issue. Prof Richard Thompson from the University of Portsmouth, the UK's leading expert in microplastics, gave an informative overview on current understanding of microplastic routes into the environment, impacts shown in studies to date and the focus needed to tackle the issue at their source driving towards circular use of plastics. Prof Thompson along with other speakers emphasised the difficulties in currently both classifying microplastics and comparing studies due to a lack of harmonisation across definitions and monitoring methodologies. Impacts of microplastics on the marine environment was covered by Dr Danielle Green of Anglia Ruskin University who shared her research on marine worms, mussels and oysters demonstrating that concentrations of plastics show

an impact on the ecosystems tested. Dr Lucy Woodall of Oxford University later shared her story of encountering microplastics during her work in deep sea areas of the Indian Ocean, and how she was also faced with the difficulty of accurately measuring and reporting. Freshwater environments were addressed through sessions by Dr Katie Whitlock and Alice Horton. Experiments on sticklebacks by the EA were described where reduced feeding and changes in behaviour were observed. In a study on the Thames evidence showed 33% of roach had ingested microplastics. It was described that research is generally considered to be behind that in marine environments. A NERC Knowledge Exchange initiative is being developed by Alice Horton to strengthen networks on the subject. Waste water treatment was covered by Dr Matt Hill from Yorkshire Water relaying the issues seen by the water industry of the 'unflushables' at treatment works, with the majority of these containing plastics. Whilst it is anticipated that a large percentage of plastics are removed from screening and sedimentation, it was also acknowledged that there is little information on the effectiveness of various treatment methods of microplastics which is due to be addressed via a UKWIR project. Dr Camilla Alexander-White covered recent RSC publications and regulatory involvement in the consultation to ban microplastic beads from wash products, demonstrating the RSCs commitment to this area. The international situation and potential mechanisms for addressing plastic pollution were presented by Dr Thomas Maes, focussing on re-education and elimination of one-use consumable plastic products. With road runoff including tyre wear previously discussed as a large freshwater source of microplastics, an innovative concept delivered by Michelin was exemplified as a 3D biodegradable printed tyre. Dr Sabine Pahl rounded off the meeting presenting her work on the psychology of society and how understanding their perceptions can help shape the route of tackling microplastic sources before entering the environment. An in depth meeting review by Tom Lynch with detailed information on each topic is due to be published in International Environmental Technology in the November/ December 2017 edition. Throughout the day it became apparent that there was interest to delve further specifically into the classification, sampling and measurement of microplastics. WSF will endeavour to follow this up. Watch this space and stay up to date with our events via social media/ WSF website to find out more! **-by Natasha Page**

WSF Events—Keep up to date with our events on the RSC event website

<http://www.rsc.org/Membership/Networking/InterestGroups/WaterScience/ForthcomingEvents.asp>

Famous Water Quotes



“If the wars of this century were fought over oil, the wars of the next century will be fought over water - unless we change our approach to managing this precious and vital resource.” -Ismael Serageldin

“Water is the driving force of all nature.” -Leonardo da Vinci

“No water, No life, No blue, No green.” -Sylvia Earle

WSF Bursary Report: Mobilisation of Elements During Shale-Water Contact

The Geochemistry Research Group led by Veerle Vandeginste in the School of Chemistry at the University of Nottingham is extremely grateful for the Water Science Bursary awarded to us. This bursary made two Master projects possible to investigate the environmental implications of fracking in the UK in terms of potential groundwater contamination.

In this research project, we focused on the mobilisation of inorganic elements by conducting laboratory batch reactor experiments testing the interaction of Bowland-Hodder shale, targeted for hydraulic fracturing in the UK, and fluids that simulate (simplified) fracking fluids. The project carried out by Imogen Player focused on the impact of the acidity and temperature of fracking fluids on inorganic element leaching from the shale rocks due to interaction with the fluids. Grace Belshaw concentrated on the impact of redox conditions of the fluids on element mobilisation from interaction with shale rocks. The bursary enabled the purchase of pH meter, dissolved oxygen meter, hotplate stirrer and other lab consumables essential for the projects. The research used samples from the Bowland-Hodder Shale Formation, collected from cores hosted at the British Geological Survey. The results from the study demonstrated that the carbonate present within the shale rock quickly buffered the HCl acidity of the fluids, and as a result, limited the potential acidity driven release of heavy metals in the fluids. The addition of citric acid in the fluids caused significant release of iron from the shale rocks. Moreover, the research indicated that changing redox conditions caused the oxidation of pyrite (iron sulphide present in the shale) which resulted in turn in a decrease of pH, increasing element mobilisation.

These batch reactor experiments have provided a good fundament and insight in potential elemental release linked to fracking activities. Further research on site and at reservoir scale, incorporating time scales, flow conditions and volume scales of fracking activities will complement our current research and allow assessment of direct environmental implications.

Water Science Forum bursaries

Water Science Forum bursaries have helped support research on the immobilised algae beads and shale water contact work reported on in this issue. If you are interested in applying for our Water Science Forum Bursaries, up to £2000 is available per applicant for both the Alan Tetlow and Water Science Bursary. They are open to all WSF members from any country and the money available can be used for a wide range of activities including conferences, research, lab visits and research projects across a range of topics including water quality.

Contact: Hon Sec, RSC Water Science Forum, Thomas Graham House, Science Park, Milton Road, Cambridge, CB4 0WF, UK

See our website for more information: <http://www.rsc.org/Membership/Networking/InterestGroups/WaterScience/bursaries.asp>

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The views expressed in the newsletter are those of the authors and do not necessarily represent the views of the RSC, the Water Science Forum or the author's organisation.



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