The Newsletter of the Royal Society of Chemistry

Water Science Forum

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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."

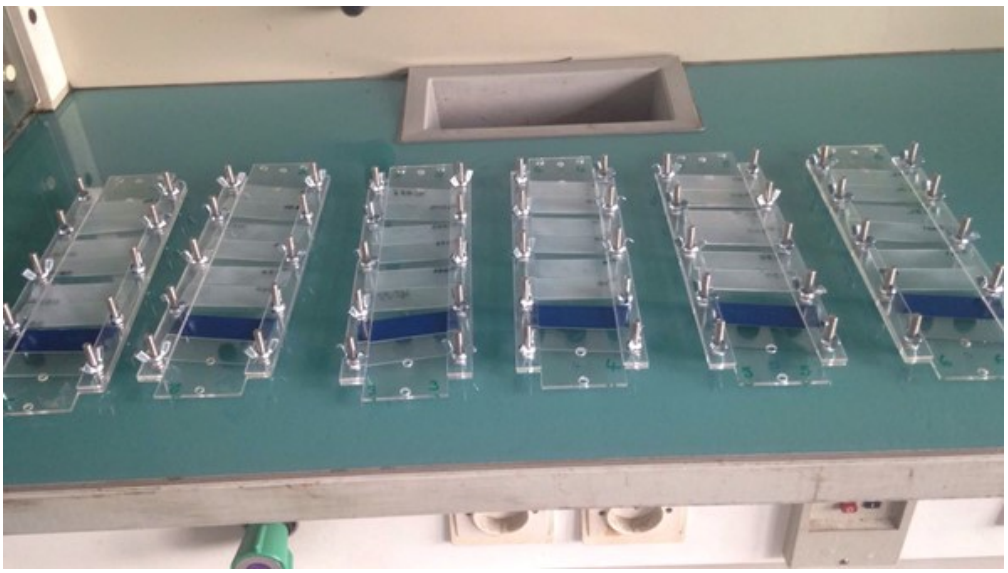
In this issue:

Marine Inspired Design for Antifouling Technology

The DCU Water Institute led by Professor Fiona Regan is very grateful for the Alan Tetlow Bursary awarded to us. This bursary enabled one of our research masters students to travel to the University of Toulon in France to investigate the use of novel transparent hydrophobic coatings and surface topographies to combat fouling in the Mediterranean Ocean.

This research project focuses on overcoming the challenges that biofouling presents for ship owners in the marine environment. Biofouling is the process by which artificial structures immersed in water undergo fouling from organic matter. This leads to the accumulation of large amounts of biomass causing damage to ships, sensors and buoys resulting in huge economic losses for ship owners. The goal of this project is to use surface topographies inspired from nature to combat fouling. Currently, we are developing surface topographies inspired by the scales of fish and pillars of crab. We also develop novel hydrophobic and hydrophilic sol-gel coatings to prevent fouling.

The study carried out in Toulon focused on the effect that these developed coatings and topographies had on the adhesion of biofouling organisms, marine benthic diatoms. It also looked at the diversity of these species in the Mediterranean Ocean in comparison to the Atlantic Ocean study we had carried out in Galway Bay. We will soon receive the results of this study which will hopefully display some of the differences between biofouling organisms in a Mediterranean climate versus Atlantic, and if the surface topographies of fish and crab can combat fouling.



Novel transparent hydrophobic coatings assembled for deployment in Toulon, France with the University of Toulon.

- by Chloe Richards

Water Factoid—3496 litres of water is used for the production of the food we eat, per person, per day!

Flow Cytometry Seminar

On May 15th, 2018, the Water Science Forum hosted a one day seminar entitled *Flow cytometry for assessing the microbiology of drinking water - from source to tap*. The seminar was highly successful, being attended by 83 people from different backgrounds, but dominated by the UK water companies, who heard presentations from academia and industry. Six companies participated in the associated exhibition. The keynote presentation was given by Frederik Hammes from the Swiss water research institute, Eawag. Dr Hammes is the leading researcher in the use of flow cytometry for microbiological examination of water supplies. Also presenting was Dr. Andreas Nocker from IWW in Muelheim, who worked closely with Scottish Water and Yorkshire Water, when he was at Cranfield, to pioneer the use of flow cytometry in the UK Water Industry. Other presenters included representatives from academia and from UK water companies.

Water Science Forum Organisers From L-R: Ian Barnabas, Simon Gillespie, Fiona Campbell, Natasha Page & Tilele Stevens

Flow cytometry is based on the use of microfluidic systems to focus a very narrow stream of liquid, which is passed in front of lasers such that any particles in the liquid stream, interrupt the light path one at a time and can thus be counted. The light scatter pattern gives information about the size and morphology of the particles, and by using laser light of different wavelengths, further information about the nature of the particles can be obtained. For assessing the bacterial content of water, the sample is treated with two chemical stains that specifically bind to DNA. One of the stains, SYBR Green can penetrate the intact bacterial cell wall and fluoresces at the green end of the visible light spectrum. The other stain, propidium iodide fluoresces at the red end of the spectrum, binds more strongly to DNA than SYBR Green and will displace it, but cannot penetrate the intact cell wall. Measuring the relative proportions of red and green fluorescence allows the analyst not only to obtain an overall bacterial cell count in a water sample, but importantly, to determine the number of intact, and therefore potentially viable cells. Flow cytometry methods are currently mainly offline, and laboratory or field based, but on-line instruments are now being developed in Europe and currently under trial in the UK by Scottish Water.

Applications for flow cytometry in the water industry include monitoring seasonal changes in water sources, assessing the efficiency of different disinfection regimes, monitoring membrane filter integrity, and assessing bacterial regrowth throughout the water network. Use of the technique is still in its infancy and its potential for further application is high. The delegates at this seminar were overwhelmingly in favour of the WSF organising a follow-up in 2020 to review latest developments, and this is now in our conference calendar. ***- by Simon Gillespie***

Matthew Bower presented on a Regulatory perspective

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

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

The agriculture water interface: Current topics

1 November 2018, Burlington House, London

This one day meeting has three distinct themes covering the Industry Perspective, Regulatory Issues and the Monitoring and Fate of Pollutants.

Join us for the event bringing together leading academics, regulators and industry experts to discuss current issues on how water quality and quantity is impacted by agricultural activities

For more information and to book, visit the RSC event website:

http://www.rsc.org/events/detail/34576/the-agriculture-water-interface-current-topics

In the News

'Talking' algae could help monitor climate change, study finds— *WWT*
Research groups demonstrate algae communicating under stress through electrical interactions.

Worlds cleanest drop of water reveals why nothing is ever truly clean— *New Scientist*
In a bid to find out where molecular dirt comes from researchers have created the worlds cleanest water.

Chemicals that keep drinking water flowing may also cause fouling— *Water Online*
Study shows the use of anti-scalant chemicals impact the nature of biofilms and water microbiology.

Earth has a hidden plastic problem-scientists are hunting it down—*Scientific American*
This three part series examines our growing understanding and the impacts on microplastic pollution.

Smartphone system to test for lead in water — *Science Daily*
Researchers have created an inexpensive system using a smartphone and a lens made with an inkjet printer that can detect lead in tap water at levels commonly accepted as dangerous.

Our thirst for water is turning the oceans saltier — *New Scientist*
As the need for clean drinking water grows, the only option may be to get it from our oceans. But there is a catch.

Papers of Interest (RSC Journals)

Measuring metaldehyde in surface waters in the UK using two monitoring approaches
https://pubs.rsc.org/-/content/articlelanding/2018/em/c8em00180d#!divAbstract

Impact of upstream chlorination on filter performance and microbial community structure of GAC and anthracite biofilters
https://pubs.rsc.org/-/content/articlelanding/2018/ew/c8ew00115d#!divAbstract

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Visit MyRSC: http://my.rsc.org/groups/home/74

Microplastic Methods: achieving new standards

Microplastic particles (defined as 5mm or less in diameter) derive from larger pieces of plastic that break down in the ocean. They also come from more unexpected land-based sources that degrade as we use them and get flushed into drains and surface waters, including car tyre abrasions, bits of road markings, city dust, effluent from manufacturing industries, micro beads in cosmetics and fibres from synthetic clothing. Standard water treatment processes provide incomplete removal of microplastics from wastewater, and while the bulk get filtered out they also enter the environment via the sewage sludge that gets spread on land as fertiliser. There is growing concern over the harmful effects of these chemically diverse microscopic particles on our aquatic and terrestrial ecosystems. In order to be able to understand the risks posed and reduce pollution from microplastics it is important to be able to measure how much is concentrated in which places, where it is coming from and how it is redistributed.

The Water Science Forum has recently held two workshops on this important topic. The first was an open meeting which took place in October 2017 'Microplastic Pollution; everyone's problem, but what can be done about it?' This highlighted the need to establish standardised methods of sampling and analysis. The resulting Microplastic Methods Workshop took place in May and was organised by Adrian Clark of WSF together with Alice Horton, CEH Wallingford and Professor Richard Thompson OBE, University of Plymouth., and was held in collaboration with the U.K. Microplastics Network. The programme for the day comprised a morning session devoted to 12 presentations. This was then followed by a break-out session in the afternoon, in which the invited delegates were divided into individually-moderated groups to address Air and Water; Biota and Sludge; Soil and Sediment.

Adrian opened proceedings with an overview of recent RSC and WSF activities on microplastics. The presentations which followed covered current capabilities of optical, thermoanalytical and spectroscopic methods of analysis, together with sampling and extraction techniques. Two speakers were invited from Germany to provide a European perspective, setting out current activities by ISO/TC61/SC14/WG4 Standards Committee and efforts to harmonise analytical methods.

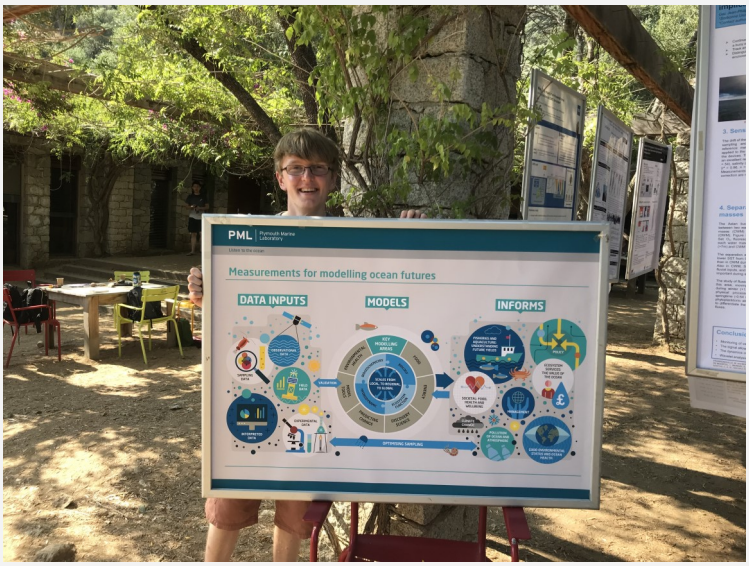
U.K. and EU experts were brought together from diverse backgrounds, many for the first time, and provided an excellent opportunity for future networking. Pros and cons of the different methods of collecting, separating and analysing were highlighted and spanned a wide variety of samples, including marine and freshwater environments, wastewaters, sediments, and sludge. Some areas of investigation which still remain problematic include: working with nanoplastics; understanding health and environmental risks taking into account of the wide chemical diversity of polymers, and tracing the ultimate fate of microplastics. Techniques for measuring the specific impact on biota are also in their infancy. Harmonisation of methods and data interpretation were agreed by delegates to be equally, if not more important, than rushing to produce new standards. However, some areas, particularly those relevant to the water industry, were recognised as having regulatory priority due to growing public concern.

Professor Thompson wound up proceedings by stressing researchers need to be particularly careful in selecting the most appropriate techniques. Also to understand the limitations and purpose to which the data is to be put if it is to be meaningful, reliable and comparable, thereby enabling it to be of use to other researchers. Copies of both workshops have been posted on WSF Past Events website. Findings from the workshop are being used to inform future U.K. plastics strategy and support RSC Policy Team advice. ***- by Adrian Clark***

The jointly-published report is now available on the U.K. Microplastics Network website: http://ukmicroplasticsnetwork.co.uk/files/methods-workshop-2018/

Alan Tetlow Memorial Bursary Report: Biogeochemical controls on the heterogeneous oxidation of marine dissolved organic matter

In June 2018, money awarded from the Alan Tetlow Memorial Bursary allowed Daniel Phillips, a PhD student at Plymouth Marine Laboratory, the opportunity to attend the highly renowned SOLAS summer school. Daniel's research project focuses on the production of volatile organic compounds, which have an important influence on atmospheric chemistry and climate (i.e. isoprene, acetone etc.), with particular emphasis on the heterogeneous oxidation of marine dissolved organic matter at ocean surface.



The 10 day SOLAS summer school taught visiting students the important physics, chemistry and biology of the ocean -atmosphere dynamic system, achieved through a mixture of lectures, practical workshops, student oral presentations and poster discussions. In his poster and oral presentation, Daniel primarily discussed his recent air -sea flux measurements of VOCs in the Western English Channel. Through this process, he met six early career researchers in similar research fields and hopes these contacts will aid future international collaboration.

All the knowledge shared through the school directly benefited Daniel's research project making the school an extremely valuable experience. Some of the new knowledge Daniel learned included ocean biology and physics, atmosphere/ocean modelling and remote sensing data acquisition. Additionally, existing knowledge further developed included surface microlayer chemistry and aerosol chemistry and physics. In spring 2019, Daniel will use the modelling experience gained to prepare a 1D chemical model of the ocean and atmosphere to study the significance of these surface heterogeneous reactions. Daniel is extremely grateful to the Water Sciences Forum for enabling this rewarding experience in the early stages of his PhD.

Water Science Forum bursaries

Water Science Forum bursaries have helped support research across a number of subjects. 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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