OÉ Gaillimh
NUI Galway

Centre for One Health
An tIonad Aon Sláinte
Amháin

Ryan
Institute

Centre for One Health Annual Conference

Toxic Organic Contaminants in our Environment





NUI Galway

Friday 20th September 2019

Contents

Welcome

Welcome to the second annual conference of the NUI Galway Ryan Institute's Centre for One Health (COH). The theme of our conference this year is 'Toxic Organic Contaminants in Our Environment'. The conference's overarching objective is to promote awareness of issues relating to the presence of toxic organic contaminants within the Irish environment. This will be achieved by bringing together relevant stakeholders in Irish industry and policy-making sectors with researchers actively investigating the sources, pathways and impacts of toxic organic contaminants on the Irish environment. By so doing, it will help establish networks and foster knowledge exchange between stakeholder groups to help develop solutions to problems associated with toxic organic contaminants.

The conference will be split into 3 sessions, namely:

- **International and Policy Perspectives**
- **Contamination of the Environment and Human Exposure**
- **Implications for Waste Management**

Scientific Committee

Dr Marie Coggins is a lecturer in Exposure Science in the School of Physics and also a member of the NUIG Ryan Institute's Centre for Climate and Air pollution and Centre for One Health. Over the past 23 years she has worked in industry and academia, managing numerous research projects related to the measurement of human exposure to a range of occupational and environmental pollutants.

Nina Wemken is a PhD candidate in Exposure Science in the School of Physics and also a member of the NUIG Ryan Institute's Centre for Climate and Air pollution and Centre for One Health. She has a BSc in Forensic Science and Analysis and an MSc in Toxicology from the National University of Ireland, Galway. She is in her 4th year of her PhD working on human exposure to Persistent Organic Pollutants (POPs) in the Irish population on the ELEVATE project.

Dr Harald Berresheim is a Senior Lecturer in the School of Physics at NUI Galway, a leading expert on air pollution and climate change, with research foci on atmospheric trace gas and radical chemistry, POCs in waste items, and sustainable energy sources.

Dr Martin Sharkey is a recent PhD graduate and now working on a post-doc in NUIG. Martin Sharkey is the Ireland-based project researcher working on FUEL. He has completed his bachelor's degree in Physics with Applied Physics, including studies on Environmental and Atmospheric Physics, and was part of the WAFER research group working on sample collection and chemical analysis

as well as dissemination of research findings at several international conferences on POPs.

Prof. Stuart Harrad from the University of Birmingham is a world-leading expert on the environmental fate and behaviour of persistent organic pollutants, with a particular focus on BFRs. He has coordinated three EPA research projects in Ireland – the WAFER, ELEVATE and FUEL projects dealing with various aspects of POPs in the Irish environment – and has led three EU-funded Marie Curie Initial Training Network Projects – A-TEAM, ELUTE, and INFLAME – which focus on training new generations of scientists to tackle the hazards posed by persistent organic pollutants in the environment.

Conference Administration

Norah O'Halloran is conference administrator for 'Toxic Contaminants in our Environment' and administrative staff in the NUIG Ryan Institute.

- (ELEVATE) http://www.nuigalway.ie/elevate/
- (FUEL) http://www.nuigalway.ie/fuel/
- (WAFER) http://www.epa.ie/researchandeducation/research/researchpublications/researchreports/research272.html
- (A-TEAM) https://cordis.europa.eu/project/rcn/105508/reporting/en
- (ELUTE) https://www.birmingham.ac.uk/research/activity/elute/index.aspx
- (INFLAME) https://cordis.europa.eu/project/rcn/96854/reporting/en

Conference Information

Location

The conference will be held at the O'Donoghue Centre for Drama, Theatre and Performance, Cappa Villa, University Rd University Rd, Galway, H91 RTR6 Ireland. Number 20 on the Campus map.

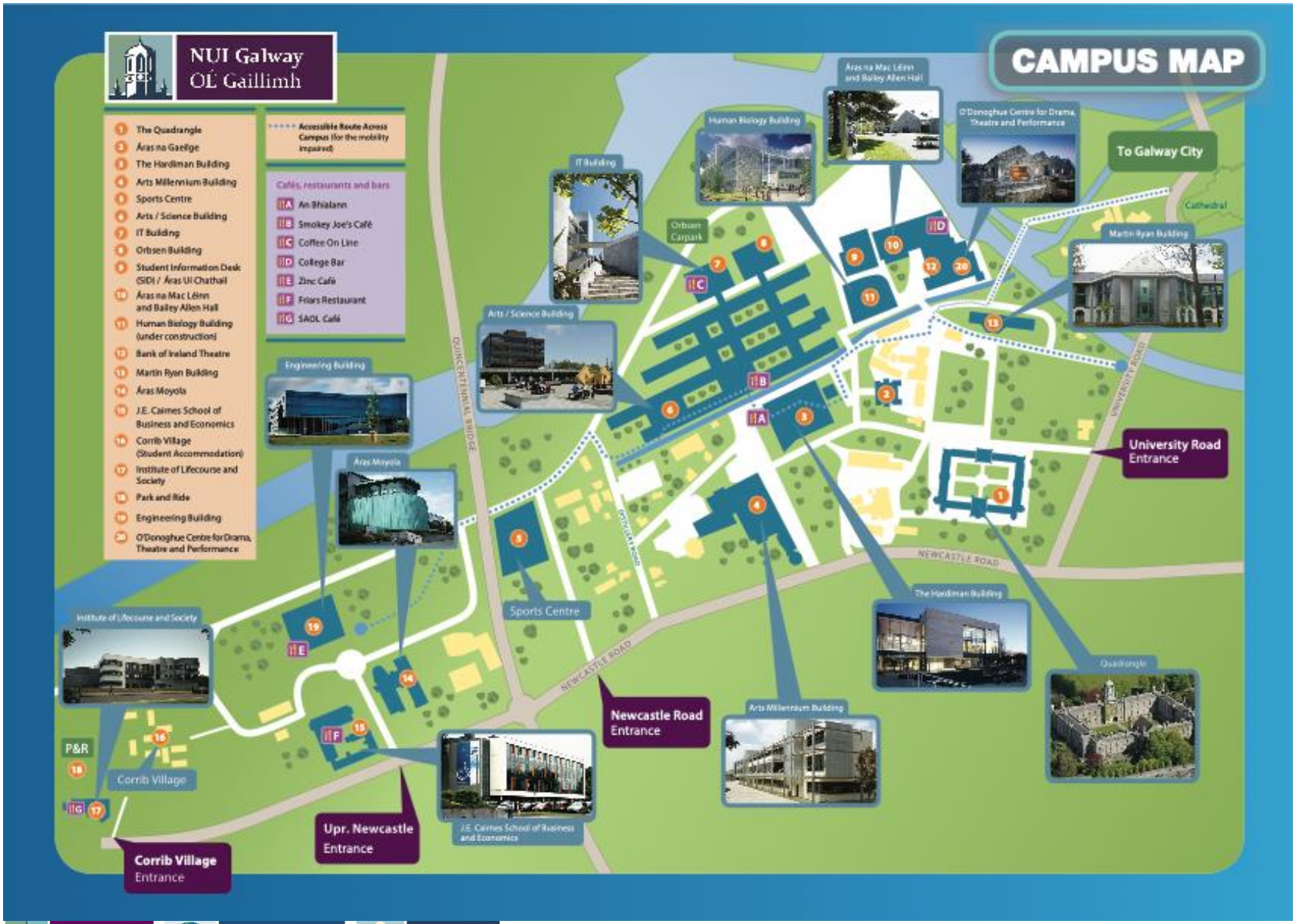
Parking at NUI Galway is heavily restricted on the main campus and clamping is in operation.

Free parking for conference delegates will be available on the day of the conference in the Dangan Carpark, North Campus (North West of Corrib Village) – See page 8 for attached Campus Map. Dangan Carpark can be accessed via Upper Newcastle Road.

All conference delegates can apply online for parking permits (https://apcoa-ie-permit.giantleap.no/#/login), which must be displayed on your car. Please park only in designated parking bays, and not in Pay and Display spaces.

A free shuttle bus service is available to all users of the Dangan Carpark. This shuttle bus runs at regular intervals to the Orbsen Building (number 8 on the campus map) which is only a short walk to the O'Donoghue Centre for Drama, Theatre and Performance.

Please note: Dangan Carpark closes at 19:30.



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Name Badges

Name badges will be available for all conference delegates in the foyer O'Donoghue Centre for Drama, Theatre and Performance on Friday September 20th from 08:00 am. All delegates are encouraged to wear name badges during the conference.

Refreshments

Tea/coffee and lunch will be served in the foyer O'Donoghue Centre for Drama, Theatre and Performance at the following times:

- **9:30 - 10:00 (Tea/Coffee)**
- **12:00 - 13:15 (Buffet Style Lunch)**
- **14:55 - 15:25 (Tea/Coffee)**

Posters

The poster presentation viewing area will be in the foyer O'Donoghue Centre for Drama, Theatre and Performance. All posters must be put up on the morning of Friday September 20th only, before 09:30. Please do not remove your poster until the last poster viewing session has finished, but no later than 15:20. Posters can be mounted on any empty poster board in the foyer O'Donoghue Centre for Drama, Theatre and Performance. Poster mounting stickers will be provided on the day.

There will be three poster viewing sessions throughout the day.

- **09:30 - 10:00**
- **12:00 - 13:15**
- **14:55 - 15:20**

More Information

Webpage https://nuigalwaycentreforclimateandai.clr.events/event/128407

Email

onehealthconference@nuigalway.ie

Twitter

@onehealth_nuig

Conference Programme

08:00 – 09:30 *Registration / Posters Set-Up*

09:30 – 10:10 *Poster Viewing / Tea & Coffee*

10:00 – 10:15 **Prof. Martin Cormican, HSE: *Welcome/Opening Conference***

SESSION 1 – INTERNATIONAL AND POLICY PERSPECTIVES

10:15 – 10:55 **Prof. Cynthia De Wit, Stockholm University:** *International perspectives on persistent organic pollutants: Exposure and effects*

10:55 – 11:20 **Prof. Michael Hynes, NUI Galway/REACH:** *Interactions between ECHA and the EU POP Regulation*

11:20 – 11:45 **Dr Joseph Hannon, FSAI:** *Current regulatory status of persistent organic pollutants in food in Ireland and future developments*

11:45 – 12:00 **Questions / Panel Discussion**

12:00 – 13:15 *Lunch / Poster Viewing*

SESSION 2 – CONTAMINATION IN OUR ENVIRONMENT AND HUMAN EXPOSURE

13:15 – 13:35 **Catherine Allen, DCU:** *Phthalates in the environment: An Irish perspective*

13:35 – 13:55 **Nina Wemken, NUIG:** *Brominated flame retardants in indoor dust/air*

13:55 – 14:15 **Dr Marie Coggins, NUIG:** *Brominated flame retardants in human breast milk*

14:15 – 14:35 **Dr Colmán Ó Ríordáin, The State Laboratory:** *Dioxins and furans in human breast milk*

14:35 – 14:55 **Dr Liam Morrison, NUIG:** *The removal of silver nanoparticles from aqueous samples using milled activated charcoal*

14:55 – 15:25 *Poster Viewing / Tea & coffee*

(All posters must be removed between 15:10 and 15:20)

SESSION 3 – IMPLICATIONS FOR WASTE MANAGEMENT

15:30 – 15:50 **Prof. Stuart Harrad, UoB:** *Is hand-held XRF a viable option for screening compliance with legislative limits on BFRs in waste?*

15:50 – 16:10 **Dr Martin Sharkey, NUIG:** *Brominated flame retardants in landfill leachate: Levels and tends in Irish waste*

16:10 – 16:30 **Dr Alma Siggins, NUIG:** *Use of pyrolysed waste to treat environmental trichloroethylene contamination*

16:30 – 16:45 **SUMMARY AND CLOSING REMARKS**

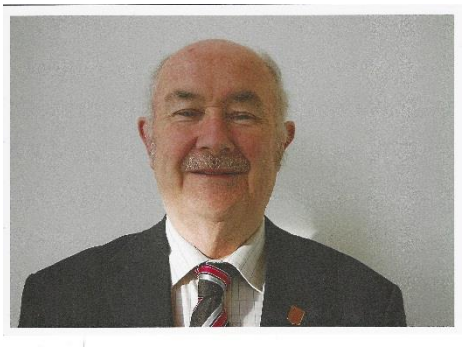
This conference is supported by the Environmental Protection Agency

Keynote Speakers

Prof. Cynthia de Wit

Cynthia de Wit is professor in environmental science at the Department of Environmental Science and Analytical Chemistry, Stockholm University. She first became involved in research on organic environmental contaminants at the Swedish Environmental Protection Agency in 1988 and from 1992 at Stockholm University within a national survey of polychlorinated dioxins and related chemicals. Her current research is focussed on legacy and emerging flame retardants (brominated, chlorinated, organophosphate-based) in indoor and outdoor environments, including performing human exposure assessments for both adults and children. Other research interests include organohalogen chemicals in terrestrial as well as Baltic Sea food webs. She is a co-lead of the Persistent Organic Pollutants Expert Group of the Arctic Monitoring and Assessment Programme (AMAP) since 1994. In that role, she has been involved in leading four international assessment reports on persistent organic pollutants, including contaminants of emerging concern, in the Arctic.

Prof. Michael Hynes



Michael Hynes was awarded a D.Sc. degree by the National University of Ireland in 1994, he lectured in the Chemistry Department on Inorganic Chemistry and Analytical Chemistry. Prior to his retirement he set up REACH for hynes of which he is owner and CEO. He has worked on issues associated with REACH with a number of companies, including registrations and the preparation of Chemical Safety Reports. He is competent in the use of IUCLID6 and the ECHA Chesar tool. During dossier preparation, he has also used the ECETOC tool to

calculate the risk of exposure to workers. In recent months he has migrated all dossiers to ECHA Cloud Services.

Dr Joseph Hannon

Joseph Hannon is a technical executive working in the Food Safety Authority of Ireland's Chemical Safety Team where he is involved in the risk assessment of contaminants, additives and food contact materials. He holds a Bachelor's degree in mechanical engineering from Technical University Dublin and a PhD in Biosystems and Food Engineering from University College Dublin. His doctoral thesis focussed on the migration and exposure assessment of nanoparticles from coated food contact materials.

Speaker Abstracts

10:15 – 10:55 Prof. Cynthia de Wit

Title: International perspectives on persistent organic pollutants: Exposure and effects

Authors: Cynthia A. de Wit

Department of Environmental Science and Analytical Chemistry, Stockholm University, SE-10691 Stockholm, Sweden

Keywords: Persistent organic pollutants (POPs), organochlorines, flame retardants, per- and polyfluorinated substances

Abstract: In 1962, Rachel Carson's book "*Silent Spring*" alerted the world to the widespread occurrence and effects of organochlorine pesticides, including DDT, used widely to kill mosquitos and agricultural pests. DDT accumulated in birds of prey, caused egg-shell thinning, subsequent reproductive failure and population collapses. Later, other organochlorine compounds such as PCBs (used as transformer fluid, plasticizer, flame retardant) were also discovered to be widespread in the environment, to accumulate in organisms with highest concentrations in top predators, and reproductive effects and population declines were seen. Organochlorines were stable, persistent and their fat-solubility led to bioaccumulation in the fatty tissues of living organisms (including humans), which in turn led to increasing concentrations with each step in a food chain. Persistent, bioaccumulative and toxic chemicals (PBT criteria) are designated persistent organic pollutants (POPs). Most POPs are semivolatile, evaporating to some extent into air and thus can spread globally, including to the Arctic. Organochlorine POPs are emitted to air, soil and water from point sources such as industries and agriculture. Human exposure to these POPs is predominantly from dietary intake. Many POPs are now banned or restricted.

New generations of problematic chemicals have been introduced, often as replacements for "old" POPs. These include organobromine and organofluorine compounds, used as flame retardants plasticizers and surfactants. Many have similar chemical properties as the "old" POPs and thus behave similarly in the environment. Many fulfil PBT criteria and some are now banned. They are used in consumer products found indoors, thus their sources are more diffuse. Although dietary exposure may dominate, exposure from indoor air and dust is also important for these chemicals. For per/polyfluorinated substances, their use as fire-fighting foams at e.g. airports has led to widespread groundwater contamination in many countries. The toxicity of POPs is often related to disturbances in hormone systems.

10:55 – 11:20 Prof. Michael Hynes

Title: Interactions between ECHA and the POP Regulation

Authors: Michael J Hynes
REACH for hynes

Keywords: ECHA, PACT, POP, Stockholm

Abstract: While the competent authority for implementation of the POP Regulation in Ireland is the Environmental Protection Agency (EPA), many other organisations have a wide range of responsibilities. With so many organisations involved, it is difficult to see how they could interact effectively. Due to deficiencies and changes in the original Stockholm Conventions (Regulation (EC) No 850/2004 of the European Parliament and the Council, it has been amended many times. As it is now necessary to make further amendments, it was decided to recast the Regulation. This has resulted in Regulation EU 2019/1201 (July 2019).

Even though the REACH Regulation did not come into force until June 2006, its establishment was foreseen in Section 8 of 850/2004. In June 2019, the European Chemicals Agency (ECHA) started to support the European Commission and EU states in identifying new POPs within the

Stockholm Convention's POP review and POP identification is now a key priority of ECHA. The Public Activities Coordination Tool (PACT) will play a key role in these activities.

The REACH Regulation (1907/2006) requires that all chemicals manufactured or imported into the EU in quantities of greater than one tonne per annum be registered with ECHA. Companies have the responsibility of collecting information on the properties and uses of substances they manufacture or import. These data are submitted to ECHA in the form of a dossier and if greater than 10 tonnes per annum, a Chemical Safety Report

Arising from this ECHA has the most extensive chemical database in the world with data on 21,551 substances registered under REACH and 120,000 substances notified to the CLP database. It has some 2 million summaries of chemical substances on its website and the properties of 191 of the most hazardous substances (SVHC) have been identified As a result, ECHA is in a unique position to contribute to POP activities.

11:20 – 11:45 Dr Joseph Hannon

Title: Current regulatory status of persistent organic pollutants in food in Ireland and future developments

Authors: Joseph C. Hannon[1], Julia Le Jeune[1], Emer O'Reilly[1], Christina Tlustos[1]

[1]Food Science and Standards, Food Safety Authority of Ireland, Dublin 1.

Keywords: Regulatory measures, persistent organic pollutants, mitigation

Abstract: Persistent organic pollutants (POPs) includes a diverse group of chemical substances that are known to accumulate and persist in the environment. Due to their ubiquitous occurrence caused mainly by anthropogenic activity, they occur in food and it is not possible to completely eliminate them. An increased awareness of the potential health risks posed by POPs in the food chain has intensified discussions on measures that can be implemented to mitigate exposure to these substances. The European Food Safety Authority (EFSA) has published two Scientific Opinions on the risk to human health from exposure to dioxins and polychlorinated biphenyls (PCBs), and exposure to perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) in food. Both Opinions, which identified critical effects from epidemiology studies resulted in substantially lower health-based guidance values (HBGVs) compared to previous Opinions. Consequently, large portions of the population were considered to have exposures exceeding the HBGVs, signifying a concern for human health. While a proposed re-evaluation of the World Health Organisation's Toxic Equivalency Factors (TEFs) for dioxins and PCBs may partially alleviate these concerns and delay any changes to regulatory maximum levels (MLs), at European Union level, discussions on setting MLs for PFOS and PFOA in food will proceed. The Irish contribution to the development of these measures will mainly stem from past surveys that investigated the occurrence of perfluoroalkyl substances (PFAS) in food and will be supplemented by newly generated data from a survey in 2018, which included a variety of foods of animal origin, as well as

packaged fast- and convenience food. Other regulatory developments in the POPs area will be driven by upcoming evaluations being performed by the EFSA on a number of other POPs, including; brominated flame retardants, PFAS other than PFOS and PFOA, and short, medium and long chain paraffins.

13:30 – 13:50 Catherine Allen

Title: Environmental Occurrence and Potential Health Impacts of Phthalates in Ireland

Authors: Catherine Allen[1], Lisa Jones[1], Matthew Jacobs[2], Anthony Staines[3], Fiona Regan[2] and Jenny Lawler[1].

[1]School of Biotechnology and The Water Institute, Dublin City University, Dublin, Ireland.

[2]School of Chemistry and The Water Institute, Dublin City University, Dublin, Ireland.

[3]School of Nursing and Human Sciences, Dublin City University, Dublin, Ireland.

Keywords: Phthalates, endocrine disrupting chemicals, human exposure

Abstract: Phthalate esters are synthetic organic chemicals used in many consumer products including cosmetics, toys, flooring and medical devices, and are ubiquitous within the environment (Gao and Wen, 2016). Humans are constantly exposed to phthalates, with increasing evidence of detrimental health effects (Ejaredar et al., 2015; Jurewicz and Hanke, 2011; Polańska et al., 2016). The European Commission is preparing to amend the Authorisation List (Annex XIV to REACH) with the additional identification of four phthalates as substances of very high concern (SVHCs) with endocrine disrupting effects on human health or the environment (European Commission, 2015). The phthalates in question are bis(2-ethylhexyl) phthalate (DEHP), dibutyl phthalate (DBP), benzyl butyl phthalate (BBP) and diisobutyl phthalate (DiBP). Other phthalates have yet to be studied extensively, and it is predicted that these replacement phthalates may prove to be as dangerous as those under legislative control.

This study examines eleven phthalates in a range of Irish environmental matrices. A novel triple-quad LC-MS method has been developed with optimisation of sample preparation (solid phase and ultra-sonication). The examination of phthalate burden in Ireland has shown that levels in Ireland are consistent with those reported elsewhere in Europe. A

wastewater epidemiology approach is employed to assess human exposure to phthalates via measurement of phthalate metabolites. A meta-analysis on health data serves to relate the level of exposure to an associated risk, providing the first step in phthalate risk assessment within the Irish environment. This will close the knowledge gap from lack of biomonitoring data and inform future policy.

13:50 – 14:10 Nina Wemken

Title: Brominated flame retardants and perfluoroalkyl substances in indoor dust/air

Authors: N. Wemken[1], D.S. Drage[2], M. Abdallah[2], S. Harrad[2], M. Coggins[1]

[1]School of Physics & the Ryan Institute, National University of Ireland, Galway, H91TK33, Ireland,

[2]School of Geography, Earth and Environmental Sciences, University of Birmingham, B15 2TT, U.K.

Keywords: BFRs, POPs, HBCDD, PBDEs, air sampling, dust sampling, exposure estimates

Abstract: Polybrominated diphenyl ethers (PBDEs), hexabromocyclododecane (HBCDD) – "POPBFRs"– and decabromodiphenyl ethane (DBDPE) were measured in air and dust samples from Irish indoor microenvironments (MEs). PBDEs and HBCDD are classified as persistent organic pollutants (POPs) under the UNEP Stockholm Convention. Such legislative restrictions have created a market for replacement flame retardants, such as DBDPE. This study reports for the first time the estimated exposure of Irish adults and toddlers to PBDEs, HBCDD and DBDPE via dust ingestion and air inhalation from several MEs.

Samples were collected from Irish homes, cars, offices and primary schools (n=30 per ME) between2016-2017. Air samples were collected using a sorbent (XAD-3) impregnated polyurethane foam disk, extracted via pressurised liquid extraction using an ASE-350. Dust samples were collected by vacuuming floor surfaces, extracted via a combination of vortexing and ultrasonication. Extracts were further purified on SPE cartridges, concentrated and analysed via GC-EI/MS or LC-MS/MS.

BDE-209 followed by DBDPE were the most abundant BFRs detected in both dust and air. Highest concentrations of BDE-209 in air were detected in schools (median: 410 pg/m3) and in cars for dust (26,000 ng/g). BDE-209 concentrations in school dust were positively correlated with the number of electronics in classrooms (p<0.01). Highest concentrations of

DBDPE in air were detected in homes (7000 pg/m3) and in schools for dust (10,000 ng/g). Schools contained the highest ΣHCBDD concentrations for both air and dust (38 pg/m3 and 800 ng/g). Homes built after 2013 (n=2) displayed lower concentrations of ΣHCBDD (p<0.01) compared to those constructed before this date (n= 24) possibly suggesting a downward trend in the use of this BFR.

Concentrations of DBDPE in dust samples for all our studied MEs are substantially higher than those previously reported internationally. Our data suggests the widespread use in Ireland of both BDE-209 and DBDPE. Exposure estimates for DBDPE and BDE-209 for both Irish adults and toddlers via air inhalation and dust ingestion exceed reported exposure estimates for the UK population. Estimates of exposure of the Irish population to Σtri-deca-PBDEs exceed previous estimates for Ireland via dietary exposure.

14:10 – 14:30 Dr Marie Coggins

Title: Brominated flame retardants in human breast milk

Authors: N. Wemken[1], D.S. Drage[2], Claire Cellarius[3], Kathy Cleere[4], J. Morrison[3], S. Daly[4], M. Abdallah[2], C. Tlustos[5], S. Harrad[2], M. Coggins[1]

[1]School of Physics, & the Ryan Institute, National University of Ireland, Galway, H91TK33, Ireland.

[2]School of Geography, Earth & Environmental Sciences, University of Birmingham, B152TT, U.K.

[3]Obstetrics & Gynaecology, University Hospital Galway, Galway H91 YR71, Ireland;

[4]Obstetrics & Gynaecology, Coombe Women's & Infants University Hospital, Dublin D08 XW7X, Ireland

[5]Food Safety Authority of Ireland, Dublin D01 P2V6, Ireland

Keywords: Brominated flame retardants, perfluoroalkyl substances, human biomonitoring

Abstract: Concentrations of the flame retardants (FR) hexabromocyclododecane (HBCDD), eight polybrominated diphenyl ether congeners (PBDEs), decabromodiphenyl ethane (DBDPE) and ten perfluoroalkylated

substances (PFASs) were measured in 16 pooled samples of human breast milk collected from 92 Irish primiparas. Concerns regarding the impact of these chemicals on animal and human health have led to the classification of these chemicals as persistent organic pollutants (POPs) under the UNEP Stockholm Convention however, market demand has led to the marketing of replacement FRs such as DBDPE. Analysis of human breast milk can provide a direct measurement of the human boody burden of POPs. The objective of this study is to replicate as far as possible the sampling strategy of an earlier Irish Biomonitoring study, and compare results to previous Irish and international studies. Evidence for possible temporal reductions in human body burdens in Ireland in response to actions (both legislative and voluntary) designed to reduce human exposure over the last decade will be examined. The sampling strategy was developed in line with that of the previous Irish bio-monitoring programme for POPs, and (with minor deviations) the 4th WHO UNEP protocols. Primiparas were recruited from two Irish maternity hospitals over 2016–2018. Samples (30 - 60 mL) of breast milk were procured from participating primiparas and stored at -20 °C prior to pooling. Aliquots of pooled samples were extracted into 100 mL of dichloromethane (DCM) using pressurized liquid extraction (PLE) and subsequently cleaned by passing extracts through acid silica– packed columns. Samples were analysed via LC-MS/MS and GC/MS. Significant decreases are observed in concentrations of BDE-47 and BDE-153 (p<0.01, p<0.05) whereas levels of BDE-99 and BDE-100 are not detected compared to results from the last Irish HBM in 2010, most likley reflecting the impact of voluntary and legislative bans on the use of these flame retardant containing products. A simple one compartment pharmacokinetic model was used to compare predicted exposures via air, dust and diet with total burden estimates from concentrations measured in the human breast milk. Average exposure estimates for Irish nursing infants to all the FRs and PFASs included in this study were calculated and do not suggest a health concern.

14:30 – 14:50 Dr Colman Ó Ríordáin

Title: Dioxins and furans in human breast milk

Authors: Colmán Ó Ríordáin[1], Julie Tierney[1], Myra Keogh[1], Marie Coggins[2], Nina Wemken[2].

[1]State Laboratory, Backweston Lab Campus, Young's Cross, Celbridge, Co. Kildare, W23 VW2C,

[2]School of Physics, & the Ryan Institute, National University of Ireland, Galway, H91TK33

Keywords: Dioxins, furans, PCBs, TEF, TEQ, human biomonitoring

Abstract: Dioxins and their related compounds are a class of environmental pollutants that pose a serious toxicological risk when exposure continues over an extended period. The Stockholm Convention on Persistent Organic Pollutants (POPs) has the objective to protect human health and the environment from POPs by reducing or eliminating their release into the environment. Human milk was recommended as a core matrix for biomonitoring of these dioxins.

Concentrations of 17 polychlorinated dibenzo-p-dioxins (PCDDs), 10 Polychlorinated dibenzofurans (PCDFs), and 8 polychlorinated biphenyls (PCBs) in 16 pooled samples of human breast milk were analysed in the State Laboratory, and the Toxic Equivalency (TEQ) of each sample calculated. The results were compared to studies done in Irish human milk samples from 2002 and 2008, and to global surveys done for WHO/UNEP.

The PCDD and PCDF congener profiles showed significant decreases in concentration for all but 2 congeners with drops of up to 75% vs levels in 2002 study (e.g. most toxic congener, 2,3,7,8-TCDD went from, on average, 1.00 ng/kg to 0.67 ng/kg in 2008, and now to 0.36 ng/kg based on these 2018 samples). The same trend was seen for the PCB congeners. This is in line with global trends, where increased monitoring has

contributed to an overall reduction in dioxin levels in the environment, as measured in human milk.

14:50 – 15:10 Dr Liam Morrison

Title: The removal of silver nanoparticles from aqueous samples using milled activated charcoal

Authors: L. Morrison[1,3], E. McGillicuddy[2,3], M. Cormican[2,3], D. Morris[2,3]

[1]Earth and Ocean Sciences, National University of Ireland, Galway

[2]Antimicrobial Resistance and Microbial Ecology Group, School of Medicine, National University of Ireland, Galway

[3]Centre for Health from Environment, Ryan Institute, National University of Ireland, Galway

Abstract: Background: The impact of silver nanoparticles (AgNPs) on the environment is a topic of interest due to the recent incorporation of AgNPs into numerous nano-functionalised consumer products, including; medical devices, food contact materials and textiles. The incorporation of AgNPs into these products poses a potential risk to the aquatic environment as AgNPs may be released throughout the products lifetime from manufacturing to end-of-life disposal.

Methods: Activated charcoal, Norit® CA1 (Sigma-Aldrich), a commonly used filter material, was selected as a capture material for AgNPs in water samples. Initially water samples containing 100 ppb, 25 nm PVP coated AgNPs (nanoComposix) were prepared in Milli-Q water. These samples were exposed to the charcoal for 20 hours after which the decrease in silver concentration was measured using ICP-MS. The removal efficiency of the charcoal was improved by milling the charcoal. The processed charcoal was then exposed to samples containing AgNPs as in initial tests.

Results: In the initial tests, roughly 10% of the silver was removed from the water samples using the unaltered activated charcoal granules. The capture of the AgNPs was improved using the milled charcoal, with a capture efficiency of 94% at concentrations of 10 ppb. This study found that increasing the surface area of the charcoal increased the silver reduction in the samples. Further a procedure was developed allowing the silver captured by the charcoal to be quantified using a HCl leeching procedure.

Conclusion: A knowledge gap exists with regards to the concentration of AgNPs in the aquatic environment. Sampling difficulties are associated with the speciation AgNPs can undergo in natural waters. These studies show that milled activated charcoal shows promise as a nanoparticle capture material. It was found that increasing the surface area of the charcoal increases the capture of AgNPs from the sample.

15:30 – 15:50 Prof. Stuart Harrad

Title: Is hand-held XRF a viable option for screening compliance with legislative limits on BFRs in waste?

Authors: Stuart Harrad[1], Martin Sharkey[2], Harald Berresheim[2], Daniel Drage[1], Mohamed Abdallah[1]

[1]School of Geography, Earth and Environmental Sciences, University of Birmingham

[2]School of Physics, & the Ryan Institute, National University of Ireland, Galway, H91TK33

Keywords: PBDEs, HBCDD, POPs

Abstract: To prevent recycling of waste containing restricted brominated flame retardants (BFRs), the EU has introduced low POP concentration limit (LPCL) values whereby articles containing such BFRs (polybrominated diphenyl ethers (PBDEs) and hexabromocyclododecane (HBCDD)) at concentrations exceeding the LPCL (1,000 mg/kg) cannot be recycled and instead their BFR content must be destroyed. Given the widespread use of PBDEs and HBCDD in electrical and electronic equipment (EEE), polystyrene building insulation foam, as well as seating foam and fabrics in homes, offices, and cars; monitoring compliance with LPCLs represents a substantial undertaking, compounded by the fact that conventional methods for measuring PBDEs and HBCDD are destructive, time-consuming, expensive, and cannot be conducted *in situ* at waste handling sites. Our principal objective was thus to evaluate the feasibility of using hand-held X-ray fluorescence (XRF) spectrometers to determine bromine in waste articles as a surrogate metric of exceedance of LPCL values. Of particular concern is the incidence of false exceedances (where the concentration of bromine but not PBDEs or HBCDD exceeds the LPCL) and false negatives (i.e. where the concentration of PBDEs or HBCDD but not bromine exceeds the LPCL) occurred. False exceedances occur when a BFR other than a PBDE or HBCDD (e.g. tetrabromobisphenol-A (TBBP-A)) is present above 1,000 mg/kg. We measured bromine, PBDEs and

HBCDD in 555 waste articles collected in Ireland between 2015 and 2016. Our measurements revealed concentrations of PBDEs and HBCDD exceeded LPCLs in 47/555 (8.5 %) articles. No false negatives were detected, while the number of false exceedances was 34 (6.1 %). These are mainly caused by the presence of TBBP-A in waste EEE (WEEE). Overall, despite some caveats, hand-held XRF could be a viable option for checking LPCL compliance. Effective enforcement of LPCL values will eliminate >98% of PBDEs and HBCDD from the Irish recycling stream.

15:50 – 16:10 Dr Martin Sharkey

Title: Brominated flame retardants and perfluoroalkyl substances in landfill leachate from Ireland

Authors: Martin Sharkey[1], Stuart Harrad[2], Daniel Drage[2], Harald Berresheim[1]

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Keywords: PBDEs, HBCDD, POPs, leachate, PFASs

Abstract: Landfilling has historically been one of the major waste disposal methods in Ireland. However, by 2020, the country aims to limit such operations to only non-recyclable and non-recoverable waste. Despite this, over their decades of operation, large volumes of domestic materials potentially containing hazardous substances have been disposed of in these sites. Prior to the introduction of the EU WEEE directive in 2003, there were no restrictions on the disposal of electronic goods in landfills, goods which are known to have been treated with hazardous brominated flame retardants (BFRs). In a similar way, large volumes of domestic furniture and soft furnishings treated with perfluoroalkyl substances (PFASs) have also been disposed of in landfills with little restriction.

Many BFR and PFAS compounds are known to be ubiquitous, persistent, bioaccumulative, and environmentally hazardous at high concentrations. Their presence in environmental matrices have been the topic of increased scrutiny in recent years, in particular in the area of waste management. Landfills are thought to be huge sinks of BFR- and PFAS-treated materials, but the levels of environmental contamination from these sites are unknown in Ireland, and little-known elsewhere in the world.

Our study involved the collection of 40 leachate samples from sites across Ireland and assessing them for BFR- and PFAS-content. The results show that several prominent BFR (*i.e.* HBCDDs & PBDEs) and PFAS (including

PFOA, PFOS, PFNA, & PFBS) compounds are present at high concentrations at these sites. Results further indicate that some degree of environmental contamination by these compounds has occurred at a selection of these sites due to the sub-par infrastructures at older unregulated landfills. Finally, a heavy burden may be placed on waste water treatment plants due to the high concentrations of these compounds present in landfill leachate.

16:10 – 16:30 Dr Alma Siggins

Title: Use of pyrolysed waste to treat environmental trichloroethylene contamination

Authors: Dr Alma Siggins[123], Dr Florence Abram[23], Prof. Mark Healy[23]

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Keywords: Trichloroethylene, biochar, adsorption, kinetic study, circular economy

Abstract: Trichloroethylene (TCE) is an Environmental Protection Agency priority pollutant associated with cancer in humans. With numerous industrial applications and regular landfill disposal, TCE is a common landfill leachate pollutant. In situ treatment barriers use costly fill materials such as granular activated carbon (GAC). The "TOOLBOX" project, funded by an EU Marie Skłodowska Curie Actions Individual Fellowship, showed that waste-derived biochar showed excellent capacity for TCE adsorption. Batch scale TCE removal efficiencies by spruce and oak-derived biochars were > 99.5 %, outperforming GAC (95 %) and herbal pomace biochar (93 %). Modelling of the non-linear Langmuir isotherm predicted a maximum adsorption capacity for herbal pomace and spruce biochars of 562 and 467 $mg.g^{-1}$, respectively. Kinetic modelling data indicated that the mechanism of TCE adsorption differs between biochars, with adsorption by herbal pomace biochar limited by physisorption, and adsorption by oak and spruce biochars limited by chemisorption, potentially due to the different surface characteristics observed. In a column experiment, herbal pomace and spruce biochar were observed to be capable of almost complete removal of TCE from the waste stream during the study. TCE dechlorination, mediated by microorganisms contained in landfill leachate, was observed. Of note, assessment of pollution swapping potential revealed release of phosphate by all biochars. This will require further consideration, so as to prevent negative environmental impacts such as eutrophication resulting from nutrient

overloading. Overall, these data demonstrate the potential for pyrolysed waste material to be used as an alternative fill material for in situ remediation applications, thereby also addressing the European Circular Economy Strategy.

Poster Abstracts

Title: The IMAGE Project: Evaluating environmental exposure to glyphosate among Irish families

Authors: Alison Connolly[1], Holger M. Koch[2], Marike Kolossa-Gehring[3], André Conrad[3], Marie Coggins[1]

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Keywords: Exposure science, human biomonitoring, glyphosate, environmental exposures

Abstract: Glyphosate is the highest volume used herbicide globally, used in the agricultural and horticultural industry, as well as in amateur gardening. This widespread and high quantity use worldwide has resulted in this chemical becoming ubiquitous in the environment. In 2015, the International Agency for Research on Cancer's classified glyphosate as a '2A probably carcinogenic to humans', which intensified international controversy over this chemical. The Human Biomonitoring for Europe (HBM4EU) initiative has also classed glyphosate as a priority substance for future analysis.

Occupational exposure studies have been previously conducted in Ireland among amenity horticulturists, which detected low levels of glyphosate in urine samples of the workers, as well as identifying potential sources of workers and para-occupational exposures. Previous environmental studies have also found detectable glyphosate levels of 0.80 – 1.35 µg L^{-1} in 20% of the urine samples collected among non-occupationally exposed individuals.

To fully evaluate glyphosate exposures, the IMAGE project has initiated – **I**reland's bio**M**onitoring **A**ssessment of **G**lyphosate **E**xposures: An environmental assessment of glyphosate exposures among the Irish population using human biomonitoring. This follow-on human

biomonitoring study will collect and analyse urine samples from families in Ireland. Samples will be collected from both farm and nonfarm families', which will include both parents and child (between 6 – 17 years old) and analysed for glyphosate and its main metabolite, Aminomethylphosphonic acid. Questionnaires, (aligned with the harmonised HBM4EU protocols) will collect detailed contextual information to support the human biomonitoring data including information on diet, occupation, lifestyle, health and place of residence. Project methodology and sampling protocols will be presented at the conference.

Title: Improving status of imposex in dogwhelk (Nucella lapillus) in Irish coastal waters

Authors: Brendan McHugh[1], Michelle Giltrap[2], Robert Kennedy[3], Evin McGovern[1], Eileen Joyce[1], Laura Brophy, Marissa Parker[1], Andrew Conway[1], Orla McDonnell[3], Rob Fryer[4]

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Keywords: Imposex, dogwhelk, tributyltin (TBT), MSFD

Abstract: Around the 1960's tributyltin (TBT) based paints were discovered to be effective anti-foulants in the prevention of biological growth on marine vessels and structures. Use of the compound has not come without consequences with TBT now unequivocally linked in causing reproductive impairment (i.e. the superimposition of male genitalia) in female dogwhelks (Nucella lapillus L.), via the condition of imposex. The recognition of these environmental impacts led to implementation of various national, EU and international measures over a number of decades, ultimately with the global prohibition of the use of TBT in 2008. Imposex monitoring in Ireland has now been under way for around 30 years. This 2018 imposex assessment concluded that, with a small number of exceptions, there has been a dramatic reduction of TBT contamination around the Irish coast with almost all locations found to be at or close to background exhibiting little evidence of imposex. Imposex measurement in dogwhelks is recognised as being the most clear-cut tool for Ireland's monitoring of contaminant-specific pollution effects under the Marine Strategy Framework Directive (MSFD). This demonstrates that measures taken nationally and internationally to phase out known toxic substances can be very effective in reducing marine pollution.

Title: Fugitive emissions from a breath actuated nebuliser and a vibrating mesh nebuliser for a paediatric patient

Authors: Ciarraí O'Toole[1], James McGrath[1], Gavin Bennett[2], Mary Joyce[2], Ronan Mac Loughlin[2], Miriam Byrne[1]

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Keywords: Indoor air, medical aerosol, occupational exposure

Abstract: Introduction: Recent studies have identified the potential for fugitive emissions to be released during nebulisation treatments [1, 2]. Here we quantify fugitive emissions from a breath actuated compressor driven jet nebuliser (JN) designed to reduce emissions, and a vibrating mesh nebuliser (VMN) and valved spacer.

Methodology: A breath actuated jet nebuliser with a mouthpiece (Aeroeclipse2, Monaghan Medical, Canada) was operated at 8 L/min. Two modes on the nebuliser were tested during simulated paediatric breathing (V_t 250 mL, breath rate 25 BPM, I:E ratio 1:2); breath-actuated nebulisation (BAN) and continuous nebulisation (CN) (n = 5). A vibrating mesh nebuliser (VMN) (Aerogen Solo with Aerogen Ultra, Aerogen, Galway, Ireland) was used with a mouthpiece in CN mode only. A standard prescription dose of 3 mL of 2 mg/mL salbutamol was nebulised. An Aerodynamic Particle Sizer (TSI Inc., US) placed at 0.8 m (arm's length) from the nebuliser was used to characterise the fugitive aerosol concentration (mg drug/m3) over a 45 minute period.

Results: Medical aerosol was released during nebulisation treatment for both nebuliser types and both modes. CN mode on the jet nebuliser had a higher fugitive aerosol concentration of 0.061 ± 0.048 mg/m^3 compared to the BAN and the VMN (0.044 ± 0.030 mg/m^3 and 0.011 ± 0.006 mg/m^3). MMAD averaged 1.21 ± 0.05 for JN CN, 1.22 ± 0.04 for JN BAN and 1.20 ± 0.12 µm for VMN.

Conclusion: The results confirm that fugitive emissions are released into the surrounding environment during respiratory therapy using both CN and BAN mode on the jet nebuliser as well as CN mode for the vibrating

mesh nebuliser. However, across all tests, the vibrating mesh nebuliser in combination with a valved spacer recorded the lowest secondary emissions.

Title: Application of PDMS passive sampling for the analysis and quantification of dissolved water concentration of priority contaminants in waster bodies in support of compliance monitoring

Authors: Denis Crowley, Brendan McHugh, Evin McGovern
Marine Institute, Rinville, Oranmore, Co. Galway

Keywords: PDMS, passive sampling, WFD, priority pollutants

Abstract: Traditionally marine pollution monitoring programmes such as the Water Framework Directive (WFD) or the Oslo Paris Commission (OSPAR) have mandated the collection and analysis of spot water and/or resident biota for compliance assessment.

The use of these conventional matrices for compliance purposes though can often result in logistical and analytical challenges, such as the non-availability of biota at sampling locations and matrix specific limits of detection when trying to measure at environmentally relevant levels.

While currently only acceptable as a supporting technique for legislative compliance purposes, Polydimethylsiloxane (PDMS) sampling devices have the potential to determine pollutant concentrations in the order of pg/L, potentially overcoming current analytical threshold limitations while also meeting logistical requirements for spatial and temporal sampling, and as such are sensitive and cost-effective alternative tools for environmental monitoring purposes.

Passive samplers were deployed to determine time weighted average (TWA) dissolved water concentrations of priority contaminants at four sites along the Shannon Estuary from Limerick Dock to the outer reaches of the estuary. A decrease in concentration of 15 polycyclic aromatic hydrocarbons (PAHs) was observed from Limerick dock at 11736pg/L through to the Upper Shannon Estuary at 8390pg/L to both the Fergus Estuary 5229pg/L and to the Lower Shannon Estuary at 4116pg/L. Similar decreases in polychlorinated biphenyls were detected along the gradient from Limerick Dock to the outer estuary.

This study ultimately demonstrates the applicability of PDMS devices for the purposes of both investigative and temporal trend monitoring.

Title: Policy changes and their impact on the circular economy: Batteries

Authors: Emma Goosey

Consultant, Env-Aqua Solutions Ltd

Keywords: Batteries, policy, recycle, flame retardants

Abstract: Batteries are becoming a staple in our everyday lives. Our reliance on batteries is only going to rise, especially as globally, governments have mandated change towards renewable energy and low emissions vehicles. These two industries rely on batteries, and huge volumes are now being manufactured. End-of-life management must be considered at this point of change, in order to develop the necessary infrastructure for handling battery waste.

For electric vehicles, waste batteries have been highlighted both as a potential problem, and as a large reserve of critical raw materials. An electric vehicle battery reaches end-of-life with 70-80% operating capacity. Whilst unsuitable for vehicles, the remaining capacity is sufficient for other applications, including home and renewable energy storage and commercial products. New businesses are being created to utilise these end-of-life vehicle batteries but a major limitation to market exploitation is policy.

Companies placing reused or repurposed batteries back on the market must classify the batteries as new (to market). Therefore, these batteries must meet policy and regulations with regards to placing them on the market and subsequent REACH, RoHS and POPs regulations. However, there can be a lag of 8-10 years between battery manufacture and point of resale. During which time policy can change.

Battery safety has been highlighted by significant incidents (e.g. Airbus Dreamliner A350, Tesla Model 3 and Samsung Galaxy-Note 7). In order to improve their safety, flame retardants are being added to the casings and the electrolytes to help constrain thermal runaway. Identification of batteries and the types of POPs they contain at end-of-life is a challenge for the recycling industry, and may be restrictive for circular economy business models.

This review includes identification of substances currently used in batteries, details how recyclers can identify batteries containing potential pollutants, and presents the challenges for recyclers and the circular economy.

Title: Isolation and characterisation of PFOS degrading bacteria from landfill leachate

Authors: Gaurav Chugh[1], Marcus Daly[1], Navdeep Kaur[2], Olivier Thomas[2], Florence Abram[1]

[1]Functional Environmental Microbiology laboratory, Department of Microbiology, National University of Ireland Galway, University Road, Galway
[2]Marine Biodiscovery Group, Department of Chemistry, National University of Ireland Galway, University Road, Galway

Keywords: PFAS, PFOS, microbial degradation, LC-MS/MS

Abstract: Perflourinated compounds (PFAS) such as perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) are emerging contaminants which pose a serious concern to the environment and the public worldwide. This is due to their ubiquitous presence, persistence, toxicity, and bioaccumulation potential. The specific properties of the F–C bond give PFAS a high stability and makes them very useful in a wide range of consumer applications. The understanding of the physicochemical properties, fate and transport of PFASs in groundwater is still limited. In addition, current PFAS conventional remediation technologies are not sustainable. Hence, the development of in situ cost-effective and environmentally friendly treatment methods is urgently needed. The objective of this work was to investigate the potential of microorganisms for the biological degradation of PFAS. To this end, we first developed a quantitative method for the determination of per- and polyfluoroalkyl substances (PFAS) using liquid chromatography (LC) tandem mass spectrometry (MS/MS). Then, we isolated targeted bacterial species from contaminated landfill leachate and assessed their ability to utilize PFOS as a sole carbon source using minimal media containing up to 500 mg/L PFOS. So far, 59 bacterial strains have been isolated from PFAS contaminated landfill leachate, amongst which three pure culture isolates, including a strain of Pseudomonas, were shown to be capable of growing on medium containing PFOS as sole carbon source. Future work will assess the rest of the isolate collection for their ability to grow on PFOS containing medium and will carefully monitor PFOS concentrations and degradation intermediates.

Title: A pilot study evaluating indoor environment quality in energy efficient Irish dwellings: The VALIDate Project

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Keywords: Indoor air quality, indoor built environment, longitudinal study, radon, energy efficiency

Abstract: Previous studies evaluating energy efficient dwellings have highlighted the practical challenges of maintaining good indoor environmental quality. Measures that increase air tightness have been shown to have both positive and negative influences on thermal comfort, and thus on health and well-being. Currently, there is a knowledge gap in Ireland regarding the effectiveness of ventilation required to maintain a healthy and comfortable environment within energy efficient residential dwellings. The current longitudinal study uses customer-grade sensors to continuously monitor the thermal comfort and indoor environmental quality in energy efficient Irish residential dwellings. Sensors are placed in four rooms per dwelling; two habitable rooms (living room and bedroom) and two wet rooms (kitchen and bathroom). Environmental and air quality data is remotely collected, as well as pollutant parameters (temperature, humidity, CO_2, radon and VOCs). The advantages of continuous monitoring in four separate rooms within a dwelling is that pollutant dispersions can be observed, varying ventilation conditions between rooms can be identified, and reliable air pollution exposure estimates can be made. In addition, continuous monitoring reduces the uncertainties associated with short-term monitoring, such as occupant behaviour and short-term changes in the built environment. Detailed contextual information is also collected to accompany sensor data, as well as a photographic survey being conducted by the researcher within each of the residential dwellings, which documents the presence of ventilation and extraction systems and their accompanying switches, as well as windows and doors, to identify potential sources of draughts and potential energy conservation of energy measures.

Title: Organic contaminants in Irish fishery products

Authors: Smith, J., Reid, A., McHugh, B., Boyle, B., O'Hea. L., Parker, M., McKeown, A., Crowley, D., Szumski, T., Morrissey, A., Nolan, S., Moffat, R., Kelly, C., Toomey, M., Glynn, D., McGovern, E.

Marine Institute, Rinville, Oranmore, Co. Galway

Keywords: Organic contaminants, persistent organic pollutants, seafood, trends

Abstract: For over 20 years, the Marine Institute has measured contaminants in seafood. This has been led by a number of different regulations and conventions which share the aim of reducing levels of contaminants in the marine environment and in seafood for human consumption. These include Directive 2008/56/EC (Marine Strategy Framework Directive) Descriptor 9 relating to contaminants in seafood, Commission Regulation 1881/2006, and the Stockholm Convention on Persistent Organic Pollutants, which aims to eliminate or restrict the production and use of persistent organic pollutants (POPs).

In accordance with these and other service level agreements, the Marine Institute collects samples of commercially important fish species landed at the major Irish fishing ports on an annual basis. These are tested for heavy metals, certain persistent organic pollutants including certain pesticides, industrial chemicals such as polychlorinated biphenyls (PCBs), and unintentionally produced substances such as dioxins. Levels of these contaminants are also tested in bivalve molluscs sampled from shellfish growing waters and in farmed finfish as sampled under the National Residues Control Plan.

The results of testing of the edible portion of species sampled between 2013 to 2017 for organochlorine compounds (OCs), indicator PCB, polychlorinated dibenzodioxins and furans (PCDD/Fs), dioxin-like PCBs (dl-PCBs) and selected brominated flame retardants (primarily polybrominated diphenyl ether congeners - PBDEs) are presented, along with an assessment of trends in the concentrations of these pollutants, particularly legacy organic pollutants, in a number of these species.

Title: Biomonitoring research by post: Generating reference ranges for key biomarkers within the UK population

Authors: R. Bevan[1], K. Jones[2], J. Cocker[2], F.L. Assem[1], L.S. Levy[1]

[1]Institute of Environment and Health, Cranfield University, Cranfield, MK43 0AL, UK

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Keywords: Urine, postal survey, reference range

Abstract: Background: Human biomonitoring (HBM) is a widely accepted tool to aid assessment of chemical uptake in risk assessment. However, our understanding of the biological relevance of the results of HBM can be restricted, due in some part to the limited information on background environmental exposures and biomarker concentrations in the general population. The study described here specifically addresses the question of what constitutes normal background levels in the UK population of a number of biomarkers (the chemical itself or one of its stable metabolites) for a variety of environmental chemicals that are frequently encountered because of their widespread use.

Methods: The environmental chemicals selected for this study were benzene, chlorinated hydrocarbons, dithiocarbamates, cadmium, mercury, naphthalene, diethylhexyl phthalate, synthetic pyrethroids and xylene. Volunteers (n = 436) were randomly sought by a postal survey based on the UK Electoral Register. Participants were asked to complete a questionnaire and provide a urine sample.

Results: The overall response rate was 7.5%, with volunteers being recruited from all areas of the UK including, England, Scotland, Wales and Northern Ireland. Study participants were adults and comprised 45% male and 55% females. Cadmium, mercury and metabolites of naphthalene, diethylhexyl phthalate and some pyrethroids were detectable in more than 80% of urine samples. Some other biomarkers (other pyrethroids, dithiocarbamates, xylene, chlorinated hydrocarbons) were detectable in urine from fewer than half of the participants.

Conclusions: We have conducted a simple, postal-based, cost-effective study and generated similar reference values to very large surveys such

as NHANES. This demonstrates that large investigations may not be necessary to get a reasonable idea of environmental exposures, especially in initial 'screening-type' investigations to identify particular exposures of concern or to demonstrate that exposures are reassuring low and that no further survey data needs to be gathered.

Title: An investigation of elevated dioxin levels in ovine livers in Ireland

Authors: O'Shea N.[1], Houlihan. M.[1],Ó Ríordáin C.[1], Keogh M.[1], Noone C.[1], Houlihan M.[1], Smith H.[1], Tierney J.[1]

[1]Contaminants Section, The State Laboratory

Keywords: Dioxins/PCBs, contaminated site study

Abstract: Under the European Commission recommendation (2013/711/EU), member states should perform, proportionate to their production, use and consumption of food and feed, random monitoring of the presence of dioxin, dioxin-like PCBs and non-dioxin-like PCBs.

As the Irish NRL for dioxins and PCBs in food and feed, The State Laboratory performs the analysis for this monitoring program on behalf of the FSAI. This program establishes long-term baseline levels of dioxins in food in a variety of matrices and across six species, and hence is an important indicator of the background levels of dioxins and PCBs present in the Irish environment.

In December 2017, an elevated result in an ovine composite sample raised concern. This elevated result triggered a series of further analysis, which resulted in a multidisciplinary investigation into dioxin levels in ovine livers in order to determine the source of contamination.

Additional samples, including additional ovine livers and any feed material suspected to have entered the ovine food chain from the original source farm, as well as liver samples from the same geographical location, were collected for further analysis by GC-HRMS.

Elevated dioxin levels were found in some ovine liver samples, but follow-up samples from the source farm indicated that not all the flock had been affected. Feed was ruled out as a source of contamination.

The on-farm investigation has not revealed any obvious source of contamination. A source of contamination could be to illegal backyard burning in this area, which is a known source of contamination in Ireland.

Title: An assessment of the exposure of the Irish population to selected brominated flame retardants via indoor air and dust

Authors: N. Wemken[1], D.S. Drage[2], M. Abdallah[2], S. Harrad[2], M. Coggins[1]

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[2]School of Geography, Earth and Environmental Sciences, University of Birmingham, B15 2TT, U.K.

Keywords: BFRs, POPs, HBCDD, PBDEs, air sampling, dust sampling, exposure estimates

Abstract: Introduction: This study aims to assess exposure of the Irish population to polybrominated diphenyl ethers (PBDEs) and hexabromocyclododecane (HBCDD) – collectively "POP-BFRs" – and decabromodiphenyl ethane (DBDPE) in common indoor microenvironments (MEs). HBCDD and PBDEs were used as flame retardants in a variety of soft furnishings, building insulation foams, electronic and electrical goods. PBDEs and HBCDD are classified as persistent organic pollutants (POPs) under the UNEP Stockholm Convention. Previous Irish human bio-monitoring data and information regarding concentrations of POP-BFRs in foodstuffs suggest that exposure in Ireland is low in an international context. This study reports for the first time the estimated exposure of Irish adults and toddlers to POPBFRs and one of their replacements (DBDPE) via dust ingestion and air inhalation from several microenvironments.

Materials and Methods: Samples were collected from Irish homes, cars, offices and primary schools (n=30 per ME) between 2016 and 2017. Air samples were collected using a sorbent (XAD-3) impregnated polyurethane foam disk, extracted via pressurised liquid extraction using an ASE-350. Dust samples were collected by vacuuming floor surfaces, extracted via a combination of vortexing and ultrasonication. Extracts were further purified on SPE cartridges, concentrated and analysed via GC-EI/MS or LC-MS/MS.

Results: BDE-209 followed by DBDPE were the most abundant BFRs detected in dust and air. Highest concentrations of BDE-209 in air were detected in schools (median: 410 pg/m^3) and in cars for dust (26,000 ng/g). BDE-209 concentrations in school dust were positively correlated with the number of electronics in classrooms (p<0.01). Highest concentrations of DBDPE in air were detected in homes (7000 pg/m^3) and in schools for dust (10,000 ng/g). Schools contained the highest ΣHBCDD concentrations for both air and dust (38 pg/m^3 and 800 ng/g). Homes built after 2013 (n=2) displayed lower concentrations of ΣHCBDD (p<0.01) compared to those constructed before this date (n=24) possibly suggesting a downward trend in the use of this BFR.

Conclusion: Concentrations of DBDPE in dust samples for all our studied MEs are substantially higher than those previously reported internationally. Our data suggests widespread use in Ireland of BDE-209 and its replacement DBDPE. Estimates of exposure via air inhalation and dust ingestion for both Irish adults and toddlers to DBDPE and BDE-209 exceed reported exposure estimates for the UK population.