Media Briefings 2020

#2 Environmental Research: Igniting Innovation

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EMEA PR Manager

22 April 2020

Media Briefing Series

‘Igniting Innovation’ a catalyst for the advancement of science and technology.

Showcasing the drivers of **Innovation** in today’s world:

- **Product innovation** advances in technology offering new approaches that work smarter and faster for the lab of the future
- **Sustainability** of the lab and operations
- **Collaborations and partnerships** that advance science

20 Years of **Agilent** Igniting **Innovation**

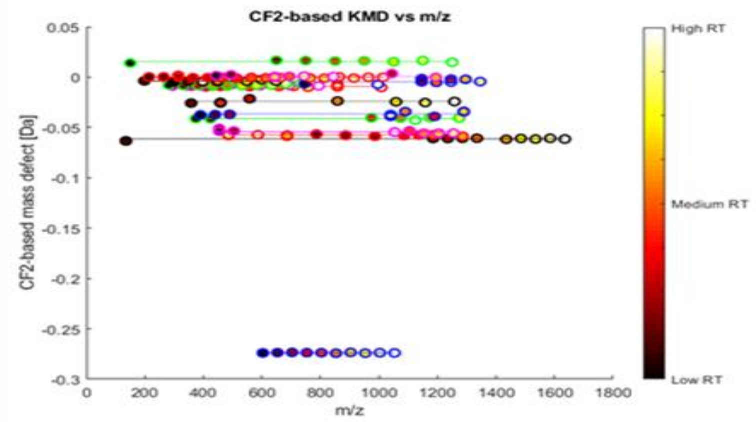
#2 Environmental Research: Igniting Innovation

Today’s Agenda

	Speaker	Presentation
	**Professor Dr. Christian Zwiener** University of Tübingen, Germany	**Emerging pollutants (focus on per- and polyfluoroalkyl substances (PFAS))** Identifying and characterizing emerging contaminants in water treatment systems and their removal to promote safe drinking water
	**Professor Jes Vollertsen** Aalborg University, Denmark	**Microplastics here, there and everywhere** Development and improvement of analytical methods to quantify microplastics in environmental matrices, with a focus on airborne microplastics
	**Professor Fiona Regan** Dublin City University, Ireland	**Optimising techniques to enhance the detection of Persistent Organic Pollutants (POPs)** Emerging concerns for contaminants at low concentrations giving rise to new analytical and preparation technologies for different types of water such as ground level, surface level, and wastewater effluents
	Closing remarks session	**Audience Q&A and briefing recap**

EBERHARD KARLS UNIVERSITÄT TÜBINGEN

MATHEMATISCH-NATURWISSENSCHAFTLICHE FAKULTÄT



Emerging pollutants - PFAS

Environmental Analytical Chemistry
Center for Applied Geoscience

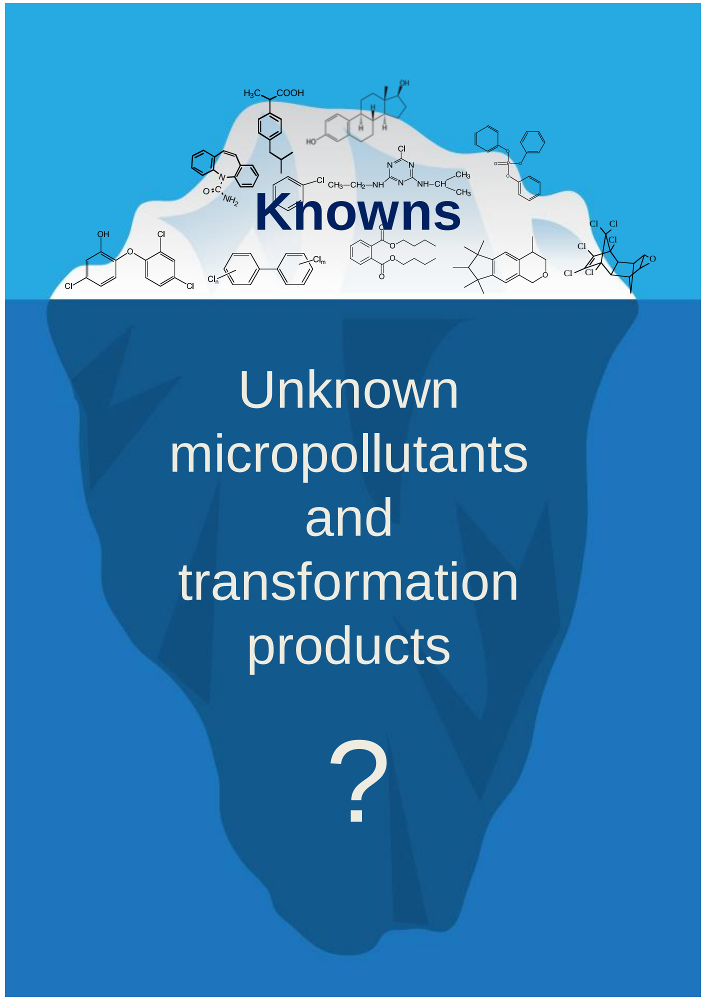
EAC Environmental Analytical Chemistry

Emerging Pollutants

- > 120,000 chemicals registered (EU)
- > 30,000 REACH chemicals in daily use
- More than 700 pollutants found in EU waters (Norman network)

→ **Challenge for**
- monitoring programs
- assessment of fate and risks

➢ **Multianalyte methods**, harmonized
➢ Low **LOQs** for highly hazardous compounds
➢ **Prioritization** approaches
➢ PC data on **metabolites** and pollutants
➢ Approaches to assess **cumulative risks**

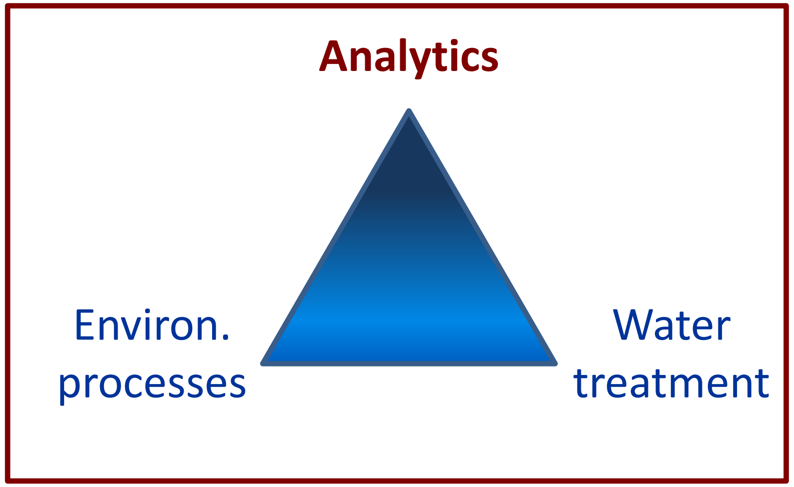


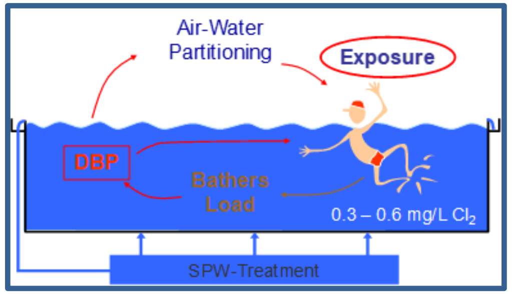
„Chemicals challenge“

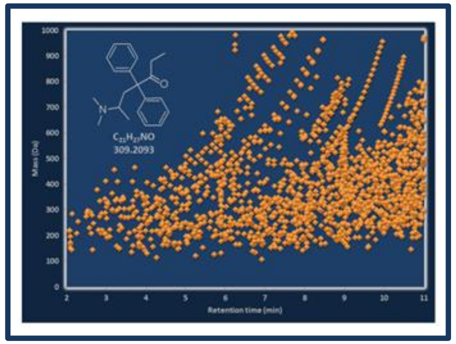
Our research

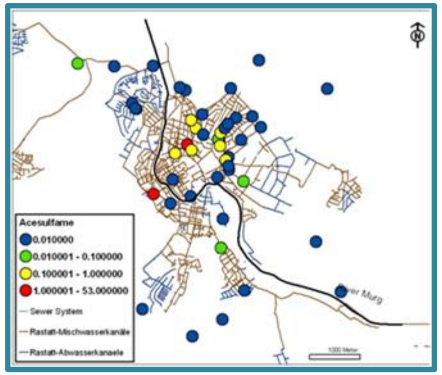
Occurrence and fate of polar organic pollutants in the environment and in water treatment

- Non-target screening (HRMS)
- Identification of TPs
- Electrochemistry
- Reactive membranes
- Disinfection byproducts









Our instrumentation

→ **Sample preparation**
automated and manual SPE
(Gilson GX-271 ASPEC)

→ **Target methods for multiple analytes, low LOQ**
LC-TQ-MS (Agilent 6490, 6470)
GC-Membrane-inlet-MS (Thermo Fisher Scientific, DSQ II MS)

→ **Nontarget methods, suspect screening, high resolution and mass accuracy**
LC-QTOF-MS (Agilent 6550 iFunnel)

Emerging pollutants and their effects

CRC 1253 CATCHMENTS AS REACTORS

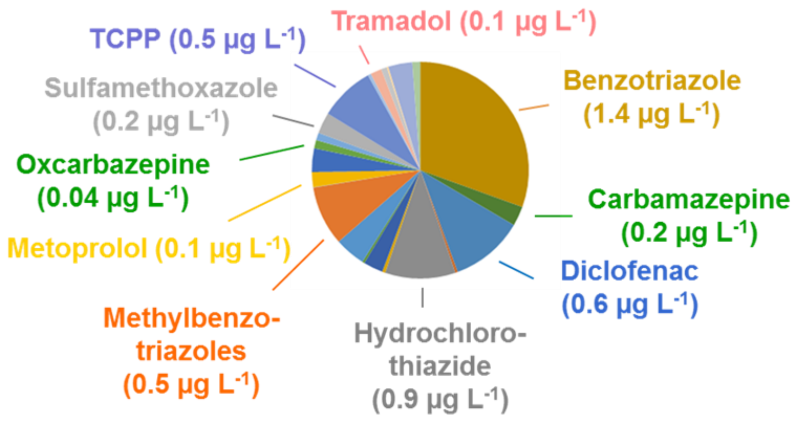
CAMPOS

Environmental Sciences Europe

RESEARCH Open Access

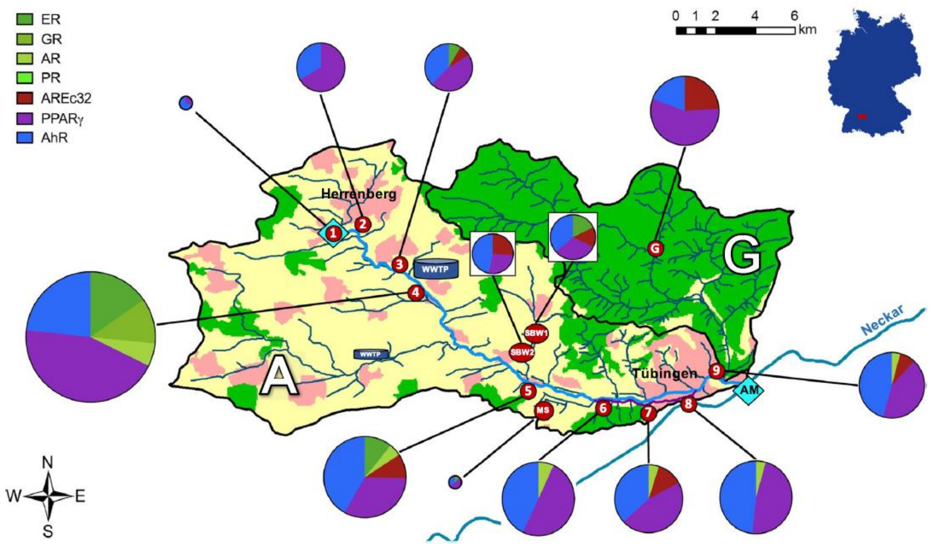
Combining in vitro reporter gene bioassays with chemical analysis to assess changes in the water quality along the Ammer River, Southwestern Germany

Maximilian E. Müller[1], Beate I. Escher[1,2], Marc Schwientek[1], Martina Werneburg[1], Christiane Zarfl[1] and Christian Zwiener[1*]



→**Target methods**

→**Cell-based bioassays**



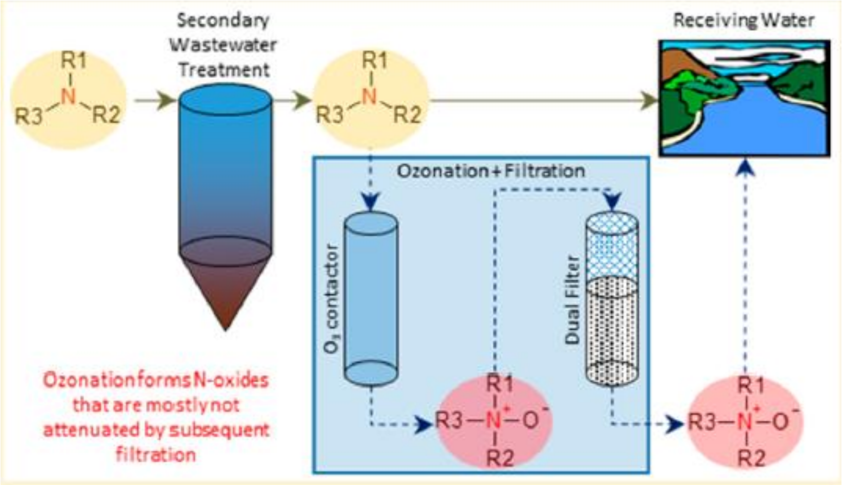
Nontarget screening

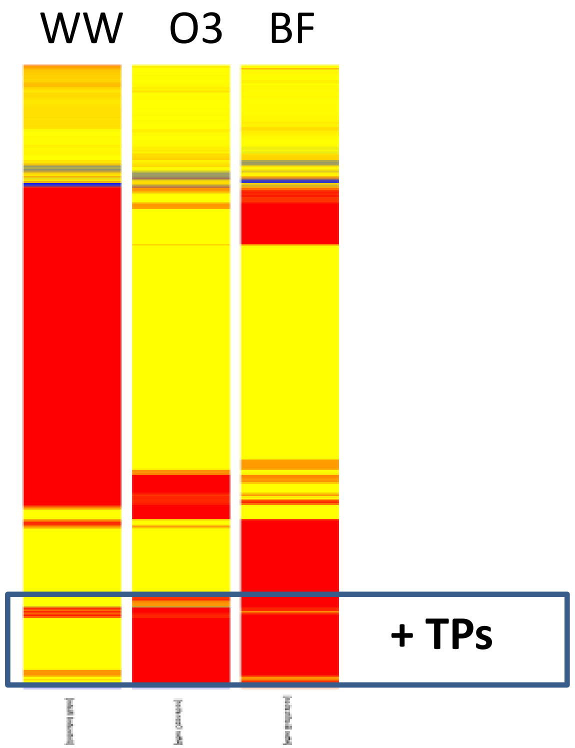
Environmental Science & Technology
Article
pubs.acs.org/est

Assessment of *N*-Oxide Formation during Wastewater Ozonation

Sylvain Merel, Sascha Lege, Jorge E. Yanez Heras, and Christian Zwiener*

Environmental Analytical Chemistry, Center for Applied Geosciences, Eberhard Karls University Tübingen, Hölderlinstraße 12, 72074 Tübingen, Germany





→**HRMS**

→**Workflows for data evalution**

TP identification

Environmental Science & Technology

Article

Cite This: Environ. Sci. Technol. 2019, 53, 7400–7409

pubs.acs.org/est

Transformation Products of Fluoxetine Formed by Photodegradation in Water and Biodegradation in Zebrafish Embryos (*Danio rerio*)

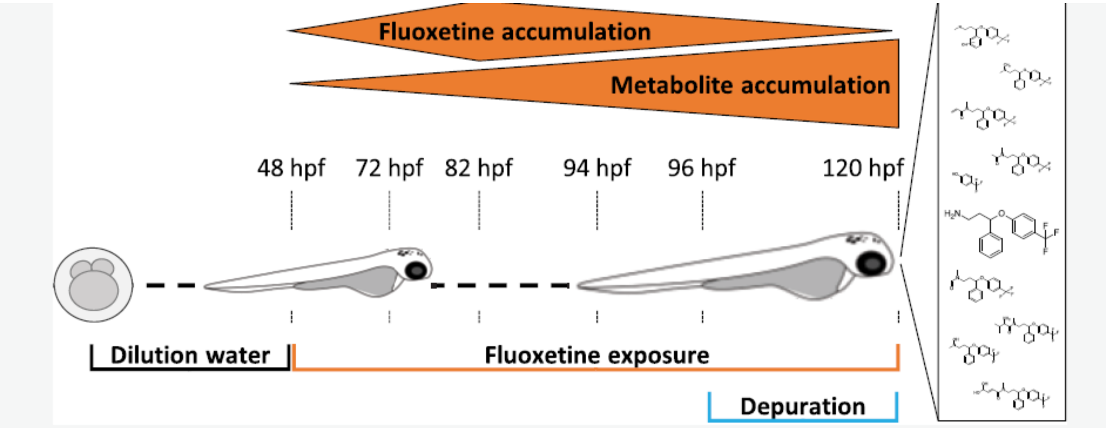
Selina Tisler,[†] Florian Zindler,[‡] Finnian Freeling,[§] Karsten Nödler,[§] László Toelgyesi,[||] Thomas Braunbeck,[‡] and Christian Zwiener[*,†]

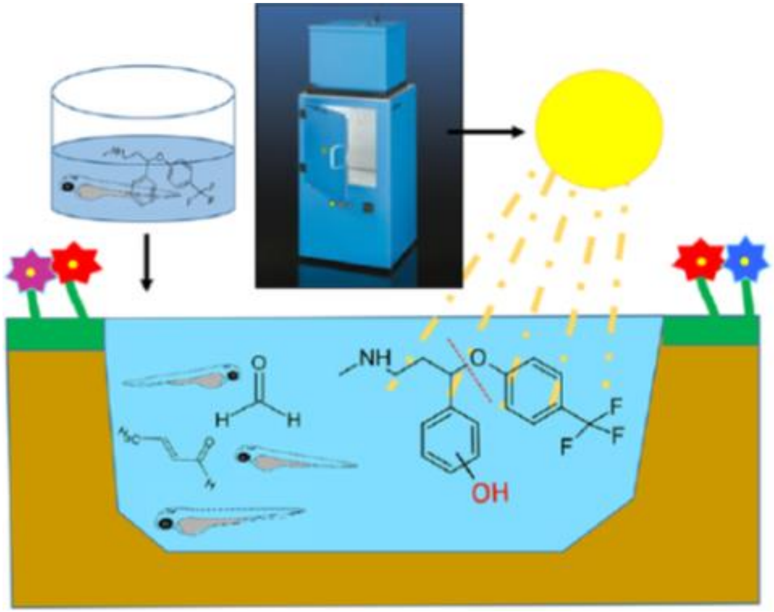
Norfluoxetine Is the Only Metabolite of Fluoxetine in Zebrafish (*Danio rerio*) Embryos That Accumulates at Environmentally Relevant Exposure Scenarios

Florian Zindler,[*] Selina Tisler, Ann-Kathrin Loerracher, Christian Zwiener, and Thomas Braunbeck

Cite This: https://dx.doi.org/10.1021/acs.est.9b07618

Read Online





→ **Metabolite ID**

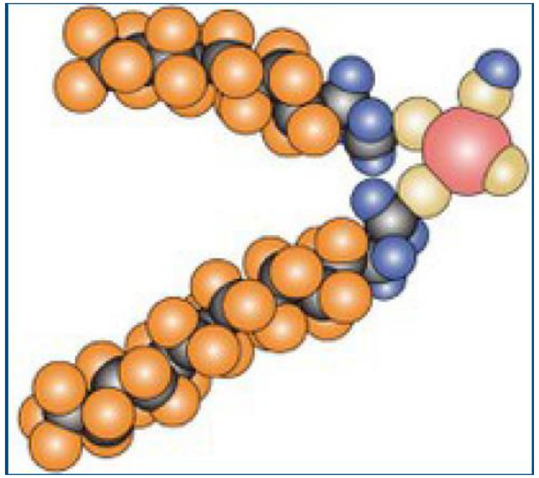
→ **Effects**

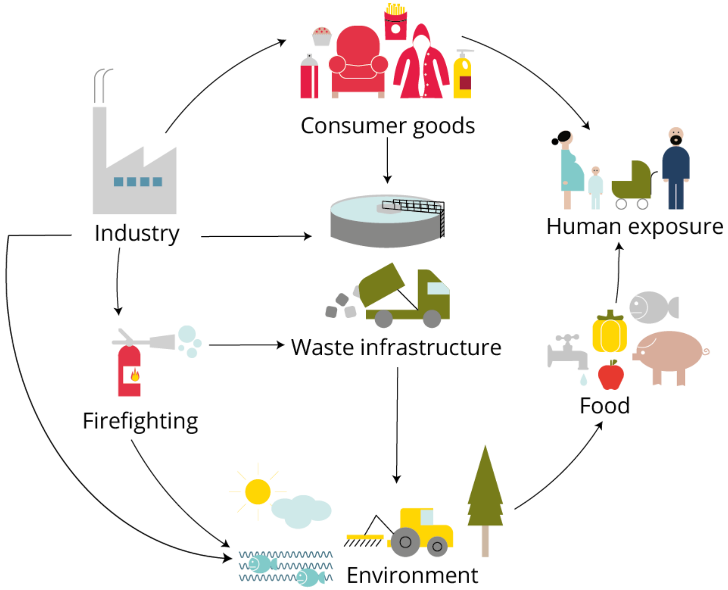
Effect Network in Water Research

EffeNet

PFAS

- > 4700 **Poly- and perfluorinated substances** (PFAS; OECD portal)
- PFAS are **persistent and mobile**, accumulate in humans and in the environment
- **PFOS and PFOA** in Annex A (Stockholm Convention)
- PFOA and PFOS are **priority hazardous substances** (WFD 2000/60/EC)
- → Proposal of regulating **PFAS as class**, 0.5 µg/L group limit, 0.1 µg/L for 16 individual PFAS (European Environment Agency 2019)

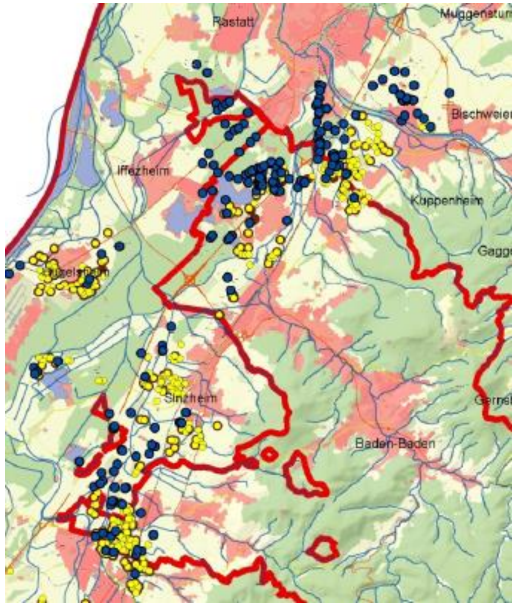




PFAS contaminaton

„Rastatt Case“ – Large-scale PFAS contamination

- **2013 PFC** found by chance in GW & DW in Rauental
- Monitoring showed **large-scale contamination** of wells
- **PFAS input** on agricultural land
- **Compost and paper fibers** as input sources
- → 7.8 Mio m² agricultural soils contaminated
- → 2 Drinking water works closed, other with enhanced treatment

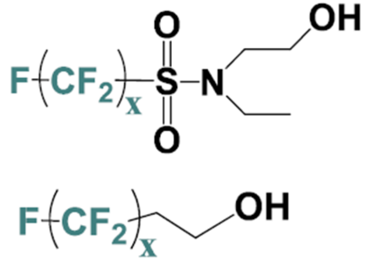


Input & fate of PFAS contamination

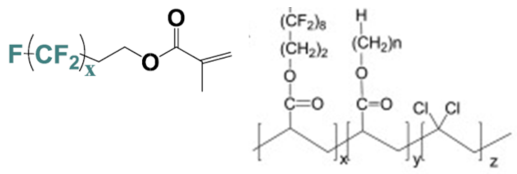
PFAS in paper and card board

- PFAS are **oil and water repellent**
- Use in **food contact materials**, textiles, leather, cleaning agents…
- Commercial **PFAS products** contain homologue series

PreFOS, FTOH, FTSH

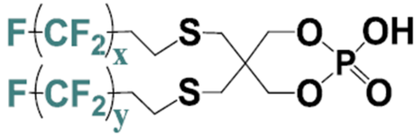


Fluoroacrylates

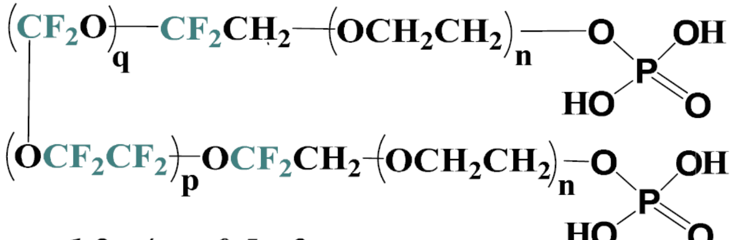


Fluoroacrylate copolymer

PAPs



Polyfluorinated Polyethers



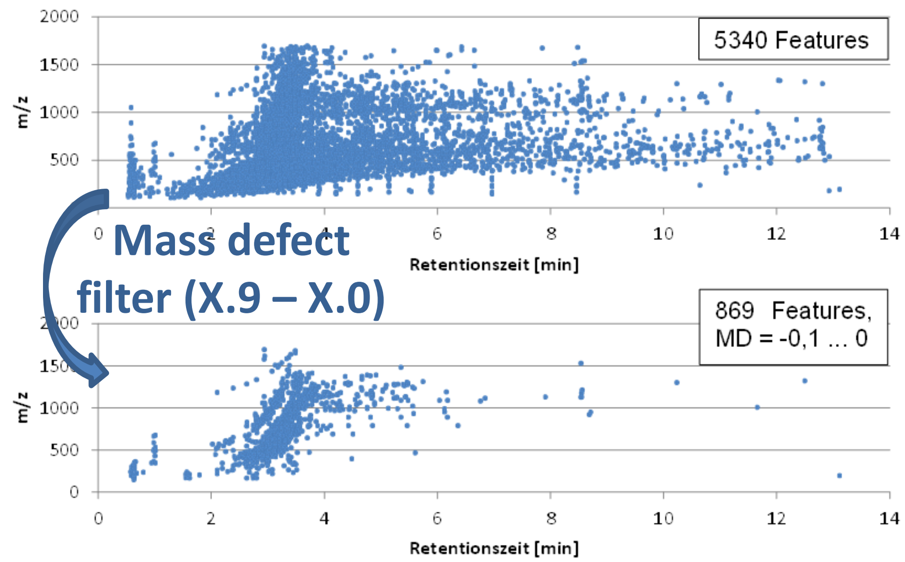
n=1,2 p/q = 0.5 - 3

Trier et al. Environ. Sci. Pollut. Res. 18 (2011) 1108-1120

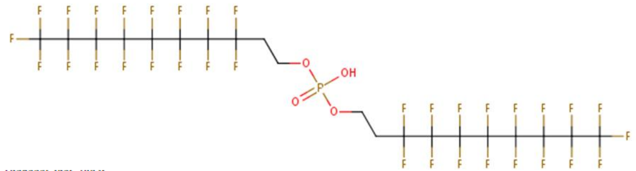
HRMS screening

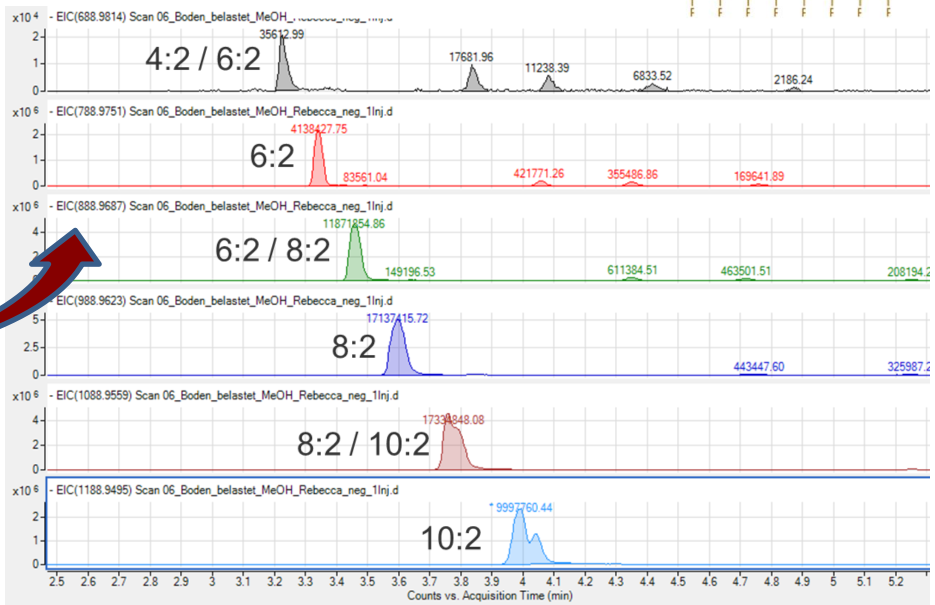
- LC-ESI-QTOF-MS screening of soil extract
- Data evaluation:

  - Peak finding (MFE)
  - mass defect filter,
  - Kendrick mass analysis



diPAPs





Kendrick mass analysis

($-C_2F_4-$ homologue series)

HRMS screening

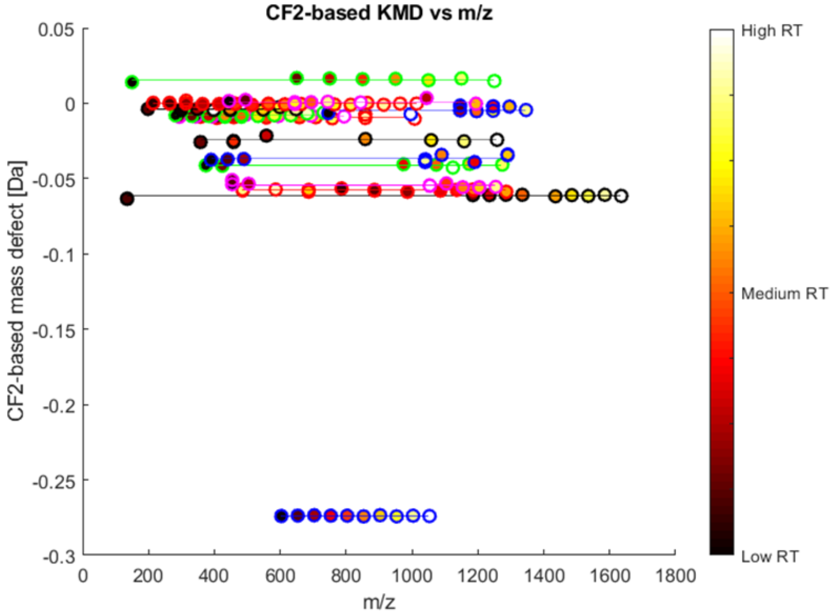
Analytical and Bioanalytical Chemistry
https://doi.org/10.1007/s00216-019-02358-0

PAPER IN FOREFRONT

LC-MS screening of poly- and perfluoroalkyl substances in contaminated soil by Kendrick mass analysis

Boris Bugsel[1] · Christian Zwiener[1]

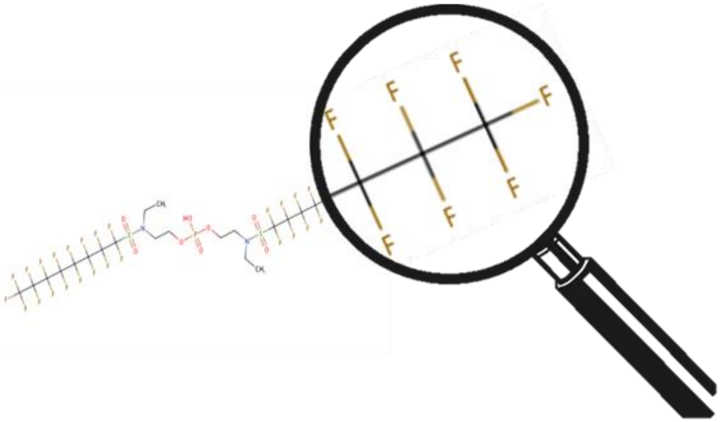
Compound	Number of compounds	Mass range	Identification
PFCA	17	263 - 1013	Standard (PFOA)
PFSA	5	399 - 599	Standard (PFOS)
FTUCA	10	357 - 857	Standard (8:2 FTUCA)
FASA	4	398 - 648	Standard (FOSA)
diPAP	9	689 - 1489	Standard (6:2/8:2)
PFPIA	4	751 - 901	Homologue series
n:2 FTCA	3	427 - 527	Standard (8:2 FTCA)
n:3 Acid	6	391 - 641	Standard (7:3 Säure)
PFAL	6	297 - 547	Homologue series
MeFASA	1	512	No homologue series
EtFASA	1	526	No homologue series
diSAmPAP	8	953 - 1303	Standard (C8)
monoPAP	11	343 - 843	Standard (8:2)
EtFASAA	4	534 - 684	Standard (C8)
2*H*-PFCA	15	345 - 1045	Homologue series
triPAP	>4	n.a.	Homologue series
PF-polyether	4	1071 - 1221	Homologue series



- Most important precursors are diPAPs and diSAmPAP
- Degradation products: PFCAs, PFOS, N-Ethyl FASAA

Future needs and developments

- Sample prep and **separation methods** for polar pollutants
- **HRMS:** Enhanced resolution and accuracy → assignment of chemical formula
- **Data evaluation:** Automated workflows for NTS data
- Cheap and **easy to use (field) analysis approaches** to monitor and control PFAS in remediation and water treatment



Thanks

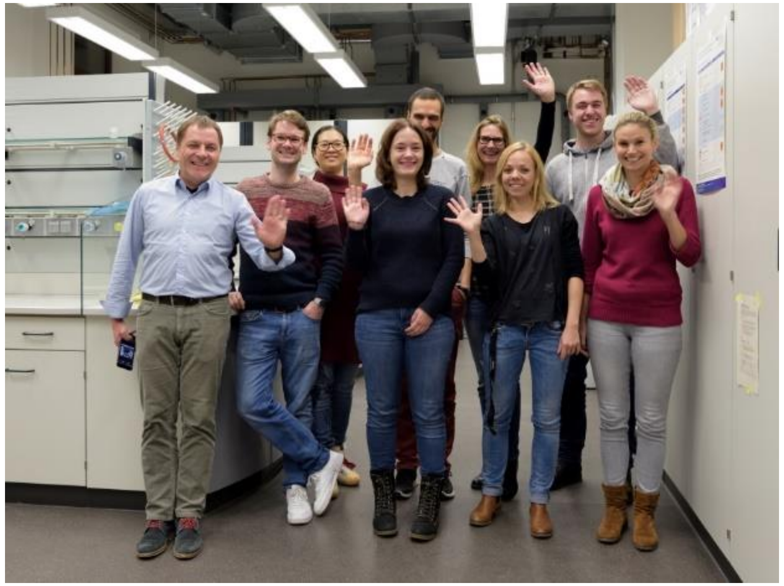
Funding:

Baden-Württemberg Programs (KIT)

- **EOFplus (L75 17012)**
- **FluorTECH (BWPFC 19010)**

DFG CRC 1253 Campos

Ministry for Research and Education BW



Project partners:

- Technology Center Karlsruhe TZW
- Fraunhofer Institute for Process Engineering and Packaging IVV, Freising
- Helmholtz Center for Environmental Research, Leipzig
- Agricultural Technology Center Augustenberg LTZ, Karlsruhe

Students: Boris Bugsel, Selina Tisler, Jonathan Zweigle, Rebecca Bauer, Yudha Haeqal

Microplastics here, there and everywhere

Development and improvement of analytical methods to quantify microplastics in environmental matrices, with a focus on airborne microplastics

Jes Vollertsen, Professor, Aalborg University, Denmark

Environmental Engineer with focus wastewater and stormwater

Came into microplastics research in 2016

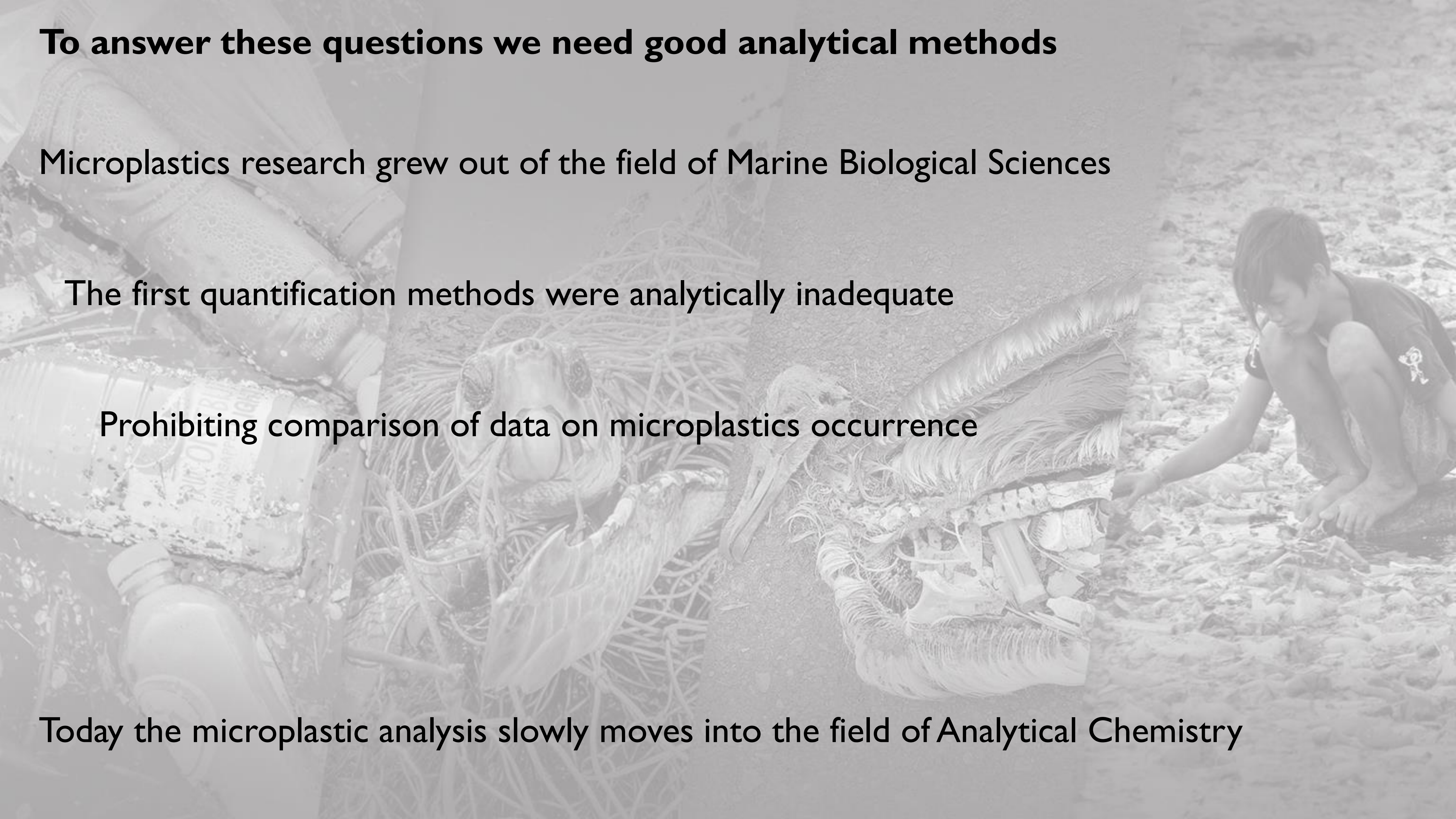
An estimated

4.8 and 12.7 million tonnes

of plastic is emitted into the
marine environment every year

How much is elsewhere? in the air you breath, the food you eat and the water you drink?
What harm does it cause?
What can we do about it?

Data from: Jambeck et al., 2015, Science



To answer these questions we need good analytical methods

Microplastics research grew out of the field of Marine Biological Sciences

The first quantification methods were analytically inadequate

Prohibiting comparison of data on microplastics occurrence

Today the microplastic analysis slowly moves into the field of Analytical Chemistry

The microplastic team at Aalborg University

Professors
Jes Vollertsen
Asbjørn H Nielsen
Diana A Stephansen

Postdocs
Alvise Vianello
Inga Kirstein
Claudia Lorenz
Fan Liu

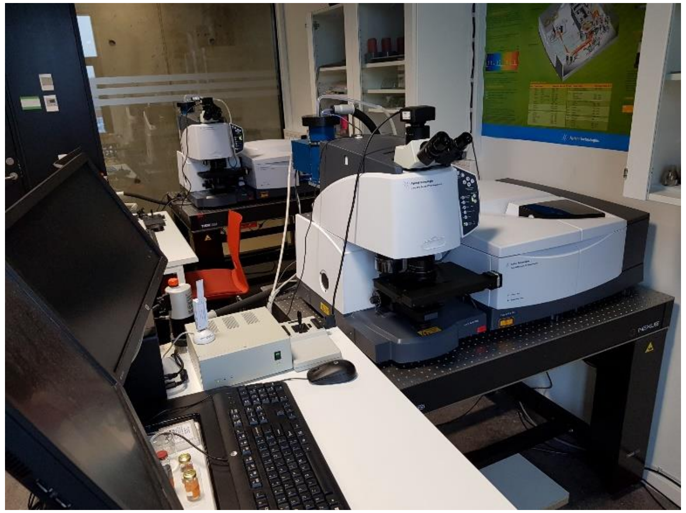
PhD students
Nikki van Alst
Marta Simon
Kristina B Olesen
Lasse A Rasmussen
Rupa Chand
Jeanette Lykkemark
Lucian Iordachescu
Marziye Molazadeh
Luca Maurizi
Yuanli Liu

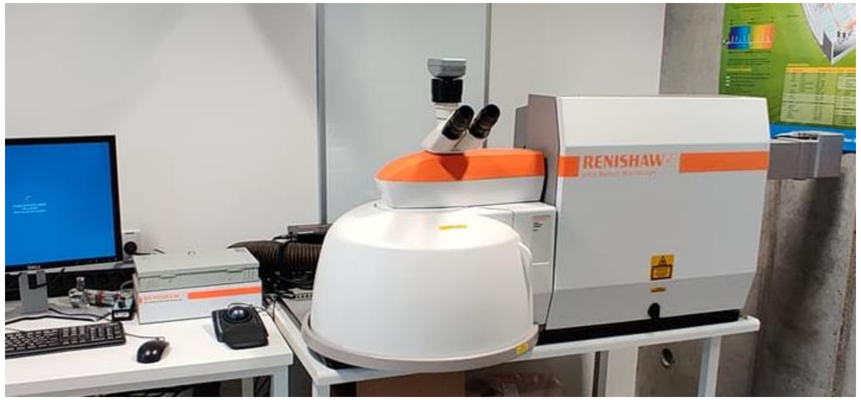
Technicians
Jytte Dencker
Henrik Koch

Research assistants
Konstantinos Papacharalampos
Fides Hensel

Key lab infrastructure

μFTIR imaging
ATR-FTIR
Pyrolysis GC-MS
μRaman
Single-cell ICP-MS
FlowCam
Clean-lab facilities
Field monitoring equipment





How we analyze for small microplastics

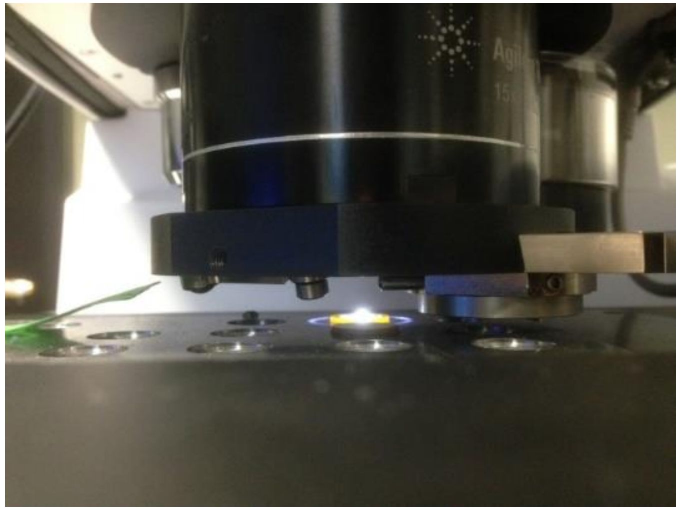
Sample pre-treatment

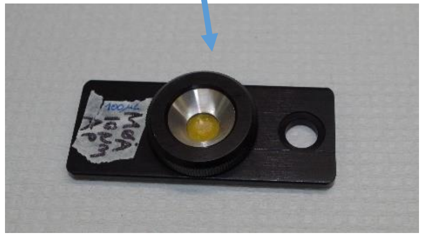
Collect samples in vial

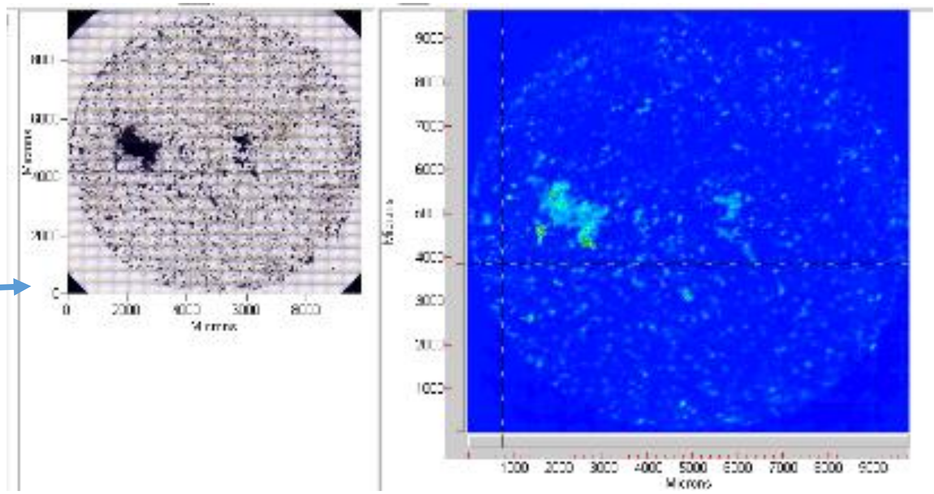
Deposit sample on slide, window or filter

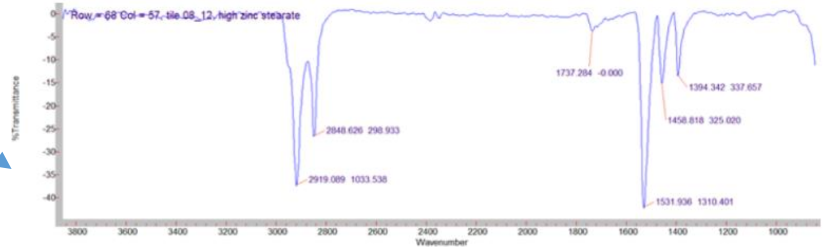
Scan it

Interpret

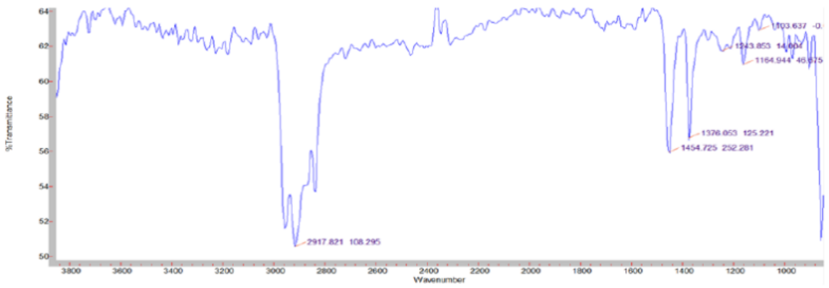








A good IR spectrum of what looks like zinc stearate



A medium quality spectrum of what likely is polypropylene

And out comes the data monster

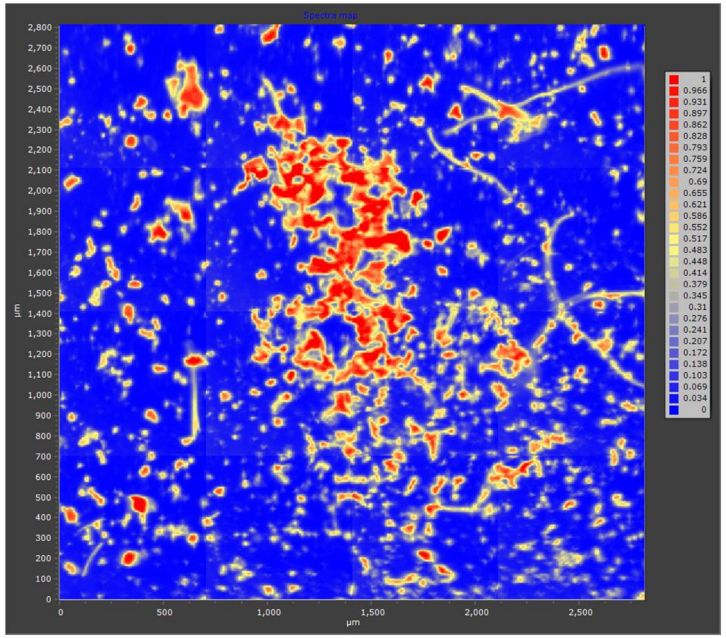
We typically scan an area of 10x10 mm at 5.5 µm pixel resolution to create a map of 3,211,264 individual spectra

We then compare each spectrum with several hundreds reference spectra

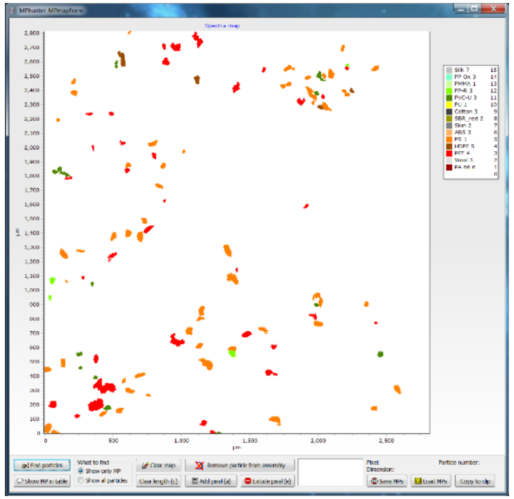
We build our own software together with a German research group:

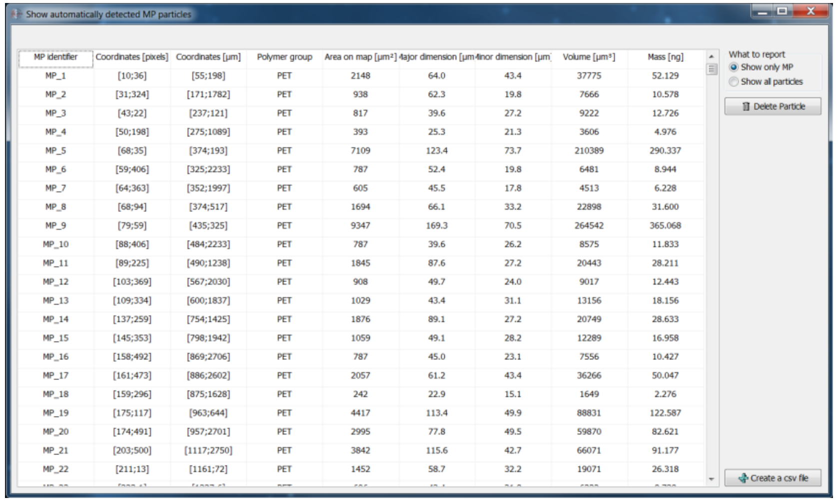
siMPle

(MP analysis for non-nerds)



Data crunching

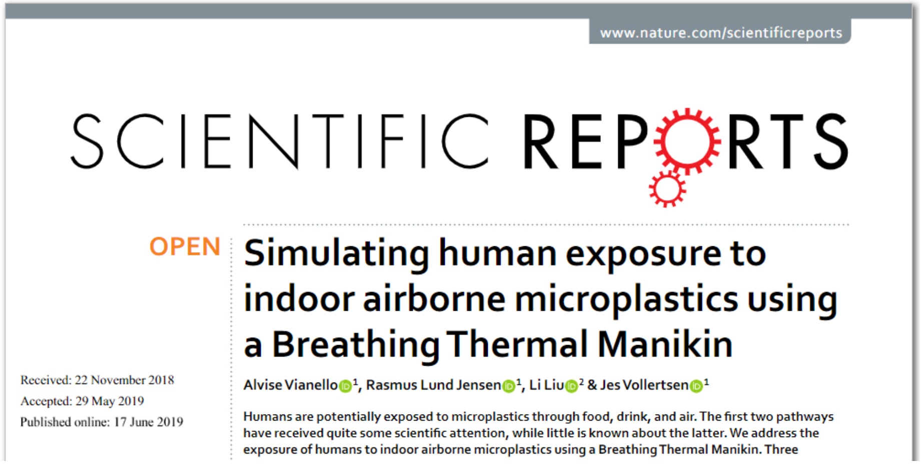




www.simple-plastics.eu

MP in indoor air

A study of microplastics in indoor air



www.nature.com/scientificreports

SCIENTIFIC REPORTS

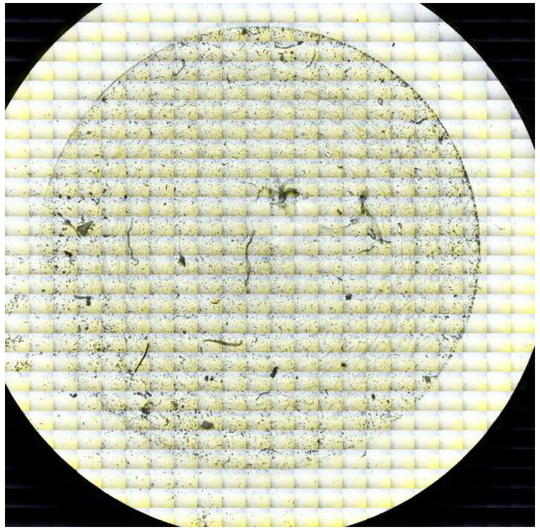
OPEN

Simulating human exposure to indoor airborne microplastics using a Breathing Thermal Manikin

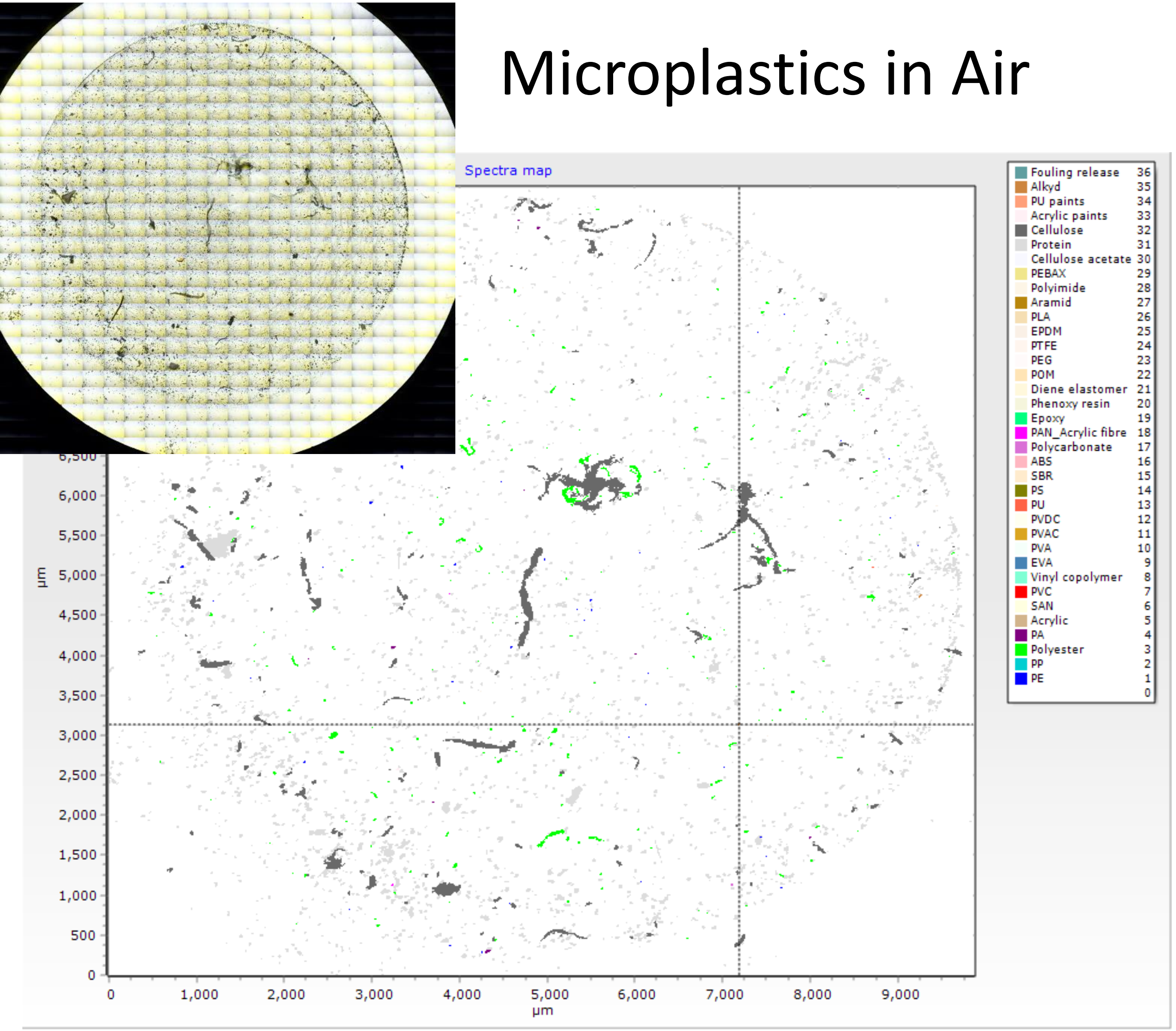
Received: 22 November 2018
Accepted: 29 May 2019
Published online: 17 June 2019

Alvise Vianello[1], Rasmus Lund Jensen[1], Li Liu[2] & Jes Vollertsen[1]

Humans are potentially exposed to microplastics through food, drink, and air. The first two pathways have received quite some scientific attention, while little is known about the latter. We address the exposure of humans to indoor airborne microplastics using a Breathing Thermal Manikin. Three

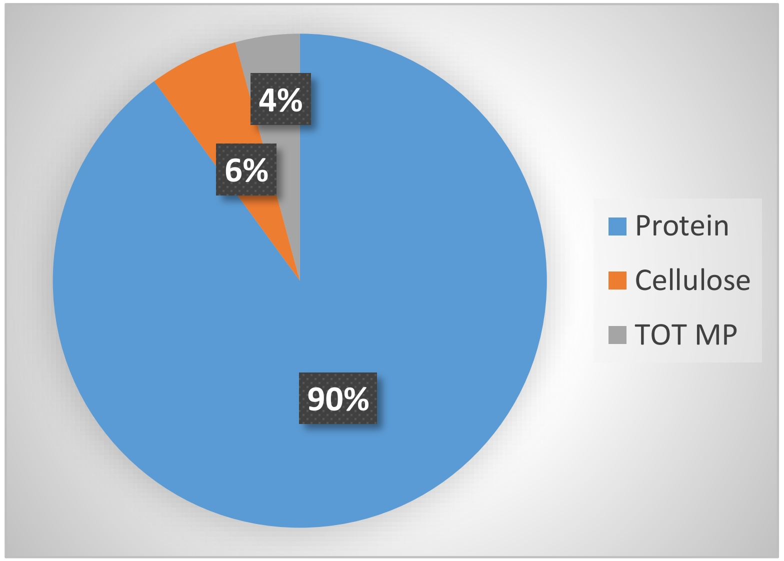


Microplastics in Air



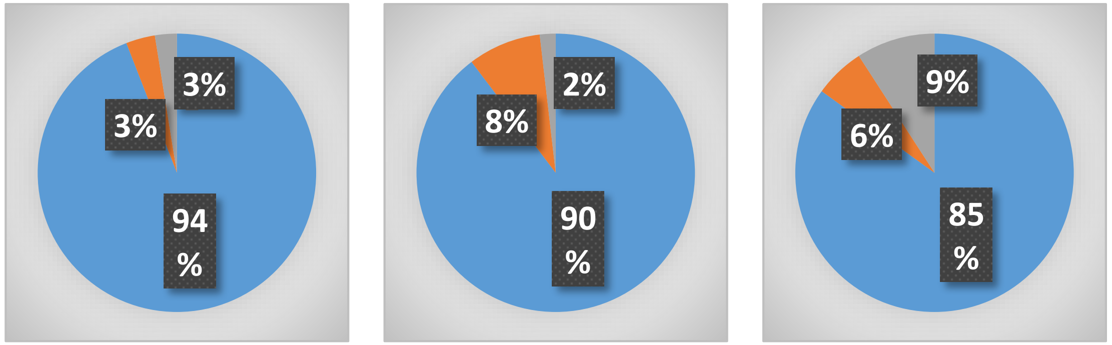
Gray: Natural materials
Colored: Plastics

Composition of the organic material in the dust



- Proteins, for example skin and hair
- Cellulose, for example cotton
- TOT MP: all sorts of microplastics

Variations between the 3 flats

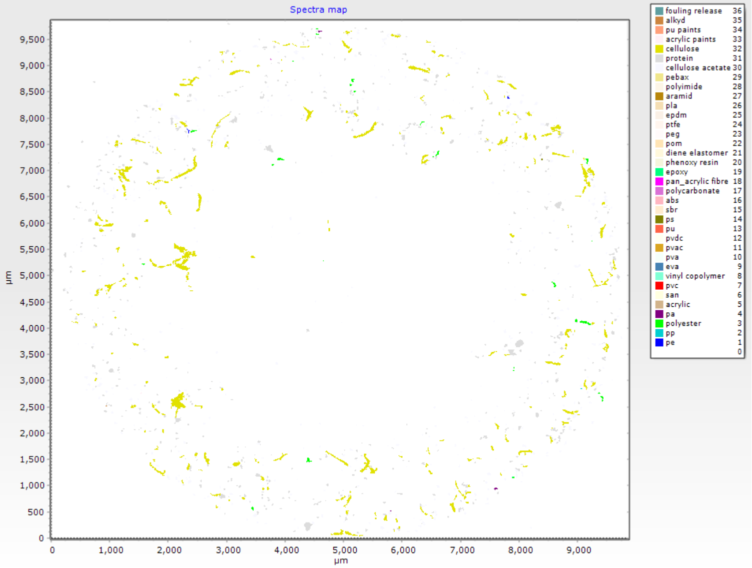


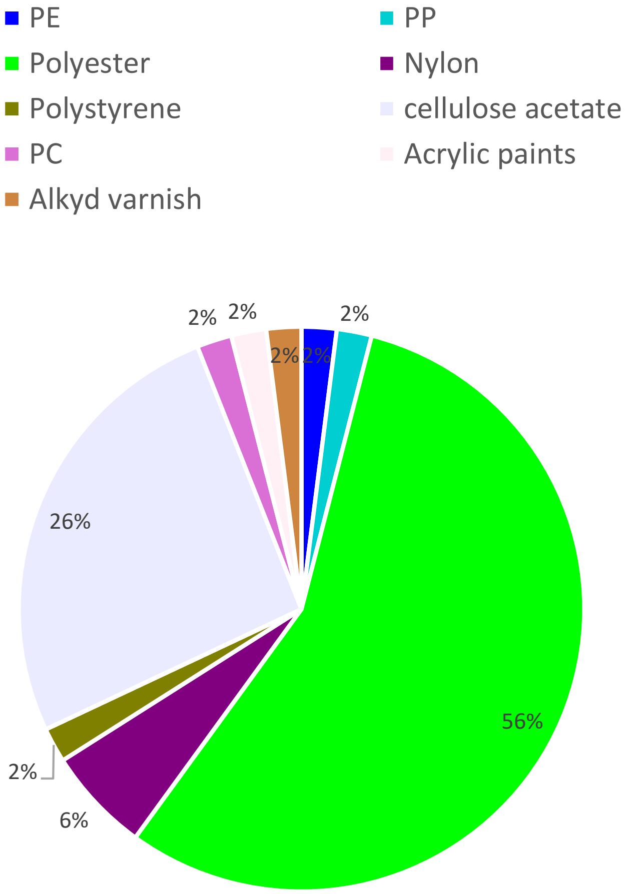
Another study of microplastics in indoor air

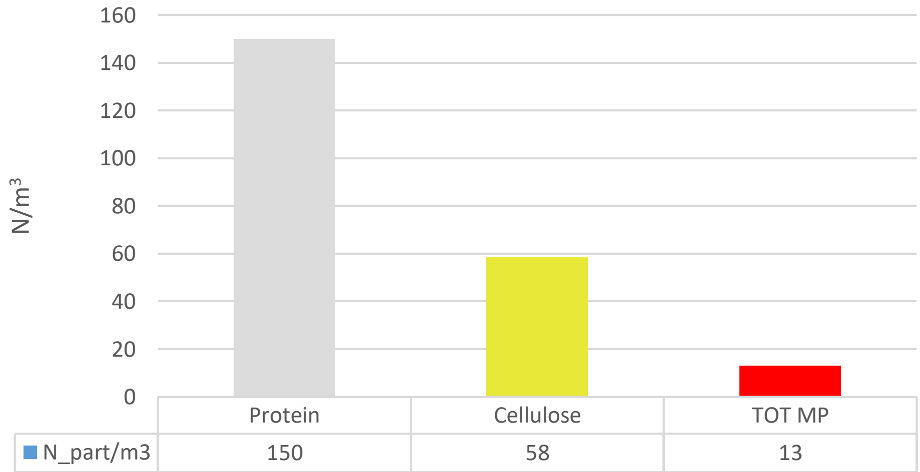
Microplastics in a flat in Copenhagen – a part of a Danish TV production

We measured the microplastics in the air

Air was filtered for 8 hours, analyzed on the Cary 620/670



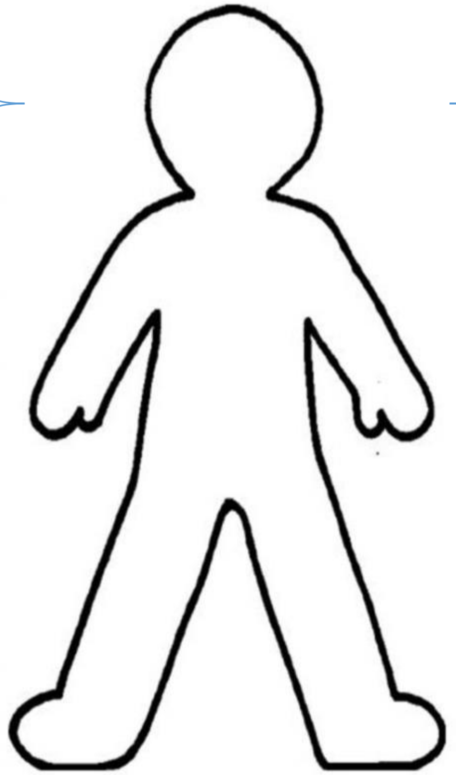




How much microplastics does a human take in?

The comparison is done on data from Aalborg University only, so we are sure it is comparable
(part is still unpublished)

Indoor air ≈ 4000 m^3/year	20,000 pieces of plastic per year
Drinking water ≈ 1000 L/year	20 pieces of plastic per year
Soft drinks ≈ 400 L/year	1,500 pieces of plastic per year
Food ≈ 400 kg/year	? pieces of plastic per year (likely less than soft drinks?)



Outlook and challenges

Routine monitoring
Commercial laboratories

Standardized methods
High reproducibility
Low cost
Fast analysis

Microplastics research
Universities, research institutions, …

High flexibility
Challenge method boundaries
Price and time less important


not The End
Lets together work for that goal

Optimising techniques to enhance detection of persistent organic pollutants

Professor Fiona Regan
School of Chemical Sciences

Director, Water Institute

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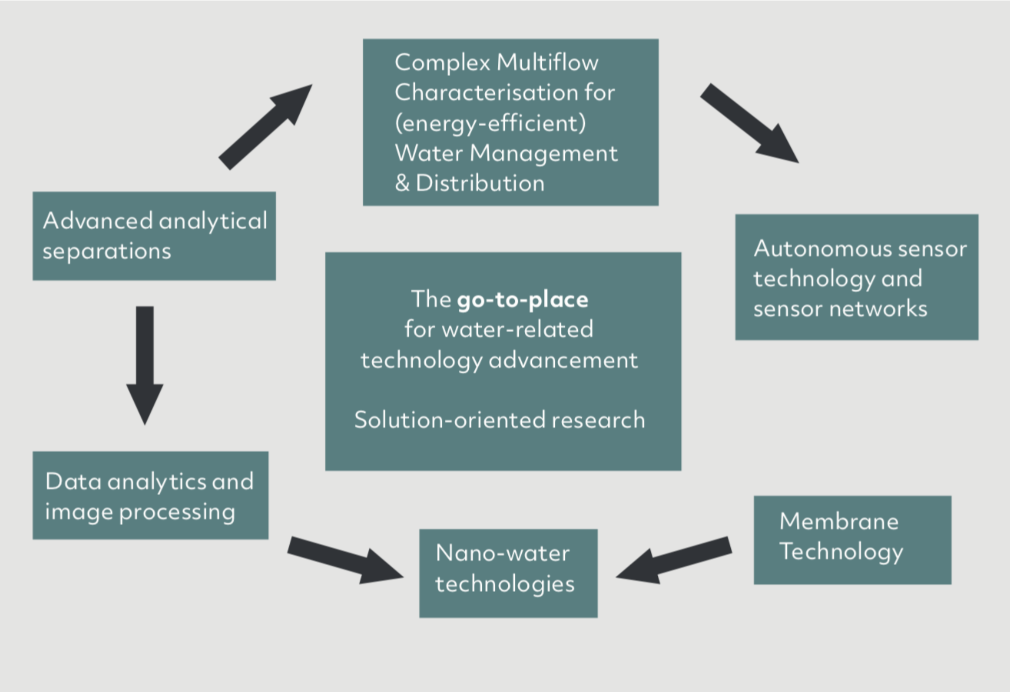
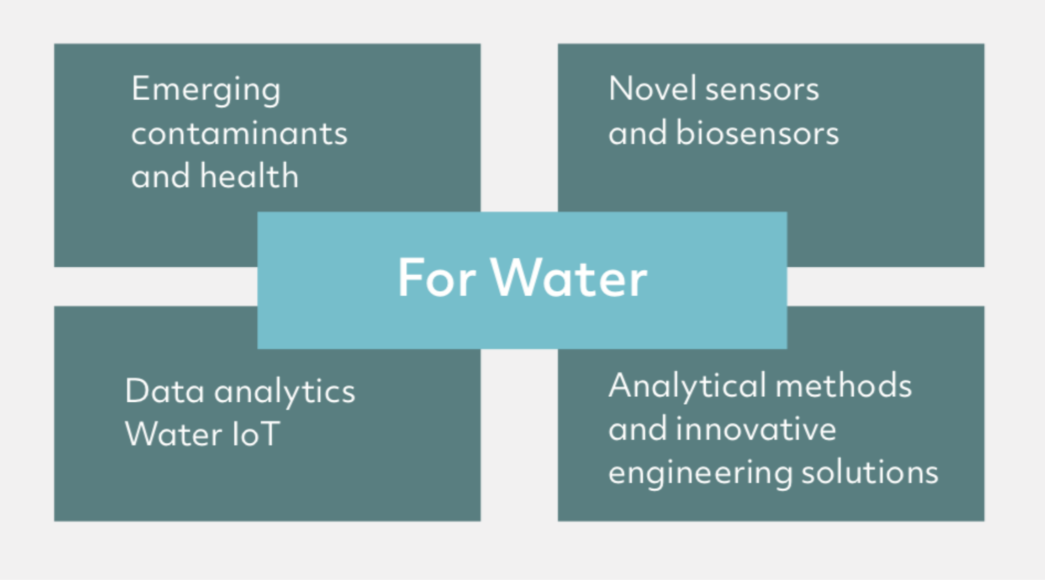
DCU Water Institute

Introduction

DCU Water Institute

Our mission is to support society by carrying out research and development that generates innovative solutions that help to address major water challenges.





Phthalates and human health

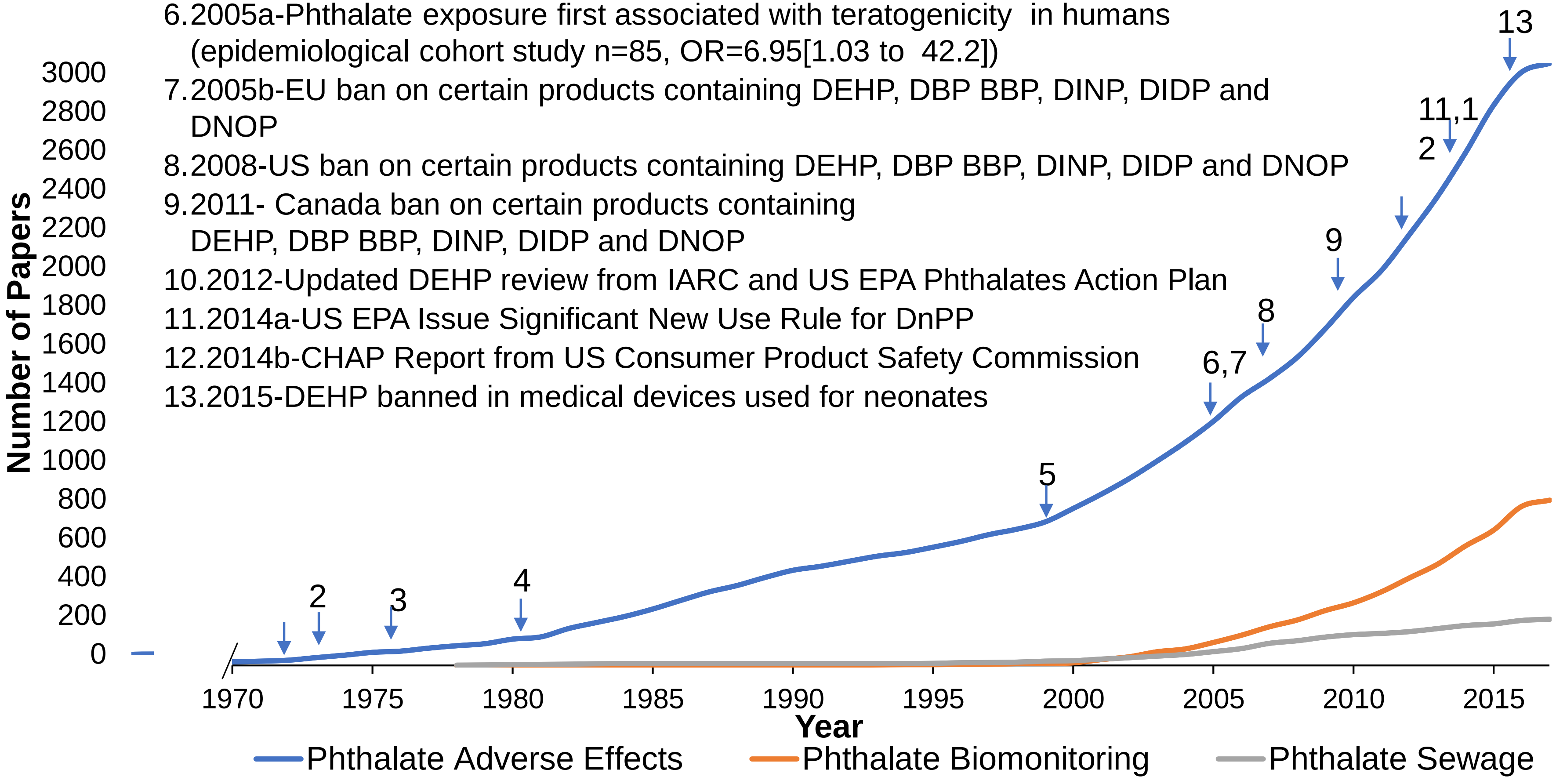
Research Questions

- To what degree are humans exposed to phthalates?
- What do we know about how phthalates affect human health?
- Is wastewater-based epidemiology an effective tool for risk assessment of these chemicals?
- With this information what recommendations can be made for future phthalate legislation?

What is driving research efforts

Phthalate research and legislation

1. 1972-Teratogenicity of phthalates first studied (rat model)
2. 1973-Monesters as phthalate metabolites first (rat model)
3. 1978-Monoesters as phthalate metabolites first studied (humans)
4. 1982-First review on carcinogenicity of DEHP, BBP published by IARC
5. 1999-First use of monoesters for human biomonitoring
6. 2005a-Phthalate exposure first associated with teratogenicity in humans (epidemiological cohort study n=85, OR=6.95[1.03 to 42.2])
7. 2005b-EU ban on certain products containing DEHP, DBP BBP, DINP, DIDP and DNOP
8. 2008-US ban on certain products containing DEHP, DBP BBP, DINP, DIDP and DNOP
9. 2011- Canada ban on certain products containing DEHP, DBP BBP, DINP, DIDP and DNOP
10. 2012-Updated DEHP review from IARC and US EPA Phthalates Action Plan
11. 2014a-US EPA Issue Significant New Use Rule for DnPP
12. 2014b-CHAP Report from US Consumer Product Safety Commission
13. 2015-DEHP banned in medical devices used for neonates



European Chemicals Agency (ECHA)

- Recommendation to the European Commission

- **ECHA has submitted a recommendation to the European Commission to amend Authorisation List (Annex XIV of REACH) entries by adding the endocrine disrupting properties of four phthalates.**
- **Helsinki, 10 July 2019** - ECHA has prepared a recommendation to amend the Authorisation List to include endocrine disrupting properties into the respective entries of:
- **bis(2-ethylhexyl) phthalate (DEHP)** (EC 204-211-0, CAS 117-81-7)
- **benzyl butyl phthalate (BBP)** (EC 201-622-7, CAS 85-68-7)
- **dibutyl phthalate (DBP)** (EC 201-557-4, CAS 84-74-2)
- **diisobutyl phthalate (DIBP)** (EC 201-553-2, CAS 84-69-5).

Legislation

- They were identified as substances of very high concern (SVHCs) due to endocrine disrupting properties with effects on human health.
- DEHP was also identified for its effects on the environment.
- The Candidate List entries for these substances were updated accordingly in 2014 and 2017.
- These four phthalates had earlier been identified as SVHCs (in 2008 and 2009) and subsequently added to the Authorisation List in 2011 and 2012 due to their classification as toxic for reproduction.

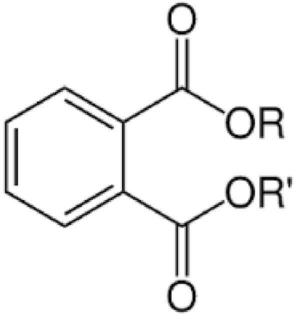
Cycle of Phthalates and their Metabolites in the WWTP

Phthalates are ubiquitous synthetic organic compounds
- Plasticizers
- Endocrine disruptors
- Banned/limited in manufacturing

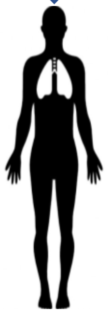
Exposure routes:
- Ingestion
- Inhalation
- Absorption

Health Impacts:
- Male Birth Defects
- Impaired neurological development in children
- Obesity

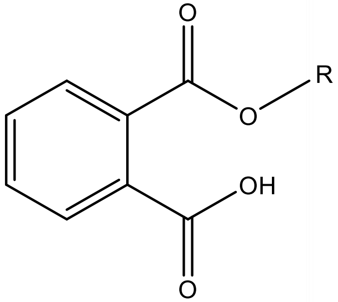
Diesters
Household and Industry



Diester:Monoester ratio



Monoesters
Human metabolism



Identifying and characterizing POPs

Environmental Analytical Approach

Rationale	Proposed
Small scale WWTP	Influent (diester and monoester), Effluent, Sludge
Medium scale WWTP	Influent (diester and monoester), Effluent, Sludge
Large scale WWTP	Influent (diester and monoester), Effluent, Sludge
Surface water catchment	12 months grab
Soil catchment (2 x farms, Tolka Park, industrial estate)	1 x winter 1 x summer Starting July 2018
Landfill + groundwater	4 quarterly samples starting Aug 2018
Recycling plant Green, brown, black	1 of each Dec. 2017
Passive samples	2 deployments winter and summer

DCU

Contamination Control in Phthalate Analysis

Reduce Contamination:

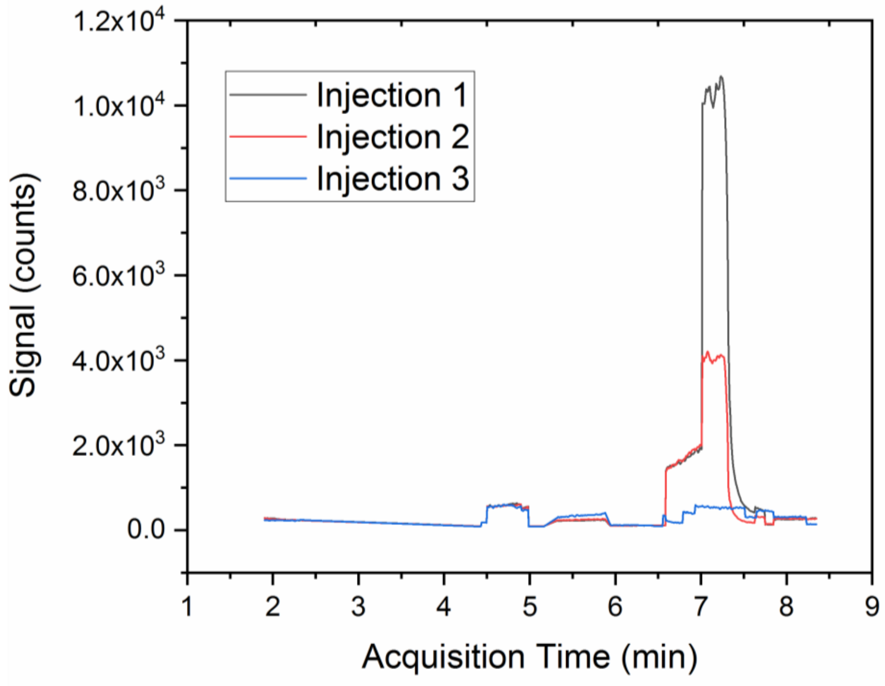
- Extensive glassware preparation with quality controlled solvents
- Minimal handling/analysis steps
- Quality checks on each batch of solvent

Engineering Controls:

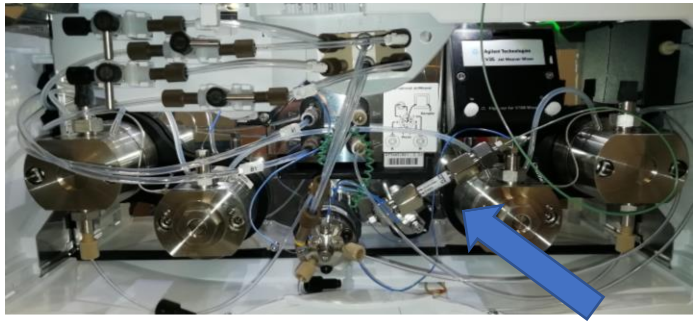
- Stainless steel fittings,
- Delay column fitted
- Multi-wash system and 3 analytical blanks are run between each sample

Eliminate Residual Background:

Subtract Procedural Blank



Analytical Blanks Multi-wash



Delay Column

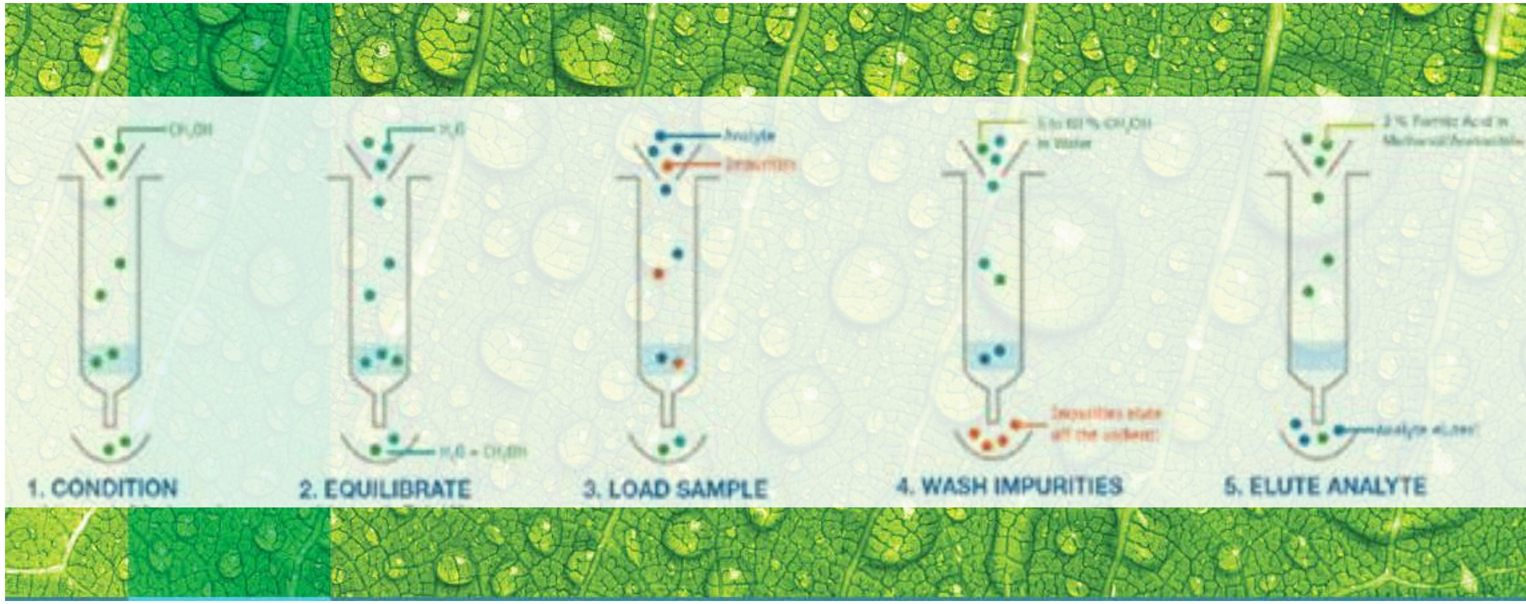
Method Development - Extraction

Solid Phase Extraction (SPE):

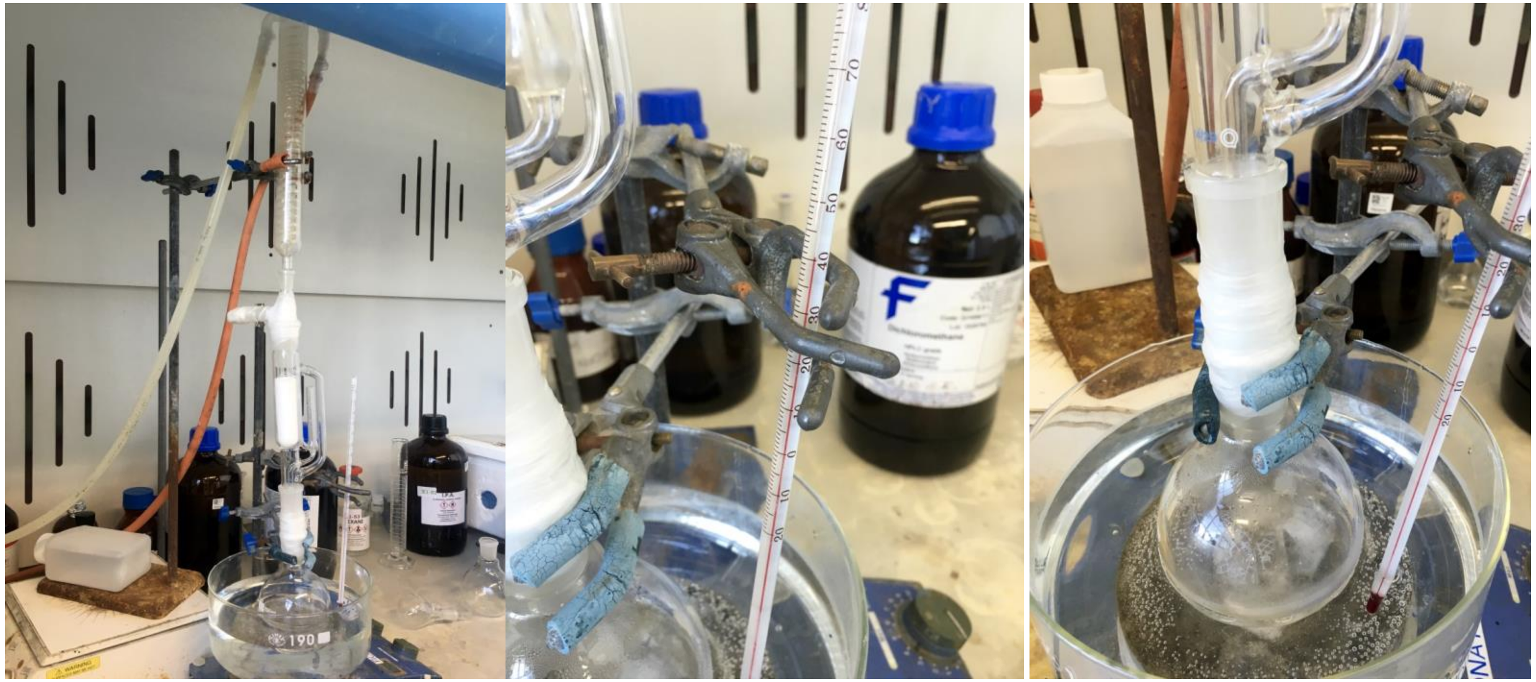
water, leachate, sludge (after pre-prep)

Strata-X Teflon cartridges

- Condition: 20 mL of ACN
- Equilibrate: 20 mL of water
- Load: Sample (*500 mL – 1 L of sample and matrix very slowly*)
- Wash: 20 mL of (40:60) Methanol:Water
- Dry: 10 min under full vacuum
- Elute: 20 mL of ACN



Sample Extraction



Soxhlet Extraction (SE): solids, plastics

- 1 g of material
- Place in round bottom flask and add 100 mL dichloromethane
- Assemble SE apparatus
- Bring to 40ºC and maintain for 16 h

Phthalate target ions

Log Kow 1.6 - 10

Peak No.	Compound	Precurser Ion	Product Ion
1	Dimethylphthalate (DMP)	195.1	162.9
		195.1	77
2	Benzylbutylphthalate (BBP)	313.2	91
		313.2	148.9
3	Diisobutylphthalate (DIBP)	279.2	205.1
		279.2	149
4	Dibutylphthalate (DBP)	279.2	205
		279.2	148.9
5	Diisopentylphthalate (DIPP)	307.18	149
		307.18	77.1
6	Dipentylphthalate (DNPP)	307.2	219
		307.2	148.9

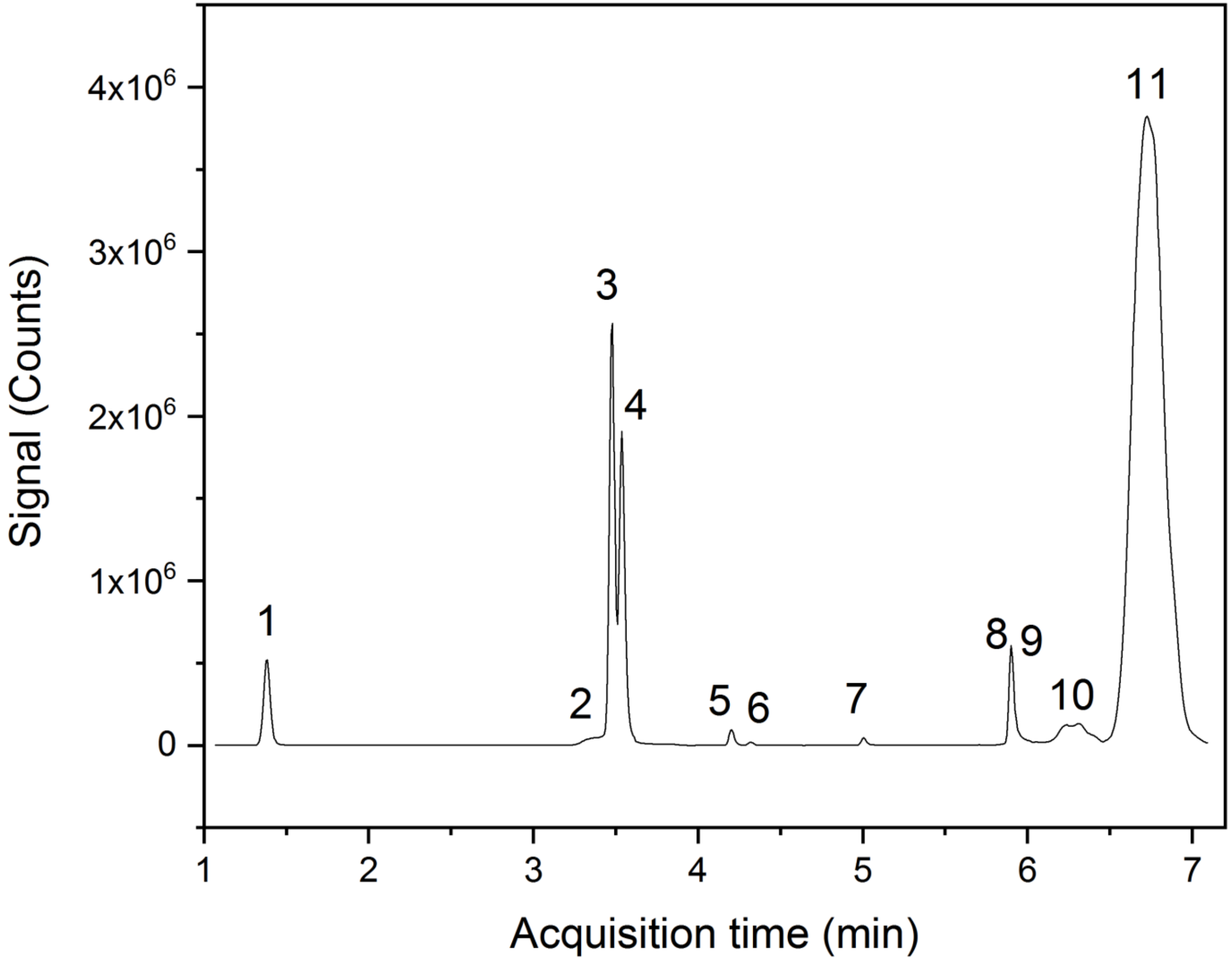
Peak No.	Compound	Precurser Ion	Product Ion
7	Dihexylphthalate (DHP)	335.2	233
		335.2	148.9
8	Diethylhexylphthalate (DEHP)	391.3	279
		391.3	148.9
9	Di-n-octylphthalate (DNOP)	391.3	166.9
		391.3	148.9
10	Diisononylphthalate (DINP)	419.31	148.9
		419.31	71.1
11	Diisodecylphthalate (DIDP)	447.3	141.1
		447.3	85.1

Diester Separation

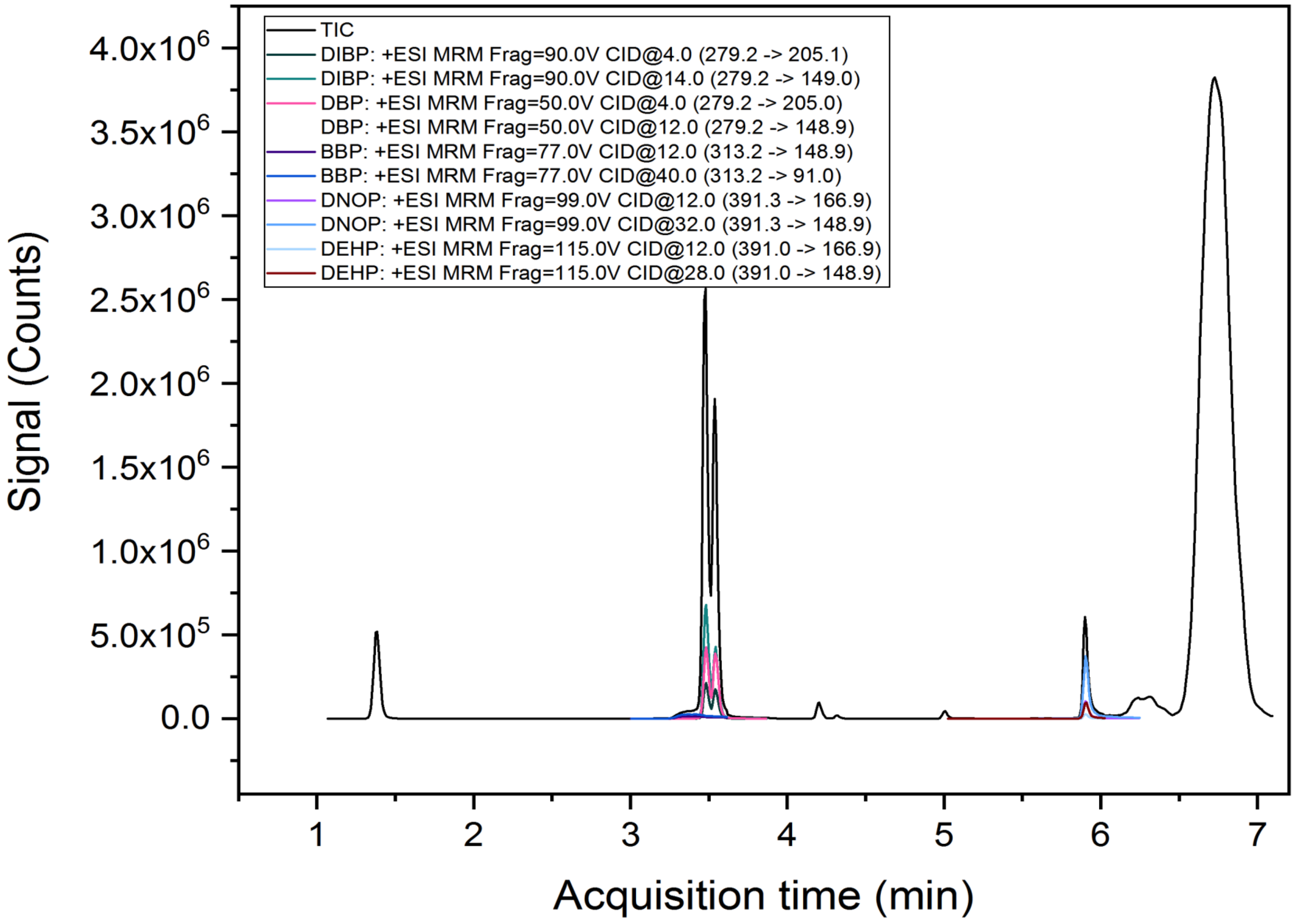
Column: 2.1 x150 mm, 2.7 μm internal diameter Poroshell, temperature 60^{O} C

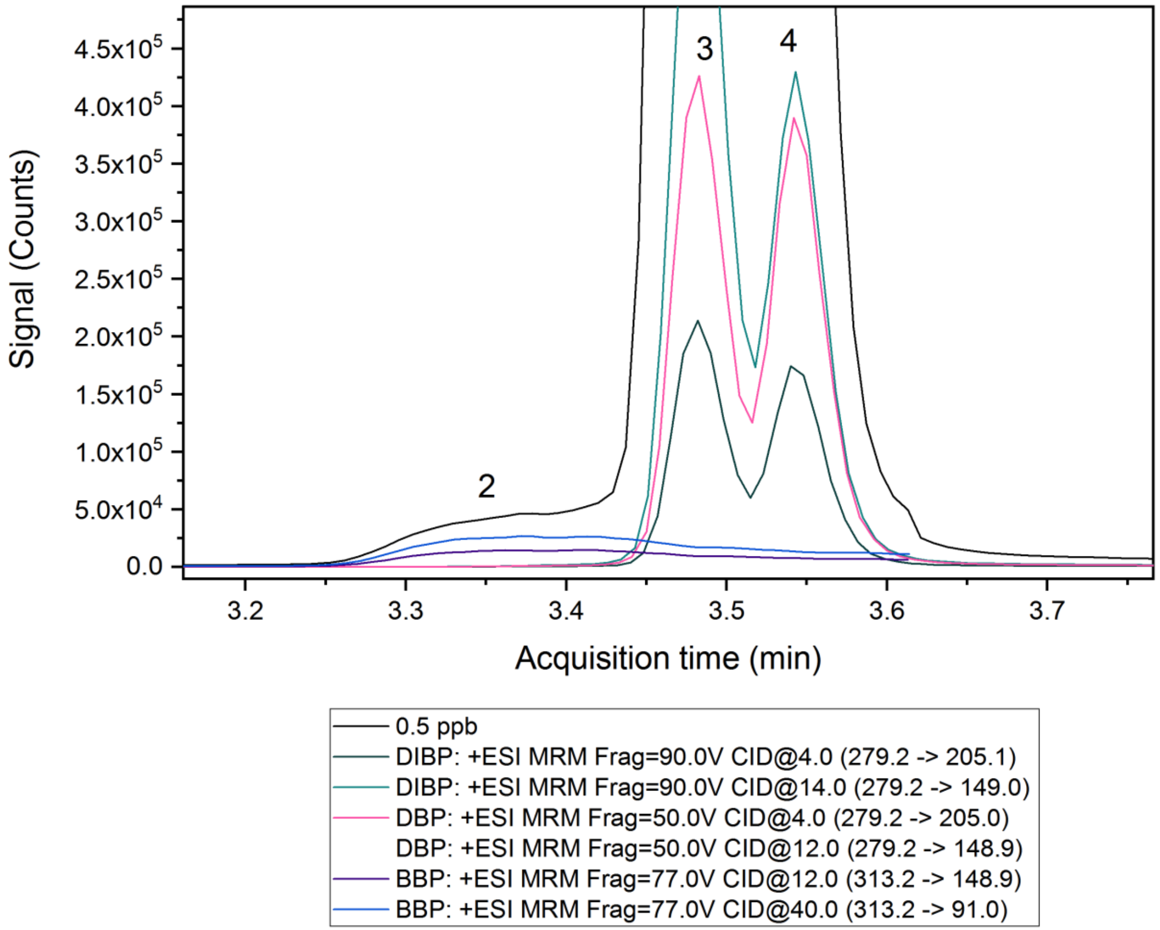
Mobile Phase: Water 50:50 MeOH:ACN
Gradient: 0 min 60%B, 2.0 min 80% B, 5.0 min 100%B, 9.1 min 60% B

Flow Rate: 0.4 mL/min
Injection Volume: 2 μL

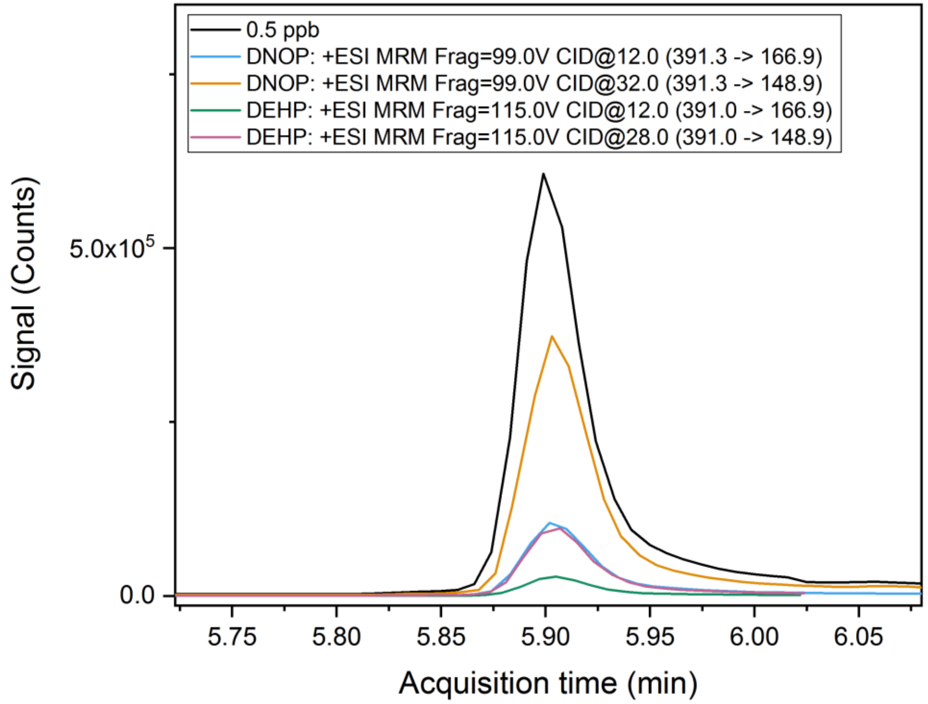


Suite of 11 phthalates and overlapping MRMs





Signal (Counts)
4.5x10^5
4.0x10^5
3.5x10^5
3.0x10^5
2.5x10^5
2.0x10^5
1.5x10^5
1.0x10^5
5.0x10^4
0.0
2
3
4
3.2
3.3
3.4
3.5
3.6
3.7
Acquisition time (min)
0.5 ppb
DIBP: +ESI MRM Frag=90.0V CID@4.0 (279.2 -> 205.1)
DIBP: +ESI MRM Frag=90.0V CID@14.0 (279.2 -> 149.0)
DBP: +ESI MRM Frag=50.0V CID@4.0 (279.2 -> 205.0)
DBP: +ESI MRM Frag=50.0V CID@12.0 (279.2 -> 148.9)
BBP: +ESI MRM Frag=77.0V CID@12.0 (313.2 -> 148.9)
BBP: +ESI MRM Frag=77.0V CID@40.0 (313.2 -> 91.0)

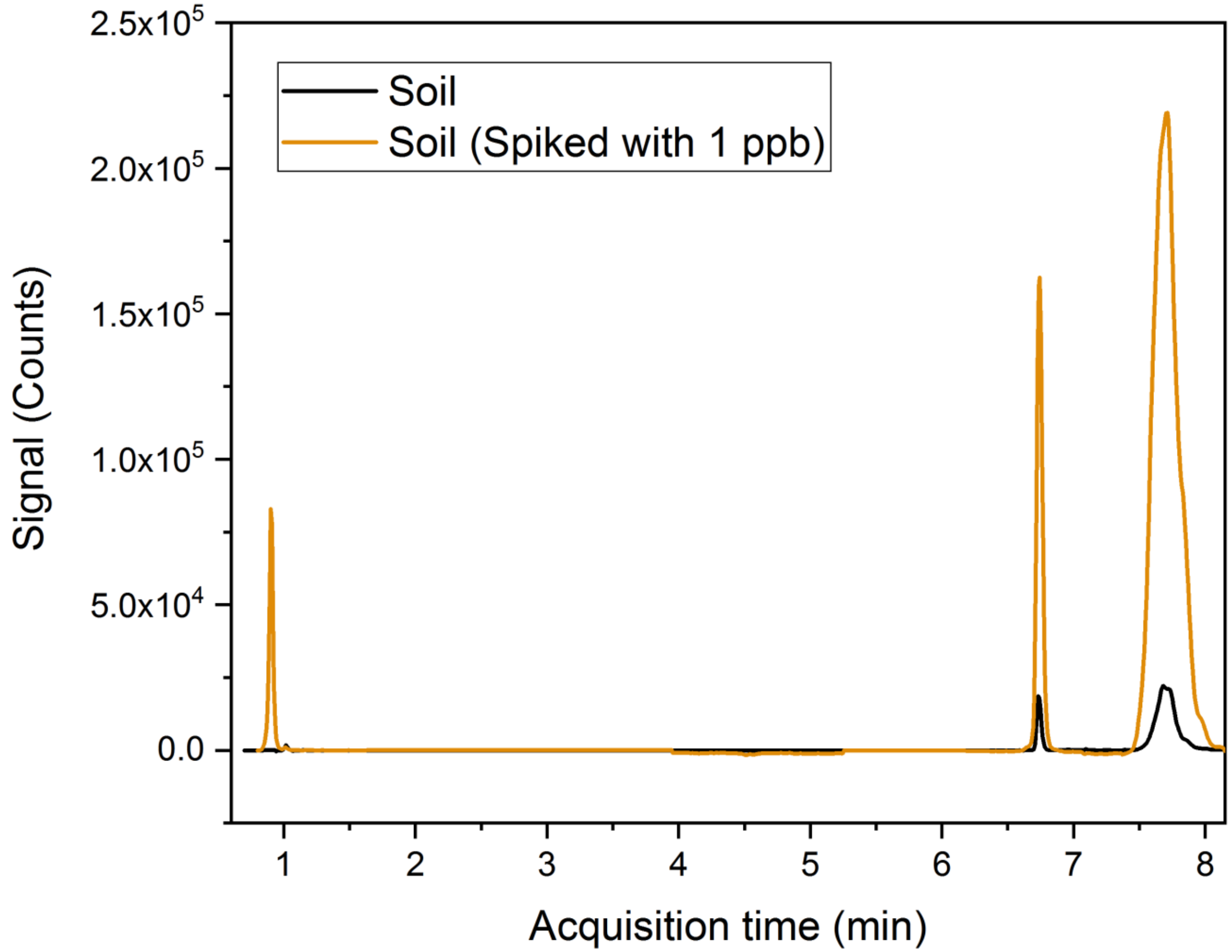


0.5 ppb
DNOP: +ESI MRM Frag=99.0V CID@12.0 (391.3 -> 166.9)
DNOP: +ESI MRM Frag=99.0V CID@32.0 (391.3 -> 148.9)
DEHP: +ESI MRM Frag=115.0V CID@12.0 (391.0 -> 166.9)
DEHP: +ESI MRM Frag=115.0V CID@28.0 (391.0 -> 148.9)
Signal (Counts)
5.0x10^5
0.0
5.75
5.80
5.85
5.90
5.95
6.00
6.05
Acquisition time (min)

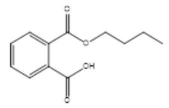
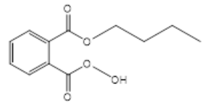
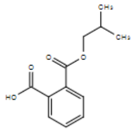
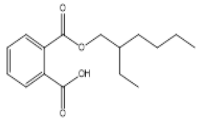
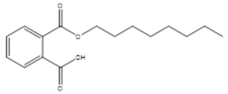
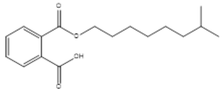
Application to soil

Peak ID

1. DMP
8. DEHP
11 DIDP

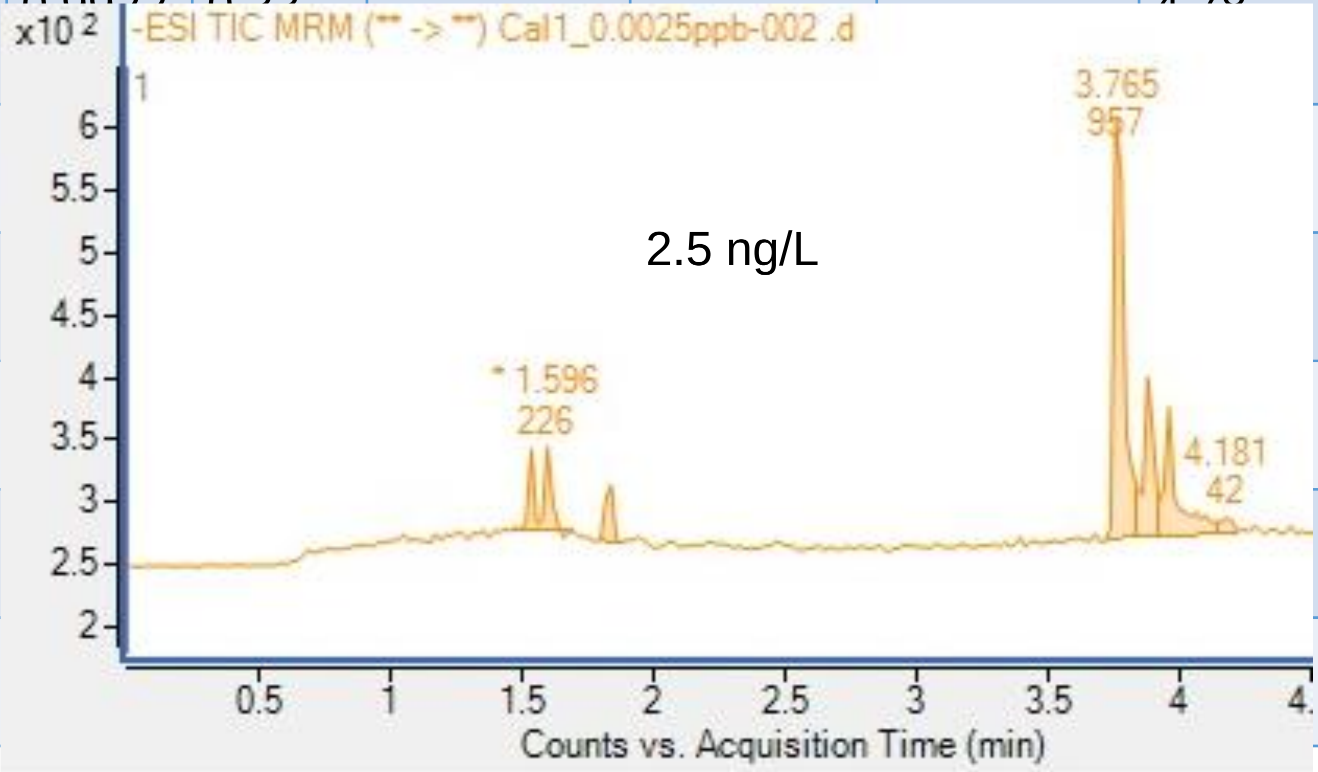


Phthalate Biomarkers

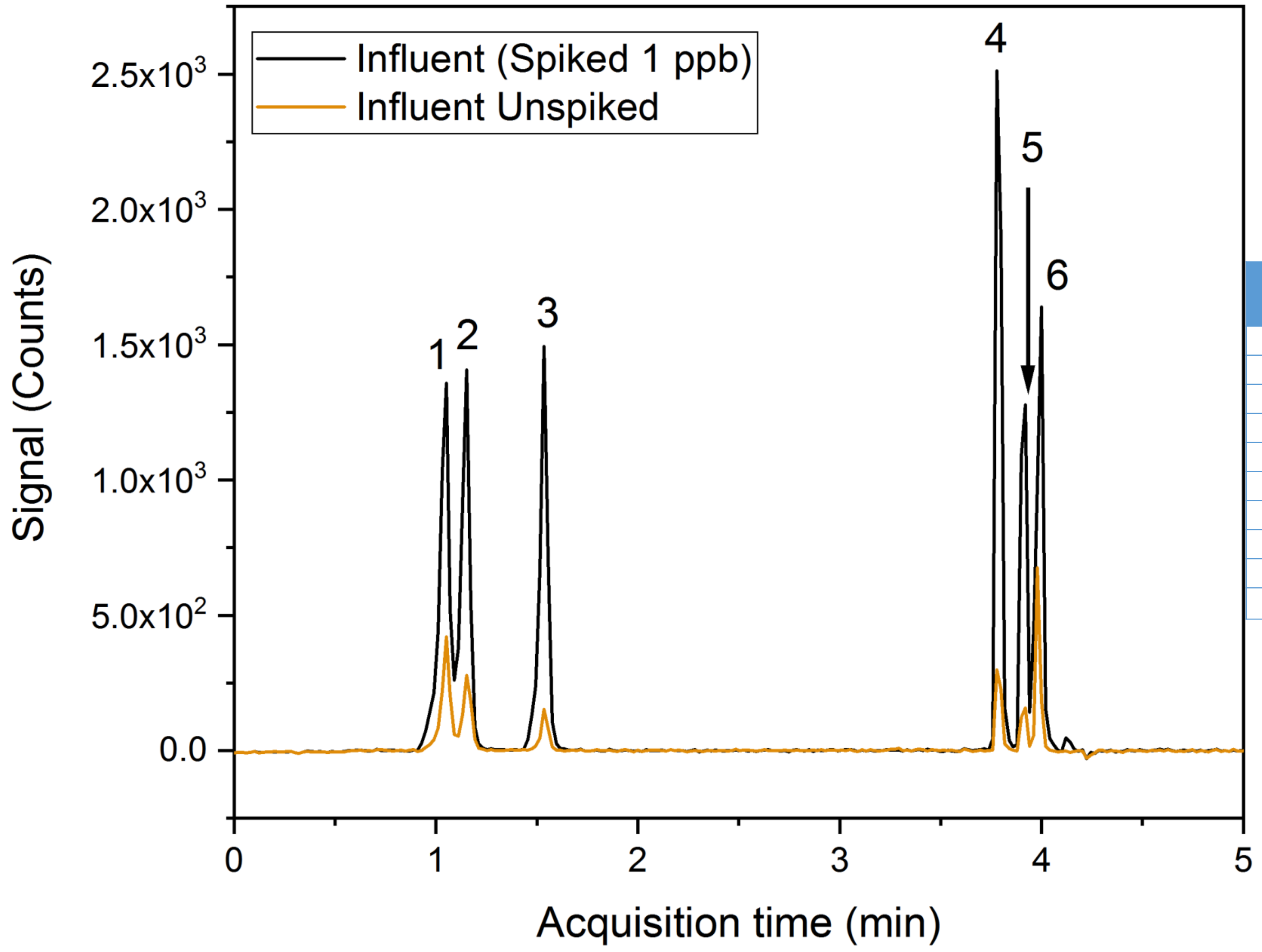
Parent Phthalate	Phthalate Biomarker	Cas No.	Structure	Molecular weight (g/mol)	Log Kow	PKa	Peak No
Benzylbutyl phthalate (BBP)	Mono-benzyl phthalate (MBzP)	2528-16-7		256.26	3.14	3.22	3
Dibutyl phthalate (DBP)	Monobutyl phthalate (MBP)	34-74-2		222.09	2.65	3.292	2
Diisobutyl phthalate (DiBP)	Monoisobutyl phthalate (MiBP)	30833-53-5		222.09	2.5	3.08	1
Diethylhexyl phthalate (DEHP)	Monoexylhexyl phthalate (MEHP)	4376-20-9		278.35	4.3	3.266	4
Di-n-octyl phthalate (DNOP)	Mono-n-octyl phthalate (MNOP)	5393-19-1		278.35	4.32	3.29	5
Diisononyl phthalate (DINP)	Monoisononyl phthalate (MINP)	68515-53-7		292.38	4.65	3.289	6

Monoester Calibration

Peak	Compound	Range of linearity (ng/L)	R^2 (n=3)	CCV RSD (%)	LOD Calculated from Slope (ppb)	LOQ (ppb) Calculated from Slope	Projected LOD	S/N (at 250 ng/L)
1	MiBP	2.5-10,000	0.9922	0.22				4.78
2	MBP	250-10,000						
3	MBzP	250-10,000						
4	MEHP	250-10,000						
5	MnOP	250-10,000						
6	MiNP	250-10,000						



Samples are pre-concentrated by a factor of 100



Peak No	Compound	Precursor Ion	Product Ion	Fragmentor Voltage	Collision Energy	Abundance
1	MiBP	221.1	77.1	82	20	45219
2	MBP	221.1	77.1	82	20	45219
3	MBzP	255.1	77.1	88	20	62690
4	MEHP	277.1	163.5	103	8	52
5	MNOP	277.1	77.1	103	24	15470
5	MNOP	277.1	127.1	103	16	21532
5	MNOP	277.1	134	103	16	8878
6	MINP	291.2	77.1	109	24	32811
6	MINP	291.2	141.1	109	20	47480
6	MINP	291.2	139	109	16	23037

Innovation and technology as an engine for environmental research

Future challenges of POPs monitoring

- Real need for easy to use sample handling systems – large volume samples needed for environmental assessment
- Innovate in effect-based tools that can link chemistry with toxic effect or risk

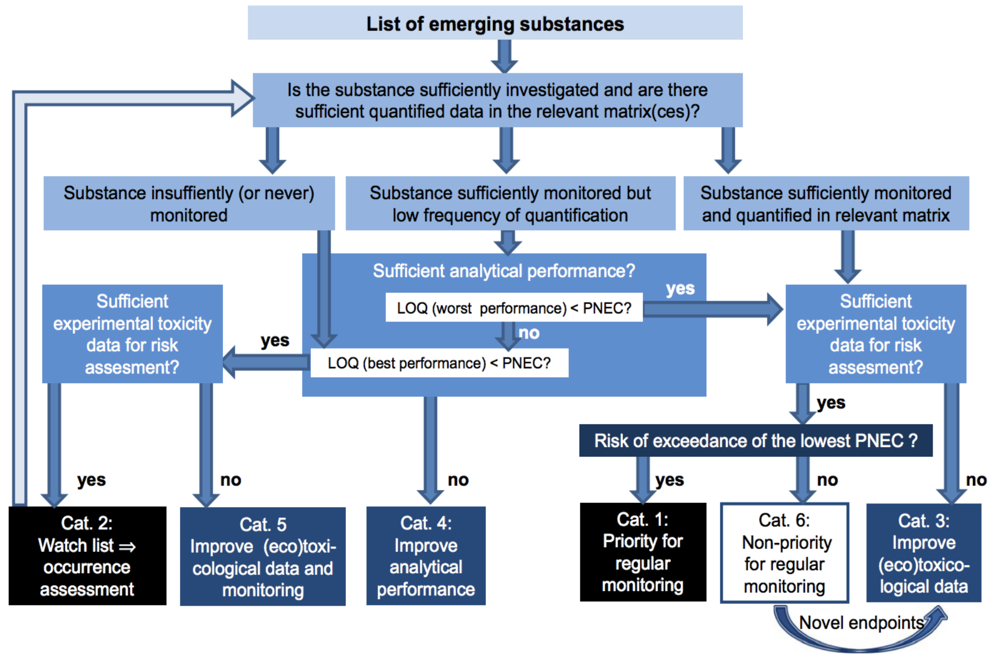


Fig. 2 Prioritization scheme of the NORMAN network

Dulio et al. Environ Sci Eur (2018) 30:5

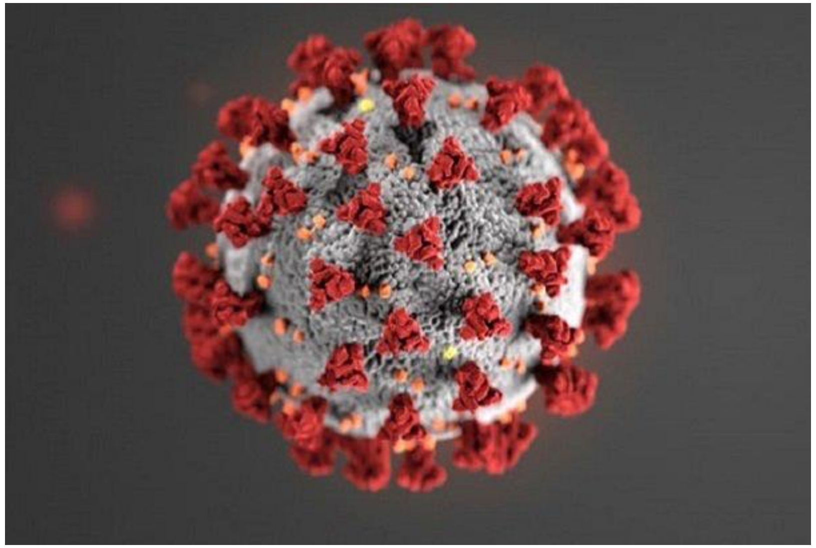
How do we monitor into the future?

ANNEX

Watch list of substances for Union-wide monitoring as set out in Article 8b of Directive 2008/105/EC

Name of substance/group of substances	CAS number (1)	EU number (2)	Indicative analytical method (3) (4)	Maximum acceptable method detection limit (ng/l)
17-Alpha-ethinylestradiol (EE2)	57-63-6	200-342-2	Large-volume SPE - LC-MS-MS	0,035
17-Beta-estradiol (E2), Estrone (E1)	50-28-2, 53-16-7	200-023-8	SPE - LC-MS-MS	0,4
Macrolide antibiotics (5)			SPE - LC-MS-MS	19
Methiocarb	2032-65-7	217-991-2	SPE - LC-MS-MS or GC-MS	2
Neonicotinoids (6)			SPE - LC-MS-MS	8,3
Metaflumizone	139968-49-3	604-167-6	LLE - LC-MS-MS or SPE – LC-MS-MS	65
Amoxicillin	26787-78-0	248-003-8	SPE - LC-MS-MS	78
Ciprofloxacin	85721-33-1	617-751-0	SPE - LC-MS-MS	89

(1) Chemical Abstracts Service
(2) European Union number – not available for all substances
(3) To ensure comparability of results from different Member States, all substances shall be monitored in whole water samples.
(4) Extraction methods:
LLE — liquid liquid extraction
SPE — solid-phase extraction
Analytical methods:
GC-MS — Gas chromatography-mass spectrometry
LC-MS-MS — Liquid chromatography (tandem) triple quadrupole mass spectrometry
(5) Erythromycin (CAS number 114-07-8, EU number 204-040-1), Clarithromycin (CAS number 81103-11-9), Azithromycin (CAS number 83905-01-5, EU number 617-500-5)



Wastewater process streams a biomarker for human health

Aim: To study the value of phthalates as a biomarker of human health in human toxicology.

Deliverables:

Analysis of phthalate levels in wastewater process streams as indicated by phthalate metabolites	Assessment of phthalates in wastewater process streams informing on human exposure, body burden and health

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Thankyou.

Questions & Answers

Please use the Q&A chat function or “raise your hand” to ask a question to our panelists.

Agilent

Thank You!

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