



International Society *of* Exposure Science Europe



Workshop proceedings

ISES Europe

Regional Chapter

1st European Exposure Science Strategy Workshop 19-20 June 2018

BAuA, Lecture Hall, Haus 1 (main building)

Friedrich Henkel Weg 1-25, Dortmund, Germany

Mission

To integrate exposure science into European regulations and industry practice, and to anchor it in academic research and education, in order to foster innovation and to create a safe and sustainable future for humans and the environment.

For information on membership and to learn more about the ISES, please visit <http://ises-europe.org/start.html> or send an email to info@ises-europe.org.

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Acknowledgements

ISES Europe want to thank the Federal Institute for Occupational Safety and Health (BAuA) BAuA, Dortmund, Germany for supporting this workshop. Special thanks to Urs Schlüter, Head of Unit Exposure Scenarios at BAuA, Melanie Berghaus and Angela Kämpfer, BAuA.



ISES Europe is especially thankful to the stakeholder sponsors of the Workshop. With their trust and support ISES Europe was able to organize its first meeting and we are grateful for this opportunity.

Workshop Sponsors:



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President's Message

The Foundation of ISES Europe to Build a European Programme on Exposure Science

by Yuri Bruinen de Bruin, PhD

My first ISES meeting (ISEA at the time) was in 1999, in Athens, Greece in early September. As a young scientist working on air pollution exposure and health effects, I was relatively new in the field of Exposure Science. This meeting, however, changed my career in multiple aspects. First, as a consequence of this meeting I could start my PhD in Occupation Medicine and Environmental Hygiene some month later in Italy, and second, I became aware that exposure was not only about chemicals, but also included other exposures, like physical threats. The 6,0 (Richter scale) earthquake that stroke ISEA caused all participants to deal with this fresh exposure experience in unique ways. Ever since 1999, I tried to join each meeting and in time ISES became a pillar throughout my career.

19 years later, in 2016, I had the honor to organize and chair the ISES meeting in Utrecht, the Netherlands together with Lesa Aylward. Supported by my previous institution RIVM (Dutch Institute for Public Health and the Environment) that has a strong interest developing Exposure Science the meeting turned out to be the largest and most international at that time with 645 paid participants from over 50 countries.



Global meeting participation ISES 2016, Utrecht, Netherlands.

During ISES 2016 a European Strategy Workshop was organized and attended by many European stakeholders. This Workshop was the start of the process to set up ISES Europe. After an additional stakeholder consultation among more than 700 European experts, it became clear that there was a shared desire to have a European Programme on Exposure Science. Together with Jos Bessems we continued the process and in summer 2017 ISES Europe was founded with an officially elected Board that I proudly and happily introduce. Last but not least, I express my hope that ISES Europe can become a Society supporting European States, EU Association States, and EU third States in the process to high standards on safety and security, health and sustainability.



Dr. Yuri Bruinen de Bruin
President of ISES Europe

ISES-Europe Executive Board

Chair/President:



Yuri Bruinen de Bruin (PhD, EC-JRC) obtained his PhD in Occupational Medicine and Environmental Hygiene in 2003. Ever since, he works in research and policy-supporting science in the

field of human and environmental health. His work incorporates coordination, planning, management, provision of research, technical and policy support, capacity-building, guidance development, stakeholder engagement, prioritization and policy support. Yuri is the President of ISES Europe and is a scientific officer at the European Commission Knowledge Management Service and active in 'safety and health' and 'security and defence'. Yuri is founder of ISES Europe.

Board Representative:



Tatsiana Dudzina (PhD, ExxonMobil) received a Ph.D. in Environmental Science from the Swiss Federal Institute of Technology in Zurich in 2014. Since graduation she has been working as an Exposure Scientist at ExxonMobil Biomedical Science Inc. (EMBSI) in Brussels headquarter, providing advice to ExxonMobil's operating businesses and sites on a broad range of health topics

Tatsiana is a member of ECETOC Human Exposure Data Task Force and ECETOC TRA Steering Team. Since 2015 Tatsiana has been co-chairing CEFIC Exposure Scenario Working and continues to be involved in the wider field of human health risk assessment science by advising Concawe on exposure research aspects, as well as activities at OECD level.

Secretary/Treasurer



Jos Bessems (PhD, VITO) is a regulatory toxicologist and risk assessor since 1996. He has extensive knowledge in toxicokinetics and the use of non-animal approaches. At present, his focus is on the exposure pillar of human health

risk assessment to include consumer, worker and environmental exposure, (molecular) epidemiology and human biomonitoring. Jos Bessems is founder and current secretary of ISES Europe.

ISES-Europe Councillors

European Exposure Science Strategy

Peter Fantke (PhD, DTU) is Associate Professor for Quantitative Sustainability Assessment at the Technical University of Denmark. He develops quantitative methods for evaluating exposure and human and environmental toxicity impacts from chemicals released along product life cycles



to address some of society's grand challenges, including reducing air pollution, human disease burden, and ecosystem degradation. He chairs several international task forces under the auspices of the Life Cycle Initiative hosted at the United Nations Environment Program. He is Managing Director of the USEtox International Centre, which develops global scientific consensus models for characterizing toxicity of chemical emissions and Councilor for a European Exposure Science Strategy in the European Chapter of the International Society of Exposure Science.

Outreach & Education



Natalie von Goetz (PhD, FOPH) is scientific officer for exposure at the Swiss Federal Office of Public Health. Previously, she worked at the Technical University ETH Zurich, where for 10 years she lead a research group for

modelling consumer exposure to chemicals of concern, with focus on the development of methodology for aggregate exposure modelling. She is member of several international and national working groups, such as e.g. the SCCS-WG on 'Nanomaterials in Cosmetic Products' or the EFSA-WG on 'uncertainty in risk assessment'.

Student representative/ Webmaster



Alison Connolly (NUIG) is a final year PhD candidate in the Centre of Climate and Air Pollution Studies (C-CAPS) in the National University of Ireland Galway (NUIG), researching occupational

pesticide exposure among amenity horticulturists. This study involves completing exposure assessments using biomonitoring, dermal and inadvertent ingestion sampling methods. Alison obtained a Bachelor of Science (B.Sc.) honorary degree in Health and Safety Systems from the National University of Ireland, Galway (NUIG) in 2014.

Communication & Capacity Building



Urs Schlüter (PhD, BAuA) Urs Schlüter is head of the unit Exposure Scenarios at the Federal Institute for Occupational Safety and Health (BAuA) which is the German Competent Authority for the

REACH and the Biocides regulations. This unit is responsible for regulatory exposure assessments for workplaces. He participated in a number of national and European working committees for Biocides and REACH. Since 2011 he has been a member of the ECHA's Committee for Risk Assessment (RAC).

Membership and benefits for being a member

ISES Europe's efforts on public health and environmental protection occur through our European and global community of members. For this we ask you to support ISES Europe via membership or individual donations. Every bit helps! Please visit <http://ises-europe.org/start.html> or send an email to info@ises-europe.org.

1. Individual membership 50 euro per year

Benefits:

1. Free Access to ISES Europe's web-based Exposure Information Platform (to be designed).
2. Free Access to extended abstract submissions and reports ISES Europe meetings/Working Group meetings
3. Have your say in the development of European scientific and policy needs related to Exposure Science
4. 10% reduction on meeting fee

2. Institutional membership 250 euro per year

Benefits:

1. Free Access to ISES Europe's web-based Exposure Information Platform (to be designed).
2. Free Access to extended abstract submissions and reports ISES Europe meetings/Working Group meetings
3. Have your say in the development of European scientific and policy needs related to Exposure Science
4. 10% reduction on meeting fee for five persons
5. 50% reduced fees for exhibition table during meeting

3. Student/Early career/ Retired professionals membership 25 euro per year or less in case some work can be done like reviewing meeting output, maintaining the website, etc.

Benefits:

1. Free Access to ISES Europe's web-based Exposure Information Platform (to be designed).
2. Free Access to extended abstract submissions and reports ISES Europe meetings/Working Group meetings
3. Have your say in the development of European scientific and policy needs related to Exposure Science
4. 10% reduction on meeting fee

Towards a European Strategy on Exposure Science

by Yuri Bruinen de Bruin, Peter Fantke, Urs Schlüter, Alison Connolly, Natalie von Götz, Tatsiana Dudzina and Jos Bessems

It was 2007 after the entry into force of REACH (1) that Europe got a clear regulatory mandate to deliver adequate exposure information to foster the safe use and management of chemicals. Last month, the third registration deadline passed and at present **more information on chemicals** (21 551 chemicals on EU market are now registered) **is available than ever before** (1).

Regulatory changes in the EU during the last decade increased the demand for high-quality exposure information in Europe more than elsewhere (2). However, in the case insufficient or missing exposure information, default assumptions are frequently used. These are often not well argued or very conservative, which in some cases lead to incorrect risk estimates due to underestimations or severe overestimations of a risk hampering decision making (3).

Diverse parts of legislation put unique demands on the European exposure science community, like REACH, the Biocides Regulation, the General Food Law, but also the Regulation on Medical Devices and Construction Products, regulations on general product safety, classification, labelling and packaging, control of air quality and major-accident hazards. Furthermore, EU strategies add additional challenges (4). These include challenges related to moving toward a Non-Toxic Environment by 2050(5), striving toward a circular and bio-based economy, promoting green and sustainable chemistry, and better understanding the potential of ICT and Omics in revealing individual patterns of diseases, which would help design future health (care) measures (6). In Europe, exposure science is closely related to regulation, because a large part of exposure science is driven by regulatory needs. However, recent scientific advances face difficulties in finding their way into regulatory common practices. Therefore, during the ISES 2016 meeting in Utrecht, the Netherlands,

European exposure professionals representing a wide range of stakeholders met and agreed that it was time to join forces and to work together building a highly needed European exposure science strategy and community.

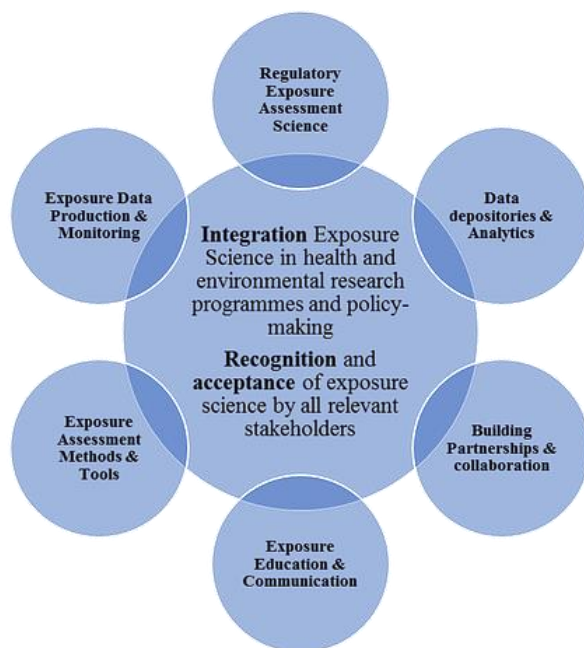
In 2017, ISES Europe was founded and after its Board members were elected, the Board started to work out the best way to promote advancements of exposure sciences. As a Board we believe that it is both important and timely to ensure that exposure science is recognized by all the European stakeholders and that each of us is also willing to contribute to this. The progressive reduction in animal testing and the greater demand for monitoring are important aspects for many of us including both regulators and industry. Multiple actors in the field expressed the need to have guidance to enhance transparency of choices made in the selection of input exposure data also understanding the representativeness of monitoring data and models. Also the translation of exposome outcomes into health-related regulatory actions require stakeholders to collaborate.

The above developments all adds weight to discuss and agree upon what the overarching discipline would be in the future and consequently how to shape the discipline in Europe. We are therefore grateful that together with the entire Board and the support of stakeholders, at 19-20 June, 2018, we can offer the first ISES Europe Workshop. European exposure professionals from academia, industry, public stakeholder groups, insurance companies, and regulatory authorities (national and EU level) meet at a first workshop in Germany in June, organised by the ISES Europe Board and the German Federal Institute for Occupational Safety and Health (BAuA). The main aim is to develop a European strategy for "promoting exposure science in support of public and environmental health research, practices and policy-making." In specific the aim is to:

- To create a European Exposure Science Strategy with a roadmap 2020-2025-2030
- To establish Working Groups with their own goals/agenda for six specific Exposure Themes
- To have a list of inscribed and committed ISES-Europe members

The workshop is structured along six overarching exposure science themes:

1. Regulatory exposure assessment,
2. Data repositories,
3. Building partnerships and collaboration,
4. Exposure education and communication,
5. Exposure assessment methods and tools and
6. Exposure data production and monitoring.



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6. Report on Preparing the Commission for future opportunities -Foresight network fiches 2030 (2015). <https://ec.europa.eu/digital-single-market/en/news/looking-future-digital-technologies>.

Program at a Glance

DAY 1: Tuesday, 19-June-2018

Exposure Science in Europe - Topics, needs, and questions

08:00-08:30	Registration		
08:30-08:45	Welcome <i>Lecture Hall</i> <i>Rolf Packoff, Head of Scientific Management, German Federal Institute for Occupational Safety and Health</i>		
08:45-09:00	Introduction to 1st ISES-Europe Workshop <i>Lecture Hall</i> <i>Yuri Bruinen de Bruin, President of ISES-Europe, European Commission Joint Research Center</i>		
09:00-09:30	Keynote lecture: <u>Scientific Visions for European Exposure Science</u> <i>Lecture Hall</i> <i>Roel Vermeulen, Professor, Institute for Risk Assessment Sciences - Environmental Epidemiology, Utrecht University</i>		
09:30-10:00	Keynote lecture: <u>Visions for Regulation and Implementation of European Exposure Science</u> <i>Lecture Hall</i> <i>Peter Korytar, Policy Officer at the European Commission, Directorate General Environment</i>		
10:00-10:30	Q&A and formation of break-out working groups <i>Lecture Hall</i> <i>Alison Connolly, ISES-Europe Student Representative; Peter Fantke, ISES-Europe European Exposure Science Strategy</i>		
10:30-11:00	Coffee and Poster viewing (odd poster IDs; please stand by your poster)		
	Break-out session: <u>Data Repositories & Analytics</u>	Break-out session: <u>Regulatory Exposure Assessment Science</u>	Break-out session: <u>Building Partnerships & Collaboration</u>
11:00-13:00	Introduction [15 min] Framing of questions [15 min] Discussion [60 min] Preparation of summary presentation [30 min] <i>Room 502</i>	Introduction [15 min] Framing of questions [15 min] Discussion [60 min] Preparation of summary presentation [30 min] <i>Room S11</i>	Introduction [15 min] Framing of questions [15 min] Discussion [60 min] Preparation of summary presentation [30 min] <i>Room E08</i>
13:00-14:00	Lunch and Posters (odd poster IDs; please stand by your poster)		
	Break-out session: <u>Exposure Data Production & Monitoring</u>	Break-out session: <u>Exposure Assessment Methods & Tools</u>	Break-out session: <u>Exposure Science Education, Training & Communication</u>
14:00-16:00	Introduction [15 min] Framing of questions [15 min] Discussion [60 min] Preparation of summary presentation [30 min] <i>Room 502</i>	Introduction [15 min] Framing of questions [15 min] Discussion [60 min] Preparation of summary presentation [30 min] <i>Room S11</i>	Introduction [15 min] Framing of questions [15 min] Discussion [60 min] Preparation of summary presentation [30 min] <i>Room E08</i>
16:00-16:30	Coffee and Posters (odd poster IDs; please stand by your poster)		
16:30-17:00	Poster Pitches (pre-selected poster IDs only) <i>Lecture Hall</i> <i>Chair: Jos Bessems, ISES-Europe Secretary/Treasurer</i>		

- 17:00-18:00 **Day 1 wrap-up presentations and agreement on discussions for Day 2** *Lecture Hall*
Chair: Natalie von Goetz, ISES-Europe Outreach & Education
- 18:00-19:00 **Guided tour** through [DASA Working World Exhibition](#) (5 min. walk from workshop facilities)
- 19:00-22:00 **BAuA/ISES-Europe Dinner** at [DASA Working World Exhibition](#), Room: "Stahlhalle"
(all workshop participants are invited)

DAY 2: Wednesday, 20-June-2018

Exposure Science in Europe - From theory into practice and future research agenda

- 08:30-09:00 **Exposure Science, Building a Strategy for Europe** *Lecture Hall*
Yuri Bruinen de Bruin, President of ISES-Europe, European Commission Joint Research Center
- 09:00-09:20 **Keynote lecture: [Implementing Exposure Science in Practice of Risk Assessment](#)** *Lecture Hall*
Tim Meijster, Health and Safety Risk Management, Innovative technologies, Shell/ECETOC
- 09:20-09:40 **Keynote lecture: [Implementing a Strategy for Exposure Science in Practice](#)** *Lecture Hall*
Jim Bridges, Emeritus Professor, Toxicology & Environmental Health
- 09:40-10:00 **Q&A and plenary discussion on ways toward a European Exposure Science Strategy** *Lecture Hall*
Peter Fantke, ISES-Europe Councillor European Strategy on Exposure Science
- 10:00-10:30 Coffee and Posters (even poster IDs; please stand by your poster)

	Break-out session: Data Repositories & Analytics	Break-out session: Regulatory Exposure Assessment Science	Break-out session: Building Partnerships & Collaboration
10:30-11:30	Framing of questions [10 min] Discussion [30 min] Preparation of summary presentation [20 min] <i>Room 502</i>	Framing of questions [10 min] Discussion [30 min] Preparation of summary presentation [20 min] <i>Room S11</i>	Framing of questions [10 min] Discussion [30 min] Preparation of summary presentation [20 min] <i>Room E08</i>
	Break-out session: Exposure Data Production & Monitoring	Break-out session: Exposure Assessment Methods & Tools	Break-out session: Exposure Science Education, Training & Communication
11:30-12:30	Framing of questions [10 min] Discussion [30 min] Preparation of summary presentation [20 min] <i>Room 502</i>	Framing of questions [10 min] Discussion [30 min] Preparation of summary presentation [20 min] <i>Room S11</i>	Framing of questions [10 min] Discussion [30 min] Preparation of summary presentation [20 min] <i>Room E08</i>
12:30-13:30	Lunch and Posters (even poster IDs; please stand by your poster)		

- 13:30-14:00 **Poster Pitches** (pre-selected poster IDs only) *Lecture Hall*
Chair: Natalie von Goetz, ISES-Europe Outreach & Education
- 14:00-15:00 **Day 2 wrap-up presentations** *Lecture Hall*
Chair: Jos Bessems, ISES-Europe Secretary/Treasurer
- 15:00-15:30 **Plenary discussion on European Exposure Science Strategy next steps** *Lecture Hall*
Peter Fantke, ISES-Europe Councillor European Strategy on Exposure Science
- 15:30-16:00 **Workshop wrap-up and closure** *Lecture Hall*
Yuri Bruinen de Bruin, President of ISES-Europe, European Commission Joint Research Center
- 16:00 Coffee and Departure

Keynote lectures

Keynote 1: Scientific Visions for European Exposure Science

Dr. Roel Vermeulen is a Professor of Environmental Epidemiology and Exposome Science at the Institute for Risk Assessment Sciences (IRAS), Utrecht University and at the Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht, The Netherlands. He is the director of the Utrecht Exposome Hub, and co-chair of the Personalized Health and Medicine Program of Utrecht Life Sciences at Utrecht University. He previously held positions at the National Cancer Institute, USA.



His scientific research focuses on environmental risk factors for cancer and neurological diseases with a strong emphasis on integrating epidemiology, high quality exposure assessment, and molecular biology into multidisciplinary investigations. One of the current research areas is the exploration of new methods for quantifying the external and internal exposome. He is the PI of several large case-control and prospective (biobank) studies in occupational and the general population. Dr. Roel Vermeulen has served on many international committees including the WHO and the National Toxicology Program in the US. He is a member of the Dutch Expert Committee for Occupational Standards of the Dutch Health council. He was elected chair of the International Commission on Occupational Health (ICOH), Scientific Committee on Epidemiology in Occupational Health (EPICOH) in 2015. He has published over 450 publications.

Keynote abstract

Exposure science is central to the protection of human, animal, and ecosystem health (i.e. planetary health). However, our environment is increasingly getting more complex with complex interactions between the chemical, social, urban, and food environments. How do we quantify these exposures and how do we use this information effectively in environmental and occupational health, risk assessment and in meaning full interventions?

In the 21st century, we are experiencing the convergence of the exponential increase in the availability and capacity of new technologies that can be effectively used to improve exposure assessments. These technologies include amongst others more ubiquitous available geospatial data, use of sensors, and agnostic omic biotechnologies. These resources present unprecedented opportunities to broaden and deepen our understanding of environmental drivers of planetary health.

Keynote 2: Visions for Regulation and Implementation of European Exposure Science

Dr. Peter Korytár holds a PhD in Analytical Chemistry from the Free University of Amsterdam. Before joining the European Commission in 2008, he worked at the Institute for Marine Resources and Ecosystem Studies as a Researcher. At DG Environment, Unit Sustainable Chemicals, he leads the team in charge of development of chemical policies in areas such as endocrine disruptors (EDs), chemical mixtures and non-toxic environment strategy.



Keynote abstract

Not available at the time of publication.

Keynote 3: Implementing Exposure Science in Practice of Risk Assessment

Dr. Tim Meijster works since 2013 with the Risk Science Team in Shell Health as an exposure scientist. In his current job his time is divided between global regulatory activities, risk assessment and management project in support of a wide variety of businesses and facilities and research activities with a strong focus on exposure science.




Tim graduated with an MSc in environmental science from Wageningen University. He completed his PhD in occupational and environmental health at Utrecht University. Tim has (co)authored 30 peer reviewed publication on various topics related to chemical risk assessment and occupational exposure assessment.

Keynote abstract

In this talk, the industry perspective on exposure science with a focus on (regulatory) risk assessment will be given. Focus will be on currently ongoing industry initiatives to make better use of exposure data and information and have access to reliable tools. Some insights will be given on the future needs and directions of exposure science in industry. The importance of a link between regulatory risk assessment and industrial hygiene will be discussed and the need to make sure both field are connected to the developments in exposure science.

Keynote 4: Implementing a Strategy for Exposure Science in Practice



Professor Jim Bridges obtained a PhD in drug metabolism and fluorimetric analysis. This led to a Lectureship in Biochemistry at St Marys Hospital Medical School, London University. He then was recruited to be Reader in Biochemistry at the new University of Surrey. Subsequently he became in turn: founding Director of the Robens Institute of Industrial and Environmental Health and Safety, Professor of Toxicology, founding Head of the European Institute of Health and Medical Sciences, Dean of Science and Dean for International Relations. He is now Emeritus Professor of Toxicology and Environmental Health. He has published over 400 scientific papers and reviews and supervised almost 100 PhD students. He was responsible for the initiation of both the first full time and part-time MSc's in Toxicology in Europe. He also played a lead role in the establishment of the British Toxicology Society, EUROTOX and the European Drug Metabolism Workshops. From 1978-2004 he served on many UK Government advisory committees e.g. Occupational standards (WATCH), Air and Water Contamination (MAWQ), Veterinary Products Committee, Novel and Irradiated Foods Committee and Chair of the Veterinary Residues Committee. From 1997-2004 he chaired the EU Independent Scientific Advisory Committee on Toxicity, Ecotoxicity and the Environment (CSTEE) and was a member of EU Scientific Steering Committee (SSC). He was the primary author of its two reports on the Harmonisation of Risk Assessment. From 2004 -2013 he chaired the newly established EU Scientific Committee on Emerging and Newly Identified Health Risks (SCENHIR) and of the WG's which produced reports such as Thresholds of Toxicological Concern and the Future of Risk Assessment (both of which were exposure focussed). Over his career served as advisory to many other organisations associated with drugs, consumer products, food, analytical equipment design, waste management and occupational safety He is currently the chairman of a consultancy 'Research for Sustainability' and has a major involvement in the development and application of quantitative weight of evidence methodology. He also chairs the Supervisory Group for the international 'IDEA' project on methodology for the prevention of fragrance induced skin allergies.

Keynote abstract

The procedures used in risk assessment over the past 40-50 years are under increasing challenge. The main reasons for this are: regulatory authorities favouring hazard assessments as simpler to act on than risk assessments, political/public pressures to replace animal testing on ethical/emotional grounds, high cost and time commitment to generate the regulatory required data and the advent of new, high throughput technologies such as 'omics'. However, hazard assessment alone is neither practical nor a scientifically justifiable in the real world. A new risk assessment procedure is clearly required. Exposure science has a major role to play in the establishment and enactment of this. The likely large number of assessments required, and the need for the regular updating of many of them, requires a tiered approach:

Tier 1. Prioritisation of chemicals to evaluate. At present, for many chemicals, this is the amount manufactured. However, a much more suitable metric would be the nature of the use(s) and end of life fate, along with the human and environmental exposure. In human risk assessment the concept of thresholds of

toxicological concern (TTC) has been developed, which is based on an extensive data base of the maximum exposure achievable to the most toxic chemicals without adverse effects. The application of TTC for prioritisation and other purposes is totally dependent on reliable maximum exposure assessments for each chemical under review.

Tier 2. Initial hazard assessment. Includes how physico-chemical properties, read across and possible abiotic and biotic fate which might affect hazard and exposure. Regarding hazard, selection of the upper dose for in vivo testing has typically been the maximum tolerated dose (MTD). This is increasingly viewed as both unnecessary and unethical. It should be replaced, where animal studies are deemed essential, by 'realistic' worst case exposure levels for man. For in vitro tests, yet there has been little guidance on exposure aspects. How such in vitro exposures can best simulate in vivo exposure situations needs to be addressed urgently.

Tier 3. In depth investigation of hazardous properties of concern. This must characterise the dose response relationship, identification of the threshold exposure conditions and modes of action. The focus is on extrapolation of the findings to humans, under realistic exposure conditions.

Tier 4. Consideration of other factors. These should include, for example, assessment of co-exposure to chemicals with potentially similar modes of action.

The above methodology has parallels with the needs for ecological risk assessment, which I do not have time to cover here. For selected chemicals some form of follow up surveillance may in future also be a requirement. This will necessitate assessment of exposure of vulnerable populations/individuals and/or measurement of biomarkers of effects.

In 2013 the EU three non-food committees, published their opinion, which I chaired, on 'new challenges in risk assessment'. This proposed the development of 'an exposure-driven flexible, tiered approach drawing continually on advances in technology and scientific understanding. The above outlines what is needed to achieve this over the next decade.

ISES-Europe 2018 workshop objectives and expected outcome

Workshop aim and objectives: The first ISES-Europe 2018 workshop aims at building a European Exposure Science Strategy along a roadmap 2020-2025-2030. The workshop has three overarching goals:

- (1) To create a European Exposure Science Strategy with a roadmap 2020-2025-2030.
- (2) To establish Working Groups with their own goals/agenda for six specific Exposure Themes.
- (3) To have a list of inscribed and committed ISES-Europe members.

Workshop themes and sessions: The ISES-Europe board has consulted the European stakeholder community and collected input about their main exposure science priorities. Priorities have been structured along six thematic areas, which will be discussed at the workshop in dedicated breakout sessions. Each thematic area has a chair, a co-chair and a rapporteur. In addition, it has one contact person within the ISES-Europe Board (who also moderates the respective breakout session). The six thematic areas (and related breakout sessions with moderators are):

(1) Data Repositories & Analytics

Chair	Stylios Kephelopoulos (Scientific coordinator, European Commission Joint Research Centre)
Co-Chair	Tanya Dudzina (Exposure Scientist, ExxonMobil)
Rapporteur	Otto Hänninen (Senior researcher, THL Public Health Solutions, Kuopio/Finland)
Moderator	Jos Bessems (Senior researcher, VITO - Flemish Institute for Technological Research, Belgium)

(2) Regulatory Exposure Assessment Science

Chair	Theo Vermeire (Chair of SCHEER, Dutch National Institute for Public Health and the Environment)
Co-Chair	Andreas Ahrens (Directorate C – Registration, European Chemicals Agency)
Rapporteur	Tim Meijster (Health and Safety Risk Management, Innovative technologies, Shell/ECETOC)
Moderator	Urs Schlüter (Federal Institute for Occupational Safety and Health, Germany)

(3) Building Partnerships & Collaboration

Chair	Jim Bridges (Emeritus Professor, Toxicology & Environmental Health, University of Surrey and Research for Sustainability, Guildford UK)
Co-Chair	Jelle Vlaanderen (Asst. Professor, Institute for Risk Assessment Sciences, Utrecht University, The Netherlands)
Rapporteur	Maryam Zare Jeddi (Researcher, Division of Toxicology, Wageningen University and Research))
Moderator	Yuri Bruinen de Bruin (European Commission Joint Research Centre)

(4) Exposure Data Production & Monitoring

Chair	Michael McLachlan (Professor, University Stockholm)
Co-Chair	André Conrad (Senior Researcher, German Federal Environment Agency)
Rapporteur	Susana Viegas (Associate Professor, Escola Superior de Tecnologia da Saúde de Lisboa, ESTeSL-IPL, Portugal)
Moderator	Natalie von Goetz (Federal Office of Public Health, Switzerland)

(5) Exposure Assessment Methods & Tools

Chair	Claudia Cascio (Scientific Officer, European Food Safety Authority)
Co-Chair	Amélie Crépet (Scientific project manager, French Agency for Health and Safety)
Rapporteur	Dag Rother (Senior researcher, Federal Institute for Occupational Safety and Health, Germany)
Moderator	Peter Fantke (Associate Professor, Quantitative Sustainability Assessment, Technical University of Denmark)

(6) Exposure Science Education, Training & Communication

Chair	Marie Coggins (Academic Director MSc OESH, National University of Ireland, Galway)
Co-Chair	Gerhard Heinemeyer (Former Head of Unit, German Federal Institute for Assessment)
Rapporteur	Véronique Poulsen (Head of Environmental Safety, L'Oréal)
Moderator	Alison Connolly (National University of Ireland Galway)

Expected workshop outcome: The identification of the key goals and needs, and key building blocks for each thematic area. The key goals and needs can be identified and prioritized based on a SWOT analysis identifying the current strengths, gaps/weaknesses, opportunities and threats for each thematic area during related breakout sessions. The workshop outcome should be structured along the templates of two tables that are presented as ‘Workshop outcome format’ at the end of the present document.

Breakout sessions – organization and preparation

Session organization: Each of the six breakout sessions has an organization committee consisting of a chair, a co-chair, a rapporteur, and a moderator. The roles of the organization committee are as follows:

Chair: Coordinates and prepares together with the co-chair and moderator the session contributions and discussions; reports back the session findings to the plenary.

Co-chair: Supports the coordination activities of the chair on the session contributions and discussion; reports or supports the reporting back of the session findings to the plenary.

Rapporteur: Takes notes and coordinates with chair, co-chair and moderator the session output to be presented at the end of each day; provides white paper input prepared together with the moderator.

Moderator: Instructs the rapporteur about expected session outcome content and format; ensures overall alignment between session and workshop focus; moderators are all members of the ISES-Europe board and are the main contact for session-related questions. The moderator also supports the contribution for the white paper prepared in collaboration with the rapporteur.

Session preparation: For each session, the ISES-Europe board has formulated a set of initial questions based on results from the stakeholder priorities consultation. The initial questions for each session are presented as ‘Initial session questions’ at the end of the present document. These initial questions form the starting point for a discussion of priorities and possible ways to move toward a European Exposure Science Strategy during the workshop.

Breakout sessions – structure and implementation during the workshop

Session structure: Each breakout session is organized as follows:

Day 1: **Topics – needs – questions:** Discussion and expected outcome related to key questions, needs, and current challenges for European exposure science

Introduction [15 min]

Framing of questions [15 min]

Discussion [60 min]

Preparation of summary presentation [30 min]

Day 2: **From theory into practice:** Discussion and expected outcome related to building blocks, solutions and ways forward to address needs and challenges for European exposure science

Framing of questions [10 min]

Discussion [30 min]

Preparation of summary presentation [20 min]

Session implementation: The moderators will introduce each session; then the chair and co-chair guide the process of framing of questions and reach agreement on the final set of questions to be discussed in-depth during the “discussion” part. The chair and co-chair will provide input to the rapporteur for the preparation of the summary presentations, which will be presented by the chair/co-chair, at the end of each day.

Breakout sessions – follow-up after the workshop

The workshop output will be used to compile a European Exposure Science Strategy white paper that will be used as basis for a communication paper/editorial to set the stage for a European exposure science roadmap 2020-2025-2030. It is expected that Working Groups will be established after the Workshop each dealing with the respective implementation activities of the key goals, needs and building blocks. Related to the workshop outcomes, future agendas will need to be assessed specifically for each working group.

Initial session questions

Based on the stakeholder consultation priorities, a set of initial session questions was built. The initial questions for each session are presented in the following table. These questions are to start the discussion but are meant to be inspiring and one is encouraged to define a set of additional or new questions.

<p><u>Data Repositories & Analytics</u></p> <ol style="list-style-type: none"> 1. What information is needed to have a complete understanding of exposure (exposure spectrum)? 2. What is the role of data storage and analytics in improving health at population and at individual level? 3. How can we promote exposure- (and risk-) informed choices by European residents? 4. How can exposure data repositories and analytics best facilitate the completion of the exposure spectrum? 5. What are the threats/risks of data repositories and analytics? 6. How can efforts on data repositories and analytics be funded?
<p><u>Regulatory Exposure Assessment Science</u></p> <ol style="list-style-type: none"> 1. What is the current status of the EU regulation and what does it address in terms of exposure information? 2. How can we integrate a holistic view of exposure into regulation and who are the main actors and responsibilities? 3. Can the current European regulation contribute to the completion of the exposure spectrum? 4. How can European regulation address data ownership/protection? 5. How can efforts on regulatory exposure science be funded?
<p><u>Building Partnerships & Collaboration</u></p> <ol style="list-style-type: none"> 1. What key players are needed to cover the exposure spectrum and to integrate it into health care? 2. What key actors are needed to collaborate on biodiversity? 3. What key players are important to involve for making a European Exposure Science Strategy and implementation successful? 4. Is there a need for new alliance-building to promote exposure science in Europe? 5. What is the role of ISES-Europe in connecting and building (new) alliances? 6. How can efforts on building partnerships and collaboration be funded?
<p><u>Exposure Data Production & Monitoring</u></p> <ol style="list-style-type: none"> 1. Which exposure data are needed to cover the exposure spectrum and connect it to health care and costs and what are the key indicators? 2. What is the role of ISES-Europe in the completion of the exposure spectrum for exposure data production and monitoring? 3. How can we make best-use of existing and novel monitoring technologies/networks? 4. How can efforts on exposure data production and monitoring be funded?
<p><u>Exposure Assessment Methods & Tools</u></p> <ol style="list-style-type: none"> 1. What are the requirements in terms of methods and tools to facilitate the completion of the exposure spectrum in Europe? 2. What are the requirements for exposure assessment methods and tool in order to be implemented by actors working in decision-making and health care? 3. How can existing and new exposure assessment methods and tools best be linked to existing and emerging data generation efforts? 4. What exposure science methods and tools are needed in Europe to work toward related targets of the UN Sustainable Development Goals? 5. What methods/tools focus on or can be linked to biodiversity? 6. How can efforts on exposure assessment methods and tools be funded?

Exposure Science Education, Training & Communication

1. How can we define/understand exposure science in European education?
2. What are the skills needed to strengthen exposure science education and training in Europe?
3. How can we develop a European exposure science curriculum?
4. What is the role of ISES-Europe as exposure science education/training facilitator?
5. How can exposure science education help to build relationships/acceptance with academia/authorities/other societies/industry?
6. How can exposure communication facilitate the use of exposure information/spectrum in improved and cost saving health care?
7. How can efforts on exposure science education, training and communication be funded?

Workshop outcome format

At the end of each session, we would like to get input to the following tables about strengths, weaknesses, opportunities and threats (SWOT), key goals and needs, building blocks, and inspiration questions/examples for each session.

DAY 1 – Key questions, needs, and current challenges for European exposure science – Session outcome table:

Theme	Strengths	Gaps/Weaknesses	Opportunities	Threats	Key goals	Key needs
1. Data repositories and analytics						
2. Regulatory exposure assessment sciences						
3. Building partnerships and collaboration						
4. Exposure data production and monitoring						
5. Exposure science methods and tools						
6. Exposure science education, training and communication						

DAY 2 – Building blocks, solutions and ways forward to address needs and challenges for European exposure science – Session outcome table:

Theme	Key building blocks	Inspiration, examples, further opportunities within this theme
1. Data repositories and analytics		
2. Regulatory exposure assessment sciences		
3. Building partnerships and collaboration		
4. Exposure data production and monitoring		
5. Exposure science methods and tools		
6. Exposure science education, training and communication		

Poster Pitches

DAY 1: Tuesday, 19-June-2018

<i>Time</i>	<i>Topic</i>	<i>ID</i>
16:30 Holger Koch, IPA-DGUV, DE	<u>Data Repositories & Analytics</u> DINCH Exposure in Germany has become omnipresent and is further increasing – urinary data from the German Environmental Specimen Bank (1999-2017)	P6
16:35 Henk Goede, TNO, NL	<u>Regulatory Exposure Assessment Science</u> Development of an integrated risk management measure library	P16
16:40 Marie Coggins, NUI Galway, IR	<u>Exposure Data Production & Monitoring</u> Elucidating Levels and Pathways of Human Exposure in Ireland to POP-BFRs and PFOS (ELEVATE)	P22
16:45 Ludovic Pepin, ANSES, FR	<u>Exposure Assessment Methods & Tools</u> Analysis of Specific Consumer Exposure Determinants (SCEDs) in comparison with observational data from EPHECT study	P37
16:50 Hubert Dobbstein, Zschimmer&Schwarz GmbH, DE	<u>Exposure Science Education, Training & Communication</u> Proposal to present the data of the Extended Safety Data exclusively in tabular form	P43
16:55	Wrap up and Discussion	

DAY 2: Wednesday, 20-June-2018

<i>Time</i>	<i>Topic</i>	<i>ID</i>
13:30 Burkhard Stahlmecke, IUTA, DE	<u>Data Repositories & Analytics</u> Possibilities and limitations of low cost PM sensors	P4
13:35 Bojan Gasic, SECO, CH	<u>Regulatory Exposure Assessment Science</u> TRanslation of EXposure MOdels (TREMOM): Multi-model approach to assess occupational exposure to chemicals	P13
13:40 Celine Brochot, INERIS, FR	<u>Exposure Data Production & Monitoring</u> Estimating the early-life exposure to perfluorinated compounds using PBPK modeling and biomarker measurements	P23
13:45 Javier Vila, ISIGlobal, ES	<u>Exposure Assessment Methods & Tools</u> Development of a Job-Exposure Matrix for occupational exposure assessment of high frequency electromagnetic fields (3 kHz-300 GHz) in the INTEROCC study	P28
13:50 Claudia Cascio, EFSA, IT	<u>Exposure Science Education, Training & Communication</u> Dietary Exposure Assessment to chemicals: EFSA activities and priorities	P44
13:55	Wrap up and Discussion	

Poster abstracts

Data Repositories and analytics

P1 Characteristics of 24-h Urine Samples and their Relevance for Human Biomonitoring - 20 Years of Trend Research

Keywords: 24 h-urine, creatinine, conductivity, specific gravity, total volume, normalization

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For documenting trends in human exposure, the German Environmental Specimen Bank (ESB) has been routinely collecting and archiving 24 h-urine samples from young adults at four sampling sites in Germany. In addition to pollutant concentrations, urinary creatinine (UC), specific gravity (SG), conductivity (CON) and total urine volume (UV_{tot}) have been routinely recorded. It is known that the above-mentioned characteristics of 24 h-urine samples vary between individuals and over time and might affect data interpretation. To identify relevant differences and trends in these parameters, we analysed ESB data from 1997-2016 from 8,916 participants also with regard to the impact of sex and sampling site. Sampling sites do not substantially affect UV_{tot} , UC, SG and CON. A significant increasing trend was revealed for UV_{tot} . This increase is associated with UC, SG, and CON decreasing over time. Effects of normalization against these urine parameters were demonstrated for urinary Ca^{2+} concentrations: From 1996-2016, Ca^{2+} concentrations showed a significant decreasing trend over time. A normalization against UV_{tot} , UC, or CON eliminated this trend. The known sex-specific excretion for Ca^{2+} is confirmed in this study. A normalization against UC, SG, or CON alleviated differences between sexes whereas a normalization against UV_{tot} did not. To avoid misinterpretations in trend analysis and of sex specific excretion, the collection of 24 h-urine samples and the calculation of the total daily excretion is recommended. Also if sampling is limited to spot or morning urine samples, the record of multiple urinary parameters should be considered for supporting data standardization. The suitability of these characterization may, however, vary by the analyte of interest, the study design, and the kind of urine sample taken. Funding by the German Ministry for the Environment (BMU) is gratefully acknowledged.

P2 Recent and on-going CEFIC Long Range Research Initiative projects to advance regulatory human exposure assessment for chemicals

Keywords: Chemicals; Exposure

Bruno Hubesch and Jan Urbanus on behalf of LRI

CEFIC (European council of the chemical industry)

CEFIC LRI programme conducts research relevant to assessment and management of risk related to chemicals (www.cefic-lri.org). Research themes include hazard assessment, and human and environmental exposure to chemicals. Specific projects are selected based on relevance and scientific innovation potential; all projects are monitored by teams of experts of CEFIC member companies.

Periodically, scoping workshops are convened in collaboration with ECETOC to take stock of project results, consider knowledge gaps and emerging issues, and set priorities for new project calls. Exposure assessment is a recognised key area of regulatory chemical risk assessment requiring further development of the underpinning science. A comprehensive set of projects addresses this need and enhances the industry's capability to conduct informative exposure assessments.

Recently completed and on-going human exposure related projects include:

- Development of an integrated risk management measures library (B15.2)
 - Awarded to TNO (NL), principal investigator: Henk Goede
 - Status: ongoing, reporting in mid-2018
- Validation of the occupational dermal exposure predictions in the ECETOC TRA (B16)
 - Awarded to a consortium of TNO and Triskelion (NL), principal investigator Jody Schinkel
 - Status: completed; published in Annals of Worker Exposure and Health (Vol. 61, No.7, 2017); web link: <http://cefic-lri.org/projects/b16-tno-external-validation-of-tier-1-workers-dermal-exposure-estimates-in-ecetoc-tra/>
- SHINE: Target and non-target Screening of cHemicals in the Indoor enviroNment for human Exposure assessment (B17)
 - Awarded to a 5-party international consortium led by the Free University of Amsterdam, principal investigator Marja Lamoree
 - Status: ongoing, reporting in 2019; web link: <http://cefic-lri.org/projects/b17-shine-target-and-non-target-screening-of-chemicals-in-the-indoor-environment-for-human-exposure-assessment/>
- Extrapolating the Applicability of Worker Exposure Measurement Data (B19)
 - Awarded to a consortium of TNO, Triskelion (NL) and HSL (UK), principal investigator Wouter Fransman
 - Status: ongoing, reporting end 2018; web link: <http://cefic-lri.org/projects/b19-extrapolating-the-applicability-of-worker-exposure-measurement-data/>
- Experimental assessment of inhalation and dermal exposure to chemicals during industrial and professional activities (B20)
 - Awarded to a consortium of TNO (NL) and BPI (Greece), principal investigator Wouter Fransman
 - Status: kicking off, reporting end 2019; web link: <http://cefic-lri.org/projects/b20-experimental-assessment-of-inhalation-and-dermal-exposure-to-chemicals-during-industrial-and-professional-activities/>

The poster will provide brief overviews of each project: objective, status, results, relevant publications and/or websites. Several members of project monitoring teams will attend the ISES conference and will be able to provide additional information.

P3 OCdBIO: a combined monitoring system to control Cd exposure at the workplace

Keywords: Biomonitoring, kidney, cadmium, workplace

M Gilles, P de Metz, F Van Assche

International Cadmium Association, SAFT, International Zinc Association

In cadmium exposure and risk management, there is general consensus that the kidney is the critical organ. The systemic accumulation of Cd in the kidney above threshold levels, and the possible resulting development of microproteinuria are the most sensitive effects of elevated exposure. Therefore, occupational risk management systems focus on the early detection of Cd accumulation in the body, through monitoring of Cd in urine (CdU, as a measure for life-time Cd-accumulation in the kidney cortex via all possible exposure routes) or Cd in blood (CdB, as a marker for recent exposure).

Recognizing the importance of this approach, the International Cadmium Association (ICdA) has engaged with EU industrial sectors where occupational cadmium exposure is likely to arise with a two-pronged approach. ICdA provides individual companies in these sectors guidance on effective worker protection, promoting the benefits of regular urinary and blood biomonitoring. In return companies are asked to report anonymously to ICdA their workers' biomonitoring measurement to the Observatory of Occupational Cadmium Biomonitoring (OCdBIO).

Participating companies to OCdBIO report anonymously on a yearly basis the most recent CdU and CdB values for all workers who are requested by the site occupational doctor to undergo regular biomonitoring.

The number of participating plants has increased from 15 upon inception in 2008, and reached 33 in 2017, covering at present over 3500 workers. It is estimated that approximately 90% of EU Cd related industry is covered by this program.

Industry has been engaged to limit the number of elevated proteinuria cases by actively working to reduce the prevalence of CdU >2µg Cd/g Creatinine. The OCdBIO database allows to track the progress made in that respect. Results over time will be presented and discussed.

P4 Possibilities and limitations of low cost PM sensors

Keywords: Low cost PM sensor; photometer; spectrometer

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In the recent years, low cost particulate matter (PM) sensors have raised increased attention among both researchers, as well as the general public. As an example, the citizen science initiative OK Lab in Stuttgart, one of Germany's most polluted cities in terms of PM₁₀, use such sensors to obtain highly resolved spatiotemporal information on the PM₁₀ mass concentration in the city. A variety of different PM sensors exist, with prices between a few Euros, for simple photometric devices, up to a few hundred Euros for particle size resolving spectrometers. Besides their application in ambient PM monitoring, these sensors can also be used to monitor dust concentrations in indoor or workplace environments or for laboratory studies in the field of aerosol science. However, for all these applications, it is necessary to know the accuracy, comparability and reliability of the sensors. A major challenge for the use of these sensors is that they all infer information on the particle mass concentration from the measurement of the intensity of light scattered by the particles. The intensity of scattered light, however, is not proportional to the particle mass and depends furthermore on additional factors, such as the refractive index and shape of the particles. To determine a mass concentration, the (mean) particle density has to be assumed in addition. In the study presented here, we investigated the response of three different sensor types (Sharp dust sensor, model GP2Y1010AU0F; Nova Fitness sensor, model SDS011; Alphasense spectrometer, model OPC-N2) in detail by challenging them with different types of aerosols and compare the response with scientific grade instruments. The ongoing laboratory and field investigations of the three sensor types will be presented and discussed in view the sensors' possibilities and limitations.



Pitch on
DAY 2!

P5 Applicability of optical aerosol spectrometers and photometers for the surveillance of workplace exposure concentrations

Keywords: Optical aerosol spectrometer; photometer; workplace

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In view of worker protection the respirable dust fraction concentration in workplaces has to be kept below the occupational exposure limit, set recently in Germany to 1.25 mg/m³. For this value the conventional gravimetric method used to determine the respirable dust fraction might reach its limit. Alternatively, direct reading optical instruments (spectrometers and photometers) can be used to determine the exposure. These instruments are factory calibrated to deliver ambient air PM₁₀, respirable (PM₄), PM_{2.5} and PM₁ mass concentrations. Because there is no worldwide standard for calibration of aerosol spectrometers and photometers, each manufacturer calibrates its instrument in a different way using different aerosols. Whereas the size calibration is straightforward, the delivered mass concentration depends on several assumptions concerning the aerosol properties influencing the measurements, e.g. particle shape, refractive index and particle density. However, especially the refractive indices and particle densities encountered in workplaces can be completely different and the mass concentrations in workplaces are likely biased. This effect is even more pronounced in case of photometers, which measure the light scattered by a cloud of particles in the measurement volume. In order to relate the measurement result to a particle mass concentration, additional assumptions on the particle size distribution are needed. The recently started project OMA aims at determining the applicability of available optical aerosol spectrometers and photometers for workplace exposure concentration measurements. First data clearly demonstrate the need for individual calibration for the workplace and/or the dust to be investigated. Some distinct differences in the size distributions could be observed, that will lead also to differences in the mass concentrations reported by the instruments. The ongoing laboratory investigations of six optical aerosol spectrometers/photometer will be presented and discussed in view of their performance and applicability to determine the exposure in terms of mass concentration at workplaces.

P6 DINCH Exposure in Germany has become omnipresent and is further increasing – urinary data from the German Environmental Specimen Bank (1999-2017)

Keywords: Human Biomonitoring; Urine; Plasticizers; DINCH

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Hexamoll® DINCH® was introduced in the year 2002 as a substitute for high molecular weight ortho-phthalate plasticizers like DEHP and DiNP which are under public and regulatory pressure due to their endocrine disrupting effects. DINCH production in Europe rose from 9.000 t in 2002, to 155.000 t in 2014 and is predicted to reach 220.000 t in 2019. For Germany, we already described the rapid increase in detections and levels of DINCH metabolites in 24h urine samples from the Environmental Specimen Bank (ESB) from 1999 to 2012.

We now report the results of ESB measurements from the sampling years 2010, 2011, 2013, 2015 and 2017. All samples were blinded and randomized before analysis. Three urinary DINCH metabolites, the side-chain oxidized monoesters OH-MINCH, oxo-MINCH and cx-MINCH, were determined by online SPE LC-MS/MS with isotope dilution quantification. The limit of quantification for all three metabolites was 0.05 µg/L, identical to our previous ESB measurements.

The major urinary DINCH metabolite OH-MINCH was first detected in samples from 2006 (6.7%) with detection rates steadily increasing thereafter (43% in 2009, 80% in 2010, 98% in 2011, 98% in 2012, and 100% in the years 2013, 2015 and 2017). Thus, from 2013 on we could detect DINCH exposure in every sample investigated. The median concentration for OH-MINCH increased from 0.15 µg/L in 2010 to 0.70 µg/L in 2017. Detection rates and concentrations for the other DINCH metabolites were lower, as expected from human metabolism studies, but strongly correlated among each other.

Overall, urinary DINCH metabolite concentrations were below the health based guidance value (HBM-I) of 4500 µg/L (sum of OH-MINCH and cx-MINCH), and calculated intakes were below the tolerable daily intake of 1 mg/kg bw*d. The ongoing increase of DINCH exposure calls for a continued exposure monitoring, preferably in subpopulations (e.g. children) with known higher exposures.



Pitch on
DAY 1!

Regulatory Exposure Assessment Science

P7 Chemicals Safety Assessment under REACH (1) – The exposure scenario concept, its challenges and solutions available

Keywords: REACH, exposure assessment, exposure scenarios, Chesar

Andreas Ahrens

European Chemicals Agency

Under REACH, manufacturers and importers of hazardous substances are required to describe and communicate the conditions of use under which their substance can be used safely. For each identified use by workers and/or consumers, the expected exposure is estimated and compared with toxicological thresholds, in order to demonstrate control of risk.

Eight years after submission of the first wave of Chemicals Safety Assessments under REACH, exposure scenario information communicated with the Safety Data Sheets has started to arrive at the bottom of the supply chain. However the content and format of the advice is not yet sufficiently supporting the needs of the recipients:

- Registrants at the top of the supply chain lack knowledge on the uses and the conditions of use relevant to their substances. Downstream user sectors organization have only learned step by step how to best communicate information in form of use-maps to the suppliers of chemicals.
- Many registrants have not connected yet their processes for generating the Chemicals Safety Assessment in an efficient manner with the existing Safety Data Sheet authoring systems. As a result, the communicated information suffers from inconsistency with registration data and is often not sufficiently user-friendly.
- In addition, many of the CSR submitted with the first registration waves have not been generated with an IT tool, but are just word/pdf documents, with the corresponding difficulties to make updates.

In order to overcome these difficulties ECHA has developed a Chemical Safety Assessment and Reporting tool (Chesar), which supports the registrants in connecting

- the use-information sourced from downstream organizations with the IUCLID data-set for the substance to be assessed,
- with the tools to generate exposure estimates and risk characterization and
- with generation of exposure scenarios for communication (with the safety data sheets) in xml format.

Based on ECHA statistics about 50% of current registrants are using the tool already.

P8 Chemicals safety assessment under REACH (2) – Exposure modelling for improving the advice on safe handling and exposure controls in safety data sheets

Keywords: Worker exposure modelling, REACH, exposure scenarios

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Eight years after submission of the first wave of Chemicals Safety Assessments under REACH, exposure scenario information communicated with the safety data sheets has started to arrive at the bottom of the supply chain. However the content and the format of the advice is not yet sufficiently supporting the needs of the recipients. One of the root causes lies with the fact that exposure modelling tools applied have originally not been designed for supporting a communication process down the supply chain.

Therefore:

- Many of the input parameters driving the exposure estimates would need a better “translation” into advice making sense for the users chemicals. The tools for this “translation” step are however not yet sufficiently developed or implemented.
- Some of the modelling tools require site-specific input information, which is however usually not available in the top-down safety assessments under REACH.
- The applicability domain of the tools in terms of use-scenarios are not always clear.
- Various modelling tools used in parallel to each other define the same exposure determinants in different words or granularity. From the communication perspective, this can lead to significant confusion for the recipients of exposure scenarios.

Under the umbrella of Exchange Network on Exposure Scenarios (ENES), ECHA has initiated a project together with the worker exposure tool owners, industry organizations and a number of member state authorities, for better understanding the applicability domains of the tools and the potential commonalities in input-parameters. First outcomes of this work will be presented.

P9 Estimating the release potential of additives from plastic articles – Method supporting prioritising and deprioritising of substances for further work

Keywords: Plastic additives, exposure, articles, REACH

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The release of hazardous substances from plastic materials is an area of high public interest. During the first two registration deadlines under REACH, several hundred substances potentially used as additives in plastics have been registered in volumes of 100 tonnes/year or more. However, for many of these substances there is significant uncertainty on the hazards and potential releases from plastic matrices.

In late 2016, ECHA and a number of Industry sector organisations have started a joint effort for characterising the uses of the various plastic additives and the corresponding potential for release from articles. This work aims to support

- industry in improving the REACH registration information on the use of plastic additives in articles and the related exposure potential, and
- authorities in prioritisation and de-prioritisation of substances for initiation of regulatory processes.

The presentation focuses on approaches and learnings when ranking plastic additives:

- Data needed to predict the release potential: list of confirmed plastic additives, substance properties determining the release behaviour, additive function and concentration, relevant polymer and article type.
- Ranking method: Development of a robust method to compare the release potential of additives from different plastic matrices.
- Generation of ranking lists: Grouping of additives by function and ranking according to their release potential.

In a subsequent step, the hazard information available for the single additives is combined with their relative release potential, in order to arrive at a risk-based prioritisation and de-prioritisation for regulatory processes. One of the key outcomes of the exercise is the identification of substances i) with significant uncertainties regarding the hazard and ii) having at the same time a high potential for release.

P10 Priorities in exposure assessment at RIVM

Keywords: Priorities, exposure assessment

Theo Vermeire and Joop de knecht

National Institute for Public Health and the Environment

Further to an international scientific audit and a corporate demand to develop a strategy on exposure and distribution of Substances, RIVM committed itself to review its current exposure assessment activities, and to strengthen and renew its position in this area, which was, on average, considered to be strong. The poster highlights key elements from the resulting “Exposure Assessment Strategy 2016-2020”. This document describes RIVM’s vision and spells out RIVM’s exposure assessment activities and priorities to achieve its goals until 2020. The ambition of the institute is to produce and deliver in time reliable knowledge, scientific advice and policy advice to risk managers and other stakeholders in the public arena, to signal on exposure and risks, to have access to reliable, actual and representative data, to develop and maintain expertise in the area of exposure assessment and to provide our support in harmonising exposure assessment practices across the EU. The primary focus of the exposure strategy is to set up an overall RIVM strategy for exposure assessment for existing and new exposure-related strategic themes, such as exposure modelling for different chemical and use categories, use of biomonitoring data, combined exposure, new and emerging risk of chemicals, and circular economy. The strategy was realised through interviews among experts from different exposure-related disciplines at RIVM, a workshop to answer questions on the vision and goals of the strategy and the needs to achieve it, finally through a series of Steering Group Meetings followed by a consultation among managers. The exposure assessment strategy offers a structure for exposure-related disciplines at RIVM to evaluate current and future activities aiming at better research, development, collaboration and integration. Based on an analysis of strengths, weaknesses, opportunities and threats, major needs were identified and prioritised, leading to priority actions.

P11 REACh2SDS – Assessing the availability and quality of risk and risk management information in Chemical Safety Reports

Keywords: REACH, risk communication and management, exposure scenarios

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REACH requires all chemicals placed on the EU market (> 1 tpa) to be registered. The registrant has to address associated hazards, relevant exposure situations and an overall risk characterisation in a Chemical Safety Report (CSR). For substances classified as hazardous, this information has to be communicated along the supply chain in an extended Safety Data Sheet (eSDS). The first phase of the REACh2SDS project aims to assess the availability and quality of risk and risk management information in the CSR of substances in the 100-1000 tpa band. At a later stage, the information consistency between the CSR and corresponding eSDS will be analysed.

Relevant markers were identified based on the REACH-Regulation and the scopes of the most commonly used exposure estimation models (e.g. ECETOC TRA, MEASE, Stoffenmanager). Using these markers, decision trees were developed along which the CSRs were analysed. Depending on their fulfilment, the markers were assigned to one of three result categories: compliant (i.e. complete fulfilment), complex (more information/deeper analysis required) or non-compliant (i.e. legal requirements are not fulfilled/boundaries of the model are not respected).

The analysis showed clear quality differences between individual reports. Out of 60 completed CSRs, 51 were rated as non-compliant or complex. The most common reasons for non-compliance included absence of details on personal protective equipment, the absence of both quantitative and qualitative risk assessment and the absence of a CSR. The majority of complex markers were due to the inadequate use of exposure estimation models and excessively high reduction factors.

However, the analysis has not taken into account the severity of an information gap for occupational safety and health (OSH). Such an unweighted approach might distort the conclusions drawn from the project. Therefore, we suggest to characterise further the non-compliant markers according to their OSH risk level using a banding approach.

P12 Quantifying the effectiveness of personal protective equipment against dermal exposure

Keywords: Dermal exposure, skin protection, dermal protective equipment, measurement methods

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In the course of risk assessments under REACH or the biocides regulation, personal protective equipment (PPE) is often specified as a measure to ensure safe use. Suggestions for exposure reduction efficiencies for PPE exist, e.g. in the ECETOC TRA tool for occupational exposure assessment under REACH and in HEEG opinion 9 for biocides. However, these suggestions are only supported by limited experimental data. Therefore, the Federal Institute for Occupational Safety and Health (BAuA) started a project with the aim to gather quantitative efficiency data for various types of dermal PPE as well as information about influencing factors (e.g. user training, challenge, carrier substances) and methodological aspects of efficiency derivation.

Information was gathered via literature searches in the databases PubMed, Scopus and WebOfScience.

As a result, a seemingly large number of studies was identified containing useful experimental data, and efficiency data from 93 references was collected in a MS Excel® database. The studies focused on gloves and whole body garments, and span a large range of efficiencies for each PPE category. However, the majority of the data is not of good quality. Hardly any information on influencing factors is reported in these studies. No standardised sampling methods, evaluation methods or study designs were found. Quantitative information was very heterogeneous concerning study design and structure but also biased towards certain industry areas or PPE types. We have also reviewed studies involving biomonitoring, but only few reliable datasets were considered adequate for the purpose of this study.

Overall, the available quantitative data do not seem to contradict the available default efficiencies. No information on carrier substances and only very little information on the influence of user behaviour or training was found. However, the collected information gives a general impression of possible protection factors, some influencing factors and available methodological research.

For detailed information, see the final report at:

<https://www.baua.de/EN/Service/Publications/Report/Gd89.html>

P13 **T**Ranslation of **E**Xposure **M**odels (**TREXMO**): **M**ulti-model approach to assess occupational exposure to chemicals

Keywords: Chemicals, Exposure Modeling, REACH, Advanced REACH Tool, Stoffenmanager, EXETOC TRA, EMKG-EXPO-TOOL, EASE, MEASE

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Several occupational exposure models have been developed for regulatory purposes within the context of REACH in the EU and under the Swiss chemical laws. They differ in complexity and often calculate different predictions for the same exposure conditions. Moreover, two users often differently interpret the same set of exposure conditions which may lead to different exposure estimates by applying the same model. The exposure assessment tool **TREXMO** (=Translation of Exposure Models) has been developed to provide more reliable and safer exposure estimates by reducing the impact of these two variabilities, i.e. **between-model** and **between-user variability**. TREXMO (v2.0) integrates six models: **ART** (v1.5), **Stoffenmanager®** (v4.0), **ECETOC TRAv3**, **MEASE**, **EMKG-EXPO-TOOL** and **EASE** (v2). The translation rules between input parameters in the six models have been defined and included in the tool. Hence, for a given exposure situation (ES), defined by a set of parameters in one model, TREXMO provides the user with the most appropriate parameters in the other models. When translating from ART, the results show that TREXMO reduced the number of possible outcomes in the other models by 1-4 orders of magnitude. Furthermore, the translation rules of TREXMO have been used to compare the estimates of ART, Stoffenmanager and TRAv3 for 319,000 ESs. It was found that the percentages of generated ESs for which estimates differed by more than a factor of 100 ranged from 14-97%, 37-99% and 1-68% for Stoffenmanager-ART, TRA-ART and TRA-Stoffenmanager, respectively. Finally, the between-user variability for TREXMO was also evaluated. Compared with the common use of models (outside TREXMO), the translations increased intra-class correlation coefficients (ICC) by factors 1.5-3. These findings emphasize the current need for a multiple-modeling approach such as TREXMO for regulatory purposes in order to establish more reliable and safer exposure estimates. Our research results also show a need for further refinements of the models' calibrations and algorithms.



Pitch on
DAY 2!

P14 Overview of the EFSA Guidance on the assessment of exposure in risk assessment for plant protection products, Workshop 2018

Keywords: Exposure, risk assessment, plant protection products

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ANSES - French Agency for Food, Environmental and Occupational Health & Safety

The French Agency for Food, Environmental and Occupational Health & Safety (ANSES) hosted a Workshop on Toxicological Risk Assessment of Plant Protection Products (PPPs) on 13-14 March 2018. The main objective of this Workshop was to identify the key factors to allow progress in the robustness and harmonisation of human health risk assessment of PPPs, with a focus on non-dietary exposure.

The principles, data requirements and methods applicable to this assessment are specified in Regulation (EC) No 1107/2009 concerning the placing of PPPs on the market and in guidance documents. According to these, and, more specifically, the EFSA Guidance on the assessment of exposure of operators, workers, residents and bystanders in risk assessment for PPPs (EFSA Journal 2014;12(10):3874), the harmonisation of methods and tools for the estimation of human exposure to PPPs is a major issue.

One of the main topics of this Workshop was thus to see both regulatory authorities' and stakeholders' perspectives, and to obtain comments on the implementation of this guidance. New developments identified as prerequisites for exposure assessment of operators, workers, bystanders and residents were also discussed.

In general, among member states a harmonised approach is implemented for operator exposure assessment, whereas varying approaches were identified for worker exposure assessment (such as variations in risk mitigation measures included for the assessment, refinement of transfer coefficients (TCs), foliar DT₅₀ values). Additional data were considered necessary for improving modelling of bystander and resident exposure. Finally, some scenarios not covered by the EFSA guidance were listed (e.g., greenhouse use, seed treatment).

P15 Biocidal pest control products - common exposure scenarios for professional users from the regulatory perspective

Keywords: Pest control, biocidal products regulation, occupational exposure, professional user, risk management measure

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Pest control products are biocides and have to be authorised according to regulation (EU) No 528/2012 in the European Union. They represent the third-largest group of biocides on the German market. In the professional context, users primarily come into contact with products for control of rodents (rodenticides) and insects (insecticides).

The exposure situations presented describe the current status of regulatory exposure assessment for professional users. The poster shall give an overview on common professional application methods of biocidal pest control products within the authorisation process, their related exposure potential and adequate risk management measures to be taken. The presented approach may also serve as a guideline for applicants in case no product specific exposure measurement data are available.

Biocidal pest control formulations that have been evaluated within the biocidal product authorisation process up to now include liquid, granular, powdery, gel-, paste- or wax-like formulations. The assessed application methods include the placing of ready to use baits (e.g. sold in bait stations or cartridges), spraying, fogging, dusting, scattering, pouring or painting.

In general professional users often apply biocidal pest control products by hand or they use manual handheld devices. The number of related exposure scenarios is numerous due to the high number of formulation types and application patterns. The use of application devices or modifications of packages are effective measures to reduce direct dermal contact and the number of decanting processes (mixing and loading) and thus exposure. Ideally, these measures are already considered in the product design stage.

P16 Development of an integrated risk management measure library

Keywords: Risk Management Measures, RMM, effectiveness, control measures, database

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REACH and other European legislation require that companies demonstrate the safe use and control of hazardous substances. For this purpose, the quantitative efficiency of Risk Management Measures (RMM) is required to evaluate the operational conditions (OCs) that are part of exposure scenarios in order to predict the resulting exposures or environmental concentrations. Presently, companies can obtain information on the quantitative efficiency of RMM from only a limited number of sources. Important sources are the CEFIC RMM Library, the TNO Exposure Control Efficacy Library (ECEL) and the OECD emission scenario documents.

Considering the different RMM libraries available, it will be preferable to combine these efforts and resources in order to collate occupational and environmental RMM data. CEFIC LRI B15-2 has started in October 2017 to address this.

This project delivered a web-based TNO ECEL v 2.0 RMM library database that is being hosted by TNO and is freely available. The ECEL v2.0 database contains data merged from ECEL v1.0 and the CEFIC LRI B15 databases. The content of the database is compatible with REACH and includes occupational and environmental RMM data. The database has a unique function which allows users to calculate efficacy values based on multiple selected studies which focus on similar processes.

A blue oval graphic containing the text 'Pitch on DAY 1!' in white, slanted font.

Pitch on
DAY 1!

Exposure Data Production & Monitoring

P17 Systematic analysis of dermal exposure to hazardous chemical agents at the workplace: outcome of the SysDEA project

Keywords: Dermal exposure measurements, comparison of methods

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BAuA¹, TNO², BPI³

The goal of the SysDEA research project was to generate scientific knowledge to improve and standardize measurement methods for dermal exposures to chemicals at the workplace. In addition, different measurement methods were compared. The experimental data generated during the project provide knowledge to reduce current uncertainties in estimating occupational dermal exposure, as well as to characterize the strengths and weaknesses of various dermal measurement methods.

During the project different dermal measurement methods (whole body dosimeter sampling (coverall/headband/gloves) patch sampling, wiping (forehead) and washing (hands), and fluorescence) were compared. Volunteers repeatedly performed a selection of exposure situations under standardized conditions in test chambers (to increase reproducibility and decrease variability), namely pouring, rolling, spraying and handling of immersed objects with low and high viscosity liquid products, and dumping of and handling objects contaminated with a dusty powder.

The generated data for all liquid scenarios suggest that using patches leads to significantly higher measured exposures compared to using coveralls, while for powder scenarios no significant difference was found. For hand exposure, wearing gloves resulted in significant higher exposures compared to washing of hands for all liquid scenarios, but only for handling of contaminated objects in case of the powder scenarios; for dumping powder no difference was found between gloves and hand wash. For head exposure, wipes resulted in higher exposure compared to using the headband for all scenarios except spraying. Although the fluorescence method was very useful for qualitative assessment of e.g. exposure patterns, quantitative assessment of dermal exposure was not yet possible.

P18 Exposure of Workers During Pest Control of the Oak Processionary Moth (OPM) by Spray Applications

Keywords: Oak Processionary Moth, OPM, spray application, diflubenzuron, workplace measurement, dermal exposure, inhalation exposure, insecticide

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The oak processionary moth (OPM) is a species native to central and southern Europe, but its range of distribution is expanding northwards. Throughout the present decade, there have been repeated mass occurrences in some regions. From their 3rd larval stage, OPM caterpillars form stinging hairs which release an irritant poison. Contact to the stinging hairs commonly causes skin and eye irritation, but more rarely also breathing difficulties or allergic reactions may occur. Therefore, the recent mass occurrences cause considerable problems for the affected population. OPM is mostly controlled by spraying insecticides, which – when applied for protection of human or animal health - require authorisation in accordance with the Biocidal Products Regulation (EU) No. 528/2012. For the risk assessment, which is a mandatory part of the application for authorisation, specific information for OPM control covering application methods and the resulting exposure of the operators is required, but this data was lacking until now. Spray applications carried out for control of OPM show significant differences to plant protection applications, thus a read-across from data available for plant protection applications would bear a high level of uncertainty. The present study investigated the potential dermal and inhalation exposure of pest control operators resulting from spraying a diflubenzuron –containing insecticide against OPM. Moreover, the potential exposure of bystanders was quantified (not addressed on the poster). Task-specific exposure data was obtained for hand-held as well as vehicle mounted sprayers. The data collected within the field studies were grouped and evaluated with regard to the type of spray application and working task, covering also tasks such as weighing and portioning of the granular product, on-site preparation and application of the spray liquid and cleaning of the equipment. The valid data obtained form a reliable database for the authorisation of biocidal products, but also for occupational risk assessment.

P19 An exposure assessment study among amenity horticulturists using glyphosate based pesticide products.

Keywords: Occupational exposure, urine, glyphosate, dermal sampling, biomonitoring.

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Introduction: Glyphosate, the highest volume used herbicide globally, has come under international debate following its classification as ‘probably carcinogenic to humans’ by IARC. There is a dearth of information on glyphosate exposure among amenity horticultural workers. To date, research on glyphosate exposures have mainly focused on agricultural and environmental exposures. The objective of this study is to evaluate the uptake of glyphosate, as well as, to evaluate the potential routes of exposures among amenity horticulturalists pesticide users.

Methods: A biomonitoring study was completed in 2017 and in parallel, a dermal and inadvertent ingestion exposure study. Workers were grouped into 3 similar exposure groups based on the type of application method used. The biomonitoring study involved the collection of, a minimum, of 3 urine samples for each task. Dermal samples were collected using Ghost wipes, of both the hands and the perioral region, before and after the work task. Worker gloves were also collected after the work task. Additional wipe samples were collected of potentially contaminated work surfaces. Detailed contextual information to support all samples was collected by the researcher.

Results: This study involved the collection of 125 spot urinary samples and 343 wipe and glove samples over 29 work tasks, which were analysed for glyphosate. The biomonitoring study show urinary glyphosate concentrations that were comparable with agricultural based studies, and higher than European environmental studies. All hand and glove samples, as well as a large proportion of the perioral region samples, had detectable levels of glyphosate. Strong positive associations were seen between the contamination levels on the perioral region and the urinary concentration of glyphosate, as well as hand and perioral region glyphosate surface loading levels. Glyphosate surface loading concentrations was seen on work surfaces which could potentially cause exposures to non-pesticide users in the workplace and para-occupational exposures.

P20 Feasibility study for consumer behaviour data collection

Keywords: Consumer Behaviour, Exposure Data, Feasibility Study

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The results of a feasibility study for the collection of consumer behaviour data is presented. Main goal was the evaluation of different methodologies of elicitation of various parameters, e.g. exposure duration, amount of substance used, location or whether product safety information was read and followed. The methods tested are mostly established in the area of food safety: Telephone interviews, protocols filled in by the consumer as well as video protocols and direct observation. Each method was evaluated in general categories like costs and workload for the researcher or burden on the participants as well as potential biases on the result. Product- and parameter specific fitness were also considered in this evaluation phase. Four methods were subsequently tested in practice using real situations of actual consumers: Two different kinds of retrospective interview as well as prospective use of participant-filled protocols with and without additional use of a camera for recording the task. Mixtures as well as articles were covered in this field phase. The final result of the study, taking into account the theoretical evaluation as well as the practical experience was the design which can be used to generate product-specific exposure data for further use in models for consumer exposure estimation like ConsExpo or ECETOC TRA. The study was performed jointly by FoBiG and aproxima for the German Federal Institute for Risk Assessment.

P21 Lead Exposure of Young Adults in Germany – Long Time Experience of the German Environmental Specimen Bank (ESB)

Keywords: Lead, exposure, decrease, influencing factors, environmental specimen bank

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Lead is used since ancient times by mankind in various ways. Its extensive use and emission (lead and lead containing compounds) resulted in considerable exposure of the environment and the human population. Due to its known toxic potential lead exposure has been routinely monitored by the German ESB since 1981. Blood lead levels (BLL) from 10,981 participants from 1981 to 2017 were evaluated for this study. From a subgroup of participants covering the years 2010-2017 data on sex, smoking, alcohol consumption, and housing situation were investigated on their impact on lead exposure in young adults. The longest time series ranges from 1981 – 2017 from participants of the sampling site Münster. BLL of young adults from Münster decreased steeply by 86 % from 1981 - 2017 for both male (1981: 8.5 µg/dL; 2017: 1.2 µg/dL) and female (1981: 7.1 µg/dL; 2017: 0.98 µg/dL) participants. A similar decrease is found for all four sampling sites since 1997. Results reflect regulation measures implemented to decrease human exposure to lead like the regulation of leaded gasoline in 1971. Since 2010 a significant decreasing trend is not observed anymore. Within this time frame (2010 – 2017) male and female smoker have significantly higher BLLs than non-smoker. Alcohol consumption is also significantly positively associated with BLLs. A significant elevation of BLLs in conjunction with living in houses build before 1949 is only observed in male participants. The observed association with sex, alcohol and tobacco consumption is in line with data from comparable studies. The ESB is funded by the German Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU).

P22 Elucidating Levels and Pathways of Human Exposure in Ireland to POP-BFRs and PFOS (ELEVATE)

Keywords: POPs, BFRs, HBCDD, PFOS, PBDEs, human exposure, bio monitoring, dust, air, water, body burden

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Ireland as a signatory of the UNEP Stockholm Convention on persistent organic pollutants (POPs) is required to eliminate or restrict the use and release to the environment of POPs in Ireland. Among the POPs covered by the Convention are some brominated flame retardants (BFRs) and perfluorooctane sulfonate (PFOS). BFRs such as hexabromocyclododecane (HBCDD) and polybrominated diphenyl ethers (PBDEs) (collectively referred to here as POP-BFRs) were used as flame retardants in a variety of soft furnishings, building insulation foams, electronic and electrical goods. PFOS has been used as a water and stain repellent in apparel and textiles such as carpets and in firefighting foams. To fully characterise human exposure to these contaminants bio-monitoring studies coupled with environmental measurements in food, household dust and air have been conducted. Previous human bio-monitoring data in Ireland and information regarding concentrations in foodstuffs suggests that exposures to these contaminants in Ireland are low. However, there is a dearth of information on concentrations of BFRs and PFOS in indoor air, dust and water (PFOS) in different microenvironments, information which is required to understand both the overall magnitude of exposure and the relative contributions of different exposure pathways. The ELEVATE project will conduct the first study of levels of BFRs and PFOS (PBDEs, HBCDD) in indoor air, dust and water in common Irish microenvironments (homes, cars, primary schools and offices). Data will be combined with existing data on concentrations in the Irish diet to evaluate the relative contribution of the different exposure pathways. A human biomonitoring study will also be conducted to provide up to date information on body burdens in the Irish population.



Pitch on
DAY 1!

P23 Estimating the early-life exposure to perfluorinated compounds using PBPK modeling and biomarker measurements

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Reverse dosimetry aims at reconstructing the external exposure using measured biomarkers, a physiologically based pharmacokinetic (PBPK) model accounting for the processes that the chemical undergoes in the human body, and individual characteristics. Such approaches are valuable to simulate exposure between biomarker measurement time points. In this work, we propose to estimate the early-life exposure of children to perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA).

Our study involved 1239 mother-child pairs of the HELIX cohort from 6 European countries. The compounds were measured in maternal plasma at the time of pregnancy, and in child plasma at the age of 6-9 years old. A PBPK model including childhood, pregnancy, and lactation periods was parameterized for each woman and child based on their individual characteristics. The PBPK model was run for mothers to provide exposure estimates for the child during the pregnancy and breastfeeding period. These estimates were then used as inputs to the PBPK model for the child together with the biomarkers to reconstruct his/her early-life exposure (i.e., daily intakes). Finally the internal exposure of children was simulated.

Our results showed that similar levels at birth and during childhood can correspond to very different exposure scenarios. A 3-factor in the diet exposure leads to a difference of 6 in C_{max} . The main determinants of the child exposure were the levels at birth (correlated with the mother's biomarker), the duration of breastfeeding, and the measured biomarker itself. Actual measurements during pregnancy and at the age of 6 to 9 do not correlate well with the predicted internal exposure during the first years of life (birth to 4 years old). The indicators depend most on the information collected through the questionnaires. Neglecting inter-individual differences and actual exposures can lead to large exposure misclassification problems, reducing the power of subsequent dose-response or association analyses.



Pitch on
DAY 2!

P24 The relevance of surfaces contamination monitoring for exposure assessment and control

Keywords: Surfaces contamination assessment, occupational exposure assessment

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Dermal exposure assessment is still not a priority in the intervention of occupational hygiene. However, for some substances in specific occupational settings, dermal intake can be the most important exposure route. Skin contamination can occur from contact with contaminated surfaces. Thus, knowing the levels of the substance present on the surfaces of the workplace is an important approach to indirectly measure dermal exposure. This paper aimed to claim attention for the relevance of surfaces contamination assessment in the occupational hygiene interventions. An extensive search was performed to identify scientific papers published after 2010, reporting data of surfaces contamination in the scope of occupational hygiene interventions. Twenty seven papers were considered and, from those, 63% were devoted to antineoplastic drugs occupational exposure assessment. Recently, the use of surface contamination measurements has been increasing and diversifying regarding substances and occupational settings. This short review allowed concluding that surfaces contamination assessment is very useful, because besides providing an indirect measure of dermal exposure, it can also give relevant information to guide interventions to prevent and control exposure. Occupational hygienists should remember surface contamination measurements as a complementary resource to a more accurate exposure assessment and to identify the most suitable risk management measures to apply.

Exposure Assessment Methods & Tools

P25 Assessment of the Oral Bioaccessibility of Semi-volatile Organic Compounds in Indoor Settled Dust Using a Simplified Method

Keywords: Human exposure; indoor environment; dust ingestion; bioavailability; pollutant

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Humans are exposed to a wide range of indoor chemical pollutants including semi-volatile organic compounds (SVOCs), which are suspected of adverse health effects such as reprotoxic and neurotoxic effects. Dust ingestion is a non-negligible pathway of human exposure to several of these compounds. To better assess this human exposure, it is necessary to consider the oral bioaccessibility of SVOCs, i.e. the fraction of pollutants released from the dust matrix in the digestive tract following the ingestion of dust. A few methods for measuring the oral bioaccessibility of SVOCs in dust have been described in the literature but they were never applied on a large number of samples because of their complexity. In this context, a simplified method was proposed. This method is an *in vitro* simulation of the gastric and intestinal stages of human digestion, in the presence of an adsorbent to simulate the dynamics of the digestion. This method was used to produce bioaccessibility data for the SVOCs present in the dust reference material SRM 2585, analyzed in triplicates. Measured bioaccessibilities (b-ac, in %) ranged from 34 to 63, 47 to 89, 25 to 88, 21 to 96, and 26 to 54 for pyrethroids, PAHs, PCBs, phthalates and PBDEs, respectively. These results were comparable to bioavailability data (b-av) measured in rats for BDE 99 (b-ac:37%, b-av:44%), and BDE 85 (b-ac:40%, b-av:39%); however they were lower for BDE 47 (b-ac:54%, b-av:69%), BDE100 (b-ac:39%, b-av:78%) and BDE 153 (b-ac:26%, b-av:73%). These results are preliminary and the measurement method still needs to be optimized and validated versus *in-vivo* tests. This project is the first step towards a better evaluation of human exposure to SVOCs in dust and particles, considering their oral, pulmonary and cutaneous bioaccessibility.

P26 MEASE 2 – Updated Occupational Exposure Assessment Tool for Metals and Inorganic Substances

Keywords: Exposure assessment, exposure modelling, metals, inorganic substances, REACH

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While various tools are available for the assessment of occupational exposure as required under the REACH regulation, most of these cover a broad range of organic substances on a generic basis. In contrast, MEASE was specifically developed for the first tier assessment of occupational exposure to metals and inorganic substances. In the meantime, this tool has been widely used for REACH registration purposes and has also been evaluated within the ETEAM project (MEASE 1). Whereas this tool has previously been assessed to provide conservative estimates the between user variability was identified as a weakness in MEASE 1, for example. Therefore, an update of this first tier occupational exposure assessment tool was launched in 2018, among others to consider the outcomes of the ETEAM project. MEASE 2 has evolved on various levels: while MEASE 1 was a Microsoft Excel based tool, where the user was able to select a set of conditions of use after selecting 1 out of 29 so-called PROCs (process categories), MEASE 2 is a Java-based application with an updated underlying exposure monitoring database and reflects most recent ECHA guidance. A PROC-selection guide is now available, providing guidance to tool users and increasing user friendliness while simultaneously reducing in-between-user variability. The underlying model was retained: initial exposure estimates are available for different PROCs and are modified depending on exposure determinants to be selected. The set of available exposure determinants, representing conditions of use, has however been expanded. In addition, some of the determinants are now interrelated and directly linked to a specific PROC in some cases, which reduces the in-between-user variability.

P27 Exposure assessment combining air measurements and biomonitoring of systemic exposure is key to manage Cd risks at the workplace

Keywords: Cadmium risk management, biomonitoring, workplace

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The EU Cd-related industry today is characterized by a high level of protection of the workers, by means of an integrated risk management system based on state of the science knowledge and extensive monitoring. As the kidney is the critical organ for Cd exposure, risk management systems focus on the prevention of accumulation of Cd in the kidney above well-established thresholds, to prevent the development of microproteinuria, the most sensitive effect of elevated exposure. Since the accumulation of Cd in the kidney is systemic, parameters integrating exposure through all possible routes should be measured. For Cd this is achieved by measuring Cd in urine and in blood.

Whilst the most prevalent approach to protect workers against adverse effects of chemical exposure is done by means of air quality standards, in the specific case of cadmium and kidney effects, it is necessary to measure cadmium accumulation, through both inhalation and ingestion routes, within the kidney. Measuring air-Cd is therefore not sufficient, since at the generally low levels of Cd in workplace air currently observed in industrial settings, industrial hygiene behaviour and related ingestion is an important route of exposure.

Recognising this, the Cd-related industry has for many years implemented an integrated risk management approach to fully protect its workers. This approach combines measurements of Cd in workplace air with systematical monitoring of systemic exposure parameters, mainly of the kidney (Cd in urine CdU, as a measure for life-time accumulated Cd exposure) or Cd in the blood (CdB, as a marker for recent exposure). The system focuses on the early detection of elevated exposure and combines biomonitoring action levels with measurements of the respirable fraction of cadmium in the workplace air. This combined system provides a much better protection of the worker against Cd-related effects than measurement of workplace air alone. The tiered risk management system will be presented and discussed.

P28 Development of a Job-Exposure Matrix for occupational exposure assessment of high frequency electromagnetic fields (3 kHz-300 GHz) in the INTEROCC study

Keywords: Electromagnetic fields, exposure assessment, intermediate frequency, job-exposure matrix, radiofrequency

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Exposure to high-frequency electromagnetic fields (EMF) has been associated with several adverse health effects. However, occupational studies have been judged inadequate mainly due to limitations in exposure assessment. Our aim was to build a job-exposure matrix (JEM), covering the intermediate (IF) and the radio frequency (RF) bands (3kHz-300GHz). Detailed occupational data were collected in a large population-based study, INTEROCC, with over 35,000 occupations coded into the International Standard Classification of Occupations system 1988 (ISCO88). These data were combined with a source-exposure matrix (SEM) to calculate estimates of probability (P) and level (L) of exposure to RF or IF electric (E) and magnetic (H) fields by ISCO88 code. L values were obtained by dividing the SEM estimates by the reference levels of the International Commission for Non-Ionizing Radiation Protection (ICNIRP) for occupational exposures. Arithmetic and geometric mean ICNIRP ratios and associated estimates of variability (standard and geometric standard deviation) were calculated. Estimates of P were obtained by dividing the number of exposed subjects by the total number of subjects per job title. A total of 419 ISCO88 occupations were included in the JEM. Of these, 67% were considered exposed to RF and/or IF. Occupations with high RF exposure probability ($\geq 30\%$; range: 0.3-65%) are mainly in the maritime, aerial and security sectors. Occupations with the highest RF exposure levels are those working with/nearby industrial heating sources or telecommunication equipment. TWA levels for RF E-fields (in ICNIRP ratio²) range from 6.94×10^{-11} to 30.2. Less than 10% of the occupations were considered exposed to IF, with exposure levels all below 1. We have constructed the first JEM for RF and IF EMF available in the literature to date. This JEM can be useful for epidemiological studies where job titles are available and for occupational health management programs to identify the occupations most at risk.



Pitch on
DAY 2!

P29 Exposure assessment of pregnant women to Di(2-ethylhexyl) phthalate by reverse dosimetry: Variability in repeated spot sample

Keywords: Phthalates, toxicokinetic modeling, reverse dosimetry

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Phthalates are a family of chemicals that can be found in a wide array of consumer products, and are suspected to induce reproductive and developmental toxicity. Among all phthalates, Di(2-ethylhexyl) phthalate (DEHP) have the strongest reproductive and developmental effects observed in animal studies. Large-scale human biomonitoring surveys typically gather biomarker measurements from single time points. For non-persistent compounds, such as DEHP, the biomarker levels are known to greatly vary within the same individual over a relatively short period of time.

Thirty women from two countries (Spain and Norway) were followed over a week during the second trimester of pregnancy. A protocol was designed specifically to assess the intra-individual variability over the week. Two spot samples per day (first and last voids) and the pool of the urines collected over the week were analyzed. A toxicokinetic model proposed by Lorber et al., (2010) was applied to back-calculate the exposure levels to DEHP from the urinary metabolites concentrations. Individual data were collected from questionnaires and integrated in the model such as the bodyweight, the times of urination, time of meal and the time of sampling. This model that integrates all the DEHP metabolites has also the capability of considering the temporal variability of concentration. Our results showed a reduced variability of daily intake estimates compared to biomarkers measurement. Daily intake estimates were performed for first and last sample separately. Our study highlights the major influence of time data in reverse dosimetry and point out major information that should be obtained in future survey to better characterize non-persistent pollutant exposure.

P30 Deriving exposure limit values for electromagnetic fields

Keywords: Electromagnetic fields, exposure limit values, scientific knowledge base

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Exposure limit values for electromagnetic fields (EMF) protect employees from adverse health effects, such as thermal heating or stimulation of nerve and muscle tissue as well as from sensory effects such as transient disturbed sensory perceptions. Exposure limit values are derived from well-established short-term biological effects. Long-term effects and their mechanisms, unspecified discomfort, or electromagnetic hypersensitivity are lacking replicable scientific evidence. Taking into account the state of the art, exposure limit values are established by multidisciplinary national and international committees, including the independent International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the German Federal Ministry of Labour and Social Affairs (BMAS). In order to assess EMF-exposure in a practical way, action levels, including safety factors, are derived from exposure limit values.

The proposed poster provides insight into technical and industrial applications of EMF, the committees concerned with establishing exposure limit values, and the biological effects and adverse health effects exposure limit values aiming to protect employees. It will be explained how to practically assess conformity with non-directly measurable exposure limit values within the body. A brief introduction of European and German legislation on occupational EMF exposure as well as for the general public is provided.

P31 The development of the mechanistic model underpinning the dermal Advanced REACH Tool (dART)

Keywords: Dermal exposure, skin, model, exposure assessment

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The dermal Advanced REACH Tool (dART) is an extension of the existing ART model and its software platform. A mechanistic model was developed for hand exposure to low volatile liquids, including solids-in-liquid products. It is based on an existing conceptual dermal source-receptor model that has been integrated into the ART framework. A structured taxonomy of workplace activities referred to as activity classes are adopted from ART. Three key processes involved in mass transport associated with dermal exposure are applied, i.e. deposition, direct emission/contact and transfer. For deposition, the model adopts all relevant modifying factors applied in ART. In terms of direct emission/contact (e.g. splashes) and transfer (e.g. hand-surface contacts), the model defines independent principal modifying factors (MFs), i.e. substance-related factors, activity-related factors, localized- and dispersion control and exposed surface area of the hands. To address event-based exposures as much as possible, the dART model includes crucial events during an activity (e.g. hand immersions) and translates objective information on tools and equipment to probable events (e.g. splashes) and worker behaviours (e.g. surface contacts). Based on an extensive review of peer-reviewed literature and unpublished field studies, multipliers were assigned to each determinant and provide an approximated quantitative value. In the absence of evidence, multipliers were assigned to determinants based on conservative assumptions made during discussions between experts developing the model. With advancing knowledge on dermal exposure and its determinants, the mechanistic model will require periodic updates and refinements, in addition to further expansion of the applicability domain of the model.

P32 SprayExpo - a deterministic indoor air model for spray applications

Keywords: Spraying, exposure model, validation, standard scenarios / fact sheets

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The deterministic indoor air model “SprayExpo” calculating inhalation exposure to aerosols released during professional liquid spraying processes and containing non-volatile active components has been developed in 2004, and validated between 2006 -2011. The model calculates the concentrations of spray related non-volatile aerosols in various health-relevant particle size fractions. It takes into account turbulent diffusion, droplet evaporation, and gravitational settling.

Sensitivity analysis has been performed to reveal the most influencing parameters. For validation, modelled values have been compared with measured values carried out at real workplaces in the fields of antifouling treatment and stored-product protection. The exposure concentrations of the active substances used were determined by time-resolved and particle size-segregated personal sampling and subsequent chemical analysis. In addition, the modelling results of SprayExpo have been compared with similar modelling using ConsExpo and BG-Spray.

SprayExpo was found to be an appropriate model for assessing exposures during indoor spraying processes and especially suited for large room volumes. The sensitivity analysis confirmed the assumption that besides the substance release rate, the droplet spectrum of the spraying device is the process parameter which decisively influences the exposure.

Standard scenarios (fact sheets) have been defined and incorporated into SprayExpo based on the information from the scenarios used in the validation experiments. This includes “Standard scenario for spraying of antifouling paints” and “Standard scenarios for stored product protection (silo cell)”; the latter can be divided into “Spraying along a line on the wall” and “Room spraying by fogging/misting”. These fact sheets can be used for exposure assessments within the biocidal product regulation (BPR) 528/2012, and can easily be extended if adequate data for other scenarios are available.

To facilitate the use of the SprayExpo model, an MS Excel® worksheet was developed. SprayExpo 2.3 can be downloaded from the BAuA website:

<https://www.baua.de/EN/Topics/Work-design/Hazardous-substances/Assessment-unit-biocides/Sprayexpo.html>

P33 Predicting exposure of humans to PCB 153 on a global scale

Keywords: Modeling, Human milk, PCBs

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Predicting human exposure from emissions is one of the great challenges in contaminant science. There are a few examples of successful prediction for some persistent organic pollutants on a local or regional scale. In this work we tested whether it can be done at a global scale. We chose PCB 153 as a test chemical. Human exposure was predicted by coupling the global multimedia fate model BETR Global and the human exposure model ACC-HUMAN. A global historical emissions scenario served as model input, while the concentration of PCB 153 in human milk was the measure of exposure. The modeled concentrations were compared with measured concentrations of PCB 153 in pooled human milk samples from 56 countries determined in the UNEP/WHO Global Monitoring Plan. A strong correlation was found between the modeled and measured concentrations ($r = 0.76$, $p < 0.0001$). For 49 out of 78 observations the concentrations were predicted within a factor of 4. Modeled concentrations were higher than measured concentrations for several European countries, which may have been due to assuming that all food was sourced within the country. Evidence was found that the model underestimated the rate of decrease of concentrations in air in European countries during the last decades, which could also have contributed to higher modeled concentrations in human milk. In contrast, in West African countries modeled concentrations in human milk were lower than measured concentrations. More work is needed to understand exposure vectors in West Africa.

P34 A review of risk management measures & their impact on occupational exposure levels to hazardous substances

Keywords: Literature review, occupational exposure, risk management measure, control banding tool

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Background & aims

Workplace intervention studies play an important role in supporting and complementing scientific validation of the assessment of the effectiveness of risk management measures (RMMs) implemented to reduce occupational exposure to hazardous substances. Knowledge of how expected reduction factors assumed by control banding tools (CBT), which offer a simplified approach to evaluate worker exposure and to identify RMMs, compare to the effectiveness of specific, implemented RMMs observed in field studies is essential to ensure appropriate RMM recommendation by the CBT to ensure protection of workers. We review a collection of published intervention studies comparing observed with CBT-predicted exposure changes.

Methods

Workplace interventions were defined as events aimed at reducing occupational exposure to hazardous substances at the workplace or where reductions occurred as a side effect, e.g. due to changes in the production process. Intervention studies published in English from 1999 up to January 2017 were considered for inclusion based on a systematic search of Pubmed. Where applicable, observed / monitored reductions in exposure are compared with predicted or anticipated exposure changes according to a CBT and the respective reduction factors and their estimated relative effectiveness for RMMs.

Results

In total 50 intervention studies have been included in this review. Overall the interventions reviewed have succeeded at reducing exposure levels. Preliminary results of the comparison of observed with predicted exposure reductions indicated that assumed reduction factors of CBT overestimate the effectiveness of individual control approaches and associated classes of RMMs.

Conclusion

There is evidence that decreases in workplace exposure levels followed a variety of interventions in a variety of industries underlining benefits of implementing RMMs at workplaces. However, at this point neither a clear tendency regarding the best choice of RMMs /or classes of RMMs can be ascertained nor any specific recommendations for workplace risk assessment can be made.

P35 Exposure Biomarker Candidates in Urine for the UV Filter Avobenzone

Keywords: Urinary Biomarkers; Human Biomonitoring; UV Filter; Consumer Products

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Avobenzone (butyl methoxydibenzoylmethane) is an organic UV filter that is used in a variety of personal care products (sunscreens and other cosmetics). The maximum permitted concentration in these products amounts to 3% in the U.S. and 5% in the European Union.

Due to its widespread use in consumer products, exposure of the general population is probable. Therefore, avobenzone was selected as a substance of interest within the scope of a large scale cooperation project between the German Ministry for the Environment (BMU), German Chemical Industry Association (VCI) and the German Environment Agency (UBA). Within this project, a human biomonitoring (HBM) method for the determination of specific urinary biomarkers of avobenzone shall be developed.

To identify specific exposure biomarkers, 5 volunteers were dosed orally with avobenzone (5 mg). Each volunteer collected consecutive urine samples over a period of 48 h post dose. These urine samples were screened for avobenzone metabolites as potential biomarkers applying a data mining software-assisted suspect screening approach with liquid chromatography–high resolution mass spectrometry (LC-HRMS and -MS/MS). We identified a large number of specific metabolites (e.g. hydrogenated, hydroxy, and carboxylic acid metabolites) corroborated by their semi-quantitative elimination kinetics.

Based on this screening approach, the four most promising urinary metabolites were selected as exposure biomarkers for HBM method development. At present, we investigate the human metabolism of avobenzone in a fully quantitative manner and derive urinary metabolite excretion factors for the selected biomarkers. In addition, we analyze samples from sunscreen users and the general population (LC-triple quadrupole-MS/MS using analytical standards and stable isotope labeled internal standards).

Prospectively, these biomarkers should be used in large scale population studies such as the German Environmental Survey (GerES) or the German Environmental Specimen Bank (ESB).

P36 Exposure to Phthalate Plasticizer Alternatives: Determination of DEHA Biomarkers in Human Urine

Keywords: Human Biomonitoring, Di(2-ethylhexyl) adipate, Urinary Biomarkers, Urinary Excretion Kinetics

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Di(2-ethylhexyl) adipate (DEHA) has a preferable toxicological profile over Di(2-ethylhexyl)phthalate (DEHP), therefore it is used as a substitute for DEHP and other phthalate based plasticizers. The principal use of DEHA is as a plasticizer in PVC consumer products, but nitrocellulose based coatings and synthetic rubbers are further fields of application. Blends of DEHA with classical phthalates improve the low-temperature flexibility in consumer goods like garden hoses, gaskets and tubing. DEHA is also used for food contact materials like flexible PVC cling film. All of these applications can lead to DEHA exposures of the general population. In 1994, the European Scientific Committee on Food derived a tolerable daily intake (TDI) of 0.3 mg/(kg bw*d). We developed an online-SPE-LC-MS/MS method with isotope dilution to investigate the metabolism of DEHA and urinary excretion kinetics of its metabolites. We orally dosed 4 volunteers with 10 mg DEHA. Urine samples were collected for 48 hours after dosage. We identified as specific and robust biomarkers of exposure the side chain oxidized monoester metabolites of DEHA in urine, 2-ethyl-5-hydroxyhexyl adipate (5OH-MEHA), 2-ethyl-5-oxohexyl adipate (5oxo-MEHA), and 5-carboxy-2-ethylpentyl adipate (5cx-MEPA). We also determined urinary conversion factors, whereby cx-MEPA was the major specific metabolite, representing approximately 0.2% of the oral dose in urine. The predominant share of the DEHA dose in urine is excreted as adipic acid, which, however, is not a specific biomarker. In a pilot biomonitoring study on German adults and pregnant Brazilian women we were able to detect all three biomarkers in the urine samples, whereby 5cx-MEPA occurred most frequently.

P37 Analysis of Specific Consumer Exposure Determinants (SCEDs) in comparison with observational data from EPHECT study

Keywords: Chemical safety assessment; Consumer exposure; Consumer products; Exposure scenarios; REACH

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The REACH regulation aims to protect human health and the environment from risks related to the use of chemicals by workers (in industrial and professional settings) and consumers. To comply with this regulation, companies establish Exposure Scenarios (ES) which include conditions of safe use of the substances. These ES are communicated to Downstream Users (DU) along the supply chain and are also used by Authorities for regulatory purpose. To help companies in their procedures and to harmonise practices, Specific Consumer Exposure Determinants (SCEDs) are produced by DU in the framework of the Exchange Network on Exposure Scenarios (ENES). They provide registrants with sector-specific sets of parameters to build ES. Three sectors have already produced SCEDs (A.I.S.E., CONCAWE and FEICA). This work aims to confront the values proposed by A.I.S.E.'s SCEDs "Consumer use of surface cleaners" to the data collected in the framework of the EPHECT project, related to frequency of use, format and amount of products, from a large sample of European consumers. SCEDs indicate a frequency of one event/day, whereas, according to the EPHECT survey, 18.9% of consumers use cleaners at least once a day. Three formats are addressed by SCEDs: solid, liquid (non-spray) and spray. In the EPHECT survey, liquids and sprays prevail (respectively 70.3% and 53.5% of respondents), but other formats such as foams, creams, gels, wipes are also commonly used. SCEDs suggest that 30 and 110 g of products are used per event for spray and non-spray respectively. The EPHECT data show that 53.7% of respondents use 0.5 to 1.5 caps of liquid cleaners, and 34.2% do two to three sprayings per use. The observations may vary between countries, gender, housing, etc. The results of this work could help to evaluate SCEDs reliability and robustness to ensure safe use of chemicals in Europe.



Pitch on
DAY 1!

P38 Human biomonitoring of volatile organic compounds (VOC): Sources of error in the pre-analytical phase using the example of n-hexane

Keywords: Volatile organic compound; VOC; Human biomonitoring; HBM; n-hexane; headspace-GC-MS; HS-GC-MS; sample storage

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Volatile organic compounds (VOCs) describe substances with high vapor pressure which are present in gaseous form at low temperatures. Internal exposure to VOCs may be quantified in blood or urine but is susceptible to exogenous contamination. E.g. vacuum blood collection systems use stoppers made of butyl rubber, which is produced using n-hexane as solvent. Within this study we investigated to which extent n-hexane from stoppers of various commercial blood collection systems migrates into the sample. Furthermore, we investigated the stability of VOCs in these systems under different conditions.

Sheep blood was spiked with VOCs and stored for up to 64 days in 3 common blood collection systems at 37°C, room temperature, 4°C and -20°C. Screwable, baked-out headspace glasses were used for control. VOCs were quantified by means of head-space GC-MS

In systems with butyl rubber stoppers an up to fourfold increase of n-hexane concentrations was observed depending on storage temperature and duration. Storage in Monovettes[®] showed a slight but steady decrease of concentrations over time, even at -20°C. The concentration of n-hexane in the gas-tight headspace glasses remained constant for up to 64 days.

By storing blood samples in collection tubes with butyl rubber stoppers, n-hexane can migrate from the stoppers into the sample leading to wrong (too high) analytical results. Monovettes were not contaminated with n-hexane but already short-term storage led to a significant loss of n-hexane. However, storage of the blood samples at room temperature in gas-tight headspace tubes for up to 14 days was not associated with a decrease of analyte concentrations.

For valid quantification of VOCs in blood (or urine), sampling material must be tested for target analyte contamination. In addition, sample transfer must take place immediately after sample collection into gas-tight headspace tubes to avoid losses of volatile analytes.

P39 Suspect Screening for Urinary Exposure Biomarkers of the Plasticizer DEHTP in a Software-Assisted LC-HRMS Approach

Keywords: Human Biomonitoring; Suspect Screening; LC-HRMS; Orbitrap; Biomarkers of Exposure; Di(2-ethylhexyl) terephthalate

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The quest for exposure biomarkers is time consuming and choosing the wrong biomarkers (e.g. metabolites which are not formed in human metabolism or only in low proportion) of the respective xenobiotic can be costly. Thus, there is a great need for reliable methods for biomarker candidate identification. LC-HRMS is a powerful resource for this purpose and is often applied to metabolite screenings in *in vitro* and animal *in vivo* studies typically with high xenobiotic concentrations involved. In order to overcome limitations of *in vitro* models and metabolic interspecies differences, we tested the applicability of a data mining software-assisted suspect screening approach in human urine samples after low oral dose (i.e. toxicologically uncritical) of a xenobiotic. A pilot study was performed on the phthalate substitute plasticizer di (2-ethylhexyl) terephthalate (DEHTP). Metabolism study samples for DEHTP with quantitative data on formation and elimination of specific urinary metabolites were available, allowing unequivocal validation of screening results.

After enzymatic deconjugation of glucuronides, samples were analyzed with LC-Q-Orbitrap-MS. After an initial screening, confirmation of hits was performed by data-dependent acquisition of product ion spectra in a separate chromatographic run. Final confirmation criteria were plausible isotopic patterns, product ion spectra, excretion kinetics, and retention times.

In total, nine DEHTP metabolites were identified, including three already established biomarkers of DEHTP exposure (5OH-MEHTP, 5Oxo-MEHTP, and 5cx-MEPTP) and the non-specific major metabolite terephthalic acid. Semi-quantitative excretion kinetics of the three DEHTP exposure biomarkers were in excellent agreement with the quantitative data from our previous metabolism study. In addition, five previously not described specific metabolites were tentatively identified.

The presented approach has proven applicable for the identification of quantitatively meaningful (conversion factor $\geq 1\%$) specific DEHTP metabolites. It is now routinely applied in biomarker development at our institute.

P40 What is the main factor determining the exposure concentration of nanoparticles in the sewer?

Keywords: Environmental fate modelling, exposure assessment, nanoparticles, sewer

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Assessing the environmental fate and exposure of engineered nanoparticles used in commerce is a challenging due to the rapid growth of the nanotechnology industry. Environmental fate and exposure models are expected to play a very important role in the nanomaterial assessment process. However, some recently developed exposure models only predict concentration on the assumption that nanomaterials directly flow into the environment retaining inherent properties despite the fact that the characteristics of nanoparticles such as size and shape, etc are actually changeable during entire life cycle. So it is very important to consider fate and transport of ENPs in intermediate path before reaching the environment. In order to implement this need, new exposure model was developed to predict change of TiO₂ nanoparticles concentration with time and space during fate and transport from household sewage to the sewage treatment plant through the sewer pipe networks.

The model derived the results which flux is the most influential among advection, sedimentation, and aggregation depending on the characteristics of the sewage and sewage system. In addition, it can be confirmed that which parameters being comprised of the main process can mostly determine the flux through sensitivity analysis of new model.

This study confirmed that aggregation process is the most influential process determining fate and transport of TiO₂ nanoparticles during flow in the sewer pipes. Furthermore, it was found that aggregation rate of nanoparticles in sewer system is more affected by sewer water properties such as concentration of suspended particulate matter (SPM) and radius of SPM than characteristics of sewer pipes such as length, manning coefficient, and slope.

New exposure model for nanoparticles in sewer system can be suggested as a useful tool for exposure assessment.

P41 Expert judgment in exposure assessment strategy definition – How to reduce uncertainties?

Keywords: Exposure assessment strategy, expert judgement, uncertainties

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An exposure assessment strategy (EAS) in case of occupational exposures is defined based on several informations. Detailed data about the objective of occupational exposure assessment campaign, workplaces and tasks description, process characteristics, risk management measures in place, daily working hours and the duration of exposure to the chemical substance being considered, relevant environmental conditions at the workplace and their possible changes during the shift, availability of measurement methods with specificity and sensitivity, number of workers with potential exposure among others are crucial for EAS. After collecting all this information a significant amount of expert judgment is used to define the EAS. This EAS should describe the similar exposure groups (SEG) to contemplate, number of samples to collect in each SEG, exposure metrics to consider, the sampling resources and analytical methods to be used, moment and duration of sampling. However, in the exposure assessment report, none of the information used to define EAS or even a short description on how the expert judgment influenced the EAS definition is normally presented. This results in uncertainties regarding the representativeness of exposure data. To overcome these uncertainties two measures can be applied: 1) occupational hygienist should be chosen with care to ensure that they possess sufficient knowledge and experience on the process and chemical substance to be assessed, and that the background information available is adequate to allow adequate decisions; 2) the reports with exposure assessment results should provide a short description of the information used by the occupational hygienist followed by a short and concise justifications of the EAS defined.

P42 Efficiency of exposure control measures – developing a User Database and Communication Tools

Keywords: Welding, MIG/MAG, Control measures, Efficiency, Database

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Workplace exposure to inhalable dust and fumes remains an important aspect in worker health. One strategy to reduce exposure is the use of tool mounted ventilation and extraction systems. To allow easier comparisons between different control measures, a web application was drafted.

A literature search for efficiency values of tool-mounted extraction and ventilation systems applicable in welding, grinding and sanding was conducted. The results were added to a MySQL-database, and a web application for filtering and displaying the entries was developed, which could be used as communication platform.

The literature review led to 80 separate database entries with efficiency values of the different control measures. The web application allows filtering and displaying of the entries based on criteria such as process, material or efficiency stated in the paper.

The project led to the development of a web application which allows to gain an overview on the otherwise quite intransparent field of on-tool extraction solutions. Because of the flexible design of the application, it can and is intended to be adapted to the users' need based on their feedback. Also, more data would allow a better representation of the state of the art, which is why contributors are encouraged to add their knowledge to the database. This tool show approaches to communicate suitable control measures, and thus will be useful for employers, regulators, engineers and researchers.

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P43 Proposal to present the data of the Extended Safety Data exclusively in tabular form

Keywords: REACH, Extended Safety Data Sheet, Risk Management Measures, Msafe, PECregional, Simple Box 3.0 model, Tonnage per Use

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Our company has developed an Extended Safety Data Sheet (eSDS) concept, whose data are deliberately restricted to the strictly necessary ones in order to enable the Downstream User (DU) to check quickly whether our product is suitable for his use. For this purpose the necessary information about uses (processing lines) and their contributing scenarios (processing steps) known to us is presented exclusively in tabular form. It comprises the names of the processing lines and their steps, the corresponding descriptors (in accordance to the R12 naming system) and, if necessary, the Risk Management Measures to be implemented by the DU.

The eSDS includes as well a so-called Msafe table, which specifies for a series of categorized Sewage Treatment Plant (STP) and River flow rates, the maximum permissible annual product amount that can be used safely by a DU. The tabulated values are based on a release fraction of 1%. By means of a single equation, which is as well included in the eSDS, the DU can derive his specific Msafe, which takes into account the actual flow rate (that mostly deviates from the categorized ones) and the release fraction applicable to his site and process.

For the time being the Msafe and the so-called PECregional are calculated only on the basis of the releases occurring in the supply chains of the concerned registrant. The Msafe derivation is applicable to any kind of substance or mixture and takes into account the determining environmental compartment (STP, freshwater aquatic, freshwater sediment, marine water aquatic, or marine water sediments).

Even for products with very numerous uses and contributing scenarios the eSDS in accordance to this concept comprises rarely more than 8 tabulated pages. In the 'Explanatory notes' that comprise 7 pages is outlined how the data should be understood.



Pitch on
DAY 1!

P44 Dietary Exposure Assessment to chemicals: EFSA activities and priorities

Keywords: Diet, Food, Contaminants, Exposure, Assessment, Data, Quality, Transparency

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The assessment of dietary exposure to hazardous chemicals is a crucial component of risk assessments to ensure public health protection carried out by EFSA. Dietary exposure is typically assessed by combining data on concentration in all food products with data on their consumption and entails some degree of modelling. The chosen method usually depends on the level of accuracy required and data availability¹. EFSA has a legal requirement to collect data on chemical occurrence (e.g. contaminants) in food and feed². In addition, EFSA works in close cooperation with national organisations towards harmonising dietary survey methodology and building of a common and high quality EU food consumption database³.

Public expectations of greater **transparency** represent an integral part of EFSA's work. EFSA aims to enhance the **quality** of its outputs by giving direct access to data and promoting the development of collaborative platforms, as well as fostering data re-use and innovation⁴. The use of **common standards** with other scientific and regulatory bodies is a preliminary condition to improve data interoperability and facilitate data exchange. For example, EFSA developed standard models for the transmission of data to EFSA in several food safety domains, e.g. for analytical results⁵, including a standardised food classification and description system called FoodEx2⁶.

EFSA develops open access **tools** for dietary exposure assessment allowing the direct use of the food consumption data at individual level, such as the Food Additives Intake Model (FAIM)⁷.

Dietary exposure is an integral part of food safety risk assessments carried out by EFSA. Exposure science is moving fast from a single-domain approach to a multidisciplinary effort for the characterization of the "exposome"⁸, defined as the totality of an individual's environmental exposures from conception onwards. EFSA keeps abreast of these developments to be prepared to tackle new trends in human exposure to chemicals under a holistic perspective.

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Pitch on
DAY 2!