Fraunhofer IME

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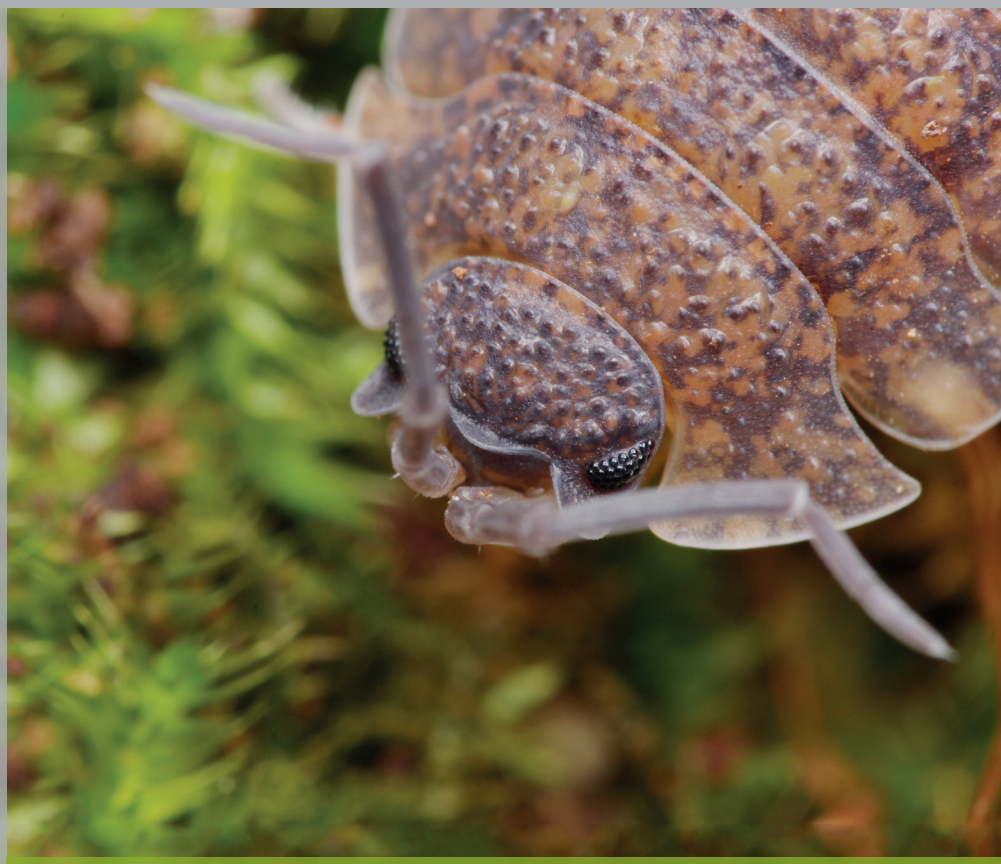
FRAUNHOFER INSTITUTE FOR MOLECULAR BIOLOGY AND APPLIED ECOLOGY IME

WELCOME

Chemicals reach the environment via production, transport, use and disposal of consumer products. From there they find their way into raw food materials. The limits of detection are continually decreasing, more and more substances can be identified in increasingly smaller concentrations. Acting as a mediator between industry and regulatory bodies we are involved in the development of many international test procedures for substance evaluation. In this first issue of the Applied Ecology Newsletter we present some of these activities. We also introduce Dr. Burkhard Knopf who retrospectively identifies substance concentrations in the framework of the German Environmental Specimen Bank.

Yours sincerely

Prof. Dr. Christoph Schäfers



Title picture: Woodlouse (Porcellio scaber)
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In this issue you can read:

DOES CONTAMINATED FEED RESULT IN AN ACCUMULATION OF POLLUTANTS?

New test system to investigate biomagnification

The potential accumulation of substances in the food chain (biomagnification) is an important factor in the environmental risk assessment of chemicals. Fraunhofer IME has developed a promising test system using woodlice (*Porcellio scaber*) to determine the bioaccumulation of chemicals by feed intake.

For terrestrial environments tests on the bioaccumulation of chemicals are performed with earthworms as a standard. However, using this test, pollutant uptake cannot be attributed to a specific route of intake since substances can be taken up via the gut from feed or via the body surface from pore water. A comparison of the results obtained with data from other test systems such as fish feeding tests is therefore difficult. ▶

Woodlice as alternative test organisms for bioaccumulation studies

Woodlice play an important role in the terrestrial food net. They feed on dead organic material, and in the ecosystem they act as a mobilizer for pollutants in soil and their transfer into higher organisms such as birds or small mammals, which use woodlice as a source of feed. Sebastian Kampe, doctoral student in the department "Bioaccumulation & Animal Metabolism", has developed a test system that allows the quantification of bioaccumulation in woodlice following the uptake of contaminated feed.

Kampe: "We expose woodlice which can easily be bred in the laboratory to a test substance under standardized test conditions." Kampe investigated the bioaccumulation of organic substances and silver nanoparticles. Nanosilver can pose a risk for soil organisms especially by uptake via sewage sludge applied in agriculture as a soil fertilizer. Professor Christian Schlechtriem, supervisor for Kampe and head of department: "The test allows clear identification of the entry pathways of the pollutants into the organisms. Therefore, the test system could provide a valuable complement to the established terrestrial bioaccumulation test with earthworms." ■

INDUSTRIAL PRODUCTION AND REGULATION OF CHEMICALS

Fraunhofer IME participates in important OECD committees

The regulation of chemicals requires standardized test procedures to identify potential risks for the environment and to assess human exposure. Scientists of Fraunhofer IME are actively involved in OECD committees in order to develop such standards.

Zebra fish also accept artificial plants as spawning ground. Photo: Fraunhofer IME

Can a chemical substance inhibit the reproduction of fish? Professor Christoph Schäfers, director of the Applied Ecology Division and Matthias Teigeler, head of laboratory in the Ecotoxicology department are members of the "OECD Fish Drafting Group" and as such involved in the development of guidelines to investigate chemical effects on fish. In cooperation with the German Environment Agency as a national coordinator they are organizing an international laboratory ring test to validate the "Zebrafish Extended One Generation Reproduction Test" developed by Fraunhofer IME according to OECD criteria. Teigeler: "The zebra fish represents the most important fish species for testing in the framework of EU authorization procedures for chemicals and pharmaceutical active ingredients. Our test procedure is significantly more animal-friendly than the currently valid test protocol with the Japanese Ricefish (Medaka). It is at least equally sensitive and can be conducted at considerably lower costs."

Reliable test procedures in line with animal welfare

Including molecular endpoints into existing test systems can help to significantly reduce the number of animal experiments. As a member of the "OECD Expert Group on Adverse Outcome Pathways" Dr. Elke Muth-Koehne pursues this objective as Professor Christian Schlechtriem does in the "OECD

Expert Group on Fish Bioaccumulation".
"To investigate nanomaterials for their environmental effects existing guidelines for substance testing need to be adapted according to the specificities of this particular substance group" says Dr. Kerstin Hund-Rinke.

She is a member of the "OECD Working Party on Manufactured Nanomaterials" aiming to develop internationally coordinated methods and strategies to identify and manage potential risks of nanomaterials to human health and the environment. ■

BETTER DATA FOR MORE PRECISE MODELS

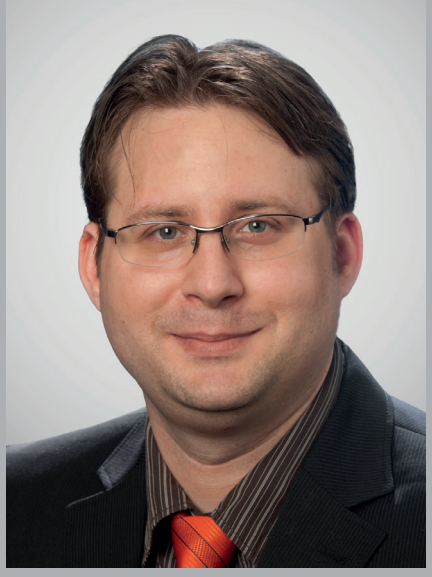
Predicting pesticide concentrations more accurately

Regulation authorities and producers of plant protection products are interested in using the most realistic data for estimating the environmental concentration of a pesticide. Fraunhofer IME develops test systems as integral parts of the authorization procedure for plant protection products in the European Union.

For the authorization of a plant protection product one factor required to be estimated is the amount of active substance or its degradation products that can leach into groundwater upon normal use. The parameter is estimated using computer models such as the "Pesticide Leaching Model" developed by Fraunhofer IME. The models use experimental data which are characteristic of the substance's properties. If no such data is available so-called default values are applied which represent a worst case situation. One process that reduces the concentration of the active substance in the pore water is the uptake of substance from the pore water by the root system of plants. "So far, a default value was used replacing the so-called "Plant Uptake Factor" (PUF), since a test method accepted by the authorities was not available", says Karlheinz Weinfurtner, head of laboratory in the Ecological Chemistry department. With the participation of Fraunhofer IME various test methods have therefore been developed and validated via interlaboratory comparison tests. Weinfurtner: "The test system developed by Fraunhofer IME was observed to be the most suitable." In a second step a ring test including ten laboratories was performed with all of them using the same test plant and test substance. In addition, IME scientists compared 14 studies carried out by different companies using different substances and plants. Weinfurtner: "The evaluation of the studies confirms the general applicability of our test system. In future, the test system will be an integral part of the authorization procedure for plant protection products in the European Union."

Tomato plant in artificial nutrient solution.
Photo: Fraunhofer IME

A process that can augment substance concentrations in soil is the washing off of the active substance from plant surfaces. So far, for this parameter called "wash off factor", a default value has been applied as well. Dr. Dieter Hennecke, head of the Ecological Chemistry department: "In the scope of a master thesis and in agreement with the European Crop Protection Association (ECPA) we have performed initial experiments to determine the "wash off factor." As a result a parameter for assessing the quality of "laboratory rain" was developed which is a prerequisite for developing a practicable test system." ■



"Even when using most recent instruments and methods of analysis – at the end it is always the human being who evaluates the quality of measurements.

Burkhard Knopf studied biology at the University of Mainz and wrote his diploma thesis at the institute for Microbiology and Wine Research. With his dissertation topic on the microbial methylation of mercury in earthworms he committed himself on applied ecology topics. Today his research work focuses on the analysis of metals/metalloids in biological matrices as fish filet, plant tissue or sediment, and the development and application of procedures for analyzing different metal species. He also applies these procedures for industrial clients in performing chemical testing of metal compounds.

Dr. Burkhard Knopf…

… has been head of the Fraunhofer IME work group on element and element species analysis since the beginning of 2010: Supporting the implementation of national environmental policy by performing studies for the German Environmental Specimen Bank – this is an important concern of the biologist.

The Environmental Specimen Bank (ESB) is an archive of environmental and human samples stored for the documentation and assessment of environmental quality, e. g. to monitor changes of pollutant levels over time. The bank for environmental samples is operated at Fraunhofer IME on behalf of the German Environment Agency (UBA). Further to time series studies for the ESB other monitoring studies are part of the tasks of Burkhard Knopf: "Our study on mercury levels in fish, e. g, indicates that from 2007 to 2013 mercury content in bream exceeded the Water Framework Directive's quality standard at five out of six European sampling sites." The importance of these results was pointed out in the EU Science for Environment Policy Newsletter 456 (2016): "The results presented in the study suggest greater efforts need to be made to prevent or reduce mercury pollution."

PRESENTING THE ESB AT THE 30TH ANNIVERSARY OF THE GERMAN FEDERAL MINISTRY FOR THE ENVIRONMENT

"To make our children and young people more aware of the need of environmental protection and to make them more familiar with the possibilities presented by science is part of our social task", says Burkhard Knopf. The 30th Anniversary Event "Environmental Policy 3.0" of the Federal Ministry for the Environment in Berlin on September 10/11, 2016 was a good opportunity to do this. At the booth of the German Environment Agency, Knopf and his team presented the operation of the ESB and gave children and young people the opportunity to experiment with liquid nitrogen and learn how environmental samples are prepared and archived for the purpose of environmental protection research.

Read more about our research activities here: www.ime.fraunhofer.de

IMPRINT

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