Workshop on

Emerging Environmental Pollutants

Key Issues and Challenges

Stresa, Italy
19-20 June 2006

norman
Network of reference laboratories
for monitoring of emerging
environmental pollutants

INERIS
maîtriser le risque
pour un développement durable

Environment Agency

ies
Institute for Environment and Sustainability

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Joint Research Centre

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European Commission
DG Joint Research Centre
Institute for Environment and Sustainability (IES)
I-21020 Ispra (VA), Italy

www.norman-network.net

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Preamble

Since the 70s the impact of chemical pollution has focused almost exclusively on lists of conventional priority pollutants, especially those referred to as PBT or POPs. The number of regulated, conventional pollutants, however, represents only a small part of the total number of potential pollutants. Emerging pollutants pose increasing threats to public health and ecosystems. Emerging pollutants are not necessarily new chemicals and some of them have often long been present in the environment, but their presence and significance are only now being elucidated.

How are emerging pollutants identified? How do emerging pollutants become regulated pollutants? What investigations should be undertaken when an emerging pollutant is identified? What are the substances that are being identified as emerging pollutants today, and what information is currently missing or required in terms of monitoring and assessment of their associated risks?

Information on these substances is often difficult to obtain and the methods used are often at a research and development stage, or not appropriate for harmonisation at the European level. This makes comparison of data and its interpretation very difficult to undertake, and represents a major difficulty for decision-making by the authorities.

The aim of the activities of the NORMAN network is to enhance the exchange of information on emerging environmental pollutants, and to encourage the validation and harmonisation of common measurement methods and monitoring tools so that the requirements of risk assessors and risk managers can be better served.

Objectives of the Workshop

- To inform participants interested in the NORMAN activities about the goals of the project
- To discuss the state of current knowledge and review the demand for, and missing information in, the analysis of emerging pollutants in respect of risk assessment and risk management programmes
- To enable an overview of the main issues and priority needs as regards additional monitoring activities on emerging pollutants and requirements for method validation and dissemination of information
- To facilitate an exchange of views with “future customers” of the NORMAN network relating to its organisation and scope of work, and how this interaction can be developed to satisfy the needs of both groups of workers.

Scientific Committee

Valeria Dulio	INERIS - Institut National de l'Environnement Industriel et des Risques (France)
Georg Hanke	JRC-IES - Joint Research Centre Institute for Environment and Sustainability (EC)
David Westwood	EA - Environment Agency for England and Wales (UK)
Pim Leonard	RIVO - Netherlands Institute for Fisheries Research (The Netherlands)
Jaroslav Slobodnik	Environmental Institute (Slovakia)
Rod Robinson	NPL Management Ltd - National Physical Laboratory (United Kingdom)
Damià Barceló	CSIC - Consejo Superior de Investigationes Científicas (Spain)
Monika Herrchen	Fh-IME - Fraunhofer Institute for Molecular Biology and Applied Ecology (Germany)

Who should attend

- Experts from research institutes, reference laboratories, co-ordinators of on-going or recent EU and national research projects dealing with emerging pollutants in different fields (water, air, soil) and receptors (human health, drinking water, ecosystems, etc.)
- Experts from regulatory bodies, organisations in charge of risk assessment / management and industry
- Key stakeholders, who may wish to be NORMAN users in the longer term.

Organisation

The workshop will involve a two-day programme. The first day will be dedicated to a general overview of the current issues, with presentations on specific topics and projects under the 5th and 6th Framework Programmes dealing with monitoring and risk assessment of emerging pollutants. Special attention will be paid to the views of users and key stakeholders (policy-makers, regulatory bodies, organisations in charge of risk assessment and risk management) regarding the current gaps in, and needs for, risk assessment and management.

The second day will focus on how NORMAN should operate, in collaboration with other existing initiatives and research projects, and implement a long-term co-ordination action to address the identified current and future needs. A plenary facilitated discussion will be followed by four parallel sessions, each of which will address a specific aspect of emerging pollutants analysis and prioritisation. Detailed questions will be prepared, and answers sought and discussed in an open forum with participants. Active participation in these working sessions is essential and all participants will be encouraged to join in.

In order to make the discussion more positive and focussed, all participants are expected to bring with them a priority list of emerging pollutants with justification for their interest. These substances will form the basis of the discussion in the parallel sessions. A preliminary list of emerging pollutants is available on the NORMAN website (**www.norman-network.net**).

Monday, 19 June 2006

9:15 **Welcome**

Giovanni Bidoglio - JRC-IES-RWER, Head of Unit

9:25 **The NORMAN Project**

Valeria Dulio - INERIS (France), Co-ordinator of the NORMAN Project

9:45 **Session I: Emerging Environmental Pollutants**

Chair: Walter Giger - EAWAG (Switzerland)

co-Chair: Georg Hanke - JRC-IES-RWER (EC)

Presentations reflecting the current concerns from the different scientific communities

Emerging substances in water

Thomas Ternes - BAFG (Germany)

Emerging substances in soil

Frank Lamé - TNO (The Netherlands)

Emerging substances in air (indoor air)

Dimitrios Kotzias - JRC-IHCP (EC)

11:15 ***Coffee break***

11:30 **Focus on some emerging topics**

Polyfluorinated contaminants (the PERFORCE Project)

Pim de Voogt - University of Amsterdam (The Netherlands)

The siloxane case: screening of new chemicals in Sweden

Eva Brorström-Lunden - IVL (Sweden)

Benzotriazole anticorrosives in municipal wastewaters and in the aquatic environment

Walter Giger - EAWAG (Switzerland)

Engineered Nanoparticles

Richard Owen - EA - Environment Agency for England and Wales (UK)

12:30 ***Lunch break***

14:00 **Session II: Science Needs for Policy Development**

Chair: Richard Owen - EA - Environment Agency for England and Wales (UK)

co-Chair: John Garrod - DEFRA

The stakeholders in the management of emerging pollutants

Monitoring data needs for risk assessment under REACH

Steven Eisenreich - JRC-IHCP-European Chemicals Bureau (EC)

Management of water resources

Water Framework Directive and emerging substances: Implications for policy development, research and monitoring from the perspective of a National Competent Authority

Nick Cartwright - EA - Environment Agency for England and Wales (UK)

Management of emerging pollutants in the marine environment from the perspective of a National Monitoring Authority

Norbert Theobald - BSH (Germany)

How the drinking water industry deals with emerging pollutants - Three decades of experience in The Netherlands

Jürgen Volz - KIWA (The Netherlands)

Management of emerging pollutants in soil

Claudio Carlon - JRC-IES-RWER (EC)

Management options for indoor air pollutants with a view to future EU policies

Dimitrios Kotzias - JRC-IHCP

15:45 ***Coffee break***

16:00 **Meeting the science needs for emerging pollutants: current work areas in EU (including EU FP projects) dealing with assessment of risks**

EU FP6 project: INTARESE, Integrated assessment of health risks of environmental stressors in Europe

David Briggs - Imperial College of London (UK)

EU FP6 project: NOMIRACLE, Novel methods for integrated risk assessment of cumulative stressors in Europe

Hans Lokke - NERI (DK)

How is industry contributing to developing science-based evidence to tackling emerging pollutants

Martin Holt - ECETOC

17:00 **Wrap-up and conclusions**

17:45 **End**

20:00 ***NORMAN Dinner, Stresa***

Tuesday, 20 June 2006

8:50 **Introduction of Agenda**

Valeria Dulio - INERIS (France)

9:00 **NORMAN Working tools and activities**

NORMAN networking activities

Anne Strugeon - BRGM (France)

NORMAN databases

Jaroslav Slobodnik - EI (Slovakia)

NORMAN validation protocols

David Schwesig - IWW (Germany)

NORMAN case studies

Damià Barceló - CSIC (Spain)

10:00 ***Coffee break***

10:15 **Plenary facilitated discussion: Introduction to parallel sessions**

Chair: Valeria Dulio - INERIS (France)

The facilitators will introduce the topics and the questions that will be discussed during the following parallel sessions. A preliminary proposal of the questions will be available before the workshop on **www.norman-network.net**

In order to make the discussion here more concrete, all participants in the workshop are invited to come prepared with a short personal priority list of emerging pollutants with justification for their interest. These substances will be used as the main reference for the discussion in the parallel sessions. A preliminary list of frequently-discussed emerging pollutants is also available on the NORMAN website: **www.norman-network.net**

10:45 **Parallel sessions**

I Data sources for emerging pollutants

Facilitator / Rapporteur: Jaroslav Slobodnik - EI (Slovakia)
Heather Leslie - IVM (The Netherlands)

Method: Round-table discussion focused on questions presented in preceding plenary discussion

Expected outputs: On the basis of concrete examples from substances identified by participants as emerging pollutants of priority interest, **an overview of:**

- ✦ available data sources (official and "grey")
- ✦ non-accessible data
- ✦ main missing data and data quality issues
- ✦ geographical and time spread of data
- ✦ comparability of data provided for different environmental compartiments
- ✦ role of NORMAN databases

II Prioritisation criteria for emerging pollutants

Facilitator / Rapporteur: Nick Cartwright - EA - Environment Agency for England and Wales (UK)
Marina Coquery - Cemagref (France)

Method: Round-table discussion focused on questions presented in preceding plenary discussion

Expected outputs: On the basis of concrete examples from substances identified by participants as emerging pollutants of priority interest, **an overview of:**

- ✦ past and currently applied prioritisation approaches (e.g. COMMPS, DYNAMEC, and other programmes at national, river basin level, etc.)
- ✦ gaps and drawbacks of current strategies
- ✦ short list of prioritisation criteria
- ✦ threshold values for triggering attention / actions
- ✦ specific data needs for prioritisation
- ✦ specific role of EU research projects in that context

III Monitoring tools and analytical methods

Facilitator / Rapporteur: Peter Lepom - UBA (Germany)
Georg Hanke - JRC-IES-RWER (EC)

Method: Round-table discussion focused on questions presented in preceding plenary discussion

Expected outputs: On the basis of concrete examples from substances identified by participants as emerging pollutants of priority interest, **an overview of:**

- general approaches in the current monitoring of emerging pollutants and role of upcoming new methodologies supporting identification and quantification of substances
- multiparameter, non-target and screening approaches as tools for monitoring emerging pollutants
- effect-based monitoring and use of synergetic effects between chemical and biological monitoring approaches
- further needs for development and validation of tools, comprising sampling strategies and sample preparation

IV Models and prediction methods

Facilitator / Rapporteur: Willie Peijnenburg - RIVM (The Netherlands)
Michael McLachlan - ITM (Sweden)

Method: Round-table discussion focused on questions presented in preceding plenary discussion

Expected outputs: On the basis of concrete examples from substances identified by participants as emerging pollutants of priority interest, **an overview of:**

- currently available modelling approaches for identification and risk evaluation of emerging contaminants, QSAR methods for risk evaluation
- models applied for predicting environmental exposure and effects of substances for which very few measurement data are available
- when can they be used, level of uncertainty associated with the results, level of validation of the results, integration of these results with the measurement data available
- needs for development of tools, integration and application of available techniques

12:30 ***Lunch break***

14:00 **Follow-up of Parallel Sessions**

14:45 ***Coffee break***

15:00 **Plenary session: feedback and conclusions**

Chair: Valeria Dulio - INERIS (France)

Feedback from Parallel Sessions, discussion

Rapporteurs from previous parallel sessions

Plenary discussion and conclusions for NORMAN strategy and evolution of the current activities

NORMAN project co-ordinator

16:30 **End**

Emerging substances in water

Thomas Ternes

Federal Institute of Hydrology (BFG)
Am Mainzer Tor 1, 56068 Koblenz, Germany

E-mail: ternes@bafg.de

The focus of environmental research has recently been extended from the more "classic" environmental pollutants such as PCBs, DDT, dioxins and pesticides to the so called "emerging contaminants" such as pharmaceuticals and personal care products (PPCPs), entering the environment mainly via regular domestic use (Barcelo, 2005; Glassmeyer et al., 2005; Richardson and Ternes, 2005). Furthermore, compounds are recently detected leaching out of electric products such as flame retardants or used in products to create inert surfaces such as perfluorinated compounds. These compounds have been detected very recently in the environment, but are frequently released in the environment for a longer time. One reason for this focus shift is that within the last 10-15 years the fast development and increasing use of a new analytical tool, the liquid chromatograph (LC) coupled with mass spectrometry (MS), has led to a "revolution" in environmental analysis enabling the identification of polar organic pollutants such as pharmaceuticals down to relative low concentration levels in all kinds of water bodies (wastewater, surface water, ground water, drinking water). Additionally, results about severe feminization or masculinization effects of endocrine disrupting compounds (e.g. the hormones) on aquatic organisms at the low $ng \cdot L^{-1}$ levels have attracted the attention of the public and the environmental researchers. More than 2800 different substances are used only as pharmaceutical ingredients in the EU today, including painkillers, antibiotics, antidiabetics, betablockers, contraceptives, lipid regulators, antidepressants, antineoplastics, tranquilizers, impotence drugs and cytostatic agents. Many of these compounds are metabolized in the body, a combination of unchanged pharmaceuticals and metabolites are therefore present in raw and treated wastewater. Personal care products comprising the ingredients of shampoos, liquid bath admixtures, skin care products, dental care products, soaps, sun screen agents, hair styling products etc. are used in enormous quantities throughout the world. In the end of 1990s their annual production exceeded 500000 t for Germany alone.

Private households are the main source for most human pharmaceuticals, hormones, biocides, ingredients of personal care products and food ingredients to enter municipal wastewater. Hospital wastewater also contributes to the total loads of pharmaceuticals and biocides to a significant but not major extent. Compounds that are not readily (bio)degradable enter the receiving waters either as dissolved pollutants or sorbed onto suspended matter via the discharges of wastewater treatment plants (WWTP). Therefore, the removal efficiency of WWTPs is crucial for the contamination of the receiving water bodies with these "emerging" and often polar compounds. Another route into the environment is represented by point-source discharges from manufacturing plants which may cause locally elevated levels of contamination. Leakages into groundwater from landfill sites may lead to groundwater contamination, since the disposal of household products via domestic waste is very common. In addition to the infiltration of polluted river water and the use of manure or dung as fertilizer on agricultural lands, leakages from sewer drains, WWTPs and manure storage tanks are potential routes for groundwater contamination. Other pathways for groundwater contamination include spray irrigation of raw and treated wastewater onto agricultural land as well as contamination from leaking septic tanks.

In recent years several studies in Europe and North America reported the identification of these "emerging compounds" in wastewater, surface water, ground water and final drinking water (e.g. Barcelo, 2005; Kolpin et al., 2000; Ternes and Joss, 2006; Glassmeyer et al., 2005; Richardson and Ternes, 2005; Daughton and Lepp, 2001). In surface waters the concentrations of these compounds ranged up to a few µg L^{-1}. Even in ground water and drinking water residues of organic emerging pollutants were detected up to the µg L^{-1} level. Eventually, there are concerns that other pharmaceuticals designed for special biological effects are also hazardous to the environment. Estrogenic effects (Routledge et al., 1998) and renal alterations (Triebskorn et al., 2004) at environmental concentration ranges were already reported for the contraceptive 17α-ethinylestradiol (EE2) and the antiphlogistic diclofenac, respectively. A recent article in Nature (Oaks et al., 2004) highlighted that residues of veterinary used diclofenac are probably be responsible for renal failure of vultures and hence lead to a dramatic decline (> 95 %) of the vulture population in Parkistan.

Most polar and persistent compounds used in appreciable quantities can be detected in aqueous environmental matrices. Although, only in a few cases adverse effects on biota have been identified, it can be expected that in future more concerns will be elucidated for "emerging substances" or even "groups of emerging substances". Due the high number of compounds, the goal should be to select *indicator substances* regulated in the Water Framework Directive representing different kind of sources for pollution.

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Emerging Substances in Soil

Frank P.J. Lamé

TNO Built Environment and Geosciences, Business Unit Soil and Groundwater
P.O.Box 80015, 3508 TA Utrecht

e-mail: frank.lame@tno.nl

The list of emerging substances as provided on the Norman website is long and most of the components are ‘exotic’. And indeed, living in a highly industrialized world, ‘exotic’ chemicals are now part of our daily life. Knowledge of the consequences of these substances and potential (adverse) affects are of major importance in order to live in a sustainable environment. Nevertheless, before getting to ‘exotic’, do we have sufficient knowledge about the presence of the more ‘common’ substances?

Looking from an environmental perspective, soil quality in the Netherlands is set by a long list of potential pollutants for which target and intervention levels are defined. Directly mentioned are 113 components, but, as a part of these are in fact sum-parameters (like sum-PAH), the existing target and intervention levels are related to a total of 233 components. Most of them can be seen as ‘more regular’ substances, but despite this feeling about regularity, for most of them the occurring background levels in the Netherlands were until recent unknown.
These background levels are not the levels that are related to the natural – undisturbed – environment. We have to acknowledge the fact that the Netherlands are densely populated and that the Netherlands, as well as the surrounding countries, are highly industrialized. Additionally, agricultural use of the land has also impacts on the soil quality; as for example heavy metals are used in food additives for cattle and pesticides are used for crop protection. Thus, the ‘background levels’ that were to be determined should be interpreted as the concentrations that occur when there is no expectation of direct or local soil pollution.
In order to find locations for sampling, a series of criteria was defined in order to exclude this direct input as good as possible. Based on these criteria 100 sampling locations were selected throughout the whole of the Netherlands, representing agricultural and natural grounds, common soil types and land use; however, excluding villages and cities in order to diminish the chance of encountering soil pollution. At each location, samples were taken over an area of 2500 m^2 for the top soil (0 – 0,1 m), the intermediate layer where influence from atmospheric input might still affect the soil quality (0,1 – 0,5 m) and the underlying soil (0,5 – 1,0 m). All of these samples have been analysed in a comprehensive analytical study, not only determining the concentrations, but also ensuring the correctness of the results. Finally, at the end of 2004, we ended up with concentration distributions for in total 252 components and soil characteristics.
These results were then taken into a policy discussion, where as a consequence, it was decided that the target levels in the Netherlands now have to be changed. In general, the target levels will be set at the 95-percentile value of the distribution of the components as found in the top soil. For some components this implies higher concentrations, but for a number of other components the target levels will be lower than we were used to. These new target levels will be implemented in the Dutch Soil Policy as per 1 January 2007. Table 1 (component names in Dutch) specifies the old and new target levels.

Knowing the background levels in the – more or less – undisturbed soils, this does not relate to the concentrations that might be found in soils when looking at soil quality on a routine basis. Most reuse of soil is of course not situated in the undisturbed soils and environments, but in the villages and cities. There, intensive use of the soil over the centuries, might have resulted in enhanced concentration levels representative for the urban areas. And indeed, in

general we are aware of that fact when analysing soil quality for the more common components like arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, sum-PAH, mineral oil and EOX. But what concentrations might be expected for other metals for which also soil quality criteria are defined? And what about the leaching behaviour of these metals in soil?
Neither the concentrations nor the leaching of components like antimony, barium, cobalt, molybdenum, tin, selenium and vanadium are measured on a regular basis – if even ever! If concentrations found in these more disturbed soils indeed exceed the target levels as defined in the first study, there is reason to determine these components on a regular basis. They are then to be included in the package of components that are routinely measured when determining the soil quality. This discussion is currently still running. However, it was already determined that the formerly mentioned routine package of components (11 components) is indeed to small. An indication of the components that should (at least) be measured on a routinely basis are arsenic, barium, cadmium, cobalt, copper, mercury, lead, nickel, zinc, cyanide, chloride, mineral oil, sum-PAH and EOX.

Given the combination of the previously mentioned two studies, apparently there is more to know about soil quality, even for the more common parameters, than we might realise. Here the conclusions for the Netherlands might well be expanded to other European countries where – in general – soil quality investigations often tend to focus on the same limited number of components. Thus apart from the more ‘exotic’ components, we might well overlook what is happening to the soil due to the more common components and sources of (diffuse) soil contamination.

Emerging substances in indoor air

Dimitrios Kotzias

European Commission-Joint Research Centre
Institute for Health and Consumer Protection
21020 Ispra (Va), Italy

E-mail: dimitrios.kotzias@jrc.it

In the past decades a large number of studies have indicated the presence of various chemical compounds in indoor environments (buildings, homes). The presence of these chemicals in indoor air is the result of infiltration of polluted outdoor air and of emissions from various indoor sources, including building materials, activities of the occupants, consumer products, smoking etc.
For many of these chemicals, the impact on human health and comfort is almost totally unknown and difficult to predict because of the lack of toxicological data and of information on the dose-response characteristics in humans or animal models. On the other hand, a full toxicological testing as requested by the "existing chemicals" legislation is difficult to accomplish for these compounds, because it would involve the investigation of acute and sub-acute toxicity, mutagenicity, carcinogenicity and reproductive toxicity according to testing protocols that are complex, time-consuming and expensive. Moreover, the EU policy on limitation of unnecessary animal testing further limits the possibility of advocating a generalized animal testing of these chemicals.
The result of this situation is that there is an objective difficulty in regulating the presence of chemicals in indoor air principally because of the absence of adequate hazard and risk assessment.
There is therefore an urgent need to develop a strategy for the identification of priorities in testing, assessment and regulation.

The INDEX project (Critical Appraisal of the Setting and Implementation of Indoor Exposure Limits in the EU) started in December 2002 and had a duration of two years, until December 2004.The project was financially supported by DG SANCO and it was coordinated and carried out by the JRC in collaboration with a Steering Committee of leading European experts in the area of indoor air pollution. Scope of INDEX was to identify priorities and to assess the needs for a Community strategy and action plan in the area of indoor air pollution by:

- setting up a list of compounds to be regulated in indoor environments with priority on the basis of health impact criteria
- providing suggestions and recommendations on potential exposure limits for these compounds and
- providing information on links with existing knowledge, ongoing studies, legislation etc. at world scale.

The main steps to be followed in the project as they have been defined by the Steering Committee were:

- literature review (step 1)
- setting up criteria to select compounds (step 2)
- review of exposure and dose/response data (step 3)
- risk characterization of the selected compounds (step 4)
- prioritization of the selected compounds (step 5) and
- recommendations on potential exposure limits (step 6)

Based on the overall population risk caused by indoor source strengths, toxicological properties including hypersensitivity for allergy and asthma, known health effects and relation to comfort, it was decided within the INDEX project to define and prioritize the main indoor pollutants as follows:

Group 1 (high priority): benzene, formaldehyde, carbon monoxide, nitrogen dioxide, and naphthalene
Group 2 (low priority): m&p-xylenes, o-xylene, acetaldehyde, styrene, toluene
Group 3 (chemicals requiring further research with regard to human exposure and dose/response): NH_3, d-limonene, a-pinene.

Perfluorinated organic compounds in the European environment

Pim de Voogt

Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam
Nieuwe Achtergracht 166, 1018 WV Amsterdam, Netherlands

E-mail: pdevoogt@science.uva.nl

Perfluorinated alkylated substances (PFAS) are getting increased interest from scientists and regulators because they have been found in wildlife and in humans. Perfluorinated compounds are used in many consumer products today. Members of the PFAS are highly stable, do not degrade in the environment and can accumulate in living organisms. To make a full risk assessment of the environmental impact of PFAS, accurate data on their physicochemical properties and new tools to assess the fate and distribution of PFAS are needed.

PERFORCE is a EU-NEST funded project bringing together expert teams, including industry, to significantly boost our understanding of PFAS. The project includes several workpackages on analytical and bioanalytical method development and improvement, data collection and quality, and knowledge transfer. The project has undertaken a large sampling campaign in order to monitor the presence of PFAS in the European environment.

PERFORCE co-organized the first interlaboratory exercise on perfluoros. The results revealed relatively large in-between laboratory variabilities, underscoring the need for further improvement of analytical methodologies.

Preliminary results from the monitoring campaigns have shown that PFAS are present everywhere in the European environment. Current scientific efforts are aimed at identifying and understanding the pathways of PFAS dissipation in the environment. Human exposure routes are difficult to quantify due to a lack of data, in particular for dermal exposure and inhalation of dust. Even for food items relatively few data are available. The latter suggest that fish consumption is possibly a major source for human exposure.

The siloxane case: Screening of new chemicals in Sweden

Eva Brorström-Lundén

IVL, Swedish Environmental Research Institute
Box 5302, 400 14 Göteborg, Sweden

E-mail: Eva.BL@ivl.se

Siloxanes form a group of chemicals, which is used in a number of industrial applications and in different consumer products. Besides this, they are widely used in consumer's applications such as personal care and biomedical products. The widespread use of siloxanes, their broad application as well as their high volatility has raised the concern for these compounds within various disciplines of environmental science.

A screening of siloxanes has been carried out in the Sweden in parallell with a coordinated screening in all Nordic countries. The objectives of the screening were to determine the concentrations of selected siloxanes in a variety of environmental media, to highlight important transport pathways and to assess the possibility of current emissions. The siloxanes included in the study were three cyclic polydimethylsiloxanes (D4, D5, and D6) and four linear analogues (MM, MDM, MD2M and MD3M). A Nordic screening of siloxanes was carried out in parallel to the Swedish study.

A sampling strategy, which was based on identified possible emission sources and use as well as on the behaviour of the chemicals in the environment, was identified. The programme included measurements in urban and background areas, and close to potential point sources. Measurements of diffuse pathways from the society included samples from sewage treatment plants systems.

The results indicated that there is a general pollution of siloxanes in Sweden as well as in the other the Nordic countries. Siloxanes were found in all the analysed media: air, water, sediment, sludge as well as biota. However there was a great variation in concentrations. The cyclic siloxanes occurred in all media in significantly higher concentrations than the linear siloxanes. D5 was the dominating siloxane in most samples, which is not in agreement with data on use in the Nordic countries, where the consumption of D5 and D4 is fairly equal. Diffuse sources seemed to be most important for the observed concentrations of siloxanes in the environment. The concentrations were generally elevated in urban areas and in areas close to sewage treatment plants.

The concentrations in fish were fairly variable. Siloxanes were mainly detected in fish samples from sites representing urban/diffuse sources and only a few background samples showed detectable levels. Siloxanes were also detected in human breast milk. On the whole the biota data indicated that siloxanes may bioaccumulate.

The Swedish screening study was performed on assignment from the Swedish Environmental Protection Agency. The Nordic screenings were carried out jointly between the Norwegian Research Institute (NILU) and the Swedish Environmental Research Institute (IVL) in collaboration with the Nordic screening project group and financed by the Nordic Minister of Council.

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Benzotriazole anticorrosives in municipal wastewaters and in the aquatic environment

Walter Giger, Christian Schaffner, Dimitra Voutsa
Swiss Federal Institute of Aquatic Scîence and Technology
Eawag, 8600 Duebendorf, Switzerland

E-mail: giger@eawag.ch

The complexing agents benzotriazole (BT) and tolyltriazole (TT) are not only widely used as anticorrosives (e.g. in engine coolants or in antifreezing liquids) but also for so-called silver protection in dish washing liquids. These compounds are characterized by high water solubility (28 and 7 g/L, respectively), low vapor pressure and low octanol water distribution coefficients (log K_{ow}: 1.23 and 1.89, respectively). Moreover, BT and TT are quite persistent to biodegradation. Consequently, it must be expected that they occur in wastewaters and eventually in ambient waters.

A quantitative analytical method was developed using solid-phase enrichment for extraction of aqueous samples and LC/MS/MS for separation and detection. OASIS HLB cartridges were found to be best suited for enrichment. Underivatized extracts in methanol / water (1:1) were analyzed by LC/MS/MS with electrospray ionization.

BT and TT concentrations in primary and secondary effluents of municipal wastewater treatment plants ranged from below 10 to 100 µg/L. Concentration ranges in grab samples from the Glatt River in ng/L were 640 – 3’700 for BT and 120 – 630 for TT. The corresponding mass flows in kg/d were 0.093–1.9 for BT and 0.018 – 0.36 for TT with clearly increasing trends along the longitudinal river profile. During winter 2003/4, BT loads in weekly composite samples from a station in the lowest stretch of the Glatt clearly indicated the effect of the nearby Zurich airport, where deicing fluids were used, that contained BT as an an anticorrosive additive. In weekly composite samples of water from the Rhine River at Weil am Rhine below Basel 0.05 to 0.5 µg BT/L were found approximately corresponding to weekly mass flows of 220 kg BT. The waters of Lake Zurich contained BT and TT concentrations of 93 – 170 and 30 – 53 ng/L, respectively.

Only ozonation provides an efficient elimination of the trace levels of BT and TT. In one water treatment plant with two ozonation steps, BT and TT concentrations in the finished drinking water were below the limits of quantification of about 10 ng/L. In the other plant with only one ozonation step, residual BT and TT concentration in the fully treated water were 90 and 30 ng/L, respectively.

Engineered Nanoparticles

Richard Owen

Principal Scientist, Environment and Human Health
Environment Agency of England and Wales (UK)

E-mail: richard.owen@environment-agency.gov.uk

Nanotechnology involves the production and application of substances and structures at the nanoscale, typically with several dimensions below 100nm (0.1microns). Substances manufactured in this size range can have very different properties when compared to their larger counterparts, reflecting surface properties and quantum effects that become important at the nanoscale. The enhanced properties of nanomaterials offer huge potential socio – economic, health and environmental benefits, which has in turn fuelled a rapid increase in current nanomaterials manufacture. Engineered nanoparticles are an important sector of nanotechnologies, representing a diverse range of substances currently on the market, from metal and metal oxide based nanoparticles to carbon – based nanotubes and fullerenes.

While engineered nanoparticles offer significant potential benefits, there are also considerable uncertainties with regards to potential risks to environment and human health. If nanoparticles have enhanced properties, are they also more toxic or more persistent? Are they more mobile within organisms, do they have novel effects? Do they affect the behaviour and toxicity of other substances they interact with in the environment? Are risk assessments for substances in their bulk form sufficient for the same materials as nanoparticles?

Pulmonary toxicology studies with incidentally – produced, so – called ultrafine nanoparticles such as coal dust have highlighted the potential for health risks from engineered nanoparticles, but the fate, behaviour and toxicity of these materials in the environment is largely unknown, and while there are likely to be current releases the ability to measure their presence is currently limited. This presents important challenges to scientists and regulators whose aim is to promote the responsible development of the technology through a comprehensive understanding of benefits and risks.

This presentation will highlight the key immediate issues and research needs for engineered nanoparticles that have been identified, summarise the latest research published in this area and discuss current and future research programmes in Europe and beyond.

Monitoring Data Needs for Chemical Risk Assessment Under REACH

Steven J. Eisenreich

European Chemcials Bureau
Institute for Health and Consumer Protection
JRC – Ispra, IT 21020

E-mail: steven.eisenreich@jrc.it

The Water Framework Directive (WFD) requires that Members States (MS) design and conduct monitoring in European river basins and near-coastal waters to support the goal of good (chemical) ecological functioning of these aquatic systems. The chemical monitoring must be done at prescribed frequencies for a list of Priority Substances (PS), and according to some harmonized principles. The question arises as to what are the anticipated new or additional monitoring needs/requirements for chemical data to support risk assessment under REACH?

For 'existing' and 'new chemicals' regulations prior to REACH, chemical risk assessments are performed by MS Competent Authorities in collaboration with the relevant industry using EUSIS as the primary tool for environmental risk assessment. Data requirements for EUSIS (*European Union System for the Evaluation of Substances*) (chemical/physical properties, reactions, persistence, emissions, environmental characteristics, toxicity, bioaccumulation, predicted/measured exposure) include the efficient use of monitoring data by IND for chemicals to be assessed. Under REACH, the Chemical Safety Assessments (CSAs) must be conducted by IND for chemicals to be registered. That is, the responsibilities of performing chemical risk assessments becomes that of the registering Industry. The CSA contributes to the extended Chemical Safety Report that travels with the produced chemical down the supply chain, for the purpose of the protection of human and environmental health. The CSA makes good use of environmental exposure (e.g., water and sediment; chemical bioaccumulation) concentrations in supporting the EUSIS or EUSIS-type modeling. Since PBTs (persistent, bio-accumulative, toxic) are important chemicals in both the WFD and REACH, the relevance of environmental data is high, and data needs under both current and REACH legislation will be presented.

This presentation will cover the essential features of REACH, the differences between current legislation and REACH, and the data needs for chemical risk assessment under both current legislation (*sans* REACH) and anticipated under REACH. The role of monitoring data and process information in evaluating PBT criteria under REACH will also be discussed.

An as yet unanswered question is defining where (and how) the WFD governs the regulation of chemicals relative to when and how REACH will do so – good ecological status vs. protective exposure scenarios.

Water Framework Directive and Emerging substances: Implications for policy development, research and monitoring

Nick Cartwright

Environment Agency for England and Wales

E-mail: nick.cartwright@environment-agency.gov.uk

The Water Framework Directive, through a forthcoming daughter directive will set environmental quality standards (EQS's) for a range of priority substances. However, it also requires Member States to establish their own standards for other specific pollutants that are discharged in significant quantities. Known issues can be addressed through river basin characterisation but emerging pollutants present a range of difficulties. To identify and address these effectively, we will need to ensure integration with the range of other national and European activities being undertaken on chemicals both to avoid duplication and find cost effective ways of filling information gaps.

In 2003, the Environment Agency developed a Chemical Strategy to help us prioritise our activities on chemicals. We are also part of the UK Competent Authority on chemicals with specific responsibility for undertaking environmental risk assessments. . As part of our Chemicals Strategy we developed a screening approach to help prioritise substances for further investigation. Our chemicals screening activities feed into a range of national and international programmes, such as ESR, and the OECD SIDS Programme. Work on persistent, bioaccumulative and toxic substances or their substitutes is now taken forward under a UK co-ordinated chemical risk management programme. It is important that as well as identifying high hazard substances we screen and possibly evaluate potential substitutes.

Our screening approach provides a hazard rating based on combinations of persistence, bioaccumulation and toxicity together with an exposure ranking to give an overall risk rating. It does not address metals. For the purposes of the Water Framework Directive we have adapted this approach to prioritise exposure via the water column. We seek to make best use of information emerging from other chemical activities but significant gaps remain on hazard information. There is a danger that these types of systems tend to prioritise substances of known concern because better data exist on these. In due course REACH will provide a firmer basis for hazard information. Meanwhile, QSARs may be used if appropriate to help fill these gaps but even then hazard information is biased toward aquatic organisms and so we are less likely to identify risks to other environmental media. Exposure is estimated using monitoring or emission information or chemical usage.

To obtain better information on exposure we have added a number of these substances onto our Pollution Inventory. This will provide information on emissions from sites we regulate under Integrated Pollution Prevention and Control but will not address diffuse inputs. We have supplemented this with a targeted, risk based, environmental monitoring programme running short campaigns on a number of substances.

A substance by substance approach may not be the best, or only, way of identifying priority issues. We also need to make best use of any emerging evidence of environmental effects and investigate their causes. The significant effort we have put into researching steroid oestrogens following evidence of their impacts on fish is one example of this.

Where risks to water are identified for a substance under the ESR it is often suggested that it should be considered for prioritisation under the WFD. However, risks are often due to Member State specific sources and we need to be sure that they are sufficiently widespread to justify the development of EC EQSs. Diffuse inputs are often significant and information collated under the Water Framework Directive needs to be fed back to inform risk management decisions on chemicals at source, under REACH.

Management of emerging pollutants in the marine environment from the perspective of a National Monitoring Authority

Norbert Theobald

Federal Maritime and Hydrographic Agency
Hamburg, Germany

E-mail: theobald@bsh.d400.de

Because of the very low concentrations observed in the open sea, monitoring of organic contaminants in the marine environment needs some special requirements concerning sampling and analytical techniques. In addition to analytical challenges, administrational, logistic and financial parameters have to be considered and optimised for monitoring strategies.

On the one side, very constant procedures at ultra-trace level with a good quality control system over many years are necessary to enable the investigation of time trends. On the other side, a continuous up-date and development of methods is needed for implementing surveys for new emerging contaminants.

Starting point for the investigation of novel contaminants in the marine environment are the lists of Priority Pollutants of various international organisations, such as the EU (EU-Water Framework Directive: EU-WFR), OSPAR Commission (for the protection of the Marine Environment of the North-East Atlantic) and HELCOM Commission (Baltic Marine Environment Protection Commission). Prioritisation procedures within the commissions help to rank the numerous compounds. Within this process, information on production quantities and exposure ways are needed. However, for the evaluation and before establishing a monitoring programme, first limited surveys are needed to investigate the occurrence and distribution of new pollutants in the marine environment. Generally, these studies are first performed on a national basis.

In contrast to “classical” pollutants, most of the "newer" hazardous substances are more polar and/or need special analytical procedures - thus knowledge on these substances in the marine environment is limited or even non-existent. The investigation of new polar compounds was possible only after the availability of new analytical procedures like HPLC-MS-MS. By this, it was shown, that many new pesticides and other xenobiotics are spread into the marine environment and are observed in part at much higher concentrations than classical non-polar pollutants. Examples are shown for different herbicide classes (triazine, phenylurea and phenoxyacetic acid) and perfluorinated compounds (PFOA, PFOS) in the North and Baltic Seas.

Because of the special analytical and logistic challenges the investigations are very expensive and it is nearly impossible for a single institution to investigate all new emerging pollutants. Therefore, co-operations with other institutions and participation in research projects become of vital importance for obtaining fast results.

In addition to activities within the monitoring bodies it is essential to use any scientific information available to identify new possible pollutants and to obtain a most comprehensive picture of the contamination burden. In this respect it is considered necessary to perform non-target screening investigations by different MS techniques in order to identify yet unknown contaminants.

Large gaps of knowledge still exist in the field of effects and evaluation, especially for chronic effects of low concentrations and multi-component mixtures. As the integration of chemical and biological monitoring still bears a great number of problems, the precautionary principle gains a special significance for the marine environment.

How the drinking water industry deals with emerging pollutants - three decades of experience in the Netherlands

Jurgen Volz

Kiwa Water Research, Nieuwegein, Netherlands

E-mail: Jurgen.Volz@kiwa.nl

Since the early 1970s the Dutch drinking water industry has been forced to deal with the (potential or proven) occurrence of an ever increasing number of emerging environmental pollutants (EEP) in groundwater, surface water and drinking water. Historically, the focus of concern has shifted from toxic heavy metals (e.g. mercury and cadmium) and disinfection byproducts (e.g. trihalomethanes) to pesticides, endocrine disruptors, pharmaceuticals and a host of other organic EEPs. The EU Drinking Water Directive and the Dutch Drinking Water Ordinance require drinking water suppliers to guarantee a) compliance with drinking water standards (MAC= Maximum Admissible Concentration) for several dozens of substances, b) that drinking water does not contain any unregulated substances (e.g. EEPs) in concentrations which may be harmful to human health. The second requirement demands adequate monitoring and risk assessment strategies. The development of these strategies, which will be illustrated with some examples, is one of the main tasks of Kiwa, the joint R&D institute of the Dutch drinking water industry. One of the most serious problems with EEPs is that regulators tend to develop purely ecotoxicological EQS (Environmental Quality Standards) for these substances without taking drinking water aspects into account.

Management of emerging pollutants in soil

Claudio Carlon

European Commission – DG Joint Research Centre, Institute for Environment and Sustainability, Rural, Water and Ecosystem Resources Unit

E-Mail: claudio.carlon@jrc.it

Risk management of contaminated land in Europe

The management of contaminated land is commonly based on risk assessment methodologies. In Europe, the Risk Based Land Management (RBLM) concept has inspired several national regulatory systems, and more recently the preparation of the European Soil Thematic Strategy.

According to the RBLM approach, the management of contaminated land differs, but is closely related to the management of the air and water compartments, as it follows:

- the term "land" indicates the need for an integrated approach to contaminated soil, surface water nearby and groundwater beneath.
- the definition of sustainable solutions requires the proper consideration of the temporal and spatial dimensions.
- as far the temporal dimension, long term care objectives should be defined in consideration of the mobility (low mobility for some contaminants in soil) and degradability of contaminants.
- a distinction is usually made between the historic contamination (inherited from the past) and the prevention of future contamination.
- as far the spatial dimension, the remediation of contaminated land is closely linked to spatial planning and is usually driven by the "fitness for use" concept.
- a distinction is usually made between local and diffuse contamination, being the former a problem to be solved by the landowners, and the latter a problem related to multiple stakeholders and environmental protection strategies at larger scale.

In support to the management of contaminated land, the risk assessment is usually applied at three different levels:

- the relative risk assessment, aimed at the identification and ranking of contaminated sites at regional scale,
- the screening risk assessment, which provides screening concentration thresholds of contaminants in soil and water based on standard scenarios,
- the site specific risk assessment, which estimates the risk at a specific site based on local conditions in support to remediation actions.

Due to wide differences in the application and outcomes of risk assessment for contaminated land across Europe, in the last few years both regulators and the scientific community invoked a certain degree of harmonisation. For this scope the JRC, in collaboration with several other European research institutes, launched a long term research framework, named **HERACLES**, **H**uman and **E**cological **R**isk **A**ssessment for **C**ontaminated **L**and in **E**uropean Member **S**tates.

HERACLES is an open research framework that addresses three levels of risk assessment, *Relative Risk Assessment*, *Screening Risk Assessment*, *Site Specific Risk Assessment*, and encompasses both human health and ecological risk assessment. It combines research and pilot projects and workgroups discussion.

With concern to emerging pollutants

With reference to the risk management of contaminated land, the assessment and management of emerging pollutants raises several open questions about major sources, their occurrence and effects. Moreover, regulatory systems might be not prepared to address emerging pollutants in soil.

Distinction between local contamination and diffuse contamination can be convenient.

Local contamination can be associated to e.g. landfills or industrial facilities. With this regard, some years ago regulators focused the attention on gasoline additives such as Methyl-tert-butyl ether (MTBE). The suspect of carcinogenic effects of MTBE was a high concern due to the frequent occurrence of spillages at gasoline stations and the high solubility and mobility of MTBE in groundwater. The EC Risk Assessment Report published in 2002 concluded that MTBE is not carcinogenic according to the criteria set forth in the EU Directive on Dangerous Substances.

A concern exists that the disposal of electronic equipment (e-waste) may leach toxic chemicals into the leachate of lined landfills or contaminate groundwater near unlined landfills. Out of these chemicals, lead is a major potential contaminant. The leaching of brominated flame retardants (BFR) like Polybrominated diphenylethers can be also relevant, since electrical and electronics account for a very high consume of BFR.

In the case of local contamination, the regulatory system addresses the contaminated media (the soil) and the remediation burden is loaded on the polluter. However, emerging pollutants are not usually analyzed, or the responsibility of the polluter is difficult to be proved. Concentration thresholds (based on screening risk assessment) are not provided, and a site-specific risk assessment might be necessary. At site-specific level, the cause-effect relation can be hard to be proved. The site-specific ecological risk assessment (SS-ERA) usually relies on the TRIAD approach, where chemical, eco-toxicological and ecological evidences are jointly considered. Based on bioassays, the TRIAD approach might outline eco-toxicological and/or ecological effects that can be hardly related to the occurrence of specific substances in a mixture. In any case, the SS-ERA methodology applied to contaminated soil is far from being a standardized approach and is still in the domain of the scientific research.

As far the diffuse soil and groundwater contamination, one example is the contamination by endocrine disruptors and pharmaceuticals caused by amendments of soil by sewage sludge and manure produced by animal excreta. In general, atmospheric deposition of incineration emissions account for one of the most relevant sources of diffuse contamination. The application of polar pesticides in agriculture is also a concern for diffuse contamination of soil and water.

In the case of diffuse contamination, the regulatory system might lead to preventive measures or land use restrictions.

Emerging pollutants might have effects on humans at population level and on the ecosystem at larger scale. However, few data are available on the occurrence and bioavailability of emerging pollutants in soil. Potential large scale effects on to soil ecosystem biodiversity, safe agricultural practices and groundwater drinking reservoirs should be better defined.

Recommendations and management options for priority indoor air pollutants

Dimitrios Kotzias

European Commission-Joint Research Centre
Institute for Health and Consumer Protection
21020 Ispra (VA), Italy

E-mail: dimitrios.kotzias@jrc.it

Recommendations and management options for priority indoor air pollutants proposed for regulatory purposes, would - according to present knowledge - protect the general population and most individuals most of the time, but they will not prevent all cancer from indoor exposures nor protect the most susceptible individuals in all conditions, such as individuals with serious respiratory or cardiovascular disease, highly reactive asthmatics, genetically predisposed individuals developing haemolytic anaemia from naphthalene, etc.
In addition to specific recommendations reported below, the following general recommendations and management options apply to most or many indoor air contaminants in the high and low priority lists:

- Use of appropriate ventilation practices based on the well defined standards for indoor environments according to the recommendations of the relevant professional organisations.
- Ban tobacco smoking in all indoor spaces under public jurisdiction. Raise public awareness on the hazards of tobacco smoke, and discourage smoking in private residences, particularly in the presence of children.
- Develop building codes to restrict the construction of attached garages, and to isolate the garages from living and working quarters (closing the doorways, sealing the structures and ensuring proper air pressure difference between garage and other indoor spaces).

High priority compounds

Formaldehyde

The no-effect level (acute and chronic) is estimated to be at 30 µg/m3 as 30-minute average. Pending the outcome of the current IARC revision of the carcinogenicity of formaldehyde, a guideline value should be as low as reasonably achievable.

Management options:

- Restrict emissions of formaldehyde from building products, furnishings and household/office chemicals.
- Discourage the use of formaldehyde containing products.

Nitrogen Dioxide

A long term guideline value of 40 $\mu g/m^3$ (1-week average) and a short term guideline value of 200 $\mu g/m^3$ are proposed.

Management options:

- Apply the indoor air concentration guideline in the building design process

- Develop building codes, ventilation standards and equipment/appliance standards (design, maintenance and use) so that all indoor combustion equipment will exhaust to chimneys/hoods/vents leading outdoors.

Carbon Monoxide

The 1-hour average guideline value of 30 mg/m^3 and the 8-hour average guideline value of 10 mg/m^3 are recommended.

Management options:

- Apply the indoor air concentration guideline in the building design process
- Develop building codes, ventilation standards and equipment/appliance standards (design, maintenance and use) so that all indoor combustion equipment will exhaust to chimneys/hoods/vents leading outdoors
- Require regular mandatory inspections for indoor combustion equipment
- Recommend alarm systems responding to abnormally high concentrations (e.g. 50 mg/m^3).

Benzene

As benzene is a human carcinogen, its concentration in the air should be as low as reasonably achievable. Indoor concentrations of benzene should not exceed outdoor concentrations.

Management options:

- Sources emitting benzene (tobacco smoking, etc.) should not be allowed in the indoor environment
- Lower the permissible benzene content in any building material and consumer product.

Naphthalene

A long term guideline value of 10 $\mu g/m^3$ is recommended based on irritation/inflammation/hyperplasia. This level is at the lower extreme of the olfactory perception range.

Management options:

- Restrict the use of naphthalene containing household products, particularly mothballs.

Integrated assessment of health risks from environmental stressors in Europe - the INTARESE project

David Briggs

Department of Epidemiology and Public Health, Imperial College London
E-mail: d.briggs@imperial.ac.uk

The INTARESE project is designed to support implementation of the European Environment and Health Action Plan, by providing the methods and tools that are essential to enable integrated assessment of health risks from environmental stressors.
Integrated assessment in this context is more than the simple summation of traditional assessment methods. It demands the ability to analyse and compare different aspects of the environment, human populations and health, at different spatial and temporal scales, and to produce coherent information on the combined and cumulative risks and impacts of environmental stressors in ways that can improve decision-making and enhance policy.
Integration thus involves:

- tracking risks through the full chain from source to impact (both on health and related monetary and social costs)
- assessing the combined and cumulative effects of different sources and stressors in relation to each specific health outcome
- assessing the different health effects arising from each source or stressor
- linking different policy areas and issues within a consistent and comparable assessment framework
- providing tools for risk assessment that meet the needs of the different stakeholders and users involved in any issue

As such, integrated risk assessment requires linkage and use of a wide range of data, scientific knowledge and methodologies, including:

- monitoring technologies (including ground- and space-based environmental monitoring, biomonitoring and health surveillance);
- risk and impact assessment methodologies;
- methods and tools for risk characterisation and risk communication.

In recent years, major scientific advances have been made in each of these areas. The need now is to bring these advances together, identify and fill key gaps in the existing knowledge and methodologies, and develop the tools needed to make the knowledge and technologies operational.
The aim of the INTARESE project is to achieve this integration. Drawing upon the large range of studies carried out in Europe over recent years, and in close collaboration with users, it will develop a methodological framework and a set of tools and indicators for integrated assessment that can be applied across different environmental stressors (including pollutants and physical hazards), exposure pathways (air, water, soil, food) and policy areas.
To this end, the project will:

1) develop a conceptual framework for, and systematic approach to, integrated risk assessment that spans the entire source-impact chain;

2) review, assess the adequacy, link and enhance the monitoring systems needed to support such assessments;

3) test and apply the approach through a series of integrated assessments of exposures and health risks in a number of specific policy areas, including transport, housing, agriculture, water, wastes, household chemicals and climate;

4) develop and bench-test a computer-based system and decision support tool for applying this approach on a routine basis.

Throughout, particular attention will be given to issues of uncertainty, sensitive or susceptible groups, and possible interactive and cumulative effects of different stressors. Throughout the project, also, close liaison and contact will be maintained with users (including those in the policy, industrial and research arenas) in order both to ensure that the work addresses their needs, and to provide testing and evaluation of the project results.

This paper outlines the conceptual basis for the INTARESE project, and discusses how the methods used might be used to help identify, assess risks from, and communicate risk information about emerging health issues.

EU FP6 project: NoMiracle, Novel methods for integrated risk assessment of cumulative stressors in Europe

Hans Løkke

National Environmental Research Institute (NERI), Denmark

E-mail: hlo@dmu.dk

To support current and future European strategies, in particular for environment and health, there is an urgent need for development of methods for assessing the cumulative risks from combined exposures to multiple stressors including complex mixtures of chemical, physical, and biological agents. This presented IP will support the development and improvement of a coherent series of methodologies that will be underpinned by mechanistic understanding, while integrating the risk analysis approaches of environmental and human health. The project will deliver understanding and tools for realistic risk assessment, developing a research framework for the description and interpretation of combined stressor effects that leads to the identification of biomarkers and other indicators of cumulative impacts. The IP will help increase knowledge on the transfer of pollutants between different environmental compartments, including how these processes are influenced by natural stressors such as climate, and on the impact of cumulative stressors, including chemical mixtures. By developing and using improved assessment tools and novel models, the project will quantify and aim at reducing uncertainty in current risk assessment and screening methodologies, e.g. by improving the scientific basis for setting safety factors. The new methods will take into account geographical, ecological, social and cultural differences across Europe. The NoMiracle Consortium consists of leading experts from 38 partner institutions from 17 European countries.

The aims of NoMiracle are condensed into seven major science & technology objectives:

1. To develop new methods for assessing the cumulative risks from combined exposures to several stressors including mixtures of chemical and physical/biological agents
2. To achieve more effective integration of the risk analysis of environmental and human health effects
3. To improve our understanding of complex exposure situations and develop adequate tools for sound exposure assessment
4. To develop a research framework for the description and interpretation of cumulative exposure and effect
5. To quantify, characterise and reduce uncertainty in current risk assessment methodologies, e.g. by improvement of the scientific basis for setting safety factors
6. To develop assessment methods which take into account geographical, ecological, social and cultural differences in risk concepts and risk perceptions across Europe
7. To improve the provisions for the application of the precautionary principle and to promote its operational integration with evidence-based assessment methodologies

How is industry contributing to the development of science based approaches to the environmental risk assessments of pollutants.

Martin Holt

ECETOC

E-mail: martin.holt@ecetoc.org

The risk assessment process is a stepwise process in which the assessment of the potential adverse effects and exposure is integrated and compared with increasing realism as the information is generated by increasingly higher tiers of testing. By adopting an approach which considers both the degree of exposure and the degree of hazard the information required can be specifically focused to the area of concern. Whilst the current approaches to risk assessment are imperfect representations of the real world they should be considered as providing a more rational basis of control than approaches based on hazard alone. Risk assessment is a continually developing science and the major challenge facing the risk assessor is that of how to reduce the uncertainty associated with both the environmental exposure assessment and the environmental effects assessment. This presentation will look briefly at some of the research activities that industry is involved in to improve the scientific basis of environmental risk assessment but will focus on the environmental exposure side of the risk paradigm.

One of the essential requirements for promoting improved understanding of the environmental fate and distribution of chemicals is the accurate determination of their concentration in the various environmental compartments. In recent years there has been a growing emphasis on monitoring chemicals in the environment. Although the amount of monitoring data increases every year, programmes may need to be rationalized and be "information rich" rather than "data rich". In this way the emphasis will move to investigative monitoring which takes account of emission patterns, representativeness and reliability by evaluating the site characteristics, the sampling collection and handling procedures, the analytical methods used and the geographical and time scales of the measurement campaigns. Modelling will become increasingly more important in guiding how, when and where monitoring programmes should be carried out and thus the interplay between environmental chemists and modellers needs to be encouraged. Model development needs to be encouraged and the benefits of making data more easily accessible for this purpose are clear. The potential to improve accessibility is great but it will require commitment by stakeholders (industry, academia and regulatory authorities). The increasing emphasis on biological monitoring creates an opportunity to develop programmes that integrate the skills and specific needs of chemists and biologists into the design and execution of investigative monitoring programmes and in the interpretation of the data.

Norman Workshop - Emerging Pollutants

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List of participants

Borco ALEKSOV
Central Environmental Laboratory, Ministry of Environment and Physical Laboratory
Drezdenska str. 52
1000 Skopje
Macedonia
MCE - 1000 Skopje
tel. :+38923287904 - fax: +38923287904
e mail: boralhem@yahoo.com

Laurence AMALRIC
BRGM
BRGM MMA/APO
3 avenue Claude Guillemin BP 6009

F - 45060 ORLEANS
tel. :2 38 64 34 92 - fax: 2 38 64 37 11
e mail: l.amalric@brgm.fr

Jeanette ANDERSSON
IVL Swedish Environmental Research Institute
Box 210 60
S - 10031 Stockholm
tel. :0046859856365 - fax: 0046859856390
e mail: jeanette.andersson@ivl.se

Damia BARCELó
CSIC
Jordi GIRONA 18-26
E - 08034 Barcelona
tel. :34934006170 - fax:
e mail: dbcqam@cid.csic.es

Denis BARD
Ecole Nationale de la Santé Publique
Av Pr Léon Bernard
F - 35043 rennes
tel. :+332 9902 2932 - fax: +33-2-9902-2929
e mail: dbard@ensp.fr

Rachel BENSTEAD
Environment Agency (UK)
4 The Meadows, Waterberry Drive, Waterlooville, Ha
UK - PO7 7XX Waterlooville
tel. :0044 2392 233868 - fax: 0044 2392 233869
e mail: rachel.benstead@environment-agency.gov.uk

Philippe BERSUDER
Cefas Burnham Laboratory
Remembrance Avenue
UK - CM0 8HA Burnham-on-Crouch
tel. :+44 (0)1621 787212 - fax:
e mail: philippe.bersuder@cefas.co.uk

Maria BIHARI
VITUKI Kht
Budapest, Kvassay Jeno; street 1
H-1095 Budapest
tel. :36/1/215-61-40/2393 - fax: 36/1/216-81-40
e mail: bihari@vituki.hu

Tetyana BODNARCHUK
Laboratory of the State Department of Environment and Natural Res.
Stryyska St.
Sustainability
UA - 79026 Lviv
tel. :+380 32 238-73-63 - fax: +380 32 238-73-83
e mail: tanyabodnarchuk@bigmir.net

Stephanie BOPP
European Commission - DG Joint Research Centre
IES Institute for Environment and

JRC
I - 21020 Ispra
tel. :0039-0332-785394 - fax: 0039-0332-785212
e mail: stephanie.bopp@jrc.it

Ulrich BORCHERS
IWW Institute for Water Research
Am Lohbach
Health
D - D-45470 Muelheim an der Ruhr
tel. :+4920840303210 - fax: +492084030380
e mail: u.borchers@iww-online.de

David BRIGGS
Imperial College London
Department of Epidemiology and Public

Norf
UK - W2 1PG London
tel. :44 207 594 3329 - fax: 44 207 594 3196
e mail: d.briggs@imperial.ac.uk

Eva BROSTROEM-LUNDEN
Swedish Env. Research Inst. Ltd - IVL
Unit
P.O. Box 47086
S - 402 58 GOETEBORG
tel. :+46 31 725 6200 - fax: +46 31 725 6290
e mail: Eva.BL@ivl.se

Claudio CARLON
I.E.S. - Soil, Water & Ecosystem Resources

JRC - via Enrico Fermi
I - 21020 ISPRA
tel. :+39-0332-789134 - fax: +39-0332-785601
e mail: claudio.carlon@jrc.it

Nick CARTWRIGHT
Environment Agency
Environment Agency, Block 1, Government Buildings,
UK - BS10 6BF Bristol
tel. :0117 915 6224 - fax: 0117 914 2929
e mail:
nick.cartwright@environment-agency.gov.uk

Laure CHANCERELLE
INERIS
PARC ALATA

F - 60550 VERNEUIL EN HALATTE
tel. :0344556394 - fax:

e mail: laure.chancerelle@ineris.fr

Miriam COLLOMBON
RIVM
PO Box 1
NL - 3720BA Bilthoven
tel. :+31302743783 - fax:
e mail: Miriam.Collombon@rivm.nl

Marina COQUERY
CEMAGREF
3 bis quai Chauveau, CP 220
F - 69336 LYON Cedex 09
tel. :33(0)4 72 20 86 16 - fax: 33(0)4 78 47 78 75
e mail: coquery@lyon.cemagref.fr

Helena CRNOJEVIC
Croatia Waters, Central Water Management Laboratori
Ulica Grada Vukovara 220
HR - 10 000 ZAGREB
tel. :+385 1 2410 526 - fax: +385 1 2410 509
e mail: helena.crnojevic@voda.hr

Nicole DE BRUCKER
VITO
Boeretang 200
B - 2400 MOL
tel. 00 32 14 33 50 14 – fax: 00 32 14 31 94 72
nicole.debrucker@vito.be

Geneviève DEVILLER
JRC - Via Fermi
I - 21020 Ispra (Italy)
tel.+39-0332-786692
genevieve.deviller@jrc.it

Anja DUFFEK
UBA (Federal Environmental Agency)
Bismarckplatz 1
D-14193 Berlin
tel. :49-30-8903-2662 - fax:
e mail: anja.duffek@uba.de

Valeria DULIO
INERIS
Parc Technologique ALATA - B.P. N°2
F - 60550 Verneuil-en-Halatte
tel. :+33 3 44 55 66 47 - fax: +33 3 44 55 66 00
e mail: valeria.dulio@ineris.fr

Daniela DURKOVICOVA
Slovak hydrometeorological institude
Jeseniova 17, 83315 Bratislava, The Slovak Republic
SK - 83315 Bratislava
tel. :421 2 59415 291 - fax: 421 2 54773 602
e mail: daniela.durkovicova@shmu.sk

Steven EISENREICH
Joint Research Centre
Via E. Fermi 1, IES TP 290
I - 21020 Ispra
tel. :39 0332-789588 - fax: 39 0332-789328
e mail: Steven.Eisenreich@jrc.it

Ulla ERIKSSON
ITM, Stockholm University
Frescativägen
S - 10691 Stockholm
tel. :+46 8 6747175 - fax:
e mail: ulla.eriksson@itm.su.se

Marinella FARRE
IIQAB-CSIC
C/Jordi Girona
E - 08034 Barcelona
tel. :0034-93-4006100 - fax:
e mail: mfuqam@cid.csic.es

Anne-Marie FOUILLAC
BRGM
3 AVENUE CLAUDE GUILLEMIN
BP 6009
F - 45060 ORLEANS CEDEX
tel. :0238643585 - fax: 0238643711
e mail: am.fouillac@brgm.fr

James FRANKLIN
CLF-Chem Consulting
28 Rue Edouard Olivier
Lancaster
B - 1170 Brussels
tel. :3226739558 - fax: 3226739558
e mail: james.franklin@skynet.be

Thomas GARETH
Lancaster University
Environmental Science Department,

UK - LA1 4YQ Lancaster
tel. : +44 1524 510214
e mail : g.o.thomas@lancaster.ac.uk

John GARROD
Defra
Asdown House, 123 Victoria Street
UK - SW1E 6DE London
tel. :0044 (0)207 082 8107 –
fax: 0044 (0)207 082 8086
e mail: john.garrod@defra.gsi.gov.uk

Reinhard GERHARDS
Degussa
Goldschmidtstr. 100
D - 45127 Essen
tel. :+49 201 173 2978 –
fax: +49 201 173 1997
e mail: reinhard.gerhards@degussa.com

Walter GIGER
Giger Research Consulting
Im oberen Boden

CH - 8049 Zurich
tel. :+4144 342 2520 - fax: +41 44 342 2517
e mail: giger@eawag.ch

Antonietta GLEDHILL
Waters Corporation
Atlas Park, Simonsway, Wythenshawe
UK - M22 5PP Manchester
tel. :+447795458632 - fax:
e mail: antonietta_gledhill@waters.com

Anders GOKSØYR
University of Bergen
Department of Molecular Biology
PO Box 7800
N-5020 Bergen
tel. :+4755584374 - fax: +4755589683
e mail: anders.goksoyr@mbi.uib.no

Jadwiga GZYL
Institute for Ecology of Industrial Areas
6 Kossutha St, 40-844 Katowice, POLAND
PL - 40-844 Katowice
tel. :+48 32 2542279 - fax: +48 32 2541717
e mail: gzyl@ietu.katowice.pl

Georg HANKE
EC JRC IES
Via Enrico Fermi
I - 21020 Ispra (VA)
tel. :0332-785586 - fax:
e mail: georg.hanke@jrc.it

Benoit HAZEBROUCK
INERIS
Parc Technologique Alata BP 2
F - 60550 Verneuil en Halatte
tel. :0033344556112 - fax: 0033344556556
e mail: benoit.hazebrouck@ineris.fr

Ester HEATH
IJS
Jamova
SLO - 1000 Ljubljana
tel. :+386 1 477 3584 - fax: +386 1 251 93 85
e mail: ester.heath@ijs.si

Louise HEATHWAITE
Lancaster University
Centre for Sustainable Water Management
Lancaster
UK - LA1 4YQ Lancaster
tel. :01524510225 - fax:
e mail: louise.heathwaite@lancs.ac.uk

Juliane HOLLENDER
eawag
Überlandstrasse
CH - 8600 Dübendorf
tel. :+41/44 823 5493 - fax: +41/44 823 5471
e mail: juliane.hollender@eawag.ch

Martin HOLT
Ecetoc
Av.E.van Nieuwenhuyse
Bte 6
B - 1160 Brussels
tel. :00 32 2663 3812 - fax: 00 32 2675 3625
e mail: martin.holt@ecetoc.org

Tania HUBER
I.E.S.
JRC – via Enrico Fermi
I – 21020 ISPRA
tel. :+39-0332-785723 - fax: +39-785837
e mail: tania.huber@jrc.it

Cristina JAFFRES
L'Oréal
River Plaza
29 Quai Aulagnier
F - 92600 Asnières
tel. :33 1 47 56 45 62 - fax: 33 1 47 56 72 12
e mail: jaffres@rd.loreal.com

Anders JOHNSON
Swedish Environmental Protection Agency
Blekholmsterrassen 36
S - SE-106 48 Stockholm
tel. :+46-8-698 13 63 - fax: +46-8-698 15 85
e mail: anders.johnson@naturvardsverket.se

Rakesh KANDA
STL
STL Reading
Unit 27 Robert Cort Estate
Britten R
UK - RG2 OAU Reading
tel. :0118 9214821 - fax: 0118 9214825
e mail: rakesh.kanda@stl-ltd.com

Dimitrios KOTZIAS
IHCP
JRC - Via Enrico Fermi
I - 21020 ISPRA
tel. :+39-0332-785950 - fax: +39-0332-789453
e mail: dimitrios.kotzias@cec.eu.int

_pela KOZAK LEGISA
Environmental Agency of the Republic of Slovenia
Vojkova 1b
SLO - SI-1000 Ljubljana
tel. :+386 1 478 4027 - fax: +386 1 478 4052
e mail: spela.kozak-legisa@gov.si

Zoltan KRASCSENITS
Water Research Institute
Nabr.L.Svobodu 5
SK - 812 49 Bratislava
tel. :00421 2 59343447 - fax: 00421 2 54418047
e mail: krascsenits@vuvh.sk

Frank LAME
TNO Built Environment and Geosciences
P.O. Box 80015
NL - 3508 TA Utrecht
tel. :+31 30 2564717 - fax: +31 30 2564680
e mail: frank.lame@tno.nl

Katherine LANGFORD
NIVA
Brekkeveien 19,
PO Box 173,
Kjelsås
N - NO-0411 Oslo
tel. :+47 22185321 - fax:
e mail: kla@niva.no

Peter LEPOM
Fedarl Environment Agency
Bismarckplatz 1
D - 14193 Berlin
tel. :+49-30-8903-2689 - fax: +49-340-2105-5476
e mail: peter.lepom@uba.de

Heather LESLIE
IVM
De Boelelaan 1087
NL - 1081 HV Amsterdam
tel. :+31 20 598 9597 - fax: +31 20 598 9553
e mail: heather.leslie@ivm.falw.vu.nl

Dean LEVERETT
UK Environment Agency
Biological Effects Laboratory, 4 The Meadows, 500
Wate
UK - PO7 7XX Waterlooville
tel. :01903 832666 - fax: 02392 233869
e mail: dean.leverett@environment-agency.gov.uk

Igor LISKA
ICPDR
Vienna International Center, D0443, P.O.Box

A - 1400 Vienna
tel. :+431260604403 - fax: +431260605895
e mail: Igor.Liska@unvienna.org

Hans LOEKKE
Dir. of Research Department, Nat. Env. Research Inst. (NERI)
Vejloseove 25, P.O. Xox 314
DK - 8600 SILKEBORG
tel. :+45 89 201482 - fax: +45 89 20 14 13
e mail: hlo@dmu.dk

Robert LOOS
Institute for Environment and Sustainability
JRC - TP 290
I - 21020 Ispra
tel. :+39-0332786407
e mail: robert.loos@jrc.it

Daniela LUD
Ecoappraisal-Tauw Group
Piazza Leonardo da Vinci

I - 20133 Milano
tel. :0039-02-26626157 - fax:
e mail: daniela.lud@tauw.nl

Andrea LUPTAKOVA
Slovak Hydrometeorological Institute
Jeséniova
SK - 833 15 Bratislava
tel. :+421259415243 - fax:
e mail: andrea.luptakova@shmu.sk

Emira MALJEVIC
Environmental Control Lab. Republic
Hydrometeorological Service of Serbia
Kneza Viseslava 66
Y - 1100 BELGRADE
tel. : - fax:
e mail: e.maljevic@hidmet.sr.gov.yu

Corinne MANDIN
INERIS
Parc Technologique ALATA BP2

F - 60550 Verneuil en Halatte
tel. :+33 3 44 55 61 77 - fax: +33 3 44 55 68 99
e mail: corinne.mandin@ineris.fr

Jaakko MANNIO
Finnish Environment Institute SYKE
P.O. Box 140
(Mechelininkatu 34a)
FIN - 00251 Helsinki
tel. :+358-9-403 000 - fax: +358-9-403 00490
e mail: jaakko.mannio@environment.fi

Antonio MARCOMINI
University of Venice
Calle Larga S. Marta
I - 30123 Venice
tel. :+39-0412348548 - fax: +39-0412348584
e mail: marcom@unive.it

Michael McLACHLAN
Stockholm University
Krossbacken 35
S--18770 Tääby
tel. :+46 8 674 7228 - fax:
e mail: michael.mclachlan@itm.su.se

Tomá_ MICANIK
Water Research Institute T.G.M.
Macharova (street)
Ostrava (city)
CZ - 70030 Ostrava
tel. :+420 596 134 181 - fax: +420 596 134 180
e mail: tomas_micanik@vuv.cz

Zaharie MOLDOVAN
National Institute of Research and Development
for Isotopic and
Street Donath
RO - 400293 Cluj-Napoca
tel. :+40-264-584037 - fax: +40-264-420042
e mail: zaha@oc1.itim-cj.ro

Margreet MONS
Kiwa Water Research
PO Box 1072
NL - 3430 BB Nieuwegein
tel. :+31306069657 - fax: +31306061165
e mail: margreet.mons@kiwa.nl

Anne MORIN
INERIS
PARC TECHNOLOGIQUE ALATA
RUE JACQUES TAFANEL
BP
F - 60550 VERNEUIL EN HALATTE
tel. :33 3 44 55 66 32 - fax: 33 3 44 55 68 72
e mail: anne.morin@ineris.fr

Lea MRAFKOVA
SHMU
Jeseniova 17, 83315 Bratislava
SK - 83315 Bratislava
tel. :+421259415225 - fax:
e mail: lea.mrafkova@shmu.sk

Richard OWEN
UK Environment Agency
Block 1, Government Buildings
Burghill Rd
Westbu
UK - BS10 6BF Bristol
tel. :0117 915 6805 - fax:
e mail: richard.owen@environment-agency.gov.uk

Milan PAULOVIC
VÚV Praha
Podbabská 30
160 62 Prague
CZ-160 62 Prague
tel. 00420220197205 fax: 00420220310759
e mail: milan_paulovic@vuv.cz

Willie PEIJNENBURG
RIVM - Laboratory for Ecological Risk Assessment
PO Box 1
NL - 3720 BA Bilthoven
tel. :+31-30-2743129 - fax: +31-30-2744413
e mail: wjgm.peijnenburg@rivm.nl

Mira PETROVIC
CSIC
Jordi Girona 18-26
E - 08034 Barcelona
tel. :34934006100 - fax:
e mail: mpegam@cid.csic.es

Stefano POLOSELLO
CNR-IRSA
via della Mornera
I - 20047 Brugherio
tel. :+39-216941 - fax: +39-0392004692
e mail: polesello@irsa.cnr.it

Véronique POULSEN
BERPC
60-62 rue d'Hauteville
F - 75010 Paris
tel. :+33155078982 - fax:
e mail: Veronique.Poulsen@berpc.fr

Alfred RAUCHBUECHL
Federal Agency for Water Management
Marxergasse
A - 1030 Wien
tel. :+43 1 2633474 17 - fax: +43 1 2533474 15
e mail: alfred.rauchbuechl@baw.at

Marina RICCI
EC-JRC-IRMM
Retieseweg
B - 2440 Geel
tel. :+32-14-571-962 - fax: +32 (0)14 571548
e mail: marina.ricci@cec.eu.int

Rod ROBINSON
NPL
Queens Road
UK - TW11 0LW Teddington
tel. :02089437146 - fax:
e mail: rod.robinson@npl.co.uk

Heinz RUEDEL
Fraunhofer IME
Institute for Molecular Biology and Applied Ecolog
D - 57392 Schmallenberg
tel. :+49 2972 302 301 - fax:
e mail: heinz.ruedel@ime.fraunhofer.de

Christen SACHSE-VASQUEZ
RIFM
50 Tice Blvd
3rd Floor
USA - 07677 Woodcliff Lake
tel. :201-689-8089 - fax:
e mail: csachse-vasquez@rifm.org

Martin SCHLABACH
NILU
POBox 100
N-2027 Kjeller
tel. :+47 63898213 - fax:
e mail: msc@nilu.no

Gabriele SCHOENING
European Environment Agency
Kongens Nytorv

DK - 1050 Copenhagen K
tel. :+4533367265 - fax: +4533367151
e mail: gabi.schoening@eea.eu.int

Marca SCHRAP
RWS RIZA
P.O. Box 17
NL - 8200 AA Lelystad
tel. :31 (0)320298770 - fax:
e mail: s.schrap@riza.rws.minvenw.nl

David SCHWESIG
IWW
Rhenish-Westfalian Institute for Water
Moritzstra
D - 45476 Muelheim an der Ruhr
tel. :+49 208 40303 217 - fax: +49 208 40303 80
e mail: d.schwesig@iww-online.de

Katarina SILHAROVA
Water research institute
Nabr.L.Svobodu 5

SK - 812 49 Bratislava
tel. :00421 2 59343435 - fax: 00421 2 54418047
e mail: silharova@vuvh.sk

Jaroslav SLOBODNIK
Environmental Institute
Okruzna
SK - 97241 Kos
tel. :+421465420719 - fax: +421465430917
e mail: slobodnik@ei.sk

Joan STAEB
min of transport and water management RWS-RIZA
P.O. Box 17
NL-8200 AA Lelystad
tel. :31-320-298657 - fax:
e mail: j.staeb@riza.rws.minvenw.nl

Anne STRUGEON
BRGM
3 AVENUE CLAUDE GUILLEMIN
BP 36009

F - 45060 ORLEANS CEDEX 2
tel. :33 0 2 38 64 34 16 - fax: 33 0 2 38 64 37 11
e mail: a.strugeon@brgm.fr

Andy SWEETMAN
Lancaster University
Environmental Science Department
Lancaster Univer
UK - LA1 4YQ Lancaster
tel. :+44 1524 593300 - fax: +44 1524 593985
e mail: a.sweetman@lancaster.ac.uk

Reet TALKOP
Ministry of the Environment of Estonia
Narva mnt 7A, 15172 Tallinn Estonia
EST - 15172 Tallinn
tel. :3726262975 - fax: 3726262801
13065363
e mail: Reet.Talkop@envir.ee

Thomas TERNES
Bundesanstalt für Gewässerkunde
Am Mainzer Tor
D - 56068 Koblenz
tel. :0049 261 13065560 - fax: 0049 261

e mail: ternes@bafg.de

Norbert THEOBALD
Bundesamt für Seeschifffahrt und
Hydrographie
Bernhard-Nocht-Str. 78
Hamburg
D - 20359 Hamburg
tel. :+49(0)40 3190 3340 - fax: +49(0)40 3190 5033
e mail: norbert.theobald@bsh.de

Kevin THOMAS
NIVA
Brekkeveien 19, Kjelsås
Rotherham,
N - 0411 Oslo
tel. :+47 2218 5100 - fax:
e mail: kth@niva.no

K. Clive THOMPSON
ALcontrol Laboratories
Templeborough House, Mill Close,

South
UK - S60 1BZ Rotherham
tel. :+44 1709 841078 - fax: +44 1709 841011
e mail: clive.thompson@alcontrol.co.uk

Céline TIXIER
IFREMER
Dpt Biogeochemistry - Ecotoxicology
Bratislava,
Lab. Biogeoch
F - 44311 NANTES Cedex 3
tel. :0033240374134 - fax:
e mail: Celine.Tixier@ifremer.fr

Peter TOLGYESSY
VUVH
VUVH, Nabr. arm. gen. L. Svobodu 5,

SK - 81249 Bratislava
tel. :+421259343466 - fax: +421254418047
e mail: peter_tolgyessy@vuvh.sk

Renaud TUTUNDJIAN
Cemagref
Cemagref - Groupement de Lyon
3 bis quai Chauveau
F - 69336 Lyon
tel. :33 (0) 4 72 20 87 41 - fax: 33 (0) 4 78 47 78 75
e mail: tutundjian@lyon.cemagref.fr

Sofie VAN VOLSEM
flemish environmental agency
a. van de maelestraat

B - 9320 erembodegem
tel. :+32 53 72 65 75 - fax: +32 53 72 66 30
e mail: s.vanvolsem@vmm.be

Dolf VAN WIJK
Euro Chlor
Av. E. van Nieuwenhuyse
B-1160 Brussels
tel. :32-2-6767370 - fax: 32-2-6767241
e mail: dvw@cefic.be

Jurgen VOLZ
Kiwa Water Research
P.O.Box 1072
NL - 3430 BB Nieuwegein
tel. :+31-306069597 - fax: +31-306061165
e mail: jurgen.volz@kiwa.nl

Michael WALDOCK
Cefas
Barrack Rd
The Nothe
Weymouth
UK - dt4 9pp Dorset
tel. :44 1305 206669 - fax: 44 1305 206601
e mail: m.j.waldock@cefas.co.uk

David WESTWOOD
Environment Agency
56 Town Green Street
Rothley
Leicestershire
LE7
UK - LE7 7NW Leicester
tel. :08708 506 506 - fax: 0116 237 5005
e mail:
David.westwood@environment-agency.uk

Leah WOLLENBERGER
Federal Environment Agency
Wörlitzer Platz

D - 06813 Dessau
tel. :+49-340-21032302 - fax: +49-340-21042302
49
e mail: leah.wollenberger@uba.de

Roberto ZUBIAGA
LABEIN-TECNALIA
C/Geldo-Parque Tecnológico de Bizkaia.
Edificio 7
E - 48160 DERIO (Bizkaia)
tel. :00 34 94 607 33 00 - fax: 00 34 94 607 33

e mail: zubiaga@labein.es