ScorePP - Abstracts from the dissemination workshop on Evaluating Source Control Options for Reducing Emissions of Micropollutants, Quebec City, Canada, Monday 5 and Tuesday 6 October 2009

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Publication date:
2009

Document Version
Publisher's PDF, also known as Version of record

SIXTH FRAMEWORK PROGRAMME

ScorePP

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21 January 2010:
This version has been revised in the sense that the author lists for several abstracts have been updated. Nothing else.

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More information: www.scorepp.eu

13.00

Effects of Pharmaceuticals in the Environment

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Pharmaceuticals and personal care products (PPCPs) have been detected at very low concentrations in municipal wastewater effluents (MWWEs) and rivers in North America and Europe. Pharmaceutical drugs are designed to have therapeutic (biological) effects and have been well researched in mammals; however effects on non-target organisms are less studied. Little is known about the environmental persistence and fate of most PPCPs, and since aquatic organisms are chronically exposed to these compounds, there is potential for multigenerational exposure. Review of the literature and some recent research suggest possible effects on non target organisms for several of these compounds. Effects in lab organisms at low concentrations (low ug/L or below) are overviewed for several PPCPs: antidepressants (fluoxetine, fluvoxamine), an anti-inflammatory (diclofenac), and a synthetic hormone (ethinylestradiol). These laboratory data and thresholds for effects are compared to monitoring data for these compounds in MWWEs, rivers and waters of the Great Lakes. The review suggests that some of these PPCPs appear to cause effects in aquatic organisms exposed in the laboratory at concentrations of low ng/L to low ug/L, and that some MWWEs in the Great Lakes discharge concentrations of PPCPs within these ranges. Thresholds for effects of synthetic estrogen are very low (ng/L), while other PPCPs have higher thresholds (ug/L and above) for effects in fish and invertebrates. There is evidence of effects with fish exposure to MWWEs in the lab and field. For ethinylestradiol there is enough data for some agencies or groups to propose water quality guidelines. However, for most of these PPCP compounds and mixtures we require more studies of biota in the field and lab to assess potential effects.

13.20

Regulation of priority substances in a European perspective. The Water Framework Directive. Industrial point of view

André Lecloux
Envicat, Belgium

After a brief review of the objective of the EU Water Framework Directive (WFD) and of its daughter Directive on Environmental Quality Standards (EQS), this paper will present some key elements of interest to the chemical industry related to the implementation of these Directives.
As the good chemical status is based on monitoring, it is essential that the concentrations measurements take place at representative points of the water body, outside a "mixing zone" that should be defined to avoid the confusion between the Emission Limit Values (ELV) set in the permit and the EQS value.
The phase out of certain substances foreseen in the Directives implies to consider the substitution process. This should be driven by the "fit to use" approach and based on a comparative risk assessment. The complete phase out of certain substances is technically non feasible either because they are unavoidable by-products of key industrial processes or because there is currently no acceptable substitute for some of their applications. Several examples are given to illustrate these points.
The chemical industry did not wait for the WFD to implement voluntary programmes of emission reduction and of substitution of substances in industrial applications. Examples and achievements of such initiatives are shortly reviewed.
Finally some thoughts are given on how the industry could react to the market changes induced by the legislation and by the public perception.

13.40

The US Regulations and GIS Applications to Stormwater Pollution

Mi-Hyun Park
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Stormwater runoff is frequently contaminated with pollutants common to developed areas, including fertilizers, pesticides and sediments. In the United States, the discharge of stormwater is regulated under the Federal Clean Water Act (CWA). Under the CWA, the discharge of stormwater is subject to the National Pollutant Discharge Elimination System (NPDES) permit program. The CWA also requires the development and implementation of Total Maximum Daily Loads (TMDL). In response, a total of nine TMDLs were adopted for the waters in Los Angeles, CA. To comply with TMDL requirements, voters in the City of Los Angeles approved Proposition O: the Clean Water, Ocean, River, Beach, and Bay Stormwater Cleanup Measure. It authorized the City of Los Angeles to spend $500 million on stormwater clean-up projects. The effectiveness of Proposition O projects was evaluated using a pollutant loading model and a GIS model. This evaluation has shown that no single project results in complete TMDL compliance, although these efforts can make important contributions to increasing the water supply and meeting the TMDLs.

14.00

Legal frameworks and occurrences of micropollutants in Quebec

Robert Tétreault and Hélène Tremblay
Ministère du Développement Durable, de l'Environnement et des Parcs, Québec, Canada

15.30

Improving monitoring campaigns – a case study

Kemi Seriki
Anjou Recherche, France

The presentation on Improving Monitoring campaigns will give an overview of the steps pursued to conduct a monitoring campaign on priority pollutants in one of the four case cities of the Source Control Options for Reducing Emission of Priority Pollutants. Choices of sampling points, matrixes and sampling frequencies will be explained. Encountered difficulties will be exposed and choices in extraction techniques will be mentioned. The presentation will communicate results obtained in different matrixes of the case city and compare these with Environmental Quality Standards edited by the European Commission in December 2008 in order to identify problematic priority pollutants for the city.

15.50

New Opportunities for the Analysis of Emerging Contaminants

Sébastien Sauvé, Paul Fayad, Liza Viglino and Pedro Segura
Université de Montréal, Canada

Today's society is consuming more and more pharmaceuticals drugs. We are also becoming increasingly aware that those products are being released into the environment, to an extent which is still often only vaguely quantified and with largely unknown effects upon wildlife and human health. We are developing different techniques for the liquid chromatography (LC) and tandem mass spectrometry (MS/MS) analysis of various pharmaceuticals, personal care products and pesticides in wastewaters, surface waters and drinking waters. We have automated the solid phase extraction (SPE) to have fully online methods for many of those emerging contaminants; this approach currently allows us to do an analysis, including sample preparation, in about 15 min/sample using SPE-LC-MS/MS. We are also developing tools to bypass liquid chromatography and use a laser diode thermal desorption (LDTD) interface. This methods allows the fast volatilization of analytes directly into an ionization chamber (APCI) and quantification in the the MS/MS within a sample turnover below 30 sec. Those two approaches are definitely of great benefits for resources savings, but they have certain limitations, some elution/chromatography compatibility issues with SPE-LC-MS/MS, and a somewhat restricted number of analyte amenable to the LDTD method and lower performance for detection limits.

16.10

The ScorePP approach to predict releases of priority pollutants from urban sources.

Hans-Christian Holten Lützhøft[1], Erica Donner[2], Veerle Gevaert[3], Webbey De Keyser[3], Tonie Wickman[4], Matej Cerk[5], Eva Eriksson[1], André Lecloux[6] and Anna Ledin[1]
[1]: DTU Environment, Denmark; [2]: Middlesex University, UK; [3]: Ghent University, Belgium; [4]: Stockholm Stad, Sweden; [5]: University of Ljubljana, Slovenia; [6]: Envicat, Belgium

The priority substances included in the EU Water Framework Directive shall in the course of 20 years obey environmental quality standards set for EU watercourses. The substances classified as hazardous substances shall furthermore be phased out of discharges. The aim of this study was to compile knowledge about the releases from point, diffuse and accidental sources to urban pollution of these PPs to be able to reduce or cease the emissions of said PPs. The Emission String (ES) concept was developed, which identifies an emission source by the particular pollutant being emitted (CAS #), the (economic) activity resulting in the emission (NACE), and the specific emission process (NOSE) during which the pollutant release takes place, all of which are connected to an Urban Structure descriptor, a Release Pattern descriptor and a Release Factor.
This classification approach was tested on a range of PPs listed in the WFD. Not a wealth of release factors connected to these sources could be found in the open literature, thus data like emission loads were also compiled. Of the 902 ESs established only 154 ESs were associated with release factors. No data were found for 578 ESs. Data on loads were established for 118 ESs, leaving 54 ESs assigned various information. In relation to the urban structure descriptor the majority of the ESs are related to manufacturing or production facilities, but other large source categories are households, waste disposal activities, transport, construction and agriculture, of which many can be classified as diffuse sources. Analysing the data on road transport it is seen that seven PPs are released due to vehicular combustion and wear and tear processes. Dependent on the substance and the activity or process, the releases account for between the low kg range for nickel and up to hundreds of tonnes for benzene and benzo(a)pyrene.

8.30

Visualisation of indicators of pollution sources and loads

Matej Cerk
University of Ljubljana, Slovenia

The main problem when trying to identify pollution sources is lack of data. Both measured and estimated. Therefore a common framework for visualization and identification of indicators was made. It is based on literature data compiled according to the Emission String concept. Emission strings are combination of standard classification codes: The CAS# for the priority pollutants (PP), the NACE code for economic activity and the NOSEP code for the emitting process. The Emission String data is related to an Emission string type, which represent a geographical object type (facilities, households, gardens, roads, etc.) and the Emitting Compartment, which represents where pollution is emitted to (air, water direct, water indirect, etc.).
Emission String data could be applied to any city by combining it with an Adaptation Matrix where the Adaptation Matrix represents localized data about geographic entities (legal entities, road system, railroad systems, etc.) and release estimation related data (release factors, release factor multipliers, release patterns etc.). The output of the combination is GIS data that can be presented on a map. The output map type depends on the Adaptation Matrix complexity and availability of data.
When less data is available, then the GIS data can be presented as visualization of indicators of pollution. Indicators represent GIS objects (roads, facilities, railroads) on the map where there is a chance of pollution.

When more data is available the GIS data can represent estimated loads of PP for that city. Loads are calculated from the release factors and release multipliers provided from both literature and specific city data.

8.50

(Un)successful Strategies to Reduce Emissions of Microconstituents

Hugh Monteith
Hydromantis Inc., Hamilton, ON L8P 4R5

Microconstituents enter wastewater treatment facilities from a variety of sources, including consumption of pharmaceutical and personal care products, and industrial wastewater effluents. During wastewater treatment, they may be biodegraded, sorbed onto solids, or pass through treatment in the final effluent (emissions to air is not usually a consideration for microconstituents.

An overall reduction in emissions of these compounds to the environment must rely on biodegradation by the wastewater microbial biomass. For compounds that are readily biodegradable (e.g. nonylphenol ethoxylates, estrogenic hormones), adoption of a longer solids retention time is a viable strategy for improving the contribution of biodegradation for reducing contaminant emissions. When compounds are both non-biodegradable and hydrophobic (e.g., synthetic musk fragrances, polybrominated diphenyl ethers), however, modeling suggests that increasing the solds retention time only results in more of these compounds being sorbed onto the solids, with less discharged in the treated effluent. The longer SRT strategy thus only causes a transfer of the contaminants to a different phase, with no net improvement in emission reduction.

The presentation will discuss the above issues with illustrations of modeling experiences in trying to improve the ability of wastewater treatment plants to reduce emissions of microconstituents in all environmental compartments.

9.10

Dynamic transport and fate models for microconstituents in integrated urban wastewater systems

Lorenzo Benedetti[1], Luca Vezzaro[2], Veerle Gevaert[1], Webbey De Keyser[1], Frederik Verdonck[1], Bernard De Baets[1], Ingmar Nopens[1], Peter Vanrolleghem[3] and Peter Steen Mikkelsen[4]

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The modelling of urban water quality (i.e. wastewater, stormwater) is a growing issue in water management. New regulations stress the importance of estimating the loads and the fate of micro-pollutants (MPs) in the urban water cycle. The models available to simulate the transport and removal of "traditional" pollutants such as overall organic pollution, nutrients and suspended solids in the different components of the urban water system (i.e. sewer network, stormwater treatment units, wastewater treatment plant, receiving waters) were extended with processes affecting the fate of MPs (i.e. physical, chemical and biological) depending on the compound's inherent properties. This paper describes the modelling approach and some possible applications of these unit process models including their combination to simulate urban water systems by means of three examples, developed within the EU project SCOREPP.

9.30

Urban Source Control Options from a Multimedia Perspective

Miriam Diamond, Matt Robson, Lisa Melymuk, Susan Csiszar and Amanda Giang
University of Toronto

The populations of cities continue to grow at rates faster than total population growth. To support the myriad activities that occur in cities, cities drawn in and store vast amounts of food, resources and materials from a wide geographic hinterland. As a consequence, the stock of materials and products in cities is enormous and growing, particularly since our production and use of resources in wealthy countries far exceeds that of population growth. Embedded within the large mass of products and materials of a city is a very small fraction which is micropollutants, and of this stock, an even smaller fraction is inadvertently released into the city's environment. As such, in many cities of wealthy countries, emissions from diffuse releases of micropollutants from materials and products can exceed those from point source releases.

Micropollutants released from the city enter a highly disturbed physical system characterized by impervious surfaces and an altered hydrologic regime. The impervious surfaces, which are coated with an atmospherically derived thin surface film, facilitate the mobility of atmospherically deposited micropollutants either back to air or to surface waters. Consequently, a unit release of a micropollutant in a city is far more mobile than the same unit released into a forested area.

These points are discussed with respect to PCBs (polychlorinated biphenyls) in Toronto. We have estimated the stock of in-use and in-storage which is highest in the dense urban downtown area. Of the stock, <0.01% is released annually. This release is consistent with urban-rural gradients of PCBs in soil, stream water, air and window films. The releases of PCBs can return to us in our food supply since PCBs are persistent and bioaccumulative in agricultural and aquatic food webs.

If we are to control the release of many micropollutants from our cities and our subsequent exposure via air, water and food, then we must restrain our use of these chemicals in our activities and our built environment.

11.00

Physically-validated CFD-modeling of processes for fate of particles, nutrients, and metals from urban rainfall-runoff

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Control of rainfall-runoff particulate matter (PM) and aqueous pollutant loads is challenging; in part due to PM hetero-dispersivity, interactions between aqueous and particulate phases and hydrodynamics. Such challenges and the expense associated with resolving such challenges have led to the relatively common historical examination of a spectrum of urban pollutant control systems as black-box systems. This study couples the principles of computational fluid dynamics (CFD) and physical modeling to examine the fate of PM and aqueous pollutants of these systems subject to dilute multiphase flows, typical of rainfall-runoff, within computationally reasonable limits, to a scientifically acceptable degree of accuracy. Post-processing the CFD predictions provides an in-depth insight into the mechanistic behavior of these unit operations by means of three dimensional (3-D) hydraulic profiles, pollutant breakthrough profiles and PM trajectories. Results also demonstrate that without frequent management of pollutant loads in such systems that scour or pollutant elution will result. Sustainability will ultimately require source control of pollutants, green infrastructure and hydrologic restoration. An emerging pollutant challenge in the USA is the introduction of reclaimed wastewater back onto the urban surface with commensurate volumetric benefits yet chemical legacy concerns.

11.20

Behaviour of Water Framework Directive Priority Substances in Stormwater and Greywater Treatment Systems.

Erica Donner[1*], Mike Revitt[1], Eva Eriksson[2], and Lian Scholes[1]
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[2]Department of Environmental Engineering, Technical University of Denmark, Kgs. Lyngby, DK-2800, Denmark

To meet the challenges of the European Water Framework Directive (WFD) the potential for water treatment technologies to limit the release of key pollutants to receiving waters must be assessed. This paper investigates the potential for stormwater best management practices (BMPs) to remove priority substances (PS) and also examines the PS emission control impact of household greywater treatment systems. In both cases, there is a limited availability of treatment efficiency data. Therefore, a systematic unit operating approach has been developed for assessing the comparative pollutant removal potentials of different types of BMPs, and fugacity modelling applications have been used as a surrogate to investigate the likely fate of PS during greywater treatment. The results indicate that infiltration basins and sub surface flow constructed wetlands may be particularly useful for preventing stormwater PS from reaching surface waters. By comparison, technical greywater treatment (not involving land disposal) is unlikely to be of major benefit as a PS emission barrier.

13.00

Socio-economic analysis of source control options

Colette Bessat, José Trouvé and Frédéric David
Estudis, Spain

The main goal of this socio-economic analysis is to assess the feasibility of the source control strategies proposed in the ScorePP project. The socio-economic feasibility assumes that the various end-users could have, at every geographic level, a clear vision and comprehension of a) their situation, b) the economic and financial costs of each strategy at short, middle and long term and c) the potential social, institutional, economic and financial impacts of these strategies on each of the main stakeholders.

The ScorePP study must lead in creating the tools that end-users can use in order to make a proper assessment of their situation. Therefore, this presentation underlines some specificity to consider, whilst designing the questions to answer so that they are taken into account during the decision making process.

This presentation presents in the first part the objectives of the study and in the second part the useful information to understand the problematic of the socio-economic and institutional approach. It will then present information concerning the situation and the issues in term of socio-economic data (global indicators, wastewater treatment costs, investments, reference costs), economic impacts on the main stakeholders and socio-institutional data (mode of management, institutional features, impact on employment).

13.20

The Water Environment Federation's Microconstituent Community of Practice

Joe Cleary
P.E., BCEE, HydroQual Inc. Mahwah, NJ, U.S.A.
Presented by: Hugh Monteith
Hydromantis Inc., Hamilton, ON L8P 4R5

A Microconstituent Community of Practice (COP) was established by members of the Water Environment Federation (Alexandria, VA) in 2005 with the mission of bringing together information on all aspects of microconstituent in wastewater so that the COP can serve as a technical resource for other WEF committees with overlapping interests. It also serves as the bridge from WEF to other like-minded agencies to foster better communications, and to leverage ideas and resources in accomplishing common goals.

The COP fulfils its mission in a variety of ways including webcasts, production of Technical Practice Updates (TPUs), holding a Specialty Conference on microconstituents in wastewater once every two years (the most recent being July 2009), and convening technical sessions at the Annual WEF Technical Exposition and Conference. A number of sessions have been organized for the next WEFTEC in Orlando, FL in mid-October, 2009. Several webcasts have been scheduled in the coming months, including "Microconstituents in the Aquatic Environment: Impacts for Wastewater Utilities" on October 28th (jointly produced with SETAC). Other scheduled webcasts include Microconstituents in Biosolids (December, 2009) and Microconstituents in Water Reuse (early 2010).

This presentation will discuss the COP activities in greater detail.

Membership in the Community of Practice is open to all WEF members, and participation in the COP activities is most welcome.

13.40

Feasibility of treatment options and strategies for limiting releases

Mike Revitt
Middlesex University, UK

The emissions of priority pollutants into the aquatic environment can be reduced at source (e.g. through substitution options, release minimisation, legislation/regulation or voluntary actions) or by the treatment of contaminated effluents (stormwater, greywater, industrial wastewater, municipal wastewater) prior to discharge into receiving waters. This presentation considers an approach by which the relative feasibilities of these two control options can be separately assessed and then how the results can be combined to develop an overall multi-criteria analysis approach to assess emission control strategies. A total of 12 priority pollutants (benzene, DEHP, EDC, nonyl/octylphenols, PBDE, benzo(a)pyrene, hexachlorobenzene, chlorpyrifos, diuron, cadmium, lead and mercury) have been investigated using a scoring system based on identified criteria, indicators and benchmarks for the developed approaches. The interpretation of the scoring system attempts to use a combination of qualitative and quantitative data although in the latter case the existence of data gaps can influence the validity of the results. It is important to recognise that the approach is generic and does not take account of the local context in discriminating between treatment strategies/options. Discussions with case city representatives and members of the project Advisory Steering Board are ongoing to establish criteria weightings that are acceptable to a range of different stakeholders.

14.00

Strategies for controlling emissions of priority pollutants

Eva Eriksson[1], Erica Donner[2], Laura Raggatt[2], Maria Pettersson[3] and Peter Steen Mikkelsen[1], + others

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The European Water Framework Directive (2000/60/EC) commits European Union member states to achieve 'good qualitative and quantitative status' of all surface water bodies by 2015 by implementing specific measures for reducing the emissions of priority substances (PS) and by ceasing or phasing-out the emissions of priority hazardous substances (PHS). The ScorePP project is developing emission control strategies to reduce discharges of PPs into receiving waters on an urban (city) scale as a support to regulatory authorities, water utilities and relevant industries. The applicability of these emission control strategies will subsequently be tested in selected EU case cities and developed semi-hypothetical case cities archetypes.

A 'business-as-usual' baseline has been established based on the extrapolation of existing trends whilst taking into account existing laws and development plans. The emission control strategies were then designed by combining different elements from two types of emission control measures (*mitigation*: substitution, legislation, voluntary initiatives etc and *treatment options*: wastewater and drinking water treatment, stormwater, industrial and domestic on-site treatment etc). Initial results indicate that mitigation measures can be powerful control options. However, due to financial and social costs it is apparent that not all substances can be substituted or phased-out. This indicates the need to also consider advanced end-of-pipe treatment, but as some substances are difficult to treat with existing techniques the need for a combined approach including both mitigation and treatment is evident.

Acknowledgement

"Source Control Options for Reducing Emissions of Priority Pollutants", contract no. 037036, is a project coordinated by the Department of Environmental Engineering (DTU Environment), Technical University of Denmark within the Energy, Environment and Sustainable Development section of the European Community's Sixth Framework Programme for Research, Technological Development and Demonstration. For further information on the project please visit www.scorepp.eu.