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ENVIRONMENTAL Science & Technology

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**EMERGING
CONTAMINANTS**
Special Issue



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News and Features

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What is "emerging?"

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Mislabeled waste in fertilizer leads to a water scandal.

7109 What lurks in cooling towers?

Amoebas infected with pathogenic bacteria are more prevalent in cooling towers than in natural environments.

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Vehicle life-cycle analysis • Farms and forests could store greenhouse gases • Wetlands mask methane • Nanotechnology's risks • Plastic pipes could contaminate water • Recycling cars checks mercury pollution

7110 Composting industrial waste

Solids destined to become fertilizer contain numerous emerging contaminants.

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Pharmaceuticals can persist in the environment, even after a sharp decline in use.

7112 Emerging DBPs in drinking water

A survey of U.S. drinking-water utilities reveals new disinfection byproducts.

7113 PBDEs in Great Lakes fish

Some fish transform the toxic flame retardants.

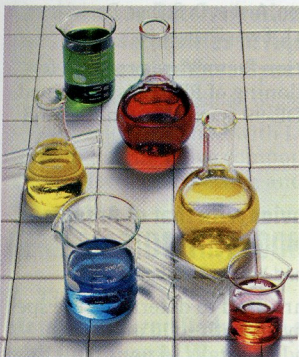
7114 A European union of analytical labs

A network of laboratories for monitoring environmental pollutants sets standards and connects EU researchers.

VIEWPOINT

7115 REACH—The New European Chemicals Law

Uwe Lahl and Katrin Anne Hawxwell



The multitude of laws governing chemicals in Europe will likely be restructured in 2007 into a single law called REACH (Registration, Evaluation, and Authorisation of Chemicals). Lahl and Hawxwell explain why European chemicals laws needed to be restructured, present the key components of REACH, and predict the impacts that the new regulation will have on global chemicals management.

Research

SPECIAL ISSUE: EMERGING CONTAMINANTS

CRITICAL REVIEWS

7122

Campylobacter in Waterfowl and Aquatic Environments: Incidence and Methods of Detection

Hussein H. Abulreesh, Timothy A. Paget, and Raymond Goulder

Healthy waterfowl carry *Campylobacter* and contribute to its occurrence in environmental waters; potential linkages among waterfowl, the environment, and human campylobacteriosis require investigation.

7132

Human Adenoviruses in Water: Occurrence and Health Implications: A Critical Review

Sunny C. Jiang

The state of knowledge on the occurrence, detection technology, and human-health implications of human adenoviruses in water is presented.

7141

Occurrence of *Escherichia coli* O157:H7 and Other Enterohemorrhagic *Escherichia coli* in the Environment

Maite Muniesa, Juan Jofre, Cristina García-Aljaro, and Anicet R. Blanch

Waterborne enterohemorrhagic *E. coli* infections and the role of shiga toxin phages in the horizontal transfer of virulence genes in the environment are reviewed.

7150

Environment Arrays: A Possible Approach for Predicting Changes in Waterborne Bacterial Disease Potential

Jack A. Heinemann, Håkan Rosén, Marion Savill, Sofia Burgos-Caraballo, and Gary A. Toranzos

Can horizontal gene transfer be used as a tool for risk identification and management?

7157

Are There Other Persistent Organic Pollutants? A Challenge for Environmental Chemists

Derek C. G. Muir and Philip H. Howard

The prospects for identifying chemicals in commerce with high predicted bioaccumulation, low rate of biodegradation, and long-range atmospheric transport characteristics are reviewed and discussed.

Supporting information is available free at <http://pubs.acs.org/est>.

Cover: Ken Eward of BioGrafx designed the cover image, which depicts emerging contaminants in the environment.

Online news: Read news first at <http://pubs.acs.org/estnews>.

CHARACTERIZATION OF NATURAL AND AFFECTED ENVIRONMENTS

■ 7167

Poly and Perfluorinated Carboxylates in North American Precipitation

Brian F. Scott, Christine Spencer, Scott A. Mabury, and Derek C. G. Muir

Perfluorocarboxylates are determined in precipitation samples from nine North American sites; detection frequency depends on location, thus indicating possible sources.

■ 7175

Occurrence of a New Generation of Disinfection Byproducts

Stuart W. Krasner, Howard S. Weinberg, Susan D. Richardson, Salvador J. Pastor, Russell Chinn, Michael J. Sclimenti, Gretchen D. Onstad, and Alfred D. Thruston, Jr.

The identity, occurrence, formation, and control of emerging disinfection byproducts of health concern are reported for 12 drinking-water treatment plants in the U.S.

■ 7186

Benzotriazole and Tolyltriazole as Aquatic Contaminants. 1. Input and Occurrence in Rivers and Lakes

Walter Giger, Christian Schaffner, and Hans-Peter E. Kohler

Benzotriazole and tolyltriazole are ubiquitous contaminants in rivers and lakes, because they are very widely applied as anticorrosives, not rapidly biodegradable, and highly mobile in water.

■ 7193

Discharge of Three Benzotriazole Corrosion Inhibitors with Municipal Wastewater and Improvements by Membrane Bioreactor Treatment and Ozonation

Stefan Weiss, Jutta Jakobs, and Thorsten Reemtsma

Benzotriazole and two tolyltriazole isomers are discharged into surface water in microgram-per-liter quantities with conventionally treated or MBR-treated municipal wastewater, except when ozonation is performed.

7200

Occurrence and Fate of Barbiturates in the Aquatic Environment

Manuela Peschka, Jan P. Eubeler, and Thomas P. Knepper

Because of their recalcitrance, barbiturates possibly leaching from landfills or recent industrial production can be detected in groundwater and surface water in Germany.

■ 7207

Survey of Organic Wastewater Contaminants in Biosolids Destined for Land Application

Chad A. Kinney, Edward T. Furlong, Steven D. Zaugg, Mark R. Burkhardt, Stephen L. Werner, Jeffery D. Cahill, and Gretchen L. Jorgensen

Trace organic wastewater contaminants are found in high concentrations in nine biosolids, which may be important sources of these compounds to terrestrial and aquatic environments.

ENVIRONMENTAL PROCESSES

■ 7216

Kinetics of Oxytetracycline Reaction with a Hydrous Manganese Oxide

Kennedy F. Rubert, IV and Joel A. Pedersen

The degradation of oxytetracycline by $MnO_2(s)$ is facile and exhibits pronounced pH dependence.

■ 7222

Oxidation of Sulfonamide Antimicrobials by Ferrate(VI) [$Fe^{VI}O_4^{2-}$]

Virender K. Sharma, Santosh K. Mishra, and Nasri Nesnas

Kinetics of the reactions between ferrate(VI) and sulfonamide antimicrobials are determined as a function of pH and temperature, and ferrate(VI) is shown to remove sulfamethoxazole in water.

■ 7228

Reaction Kinetics and Transformation of Carbadox and Structurally Related Compounds with Aqueous Chlorine

Amisha D. Shah, Jae-Hong Kim, and Ching-Hua Huang

Interactions of the veterinary antibacterial carbadox with aqueous chlorine show uniquely high reactivity of the hydrazone linkage and little impact on the biologically active *N*-oxide moieties.

■ 7236

Water Hardness as a Photochemical Parameter: Tetracycline Photolysis as a Function of Calcium Concentration, Magnesium Concentration, and pH

Jeffrey J. Werner, William A. Arnold, and Kristopher McNeill

The photochemical loss of aqueous tetracycline is described on a per-species basis, taking into account protonation state and binding to calcium and magnesium cations.

■ 7242

Occurrence and Fate of the Cytostatic Drugs Cyclophosphamide and Ifosfamide in Wastewater and Surface Waters

Ignaz J. Buerge, Hans-Rudolf Buser, Thomas Poiger, and Markus D. Müller

The two oxazaphosphorines, persistent in WWTPs and only slowly degraded in natural waters, are detected in Swiss surface waters at subnanogram-per-liter concentrations.

■ 7251

Sorption of Perfluorinated Surfactants on Sediments

Christopher P. Higgins and Richard G. Luthy

Sorption of anionic perfluorochemical surfactants to sediments is controlled by both hydrophobic and electrostatic effects.

■ 7257

Attenuation of Wastewater-Derived Contaminants in an Effluent-Dominated River

Lorien J. Fono, Edward P. Kolodziej, and David L. Sedlak

Concentrations of wastewater contaminants decrease by 60–90% through biotransformation and photolysis during a 2-week transit time in an effluent-dominated section of the Trinity River.

7263

Partitioning and Bioaccumulation of PBDEs and PCBs in Lake Michigan

Summer S. Streets, Scott A. Henderson, Amber D. Stoner, Daniel L. Carlson, Matt F. Simcik, and Deborah L. Swackhamer

The first reported bioaccumulation factors are provided for PBDEs from water to fish, partitioning of PBDEs is examined, and the biotransformation of BDE-99 is explored in the food web of Lake Michigan.

■ 7270

Comparison of Antimony Behavior with that of Arsenic under Various Soil Redox Conditions

Satoshi Mitsunobu, Teppei Harada, and Yoshio Takahashi

XAFS spectrometry and HPLC are used to determine the speciation of Sb and As, respectively, in both solid and water phases under various redox conditions.

■ 7277

Sorption of Sb(III) and Sb(V) to Goethite: Influence on Sb(III) Oxidation and Mobilization

Ann-Kathrin Leuz, Hermann Mönch, and C. Annette Johnson

Adsorption of Sb(III) on Fe hydroxides over a wide pH range may be a major pathway for the oxidation and release of Sb(V).

ENVIRONMENTAL MODELING

■ 7283

Prioritization of Pesticide Environmental Transformation Products in Drinking Water Supplies

Chris J. Sinclair, Alistair B. A. Boxall, Simon A. Parsons, and Miles R. Thomas

Formation, mobility, persistence, and toxicity are used to prioritize pesticide transformation products that may pose the greatest risk to drinking-water sources.

■ 7290

Modeling the Formation of *N*-Nitrosodimethylamine (NDMA) from the Reaction of Natural Organic Matter (NOM) with Monochloramine

Zhuo Chen and Richard L. Valentine

NDMA is formed from NOM at a rate proportional to its oxidation by monochloramine.

■ 7298

Predicting the Partitioning Behavior of Various Highly Fluorinated Compounds

Hans Peter H. Arp, Christian Niederer, and Kai-Uwe Goss

Various models for predicting the surface adsorption, vapor pressure, air/water partitioning, and octanol partitioning of highly fluorinated compounds are evaluated with experimental data.

ENVIRONMENTAL MEASUREMENTS METHODS

■ 7305

Quantitative Determination of 1,4-Dioxane and Tetrahydrofuran in Groundwater by Solid Phase Extraction GC/MS/MS

Carl Isaacson, Thomas K. G. Mohr, and Jennifer A. Field

1,4-Dioxane and tetrahydrofuran are quantitatively determined in chlorinated-solvent-contaminated groundwater by solid-phase (activated-carbon membrane) extraction and GC/MS/MS.

■ 7312

Analysis of Pharmaceuticals in Water by Isotope Dilution Liquid Chromatography/Tandem Mass Spectrometry

Brett J. Vanderford and Shane A. Snyder

LC/tandem MS measures the concentrations of pharmaceuticals in the environment; isotope dilution is used to compensate for extraction losses and matrix effects.

■ 7321

Simultaneous Determination of Psychoactive Drugs and Their Metabolites in Aqueous Matrices by Liquid Chromatography Mass Spectrometry

Daniela Hummel, Dirk Löffler, Guido Fink, and Thomas A. Ternes

A multiresidue method with LC/tandem MS detection developed for psychoactive compounds reveals their occurrence in wastewater, surface water, and drinking water.

REMEDIATION AND CONTROL TECHNOLOGIES

■ 7329

Metal-Catalyzed Reduction of *N*-Nitrosodimethylamine with Hydrogen in Water

Matthew G. Davie, Martin Reinhard, and John R. Shapley

Catalytic reduction of *N*-nitrosodimethylamine with various metals and hydrogen gas shows potential as a remediation method for contaminated groundwater and drinking water.

7336

Effect of Process Variables and Natural Organic Matter on Removal of Microcystin-LR by PAC-UF

Jungju Lee and Harold W. Walker

Ultrafiltration coupled with activated-carbon adsorption (PAC-UF) effectively removes microcystin-LR from water; the extent of removal depends on activated-carbon type and dosage as well as membrane composition.

■ 7343

Use of Reverse Osmosis Membranes to Remove Perfluorooctane Sulfonate (PFOS) from Semiconductor Wastewater

Chuyang Y. Tang, Q. Shiang Fu, A. P. Robertson, Craig S. Criddle, and James O. Leckie

A promising and effective treatment technology is described that uses a membrane separation process for removal of PFOS from industrial wastewater.

7350

Fluorochemical Mass Flows in a Municipal Wastewater Treatment Facility

Melissa M. Schultz, Christopher P. Higgins, Carin A. Huset, Richard G. Luthy, Douglas F. Barofsky, and Jennifer A. Field

Mass flows of selected fluorochemicals are determined during each stage of wastewater and sludge treatment in a field study conducted at a municipal plant.

■ 7358

Occurrence and Fate of Organic Contaminants during Onsite Wastewater Treatment

Kathleen E. Conn, Larry B. Barber, Gregory K. Brown, and Robert L. Siegrist

Organic-contaminant composition of onsite-generated wastewater varies as a function of source characteristics, and removal is enhanced by additional aerobic treatment after anaerobic pretreatment.

7367

Enhanced Biodegradation of Iopromide and Trimethoprim in Nitrifying Activated Sludge

Angela L. Batt, Sungpyo Kim, and Diana S. Aga

The biodegradation of iopromide and trimethoprim are investigated as well as the formation of their metabolites in nitrifying activated sludge.

7374

Uptake of *N*-Nitrosodimethylamine (NDMA) from Water by Phreatophytes in the Absence and Presence of Perchlorate as a Co-Contaminant

Dawit D. Yifru and Valentine A. Nzengung

Uptake of NDMA from water by poplar and willow trees in the absence and presence of perchlorate as a cocontaminant is investigated.

■ 7381

Removal of Natural Steroid Hormones from Wastewater Using Membrane Contactor Processes

Joshua L. Cartinella, Tzahi Y. Cath, Michael T. Flynn, Glenn C. Miller, Kenneth W. Hunter, Jr., and Amy E. Childress

Membrane distillation and forward osmosis are evaluated; both processes, especially membrane distillation, provide very high retention of estrone and 17 β -estradiol.

■ Supporting information is available free at <http://pubs.acs.org/est>.
▶ This issue contains a news story about this research.

7387

Life-Cycle Effects of Single-Walled Carbon Nanotubes (SWNTs) on an Estuarine Meiobenthic Copepod

Ryan C. Templeton, P. Lee Ferguson, Kate M. Washburn, Wally A. Scrivens, and G. Thomas Chandler

Exposure of SWNTs and their manufacturing byproducts to an estuarine copepod elicits size-dependent toxic responses.

7394

Stable Colloidal Dispersions of C₆₀ Fullerenes in Water: Evidence for Genotoxicity

Alok Dhawan, Julian S. Taurozzi, Alok K. Pandey, Wenqian Shan, Sarah M. Miller, Syed A. Hashsham, and Volodymyr V. Tarabara

Stable aqueous suspensions of colloidal C₆₀ fullerenes prepared by prolonged mixing and solvent-exchange methods are shown to cause damage in human lymphocyte DNA.

7402

Comparative Ecotoxicological Hazard Assessment of Beta-Blockers and Their Human Metabolites Using a Mode-of-Action-Based Test Battery and a QSAR Approach

Beate I. Escher, Nadine Bramaz, Manuela Richter, and Judit Lienert

β-Blockers exhibit a specific mode of action in algae, and QSAR modeling reveals that the algal toxicity is decreased after metabolism in humans.

7409

Aquatic Toxicity of Nine Aircraft Deicer and Anti-Icer Formulations and Relative Toxicity of Additive Package Ingredients Alkylphenol Ethoxylates and 4,5-Methyl-1H-benzotriazoles

Steven R. Corsi, Steven W. Geis, Jorge E. Loyo-Rosales, and Clifford P. Rice

Aquatic toxicity of aircraft deicer and anti-icer formulations is characterized with relation to toxicity of additive package ingredients alkylphenol ethoxylates and 4,5-methyl-1H-benzotriazoles.

7416

Distribution of Human Polyoma-viruses, Adenoviruses, and Hepatitis E Virus in the Environment and in a Drinking-Water Treatment Plant

Nestor Albinana-Gimenez, Pilar Clemente-Casares, Silvia Bofill-Mas, Ayalkibet Hundesa, Ferran Ribas, and Rosina Girones

Human adenoviruses, JCPyV, BKPyV, and HEV are analyzed in the environment and in a drinking-water treatment plant.

ECOTOXICOLOGY AND HUMAN ENVIRONMENTAL HEALTH

7423

Genetic Variation in the Conservative Gene Region of Norovirus Genogroup II Strains in Environmental and Stool Samples

Daisuke Sano, You Ueki, Toru Watanabe, and Tatsuo Omura

The difference in the average of the estimated number of nucleotide substitutions is observed in the conservative gene region of NoV genotype 4 variants in environmental and stool samples.

7428

Quantitative Risk Assessment of Noroviruses in Drinking Water Based on Qualitative Data in Japan

Yoshifumi Masago, Hiroyuki Katayama, Toru Watanabe, Eiji Haramoto, Atsushi Hashimoto, Tatsuo Omura, Tsuyoshi Hirata, and Shinichiro Ohgaki

The health risk of ingesting noroviruses in drinking water is assessed with a new approach to estimate distributions of microorganisms in water.

7434

Effect of Intracellular Resuscitation of *Legionella pneumophila* in *Acanthamoeba polyphage* Cells on the Antimicrobial Properties of Silver and Copper

Myoung Goo Hwang, Hiroyuki Katayama, and Shinichiro Ohgaki

The endosymbiosis of *L. pneumophila* with *A. polyphage* can support the intracellular resuscitation of *L. pneumophila* and enhance survivability against exposures to silver and copper.

7440

Occurrence of Infected Amoebae in Cooling Towers Compared with Natural Aquatic Environments: Implications for Emerging Pathogens

S. G. Berk, J. H. Gunderson, A. L. Newsome, A. L. Farone, B. J. Hayes, K. S. Redding, N. Uddin, E. L. Williams, R. A. Johnson, M. Farsian, A. Reid, J. Skimmyhorn, and M. B. Farone

Possible new human pathogens infecting amoebae are found more frequently in cooling towers than in nature.

7445

Antibiotic Resistance Genes as Emerging Contaminants: Studies in Northern Colorado

Amy Pruden, Ruoting Pei, Heather Storteboom, and Kenneth H. Carlson

The distribution of resistance genes to sulfonamide and tetracycline antibiotic in various environmental compartments in northern Colorado with respect to urban/agricultural impacts is explored.

Supporting information is available free at <http://pubs.acs.org/est>. This issue contains a news story about this research.

HARVARD UNIVERSITY DIVISION OF ENGINEERING AND APPLIED SCIENCES

The Division of Engineering and Applied Sciences at Harvard University invites applications for a faculty position in Environmental Applied Mathematics, with particular application to engineering problems in the environment having chemical, physical or biological aspects. The successful candidate will be expected to teach courses to support the curricula in both environmental engineering and applied mathematics. We intend to make this appointment at the Assistant or, in exceptional cases, at the Associate Professor level (untenured).

We particularly encourage applications from women and minorities. An application, assembled as a single PDF file, should include a curriculum vitae, separate two-page statements of research and teaching interests, and up to three scientific papers. Three to five letters of recommendation should be requested and sent separately. Applications will be reviewed beginning December 31, 2006, although applications received after that date may also be considered.

Applications should be sent via email to environmental_applied_mathematics@deas.harvard.edu. Letters of recommendation are also preferred by email at the same address but may optionally be mailed to Chair, Environmental Applied Mathematics Search Committee, Division of Engineering and Applied Sciences, Harvard University, Cambridge, MA 02138.

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