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ENVIRONMENTAL Science & Technology

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Environment *in the*
CZECH REPUBLIC

**Air-Quality Impacts of
Climate Mitigation**

**Are Nitrogen-Containing
DBPs More Toxic?**

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Researchers analyze a real scenario in the U.K. to conclude that climate-change policy making has trade-offs.

353 Chemicals in salmon vary by species

Some farmed and wild salmon from British Columbia differ only slightly with respect to their contaminant loads, but species can be very different.

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Warming up to climate change • China to top CO₂ emitter list sooner than expected • Chloramines raise lead levels in water • A decade of acid rain controls • Solar electricity soaring • Spain embraces the sun

354 Hamster cells bring DBPs into the library

Are nitrogen-containing disinfection byproducts more toxic than other organic halogens?

355 Wetlands reduce estrogens from wastewater

Constructed wetlands can reduce natural estrogens in swine wastewater, particularly in cooler weather.

356 Renewable hydrogen fueling

Vermont demonstrates how hydrogen can be generated from renewable resources in a cold, hilly, rural environment.

357 EU gets renewed wake-up call on Kyoto targets

Rapidly increasing emissions from the transportation sector could stymie Europe's efforts to achieve targeted reductions of greenhouse gas emissions.



FEATURE

358 Environment in the Czech Republic: A Positive and Rapid Change

Bedrich Moldan and Tomas Hak

When people think about the Czech Republic, images of air and water pollution, uncontrolled waste disposal, and devastation of the countryside often come to mind. However, the former communist country has witnessed significant improvements in terms of environmental quality since the

1990s and now ranks 4th among 133 countries in terms of its environmental performance. Moldan and Hak describe the condition of the Czech environment and how it got to where it is today.

Research

CRITICAL REVIEW

■ 363

Drowning in Disinfection Byproducts? Assessing Swimming Pool Water

Christian Zwiener, Susan D. Richardson, David M. De Marini, Tamara Grummt, Thomas Glauner, and Fritz H. Frimmel

Different aspects of disinfection byproducts in swimming-pool water are covered, including formation, analysis, and treatment as well as toxicological and epidemiological implications.

POLICY ANALYSIS

■ 373

A Comparative Hierarchical Decision Framework on Toxics Use Reduction Effectiveness for Electronic and Electrical Industries

Hai-Yong Kang, Oladele Ogunseitan, Andrew A. Shapiro, and Julie M. Schoenung

Reduction-type regulations for toxics use are analyzed with a decision-making framework to evaluate their effectiveness within the electronic and electrical industries; a case study is also reported.

■ 380

Ammonia Emission Controls as a Cost-Effective Strategy for Reducing Atmospheric Particulate Matter in the Eastern United States

Robert W. Pinder, Peter J. Adams, and Spyros N. Pandis

Larger reductions in inorganic particulate matter are available at lower cost by reducing ammonia emissions than by imposing further controls on SO₂ and NO_x sources.

■ 387

► Air Quality Impacts of Climate Mitigation: UK Policy and Passenger Vehicle Choice

Eric A. Mazzi and Hadi Dowlatabadi

Diesel cars in the U.K. reduce CO₂ emissions and oil consumption, but at what price?

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

Cover: The cover photo of a pumped storage power station called Dlouhe Strane in the Jeseniky Mountains, Czech Republic, was provided by the Czech News Agency, CTK.

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

CHARACTERIZATION OF NATURAL AND AFFECTED ENVIRONMENTS

■ 393

Comprehensive Characterization of Atmospheric Organic Matter in Fresno, California, Fog Water

Pierre Herckes, Jerry A. Leenheer, and Jeffrey L. Collett, Jr.

Chemical fractionation followed by NMR and IR analysis is used to characterize ~80% of the organic matter in Fresno fog water.

■ 400

Studies of the Compositions of Humic Acids from Amazonian Dark Earth Soils

Etelvino H. Novotny, Eduardo R. deAzevedo, Tito J. Bonagamba, Tony J. F. Cunha, Beáta E. Madari, Vinícius de M. Benites, and Michael H. B. Hayes

Humic acids, major contributors to the fertility of Amazonian dark earth soils, are shown to have origins in pyrogenic carbon from the pre-Columbian era.

■ 406

Multiple Environmental Monitoring Techniques for Assessing Spatial Patterns of Airborne Tungsten

Paul R. Sheppard, Robert J. Speakman, Calvin Farris, and Mark L. Witten

Environmental monitoring by chemical analysis of airborne dust, surface dust, and lichens is shown to accurately reflect tungsten in a town with known tungsten emissions.

■ 411

Biomagnification of PBDEs in Three Small Terrestrial Food Chains

Stefan Voorspoels, Adrian Covaci, Veerle L. B. Jaspers, Hugo Neels, and Paul Schepens

Biomagnification of PBDEs is seen in terrestrial avian wildlife but not in the red fox.

■ 417

Fate of Higher Brominated PBDEs in Lactating Cows

Amelie Kierkegaard, Lillemor Asplund, Cynthia A. de Wit, Michael S. McLachlan, Gareth O. Thomas, Andrew J. Sweetman, and Kevin C. Jones

In cows, higher-brominated PBDEs accumulate in adipose tissue, debrominate to lower-brominated congeners, and are transferred to milk only to a small extent.

■ 424

Levels, Tissue Distribution, and Age-Related Accumulation of Synthetic Musk Fragrances in Chinese Sturgeon (*Acipenser sinensis*): Comparison to Organochlorines

Yi Wan, Qiwei Wei, Jianying Hu, Xiaohui Jin, Zhaobin Zhang, Huajun Zhen, and Jianyi Liu

The levels, tissue distribution, and age-related accumulation of synthetic musk fragrances in Chinese sturgeon (*Acipenser sinensis*) are investigated and compared with those of organochlorines.

■ 431

Tc and Re Behavior in Borosilicate Waste Glass Vapor Hydration Tests

David A. McKeown, Andrew C. Buechele, Wayne W. Lukens, David K. Shuh, and Ian L. Pegg

Technetium and rhenium in borosilicate waste glasses subjected to vapor hydration tests behave quite differently with respect to their mobility, valence, and local structural changes during alteration.

■ 437

Flesh Quality of Market-Size Farmed and Wild British Columbia Salmon

M. G. Ikonomou, D. A. Higgs, M. Gibbs, J. Oakes, B. Skura, S. McKinley, S. K. Balfry, S. Jones, R. Withler, and C. Dubetz

Flesh quality is evaluated and a risk-benefit assessment performed for the consumption of market-size farmed and wild salmon from British Columbia, Canada.

■ 444

Estrogenic Activity and Steroid Hormones in Swine Wastewater through a Lagoon Constructed-Wetland System

Nancy W. Shappell, Lloyd O. Billey, Dean Forbes, Terry A. Matheny, Matthew E. Poach, Gudigopuram B. Reddy, and Patrick G. Hunt

Hormonal activity is measured at various stages in a swine wastewater treatment system with MCF-7 E-Screen and LC/MS-MS analyses.

451

Changes in Palladium, Platinum, and Rhodium Concentrations, and Their Spatial Distribution in Soils Along a Major Highway in Germany from 1994 to 2004

Fathi Zereini, Clare Wiseman, and Wilhelm Püttmann

Original results are presented on the concentration, distribution, and spatial pattern of palladium, platinum, and rhodium in soil along a heavily frequented stretch of highway in Germany from 1994 to 2004.

■ 457

Unresolved Complex Mixtures of Aromatic Hydrocarbons: Thousands of Overlooked Persistent, Bioaccumulative, and Toxic Contaminants in Mussels

Andy M. Booth, Paul A. Sutton, C. Anthony Lewis, Alastair C. Lewis, Alan Scarlett, Wing Chau, John Widdows, and Steven J. Rowland

GC×GC-TOFMS is used to resolve and identify thousands of previously unresolved hydrocarbons that bioaccumulate in mussels at concentrations sufficient to elicit narcotic toxic effects.

ENVIRONMENTAL PROCESSES

465

On the Acid-Base Properties of Humic Acid in Soil

James D. Cooke, John Hamilton-Taylor, and Edward Tipping

Proton binding by aggregated humic acid has a greater ionic-strength dependency than current models predict and is more representative of humic acid in soil.

■ 471

Fe(II) Sorption on Hematite: New Insights Based on Spectroscopic Measurements

Philip Larese-Casanova and Michelle M. Scherer

Interfacial electron transfer readily occurs upon sorption of Fe(II) on hematite at Fe(II) concentrations below site saturation, whereas above site saturation, a sorbed Fe(II) phase forms.

■ 478

Diffusion of ²²Na and ⁸⁵Sr in Montmorillonite: Evidence of Interlayer Diffusion Being the Dominant Pathway at High Compaction

Martin A. Glaus, Bart Baeyens, Michael H. Bradbury, Andreas Jakob, Luc R. Van Loon, and Andriy Yaroshchuk

Diffusion of ²²Na and ⁸⁵Sr through compacted montmorillonite occurs predominantly through the interlayer porosity and is driven by the gradient of sorbed tracer cations.

■ 486

17β Estradiol-Degrading Bacteria Isolated from Activated Sludge

Chang-Ping Yu, Hyungkeun Roh, and Kung-Hui Chu

Fourteen phylogenetically different strains, widely distributed among eight different genera, can convert 17 β -estradiol to estrone, but only three strains can degrade estrone.

■ 493

Colloid Population Heterogeneity Drives Hyperexponential Deviation from Classic Filtration Theory

Meiping Tong and William P. Johnson

Retained colloid profiles from columns in series demonstrate that colloid population heterogeneity drives hyperexponential deviation from filtration theory under the conditions examined.

500

Effect of Fungal Hyphae on the Access of Bacteria to Phenanthrene in Soil

Lukas Y. Wick, Rita Remer, Birgit Würz, Jana Reichenbach, Sebastian Braun, Franziska Schäfer, and Hauke Harms

Fungal mycelia provide networks of continuous water pathways in air-filled soil, allowing for dispersion of PAH-degrading bacteria and PAH degradation not found in the absence of fungi.

506

Production of Anatoxin-a and a Novel Biosynthetic Precursor by the Cyanobacterium *Aphanizomenon issatschenkoii*

Andrew I. Selwood, Patrick T. Holland, Susanna A. Wood, Kirsty F. Smith, and Paul S. McNabb

Cultures of a strain of the cyanobacterium *Aphanizomenon issatschenkoii* produce anatoxin-a and the biosynthetic precursor 11-carboxyl anatoxin-a.

511

Adsorption of Alkylimidazolium and Alkylpyridinium Ionic Liquids onto Natural Soils

Piotr Stepnowski, Wojciech Mrozik, and Joanna Nighthauser

The mechanism of ionic liquid sorption onto selected natural soils differing in their organic content, cation exchange capacity, and particle size distribution is discussed.

517

Evidence for Organosulfates in Secondary Organic Aerosol

Jason D. Surratt, Jesse H. Kroll, Tadeusz E. Kleindienst, Edward O. Edney, Magda Claeys, Armin Sorooshian, Nga L. Ng, John H. Offenberg, Michael Lewandowski, Mohammed Jaoui, Richard C. Flagan, and John H. Seinfeld

Organosulfates, formed by particle-phase esterification, are detected in laboratory-generated and ambient aerosol; this offers one explanation for acidic aerosol-enhancing SOA yields.

528

Cr(III) Is Indirectly Oxidized by the Mn(II)-Oxidizing Bacterium *Bacillus* sp. Strain SG-1

Karen J. Murray and Bradley M. Tebo

The Mn(II)-oxidizing bacterium *Bacillus* sp. strain SG-1 rapidly oxidizes Cr(III) to the more hazardous Cr(VI) indirectly through the production of very reactive oxidized Mn.

■ 534

Deposition of Polybrominated Diphenyl Ethers, Polychlorinated Biphenyls, and Polycyclic Aromatic Hydrocarbons to a Boreal Deciduous Forest

Yushan Su, Frank Wania, Tom Harner, and Ying D. Lei

Long-term average dry deposition velocities for gaseous and particle-bound PBDEs and PCBs to a boreal deciduous forest are high; this confirms the ability of forests to act as efficient filters.

ENVIRONMENTAL MODELING

■ 541

Sorption of Yttrium and Rare Earth Elements by Amorphous Ferric Hydroxide: Influence of Temperature

Kelly A. Quinn, Robert H. Byrne, and Johan Schijf

Molar enthalpy values are determined to provide a temperature- and pH-dependent model of yttrium and rare earth element sorption by amorphous ferric hydroxide.

■ 547

Hydration-Assisted Sorption of a Probe Organic Compound at Different Peat Hydration Levels: The Link Solvation Model

E. R. Graber, L. Tsechansky, and M. Borisover

Phenol sorption isotherm data at nine NOM hydration levels is successfully fit by the link solvation model with a single set of three unique parameters.

■ 555

Qualitative Modelling of Gold Mine Impacts on Lihir Island's Socioeconomic System and Reef-Edge Fish Community

Jeffrey M. Dambacher, David T. Brewer, Darren M. Dennis, Martha Macintyre, and Simon Foale

Qualitative dynamics of human and ecological systems are explored on a small South Pacific island impacted by a gold mine.

ENVIRONMENTAL MEASUREMENTS METHODS

563

Optimization of Blood Collection Card Method/Enzyme-Linked Immunoassay for Monitoring Exposure of Bottlenose Dolphin to Brevetoxin-Producing Red Tides

Jennifer M. Maucher, Lyn Briggs, Colleen Podmore, and John S. Ramsdell

Analysis of blood collection cards by an ELISA highly sensitive to brevetoxins and its metabolites allows biomonitoring of dolphins in regions impacted by red tides.

■ 568

Calibration of a Passive Sampler for Both Gaseous and Particulate Phase Polycyclic Aromatic Hydrocarbons

Shu Tao, Yanan Liu, Wei Xu, Chang Lang, Shuzhen Liu, Han Dou, and Wenxin Liu

A novel passive air sampler is developed and calibrated for simultaneously monitoring gaseous and particulate-phase PAHs in air.

■ 574

Novel Method for On-Road Emission Factor Measurements Using a Plume Capture Trailer

L. Morawska, Z. D. Ristovski, G. R. Johnson, E. R. Jayaratne, and K. Mengersen

Motor vehicle emission factor measurements are based on naturally diluted plume samples collected at distances of up to 3 m from the exhaust pipe.

580

Low Acetaldehyde Collection Efficiencies for 24-Hour Sampling with 2,4-Dinitrophenylhydrazine (DNPH)-Coated Solid Sorbents

Jason S. Herrington, Zhi-Hua (Tina) Fan, Paul J. Liroy, and Junfeng (Jim) Zhang

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

Results from laboratory tests indicate that if the EPA compendium method TO-11A is used with sampling durations >6 h, acetaldehyde concentrations are underestimated by ~50%.

■ 586

Spectroscopic Investigation of Cr(III)- and Cr(VI)-Treated Nanoscale Zerovalent Iron

Bruce A. Manning, Jon R. Kiser, Hanchoul Kwon, and Sushil Raj Kanel
X-ray spectroscopy confirms that Cr(VI) is reduced to Cr(III) by zerovalent iron nanoparticles, followed by precipitation as $\text{Cr}(\text{OH})_3$ and $\text{Cr}_x\text{Fe}_{1-x}(\text{OH})_3$.

593

Analysis of Mercury in Sequential Micrometer Segments of Single Hair Strands of Fish-Eaters

Melissa Legrand, Rebecca Lam, Carlos José Sousa Passos, Donna Mergler, Eric D. Salin, and Hing Man Chan

Analysis of mercury is conducted in sequential micrometer segments of single hair strands of fish-eaters by laser ablation-inductively coupled plasma-mass spectrometry.

REMEDIATION AND CONTROL TECHNOLOGIES

599

Transgenic Indian Mustard Overexpressing Selenocysteine Lyase or Selenocysteine Methyltransferase Exhibit Enhanced Potential for Selenium Phytoremediation under Field Conditions

Gary Bañuelos, Danika L. LeDuc, Elizabeth A. H. Pilon-Smits, and Norman Terry

Transgenic Indian mustard that overexpresses selenocysteine methyltransferase and selenocysteine lyase shows enhanced selenium phytoremediation potential (increased tolerance and selenium accumulation) in field conditions.

606

Control of Aerosol Contaminants in Indoor Air: Combining the Particle Concentration Reduction with Microbial Inactivation

Sergey A. Grinshpun, Atin Adhikari, Takeshi Honda, Ki Youn Kim, Mika Toivola, K. S. Ramchander Rao, and Tiina Reponen

In this hybrid system, particle removal occurs because of unipolar ion emission, while the inactivation of viable airborne microorganisms is associated with photocatalytic oxidation.

■ 613

The Aqueous Degradation of Butylated Hydroxyanisole by $\text{UV}/\text{S}_2\text{O}_8^{2-}$: Study of Reaction Mechanisms via Dimerization and Mineralization

Tim K. Lau, Wei Chu, and Nigel J. D. Graham

Antioxidant BHA removal by a UV-aided peroxydisulfate process is examined at various pH levels and $\text{S}_2\text{O}_8^{2-}$ dosages, and the byproducts are studied.

■ 620

Methane Oxidation in Biofilters Measured by Mass-Balance and Stable Isotope Methods

D. K. Powelson, J. P. Chanton, and T. Abichou

A model is described that accounts for isotope-based underestimation of methane oxidation by assuming that part of the methane is completely oxidized.

■ 626

Oxidation Kinetics of Selected Taste and Odor Compounds during Ozonation of Drinking Water

Andreas Peter and Urs Von Gunten

The reaction kinetics of the oxidation of 11 taste and odor compounds are studied during drinking-water ozonation.

632

Membrane Biofouling in Pilot-Scale Membrane Bioreactors (MBRs) Treating Municipal Wastewater: Impact of Biofilm Formation

Yuki Miura, Yoshimasa Watanabe, and Satoshi Okabe

Biofilm development on hollow-fiber MF membrane surfaces causes severe irreversible fouling during long-term operation of pilot-scale MBRs treating municipal wastewater.

639

Evaluation of Microbial Reduction of Fe(III)EDTA in a Chemical Absorption-Biological Reduction Integrated NO_x Removal System

Wei Li, Cheng-Zhi Wu, Shi-Han Zhang, Ke Shao, and Yao Shi

The inhibition kinetics of Fe(II)EDTA-NO or Fe(II)EDTA on *Escherichia coli* FR-2 cell growth and the associated biological reduction of Fe(III)EDTA are investigated experimentally and modeled.

ECOTOXICOLOGY AND HUMAN ENVIRONMENTAL HEALTH

■ 645

Haloacetonitriles vs. Regulated Haloacetic Acids: Are Nitrogen-Containing DBPs More Toxic?

Mark G. Muellner, Elizabeth D. Wagner, Kristin McCalla, Susan D. Richardson, Yin-Tak Woo, and Michael J. Plewa

The haloacetonitriles are potent cytotoxins in mammalian cells, and these data increase concern about the health impacts of nitrogenous drinking-water disinfection byproducts.

652

Isolation and Identification of Xenobiotic Aryl Hydrocarbon Receptor Ligands in Dyeing Wastewater

Pei-hsin Chou, Saburo Matsui, Kentaro Misaki, and Tomonari Matsuda

Quinoline disperse dyes isolated from dyeing wastewater are suggested to be potent xenobiotic ligands of the AhR.

■ 658

Photoelectrochemical DNA Sensor for the Rapid Detection of DNA Damage Induced by Styrene Oxide and the Fenton Reaction

Minmin Liang and Liang-Hong Guo

Photoelectrochemical DNA sensors are developed for the simple and rapid detection of DNA damage caused by styrene oxide and Fenton reagents.

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