



**2011 Environmental and Occupational Health
Technical Symposium**

***Pharmaceuticals and Personal Care
Products (PPCPs) in Water Supplies:
“Potential Impacts and Sustainable
Solutions***

February 16, 2011

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2011 Environmental and Occupational Health Technical Symposium

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2011 Environmental and Occupational Health Technical Symposium

February 16, 2011

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On behalf of the Environmental and Occupational Health (EOH) alumni, faculty, and students of California State University Northridge, and our sponsors, we welcome you to our annual EOH Technical Symposium. We hope that you will find today's program to be of great value.

Pharmaceuticals and personal care products (PPCPs) are a large and diverse group of chemicals that are widely disseminated at low concentrations in the aquatic environment. PPCPs enter the nation's waterways from a variety of sources: household disposal of unwanted medications, sewage treatment plant effluent and sludge (often used as fertilizer on agricultural fields), pharmaceutical production plant effluent, veterinary medicine (particularly in agriculture), and aquaculture. Potential solutions for PPCPs in the environment are as varied as the compounds, themselves. As scientists, industry, policymakers, educators, and other stakeholders grapple with the far-reaching and complex implications of PPCPs in the environment, the need for interdisciplinary communication becomes of paramount importance.

This year's distinguished group of speakers provides a cross-section of perspectives to help us better understand the issues leading researchers and policy makers in the field of emerging contaminants will discuss potential impacts and sustainable solutions regarding PPCPs. The symposium will explore the presence of PPCPs in drinking and surface waters, investigate the potential human and environmental health impacts, discuss remediation technologies, and provide attendees with an understanding of the broad scope of challenges presented by this emerging issue.

The alumni associations, faculty, and students wish to take this opportunity to thank Ralph Jones who recently retired as President of the Environmental and Occupational Alumni Chapter. Ralph's unwavering enthusiasm and dedicated leadership over the years has brought the contributions of the Alumni Chapter to unparalleled heights. As a past Alumni Chapter Honoree, Ralph has also been recognized by other Alumni Chapter Presidents as a guiding force in making their Chapters and events even more successful. Although Ralph will continue to be our guide and mentor, we wish him continued success and good health in the years to come.

We hope you enjoy today's symposium and will join us for future events.



Lorraine Sedlak
Symposium Co-Chairperson
EOH Alumni Chapter



Dr. Antonio F. Machado
Symposium Co-Chairperson
EOH Department



Bob Finkelstein
President
EOH Alumni Chapter



Veronica Becerra
Symposium Co-Chairperson
EOH Student Association

Program Schedule

- 3:00 – 3:50 **Registration /Networking and Social Period**
- 3:50 - 4:05 **Welcome and Introductory Comments – Antonio Machado, Ph D, REHS, CSUN**
- 4:05 - 4:45 **“Pharmaceuticals and Personal Care Products (PPCPs) in the Aquatic Environment: An Overview”**
**Shane Snyder, Ph D, Professor of Chemical and Environmental Engineering
University of Arizona**
- 4:50 - 5:00 **Q&A**
- 5:00 - 5:10 **Break**
- 5:10 – 5:35 **“Quantification of PPCPs in Water: Current Technology and Challenges posed by Adverse Conditions”**
Michael Flournoy – Technical Director at Test America, West Sacramento Lab.
- 5:35 – 5:45 **Q&A**
- 5:45 – 6:00 **Refreshment Break and Raffle**
- 6:00 – 6:40 **“Contamination of Water Systems with Pharmaceuticals and Personal Care Products (PPCPs): Ecotoxicological Ramifications”**
**Daniel Schlenk, Ph.D. – Professor of Aquatic Ecotoxicology and Env. Toxicology –
University of California Riverside**
- 6:40 – 6:55 **Q&A**
- 6:55 - 7:05 **Break**
- 7:05 – 7:45 **“Pharmaceuticals and Personal Care Products (PPCPs) in the Environment: EPA Initiatives and Strategy”**
Octacvia D. Conerly, MPH, U.S. EPA Headquarters, Office of Water.
- 7:45 – 8:00 **Q&A**
- 8:00 – 8:10 **Break**
- 8:10 – 8:35 **“Natural Attenuation and the Potential for Treatment of PPCPs in Water”**
Eva Steinle-Darling, Ph. D., Erler & Kalinowski, Inc.
- 8:35 – 8:45 **Q&A**
- 8:45 – 9:00 **Closing Comments – Antonio F. Machado, Ph.D., REHS, CSUN, All Speakers**

*Your opinion is important to us. Please complete and hand-in the
Attendee Survey Form before you leave the event.*



2011 Environmental and Occupational Health Technical Symposium

Speakers

Shane Snyder, Ph D

Pharmaceuticals and Personal Care Products in the Aquatic Environment



Dr. Shane Snyder is a Professor in the College of Engineering at the University of Arizona. He is also the Co-Director of the Arizona Laboratory for Emerging Contaminants. For over 15 years, Dr. Snyder's research has focused on the identification, fate, and health relevance of emerging water pollutants. In 2000, Dr. Snyder became the first R&D Project Manager at the Southern Nevada Water Authority and was a founding member of SNWA's Applied R&D Center. Dr. Snyder and his team have published over 100 peer-reviewed manuscripts and book chapters on emerging contaminant analysis, treatment, and toxicology. In April of 2008, Dr. Snyder was one of six experts invited to testify before the U.S. Senate regarding pharmaceuticals in US waters. He has since been invited to brief the U.S. Congress three additional times. Dr. Snyder has served two terms on the federal advisory committee to EPA's Endocrine Disruptor Screening Program and was an invited expert panel member for the development of EPA's CCL3. Dr. Snyder is a member of the National Research Council's Committee on Water Reuse and has served two appointments on the California Chemicals of Emerging Concern Expert Panels. He is also a Trustee of the American Water Works Association's Water Science & Research Division and a Research Advisory Council Member of the WaterReuse Research Foundation. Dr. Snyder joined the University of Arizona faculty in 2010 and

Daniel Schlenk, Ph D

Contamination of Water Systems with Pharmaceuticals and Personal Care Products



Daniel Schlenk, Ph.D. is Professor of Aquatic Ecotoxicology and Environmental Toxicology at the University of California Riverside. Dr. Schlenk received his PhD in Toxicology from Oregon State University in 1989. He was supported by a National Institute of Environmental Health Science postdoctoral fellowship at Duke University from 1989-1991. Since 2007, he has been a permanent member of the USEPA FIFRA Science Advisory Panel. From 2003-2006, he was a member of the Board of Directors for the North American Society of Environmental Toxicology and Chemistry. He is the co-editor-in chief of *Aquatic Toxicology* and serves on the editorial boards of *Toxicological Sciences*, *The Asian Journal of Ecotoxicology* and *Marine Environmental Research*. He has co-edited a 2 volume series entitled "*Target Organ Toxicity in Marine and Freshwater Teleosts*" and has published more than 150 peer reviewed journal articles. He has been a recipient of the Ray Lankester Investigatorship of the Marine Biological Association of the United Kingdom; a visiting Scholar of the Instituto Del Mare, Venice Italy; a visiting Scholar in the Department of Biochemistry, Chinese University of Hong Kong; and a Visiting Scientist at the CSIRO Lucas Heights Laboratory, in Sydney Australia. He has been an ad hoc member for the USEPA Science Advisory Board for Aquatic Life Criteria Guidelines from the Ecological Processes and Effects Committee, and has participated in proposal review panels for the NSF, USEPA, NOAA, and the National Institute of Environmental Health Sciences. His research interests focus around mechanisms of action of pesticides and emerging compounds in aquatic organisms.



2011 Environmental and Occupational Health Technical Symposium

Speakers

Octavia D. Conerly, MPH,

Pharmaceuticals and Personal Care Products in the Environment



Ms. Conerly is an Environmental Scientist at the Environmental Protection Agency, Office of Water, Health and Ecological Criteria Division. She received her Bachelor of Science degree in Mathematics from the University of New Orleans and a Master of Science in Public Health from Tulane University, New Orleans, LA. Following graduation in 1997, she spent a short period of time working for the Louisiana Department of Environmental Quality as an Environmental Scientist focused on environmental compliance of commercial facilities and oil refineries in Southeast Louisiana. In 1998, she began working for EPA in the Office of Science and Technology within the Office of Water. Her work has included duties related to the Contaminant Candidate List (CCL), the Six Year Review process, human health risk assessment and, most recently, contaminants of emerging concern and endocrine disruptors. She has been involved in work focused on understanding the potential risk posed by the occurrence of pharmaceuticals and personal care products at low levels in water since 1998.

Eva Steinle-Darling, Ph D

Natural Attenuation and the Potential for Treatment of PPCPs in Water



Eva Steinle-Darling earned her Bachelor's Degree in Chemical Engineering from Princeton in 2003 and went on to earn a M.S. and Ph.D. in Environmental Engineering at Stanford in 2004 and 2008, respectively. Her doctoral research, advised by Professor Martin Reinhard, focused on the removal of trace organic contaminants, including pharmaceuticals and personal care products ("PPCPs"), using nanofiltration and reverse osmosis membranes. She is the author of several peer-reviewed articles on this topic and gives regular presentations on the subject of fate, transport, and treatability of PPCPs. Dr. Steinle-Darling is currently a Project Engineer for Eler & Kalinowski, Inc., in Burlingame, California, where her work includes a variety of projects, including many that focus on the fate, transport, attenuation, and treatment of contaminants in the subsurface.



2011 Environmental and Occupational Health Technical Symposium

Speakers

Michael Flournoy **Quantifications of PPCPs in Water**



Michael Flournoy has over 20 years of laboratory experience and has spent the majority of his working experience in the High Resolution Gas Chromatography Mass Spectrometry (HRGCMS) department. He has held positions of HRGCMS Instrument Operator, Department Manager of various departments, Operations Manager, and Manager of Customer Service.

Mr. Flournoy's accomplishments include being involved in specialty development in analyzing Steroids, Hormones, Antibacterial products, Over the Counter (OTC) Medication, and other Pharmaceuticals and Personal Care Products (Modified EPA Method 1694 and Modified EPA Method 1698). Mr. Flournoy has also been involved in the analysis of Nonylphenol and bis-Phenol-A (BPA) by GCMS, Tribromsalan by GCMS, and Ring and Puck Mill grinding per EPA Method 8330B.

He contributed to the development of High Resolution GCMS Pesticide and Toxaphene equivalent to EPA Method 1699, in addition to developing an application to evaluate and upload instrument data into Laboratory Information Management System (applicable to all GC, GCMS, LC and LCMS data).

Mr. Flournoy is currently the Technical Director at TestAmerica (West Sacramento facility). Mr. Flournoy graduated from the University of California at Davis with a Bachelors of Science in Chemical Engineering.

Speaker Abstracts

Shane Snyder, Ph D, Professor of Chemical and Environmental Engineering, University of Arizona

Title: *Endocrine Disruptors and Pharmaceuticals: Implications for Water Sustainability*

The availability of safe freshwater is diminishing at an alarming rate globally. Increasing human population is stressing water supplies and contributing to water pollution. Population density increases and climate changes including epic droughts in certain parts of the world have led to the utilization of non-conventional water resources. These resources include desalinated sea water and recycled water to meet potable water needs. The water quality in many parts of the world is changing. The burgeoning human population taxes not only water resources but also food supplies, leading to rising demands for irrigation water and consequently to greater potential for water contamination by pesticides, fertilizers, and naturally occurring constituents. The public perception of water is shifting, with growing public awareness of certain groups of contaminants due to media coverage and non-government organization (NGO) concerns. Modern analytical technology has permitted the discovery that minute concentrations of contaminants of distinctly human origin occur in the water cycle. Many of these so-called "contaminants of emerging concern" have been, and will continue to be, detected in potable water supplies. Without question, the propensity for the contamination of fresh water will rise as human population continues to grow. Water treatment technology also continues to evolve. Advanced water treatment processes can provide effective and efficient contaminant removal. This presentation will describe the history, current status, and future implications that the detection of endocrine disruptors and pharmaceuticals will have on water and energy sustainability, with a particular emphasis on water treatment technologies.

Michael Flournoy – Technical Director at Test America, West Sacramento Lab

Title: *"Quantification of PPCPs in Water: Current Technology and Challenges posed by Adverse Conditions"*

The existence of pharmaceutical products is believed to date back to "prehistoric medicine". In today's world pharmaceutical products including steroids and hormones are very complex, extremely potent and can target a specific part of the body to heal or protect. Steroids and hormones are used to grow and/or control body functions such as birth control, build muscle mass, or increase protein synthesis. One drawback is that some medicines stay in the body and some are excreted. The medicine is now able to enter the environment through our waste treatment systems. Recent studies have shown significant adverse impacts to the environment when these products or their metabolites are introduced by "normal" waste streams (i.e. waste water treatment plants or medical waste processes). Some observations include fish and frogs being able to change sex organs or having antibiotic resistant strains of bacteria.

Efforts are underway to show better treatment systems using newer technology including UV treatment and Reverse Osmosis. TestAmerica has developed procedures that aid in detecting analytes of concern using definitive analytical procedures including a technique called isotope dilution coupled with solid phase extraction and LC/MS/MS.

Isotope dilution uses irradiated isotopes (either with deuterium or ^{13}C labeled) of the compounds of interest. This allows for the actual concentration of the compound we are detecting to be corrected for analytical efficiencies. Each compound that has labeled compound associated with it will have a higher confidence value associated with its concentration and essentially corrects for losses that occur in the extraction and analysis of the sample. Solid phase extraction allows for the isolation and elution of specific analytes using specific pH and solvent strengths to isolate the compounds of interest. The analysis using LC/MS/MS allows for detections in the low ng/L range. Using these techniques in tandem allows for a robust analysis that helps aid in the efforts to show what compounds are present in the influent, effluent and all treated steps for waste treatment with an overall goal of reducing PPCP contamination entering our environment.

Daniel Schlenk, Ph D, Professor of Aquatic Ecotoxicology and Environmental Toxicology – University of California Riverside

Title: *Use of Bioassays to Identify Contaminants of Emerging Concern in Aquatic Ecosystems*

Contaminants of Emerging Concern (CECs) represent a "universe" of known and unknown compounds including pharmaceutical and personal care products, nanomaterials, and human metabolites. Aquatic organisms tend to have the greatest exposure to human-derived CECs due to point source discharge of domestic wastewater effluents and to non-point source runoff to surface water. Significant uncertainty exists in determining the ecotoxicological risk of these compounds. Some studies have shown that exposure to relatively low concentrations of synthetic hormones have abolished populations of fish. Populations of threatened and endangered species of fish in the San Francisco Bay Delta have shown significant declines leading to changes in water allocations to the Central Valley and Southern California. Using an easily measured endocrine response (estrogenic activity), evaluations of surface waters that drain into the estuary were carried out. Site-specific patterns of activity were observed with causal compounds varying between the Napa River and the Delta of the Sacramento River. Further analyses of the Sacramento River Delta have indicated the potential for pyrethroid insecticides and surfactant mixtures as contributing factors to this response. Whether estrogenic activity is causally linked to population decline is uncertain. However, the temporal association between urban pyrethroid use and population declines in Delta fish species indicates further research is necessary.

Speaker Abstracts

Octavia D. Conerly, MPH, USEPA. Headquarters, Office of Water

Title: “Pharmaceutical and Personal Care Products (PPCPs) in Water”

The US Environmental Protection Agency’s (EPA) Office of Water (OW) is responding to the issue of contaminants of emerging concern in water with a four-pronged strategy (published August 2008) aimed at: strengthening scientific knowledge; improving public understanding; identifying partnership and stewardship opportunities; and taking regulatory action when appropriate. Since the announcement of the strategy, OW has been working to make progress in each of these areas.

To strengthen its scientific understanding of the behavior of PPCPs in water, OW conducted or funded a number of studies to better understand the potential sources and occurrence of pharmaceuticals in wastewater, biosolids and fish tissue. To understand risks to human health, OW consulted the National Academy of Sciences (NAS) which convened a panel of experts to provide their ideas and opinions for understanding risks to human health. The panel had numerous suggestions for how the Agency could screen contaminants and then perform human health risk assessments for priority pharmaceuticals. The panel also discussed the importance of communicating risks (early on in the process) to the public and other stakeholders. To improve public understanding of risks, EPA has developed two websites, one focusing specifically on PPCPs in water and the other on PPCP research. However, in order to effectively address this issue, collaboration and building partnerships for stewardship are essential components.

Agency decisions are based on the foundation of sound science and reliable information. Once this foundation is sufficiently established, OW’s strategy is to rely on existing regulatory tools to minimize the amount of PPCPs entering the environment from wastewater sources. This presentation will cover OW’s strategy and the work being done to implement this strategy.

Eva Steinle-Darling, Ph D., Eler & Kallinowski, Inc.

Title: “Natural Attenuation and the Potential for Treatment of PPCPs in Water

High-quality water resources are becoming increasingly scarce throughout the world, and climate change is anticipated to intensify water supply issues. As a result, water reuse, whether direct or indirect, intentional or unintentional, is increasingly becoming a reality for many communities around the world. The presence of pharmaceuticals and personal care products (“PPCPs”), is one of the most-cited, but as of yet, mostly unregulated aspects of water reuse.

This presentation focuses on the themes of fate, transport, and treatability introduced by Dr. Snyder, and summarizes recent studies published by Dr. Steinle-Darling and others that have documented attenuation processes and removal rates of PPCPs and other microconstituents (i.e., generally small, organic molecules of anthropogenic origin) in a variety of natural and engineered systems. The attenuation processes analyzed involve both biotic and abiotic mechanisms, such as biodegradation, photolysis, size exclusion, and sorption, in natural and engineered treatment systems, including conventional treatment, membrane filtration, and soil aquifer treatment systems.

In most cases, currently available technologies can achieve a high level of treatment for many PPCPs and other microconstituents. The fundamental issue is identifying the appropriate balance between the desired level of treatment and the financial and energy cost of achieving it at any level of acceptable environmental and health risk. Significant paradigm shifts will likely be necessary on the scientific, engineering, health risk, public communication, and regulatory levels in order to effectively address the microconstituent issue.

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