

Eric R. V. Dickenson

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EDUCATION

- Ph.D. Environmental Engineering, University of Colorado at Boulder, 2005
Dissertation: "Short-Term Disinfection By-Product Formation in a Chlorine/
Chloramine Approach: Natural Waters and Model Compounds"
Advisor: Dr. R. Scott Summers.
- M.S. Environmental Engineering, University of Colorado at Boulder, 2000
- B.S. Chemical Engineering, University of California at Davis, 1995

PROFESSIONAL EXPERIENCE

- 2005 – present Post Doctoral Associate, Colorado School of Mines (CSM)
- 1998 – 2005 Graduate Research Assistant, University of Colorado at Boulder
- 2003 Researcher Abroad, Université de Poitiers, France
- 1995 – 1997 Research Assistant, Lawrence Livermore National Laboratory, CA
- 1994 Research Assistant, University of California at Davis

TEACHING EXPERIENCE

- Spring 2006 Undergraduate/graduate course: ESGN 454, Water Supply Engineering,
Colorado School of Mines
- Spring 2001– 2005 Teaching assistant for undergraduate and graduate laboratory classes:
I prepped the classes and co-taught the labs with Professor R. Scott Summers
University of Colorado at Boulder
- Spring 2000 & 2004 Guest lecturer: disinfection by-product formation, Colorado School of Mines
and University of Colorado at Boulder

RESEARCH INTERESTS

My foremost research interest is the fate, transport, and formation of contaminants during drinking water and wastewater treatment processes and in potable and non-potable water reuse applications. The focus of my research includes the fate of emerging contaminants (e.g., EDCs and pharmaceuticals) in natural systems (e.g., aquifer recharge, riverbank filtration) and conventional and advanced engineered systems (e.g., reverse osmosis, nanofiltration, GAC, ozone, AOP, MBR). Specifically, I am interested in the development and application of quantitative structure property relationship (QSPR) models for rapid screening of the environmental fate of emerging contaminants within water treatment systems. I am also highly interested in the chemistry and mechanisms of formation and control strategies for minimization of disinfection by-products formed during water treatment. In addition, I am interested in the utilization of state-of-the-art characterization methods for natural and effluent organic matter (e.g., advanced fluorescence spectroscopy methods and size exclusion chromatography coupled with organic carbon detection) for water quality characterization and optimization of disinfection processes.

RESEARCH GRANTS

\$101,065	PI 05/08-05/09	Water Environment Research Foundation “ <u>Evaluation of QSPR Techniques for Wastewater Treatment Processes</u> ”, with Dr. Jörg Drewes (CSM) and Dr. Stuart Khan (University of New South Wales).
\$294,000	Co-PI 06/07-12/08	WateReuse Foundation “ <u>Comparisons of Chemical Composition of Reclaimed and Conventional Waters</u> ”, with Dr. Shane Snyder (Southern Nevada Water Authority) and Dr. Jörg Drewes (CSM).
\$200,000	Co-PI 12/06-12/09	WateReuse Foundation “ <u>Development of Surrogates to Determine The Efficacy of Groundwater Recharge Systems for the Removal of Trace Organic Chemicals</u> ”, with Dr. Jörg Drewes (CSM) and Dr. Shane Snyder (SNWA).
\$9,142	Co-PI 12/07-02/08	Separation Processes, Inc. “ <u>Membrane Screening and Prechlorination Study</u> ”, with Dr. Jörg Drewes (CSM) and Dr. Tzahi Cath (CSM).
\$17,132	Co-PI 11/06-06/07	Water Replenishment District of Southern California “ <u>The Role of Drinking Water Organic Matter to Recharged Groundwater during Surface Spreading Operations</u> ”, with Dr. Jörg Drewes (CSM).
\$15,600	Co-PI 06/07-08/07	County Sanitation Districts of Los Angeles County, CA “ <u>Evaluation of Testing Protocols to Determine Biodegradable Dissolved Organic Carbon (BDOC) during Surface Spreading Operations</u> ”, with Dr. Jörg Drewes (CSM).

PREVIOUS RESEARCH PROJECTS

2005 – 2007: Colorado School of Mines

- “Development of Indicators and Surrogates for Chemical Contaminant Removal during Wastewater Treatment and Reclamation”, funded by **WateReuse Foundation** – I determined appropriate indicators and surrogates for the following key treatment processes: soil-aquifer treatment, MBR, ozonation, advanced oxidation, chlorination, ultraviolet disinfection, activated-carbon adsorption, reverse osmosis and nanofiltration.
- “Contributions of Household Chemicals (HHCs) to Sewage and the Relevance to Municipal Systems and the Environment”, funded by **Water Environment Research Foundation** – I examined the fate of HHCs and other emerging wastewater-derived organic contaminants during a laboratory-scale flow-through activated-sludge treatment system under differing SRTs.
- “Development of a QSPR Toolbox for Reclaimed Water Treatment”, funded by **Water Environment Research and WateReuse Foundation** – I identified viable QSPR components for major fate and treatment routes within conventional and advanced wastewater treatment: phase partitioning (e.g., biosolids); reactivity (e.g., biodegradation, oxidation), and physical separation (e.g., membrane transport) and developed QSPRs for activated-carbon adsorption.
- “Comprehensive Utility Guide for Endocrine Disrupting Chemicals, Pharmaceuticals, and Personal Care Products in Drinking Water”, funded by the **American Water Works Association Research Foundation** – I reviewed the occurrence and treatability of EDCs and PPCPs during drinking water treatment (i.e., coagulation/flocculation, disinfection processes, granular and powdered activated carbon adsorption, advanced oxidation processes, membranes, and riverbank filtration).

- Developed a new analytical method for measuring colloidal polyphosphates, which can be used by the water industry for assessing fouling due to phosphate during membrane operations.
- Established state-of-the-art analytical methods for detecting and characterizing organic matter by fluorescence spectroscopy and HPLC-size exclusion chromatography coupled with on-line organic carbon detection.

1998 – 2005: University of Colorado at Boulder

- Dissertation: Studied the control of disinfection by-product formation in a chlorine/chloramine disinfection strategy under differing water quality and operational parameters. Also, identified new polar-type fast-reacting DBP precursors. Advisor: ***Dr. R. Scott Summers***.
- Masters Thesis: Studied the control of disinfection by-product formation by targeting the removal of polar natural organic matter by advanced treatment processes (i.e., activated carbon adsorption, membranes, ozonation). Advisor: ***Dr. Gary Amy***.

1995 – 1997: Lawrence Livermore National Laboratory, California

- Studied the pore-scale flow and transport of contaminants in a unique aqueous heterogeneous porous system using a novel nonintrusive fluorescence imaging technique.

1994: University of California at Davis

- Studied the irreversible adsorption behavior of volatile organic compounds from unsaturated soils.

FELLOWSHIPS, REGISTRATIONS, AFFILIATIONS, AND SERVICES

Fellowships

- Chancellor's Teaching Fellowship, University of Colorado at Boulder, 2001 and 2004
- Associated Western Universities Fellowship, LLNL, 1996
- Science and Engineering Research Semester Fellowship, LLNL, 1995

Registrations

- Engineer-Intern in the State of Colorado
- Drinking Water Treatment Operator, Class D, State of Colorado

Affiliations

- Member, American Water Works Association
- Member, Water Environment Federation
- Member, Water Partners International

Services

- Journal Reviewer: *Environmental Science & Technology*, *Journal of Environmental Engineering*, *Water Environment Research*, *Journal of the American Water Resources Association*
- Proposal Reviewer: Mississippi-Alabama Sea Grant Consortium Omnibus Program
- Member, AWWA Organic Contaminants Research Committee
- Member, The Consortium for Research and Education on Emerging Contaminants (CREEC)
- Member, M.S. thesis committee, "Optimizing Granular Media Filtration Through Bench-scale and In-Situ Floc Particle Characterization" 2006. Colorado School of Mines.
- Member, M.S. thesis committee, "Modeling Disinfection By-product Formation in Distribution Systems and Consecutive Systems by Hold Study and Bench Study Techniques with an Investigation of Alternative Disinfection Practices for Reduction of Disinfection By-product Formation" 2008. University of Colorado at Boulder.

- Member, M.S. thesis committee, “The Role of Redox Conditions, Biodegradable Organic Carbon (BDOC) and Initial Concentration on the Removal of Wastewater-Derived Contaminants during River Bank Filtration (RBF)” 2008. University of Berlin, Germany
- Member, 1st WEF/AWWA Student Conference Committee at the Colorado School of Mines, 2004
- Member, Chemical and Biological Engineering Internal Review Committee at the University of Colorado, 2004
- High school guest teacher, Denver School of Science and Technology, 2005
- Undergraduate student mentor, 2000 & 2002: University of Colorado at Boulder

PUBLICATIONS

Journal Publications

- Dickenson, E.**, Summers, R.S., Croué, J-P., and Gallard, H., (2008) Haloacetic acid and trihalomethane formation from the chlorination and bromination of aliphatic β -dicarbonyl acid model compounds, *Environmental Science and Technology*, in press.
- Drewes, J., **Dickenson, E.**, Sedlak, D., and Snyder, S. Selection of indicator compounds occurring in conventional treated wastewaters. *Water Research*, In preparation.
- Drewes, J., **Dickenson, E.**, Sedlak, D., and Snyder, S., Surrogate and indicator regulatory framework to assess performance of indirect potable reuse treatment systems. *Journal of Environmental Quality*, In preparation.
- Dickenson, E.**, Drewes, J., Snyder, S., and Sedlak, D. Using indicators and surrogates to assess the performance of soil aquifer treatment for the removal of wastewater-derived contaminants, *Environmental Science and Technology*, In preparation.
- Dickenson, E.** and Drewes J., The effect of sludge retention time on the removal of pharmaceuticals and personal care products during wastewater treatment, *Water Environment Research*, In preparation.
- Drewes, J., Snyder, S., and **Dickenson, E.**, Occurrence and fate of high-production volume household chemicals during wastewater treatment, *Water Research*, In preparation.
- Dickenson, E.**, Drewes, J., and Snyder, S., A review of the occurrence and treatability of trace wastewater-derived organic compounds during drinking water treatment, *Chemosphere*, In preparation.
- Dickenson, E.**, and Summers, R.S., Trihalomethane and haloacetic acid formation in a sequential chlorine/chloramine disinfection approach, *Journal of American Water Works Association*, In preparation.
- Dickenson, E.** and Summers, R.S., Predicting trihalomethane and haloacetic acid formation kinetics using chlorine demand, *Journal of Environmental Engineering*, In preparation.
- Dickenson, E.**, Croué, J-P., Krasner, S., Leenheer, J., and Amy, G., Disinfection by-product formation from polar natural organic matter within drinking waters, *Water Research*, In preparation.

Book Chapters

- Dickenson, E.** and Amy, G., (2000) NOM characterization of clarified waters subjected to advanced bench-scale treatment processes, in *Natural Organic Matter and Disinfection By-products Characterization and Control in Drinking Water*, edited by S.E. Barrett, S.W. Krasner, and G.L. Amy, American Chemical Society, Washington D.C.

Published Project Final Reports

- Drewes, J., **Dickenson, E.**, and Snyder, S., (2008) *Contributions of Household Chemicals to Sewage and the Relevance to Municipal Systems and the Environment*, Water Environment Research Foundation, Alexandria, VA.
- Drewes, J., **Dickenson, E.**, Snyder, S., and Sedlak, D., (2008) *Development of Indicators and Surrogates for Chemical Contaminant Removal during Wastewater Treatment and Reclamation*, WaterReuse Foundation, Alexandria, VA.
- Snyder, S., Vanderford, B., Drewes, J., **Dickenson, E.**, Snyder, E., Bruce, G., and Pleus, R., (2008) *Comprehensive Utility Guide for Endocrine Disrupting Chemicals, Pharmaceuticals, and Personal Care Products in Drinking Water*, American Water Works Association Research Foundation, Denver, CO, USA.
- Hwang, C.J., Krasner, S.W., Scilimenti, M.J., Amy, G.L., **Dickenson, E.**, Bruchet, A., Prompsy, C., Gisèle, F., Croué J-P., Violleau, D. and Leenheer, J. (2001) *Polar NOM: Characterization, DBPs and Treatment*, American Water Works Association Research Foundation, Denver, CO, USA.

Proceeding Papers Associated with Conference Presentations

(* denotes presenter)

- ***Dickenson, E.** and Drewes, J. (2008) Removal of pharmaceuticals and personal care products during activated-sludge wastewater treatment. Proceedings of the *2008 World Environmental & Water Resources Congress Annual WaterReuse Symposium*, May 12-16, Honolulu, HI.
- ***Dickenson, E.**, Drewes, J., Snyder, S., and Sedlak, D. (2007) Applying chemical surrogates for assessing the removal of wastewater organic contaminants in groundwater recharge projects. Proceedings of the *22nd Annual WaterReuse Symposium*, September 9-12, Tampa, Florida.
- ***Dickenson, E.**, Drewes, J., Bellona, C., Snyder, S., and Lei, D. (2006) Quantitative Structure Property Relationships for Assessing the Removal of Emerging Organic Contaminants in Water Treatment. Proceedings of the *AWWA 2006 Water Quality Technology Conference*, Nov 5-9, Denver, Colorado.
- ***Dickenson, E.**, Drewes, J., Lei, D., and Snyder, S. (2006) Identifying Molecular Descriptors for Assessing the Removal of Organic Contaminants during Advanced Water Reuse Treatment Processes. Proceedings of the *21st Annual WaterReuse Symposium*, September 10-13, Hollywood, California.
- *Drewes, J., Sedlak, D., Snyder, S., and **Dickenson, E.** (2006) Viability of Indicators and Surrogates to Assess Removal of Chemical Contaminants during Indirect Potable Reuse. Proceedings of the *21st Annual WaterReuse Symposium*, September 10-13, Hollywood, California.
- ***Dickenson, E.**, Drewes, J., Sedlak, D., and Snyder, S. (2006) Classification of Indicators and Surrogates into Treatment Bins for Monitoring Wastewater-Derived Chemical Contaminants in Indirect Potable Reuse. Proceedings of the *5th International Conference on Pharmaceuticals and Endocrine Disrupting Chemicals in Water*. National Ground Water Association, March 13-15, Costa Mesa, California.
- ***Dickenson, E.**, Summers, R.S., Croué, J-P., and Gallard, H. (2005) Fast-Reacting Chlorinated Disinfection By-Product Precursors. Proceedings of the *AWWA 2005 Annual Conference*, June 12-16, San Francisco, California.

- Arias, M., ***Dickenson, E.**, and Summers, R.S. (2004) Optimization of powdered activated carbon and preoxidant application in conventional drinking water plants. Proceedings of the AWWA 2004 Water Quality Technology Conference, Nov 14-18, San Antonio, Texas.
- ***Dickenson, E.** and Summers, R.S. (2004) Bromide and prechlorination effects upon disinfection by-product formation within a chlorine/chloramine disinfection approach. Proceedings of the AWWA 2004 Annual Conference, June 13-17, Orlando, Florida.
- ***Dickenson, E.** and Summers, R.S. (2003) Using chlorine exposure (CT) to predict trihalomethane formation. Proceedings of the AWWA 2003 Water Quality Technology Conference, Nov 2-5, Philadelphia, Pennsylvania.
- ***Dickenson, E.**, Work, L., and Summers, R.S. (2002) Short-term chlorine decay and disinfection by-product formation. Proceedings of the AWWA 2002 Annual Conference, June 16-20, New Orleans, Louisiana.
- ***Dickenson, E.**, Amy, G., Hwang, C., and Scilimenti, M. (2000) Control of polar natural organic matter (NOM) by advanced treatment processes. Proceedings of the AWWA 2000 Water Quality Technology Conference, Nov. 5-9, Salt Lake City, Utah.
- *Dehmeshki, J., Rashidi, M., **Dickenson, E.**, and Daemi, F. (1997) Automatic vision system for analysis of microscopic behavior of flow and transport in porous media. Proceedings of the International Society for Optical Engineering, San Diego, California.
- *Rashidi, M., Dehmeshki, J., Daemi, F., Cole, L., and **Dickenson, E.** (1997) Color image analysis of contaminants and bacteria transport in porous media. Proceedings of the International Society for Optical Engineering, San Diego, California.
- *Rashidi, M. and **Dickenson, E.** (1997) Experimental investigation of pore-scale transport in aqueous heterogeneous porous media. Proceedings of the American Society of Mechanical Engineers Fluids Engineering Division Summer Meeting, Vancouver, British Columbia, Canada.
- ***Dickenson, E.** and Rashidi, M. (1996) Small scale flow processes in aqueous heterogeneous porous media. Proceedings American Society of Mechanical Engineers Fluids Engineering Division Summer Meeting, San Diego, California.

CONFERENCE AND SEMINAR PRESENTATIONS (with abstract only)

- Dickenson, E.**, Drewes, J., and Bellona, C. (2007) Using QSPR techniques for assessing the removal of emerging organic contaminants during wastewater and water reuse treatment processes. American Water Resources Association, Summer Specialty Conference: Emerging Contaminants of Concern in the Environment, June 25-27, Vail, Colorado.
- Drewes, J., **Dickenson, E.**, and Bellona, C. (2007) State-of-the-art approaches to monitor unregulated and regulated trace organics in indirect potable reuse. 11th Annual WateReuse Research Conference, May, El Paso, Texas.
- Dickenson, E.** and Drewes, J. (2007) Assessing the removal of emerging organic contaminants by activated carbon adsorption using quantitative structure property relationships for assessing the removal of emerging organic contaminants in water treatment. 233rd American Chemical Society National Meeting & Exposition, March 25-29, Chicago, Illinois.
- Drewes, J. and **Dickenson, E.** (2007) Wastewater treatment research on household chemicals & contaminants of concern. February 14, Metro Wastewater Reclamation District, Colorado.

- Dickenson, E.**, Drewes, J., Sedlak, D., and Snyder, S. (2006) Identifying indicators and surrogates for chemical contaminant removal during indirect potable reuse. 10th Annual Water Reuse Research Conference, May 15-16, Phoenix, Arizona.
- Jeffers, J., **Dickenson, E.**, Jennings, T. and Drewes, J. (2006) Development of freundlich adsorption coefficients for the removal of organic contaminants from wastewater by activated carbon. 3rd Annual WEF/AWWA Student Conference, May 19, Fort Collins, Colorado.
- Dickenson, E.** and Summers, R.S. (2005) Disinfection By-Product Formations under a Chlorine/Chloramine Disinfection Approach. US EPA Workshop on Optimizing the Design and Interpretation of Epidemiologic Studies to Consider Alternative Disinfectants of Drinking Water, Raleigh, June 2-3, North Carolina.
- Dickenson, E.** and Arias, M. (2004) The formation of disinfection by-products in the drinking water treatment plant. Seminar lecture at the Colorado School of Mines, Golden, Colorado, February 12.
- Dickenson, E.** (2003) Disinfection by-product formation in a chlorine/chloramine disinfection approach. Seminar lecture at the University of Colorado at Boulder, September.
- Dickenson, E.** and Amy, G. (1999) NOM characterization of clarified waters subjected to advanced bench-scale treatment processes. 217th American Chemical Society National Meeting, Anaheim, California.
- Dickenson, E.** and Rashidi, M. (1996) Fluorescent microscopic imaging: an experimental technique for quantitative visualization of subsurface contaminant transport. American Geophysical Union Fall Meeting, San Francisco, California.