

WEF Microconstituents and Industrial Water Quality 2009

WERF Research on Trace Organics in Biosolids



Water Environment Research Foundation
Collaboration. Innovation. Results.

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Today's Presentation

- Introduction (including Hais' two cents worth)
- Past and WERF Trace Organics Research
 - Overall program
 - Biosolids-specific
- Proposed research initiative for biosolids

Where's it (biosolids) going?

- 7,180,000 dry tons produced annually (2004)
- 55% applied to the land
 - 40% Class A
 - 60% Class B
- 30% land filled
- 15% incinerated
- 770,000 acres at 5 dry tons/acre for currently land-applied biosolids (<0.1% of pasture, range and cropland)
- 1.4 million acres (0.14%) if all solids land-applied

What are the issues?

- Metals – mostly behind us
- Pathogens – being overshadowed by trace organics
- Trace organics – a real “hot button”
- Big cities vs. rural communities
- Minority opposition – organized & vocal but still relatively localized
- Climate change – will it drive future practice?

Biosolids Trace Organics

- The problem
 - Trace organics is today's hot topic – food supplies, drinking water, ambient water, ecosystems
 - Expensive and hard to measure
 - New chemicals on a daily basis
 - Health and environmental effects not well understood
 - Since wastewater solids concentrate contaminants, the numbers for biosolids look high
 - EPA survey found pharmaceuticals, steroids and flame retardants in all samples, but did not speculate on the significance; survey didn't test for perfluorinated compounds (Teflon)

Biosolids Trace Organics

- The reality
 - Biosolids are a “secondary source”
 - Human exposure through biosolids likely to be minimal
 - Ecological effects likely the greatest concern (bioaccumulation)
 - Some degradation may occur at treatment plant, but source control likely will be needed if risks are significant
 - Need definitive answers, not speculation and extrapolation
 - Research is doable but expensive and time consuming; classes of compounds

Biosolids Trace Organics

Unknowns and Potential Surprises

- Even low concentrations could affect organisms in ways we haven't considered
 - Antibiotic resistance in human/animals
 - Changes in soil microbes and reactions they mediate
 - Chronic hormone exposure
 - Cumulative & synergistic effects
 - Unknown/under-appreciated HEIs
- Risk due to prolonged human and environmental exposure at low concentrations largely unknown

WERF Research on Trace Organic Compounds (TOrCs)

- Program Objective
 - Provide essential frameworks, tools and information to wastewater treatment managers at utilities and industrial facilities
 - Focus is on producing reliable effluents for multiple uses, including protection of aquatic ecosystems in receiving waters
- WERF has initiated or contributed to nearly \$2.5 million dollars of research in the area of EDCs and PACs
 - 10 completed projects
 - 8 ongoing projects

Trace Organic Constituents (TOrC) Research Challenge

Research Area Topics

- Analytical methods (developing and improving tools)
- Fate and transport
- Occurrence
- Treatment effectiveness and processes
- Understanding ecological effects
- Communication (internal/technical & external/non-technical)

New WERF Projects started May 2009

- Treatment project - 2.5 yrs; \$535K
- Aquatic/ecological project - 1.5 years for Phase 1; \$500K

Trace Organic Compounds Removal During Wastewater Treatment – Categorizing Wastewater Treatment Processes by their Efficacy in Reduction of a Suite of Indicator TOrC (CEC4R08)

- Will identify key indicator compounds that represent classes of contaminants, and assess the efficacy of various treatment processes under field-scale conditions at volunteer WWTPs
- Research team: Carollo Engineers, Colorado School of Mines, Clark County Water Reclamation District, Southern Nevada Water Authority
- Will be complete by end of 2011

Trace Organic Compounds Removal During Wastewater Treatment – Categorizing Wastewater Treatment Processes by their Efficacy in Reduction of a Suite of Indicator TOrC

- Indicator compounds will be used to validate fate models and allow rapid characterization of efficiency of conventional wastewater unit operations
- Full-scale performance data will identify mechanisms responsible for TOrC attenuation in individual unit operations
- Develop functional relationships between critical process parameters and TOrC removal efficiencies
- End product will approach to predict removal efficiencies for a wide range of TOrC

Diagnostic Tools to Evaluate Impacts of Trace Organic Compounds (CEC5R08)

Goal is to determine the relationship between exposure to TOrC and adverse impacts to aquatic populations and communities

- Will develop a screening tool
 - Assess whether observed site-specific impacts on aquatic populations or communities are caused by TOrC
 - Determine whether exposure concentrations of TOrC are likely to cause aquatic population and/or community effects
- Prioritized list of TOrC
 - Consensus list with rationale
 - Relational database and user interface

Diagnostic Tools to Evaluate Impacts of Trace Organic Compounds

- Phase 1
 - Evaluate the effects of TOrC on aquatic populations
 - Prioritize TOrC based on their potential to impact aquatic populations and communities
 - Develop a screening tool
- Phase 2
 - Field studies to examine aquatic effects in the presence of other chemical and biological stressors
- Research team: Tetrattech, E2 Consulting Engineers, FTN & Associates, Condatus Consulting, University of New Brunswick
- Phase 1 scheduled to be completed by the end of 2011

Fate of Estrogenic Compounds During Municipal Sludge Stabilization and Dewatering (04HHE6)

- Evaluate the fate of known estrogenic compounds and total estrogenic activity in solids derived from wastewater treatment and through commonly used sludge and solids treatment processes.
- Research team: AECOM, University of Arizona, USGS

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Fate of Estrogenic Compounds During Municipal Sludge Stabilization and Dewatering (04-HHE-6)

- 4 study plants – 33 sample points
- Thickening
 - gravity/gravity belt
 - dissolved air flotation
- Stabilization
 - lime addition
 - anaerobic/aerobic digestion
- Chemical conditioning
- Dewatering (centrifugation)
- Other processes including composting & pelletization.

Chemical Analysis and Bioassay

- Chemical Analysis
 - Anthropogenic wastewater indicators (59 compounds)
 - Pharmaceuticals (24 compounds)
 - Hormones (19 compounds)
- In vitro bioassay
 - Yeast Estrogen Screen (YES)
 - T47D-K Blue

WERF Research Initiative – Evaluation of Fate and Exposure for Trace Organics in Biosolids-Amended Soils

- Need
 - Latest “hot topic” for biosolids
 - Requested by WERF subscribers
 - Response to EPA survey; data needed for regulatory decisions re: Part 503
- Plan to work with full range of stakeholders
 - Wastewater utilities
 - Industry groups
 - Academia
 - Federal agencies – EPA, USGS, others?

WERF Research Initiative – Evaluation of Fate and Exposure for Trace Organics in Biosolids-Amended Soils

- Trace organics that end up in biosolids can reach the environment via land application
- Minimal research to date on fate, transport, exposure and impacts of trace organics in biosolids-amended soils
- Numerous data gaps limit scientifically sound risk assessment

WERF Research Initiative – Evaluation of Fate and Exposure for Trace Organics in Biosolids-Amended Soils

- Goal is to provide information to regulatory and other public agencies, product manufacturers, and other responsible entities to support informed regulatory and policy decisions
- WERF funded *State-of-the-Science Review* to get underway in August
 - Identify data gaps to help define proposed study
 - Provide information on current knowledge to help put issue into context and communicate more effectively with the public more effectively

WERF Research Initiative – Evaluation of Fate and Exposure for Trace Organics in Biosolids-Amended Soils

- Would seek funding from various stakeholders
 - WERF subscribers, including Targeted Collaborative Research
 - Industry groups
 - EPA (?)
- Multi-year, multi-million dollar study
- Plan to press ahead despite tough economics times

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www.werf.org/biosolids
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