The Little Things
What is Coming?

- Mercury – amalgam
- Priority Persistent Pollutants – Oregon
- Triclosan
- Nano-particles
SB 737 and BEYOND

It’s the little things that matter
SB 737 and BEYOND

TIER I
POLLUTANTS

*Persistent Pollutants (69)*
- Pesticides & Herbicides
  - *Chlorpyrifos, Diazinon*
- Consumer-Related Products
  - *Diethylstilbestrol, Triclosan, Terphenyl*
- Halogenated Flame Retardants
- Industrial Chemicals
- Poly Aromatic Hydrocarbons (PAH)
  - *Pyrene*
- Metals
- Perflourinated Surfactants

TIER II
POLLUTANTS

*Legacy Pollutants (49)*
- Pesticides & Herbicides
  - *DDT*
- Polychlorinated Napthalenes
- Dioxins / Furans
- Polychlorinated Biphenyls (PCB)
SB 737 and BEYOND

Using Data from SB 737 Effluent Sampling

Results for ~400 parameters (includes 117 persistent pollutants)

~ 90 have water quality standards

~ 25 analyzed with 40 CFR Part 138 methods

~ 50 analyzed with other methods

~ 310 do not have water quality standards

Can use data for permitting purposes:
- RPA
- Reporting by permittees

Data used only for "knowledge of process"
- Identify whether pollutant parameters are present
- Potentially identify issues that would lead to monitoring requirements at permit renewal

Data used for informational purposes only
- E.g. inform WET testing

4/26/11
SB 737 and BEYOND

Next Up

Human Health Criteria Based Water Quality Standards

Fish Consumption Rate
Currently based on 6.5 grams of fish consumed daily
Proposal to change WQ Standards based on 175 grams of fish consumed daily

DEQ developing an overall Toxics Reduction Strategy
SB 737 and BEYOND

FOR MORE INFORMATION CHECK OUT
http://www.deq.state.or.us/wq/SB737/index.htm
The Fates and Impact of Triclosan in the Environment

Rolf U. Halden, PhD, PE
The Biodesign Institute
School of Sustainable Engineering and the Built Environment
Global Institute of Sustainability
Arizona State University

Department of Environmental Health Sciences
Johns Hopkins University, Bloomberg School of Public Health

NACWA 2011 National Pretreatment and Pollution Prevention Workshop, May 19, 2011
TCS: A Public Health Protection Failure

- 2005 FDA panel concluded that TCS offers no measurable benefit in common uses such as antimicrobial hand soap

- Widespread use of triclosan (TCS) has NOT lowered incident rate of infectious diseases

- TCS promotes cross-resistance to clinically important antibiotics

- TCS is an endocrine disruptor, allergen, bioaccumulates in humans and is detectable in human milk fat at ppm levels

- TCS is a major contributor to soil, water and air pollution
Contact Time
Key to understanding TCS ineffectiveness and toxicity

5 – 10 Seconds
(ineffective)

Lifetime exposure, e.g., in aquatic organisms (toxic)

Source: US EPA
Fate of Triclosan in Activated Sludge WWTP

![Chemical Structure of Triclosan (TCS)]

- Mass in effluent
- Mass in sludge
- Mass transformed/lost

2 ±1%

48 ±19%

50 ±19%

• Aquatic Occurrence
  – 58% of U.S. streams, GW, DW
  – Ocean water
• Bioaccumulation
  – Algae
  – Crustacea
  – Fish
  – Dolphins
• Endocrine Disruption
• Other Impacts
  – Behavioral changes
  – Immuno-toxic effects
  – Growth impairment


Source: http://www.dolphinage.com/images/Dolphin.jpg
Occurrence of Antimicrobials in Aquatic Sediments

Triclosan used 45 years ago is still present today in U.S. sediments

Miller et al. ES&T 2008, 42:4570-76
Contaminated Land

Approximately 140,000 lbs/yr of Triclosan and 290,000 lbs/yr of Triclocarban are applied inadvertently on U.S. agricultural land as a result of sewage sludge disposal.

This presents a pathway for contamination of food with antimicrobials and drug-resistant microbes.

Triclosan is a Precursor of Carcinogenic Dioxins

Incineration of sewage sludge contaminated with triclosan and its derivatives is suspected to be a major contributor to dioxin emissions in the U.S.

Modeling results suggest that triclosan accounts for at least 3.6% and up to 100% of dioxins emitted from sewage sludge incinerators (which happen to be exempted from routine monitoring)

### Percent of samples or products that contain triclosan

#### People
- **Breast milk**: 97%<sup>1</sup>
- **Americans over age 6 (urine)**: 75%<sup>2</sup>
- **Cord blood**: 47%<sup>3</sup>

#### Environment, Food & Water
- **Rivers and streams**: 58%<sup>4</sup>
- **Tap water and food**: Unknown, no testing required.<sup>5</sup>

#### Consumer products
- **140 types of consumer products**: Unknown. For most products, no labeling or registration required.<sup>6</sup>
- **Liquid hand soap**: 43%<sup>7</sup>
- **Toothpaste**: 7%<sup>7</sup>

Source: Sutton, 2008
Prioritized Human Health Risks at a Glance

Degradates (including chloroform)

 Persistent Environmental Contaminant

Cross-resistance to Antibiotics

Impurities

Triclosan

Air Pollution with Dioxins

Endocrine Disruption

Bioaccumulation

Halden (2011) Congressional Briefing
Conclusions

- Triclosan persists in the environment
- Ubiquitous contamination threatens some biota
- **Current use of antimicrobials is unsustainable**
- Exposure is certain – Risks are less well understood
- **Current regulations are ineffective**
- Ban of antimicrobials is feasible (e.g., hexachlorophene in 1970s)
- **Removal of TCS & TCC from personal care products would cut the loading of PPCPs to soils by >60%!**
- **Endocrine disruption, multi-drug resistance and air pollution drive risk & require more attention/research/regulation**
Impact of Silver Nanoparticles on Wastewater Treatment

Zhihua Liang, Atreyee Das and Zhiqiang (Zack) Hu
Department of Civil and Environmental Engineering,
University of Missouri
May 11, 2011
Nanoparticles

Particles with one dimension of nanoscale (typically 1-100 nm)

TEM image of gold nanospheres
Source: biomanotechnology, 2006, Annual meeting, San Francisco, CA

Source: www.beyondpesticides.org/antibacterial/nanose.
Research Questions

- Environmental Implications
  - How will emerging nanomaterials affect wastewater treatment and anaerobic sludge digestion?
  - How will nanoparticles impact the environment?

- Environmental Applications
  - Can nanomaterials be used for water/wastewater treatment and environmental remediation?
  - How will nano-scale materials be used for water/wastewater treatment while their negative impact is minimized?
Silver Nanoparticles (AgNPs, Nanosilver) as a Emerging Antimicrobial Agent

- Silver ions and silver nanoparticles AgNPs (nanosilver): widely used in consumer products.

- Total Ag concentration range from 1.78 to 105 μg/L in wastewater influent (Shafer et al. 1998).

- With a concentration factor of more than 100 in WWTP, the predicted silver concentrations in sludge is between 7 to 39 mg/kg (Blaser et al. 2008).
RESEARCH OBJECTIVES

- Determine the impact of silver nanoparticles on the representative wastewater treatment processes
  - To determine the degree of nanosilver inhibition to bacterial activity and changes of effluent water quality
  - To evaluate the bacterial response to a shock load of silver nanoparticles and the potential change of nitrifying bacterial community structure using molecular tools such as Terminal Restriction Fragment Length Polymorphism (T-RFLP)
RESULTS OF T-RFLP before and after shock loading --Ammonia-Oxidizing Bacteria

*Nitrosomonas eutropaea* (161 bps) (A) was the dominant genus of ammonia-oxidizing bacteria (AOB) before nanosilver shock loading.

*Nitrosomonas eutropaea* (161 bps) peak **decreased** after shock loading.

\[ \text{NH}_4^+ + 1.5\text{O}_2 \rightarrow \text{NO}_2^- + \text{H}_2\text{O} + 2\text{H}^+ \]

*Nitrosomonas eutropaea*
RESULTS OF SHOCK LOADING - Nitrite Oxidizing Bacteria

*Nitrobacter* (136 bps)

*Nitrobacter* was one of the major nitrite-oxidizing bacteria before shock loading.

*Nitrobacter* was washed out after shock loading.

\[
\text{NO}_2^- + 0.5\text{O}_2 \rightarrow \text{NO}_3^-
\]
SUMMARY

- Batch test results showed AgNPs had higher inhibition on nitrification than Ag^+ ions.

- A 12-h shock load of nanosilver resulted in a peak concentration of 0.75 mg/L Ag in the MLE bioreactor, a prolonged period (> 1 month) of nitrification inhibition and deteriorate effluent water quality.

- The shock-loading event did not affect heterotrophic activity and organic matter removal.

- A shock load of nanosilver changed the nitrifying bacterial community structure, resulting in decreases of *Nitrosomonas* and *Nitrospira* population and wash-out of *Nitrobacter*. 
Not so Little Things

- Flushable Roundtable Discussion
- Towels cause grease blockages
  - Unless line sag
  - Roots
- Grease blockage is the side effect
- Finding grease is not the SSO answer!
• Redefine
  – Pollutant which causes a problem (Hawaii)
  – Any material (Orange County)
  – Any detrimental material (Green Bay)
Shift in program

- Sewer crews need to be more progressive
- Classify problems more definitively: control physical problems in specific areas
- Education with cleaning crews that use clorox wipes
- Education with apartments and rentals is difficult unless you have the ability to back-charge residents via owner agreement
-Questions???

Penny Bouchard
Environmental Specialist
Baxter & Woodman Inc.
847-223-5088
pbouchard@baxterwoodman.com