Why Not Bioassays for Biosolids?

Robert K. Bastian
Office of Wastewater Management
U.S. Environmental Protection Agency
Washington, D.C. 20460

Tele: 202-564-0653
Fax: 202-501-2397
Traditional Biosolids Exposure Pathways

Source ➔ Contaminant ➔ Fate/Transport ➔ Route ➔ Human

Air ➔ - Microbes
Soil ➔ - Chemicals
Water ➔ - Endotoxins
Biosolids ➔ - Odors

Inhalation ➔ Ingestion ➔ Dermal Absorption
Exposure Pathways Assessed Agricultural Land Application Scenario to Assess Human Exposure
Figure 1: Human Health-Based Chemical Selection Process

Chemicals reported in sewage sludge & having HHB from variety of sources (232)

Is the chemical already regulated in Round One?

No (223)

Was the chemical previously evaluated & determined not to be a hazard?

No (208)

Were measured concentrations in US sewage sludge reported in the NSSS or in the literature search?

Yes (79)

Is a HHB available from a final IRIS or OPP assessment?

Yes (61)

Is an IRIS or OPP assessment ongoing?

No (40)

Candidate chemicals for exposure screening (40)

Yes

No further evaluation at this time (9)

No further evaluation at this time (15)

No further evaluation at this time (129)

No further evaluation at this time (18)

Prioritize for possible inclusion in a targeted survey (21)
EPA 2001 Sewage Sludge Dioxin Data (94 POTWs)
AMSA 2001 Sewage Sludge Dioxin Data (200 POTWs)

[TEQ Dioxins, ppt]
Emerging Contaminants

- PPCPs
- EDCs
- Other: BFRs, PFCs, pesticides
  - BFRs – brominated flame retardants
  - PFCs – perfluorinated compounds
Contaminants of Emerging Concern in Water*

- PFOA
- PBDEs
- Prions
- Nanomaterials
- Endocrine Disrupting Compounds
- Pharmaceuticals and Personal Care Products (PPCPs)
- Pesticides

*Not an exhaustive list.
EPA Fact Sheet

Guidelines Establishing Test Procedures for the Analysis of Pollutants; Whole Effluent Toxicity Test Methods; Final Rule

Summary

EPA is approving revisions to several whole effluent toxicity (WET) test methods that are currently approved at 40 CFR Part 136. These methods are for use in Clean Water Act (CWA) data gathering and compliance monitoring programs. In addition, this final rule ratifies EPA’s previous approval of ten WET methods at 40 CFR Part 136 for nationwide use and removes two other methods from the Part 136 listing.
Acute Aquatic Toxicity

Aquatic toxicity is measured by fish bioassay. A waste can be tested for this criterion by placing some waste in a test water tank and introducing one of three acceptable fish species: fathead minnows, rainbow trout or golden shiners.

Waste is hazardous by aquatic toxicity if a 96-hour LC₅₀ is less than 500 mg/l. A 96-hour LC₅₀ < 500 mg/l = acute aquatic toxicity.

For more information on Acute Aquatic Toxicity, see Part 800 of the Standard Methods of the Examination of Water and Wastewater, 15th Edition.
Some Potential Bioassy Types:
Biotoxicity ... Soil Bioassay ... Genotoxic Effects

- **Earthworm assays** — toxicity (LD50s), bioaccumulation, cocoon production, reproduction success, biomass/growth rates

- **Nematodes** — mortality, reproduction, behavior

- **Plant assays** — seed germination success (lettuce, soybean, tall fescue, etc.), root hair growth rate (elongation)

- **Microbial Respiration/CO₂ production** — direct count, composition diversity, biomass, activity ... Microtox ... Phosphorescent bacteria
DEVELOPMENT OF A METALS TOXICITY
PROTOCOL FOR BIOSOLIDS

2004
Memorandum

To: Any Waste Producer
From: W. Lee Daniels
Re: Soil Testing Procedures for Waste Products

Date: January 10, 2004

At your request, I have prepared this memo to describe the procedures that we use to test various waste by-products for utilization as (1) soil amendments or (2) in manufactured soil mixes. In this memo I am summarizing the approach that our research team (which also includes Drs. Mike Beck, Greg Evanylo, and Lucian Zelazny) currently employs for this purpose. We have been involved in this area of work since the early 1990’s, and over that period of time, we have screened a wide range of municipal and industrial residuals for potential beneficial reuse including composts, biosolids, papermill sludges, coal fly ash, wood ash, soybean processing wastes, foundry sands, ground construction debris, and a wide array of mining and mineral processing wastes.