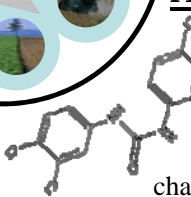


Fate and Transport of Biosolids-Borne Triclocarban

Elizabeth H. Snyder* (UF), George O'Connor (UF), and Drew McAvoy (P&G) • Funded by USEPA • In collaboration with the Procter & Gamble Company



Abstract: Triclocarban (TCC) is an active ingredient in antibacterial bar soap and a common constituent of domestic wastewater (~10 ng L⁻¹). Significant levels of TCC are also expected in biosolids. Behavior and effects of biosolids-borne TCC in the environment have been hypothesized, but not validated. Our research addresses the TCC data gaps by measuring important physico-chemical parameters and characterizing environmental fate. Work addressing potential antimicrobial resistance will begin Summer 2008. Collected data will be used to identify the most important human exposure pathways and perform a quantitative environmental health risk assessment.



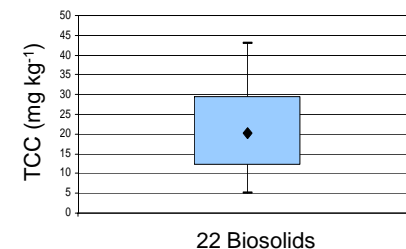
Step 2: TCC Concentrations in Biosolids

METHOD:

- Extraction method validated using ¹⁴C-TCC spikes
- 22 biosolids representative of various treatment processes extracted by shake-flask with 50:50 MeOH/acetone; extracts analyzed by HPLC/MS

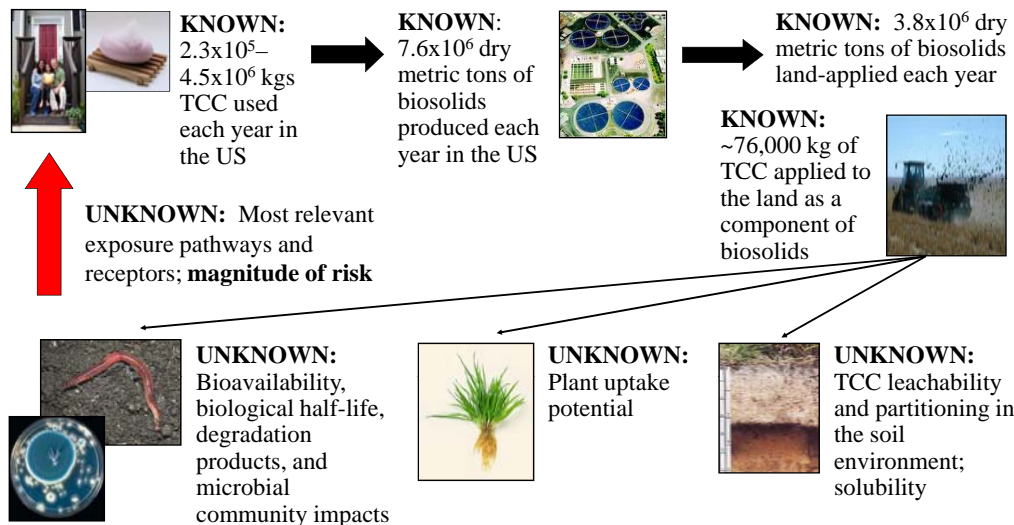
RESULTS:

- TCC concentrations in biosolids from 5-43 mg kg⁻¹, mean concentration ~20 mg kg⁻¹

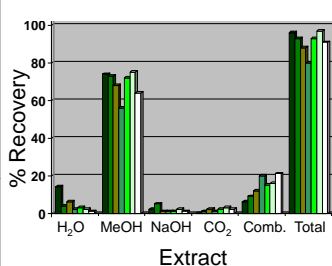


22 Biosolids

TCC Risk Assessment Data and Gaps:



Step 3: TCC Biodegradation in Amended Soils



METHOD:

- Soil amended with ¹⁴C-TCC spiked biosolids
- 8-month incubation; periodic sample removal (T0-T8) for extraction and combustion
- Evolved ¹⁴CO₂ collected in KOH
- Extracts analyzed for ¹⁴C, and by radio thin layer chromatography (RAD-TLC) for metabolite detection

RESULTS:

- 2-4% mineralization by 8 months
- No intermediate compounds identified

Step 4: TCC Leaching from Amended Soils

METHOD:

- 11 biosolids amended to soil columns and periodically leached (5 months)
- Leachates analyzed for TCC by HPLC/MS and limit of quantification (LOQ) calculated

RESULTS:

- No samples above LOQ (10 ng mL⁻¹)
- Because adverse effects observed in aquatic organisms below the 10 ng mL⁻¹, samples are being reanalyzed by HPLC/MS/MS (improved LOQ = 0.03 ng mL⁻¹)

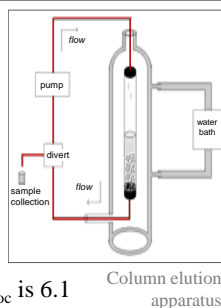
Step 1: TCC Solubility, K_{ow}, and K_{oc}

METHOD:

- Solubility determined by EPA column elution guideline
- K_{ow} determined by EPA shake-flask guideline
- K_d estimated by measuring TCC concentrations in the solid and water fractions of biosolids

RESULTS:

- Solubility is 0.045 mg L⁻¹
 - measured value less than previous quantitative structure activity relationship (QSAR) predictions
- Log K_{ow} is 3.5
 - measured value less than previous QSAR predictions
- Log K_{oc} is 6.1
 - measured value greater than estimates from spike experiments



Preliminary Conclusions

- A range of TCC concentrations are present in biosolids, but typical values are 2.5 times lower than initially publicized
- Solubility, K_{ow} and K_{oc}, measurements suggest mobility and bioaccumulation potential less than predictions using estimated values
- TCC is persistent in biosolids-amended soils, but bioavailability and leachability is expected to be limited

Future Work

- Determine TCC bioavailability and toxicity to earthworms in biosolids-amended soils
- Characterize biosolids-borne TCC effects on microbial communities by assessing changes in NH₃, NO₃, and CO₂ production
- Explore antimicrobial resistance development using gene expression microarray technology
- Perform a quantitative environmental health risk assessment for biosolids-borne TCC