

Acute Toxicity of Cigarette Butt Leachate to Marine and Freshwater Fish

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Cigarettes as Litter



- *Cigarette butts are the most common form of plastic litter on the beaches of the U.S. and world-wide. Toxic chemicals can leach out of the cigarette filters.*

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Composition of Cigarette Butts



- *Cigarette filters may look like cotton, but are made of cellulose acetate, a plastic that is slow to degrade in the environment. Cigarette filters are specifically designed to accumulate particulate smoke components including toxic chemicals.*

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Chemicals That May Leach From Cigarette Butts

- Chemicals used to grow and process tobacco, and manufacture cigarettes:
 - Fungicides, herbicides, insecticides, pesticides (Glantz et al. 1996)
- Cigarette particulate matter (tar) and mainstream smoke (MS) contain over 4000 chemicals:
 - hydrogen cyanide, nitrates, ammonia, acetaldehyde, formaldehyde, benzene, phenol, pyridines, and carbon monoxide (Hoffman and Hoffman 1997; Li et al. 2002)
- More than 50 of these are known human carcinogens: (Hoffman and Hoffman 1997)
 - Arsenic - pesticides
 - Chromium - steel
 - Cadmium - batteries

40 C.F.R. § 797.1400 Fish acute toxicity test.

Title 40: Protection of Environment

PART 797—ENVIRONMENTAL EFFECTS TESTING GUIDELINES

Subpart B—Aquatic Guidelines

- Standard EPA protocol for acute fish toxicity testing
- Developed to test substances subject to the Toxic Substances Control Act (TSCA) (Pub. L. 94-469, 90 Stat. 2003, 15 U.S.C. 2601 *et seq.*)
- Important Terms:
 - 1) **Acute Toxicity Test** – Identifies the concentration of a substance that results in a toxic effect on the test organism in a short period of time (e.g., 96 hours). In this guideline, death is the only measure of toxicity.
 - 2) **LC50** – The concentration, of test substance, that results in the death of 50% of the test population

Cigarette Butt Leachate at 24 hours

**A: Unsmoked
cigarettes
without
tobacco**

**B: Smoked
cigarettes
without
tobacco**

**C: Smoked
cigarettes with
tobacco**



Smoked, With Tobacco

Lab Control → Increasing Concentration → 4 butts/Liter



Smoked, Without Tobacco

Lab Control → Increasing Concentration → 4 butts/Liter

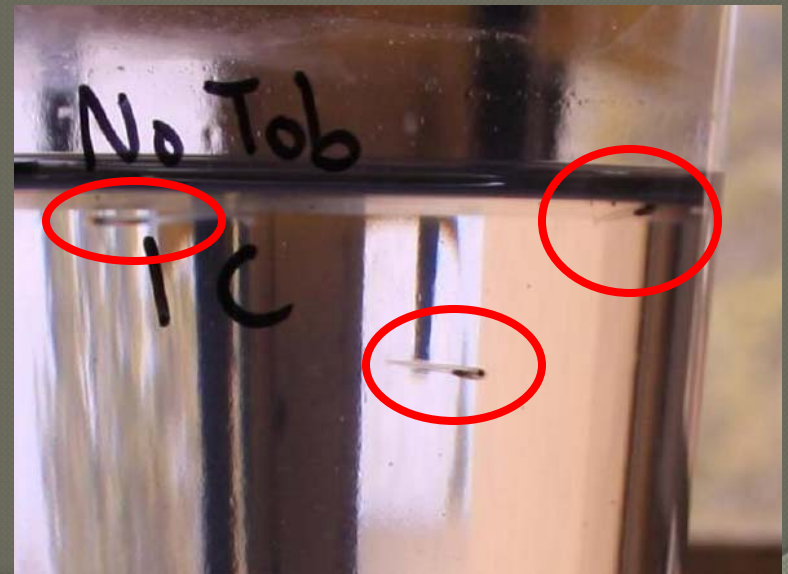


Unsmoked, Without Tobacco

Lab Control → Increasing Concentration → 16 butts/Liter



Marine Fish: *Atherinops affinis* (Topsmelt silverside)



Freshwater Fish: *Pimephales promelas* (Fathead Minnow)





Smoked, With Tobacco

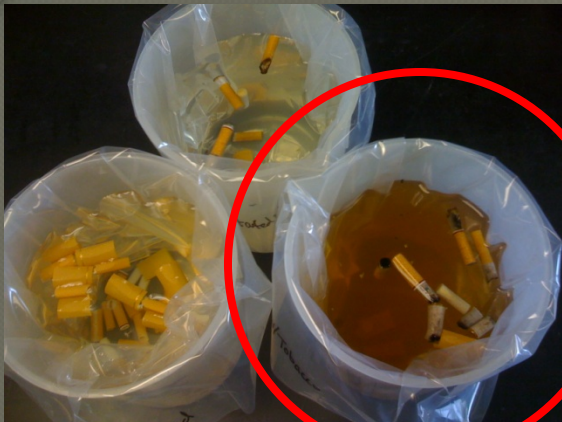




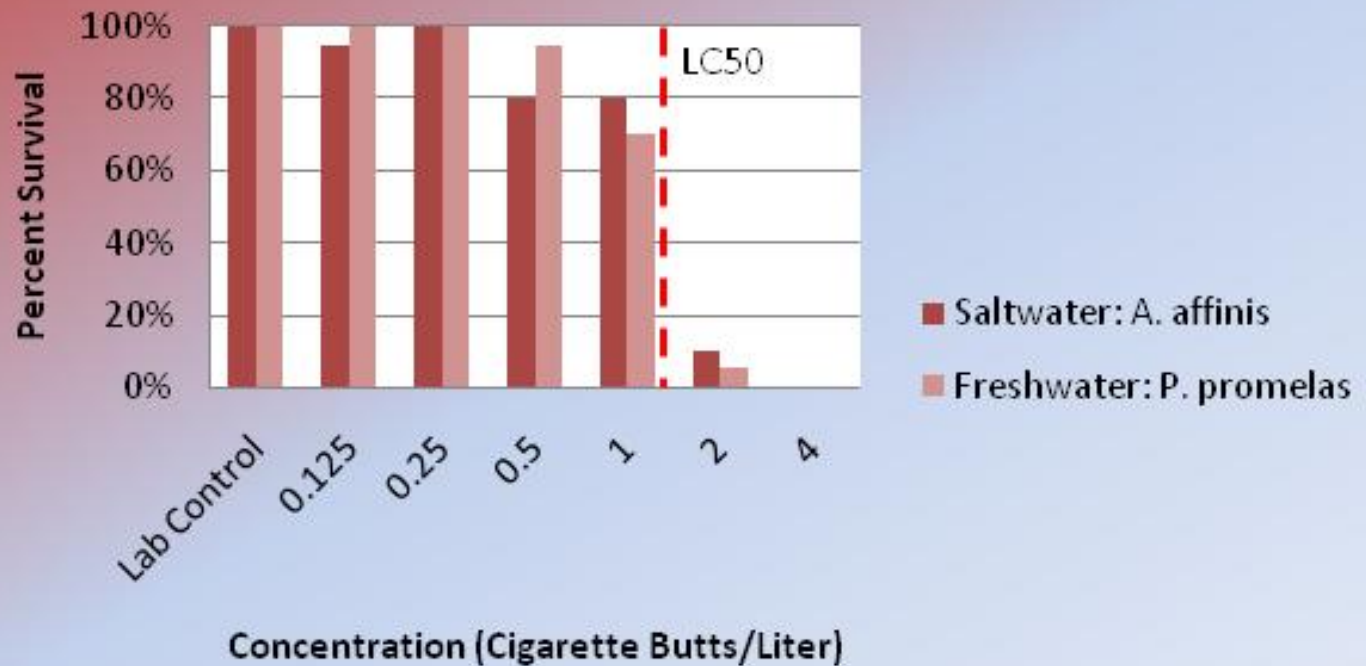
Lethality of Cigarette Butt Leachate



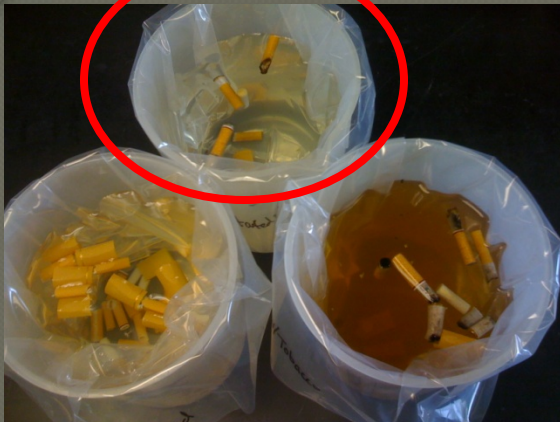
Results



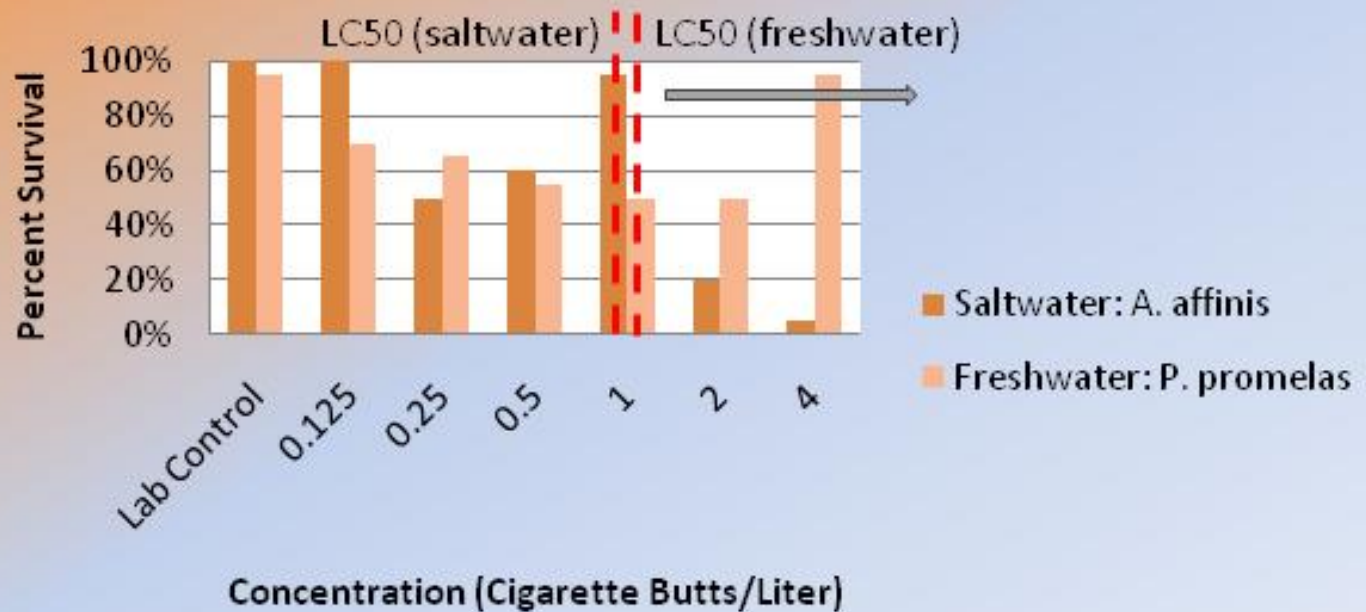
Smoked Cigarette Butts with Tobacco



Results



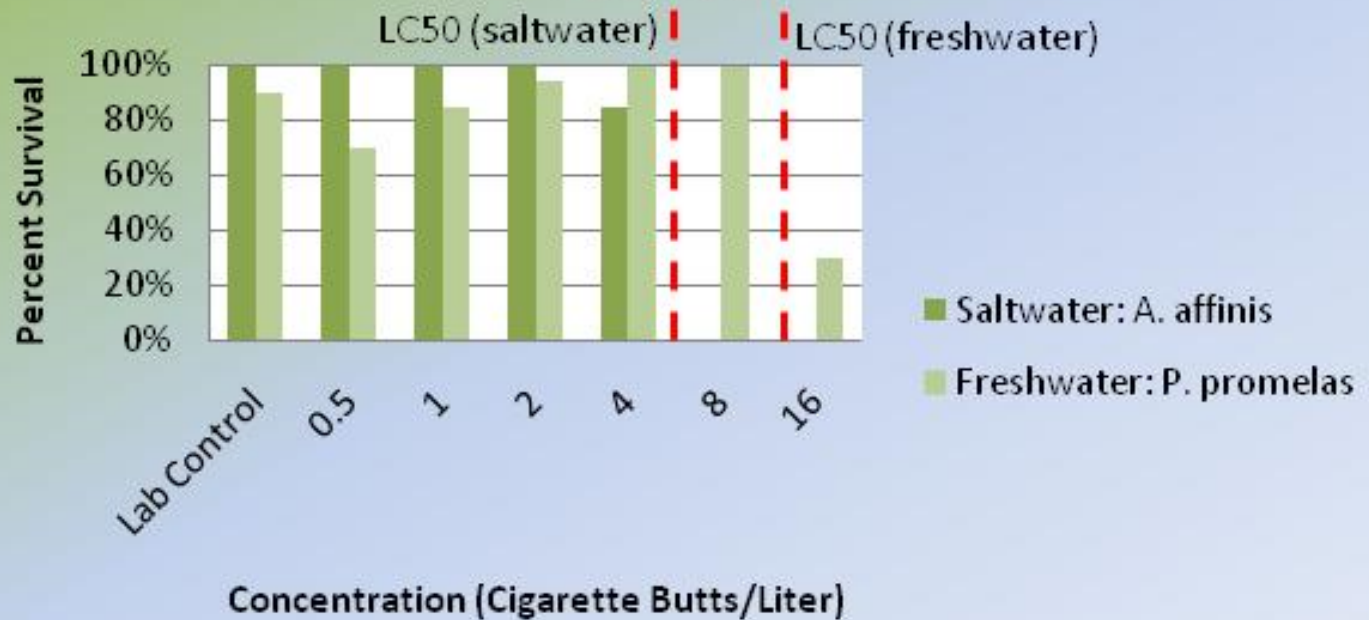
Smoked Cigarette Butts without Tobacco



Results



Unsmoked Cigarette Butts without Tobacco



Additional Issues and Recommendations for Future Research

- Chronic Toxicity Tests: Sub-lethal Effects (growth, reproduction)
- Toxicity Identification Evaluation (TIE): Identifies the **class** of chemical causing adverse effects (e.g. metals, organics, etc.)
- ICP/MS, GC/MS or GCXGC Time of Flight (TOF) MS: Analytical instruments used to identify the **specific** chemicals causing adverse effects (ex. ethylphenol)
- Bioaccumulation experiments

Thank You



