Characterizing Indoor Pesticide Use Patterns and Mass Loading in a Wastewater Catchment

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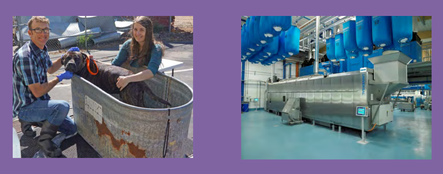
Abstract

The California Department of Pesticide Regulation, Surface Water Protection Program (SWPP) is investigating the use patterns and mass loading from indoor pesticide products to a typical wastewater sewershed. Pesticide concentrations of fipronil and pyrethroids have been reported in treated wastewater effluent at concentrations that exceed EPA Aquatic Life Benchmarks, posing potential risks to the surface waters to which they discharge. A source identification sampling study is being designed to better understand the relative mass contribution from residential, commercial, and institutional indoor pesticide use. Sampling will consist of twelve sampling sites within a sewershed catchment and paired weekday/weekend sampling events in spring, summer, and fall (6 events total). All samples will be taken as 24-hour flow weighted composites to allow for mass loading calculations. Resultant data will be used in conjunction with modeling efforts to better understand indoor pesticide products and uses that may require mitigation.

2016 Sewershed Sampling Sites

Residential

- Older Homes
- Newer Homes
- Sole Source Sewer



Commercial

- Pet Grooming
- Pest Control Operators
- Nursery
- Industrial Laundry

Institutional

- Hospital
- University
- Government

Wastewater Treatment Plant

- Influent
- Effluent

Figure 1. Proposed sampling locations within wastewater sewershed.

Introduction

There are limited data available detailing the fate and occurrence of pesticides during the wastewater treatment process. Available studies report concentrations of certain pesticides in effluent that exceed US EPA aquatic benchmarks (Table 1). A 1996 source identification study measuring organophosphates, which are no longer registered for indoor use, found mass loading of residential inputs exceeded commercial sources[1]. There is a need to gather updated information on the sources and relative mass contribution of pesticides currently registered for uses that may result in introduction to wastewater catchments.

Table 1. Summary of pesticide concentration in treated wastewater effluent reported in literature

Pesticide	PWG Survey[2]			Weston 20103[3]		Lowest EPA Benchmark[4] (ng/L)
	Average (ng/L)	DF	Max (ng/L)	Max (ng/L)	DF	
Bifenthrin	0.89	82	3.9	6.3	39	1.3
Cyfluthrin	0.60	60	4	1.7	6	7.4
λ-Cyhalothrin	0.30	48	1.6	5.5	17	2
Cypermethrin	2.11	81	13	17	6	69
Deltamethrin	0.31	16	1.2	2.7	11	4.1
Esfenvalerate	0.25	32	0.6	3.7	6	17
Fenpropathrin	0.22	3.2	0.8	0	0	64
Permethrin	20	65	170	17.2	33	1.4
Heidler 2009[5]						
Fipronil	30	-	70	-	-	11

Sampling Events

- Three sampling events: spring, summer, fall
- Paired weekday/weekend sampling events
- 24-hour flow-weighted composite samples to allow for mass loading calculations.

$$Concentration\left(\frac{mass}{volume}\right) * \text{flow}\left(\frac{volume}{time}\right) = mass\ loading\left(\frac{mass}{time}\right)$$

Objectives

1) Identify and characterize the total mass loading of pesticides to wastewater treatment facility at intake.
2) Quantify mass loading at a sub-catchment scale representing specific pesticide use patterns (residential, commercial, institutional).

Implications

- Provide information on mass loading of target pesticides to wastewater catchment.
- Identify non-target pesticides or adjuvants from unexpected uses that may require additional study.
- Construct a mass balance of specific use patterns at the sub-catchment and compare pesticide use patterns.
- Identify use patterns or active ingredients that may require mitigation.

Analytical Methods

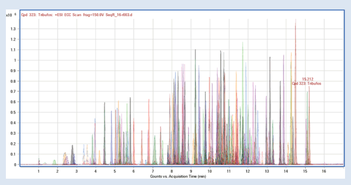
Samples will be analyzed using high resolution mass spectrometry with gas and liquid chromatography to allow simultaneous quantification of the target compounds and identification non-target analytes.

Target Analyses

- 20 Pyrethroids
- Fipronil + Degradates
- Imidacloprid
- Propoxur
- Pyriproxyfen

Non-Target Analyses

- Identification of pesticides or adjuvants not identified as priority
- Enables identification of major unexpected uses



References

[1] Singhasemanon et al. (1998) Diazinon and Chlorpyrifos in the Central Contra Costa Sanitary District Sewer System, Summer 1996, California Department of Pesticide Regulation.
[2] Markle et al. (2014). Pyrethroid pesticides in municipal wastewater: A baseline survey of publicly owned treatment works facilities in California in 2013, Pyrethroid Working Group.
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[4] http://www.epa.gov/oppefed1/ecorisk_ders/aquatic_life_benchmark.htm
[5] Heidler and Halden (2009). Fate of organohalogens in US wastewater treatment plants and estimated chemical releases to soils nationwide from biosolids recycling. J of Env. Mon. **11**(12): 2207-2215.

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