

Attenuation of Pharmaceuticals, Personal Care Products, and Endocrine-disrupting Compounds by Golf Courses Using Reuse Water

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Objectives:

1. To understand the fate and transport of PPCP/EDCs in golf courses when reuse water is used as the sole source of irrigation water.
2. To evaluate the capacity of turfgrass as a biofilter to remove PPCP/EDCs in reuse water.
3. To extend knowledge to stakeholders and reduce the uncertainty of how long-term use of reuse water for irrigation may impact groundwater quality.

Start Date: 2008

Project Duration: two years

Total Funding: \$60,000

Little is known about the fate and transport of emerging contaminants such as pharmaceuticals, personal care products, and endocrine-disrupting compounds (PPCP/EDCs) from reuse water in landscape systems receiving reuse water through irrigation. This project will investigate the fate and transport of PPCP/EDCs in turf with the goal to evaluate the effectiveness of turf in mitigating their vertical movement (i.e., leaching).

Studies to determine the stability of the target compounds in wastewater were initiated. Samples were taken at $t=0$ and regular intervals thereafter to be analyzed for the target compounds. Simvastatin hydroxy acid and estrone were removed from the target list due to their

historically low concentrations in post-UV wastewater effluent. In addition, sulfamethoxazole, phenytoin, primidone, TCP, and TCEP were added due to their high concentrations in post-UV wastewater effluent.

It was found that all compounds were stable for the first 10 days. However, by day 20, atenolol, fluoxetine, diclofenac,

g of diatomaceous earth and allowed to stand for three days. Samples were taken daily and analyzed to determine the degree to which the target analytes adsorbed onto the diatomaceous earth. Only fluoxetine was found to be affected by the diatomaceous earth, decreasing from 52 ng/L to 3.1 ng/L over the course of three days. Therefore, any fluoxetine degradation observed in the study should be viewed accordingly.

Compound	Concentration
Sulfamethoxazole	1,500
Atenolol	500
Trimethoprim	16
Fluoxetine	16
Meprobamate	480
Phenytoin	120
Carbamazepine	170
Diazepam	2.3
Atorvastatin	7.7
Primidone	130
TCP	1,900
TCEP	470
Gemfibrozil	2.3
Bisphenol A	<5.0
Diclofenac	34
Naproxen	14
Triclosan	16

Analyte concentrations (ng/L) at $t=0$ in post-UV wastewater effluent

and naproxen began to show decreases in concentration, indicating degradation had begun to occur. Therefore, it is recommended that the wastewater be sampled during the initial filling of the wastewater storage containers to determine analyte concentrations and then replaced every 2 to 3 weeks to avoid changes in analyte loading.

Studies were also undertaken to identify any effects that the lysimeter components would have on the concentration of the target analytes. Deionized water that had been spiked with the target analytes was poured into a beaker containing ~400

Summary Points

- We have purchased non-labeled and ^{13}C -labeled standards for all the candidate compounds listed in the proposal and are close to establishing analytical conditions for these compounds.
- We are developing sample preparation methods and evaluating method performance.
- We have received two soils that will be used for the laboratory-scale experiments. We plan to develop and finalize the experimental design for these laboratory-scale experiments in the second quarter.
- Efforts were devoted to assisting in the collection of soil in Eldorado Valley for the meso-scale experiments.
- The lysimeter plots at UCR are currently being renovated. New sod will be installed before spring of 2009. We plan to check leachate collection equipment from each plot and identify 8 plots for use in the research commencing in the summer of 2009.
- Meters were ordered from the vendor and shipped to Las Vegas. Equipment checked out correctly and installation at Wildhorse Golf Course is scheduled for October 2008. Other flux meters are being shipped in mid-October to golf courses in San Jose and southern California with installation to follow.



Setting the lysimeters into the holes at UCR. Researchers will check leachate collection equipment from each plot and identify 8 plots for use in the research commencing in the summer of 2009.