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**Intern Project Final Report 2024**

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Project Title: Assessment of Environmental Factors Impacting the Biotransformation of Per- and Polyfluoroalkyl Substances in Recycled Biosolids

**Abstract:**

PFAS, known as “forever chemicals,” are found in a multitude of products and are a cause for growing health concerns. Our project examines PFAS in biosolids, nutrient-rich byproducts of wastewater treatment used to enrich soil. Since wastewater treatment plants do not effectively remove PFAS, these chemicals end up in the biosolids that are applied to land for agricultural purposes. This application can contaminate groundwater or be absorbed by plants, eventually entering the food chain and human bodies. This project worked to create a comprehensive literature review on the state of PFAS in biosolids as well as designing an experiment simulating field conditions to study factors affecting the leaching, transport, and biotransformation of PFAS from biosolids into the environment.

**Introduction:**

Many farms and agricultural entities use biosolids, the byproduct of wastewater treatment, to enrich soil with nutrients and organic carbon, enhancing plant growth. In 2022, 56% of the biosolids produced by New York State were used for land application. These biosolids although beneficial to plant growth are strictly regulated and undergo treatment to ensure that they do not contaminate crops with pathogens or other harmful substances.

However, most wastewater treatment processes do not remove PFAS. Consequently, PFAS can be present in biosolids that are applied for agricultural purposes. Once in the biosolids, PFAS can leach into the groundwater used for drinking or be transpired by plants, entering the food chain, and ultimately entering humans. Research has shown that even low levels of PFAS pose significant health risks, therefore it is crucial to understand the pathways and processes through which PFAS from biosolids reach humans. This understanding includes studying the fate, transport, and biotransformation of PFAS in the environment. Our project focused on reviewing recent literature on PFAS biosolids leaching experiments. Our goal was to identify possible parameters that influence the leaching and transformation of PFAS in biosolids. Using this knowledge of parameters, we designed an experimental setup to mimic agricultural field conditions and further investigate how these parameters may impact the leaching of PFAS from biosolids.

**Methods:**

The project began with a literature review to understand the current knowledge surrounding the fate, transport, and biotransformation of PFAS in biosolids as they are applied to soil. This review also included an examination of how biosolids are used and applied, particularly in New York State. After identifying the factors that might influence the leaching of PFAS, we focused on literature detailing experimental setups for studying the fate of PFAS in contaminated biosolids. This allowed us to conceptualize our experimental setup, simulating the field conditions to study the parameters affecting PFAS leaching from biosolids. We collaborated with employees from the DEC to collect biosolids samples from wastewater treatment plants in Hancock, Deposit, and Sidney. These samples were essential for designing our experiments. Additionally, we utilized two other samples previously collected from Albion and Bergen. DNA extraction was then performed on these samples to obtain microbial DNA, which is planned to be sequenced to identify the microbial communities present in the biosolids. Understanding, what microbial communities are in the biosolids is crucial, as they can potentially influence the leaching and biotransformation of PFAS. With a draft of our experimental setup, we consulted Sally Rowland and Molly Trembley from the DEC for feedback on its implementation and to obtain characterized values for parameters of the collected biosolids. Incorporating the DEC’s input, we procured the necessary materials to implement our design and construct an experimental apparatus to monitor PFAS leaching from biosolids.

**Products:**

The results of our literature review and experimental design can be found in this location:

WRI Lab/WRI Interns/Interns 2024/PFAS in Biosolids/04\_Deliverables/Final Literature Review

The equity statement can be found in this location:

WRI Lab/WRI Interns/Interns 2024/PFAS in Biosolids/04\_Deliverables/PFAS in Biosolids Equity Statement

**Conclusion:**

The next steps for this project involve conducting a series of experiments to simulate rainfall over time and sampling the resulting water for PFAS concentrations to simulate leaching. This approach will allow us to observe the dynamics of PFAS leaching from biosolids under controlled conditions that can mimic field conditions. By analyzing the differences in leaching behavior in comparison to the differences of values for parameters for the biosolids, we can identify the specific parameters that significantly influence the leaching process. The insights gained from this experiment can then be used to produce more research on each specific parameter eventually informing decisions regarding the use of PFAS-contaminated biosolids in agriculture. Understanding which parameters most strongly affect PFAS leaching will help determine whether the continued application of these biosolids is safe or if regulatory limits should be established. Specifically, recommendations could be made on setting minimum or maximum concentration levels for certain parameters that influence the leaching of PFAS, as well as defining acceptable PFAS concentration thresholds in biosolids used for agricultural purposes. By identifying and mitigating the factors that lead to excessive PFAS leaching, we ensure that biosolids application can continue to improve agriculture and not pose a risk to environmental and human health.

[Zotero Tags For WRI Staff to fill out]

Watershed:

Congressional District: 19, 22, 25

Topic Areas: PFAS, Contamination, Soil, Soil Columns, Leaching Experiments, Biosolids, Land Application