DEPARTMENT OF CHEMICAL AND ENVIRONMENTAL ENGINEERING
COLLEGE OF ENGINEERING AND APLIED SCIENCE

RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

APPLICATION DEADLINE: September 22, 2025

PROJECT TITLE: <u>Developing a Biosolids Risk Assessment Tool</u>

Physical Requirement :
No physical requirements

Project's Technical Skills Requirement :
Experience with Excel VBA programming and knowledge of environmental fate processes

Project's Available Positions : Undergraduate Research Coop Position

Drew McAvoy
College of Engineering and Applied Science
740 Mantei Center Cincinnati, OH 45221
mcavoydm@ucmail.uc.edu
Phone: 513-556-3952

Project Description

Developing a Biosolids Risk Assessment Tool
Faculty Advisor: Drew C. McAvoy, Ph.D., P.E.
Environmental Engineering

Treatment of municipal wastewater produces massive quantities of biosolids. Disposal of biosolids traditionally include incineration, landfilling, and land application. Land application of biosolids offers multiple benefits, such as improvement of soil aggregate stability, microbial health, and plant nutrition. However, biosolids contain numerous man-made organic chemicals and such unregulated organic chemicals (UOCs) are an emerging concern impeding the beneficial use of biosolids, including land applications for food and feed crop production. In particular, there are perceived risks from accumulation of UOCs in food and feed crops, and offsite transport to contaminate groundwater or surface water resources.

The goal of this project is to develop a user-friendly risk calculator for assessing human health. This tool will be developed in Excel with VBA as the programming language. The processes to be included in the risk calculator are food chain bioaccumulation and human benchmarks so that a comprehensive risk assessment can be determined. For assessing risk, model parameters (soil properties, degradation rates, sorption coefficients, plant uptake rates, bioaccumulation factors) will be needed for accurately determined. In the absence of measured data, quantitative structure activity relationship (QSAR)

models will be used for different scenarios.

Preferred skills include:
• Experience with Excel VBA programming
• Knowledge of environmental fate processes

Training provided:
• Fate and transport modeling in soil systems including bio-uptake (earthworm, plants), leaching (rainfall, biosolids-soil concentrations, sorption), and runoff to surface waters (flow rates, biosolids-soil concentrations, sorption), and chemical attenuation (biodegradation, irreversible sorption)
• Model parameter determination (soil properties, degradation rates, sorption coefficients, plant uptake rates, bioaccumulation factors), which will include how to use QSAR models to fill data gaps
• Model accuracy assessed by statistical analysis (statistical t-test, confidence intervals, goodness of fit, or graphical comparisons)
• Risk assessment principle for assessing human health of chemicals following the land application of biosolids
• Potential for research publications and presentations at the local and national meetings