

Performance Dynamics of Trace Organic Chemicals in Onsite Treatment Units and Systems

Trace Organic Contaminants (TOCs) is the general term for the class of compounds found in products such as pharmaceuticals, personal care products, household chemicals, and flame-retardants. The concentration of these compounds ranges from the ng/L to µg/L. Although the concentrations of these compounds are relatively low compared to more traditional contaminants (metals, chlorinated solvents, excess nutrients) there is still cause for concern. Some TOCs have been shown to have toxicological or endocrine disrupting effects in the ng/L concentration range. Recent research efforts have been focused on describing the occurrence of these compounds in wastewater, drinking water, and the natural environment.



The hybrid SBMBR system at Colorado School of Mines.

Little is known about the performance of onsite wastewater systems (OWS) with respect to TOCs. This study investigated their occurrence in a full-scale septic tank and sequence batch membrane bioreactor (SBMBR). Effluent from the septic tank and SBMBR were then applied to packed soil columns designed to represent soil absorption system of OWS. Attenuation of TOC during soil treatment was also quantified.

Do TOCs Pose a Risk in Onsite Systems?

The occurrence of TOCs in onsite wastewater systems reported in this study augment existing values available in the literature. Often the communities that rely on onsite wastewater systems also use groundwater wells for drinking water. Subsurface plumes have also been documented. Understanding the occurrence and fate of these compounds is important to ensure the health of these communities.

The Occurrence of TOC in Septic Tank Effluent

There are limited data available in literature describing the occurrence of TOC in onsite wastewater systems. The occurrence studies that have been published describe a variety of onsite systems ranging in size from single-family residences to sewersheds serving several 100 users. User types can include residential, industrial, campgrounds, and schools. There is a two order of magnitude difference in reported values of many TOC investigated here. This study found effluent from one sewershed (comprised of 200 users) TOC variability reaches one order of magnitude in just a 24-hour period.

Designing Onsite Wastewater Treatment Systems for TOC Attenuation

TOC can be attenuated either above ground or during soil treatment in an onsite wastewater system (Figure 1). Above-ground units rely on oxic processes (i.e. membrane bioreactor or textile filter unit). Factors affecting TOC attenuation in soil absorption system include loading rate of wastewater, depth to groundwater, and soil type. Loading rate is the most easily engineered factor. The possibility of shock loads and variation should be considered in system design.

BENEFITS

- Explains the presence and attenuation of trace organic contaminants in onsite wastewater systems.
- Highlights research that used a full-scale septic tank and sequencing batch membrane bioreactor (SBMBR) to provide water for its experiments.
- Simulates the performance of soil absorption systems using bench-scale soil columns.

RELATED PRODUCTS

Contributions of Household Chemicals to Sewage and the Environment (O3CTS21UR)

Technical Brief: Endocrine Disrupting Compounds and Implications for Wastewater Treatment (O4WEM6)

Technical Brief: Trace Organic Compounds and Implications for Wastewater Treatment (CEC3R07)

RELATED ONGOING RESEARCH

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Soil absorption systems can be quite effective at attenuating many compounds of concern. Soil column experiments suggest that the removal of TOrc in soil absorption system increases as loading rate decreases for some compounds. This offers an inexpensive, low-energy option to optimize wastewater treatment.

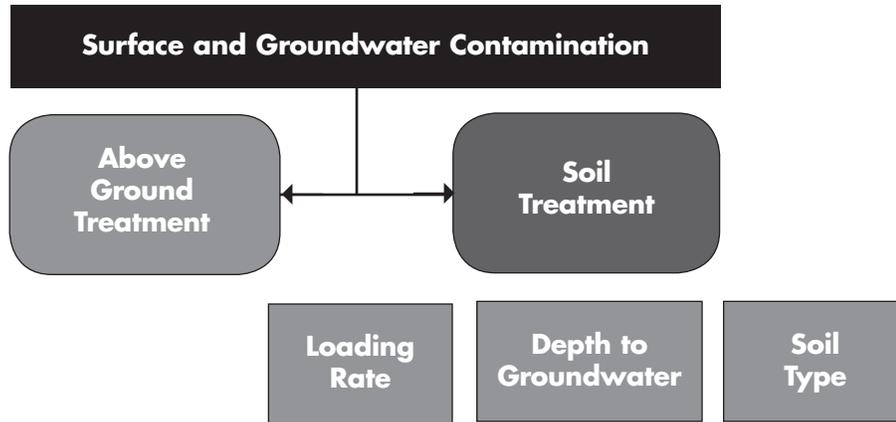


Figure 1. Possibilities for Attenuation of Contaminants in Onsite Wastewater Systems.

Advanced Above Ground Treatment for TOrc Removal

A variety of above ground treatment options are available to treat wastewater prior to soil application. The SBMBR used in this study effectively removed most TOrcs measured to concentrations less than analytical detection limits. However the increased capital cost, operation requirements, and maintenance cost of above ground treatment must be considered. For small system designs, less expensive options such as a loading rate to soil absorption system should be considered. The quality of this water is comparable to tertiary treated effluent and may be suitable for beneficial reuse of water.

In this study, some of the compounds measured were not effectively removed during above ground treatment. Identifying compounds that persist through OWS will help to streamline and prioritize further efforts. This research helps to provide a better understanding of the occurrence, fate, and transport of TOrcs in both advanced above ground treatment and soil absorption system of onsite treatment. Initial work establishing the relationship between loading rate and TOrc attenuation can help in establishing effective regulations.

An increasing number of residential communities in the U.S. are choosing decentralized wastewater treatment. Understanding the fate and occurrence of TOrcs in these systems is imperative to ensure the safety and health of the people relying on these systems and the environments in which they are installed. The link between loading rate and TOrc removal for a select number of compounds has been established here. Advances in analytical techniques, namely liquid chromatography with tandem mass spectrometry allows for analysis of a great number of compounds at lower detection limits.

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