Trace Organic Constituents of Emerging Concern and their Removal During Onsite Wastewater Treatment

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Abstract

Historically, the design of unit operations and systems for wastewater treatment has focused on achieving effective removal of conventional pollutants, such as organic matter, suspended solids, and nutrients, as well as pathogenic microorganisms. However, more recently, there has been increasing interest in the occurrence of trace organic constituents in wastewaters and whether treatment systems are effective in removing them. Trace organic constituents, which can include endocrine-disrupting compounds, can be present due to use of consumer product chemicals, pharmaceuticals, pesticides, and chlorinated flame-retardants. The general concern over trace organic constituents in wastewaters has sparked interest in their occurrence and fate in onsite systems, which are widely used to handle wastewaters from residential, commercial, and institutional sources. Onsite wastewater systems can be implemented using combinations of unit operations such as septic tanks, biofilters, membrane bioreactors, constructed wetlands, and soil dispersal units. Until recently, there has been very limited understanding concerning trace organic constituents in onsite systems, including their occurrence in wastewaters from different types of sources and their fate in different types of treatment units.

To advance the scientific understanding concerning trace organic constituents in onsite wastewater systems and thereby enable more informed decision making for onsite system design to achieve effective performance, research was carried out as part of the Small Flows Program at the Colorado School of Mines (CSM) in Golden, Colorado, USA. This research was designed to characterize the occurrence of trace organic constituents associated with consumer product chemicals (e.g., surfactants, metal-chelating agents, antimicrobials, and stimulants) in different types of wastewaters. It also investigated the removal of trace organic constituents in different types of onsite wastewater treatment systems, including those utilizing soil treatment units. The first phase of the research included field monitoring at 30 onsite wastewater systems in Colorado, USA. These systems were being used to treat wastewaters from residential, commercial, or institutional sources and they included two or more of the following unit operations: septic tanks, textile biofilters, constructed wetlands, soil treatment units. During a second phase, controlled field studies were completed at the Mines Park Test Site located on the CSM campus. Research during this phase investigated the removal of trace organic constituents during infiltration and percolation through a sandy loam soil profile and examined the effects of effluent quality (i.e., septic tank effluent or textile biofilter effluent) and hydraulic loading rate (i.e., 2 cm/d or 8 cm/d).

The results of this research revealed that trace organic constituents associated with consumer product chemicals can occur frequently in wastewaters handled by onsite systems and at concentrations that can be orders of magnitude higher than concentrations in municipal wastewaters. Transformation and removal of trace organic constituents is dependent on compound properties and treatment conditions. This can result in concentrations within a treatment unit or soil profile that can be less than, similar to, or for degradation products, even greater than influent concentrations. While treatment requirements to minimize risk are site specific and depend on many factors, onsite wastewater systems can be designed to effectively remove trace organic constituents. This presentation provides a summary of the research carried out and highlights potential implications of the findings for onsite system design and performance.

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Associated publications:

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