



WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2004AZ70G

Title: Pharmaceutically Active Compounds: Fate in Sludges and Biosolids Derived from Wastewater Treatment

Project Type: Research

Focus Categories: Groundwater, Non Point Pollution, Toxic Substances

Keywords: Biosolids, soil amendment, pharmaceutically active compounds, estrogenic activity

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Abstract

A great many pharmaceutically active compounds (PhACs) and personal care products (PCPs) are typically present in conventionally treated wastewater effluents. With the exception of estrogenic compounds, which can disrupt sexual development in male fish exposed to domestic wastewater effluent, the environmental significance of these

compounds in U.S. receiving waters is largely unknown. Few of the PhACs, other than estrogenic compounds, have been observed in surface waters at concentrations approaching those that produce a physiological response in exposed animals. Because many PhACs and all the recognized estrogenic compounds in wastewater are hydrophobic in character, they may separate with organic solids during wastewater treatment and be concentrated in resultant sludges. The fate of such compounds during solids handling/treatment and the bioavailability of PhACs when biosolids are reintroduced into the environment are essentially unknown. Hypothesis-driven research in this area is greatly handicapped by a lack of accepted methods for extracting hydrophobic contaminants from organic solids and for measuring trace concentrations of PhACs within a chemically complex, organic-rich aqueous-phase sample.

Here we would develop methods for extracting and measuring PhACs/PCPs and especially estrogenic compounds from solid-phase environmental samples. These methods would then be used to establish the fate/availability of PhACs/PCPs and estrogens that separate with sludges produced during wastewater treatment. That is, we would examine the survival of representative PhACs during anaerobic sludge digestion, sludge dewatering and composting to produce biosolids. The same extracts that are analyzed for PhACs/PCPs and known estrogenic compounds will be subjected to a variety of in vitro bioassays for whole-sample estrogenic activity. Comparison of bioassay and analytical results for specific estrogenic compounds will allow us to identify compounds responsible for estrogenic activity in sludge extracts.

In a similar way, we will measure residual levels of PhACs/PCPs and estrogenically active compounds in soils amended with biosolids. Soil/biosolids mixtures with various degrees of weathering will be extracted either (i) aggressively, using an accelerated extraction procedure and organic solvent(s) or (ii) using an aqueous solvent that represents leaching conditions in the field. The latter procedure will yield information regarding the probable bioavailability of PhACs and estrogens in soil/biosolids mixtures. Again, we will seek correlations between analytical results for specific estrogens and whole-sample in vitro bioassays. In all, results will enable us to make broad judgments about the survival and bioavailability of pharmaceuticals, especially estrogens, in the environment when biosolids are used to improve soil characteristics. This is particularly important in assessing the environmental impact of leachate and runoff from biosolid-amended soils as either point or non-point source discharges to ground and surface waters. The project will advance the procedures for extraction and measurement of PhACs in environmental samples.

The proposed project will benefit from the participation of municipal wastewater treatment agencies in Arizona and California, and from the unique experience of USGS scientists who are already making environmentally relevant measurements of PhACs/PCPs at trace concentrations in complex water samples.