

Report as of FY2006 for 2003DE32B: "Fate and Transport of Arsenic in Poultry Litter Amended Delaware Soils: Impacts on Water Quality"

Publications

Project 2003DE32B has resulted in no reported publications as of FY2006.

Report Follows

INTRODUCTION AND OBJECTIVES

The fate, cycling, and transport of arsenic (As) in Delaware's agricultural and urban/suburban soils are areas of intense interest and environmental concern today. Past, and ongoing, anthropogenic activities have added As to Delaware soils, creating questions about the potential for As to contaminate ground and surface waters. There are also concerns about As bioavailability and carcinogenicity when humans come into contact with or ingest soils that are contaminated with As. The overall goal of this study was to improve our ability to assess the risk of As to human and ecological health by increasing our understanding of the amounts, forms, solubility, and bioavailability of As in Delaware soils. Our research primarily focused on agricultural cropland, especially situations where broiler litter, well-known to be a long-term source of As to Delaware soils, had been used as a fertilizer for crop production.

RESULTS TO DATE (FY05-FY06)

Detailed laboratory studies of As sorption and desorption showed that Delaware's agricultural soils have good capacities to retain dissolved As that is released from litters, manures, fertilizers and other soil amendments. Subsoils had greater capacities to retain As than topsoils, primarily due to higher concentrations of aluminum and iron oxides, soil constituents known to sorb and tightly retain As. Arsenic sorption was greatest at the soil pH values recommended for crop production (pH 5.5 to 7.0). Kinetic studies showed that As sorption by soils occurred very rapidly (\ll 60 minutes), followed by a slower, long-term phase that continued to remove As from solution for hours.

Phosphate, present at high concentrations in many Delaware soils from long-term applications of manures and fertilizers, was preferentially sorbed by soils, relative to As, and thus has the potential to inhibit As sorption through competition for similar sorption sites on soil constituents. Desorption studies showed that solutions with high phosphate concentrations could displace previously sorbed As from soils, particularly subsoils.

X-ray absorption near edge structure (XANES) and x-ray fluorescence (XRF) spectroscopy were used to provide direct *in-situ* speciation of As and its distribution and association with other elements, respectively, in broiler litters. These analyses showed that the organo-arsenical Roxarsone found in litters is rapidly converted to arsenate (As (V)) during litter storage. A significant portion (~50%) of the total As in litters was found to be water-soluble. Our results suggest that if litters are thoroughly incorporated with soils, soluble litter As will be sorbed quickly and will not be susceptible to significant losses by leaching or surface runoff. However, if bypass flow pathways (cracks, old root channels, macropores) predominate in soils with shallow water tables, soluble As in litters has the potential to leach through soil profiles to the water table. Similarly, if litters are applied to the soil surface, runoff may dissolve and transport As to nearby surface waters.