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Study Examines the Fate of Multiple Contaminants when Biosolids are Applied to Agricultural Land

Background:

Biosolids are solid residues produced by wastewater that are treated to meet federal and state regulations for land application. About 60% of biosolids are applied to land as an agricultural amendment in the United States. Communities in all 50 states reuse their biosolids, many for the nutrient-rich benefits.

Anything that can be flushed down a toilet, go down a drain in a home or industrial facility, or enter a storm sewer can potentially end up in wastewater. Chemicals such as pharmaceuticals and cleaning products often used in homes are being detected in wastewater. Domestic wastewater also contains bacteria and other microbes from the digestive tracts of humans. Appropriate wastewater treatment methods are designed to remove pathogens in biosolids to safe levels. Many chemicals are monitored in biosolids before land application.

In 1993 under the Clean Water Act, the U.S. Environmental Protection Agency (EPA) issued regulations governing land application of biosolids, commonly referred to as the Part 503 Rule. In the years since the regulations were issued, however, wastewater treatment technologies and practices have changed and public concerns about the land application of biosolids have grown.

In 2002, the National Research Council (NRC) of the National Academy of Science issued a report entitled: "Biosolids Applied to Land: Advancing Standards and Practices" (NRC, 2002) recommending additional research to reduce uncertainties about the potential for adverse human health effects from exposure to biosolids. Motivated by this report and other research questions, a collaborative research team under the leadership of the EPA's Office of Research and Development was assembled. A field-scale land application study was undertaken to evaluate sampling methods and analytical techniques.

Research Details:

A major objective of the Biosolids study was to screen many of the available methods for applicability. The study included four environmental matrices (air, airborne particles, soil, and biosolids), 35 analyte groups, and 13 sampling methods.

The multimedia approach and numerous analyte-matrix combinations used in this study were unique in comparison with other projects in this area of study. Many studies focus narrowly on a class of analytes such as pathogens or chemicals, or an environmental matrix such as air or soil.

Conducting Bioaerosol Sampling Behind Biosolids Applicator

The sewage sludge used in this study was anaerobically digested, dewatered by centrifugation, and treated with lime. Polymer was added during sludge treatment. This type of sludge treatment is commonly used in wastewater treatment plants and is likely to produce biosolids with detectable odors and aerosolized particulates. These biosolids were applied at typical rates using a commercial spreader to a field at the Piedmont Research Station of the North Carolina Department of Agriculture and Consumer Services.

In this study, microbial and chemical concentrations were measured in the air and soil around the applied biosolids. Microbial analyses of air samples included indicator organisms, bacterial pathogens, viruses, and bacterial endotoxins. Air samples were also analyzed for odors, volatile compounds, ammonia, and hydrogen sulfide before, during and after application. Microbial and chemical concentrations were determined for soil samples before and after biosolids application.

Some of the results of the research, while not definitive, were encouraging in terms of public health impact. While in some cases microbes were detected, no bacterial pathogens or viruses were detected in the air samples collected. This study was not able to determine whether this result was because microbes were absent, or present and not detected. Approximately 20% of the soil samples contained detectable concentrations of enteric viruses, *Salmonella* spp. and viable helminth ova. Odors were detected in the air after biosolids application, but dissipated after 4 days.

Collection of Biosolids Sample for Headspace Analysis of Volatile Organic Compounds

Outcomes and Impacts:

By obtaining data on the concentrations of airborne and soil-bound contaminants during the application of biosolids on land, this research along with the research of others may lead to the development of protocols that can be used in future studies to protect public health. Data gained from this project constitute a landmark set of simultaneous multimedia information associated with the application of biosolids on land. These data will be used to assist in the development of method protocols for sampling at other land sites where biosolids are applied. This information can also be used by risk managers, such as those at EPA program offices and regions, to evaluate the benefits and potential concerns with land application of biosolids.

LAND RESEARCH PROGRAM WEB SITE: www.epa.gov/nrmrl/lrpcd

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REFERENCES

Foote, E. A., C. M. Acheson, E. F. Barth, R. F. Herrmann, R. C. Brenner, D. B. Harris, S. J. Naber, R. H. Forbes, Jr., L. L. McConnell, and P. D. Millner. Multimedia Sampling During the Application of Biosolids on a Land Test Site. EPA/600/R-11/020, U.S. Environmental Protection Agency, Washington, DC. 2011

Barth, E. F., R. F. Herrmann, T. Dahling, R. C. Brenner, S. Wright, and P. Clarke. Evaluation of Airborne Endotoxin Concentrations Associated with Management of a Crop Grown on Applied Biosolids. P. Brent Duncan (ed.), Journal of Residuals Science and Technology. DEStech Publications, Inc, Lancaster, PA, 6(2):61-65, (2009).

Acheson, C. M., R. F. Herrmann, E. Foote, S. Naber, R. C. Brenner, T. Dahling, M. Graves, J. Heckman, T. Strock, S. J. Stoll, J. Tompkins, S. Vonderhaar, S. Wright, and L. Zintek. A Study of Land Application of Anaerobically Digested Biosolids. Presented at the 10th Annual National Biosolids Conference/Workshop, Potomac, MD, June 16, 2008.

National Research Council (NRC). *Biosolids Applied to Land — Advancing Standards and Practices*, The National Academies Press, Washington, DC. 2002.