



Project Summary

Demonstration of Acceptable Systems for Land Disposal of Sewage Sludge

A project was conducted to demonstrate systems for managing sewage sludge application to farm land and to investigate sludge-related health risks to rural residents and their livestock. The study areas included four communities representative of Ohio conditions--Columbus, Defiance, Springfield, and Medina County.

The study demonstrated that large municipalities can work cooperatively with large numbers of farmers in a mutually beneficial program. Health risks were found to be insignificant when sludge was applied at the low application rates of this study using the management systems described here.

This Project Summary was developed by EPA's Water Engineering Research Laboratory and Toxicology and Microbiology Division, Health Effects Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Sewage sludge has been disposed of on farms throughout the United States for many years, with only occasional problems arising from careless handling or mismanagement. However, such incidents can be irritating and possibly hazardous to the farm community. The need existed for demonstrations of the best available sludge application technology. The potential problems and health risks associated with sludge applications to land are still real issues for many Ohio farmers. Members of the Ohio Farm Bureau Federation have repeatedly voted to sponsor or seek support for a project to demonstrate man-

agement systems that would address the rural community's concerns and that would more clearly define the health risks to local residents and their livestock. This project met those needs by conducting 15 separate studies on the topics of concern. The general areas of study and the results are discussed here briefly.

Management Systems

A major objective of this project was to define and demonstrate sludge application management systems that would minimize adverse effects on the rural community. The key factors in managing land application of sewage sludge on privately owned farm land are described as follows.

- A. A large number of farmers and application sites should be involved so that the general public will not identify a particular farm or neighborhood as the sludge disposal site.
- B. Public meetings, consultation with community leaders, field days, etc., should be held to make the public fully aware of the scope, objectives, and safety of the program. The residents of Ohio were generally supportive of the concept of applying sludge to farm land as long as there was a considered management approach that minimized odor problems, avoided nuisance situations in the transport and handling of the sludge, and maintained the metal content of the sludge at reasonable levels.
- C. These projects should use low sludge application rates that provide enough sludge for either the nitrogen or phosphorus require-

ments of crops. This concept is readily accepted by the public. Such rates provide for efficient use of the plant nutrients in the sludge, and they minimize the potential for surface runoff and groundwater pollution since the level of nutrients applied are comparable with fertilizer applications on non-sludge-treated land. Low application rates also minimize the possibility of damages resulting from the land application of unwanted metals or organics in sludge whose quality has not been adequately monitored.

- D. A rapport should be developed between those who spread the sludge and the farmers who receive it. Someone versed in agronomy is needed to serve as liaison between the farmers and the sludge generator. This person should discuss with the farmer the nutrient value of the specific loads of sludge to be received. The liaison should also present a contract to farmers to define the working relationship between the farmer and the sludge generator. In general, the job of the liaison is to trouble-shoot and maintain a good relationship between farmers and sludge generators.
- E. Sludge quality should be monitored closely, and care should be taken to produce a well stabilized, odor-free sludge. Odorous sludges do arise when sewage plants are not functioning properly. The disposal of such sludges on the land must not be considered an emergency that the public must simply accept. A plan for such situations should be worked out ahead of time. At the very least, odorous sludges should be incorporated into the soil as they are applied on the land.

When these recommendations were followed carefully, a good relationship was maintained between farmers and cities of all sizes. Large volumes of sludge were applied to the land at low application rates with very few complaints from the public.

Problems were encountered when the City of Columbus applied a very odorous sludge to farms in Pickaway County. This application was considered an emergency effort by Columbus officials and was not conducted as part of this project. Unfortunately, commu-

nications broke down between the project staff and the city regarding this application. The result was an injunction by the Pickaway County Board of Health against all land application of Columbus sludge within Pickaway County. This experience indicates that application of odorous sludges to the land requires very careful planning. The only acceptable approach is to incorporate the sludge as it is applied to the land.

Health Risks

Another major objective of this project was to evaluate health risks to rural residents and their livestock resulting from the application of sludge to crop land. Studies were designed to determine whether the presence of sludge on land in the rural community would increase the risk of disease above that associated with daily living. Literature reviews were also made of the risks associated with sewage sludge.

Health risks were not significant when sludge was applied using the low application rates and management systems of this study. The risks of respiratory illness, digestive illness, infection with *Salmonella*, *Shigella* sp., and *Campylobacter* sp., and general symptoms of illness were not significantly different between sludge and control groups. Similarly, no significant differences occurred in the health of domestic animals on sludge and control farms. Viral infections among household members showed no significant difference in frequency between the sludge and control groups. Fecal Cd levels in humans were not significantly affected by the exposure of rural residents to sewage sludges.

Agronomic Studies

Agronomic studies were conducted to support and evaluate the land application program. Field plots were maintained to demonstrate that crop yield response to sludge, metal accumulation in soils, and metal accumulation in plant tissue under Ohio conditions were typical of results reported in the literature. This information was used in educational programs for the public and for sanitary engineers, public health officials, and other interested professionals.

Monitoring Sludges for Metals

The metal contents of six sludges were monitored for 3 to 4 years. Sludge samples were collected daily, and analysis was performed on a monthly com-

posite. These analyses were considered sufficient for monitoring the quantities of metals that might be applied to soils. Compositions were reasonably steady throughout this period. Abrupt changes were observed only when sewage plant modifications were started up or when industrial pretreatment programs were initiated.

Soil Compaction from Application Vehicles

Soil compaction studies were conducted in the Medina project to evaluate the possible damage to soil structure resulting from the travel of application vehicles through fields. This issue requires further study, since we could observe compaction effects with only one type of application vehicle on one soil type. Also, the application rates in the Medina area were fairly low and required only one or two passes of the application vehicle to provide the total annual application. Soil compaction resulting from the sludge application equipment was not of great concern under the conditions of the Medina project.

Nitrogen Mineralization and Ammonia Volatilization

A number of Ohio sludges were used in laboratory studies of nitrogen mineralization and ammonia volatilization losses from soils amended with sewage sludge. Nitrogen mineralization of sludge in soils was extremely variable, depending on the sludge and field conditions. Based on this research, a 30 percent mineralization rate is recommended for estimating nitrogen release when sludge is first applied to the land.

The study examined a number of parameters that influence the volatilization of ammonia from sludge-amended soils. The most important observation was that ammonia is quickly lost when sludges are applied to soil surfaces. In this project, sludges were applied to the surface of soils and often remained on the surface for a week to 2 months before incorporation into the soil. Most of the nitrogen was assumed to have been lost. Such losses cannot be avoided when applications are made to hay and pasture lands and to fields that support application equipment but are not in a suitable condition for tillage at the time.

PCB Degradation and Absorption

A laboratory study was conducted on the factors affecting soil degradation

and plant absorption of PCB from PCB-amended sewage sludge. The sludges used in the field demonstrations were not contaminated with PCB, but concern always exists about the possibility of PCB soil contamination resulting from application of sewage sludge. PCB resisted biodegradation in soils. Volatilization from soils was decreased by their organic component. Uptake of PCB by Kentucky 31 fescue was very limited. Possible contamination of crop land with PCB and other toxic organics is a concern to farmers who receive sludge. More research is needed on the hazards associated with the presence of these materials in the soil. Also needed are less expensive and more reliable methods for monitoring the presence of toxic organics in sludge.

Status of Sludge Application in Ohio

A survey was made of the state of the art of sludge application to land in Ohio. A total of 56 landspreading communities were identified in this state. The quality of landspreading programs in Ohio has been improved substantially over the past 5 years. Communities are more aware of the contents of their sludges, and they spread them more judiciously.

Computerized Economic Analysis

An economic analysis of sludge spreading on land was prepared in a computer format so that the specific conditions of a given community could be quickly evaluated. Land spreading of a sludge is an economic method of disposal for most Ohio communities.

Extractability of Cadmium

The effect of soil pH on the extractability of Cd was observed for several Ohio soils and sludges in laboratory studies. The movement of Cd from sludge-treated soils into the food chain is a concern. The extractability of Cd in sludge-amended soils increased dramatically as the pH of the system dropped below 6.0.

The full report was submitted in fulfillment of Cooperative Agreement No. CS 805189 by the Ohio Farm Bureau Development Corporation under the sponsorship of the Water Engineering Research Laboratory and the Health Effects Research Laboratory's Toxicology and Microbiology Division of the U.S. Environmental Protection Agency.

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The complete report, entitled "Demonstration of Acceptable Systems for Land Disposal of Sewage Sludge," (Order No. PB 85-208 874/AS; Cost: \$37.00, subject to change) will be available only from:

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