



## *Project Summary*

# **Aerosols Generated by Liquid Sludge Application to Land**

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**This report provides data on characterization of geographically diverse digested municipal sludges with respect to microbiological, trace metal, pesticide, and polychlorinated biphenyl constituents plus micro-organism levels in aerosols generated in the land application of these sludges, utilizing tank trucks and spray guns. With a knowledge of aerosol levels from this practice, recommendations can be made to reduce exposure to potentially harmful materials.**

*This Project Summary was developed by EPA's 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 information at back).*

### **Introduction**

Land application of human waste is an attractive waste disposal alternative to disposal in surface waters. This approach avoids contamination of the surface water supplies, returns nutrients to the soil, reuses the water and other wastes, and provides additional waste treatment. The policy of the Environmental Protection Agency is to "press vigorously for publicly-owned treatment works to utilize land treatment processes to reclaim and recycle municipal wastewater." Disposing of municipal sludge has become a major public concern in that sludge will be produced at municipal treatment plants in the U.S. at the rate of approximately

four and one-half billion dry kilograms annually by the early 1980's. At the present time, municipal sludge is being disposed of via incineration (35 percent), ocean disposal (15 percent), landfills (25 percent), and land application (25 percent). Incineration contributes to air pollution and is also energy dependent. Federal regulations will prohibit ocean dumping of sludge after 1981. Landfill is not practical in all areas of the U.S. and has potential problems in contamination of ground and surface waters due to the concentration of sludge in one area. Land application is an attractive alternative to these processes.

### **Objectives**

This study was initiated to provide information on the generation of harmful microbial aerosols near sites practicing land application of liquid municipal sludge. Very little information is available regarding the production of microbial aerosols as to the types or quantities of organisms produced. Because of the importance of land application of municipal sludges, the U.S. Environmental Protection Agency must collect the necessary data to answer the safety questions. If problems are identified, then it is likely that changes in the mechanism in applying sludge can be made using current technology.

The original objective of this study was to determine if the use of tank trucks in applying liquid sludge to land resulted in the formation of pathogenic

microbial aerosols. A secondary objective was to characterize the sludge from several sites practicing land application for the presence and levels of microbiological constituents, trace metals, and pesticides.

During preliminary site evaluation, sites were identified which utilized high-volume spray guns to apply liquid sludge. The program objectives were expanded to include evaluation of aerosols generated at spray application sites and to compare these results to those from the truck sites and to sites conducting spray application of wastewater.

## Methods

A preliminary screen was conducted at six sites to characterize sludge with regard to bacterial and viral microorganisms, trace metals, organochlorine pesticides, and polychlorinated biphenyls (PCB's), and to evaluate each site for its suitability for aerosol monitoring. Four sites were selected for aerosol monitoring, two practicing tank truck application and two practicing spray gun application. From five to eight aerosol monitoring runs were made at each of the four sites, and a special enterovirus aerosol run was conducted at one of the spray sites.

The preliminary screens were used to indicate what levels of microbiological and chemical constituents could be routinely expected in liquid sludge. The aerosol data were used to indicate whether there was aerosolization of microbiological constituents and as input to dispersion modeling.

## Conclusions

All six sites and all samples contained measurable levels of cadmium, copper, mercury, nickel, lead, and zinc. The mean concentrations ranged from 15.7  $\mu\text{g/g}$  for mercury to 9,180  $\mu\text{g/g}$  for zinc, on a dry weight basis. Molybdenum was detected in only three samples, at concentrations of 40, 48, and 140  $\mu\text{g/g}$ , dry weight.

Of the 16 priority pollutant pesticides and seven PCB formulations screened for in the sludge, only chlordane and Aroclor 1248 were detected in any of the samples. The chlordane concentration in sludge fell between 11 and 16  $\mu\text{g/g}$  in the four samples in which it was detected. Both samples from one site (Muncie, Indiana) were found to contain AR 1248, at 25 and 26  $\mu\text{g/g}$ .

Microbiological screens of sludge samples from all sites contained four non-enteric bacteria and eight enterobacteria organisms. Other organisms were found in samples from one or more of the sites.

Generation of microbiological aerosols most likely does occur at sites utilizing tank trucks, but results in very low bacterial aerosol levels. Monitoring at these sites is difficult due to the fact that a truckload of sludge is applied over a short period of time while the truck passes over several hundred meters of land.

There was strong evidence for aerosolization of microbiological organisms at the spray application sites, notably among the fecal coliform, fecal streptococci, and mycobacteria results. Fecal coliform and fecal streptococci were detected downwind at both sites, while at Portland they were not consistently detected at the background site and at St. Petersburg were approximately two orders of magnitude lower at the background sites. Mycobacteria data at St. Petersburg gave similar results to the fecal coliform data.

On a special virus run, 1,470  $\text{m}^3$  of air was sampled and no human enteric viruses were detected from the pooled sample. This converts to a concentration of less than 0.0016 pfu/ $\text{m}^3$  of air, and the implication is that aerosolization of viruses does not present a significant problem.

## Recommendations

Where tank truck application is exercised as the means of sludge disposal, the generation of aerosols is likely to be minimal. If further reduction is deemed necessary, the option of sub-surface injection should be considered.

Where spray application is the means of disposal, certain practices may be observed to reduce formation of and exposure to aerosols, e.g., creation of a buffer zone around the application site, application as much as possible under ideal meteorological conditions, and the use of low-pressure, downward-directed nozzles.

The presence of microbiological organisms in the sludge, as well as toxic metals, pesticides, and polychlorinated biphenyls (PCB's), suggests that the composition of the sludge should be well known before land application is accomplished. In addition to aerosol generation, there is a potential for harmful effects through soil and ground

water, and there should be some assurance prior to land application that levels of these contaminants do not exceed tolerable levels.

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*The complete report, entitled "Aerosols Generated by Liquid Sludge Application to Land," (Order No. PB 81-178 857, Cost: \$11.00, subject to change) will be available only from.*

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