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Project Summary

Leachate Collection and Gas Migration and Emission Problems at Landfills and Surface Impoundments

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The available information on clogging potential of landfill (LF) leachate collection systems (LCS) and on gas migration and emissions at LFs and surface impoundments (SI) was reviewed; as a further step, corrective and preventive measures and research and development (R&D) needs were identified.

There has been limited operating experience with LCS and little opportunity for corrective action at hazardous waste landfills (HWLFs) that meet or exceed RCRA design and operating standards. Gas generation and migration problems are largely associated with municipal and co-disposal LFs. The limited available air emissions data indicate ambient concentrations of specific pollutants near the detection limits of the sampling and analytical procedures used. LCS- and gas-/emissions-related problems can best be addressed through preventive design and operating measures.

Areas for R&D include development of an improved basis for LCS design, evaluation of innovative approaches to LCS design, evaluation of cost-effective methods for retrofitting older sites with LCS, parametric evaluation of various cover systems for LFs from the standpoint of emissions control, and expansion of the current data base on emissions.

This Project Summary was developed by EPA's Hazardous Waste Engineering 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

A recent study of liner installation practices and an assessment of surface impoundment (SI) technology led to identification of a number of design- and operation-related problem areas requiring further studies. Two such areas, which are the focus of the present study, relate to leachate collection systems (LCS) and air emissions from landfills (LFs) and SIs.

Early review of the literature indicated little information in the areas of interest. Accordingly, the present study emphasized acquisition of information and professional perspectives from design engineers, owners and operators of land disposal facilities, and cognizant state regulatory agencies.

Problems With and Remedies For LCS

Limited information is available on the extent of LCS clogging in engineered hazardous waste landfills (HWLFs). Most of the reported LCS problems occur with the older systems (primarily at municipal or co-disposal sites), which lacked sophisticated designs. LCS clogging was a problem of major concern at only one site studied in this survey — a unique co-disposal facility handling a significant volume of liquid industrial waste; two HWLFs reported some previous experi-

ence with minor siltation in the LCS standpipes. Corrective actions taken at some co-disposal sites include (a) using gravel trenches or pipes to intercept leachate, (b) installing caissons in LFs and pumping out the accumulated leachate, and (c) replacing sections of the collection system where the depth of the overlying waste is not significant. Such corrective actions, however, would be very costly, especially for large HWLFs and can present considerable risk and safety hazards. Accordingly, the problems can best be addressed through preventive means involving a combination of good design, construction and operating practices. Some helpful considerations are listed in Table 1. These are aimed at reducing the potential for leachate generation, providing better leachate control, and reducing adverse impacts on LCS.

Gas Migration and Air Emission Problems and Applicable Controls

The very limited attempts at systematic evaluation of emissions from HWLFs have been largely of a problem-definition nature with a major objective of develoing suitable sampling and analytical protocols. These studies have yielded variable results apparently caused by (a) emission contributions from other sources, (b) activities at the disposal sites tested, and (c) the yet unproven reliability and accuracy of the sampling and analysis protocols used. As these studies indicate, volatile organics are difficult to measure at closed HWLFs because the ambient concentrations of specific compounds are often near or below the detection limits of the methods employed.

LF gas characterization established from samples collected at municipal and co-disposal LFs indicate that (a) ppm levels of chlorinated and/or aromatic hydrocarbons are present in gas from all LFs; (b) the levels of these gases (which include some hazardous compounds such as benzene) are not necessarily higher in sites that have accepted hazardous wastes; and (c) the volatile organic compounds (VOC) content of the gas varies greatly, both among the LFs and within an LF. Unless an LF is equipped with an effective gas extraction system, the gas produced would be gradually emitted to the atmosphere; such LFs should therefore be regarded as point sources of air pollution.

Since there should be little biological activity in a properly operated HWLF, emissions from a closed HWLF would involve primarily waste volatilization. Preventive measures would include (a) use of multiple cell design to segregate wastes; (b) use of state-of-the-art liners and covers, (c) control of vents, sumps, cleanouts, etc.; (d) source control; (e) placement of waste to prevent formation of internal barriers to gas flow; (f) control of runoff; and (g) control of fugitive emissions from waste handling and placement activities.

At municipal and co-disposal LFs, emission control measures include source and operating controls, venting, interception and collection of gas for incineration or energy recovery. Source controls involve (a) excluding disposal of bulk solvents and wastes containing a high concentration of volatiles, and (b) neutralization/inactivation of certain troublesome wastes (e.g., via solidification) prior to disposal. To prevent lateral migration of gas to nearby structures and to facilitate gas collection for energy recovery, operating controls are aimed at eliminating internal barriers to gas movement. The systems employed at a number of sites for interception and collection of LF gas fall into two categories, passive and active. The passive systems are aimed at releasing the internal gas pressure in the LF by providing wells and trenches in or around LFs for venting of the gas to the atmosphere. Passive systems would not provide acceptable emission control, since any toxic substances in the gas would be released to the atmosphere. Active gas systems use blowers to collect gas through a network of extraction wells and/or trenches. The collected gas is either disposed of by flaring or combusted for energy recovery. In either case, a high degree of destruction of toxic organics can be achieved when combustion temperatures are kept at 800°C or greater.

Currently, very little quantitative data exist on volatile toxic emissions from SIs. Much of the concern over SI emissions has involved odor complaints. The most common solutions for such problems have been source control and proper siting.

Most SI emissions studies have involved comparative testing of various sampling protocols and equipment and verification of predictive models. Results from the limited number of SIs tested indicate very low VOC emissions (often near the detection limits). Agreement between the results using different sampling protocols and between the measured values and those predicted using models is currently not complete.

Emission controls for SIs include source control, proper siting and use of side enclosures, floating covers, surface films and wind fences. Source control, considered by some to be the most viable, involves reducing the concentration of volatiles in the raw waste stream or the potential for their emission through in-

Table 1. *Key Considerations For Improving Site Performance From The Standpoint of Leachate Management*

Consideration	*Objective/Description*
Progressive Design	*Limiting the size of the active cell, thereby restricting the leachate volume to water entering cell during short active life*
Infiltration Control	*Using state-of-the-art cover design and surface and subsurface water interception systems*
Segreated Waste Disposal	*Dedicating specific cell/areas to specific waste/waste type and tailoring design and operation to specific waste properties*
Ease of Access	*Providing easy access to pipes for inspection and maintenance through the use of specialty pipe connectors, sweep bends, 6-in. or larger pipes, cleanouts at strategic locations, etc.*
Covers for Manholes	*Preventing wind-blown debris from entering lines*
Traffic on Pipes	*Minimizing potential for pipe collapse through design/operation which would eliminate or reduce traffic on pipes*
Leachate Head Control	*Using level-activated leachate pumping system with high level alarm and leachate head observation wells in the fill*
Side Slopes	*Using suitable side slopes and protective cover to prevent erosion washing of clay from side slopes*
Construction QA/QC	*Supervising construction to ensure conformance with design specs.*
Course Control and Waste Placement	*Not accepting liquids, placing sludges and low permeability wastes near top, using permeable material as intermediate cover, etc.*
Preventive Maintenance	*Periodically inspecting and cleaning lines and cover maintenances*

plant controls or wastewater pretreatment. The applicability and effectiveness of floating covers, surface films, wind fences, etc. are very waste- and site-specific. Some of these measures would most likely be inapplicable to (or not economical for) very large impoundments or where SIs are to serve as evaporation disposal ponds. Also, at present there is very little experience with the use of these systems in full-scale facilities. Moreover, unless the volatile constituents in the wastewaters are biodegraded or modified, or collected and destroyed (e.g., via incineration of overhead vapors), the emissions control for SIs may only serve a temporary purpose and the problem would be accumulated or transferred to downstream treatment systems.

Recommendations

Areas suggested for further R&D include:

- Studies of LCS performance in full-scale facilities.
- Evaluation of cost-effective approaches to retrofitting older sites with LCS.
- Development of reliable systems for monitoring the functioning of LCS.
- Evaluation of innovative design concepts for LCS.
- Expansion of the data base for emissions from HWLFs and SIs.
- Evaluation of various cover systems at operating landfills from the standpoint of emissions control.

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***B. Vincent Salotto** and **Norma M. Lewis** are the EPA Project Officers (see below).*
The complete report, entitled "Leachate Collection and Gas Migration and Emission Problems at Landfills and Surface Impoundments," (Order No. PB 86-162 104/AS; Cost: $22.95, subject to change) will be available only from:

National Technical Information Service
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