United States
Environmental Protection
Agency

Water Engineering Research
Laboratory
Cincinnati OH 45268

Research and Development

EPA-600/S2-84-168 Dec. 1985

EPA

Project Summary

Field Studies of Liner Installation Methods at Landfills and Surface Impoundments

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Procedures were investigated for subgrade preparation and liner placement during the construction of lined surface impoundments and landfills. Lining materials studied include admixes, soils and clays, sprayed on membranes, and polymeric membranes.

Objectives of the study were to (1) identify liner installation practices recommended by industry, (2) identify methods and equipment used for subgrade preparation and liner installation, and (3) compare industry-recommended procedures with actual practice. The study also identifies special problems that can be avoided by following proper placement procedures. Polymeric membrane liners are emphasized because most liners currently being installed are of this type.

This Project Summary was developed by EPA's Water 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

The use of surface impoundments and landfills has long been a cost-effective method for industrial and municipal agencies to store, treat, and dispose of unwanted materials. But recent studies show that the use of such facilities can result in subsurface migration of hazardous materials into groundwater. The Resource Conservation and Recovery Act (RCRA) of 1976 and proposed U.S. Environmental Protection Agency (EPA) regulations require that the subsurface migration of contaminants be prevented at facilities where hazardous materials are stored. Natural and manmade liners are currently being used to prevent or minimize seepage of polluting fluids from surface impoundments and landfills.

Numerous types of liners exist. Liners most often used in disposal facilities are classified by type of construction, structure, materials, and method of application. These liners prevent or minimize fluid seepage in two ways: Either they physically impede the flow of fluid, or they absorb or retain contaminating chemicals from the fluid. Soils generally absorb certain contaminants and also impede the flow of fluid because of low permeability. Manmade liners function more as a barrier to fluid flow as a result of very low permeability.

This study was initiated in 1979 to investigate liner placement procedures and subgrade preparation during the construction of lined fluid surface impoundments and landfills for fluids. A variety of liner materials were investigated, including admixes, soils and clays, sprayed on membranes, soil sealants, and polymeric membranes. The objectives of the study were as follows:

1. To identify liner installation practices suggested by industry,
2. To identify the methods and equipment used for subgrade preparation whenever possible,
3. To identify methods and materials used to install liners,
4. To compare suggested procedures with actual practice, and

5. To identify special problems that can be avoided by following proper placement procedures.

Procedures

Identifying Industry-Suggested Practices

Personal contacts with industry representatives and review of current industry literature were used to identify liner installation procedures and desirable subgrade characteristics suggested by industry Suggested practices were solicited for the following.

Installation procedures.

Site storage of material
Equippment used to place liner
Technique of positioning liner
Material overlap
Field seaming technique
Adhesives used
Tools required
Weather limitations
Crew size and experience
Sealing around penetrations
Anchoring system
Soil cover details
Quality control program
Application rates for soil sealants
Clay composition
Support fabric used

Subgrade characteristics

Surface texture
Compaction required
Herbicide treatment
Surface geometry
Surface composition

Selecting Sites to Visit

Criteria used to determine which sites to visit were the following.

Liner type (membrane, clay, soil sealant, etc)
Facility type (landfill, surface impoundment, etc)

Construction schedule
Permission to take photographs
Experience of installation crew
Size of facility

Every effort was made to locate construction sites representative of the five liner types included in the project Sites were eliminated from consideration if photographs were not allowed and if the construction schedule did not coincide with the project schedule Whenever possible, site visits were scheduled when both subgrade preparation and liner installation were in progress.

An installation summary was prepared before each site visit detailing the industry-recommended installation practices, the desirable subgrade characteristics, and the anticipated activities This analysis was the basis for comparing expected and observed practice

Documenting Field Installation Procedures

Field installation procedures and subgrade characteristics were observed at 21 facilities (Table 1) Onsite activities were discussed with the person in charge to clarify the rationale for observed installation and subgrade construction methods Every effort was made to remain at the site long enough to observe all aspects of liner installation procedures Field placement procedures and subgrade construction activities were compared with the industry-suggested practices during the site visit Comments were solicited from the field personnel regarding the reasons for observed field activities

Results

Membrane Liners

Field observations at 14 flexible membrane liner construction sites indicate that installers generally follow applicable industry recommendations For all sites visited, considerable efforts had been made to anticipate installation problems and develop solutions

Crew experience varied considerably. In one case, only the foreman had previous installation experience, but in others, the entire crew had previous experience In all cases, either an experienced installation crew chief was on site or a technical advisor was present to represent the manufacturer or fabricator of the liner material The presence of at least one experienced liner installer at a given site appears to alleviate the severity of installation problems and elevate the overall quality of a given installation

Three installation activities appeared to deviate from industry suggestions at more than one site (1) working during marginal or adverse weather, (2) sealing around penetrations, and (3) field inspection or laboratory testing of field seams Though an installer may be forced to work in adverse weather (wet, hot, or cold conditions), he can and should take advantage of specialized tools and techniques to mitigate the effects **Observed methods of sealing liners to** structural penetrations did not always follow industry suggestions, particularly when the installer had no input into the sealing techniques specified At approximately half of the sites visited, little attention was paid to thorough

Table 1. *Facility and Liner Types Studied*

Facility Type	*Liner Type*
Tailings storage	*Polymeric membrane*
Municipal landfill	*Polymeric membrane*
Evaporation pond	*Sprayed-on membrane*
Potable water storage	*Polymeric membrane*
Municipal/industrial wastewater	*Soil sealant*
Geothermal brine storage	*Polymeric membrane*
Municipal landfill	*Asphaltic concrete*
Evaporation pond	*Polymeric membrane*
Tailings storage	*Polymeric membrane*
Potable water storage	*Soil sealant*
Evaporation pond	*Recompacted clay*
Municipal landfill	*Soil sealant*
Potable water storage	*Polymeric membrane*
Evaporation pond	*Polymeric membrane*
Hazardous materials landfill	*Clay/polymeric membrane*
Naptha spill containment	*Polymeric membrane*
Industrial wastewater storage	*Polymeric membrane*
Municipal landfill cover	*Polymeric membrane*
Municipal wastewater storage	*Polymeric membrane*
Cooling tower blowdown treatment	*Soil sealant*
Fuel oil spill containment	*Polymeric membrane*

inspection of completed field seams.

Clay Liner

Construction activities at the clay liner site visited indicated reasonable adherence to industry recommendations. The clay liner was compacted in 6-in. lifts to slightly less than the recommended height of 2 ft. Compaction densities of less than the recommended 95 percent were achieved. Construction occurred during dry weather, allowing control of water content in the clay.

Spray-On Liner

The installation of the observed sprayed-on liner system complied with all applicable industry recommendations. An experienced field crew constructed the liner under the supervision of the asphalt manufacturer. Quality control measures recommended by the manufacturer were followed.

Soil Sealant Liner

Installation practices at the four soil sealant (bentonite) liner sites varied as to application methods and blending techniques. Industry specifies the importance of uniform application and complete blending of the bentonite and soil. Application equipment used at three of the four sites appeared to produce uniform distribution of bentonite, but the method used at the fourth site did not. Complete blending of the bentonite and soil was achieved at two sites using agricultural Rototillers, but it did not appear to be complete at the two other sites. The latter conclusion was based on observation of the soil and not on laboratory tests.

Asphaltic Concrete Liners

The observed asphaltic concrete liner was installed according to industry recommendations with one exception. Hot asphalt was not sprayed on the subgrade before concrete application. The reason for omission of the hot liquid asphalt is not known.

Conclusions

Field observations at 21 liner construction sites indicate that installers generally complied with industry suggestions regarding subgrade preparations and liner placement procedures. Two important aspects of the flexible liner industry that need development and definition are quality control inspection procedures and field seam testing requirements. Several manufacturers and installers of polymeric membrane liners are developing and implementing methods to test the quality of field seams.

Though the liner industry literature suggests procedures for installation, these must often be modified to accommodate special site problems or characteristics. Accommodation that ensures reliable construction and installation methods requires an experienced, knowledgeable installation crew that can adapt to various field situations. At present, the final responsibility for liner system performance rests with the owner, who should take an active part in the planning, installation, and operation of a lined surface impoundment or landfill. No particular liner installation technique or procedure guarantees a successful liner system.

Facts about the impact of installation procedures on successful systems are not available to the entire technical community involved in liner system design, construction, and operation. Factual, unbiased data are needed to improve the overall quality and reliability of liner systems.

Recommendations

1. Research should be done to determine the impact of installation procedures and subgrade conditions on liner system performance. One approach would be to track the performance of the liner systems observed during this study

2. Research should be conducted to develop methods for testing the quality of field seams for membrane liner systems. The most desirable method would be nondestructive to the liner so that all seams could be tested. The method would also need to be operable in the field.

The full report was submitted in fulfillment of Grant No R806645010 by Southwest Research Institute under the sponsorship of the U S. Environmental Protection Agency

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The complete report, entitled "Field Studies of Liner Installation Methods at Landfills and Surface Impoundments," (Order No. PB 85-117 067; Cost: $11.95, subject to change) will be available only from:
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