Technology>> Soil, Sediment, Bedrock and Sludge
>>3.7 Containment
>>4.26 Landfill Cap

Introduction>> Landfill caps are used for contaminant source control.

Description:

Figure 4-26: Typical RCRA Subtitle C Landfill Cap System Landfill caps can be used to:

- Minimize exposure on the surface of the waste facility.
- Prevent vertical infiltration of water into wastes that would create contaminated leachate.
- Contain waste while treatment is being applied.
- Control gas emissions from underlying waste.
- Create a land surface that can support vegetation and/or be used for other purposes.

Landfill Capping is the most common form of remediation because it is generally less expensive than other technologies and effectively manages the human and ecological risks associated with a remediation site.

The design of landfill caps is site specific and depends on the intended functions of the system. Landfill Caps can range from a one-layer system of vegetated soil to a complex multi-layer system of soils and geosynthetics. In general, less complex systems are required in dry climates and more complex systems are required in wet climates. The material used in the construction of landfill caps include low-permeability and high-permeability soils and low-permeability geosynthetic products. The low-permeability materials divert water and prevent its passage into the waste. The high permeability materials carry water away that percolates into the cap. Other materials may be used to increase slope stability.

The most critical components of a landfill cap are the barrier layer and the drainage layer. The barrier layer can be low-permeability soil (clay) and/or geosynthetic clay liners (GCLs). A flexible geomembrane liner is placed on top of the barrier layer. Geomembranes are usually supplied in large rolls and are available in several thickness (20 to 140 mil), widths (15 to 100 ft), and lengths (180 to 840 ft). The candidate list of polymers commonly used is lengthy, which includes polyvinyl chloride (PVC), polyethylenes of various densities, reinforced chlorosulfonated polyethylene (CSPE-R), polypropylene, ethylene interpolymer alloy (EIA), and many newcomers. Soils used as barrier materials generally are clays that are compacted to a hydraulic conductivity no greater than 1×10^{-6} cm/sec. Compacted soil barriers are generally installed in 6-inch minimum lifts to achieve a thickness of 2 feet or more. A composite barrier uses both soil and a geomembrane, taking advantage of the properties of each. The geomembrane is essentially impermeable, but, if it develops a leak, the soil component prevents significant leakage into the underlying waste.

For facilities on top of putrescible wastes, the collection and control of methane and carbon dioxide, potent greenhouse gases, must be part of facility design and operation.

Asphalt/Concrete Cap

The most effective single-layer caps are composed of concrete or bituminous asphalt. It is used to form a surface barrier between landfill and the environment. An asphalt concrete cap would reduce leaching through the landfill into an adacent aquifer.

RCRA Subtitle C Cap

The RCRA C multilayered landfill cap is a baseline design that is suggested for use in RCRA hazardous waste applications. These caps generally consist of an upper vegetative (topsoil) layer, a drainage layer, and a low permeability layer which consists of a synthetic liner over 2 feet of compacted clay. The compacted clay liners are effective if they retain a certain moisture content but are susceptible to cracking if the clay material is desiccated. As a result alternate cap designs are usually considered for arid environments.

RCRA Subtitle D Cap

RCRA Subtitle requirements are for non -hazardous waste landfills. The design of a landfill cover for a RCRA Subtitle facility is generally a function of the bottom liner system or natural subsoils present. The cover must meet the following specifications:

- the material must have a permeability no greater than 1 x 10-5 cm/s, or equivalent permeability of any bottom liner or natural subsoils present, whichever is less.
- The infiltration layer must contain at least 45 cm of earthen material.
- The erosion control layer must be at least 15 cm of earthen material capable of sustaining native plant growth.

Alternative design can be considered, but must be of equivalent performance as the specifications outlined above. All covers should be designed to prevent the "bathtub" effect. The bathtub effect occurs when a more permeable cover is placed over a less permeable bottom liner or natural subsoil. The landfill then fills up like a bathtub.

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Synonyms:

Cap Landfill cover Surface cover.
SERTS Codes:

I0 (Containment)
I1 (Capping)

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□pplica□ility:

Landfill Caps may be temporary or final. Temporary caps can be installed before final closure to minimize generation of leachate until a better remedy is selected. They are usually used to minimize infiltration when the underlying waste mass is undergoing settling. A more stable base will thus be provided for the final cover, reducing the cost of the post-closure maintenance. Landfill caps also may be applied to waste masses that are so large that other treatment is impractical. At mining sites for example, caps can be used to minimize the infiltration of water to contaminated tailings piles and to provide a suitable base for the establishment of vegetation. In conunction with water diversion and detention structures, landfill caps may be designed to route surface water away from the waste area while minimizing erosion.

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Limitations:

Landfilling does not lessen toxicity, mobility, or volume of hazardous wastes, but does mitigate migration. Landfill caps are most effective where most of the underlying waste is above the water table. A cap, by itself, cannot prevent the horizontal flow of ground water through the waste, only the vertical entry of water into the waste. In many cases landfill caps are used in conunction with vertical walls to minimize horizontal flow and migration. The effective life of landfill components

(including cap) can be extended by long-term inspection and maintenance. Vegetation, which has a tendency for deep root penetration, must be eliminated from the cap area. In addition, precautions must be taken to assume that the integrity of the cap is not compromised by land use activities.

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Data eeds:

A detailed discussion of these data elements is provided in Subsection 2.2.1 (ata Requirements for Soil, Sediment, and Sludge). Many laboratory tests are needed to ensure that the materials being considered for each of the landfill cap components are suitable. Tests to determine the suitability of soil include grain size analysis, Atterberg limits, and compaction characteristics. Landfill instability can be solved by understanding interface friction properties between all material layers, natural or synthetic. The maor engineering soil properties that must be defined are the shear strength and hydraulic conductivity. Shear strength may be determined with the unconfined compression test, direct shear test, or triaxial compression test. ydraulic conductivity of soils may be measured in the laboratory by the constant head permeability test or the falling head permeability test. Field hydraulic conductivity tests on test pads are generally recommended prior to actual cover construction to ensure that the low-permeability requirements can actually be met under construction conditions.

Laboratory tests are also needed to ensure that geosynthetic materials will meet the cap requirements, For example, geosynthetics in caps may be subected to tensile stresses caused by subsidence and by the gravitational tendency of a geomembrane or material adacent to it to slide or be pulled down slopes.

Since facility performance is a function of quality construction more so than selection of materials, construction quality assurance of caps are critical. EPA has generated a technical guidance document on this subect. The technical guidance should be strictly followed during design and construction.

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erformance Data:

Previously installed caps are hard to monitor for performance. Monitoring well systems or infiltration monitoring systems can provide some information, but it is often not possible to determine whether the water or leachate originated as surface water or ground water. Performance can be monitored much more effectively by including pan lysimeter in future caps.

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Cost:

Landfill caps are generally the least expensive way to manage the human health and ecological risks effectively. Rough industry cost are 15k/acre for RCRA Subtitle , and 225k/acre for RCRA Subtitle C.

Additional cost information can be found in the azardous, Toxic, and Radioactive astes (TR) istorical Cost Analysis System (CAS) developed by Environmental istorical Cost Committee of Interagency Cost Estimation Group.

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- Lawrence Livermore ational Laboratory (LLL) Site 00 - Pit 6 Landfill Operable nit (O), Livermore, CA.

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Site Information:

- AFCEE action, Fairchild AF, A
- OE Oak Ridge, T facility
- Lawrence Livermore ational Laboratory, Site 00, Coast Ranges, CA
- OE emo, Lee Acres landfill, Farmington, M
- Lawrence Livermore ational Laboratory, Site 00, Pit 6 Landfill O, Livermore, CA
- Seymour Recycling Corporation Superfund Site, Seymour, I
- Sylvester/Gilson Road Superfund Site, ashua,

oints of Contact:

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General FRTR Agency Contacts

Technology Specific e Sites:

Government eb Sites

on Government eb Sites

endor Information:

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A list of vendors offering Soil Containment Treatment is available is from EPA REAC IT which combines information from three established EPA databases, the Vendor Information System for Innovative Treatment Technologies (VISITT), the Vendor Field Analytical and Characterization Technologies System (Vendor FACTS), and the Innovative Treatment Technologies (ITT), to give users access to comprehensive information about treatment and characterization technologies and their applications.

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azard Analysis

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