LANDFILL COVERS: PERFORMANCE

Conventional Landfill Covers

Conventional, barrier-type landfill covers are widely accepted and thousands are already in service. Although regulatory bodies readily accept their use, they are expensive and subject to failure. Some users and regulators describe them as containing “impermeable” layers, thus fostering a false sense of security regarding their effectiveness. Suter et al. (1993) reviewed failure mechanisms for compacted clay layers in landfills; they concluded, “...natural physical and biological processes can be expected to cause [clay] barriers to fail in the long term.” Melchior (1997) reported results of a German study in a cool, wet climate. He found that clay barriers in landfill cover test sections leaked 150 to 200 mm per year in the eighth year of operation.

Alternative Barrier Materials for Conventional Landfill Covers

Alternative materials for barrier-type landfill covers have been tested in experiments, but they have not been used in practice.

The capillary barrier consists of a series of layers, including (from the surface downward) a layer of fine soil over a layer of coarser material (e.g., sand or gravel). The barrier in this type of cover is created by the large change in pore sizes between the layers of fine and coarse material (Stormont, 1997; Gee and Ward, 1997; and Ankeny et al., 1997). Capillary forces cause the layer of fine soil overlying the coarser material to hold more water than if there were no change in particle size between the layers. However, if too much water accumulates above the barrier the water will break through the barrier.

The dry barrier is sometimes called the convective air-dried barrier. It is similar to the capillary barrier cover except that wind-driven airflow through the layer of coarse material helps to remove water that may infiltrate into that layer (Ankeny et al., 1997).

The asphalt barrier may replace the compacted clay layer in covers built in arid climates. Clay barriers may fail in arid climates because of desiccation and cracking (Gee and Ward, 1997).

Alternative Landfill Covers

There are two innovative landfill covers that have no barrier, they are:

- Modified surface runoff (MSR) and
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- The Evapotranspiration (ET) cover.

**Modified Surface Runoff (MSR) cover**

The MSR cover employs metal or other roofing panels to intercept and remove part of the precipitation from the landfill cover. Variable amounts of open space are left between the roofing panels and the space between the panels supports vegetation. During a 10-year test in Maryland, O'Donnell et al. (1997) found these covers to be highly effective. The Navy tested the concept in Hawaii during a 21-month test; the covers leaked 2.3 or 3.8 cm of water depending on construction practice (Karr et al., 1999). Construction cost data are unavailable. Maintenance may be expensive because they may require repair as frequently as a conventional building roof.

**The Evapotranspiration (ET) Landfill Cover**

The ET landfill cover is designed to work with the forces of nature rather than attempting to control them. It utilizes a layer of soil covered by native grasses, and it contains no barrier layers. The ET cover uses two natural processes to control infiltration into the waste, (1) the soil provides a water reservoir, and (2) natural evaporation from the soil plus plant transpiration (ET) empties the soil water reservoir. It is an inexpensive, practical, and easily maintained biological system that will remain effective over extended periods of time, perhaps centuries, at low cost.

The ET cover differs from those that are commonly called vegetative covers. It has the following minimum criteria:

- The soil must support rapid and prolific root growth in all parts of the soil cover
- The soil must hold enough water to minimize water movement below the cover during extreme or critical design periods.

Because of these minimum criteria, design and construction methods for ET covers differ from those of conventional vegetative and barrier covers. In keeping with the requirements for all landfill covers, the ET cover must minimize infiltration, isolate wastes, control landfill gas, control erosion, and remain effective over long time periods. At most sites, ET landfill covers can meet these requirements.

**Verification of the ET Cover Concept:** The technology that forms the basis for the ET landfill cover concept was developed, tested, and understood years ago, and field data are available from water balance measurements in soil systems similar to those required for ET covers. The concept was confirmed in the field by both short- and long-term measurements that were collected during the past century.

http://www.afcee.brooks.af.mil/products/techtrans/landfillcovers/LandfillPerformance.asp, 4/18/05
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The long-term measurements established the water balance under grass over time periods from three decades to several centuries and included unusually wet periods, fires, and other natural disasters. These data demonstrate that the ET cover can minimize movement of precipitation into stored wastes by using natural forces and the soil's water-holding capacity.

The ET landfill cover concept and proof of performance are described more completely in Hauser et al. (2001) and in the references available from the AFCEE (see below).

**Alternative Cover Assessment Project (ACAP)**

The ACAP project has constructed several test covers from Georgia to California; they employ vegetation, but no barrier layers. The ACAP program is sponsored by the U.S. EPA as part of the Phytoremediation of Organics Action Team established in 1997 under the EPA's Remedial Technology Development Forum (RTDF).

**References**


**Documents available from the Air Force Center for Environmental Excellence (AFCEE):**

- "Landfill Covers for Use at Air Force Installations" (AFCEE, Feb. 1999);

http://www.afcee.brooks.af.mil/products/techtrans/landfillcovers/LandfillPerformance.asp, 4/18/05
Landfill Covers: Performance

- "Survey of Air Force Landfills, Their Characteristics, and Remediation Strategies" (AFCEE, July 1999);
- An Access database (407 Kb self-extracting zip file) containing the survey results above
- "Decision Tool for Landfill Remediation" (AFCEE, August 1999);
- "Vegetated Landfill Covers and Phytostabilization—The Potential for Evapotranspiration-Based Remediation at Air Force Bases" (AFCEE, May 2001)
- "Alternative Landfill Covers [prepared for the ITRC's Alternative Landfill Covers summit]" (AFCEE, July 2001)
- "Protocol for Controlling Contaminated Groundwater by Phytostabilization (980 KB) (AFCEE, Dec. 2001)

Document available from the U. S. Navy, Naval Facilities Engineering Service Center, 1100 23rd Ave., Port Hueneme, CA 93043-4370


Web page links:

Remedial Technology Development Forum (RTDF)
ACAP, Alternative Covers Assessment Program

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