# Better Daily Cover Material Selection for Improved Odor Control and Suppression of Leachate Formation

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Landfills of today are increasingly concerned with suppressing gaseous odors and reducing the generation of leachate. Alternative Daily Cover Materials (ADCM's) and earthen Daily Covers have different capabilities in this regard. Plastic landfill cover, an ADCM classified by ASTM D6523 as a "Non-Reusable Geosynthetic", has been found to provide the most effective continuous water runoff barrier, a property which also extends to air pollution and odor control.

This study tests and compares the fluid barrier performance of daily cover materials. It reports the results of several simulated daily cover test pads constructed so as to determine the ability of different materials to shed simulated rain events.

Table 1 displays a summary of results from the test pad studies. The different daily covers tested varied in their time required for a simulated rain of 1.6 inches per hour to break-through the cover and begin flow into the collection trench. Once the cover became saturated with water, breakthrough occurred and a fairly stabilized flow rate (measured in U.S. gallons per minute, gpm) of cover penetration began which was measured at the bottom of the collection trench. The total measured flow through the cover was calculated as a percent of total water flow (simulated rain) impacting the test pad.

Table 1. Summary of Daily Cover Test Pad Studies - Rainfall, Cover Penetration, Collection and Measurement

| **Daily Cover** | **Rainfall Time to Break-through @1.6 in/hr** | **Stabilized Penetration Rate Through Cover** | **% of Rainfall Penetration** |
|---|---|---|---|
| Non-Reusable Geosynthetic (plastic cover - average of panel overlaps shingled with and against fluid flow) | 17.5 minutes | 0.105 gpm | 3 % |
| Soil (Soil Classification – Silty Sand) | 20 minutes | 1.1 gpm | 32 % |
| Green Waste | 44 minutes | 3.4 gpm | 100 % |

**Test Construction with Non-Reusable Geosynthetic:** A 30 ft by 35 ft test pad was installed lengthwise down a 7% slope. The pad consisted of a 30 mil (0.75 mm) polyethylene geomembrane overlain by a geotextile/geonet/geotextile double-sided drainage geocomposite. A 9 in x 9 in "flow interceptor trench" was cut in the soil beneath the geomembrane across the width of the pad at 4/5ths of the distance downslope, angling so as to drain to the opposite edge of the pad.

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Figure 1 illustrates the pad overlain by a non-reusable geosynthetic brand of plastic landfill cover - Enviro™ Cover by EPI Environmental Products Inc.

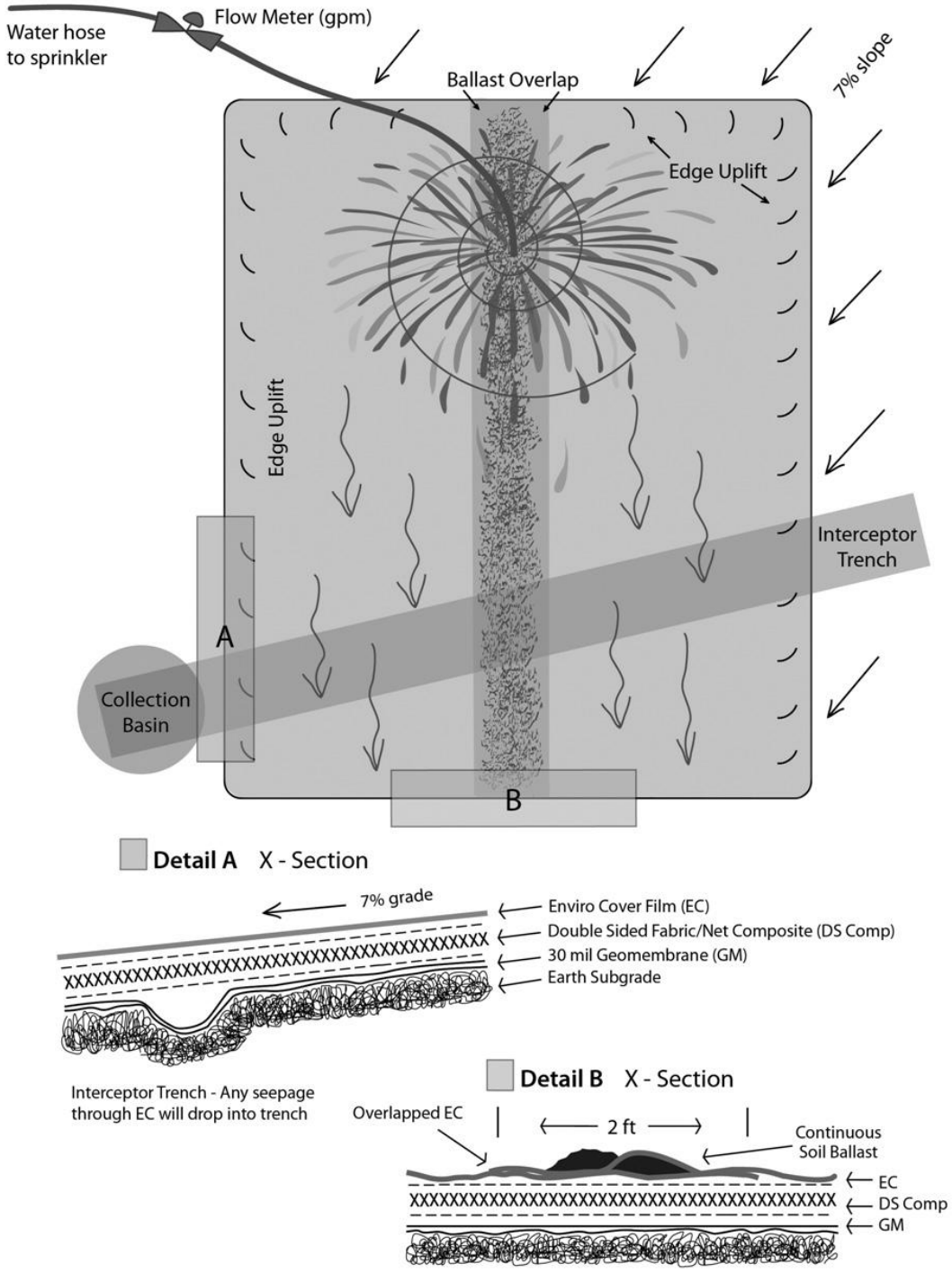


Figure 1. Test pad configuration – plan view and key cross sections

The underlying geomembrane was draped into this trench while the overlying drainage geocomposite was allowed, with its relative stiffness, to span and bridge over the trench. In this way runoff remaining in or on the daily cover would be carried across the trench and off the downslope end of the pad. Yet any seepage of fluid through the daily cover would be drained by the geocomposite onto the underlying geomembrane and be conducted into the flow interceptor trench where it would flow down the trench to be collected and measured.

For the testing of the non-reusable geosynthetic, two panels of the film-like tarp ADCM were placed over the geocomposite of the pad, with overlap between panels constructed using soil ballast along the edges simulating typical ballast deployment for the Enviro™ Cover System of landfill cover application. Detail B of Figure 1 illustrates a cross-section of the continuous soil ballast normally applied at the overlapped panels and tested on the test pad.

The panels and overlap were then subjected to a spray of water simulating a rain event - all water-spray being captured on top of the pad. An in-line flow meter leading to the sprinkler measured the flow rate of the simulated rain event over the calculated wetted area on the pad. Two overlap conditions of the non-reusable geosynthetic Enviro™ Cover film were tested under the water spray, one placing the upper overlap with top edge facing upslope (shingled against the flow) and the other with the top edge facing downslope (shingled with the flow).

The simulated rain events were monitored for each overlap condition and a graduated container was placed in a depression at the bottom outlet of the flow interceptor trench, dug so as to catch any flow from off the geomembrane draining down the trench and allowing measurement of the amount of simulated rain penetrating/permeating the ADCM.

Figure 2. In-line flow meter measuring total simulated rainfall viewed from top side of test pad.
Figure 3. Lower corner of test pad at end of collection trench where cover-penetrating quantity is collected in a graduated pitcher. Most fluid is shed as runoff by this continuous barrier ADCM.

Enviro™ Cover panels are normally deployed parallel to the slope direction, so that as rain water is shed by the tarp-like film by meandering down-slope, flow will sometimes cross a panel overlap with the shingled direction and sometimes against the shingled direction. Thus a

reasonable assumption is that water flow across the soil-ballasted panel overlap of Detail B in Figure 1 occurs equally in both shingled-up and shingled-down directions, with the averaged rain fall percent penetration coming to 3%. This value for the ADCM film is much better than the penetration allowed by either the soil or green waste in the testing.

**Green Waste Daily Cover and Soil Cover:** Similar testing was conducted for: 1) Approximately 6 inches of uncompacted green waste (pine mulch), a popular ADC and 2) Approximately 6 inches of a silty sand soil cover. The same protocol was applied and penetrating flows through the covers to the interceptor trench were collected and measured in comparison to the total flow through the flow meter - equal to the total simulated rainfall over the wetted area on the test pad. Figures 4 and 5 are photographs of the testing conducted with the green waste and the soil. Both green waste and soil were dry and no moisture testing was conducted, while the soil met Soil Classification description as a silty sand. Moisture content and further classification is beyond the general purpose of this testing as moisture content will differ from day to day with the thin daily cover and soils for daily cover are quite varied.

The green waste absorbed a great amount of rainfall before becoming saturated and flowing through at effectively 100% penetration (See Figure 4). The soil also absorbed some rain-fall, but shed some as well, with a great amount of visible soil erosion in the water runoff (See Figure 5). Enviro™ Cover greatly exceeded the barrier properties of either the soil or the green waste, shedding most of the rain-fall and absorbing only a small amount at the soil ballasted overlap.

Figure 4. Green waste after breakthrough, allowing 100% rainfall to enter collection trench.
Figure 5. Soil cover runoff demonstrating ponding and erosion

**Tarps and Foams:** Geosynthetic tarps come in two classifications according to ASTM D6523 "Standard Guide for Evaluation and Selection of Alternative Daily Covers (ADC's) for Sanitary Landfills" – either reusable or non-reusable. The reusable tarps are thick mats that can be unrolled or pulled over a working face at the end of the work day and removed again before the start of the next day. A non-reusable geosynthetic is simply buried in the working face and subsequently destroyed with the next day's waste. An advantage of a non-reusable geosynthetic is that it continues with barrier benefits through to the following waste fill sequence.

In other words, it provides a continuous extended barrier between waste and the environment. Reusable tarps provide good barrier action against fluid migration only while in place, but their time in actual coverage is limited to a partial day - being applied at day's end and taken up from the working face before the start of operation the next day. Assuming a 12 hour work day, this would be 1/2 coverage through a 24 hour day, allowing the waste to go uncovered for the remaining 1/2 day. This means that the average reusable tarp provides exposure to precipitation for leachate generation with a penetration rate of 50 % in the working face. In effect, reusable tarps offer less leachate penetration resistance than any of the other materials tested in this study.

Foams and slurries, while not tested in this study, can for the most part be expected to perform similarly to green waste but with a different degree of water absorption and penetration. These are permeable materials and will compare poorly with an impermeable ADCM in shedding precipitation, allowing 100% penetration once the rain saturates and dissipates the foam or slurry.

**Extension of Results to Odors and Landfill Gas:** Using the concept of intrinsic permeability, we can correlate flows of water to flows of gas and therefore to the flow of odors as well. Intrinsic permeability is a characteristic of any porous medium and entirely independent of the nature of the fluid – whether gas or liquid. Simplifying from Darcy's Law for water and gas flow through a permeable medium and solving for the intrinsic permeability coefficient in common (Ref 2, 3), we can calculate volumetric flow of landfill gas $Q_{lfg}$ through daily cover as proportional to volumetric flow of water $Q_w$. This constant of proportionality is simply the ratio of respective fluid viscosities and densities - as in Equation 1. Tests and conclusions for water testing as reported here can thereby be used to apply proportional results for gaseous flows.

$$Q_{lfg} = Q_w(\mu_w\gamma_{lfg}/\mu_{lfg}\gamma_w) \qquad (1)$$

**Conclusions:** Daily Covers can make a significant difference to landfill operations, not only in air space savings and operation costs but in other aspects of economic and environmental benefit. Landfill gas and odor control, along with leachate volume reduction and management, are two such areas where the choice of Daily Cover Materials can strongly direct a landfill's operational benefits and future cost savings. The impact of good Daily Cover Material selection can go far beyond what landfills may be accustomed to thinking about in the practice and application for Daily Cover.

**References**

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