

RESEARCH BULLETIN

Biologically Active Covers for Mitigation of Landfill Gas Emissions

ABSTRACT: *The objective of this work was to compare emissions of methane (CH₄) and non-methane organic compounds (NMOCs) from landfill cells covered with soil and a biologically active cover consisting of yard waste compost.*

Methane (CH₄) is a greenhouse gas with an infrared activity 25 times that of carbon dioxide (CO₂) and therefore an important gas in climate forcing.

Atmospheric CH₄ has increased by a factor of two over the last century and almost 70 percent of the annual atmospheric input of CH₄ is from anthropogenic (i.e., manmade) sources. On a global scale, landfills make up eight percent of the total CH₄ sources and are the largest source of anthropogenic CH₄ in the United States.

Several factors influence the extent of CH₄ oxidation in landfill cover soils including CH₄ and oxygen (O₂) concentrations, temperature, moisture content, soil composition, moisture holding capacity, pH, and nutrient content. To the extent that O₂ availability limits CH₄ oxidation, cover designs that enhance O₂ availability will enhance CH₄ oxidation.

In addition to CH₄, landfill gas contains trace organic compounds including alkanes, aromatics, chlorinated aliphatic hydrocarbons, alcohols, ketones, terpenes, chlorofluoro compounds (CFCs), and siloxanes. Some of these compounds biodegrade



Figure 1. Biocover Installation

under aerobic (i.e., with air) conditions. Therefore covers that promote CH₄ oxidation may also result in decreased emissions of trace organic compounds.

The objective of this research was to compare emissions of CH₄ and non-methane organic compounds (NMOCs) from landfill cells covered with traditional soil covers to a biologically active covers (biocovers) consisting of yard waste compost. The hypothesis tested was that the compost-covered areas would exhibit lower CH₄ and trace organic compounds than the soil-covered areas because of greater oxidation rates. The efficiency of the



Figure 2. Static Chamber Sampling

compost cover was tested with the gas extraction system both on and off to simulate conditions prior to gas collection system installation.

The study was conducted on a section of the Outer Loop Landfill in Louisville, KY. Refuse in the test area was three to five years old when emission testing began and an active gas collection system was in operation. The soil cover was approximately three feet of clay, while the biocover consisted of six inches of clay, overlain by six inches of tire chips, which served as a gas distribution layer, followed by three feet of shredded composted yard waste. The biocovers were constructed by excavating the original soil covers on both flat and sloped sections of the landfill (Figure 1).

Emissions tests were conducted in April, June, and September 2002 and June 2003 using triplicate 1 m² static chambers on both flat and sloped soil covers and biocovers. The static chambers included a 1 m²

stainless steel collar and lid. The lid included a fan to mix the chamber headspace, a temperature probe, a pressure probe, and four outlets for sample collection. Gas samples were collected using syringes or summa canisters. The gas-sampling chamber is shown in Figure 2.

The data collected showed that both covers performed well most of the time when the gas collection system was operational. Surface uptake of CH₄ from the atmosphere was observed roughly half the time for both the soil cover and biocover when the gas collection system was on. Conversely, when the gas collection system was off, the biocover continued to take up atmospheric CH₄ about 60 percent of the time compared to only 12 percent on the soil cover where there were several relatively high fluxes.

Based on the findings, the advantages of the biocovers were most apparent in the absence of an operating gas collection system. Therefore the use of biocovers as an intermediate cover can reduce gas emissions when gas collection and control is not in place, when the gas collection system is not fully extended to a particular area, or when the gas collection system is not operational. In addition, biocovers have advantages over traditional soil covers because they are less susceptible to cracking and erosion, and can serve as a gas polishing system for fugitive emissions.

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