U.S. Field Test Measurement Programs for Landfill Gas

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INTRODUCTION

This paper will provide an overview of three ongoing field test measurement programs by the U.S. EPA's National Risk Management Research Laboratory (NRMRL). The data will be used to update existing emission factors as needed to more accurately reflect emissions from landfills. Much of the data used to develop existing emission factors are from the 1980s and early 1990s. Given changes that have occurred to waste composition, management practices, combustion technologies, and regulatory requirements, questions exist about whether these factors represent today's operations at landfills.

Landfills are identified as a source under the Urban Air Toxics Strategy for evaluation of residual risk. There is concern about potential toxics from landfills, particularly those pollutants that are persistent bioaccumulative toxics (PBTs) such as mercury. Emissions of methyl- and dimethyl- mercury have been detected at municipal solid waste (MSW) landfills in some limited work that was done in Florida. The fate of mercury in landfilled waste, particularly for sites where septic sewage is being added to provide more optimum conditions for the microbes, has been raised as a potential issue. Landfills have been found to emit more than 100 non-methane organic compounds (NMOCs) such as benzene, ethane, toluene, and vinyl chloride, in addition to carbon dioxide and methane. Over 30 of these compounds are classified as hazardous air pollutants (HAPs). Up-to-date, credible data are needed as input to emission inventories and evaluation of residual risk.

This paper will provide an overview of ongoing field tests including measurement of fugitive gases such as methane.

REMOTE SENSING

Remote sensing is what EPA recommends for measuring fugitive emissions from landfills and other large area sources. This technology uses multiple-beam Optical Remote Sensing (ORS) in radial configurations providing spatial data for emission calculations. It has been used at production houses and lagoons at large-scale hog farms, coal mines, wastewater treatment facilities, and landfills. It is used to measure gases such as methane, volatile organic compounds (VOCs), and hazardous air pollutants (HAPs) over large area sources. The technology is based on optical remote sensing with computed tomography (ORS-CT). It is an iteration of the measurement technique known as open path Fourier transform infrared (OP-FTIR) spectrometry.

Traditional OP-FTIR has combined path-integrated concentration (PIC) data over a single downwind path, meteorological measurements, and plume dispersion modeling to calculate an average emission rate over an upwind area source. ORS-CT is a method of calculating the emission rate from OP-FTIR measurements over multiple optical paths in a vertical or horizontal plane section of the volume above the area source. The CT technique applies the smooth basis function minimization (SBFM) method to the PIC data and wind speed data to estimate the total emission flux from the area source. It does not rely on plume dispersion modeling assumptions.

ORS-CT measurements require an infrared light source, an automated scanner, multiple retroreflectors, a Michelson interferometer, a light detector, wind speed and wind direction data, and temperature, relative humidity, and barometric pressure data. The scanner sequentially transmits light to each retroreflector and collects the returned light. Accurate measurements of the optical path length to the retroreflectors are required. A typical setup combines ORS-CT measurements downwind of the area source and OP-FTIR measurements upwind of the source to account for any background emissions not attributable to the source.

LANDFILL FIELD TESTS

There are three active field test programs providing methane emission data in addition to VOC and HAPS data. The first of these is being conducted in partnership with the Environmental Research and Education Foundation (EREF) through a Cooperative Research and Development Agreement (CRADA). The objective of this field test program is to quantify constituents in landfill gas (i.e., methane, VOC, HAPs, and PBTs) through sampling the raw gas. Combustion outlets are also being sampled for combustion by-products for the range of technologies in use (i.e., enclosed flares, reciprocating engines, turbines, boilers). Comprehensive measurements, using the highest level of quality assurance, are underway at 8 to 10 U.S. landfills.

The second field test program is part of a CRADA with Waste Management to evaluate full-scale landfill bioreactors. Data are being collected for all media. Our role is to measure for any potential mercury and fugitive gaseous emissions. This site has three areas under evaluation:

- Operation as a bioreactor after waste has been landfilled;
- Operation as a bioreactor as soon as waste is landfilled; and
- Operation using conventional landfilling practices (i.e., control).

All three areas are being evaluated for any differences in mercury and fugitive emissions. For mercury, the raw gas is being analyzed for total, elemental, and speciated mercury (including methyl- and dimethyl-mercury). Optical remote sensing with computed tomography is being used to evaluate any potential fugitive emissions at each of the areas identified above. The goal is to be able to determine any difference in mass emission rates for methane and other potential fugitive gases. Remote sensing is also being used at this site to evaluate the performance of “biocovers” in use.

The third field test program is for superfund landfills which are typically older landfills where there is co-disposal of hazardous and municipal waste. There is a great deal of interest in the re-use of these sites as parks and recreational use. A guidance document has been developed that recommends field tests for obtaining data to evaluate any potential air pathway concerns at these sites. Three sites have been selected to illustrate this guidance prior to its publication in the fall of 2003. At one of these sites, optical remote sensing with computed tomography is being used in addition to collecting samples from perimeter probes and punch probes to analyze for methane, VOC, and HAPs.

CONCLUSIONS

Field test programs underway will result in data to more accurately characterize landfill gas emissions. These data will be used to update existing emission factors for landfill gas. Fugitive emissions are being evaluated using remote sensing technology. Results from these ongoing field test programs will be submitted for publication to peer-reviewed journals.

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