A case study of methane emission and methane oxidation at a large scale Swedish landfill

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Introduction

Methane is an important climate gas contributing significantly to global warming. Landfills constitute a significant source of anthropogenic methane emissions. In Sweden, landfills are estimated to make up 3 % of the national emission of climate gases, in terms of CO_2-equivalents. Although these emissions are decreasing, due to national waste management policy, there is a need of reliable field measurement methods. By observing the current emission situation at different sites, improvement measures decreasing the landfill gas emissions can be initiated, model calculations may be validated and it can be concluded whether regulations are fulfilled or not. This study presents measurement results from a large scale Swedish landfill, using an area integrating technique based on tracer gas release and time resolved plume concentration analysis. Both total landfill methane emission and methane oxidation are considered.

Methods

In order to overcome the large spatial and temporal variation in the emission encountered at a landfill, measurement methods integrating in space and time are desirable. In Sweden one approach based on tracer gas release in combination with time resolved concentration analysis in the downwind landfill plume has been adapted. The method is called TCT – Time Correlation Tracer, and has been used in a project initiated by the Swedish Energy Administration, measuring at 8

landfills throughout Sweden, during different seasons and meteorological conditions. Tracer gas is released in a controlled way by use of point sources distributed over the landfill surface. The tracer effectively mixes with the emitted methane in the landfill plume, and at a large enough distance downwind the site a good source simulation by the tracer is obtained. The concentrations of methane and tracer gas in the plume are analysed with good time resolution using FTIR spectroscopy. By either traversing the plume with the measurement system, or by letting the plume sweep over the measurement location, the quota between the methane and the tracer concentrations are derived, yielding the methane flux. By observing the degree of correlation between the tracer and methane concentration in time, it can be judged in real time whether the tracer simulates the methane emission in an accurate way or if the measurement set-up needs to be adjusted.

The rate of methane oxidation at the landfill site is estimated using the common method based on a shift in isotopic carbon signature, occurring as methane is transported from the anoxic zone through the cover material into the atmosphere. The fractionation factor of the bacteria in the soil is retrieved by incubation studies. In order to obtain the oxidation rate, the isotopic constituent of the landfill gas is analysed both in samples taken in the downwind landfill plume, in the anoxic zone as well as in the background atmosphere.

Results

Measurement results from several occasions, ranging from November 2001 (winter) until September 2002 (autumn) will be presented and discussed, addressing both total methane emission and methane oxidation. The data series also include the effect of a gas collection system improvement.

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