Microbial Oxidation of Methane form Old Landfills in Biofilters

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Introduction

In a four-year co-operative research project funded by the German Federal Ministry of Education and Research, the potential of methane oxidation in biofilters is investigated. The aim of the project is to provide a process for the treatment of low concentrated landfill gas (LFG) that can not be energetically utilized in order to reduce greenhouse gas emissions. This presentation focuses on systems using forced aeration techniques, where LFG is mixed with ambient air and introduced into the biofilter.

Experimental Setup

The experiments are carried out in a bench scale and a technical scale plant as well as in laboratory batch essays.

In the bench scale plant, biofilters with volumes of approx. 12 L each were loaded with 150 L/h of air mixed with varying concentrations of methane. Before entering the filters, the air was humidified by means of a scrubber. From the results of these experiments, design data for the larger technical scale plant was extracted.

The technical scale plant is set up at an old landfill, so the experiments can be carried out with LFG that, besides methane, also contains carbon dioxide and a variety of trace gases. The technical scale plant consists of four biofilter units, each divided into three stages. The total filter volume is about 4 m^3. The technical scale plant has been designed to treat approximately 20 m^3/h of a LFG-air mixture with a methane concentration of 2 % v/v. In order to provide sufficient temperatures for the microorganisms, thermal insulation of the container, pre-heating of the inlet air, and a partial recirculation of the treated gas has been installed [Streese *et al.*, 2001].

Experimental Results

In first experiments, degradation rates of up to 25 g CH_4 per m^3 filter material and hour could be obtained at temperatures around 29 °C (Fig. 1, circles). A strong temperature dependency was observed that may lead to problems during winter time operation and had to be taken into account for the technical scale plant [Dammann *et al.*, 1999].

A problem that occurred with fine-grained filter materials was the accumulation of exopolymeric substances (EPS), leading to clogging of the filter material and hence to a breakdown of the degradation rates [Kholiq *et al.*, 2000]. To avoid clogging problems, experiments with new substrates are now carried out both in the bench scale plant and in the technical scale plant. Fine compost (< 10 mm) was mixed with peat and crushed wood fibers in order to increase mass transfer. In another filter, additional horizontal gas distribution layers were used.

In these experiments, very high degradation rates of up to 60 g/m³h could be obtained at concentrations of 3 % methane and temperatures of about 30°C. These results are higher than any values we found in the literature.

Although pure compost showed the highest degradation rates in the beginning of the experiment (fig. 1), they decreased after several months and eventually dropped below the degradation rates of the filters with improved mass transfer.

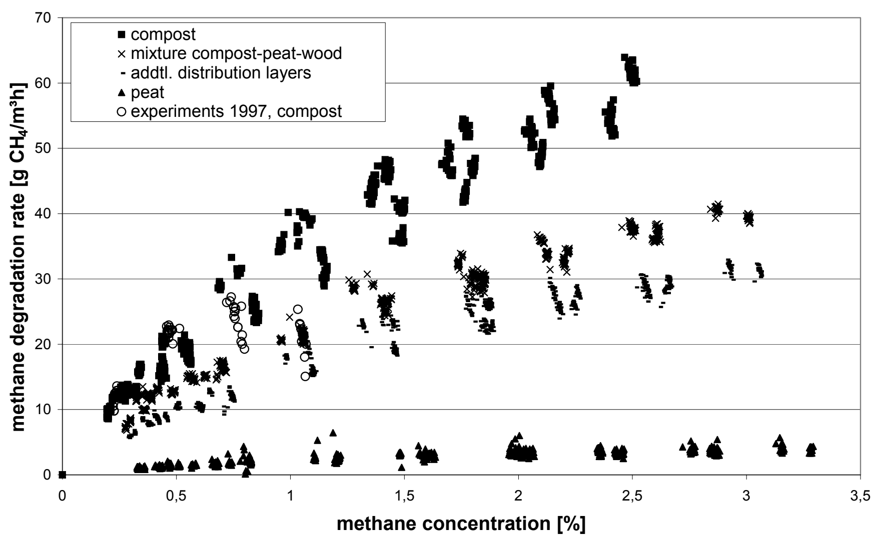

Figure 1: Concentration dependency of methane oxidation in biofilters

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