Assessing the operational performance of biofilters

Report title: Understanding biofilter performance and determining emission concentrations under operational conditions

Sniffer code: ER36

Main audience: Regulators and operators

Contact: Dr Louise Fletcher, l.a.fletcher@leeds.ac.uk

Date: April, 2014

Objectives

The research was designed in order to answer the following questions:

- What current technologies are being used throughout the UK biowaste industry to treat emissions, what emission concentrations are they achieving and what rates of reductions relative to untreated emissions do these represent?
- What design configurations and operating conditions are required to ensure that maximum reduction rates are achieved, taking into consideration the different processes?
- What is the degree of aerobicity/anaerobicity in existing, enclosed, biowaste treatment processes? How significant of an impact does it have on the levels and types of bioaerosol and odour emitted and what impact does it have on the site's overall environmental performance?
- Which technology (ies) might be put forward as candidates for Best Available Techniques (BAT) for bioaerosol and odour abatement and what final bioaerosol and odour concentrations are achievable.

Open biofilter at a biowaste site showing the biofilter media surface and the arrangement of the inlet duct

Key findings and recommendations

Some of the key findings from this research project are:

- Emissions from enclosed biowaste facilities contain bioaerosols, and a range of odorous compounds. The concentration varies between sites and over time and is influenced by a complex interplay of factors that include waste type, process type and extraction system design.
- Well designed, operated and maintained biofilters are capable of achieving significant and sustainable reductions in biowaste odours up to 94%. Typical outlet concentrations range from 200 to 5500 OU_E/m^3.
- Biofilters can achieve reductions in bioaerosols although performance is variable with time and from site to site. At low inlet concentrations biofilters may be net emitters of bioaerosols and in particular fungi.
- The impact of biofilter design and operating parameters varies and the key variables do not appear to be the same for odour and bioaerosols which may reflect the different removal mechanisms involved.
- Upstream scrubbers are beneficial in terms of removing bioaerosols, dust and potentially toxic pollutants such as ammonia that may adversely affect biofilter performance. The requirement for scrubbing needs to be evaluated on the basis of site specific conditions.
- Biofilters in isolation and in combination with scrubbers represent a candidate BAT odour control technology if properly operated and designed.
- Enclosure of biofilters does not influence odour removal performance but does appear to have an influenced on bioaerosol removal and generation.

Project context

Recent years have seen a significant rise in the number of composting facilities operating in the UK. As early as the 1990s concerns were growing regarding the risks associated with the emission of bioaerosols in particular. Biofilters have been used as an abatement technology primarily for odour removal but also for the control of bioaerosols for many years. Research over the past 20 years has led to a better understanding of the principles of operation of biofilters. However there are still many gaps in the knowledge which need to be addressed if biofilters are to be designed in a more rational way

Next steps

- Overall there continues to be a lack of good quality data regarding the concentration of bioaerosols in the air emitted from enclosed biowaste processes and biofilters. More sampling needs to be undertaken using robust, standardised sampling procedures in order to provide a more comprehensive data set.

- More data is needed to investigate the impact of anaerobicity on odour and bioaerosol emissions and more specifically whether there are any relationships between specific VOCs / VOCs groups and odour that may serve as markers for anaerobicity / abnormal conditions.

- More research is needed :

    - To investigate the performance of these systems in terms of their ability to treat the air emitted from biowaste process that are operating under 'abnormal' conditions. This will help to define the operational limits for application of biofilter technology to composting processes.
    - To evaluate the performance of biofilters with different media types or with combinations of different media or media mixes in terms of odour and bioaerosol emissions and removal.
    - To investigate the criticality of these parameters in order to refine operational ranges and firmly define boundary conditions between normal and abnormal biofilter operations.
    - To determine if a single biofilter can be optimised for the removal of bioaerosols and odour. Additional research should be carried out on the feasibility of using a two stage biofilter system with each stage optimised for the removal of odour or bioaerosols.
    - To investigate the potential for net emission of bioaerosols from biofilters both in terms of the overall concentration and also the individual species. This research should also evaluate the potential for applying scrubbing post biofiltration to remove bioaerosols.

Further information

Copies of the research outputs can be downloaded from Sniffer.org.uk

For more information e-mail info@sniffer.org.uk or call 0131 650 5326

Partners

SEPA Scottish Environment Protection Agency

DOE Department of the Environment www.doeni.gov.uk

Environment Agency

Contractor

University of Leeds

Odournet air quality and odour research consultants

Sniffer, ECCI, High School Yards, Infirmary Street, Edinburgh, EH1 1LZ, Scotland, UK
T: 0131 650 5326 E: info@sniffer.org.uk W: www.sniffer.org.uk : @SnifferScotland
Scottish Charity No SC022375, Company No SC149513. Registered in Edinburgh.
Registered Office: Edinburgh Quay, 133 Fountainbridge, Edinburgh, EH3 9AG

sniffer knowledge brokers for a resilient Scotland