



Assessment of Ground Gas Potential using Forensic Total Organic Carbon (fTOC)

The assessment of ground gas risk can be made using the approach established in Contaminated Land: Applications in Real Environments (CL:AIRE) Research Bulletin 17 (RB17 - A pragmatic approach to ground gas risk assessment). This alternative methodology involves a forensic description and determination of total organic carbon (TOC) to assess the amount of degradable material present. The forensic description is a detailed quantitative assessment of the organic content of soil by sorting and weighing.

Identification of low-risk sites requires a good understanding of the nature of the source material. On many very low to low-risk sites, installation and monitoring of wells can be avoided.



Introduction

The assessment of ground gas risk can be made using the approach established in Contaminated Land: Applications in Real Environments (CL:AIRE) Research Bulletin 17 (RB17 - A pragmatic approach to ground gas risk assessment). This alternative methodology involves a forensic description and determination of total organic carbon (TOC) to assess the amount of degradable material present. The forensic description is a detailed quantitative assessment of the organic content of soil by sorting and weighing.

Identification of low-risk sites requires a good understanding of the nature of the source material. On many very low to low-risk sites, installation and monitoring of wells can be avoided. Examples include:

- Made Ground where low gas generation risk is present;
- soils where the only sources of methane and carbon dioxide are natural deposits, in the form of alluvium or carbonate strata (e.g. chalk).

In such cases, RB17 might provide a more reliable and rapid indicator than current approaches that rely on long-term periods of gas monitoring.

The data required on the source material is quick and easy to obtain during an intrusive site investigation (TOC testing and forensic description). Gas migrates in the ground and concentrations can be spatially and temporally variable. Gas monitoring results can be sensitive to external influences. This method uses data that is not subject to temporal variations leading, in some cases, to a more robust risk assessment. Careful application is still required when using this methodology.

Application of RB17

The framework is based on a comprehensive desk study, robust conceptual site model (CSM), adequate site investigation and appropriate laboratory testing of soils. Further information on the application of fTOC is given in BS 8485 (limiting values of thickness and organic content of made

ground are specified in Table D.1) and in NHBC's recent ground gas guidance (NHBC, 2023).

This methodology can also be used alongside gas monitoring as a separate line of evidence in risk assessment. Although RB17 was originally written to allow simple screening of low-risk sites, it has subsequently been used for high-risk sites, including sites assessed under Part 2A. This is because the data collected enables a better understanding of soil chemistry, gas generation processes and the volumes of gas produced.

Reporting Requirements

The whole 'as received' bulk sample is weighed and then placed on a suitable surface. The main constituents are divided into separate fractions. The fractions are weighed to determine the proportion of each in the sample. The TOC content of the fine fraction is then analysed.

Forensic Description Fractions

- Coarse inert particles including gravel, concrete, brick >10mm
- Visible wood, branches, tree etc.
- Visible vegetation grass, food waste etc.
- Visible cloth, leather
- Visible metal, glass, ceramics and other inert material
- Paper and card
- Other degradable material

- Fine soil including gravel <10mm (original sample weight minus sum of the above)

The forensic description, for one sample, can take up to 5 hours. The method involves a detailed assessment of the sample submitted. Analysis of TOC on all fractions can also be requested.

Sampling Requirements

The main intention of RB17 is to ensure that the source is adequately characterised. The site investigation will therefore require sufficient coverage to give a robust assessment of the nature of any potential

gas source. More than one sample will typically be required per trial pit, for example, where there are significantly different horizons within Made Ground. A greater density of sampling is needed where there is variability across a site – further information is provided in BS 10175. The samples should be collected in bulk bags and be representative of the source material. The sample size should be between 10-15 kg.

Table 1 Analytical Overview

Test Method	Forensic Description and TOC
Method	TM 408/TM 132
Sample Containers	Bulk bag (10kg sample)
Holding Time	6 months

Total Organic Carbon

Analysis of TOC is carried out using high temperature (dry) combustion. The sample is treated with hydrochloric acid to remove inorganic carbon before being heated in a stream of oxygen. BS 15936 (2022) replaces BS 13137 (which is now withdrawn) – both methods refer to dry combustion.

Where the TOC limits are exceeded, dissolved organic carbon (DOC) using 10:1 leaching analysis may be used to assess whether the TOC is degradable or not and thus allow an appropriate Characteristic Situation (CS) to be defined. DOC is scheduled separately from the above.

As with assessment using gas monitoring data, before assignment of a CS, careful consideration is given to possible changes in ground conditions that might arise from foreseeable natural events (e.g. changes in groundwater levels and sudden drops in atmospheric pressure), construction activities or on completion of the planned development (e.g. disturbance of the ground admitting water and air, inhibition of ground gas exchange with the atmosphere and creation of permanent pathways by which water and/or air could enter the ground).

All assumptions made leading to an assignment of a CS, and the reasoning behind them should be carefully recorded and reported together with all relevant data and other information.

References

- BS 8485:2015+A1:2019 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.
- British Standards Institute. BS 10175:2011+A2:2017 Investigation of potentially contaminated sites – code of practice.
- BS EN 15936:2022 Soil, waste, treated biowaste and sludge. Determination of total organic carbon (TOC) by dry combustion.
- Contaminated Land: Application in Real Environments: A Pragmatic Approach to Ground Gas Risk Assessment. RB17. CL:AIRE, 2012.
- Construction Industry Research and Information Association. Wilson S., Oliver S., Mallett H., and Card G. Assessing risks posed by hazardous ground gases to buildings (C665) London: CIRIA 2007.
- NHBC 2023 Hazardous ground gas – an essential guide for housebuilders publication NF94.

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