



BSI Standards Publication

Characterization of waste — Determination of brominated flame retardants (BFR) in solid waste

National foreword

This British Standard is the UK implementation of EN 16377:2013.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

**Characterization of waste - Determination of brominated flame
retardants (BFR) in solid waste**

Caractérisation des déchets - Détermination des
retardateurs de flamme bromés (BFR) dans les déchets
solides

Charakterisierung von Abfällen - Bestimmung bromierter
Flammschutzmittel (BFR) in Feststoffabfall

This European Standard was approved by CEN on 10 August 2013.

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Foreword

This document (EN 16377:2013) has been prepared by Technical Committee CEN/TC 292 "Characterization of waste", the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2014, and conflicting national standards shall be withdrawn at the latest by March 2014.

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Introduction

WARNING — Persons using this European Standard should be familiar with common laboratory practice. This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

IMPORTANT — It is absolutely essential that tests conducted according to this standard be carried out by suitably trained staff.

1 Scope

This European Standard specifies a method for the determination of selected polybrominated flame retardants (BFR), chemically known as polybrominated diphenylethers (BDE), in waste materials using gas chromatography/mass spectrometry (GC-MS) in the electron impact (EI) ionisation mode (GC-EI-MS).

When applying GC-EI-MS, the method is applicable to samples containing 100 µg/kg to 5 000 µg/kg of tetra- to octabromodiphenylether congeners and 100 µg/kg to 10 000 µg/kg of decabromo diphenylether (see Table 1). It is also possible to analyse other brominated flame retardants applying the method described in this European Standard, provided the method's applicability has been proven.

Table 1 — Brominated flame retardants determined by this method

No.	Congener	Formula	Abbreviation ^a	Molar mass g/mol
1	2,2',4,4'-Tetrabromodiphenylether	C ₁₂ H ₆ Br ₄ O	BDE-47	485,795 0
2	2,2',4,4',5-Pentabromodiphenylether	C ₁₂ H ₅ Br ₅ O	BDE-99	564,691 1
3	2,2',4,4',6-Pentabromodiphenylether	C ₁₂ H ₅ Br ₅ O	BDE-100	564,691 1
4	2,2',4,4',5,6'-Hexabromodiphenylether	C ₁₂ H ₄ Br ₆ O	BDE-154	643,587 2
5	2,2',4,4',5,5'-Hexabromodiphenylether	C ₁₂ H ₄ Br ₆ O	BDE-153	643,587 2
6	2,2',3,4,4',5',6-Heptabromodiphenylether	C ₁₂ H ₃ Br ₇ O	BDE-183	722,483 2
7	Decabromodiphenylether	C ₁₂ Br ₁₀ O	BDE-209	959,171 4
^a Numbering for the BDE according to IUPAC nomenclature for PCB.				

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 14346, *Characterization of waste — Calculation of dry matter by determination of dry residue or water content*

EN 15002, *Characterization of waste — Preparation of test portions from the laboratory sample*

ISO 8466-1, *Water quality — Calibration and evaluation of analytical methods and estimation of performance characteristics — Part 1: Statistical evaluation of the linear calibration function*

3 Principle

Brominated diphenylethers (BDE) are extracted from the dried sample using an organic solvent. In case of high levels of plastic waste matrices, cryo-grinding is required in order to provide particle sizes that allow the complete extraction of the analytes. Appropriate extraction techniques are soxhlet, sonication or pressurised fluid extraction. The obtained extracts are concentrated and cleaned up by column chromatography and Gel Permeation Chromatography (GPC).

Following the concentration and clean-up process, the brominated diphenylethers are separated by capillary gas chromatography and detected by mass spectrometry in the selected ion monitoring mode using electron impact ionisation (EI). Quantification is carried out by the internal standard method.