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Water quality — Analysis of microplastic in water —

Part 2: Vibrational spectroscopy methods for waters with low content of suspended solids including drinking water

Qualité de l'eau — Analyse des microplastiques dans l'eau —

Partie 2: Méthodes de spectroscopie vibrationnelle pour les eaux à faible teneur en matières en suspension, y compris l'eau potable

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Contents

Page

Foreword ..... **v**
Introduction ..... **vi**
1 Scope **1**
2 Normative references **2**
3 Terms, definitions and abbreviations **2**
3.1 Terms and definitions 2
3.2 Abbreviations 3
4 Principle **4**
5 Interferences **4**
6 Reagents, consumables and reference materials **4**
6.1 General 4
6.2 Particle-free water of known quality 4
6.3 Surfactant solution 5
6.4 Ethanol 5
6.5 Plastic reference material 5
6.6 Containers for filter storage 5
7 Precautions for the laboratory environment, equipment and materials **5**
7.1 Operating precautions linked to the laboratory environment 5
7.2 Equipment 5
7.2.1 General 5
7.2.2 Infrared (IR) apparatus coupled to microscope 5
7.2.3 Raman coupled to microscope 6
7.2.4 Filtration system 6
7.2.5 Characteristics of filters: type and sizes 7
7.3 Precautions and cleaning protocol for materials 7
7.4 Bottles or containers for sampling 7
8 Sampling **8**
9 Operating protocol **8**
9.1 Volume of test sample 8
9.2 Sample filtration protocol 8
9.3 Analytical control blanks 9
9.4 Adjustment and calibration of instruments 9
9.4.1 Infrared microscope 9
9.4.2 Raman microscope 9
9.5 Cartesian coordinates of analysed particles 10
9.6 Analysis of the filter surface 10
9.6.1 General 10
9.6.2 Choice of the optical objectives 10
9.6.3 Selection of particles to be analysed or choice of the analysed surface area 10
9.6.4 TOTAL Model 10
9.6.5 RANDOM Model 11
9.6.6 CAKE Model 11
9.6.7 SPIRAL or HELIX Model 12
9.6.8 Particles enumeration and size description 12
9.6.9 IR spectra acquisition and particle identification 12
9.6.10 Raman spectral acquisition and particle identification 13
9.7 Sampling and analytical control blank analysis 13
9.8 Spectra treatment 13
9.9 Criteria of chemical composition identification 14
9.10 Spectral interferences 14
9.10.1 General 14

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9.10.2 Pigments or dyes ... 15
9.10.3 Polyamide versus natural proteins ... 15
9.10.4 Polyethylene versus other molecules with long CH-chain ... 15

10 Method characterization and verification ... 15
10.1 General ... 15
10.2 Verification of the particle size measurement accuracy ... 15
10.3 Verification of microplastics identification and classification at claimed size ... 15
10.4 Determination of minimal HQI for automatic identification ... 16
10.5 Determination of the reporting limits of the method ... 16
10.6 Verification of microplastics recovery rate of the method ... 17

11 Quality check of analytical control blanks in test series ... 17

12 Expression of results ... 18

13 Test report ... 18

Annex A (informative) **List of characteristic wavenumbers for the main polymers ... 20**

Annex B (informative) **Creation of an internal spectral database ... 23**

Annex C (informative) **Description of known interference during acquisition of spectral fingerprint — Presence of pigments ... 26**

Annex D (informative) **Description of known interference during acquisition of spectral fingerprint — Interference between natural and synthetic polyamides (proteins and polyamide 6-6) ... 27**

Annex E (informative) **Description of a known interference during acquisition of a spectral fingerprint – Interferences of molecules with long CH-chain ... 29**

Annex F (informative) **Quantum Cascade Laser (QCL) IR microscopy ... 32**

Annex G (informative) **Performance data ... 33**

Bibliography ... 35

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Foreword

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Introduction

Pollution linked to microplastics is recognized as a global phenomenon. The standardization of the sampling, quantification and identification protocols is required to ensure reliability and comparability of the data produced for health and environmental risk assessments.

Microplastics in water can be identified and quantified using various methodological approaches. Depending on the measurement objectives, several complementary approaches shall be used to cover the full spectrum of microplastics (size and chemical nature). Table 1 resumes the characteristics and the information obtained with spectroscopic techniques.

Table 1 — Characteristics of the various analytical techniques and information obtained.

Characteristics and information obtained	Raman micro spectroscopy	Infrared micro spectroscopy
Type of sample	Water filtrate residues	
Chemical nature of the polymer	Yes	
Information provided by analytical technique	Functional groups	
Results expression	Polymer type, number of particles, size of particles	
Minimum measurable size range of particles	1 µm to 5 µm	20 µm
Minimum mass subject to measurement after preparation	Undefined	
Consequences for the test sample after measurement	Non-destructive	
Main interferences	mineral particles, coloured particles, pigments, fluorescence, fatty acids, fatty amides, proteins, surface alterations by biofilms or weathering, carbohydrates, generated by microbes	mineral particles, proteins, surface alterations by biofilms or weathering, particles loaded with carbon black, presence of water, carbohydrates generated by microbes

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Water quality — Analysis of microplastic in water —

Part 2: Vibrational spectroscopy methods for waters with low content of suspended solids including drinking water

WARNING — Persons using this document should be familiar with normal laboratory practice. This document 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.

IMPORTANT — It is absolutely essential that tests conducted in accordance with this document be carried out by suitably qualified staff.

1 Scope

This document establishes key principles for the investigation of microplastics in drinking water and water with low content of natural suspended solids using a microscopy technique coupled with vibrational spectroscopy.

This method is applicable to:

— determine the size of microplastics [which range from 1 µm to 5 000 µm], count them and classify them by size range;

— identify the chemical composition of microplastics, the main ones (most used in industry and most abundant in the environment) being: polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET), polycarbonate (PC), polystyrene (PS), polytetrafluoroethylene (PTFE), polyvinyl chloride (PVC), polyamide (PA), polymethyl methacrylate (PMMA) and polyurethane (PU);

This method is applicable to water with a low content of organic matter and other suspended matter as defined in ISO 6107 (1 mg/l to 100 mg/l or lower when interfering with the determination), i.e.,

— ultrapure water;

— water intended for human consumption;

— raw groundwaters.

Given the very low concentrations of microplastics usually present in these waters, special attention needs to be paid to potential sources of contamination during sample preparation.

This method is intended to determine and characterize large numbers of particles in the sample in automatic mode.

This method can also identify the nature of the other particles that are outside the scope of this document, for example minerals, proteins, cellulose and pigments.

This method does not apply to the characterization of substances intentionally added to or adsorbed on the surface of microplastics. This method does not apply to the determination of the geometric shape of microplastics.

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2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14644-1:2015, *Cleanrooms and associated controlled environments — Part 1: Classification of air cleanliness by particle concentration*

ISO/IEC Guide 99:2007, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
microplastics
solid plastic or synthetic polymer particle insoluble in water with the largest dimension between 1 µm and 5 mm

Note 1 to entry: Microplastics can have various shapes.

Note 2 to entry: This definition encompasses the ISO/TR 21960 definitions of large microplastics and microplastics.

Note 3 to entry: The term “microplastics” covers the sum of several individual microplastic particles.

3.1.2
microparticle
solid particle insoluble in water, with the largest dimension between 1 µm and 5 mm

3.1.3
Raman spectroscopy
spectroscopy in which the *Raman effect* (3.1.4) is used to investigate molecular energy levels

[SOURCE: ISO 18115-2:2021, 5.129]

3.1.4
Raman effect
emitted radiation, associated with molecules illuminated with monochromatic radiation, characterized by an energy loss or gain arising from rotational or vibrational excitations

[SOURCE: ISO 18115-2:2021, 5.128]

3.1.5
infrared spectroscopy
analytical chemical technique based on absorption of infrared radiation by chemical moieties (functional groups) in the specimen, used to identify and quantitate the absorbing chemical moieties

[SOURCE: ISO/TS 14101:2012, 3.3]

3.1.6
particle-free water
water not containing *microplastics* (3.1.1) or with the lowest possible concentration of *microplastics* (3.1.1)

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3.1.7
Feret diameter
distance between two parallel lines which are tangent to the perimeter of a particle

[SOURCE: ISO 10788:2014, 2.1.4]

3.1.8
maximum Feret diameter
maximum length of an object whatever its orientation

[SOURCE: ISO/TR 945-2:2011, 2.1]

3.1.9
reporting limit
smallest number of objects (*microplastics* (3.1.1)) that the laboratory can measure reliably by type of polymer and size class under routine laboratory operating conditions

Note 1 to entry: A different reporting limit can be associated with each filter reading model.

Note 2 to entry: For the determination of the reporting limit see 10.5.

3.1.10
correlation index
hit quality index
HQI
index or spectral correlation coefficient (typically between 0 and 1) or percentage allowing the calculation of the similarity between two spectral signatures

3.2 Abbreviations

ATR	Attenuated total reflection
FTIR	Fourier-transform infrared spectroscopy
HEPA filter	High-efficiency particulate air filter
HQI	Hit quality index
IR	Infrared spectroscopy
PA	Polyamide
PC	Polycarbonate
PE	Polyethylene
PET	Poly(ethylene terephthalate)
PMMA	Poly(methyl methacrylate)
PP	Polypropylene
PS	Polystyrene
PTFE	Polytetrafluoroethylene
PU	Polyurethane
PVC	Poly(vinyl chloride)
R_L	Reporting limit
SDS	Sodium dodecyl sulfate
USAF	United States Air Force
µFTIR	Microscopy coupled with FTIR spectroscopy
µRaman	Microscopy coupled with Raman spectroscopy

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