SLOVENSKI STANDARD
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Načela za analizo plastike in mikroplastike v okolju (ISO/DIS 24187:2021)

Principles for the analysis of plastics and microplastics present in the environment (ISO/DIS 24187:2021)

Grundsätze für die Analyse von Kunststoffen und Mikroplastik in der Umwelt (ISO/DIS 24187:2021)

Principes pour l'analyse des plastiques et des microplastiques présents dans l'environnement (ISO/DIS 24187:2021)

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Principles for the analysis of plastics and microplastics present in the environment

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Foreword

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This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 14, *Environmental aspects*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The analysis of plastics and microplastics is a rather new field in relation to other areas of environmental analysis. A large number of scientific publications exist, but they do not apply a uniform analysis, which makes it difficult to compare the results.

The differences in the approaches start with very basic things, which are quite different from the approach of conventional environmental analysis.

This standard sets out key principles for the investigation of microplastics in the environment, which should be taken into account in the subsequent development of specific procedures for sampling, sample preparation and detection. A large number of the principles described in this document could be applied, analogously, to other matrices and products, including foodstuffs and drinking water. The objective is to present a pool of methods and notes that is as harmonized as possible and to make it available for use in science, businesses and administrations.

What is true for analytics is also true for definitions in the same way. On the one hand, the terms used here are based on existing definitions in the subject area, but on the other hand, analytical requirements are also taken into account. This applies, for example, to the terms “large microplastics” and “small macroplastics”. The particle size to be investigated is closely related to the detection method to be selected. In the course of future specific work, it will therefore probably be necessary to modify existing definitions slightly and adapt them to new knowledge and requirements.

The definitions chosen in this document are adapted from the ISO report on plastics. The basis of the classification is based on the metric sizes and the associated designations. Microplastics is thus derived from micrometres.

NOTE Microplastics can also stem from different sources not specifically mentioned in this document, such as textiles, paints and tyres.

Principles for the analysis of plastics and microplastics present in the environment

1 Scope

This document describes the principles to be followed in the analysis of plastics in various environmental matrices (plastics testing). This includes the unique particle size classification of plastics, the use of certain apparatus with regard to sampling, sample preparation, and the determination of representative sample quantities. The purpose of this standard is to specify minimum requirements until specific standards for the different case situations are available. This is important to ensure that the development of the specific standards is done on a consistent basis to ensure that comparison or correlation of results is possible.

This standard does not include requirements for monitoring actions.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472 and the following 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
analysis
sequence of sampling, sample preparation and detection

Note 1 to entry: Detection may include particle counting, determination of mass, particle sizing and identification of chemical composition.

3.2
plastics
material which contains as an essential ingredient a high polymer and which, at some stage in its processing into finished products, can be shaped by flow

Note 1 to entry: Plastics contains mainly polymers and minor contents of additives. In addition reinforcements may be added in very variable amounts.

Note 2 to entry: Supplementary to the term "plastics", "plastics product" is also used. According to ISO 472, a plastics product represents "any material or combination of materials, semi-finished or finished product that is within the scope of ISO/TC 61 "Plastics".

Note 3 to entry: Plastics comprise both thermoplastics and thermoset materials.

Note 4 to entry: In the broader society discussion rubber is included.

[SOURCE: ISO/TR 21960:2020, 3.2, modified — term numbers in Notes to entry removed, Note 4 to entry added.]

3.3
macroplastics
any solid plastics particle or object insoluble in water with dimension above 5 cm

Note 1 to entry: Typically, a macroplastics object represents an item consisting of plastics or a part of an end-user product or a fragment of the respective item.

Note 2 to entry: The defined dimension is related to the longest length of the particle.

[SOURCE: ISO/TR 21960:2020, 3.8, modified — in Note 1 to entry, “for example cups, cup covers” was deleted; In Note 2 to entry, “distance” was replaced by “length”.]

3.4
small macroplastics
any solid plastics particle or object insoluble in water with dimension between 5 mm and 5 cm

Note 1 to entry: Typically, a macroplastics object represents an item consisting of plastics or a part of an end-user product or a fragment of the respective item.

Note 2 to entry: The defined dimension is related to the longest length of the particle.

3.5
large microplastics
any solid plastics particle insoluble in water with any dimension between 1 mm and 5 mm

Note 1 to entry: Microplastics may show various shapes.

Note 2 to entry: Typically, a large microplastics object represents an item consisting of plastics or a part of an end-user product or a fragment of the respective item.

Note 3 to entry: Microplastics in this size range are, for example, plastics pellets as intermediates for further down- stream processing such as moulding, extrusion etc. resulting to semi-finished products which are not final end-user products.

[SOURCE: ISO/TR 21960:2020, 3.10, modified — term number in Note 1 to entry was removed,]

3.6
microplastics
any solid plastics particle insoluble in water with dimension between 1 µm and 1 000 µm (= 1 mm)

Note 1 to entry: Primary microplastics object represents a particle intentionally added to end-user products for example cosmetic means, coatings, paints etc. Secondary microplastics object can also result as a fragment of the respective item.

Note 2 to entry: Microplastics have regular and irregular shapes (see ISO 9276-6:2017) .

Note 3 to entry: The defined dimension is related to the longest length of the particle.

[SOURCE: ISO/TR 21960:2020, 3.9, modified — Note 1 to entry was removed, all other Notes to entry were changed.]

3.7
nanoplastics
plastics particles smaller than 1 µm

Note 1 to entry: According to OECD and ISO 19430 nanoparticles are up to 100 nm.

[SOURCE: ISO/TR 21960:2020, 3.13]

3.8
degradation
any physical or chemical change in polymer as a result of environmental factors, such as light, heat, moisture, chemical conditions or biological activity

3.9
particle
minute piece of matter with defined physical boundaries

[SOURCE: ISO 26824:2013, 1.1, modified — Notes to entry were removed.]

3.10
zero sample
sample taken before the start of a spiking test

3.11
blank sample
sample of a similar solid or liquid to the real sample excluding the objects to be investigated

3.12
state of degradation
state of a substance or material after influence of chemical, biological or physical processes, for example hydrolysis, photolysis, reduction and oxidation

3.13
additives
chemicals added to polymers to improve/change the individual properties of the specific plastic material

Note 1 to entry: Important additives such as fillers/reinforced materials, softeners and flame retardants are referenced according to ISO 1043-2 to ISO 1043-4.

4 General Aspects

Microplastics is a term that comes along with different physical and chemical properties, such as shape, size (range), type of polymer(s), presence of additives, presence of fillers, state of degradation and so on. The amount of microplastics in a given matrix can be measured in different ways, i.e. as number (of particles) or mass content/fraction in relation to the sample's quantity, which itself can be based on various units (volume, weight, etc.). Hence, before selecting a suitable (set of) method(s), the question(s) to be answered and properties to be measured need to be defined carefully. This applies not only to detection methods but also to the sampling and processing/preparation methods associated with them, right up to the statistical evaluation of results. At the end of the document, an overview of the strengths and limitations of different methods with regard to a given problem can be found. An essential objective for the assessment of methods was the safe and comprehensible investigation of the transport paths and entry points into various environmental media such as water and soil using appropriate measurement and analytical methods.

A schematic representation of the interdependencies of microplastics analysis is shown in Figure 1. As a rule, the objective or objectives of a measurement or a measurement program is/ are based on a clear question/task or on an evaluation concept involving necessary assessment parameters, respectively (for example integration into an overall ecological context, thresholds for monitoring). A suitable detection method is then selected, which generates the desired result parameters (such as polymer type, mass content, number, shape, size, degradation status).

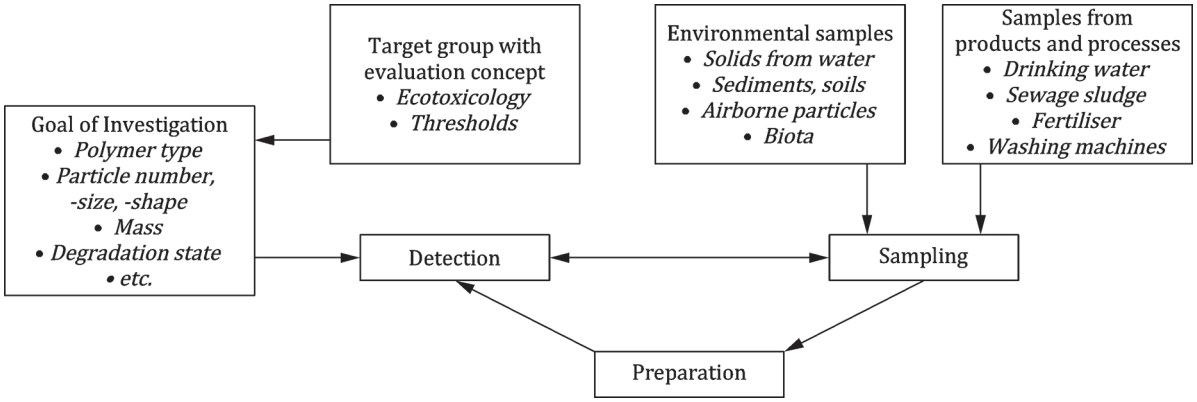

Figure 1 — Schematic representation of interdependencies during microplastics analysis in environmental and related matrices

5 General requirements for all analytical steps

All analytical steps (sampling, sample preparation, detection) shall be undertaken in plastics-free or low-plastics working conditions. These include the avoidance of standard plastics products (for example tubes, vessels). Cross-contamination shall be avoided, the user should avoid using plastics equipment wherever possible. Instead, alternatives made of metal, glass or ceramics should be used. As an exception types of plastics that are not to be detected or evaluated can be used as well. Care should be taken that also personal protective equipment (e.g. lab coats, gloves) are made of non-synthetic material or material that does not interfere with the analyses. Recovery tests should be performed for each analytical step.

If feasible, samples should be handled in laminar flow boxes in the laboratory or clean rooms (class 3 according to ISO 14644-1, especially during the preparation process of samples and during the determination of particle numbers.

It shall be determined beforehand, whether a hygienization of samples is necessary. Sterilization is a standard recommendation for the analysis of dry samples from wastewater, sewage sludge and organic wastes. Various methods can be applied, but each of them has specific impact on the integrity of microplastics particles in the sample:

i. Steam sterilization: risk of melting microplastics (for example PE, PP)

ii. Radiation sterilization (gamma, beta radiation, UV radiation): risk that the polymer structure is degraded (cleavage of polymer chains and oxidation)

iii. Chemical sterilization: risk that polymer structure or the particles' surface is chemically modified

Relevant information about the measurement conditions and control processes (quality assessment and quality control/QAQC) shall be recorded, including all analytical steps. For general quality control measures in laboratories, see ISO/IEC 17025:2017. For intercomparison tests, see ISO 13528:2005.

The documentation and measurement of zero samples or blank value determination for the applied detection methods is essential, since contamination (for example by airborne particles) during sampling, preparation and detection can easily occur. Determination of blank values is necessary; the number of blanks depends on the concrete method to be applied. More specific requirements have to be given in upcoming standards.

A classification of microplastics analyses into size classes according to Table 1 is recommended. Small particles that occur in higher quantities are grouped into narrower classification clusters than the larger particles, which are more relevant in terms of mass and classified into wider clusters. This also enables a higher methodological feasibility of processes (including feasibility of filtration, detection limits in analytics) and a better integration of particle quantities/masses in impact analyses (i.e. for