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Plastics — Environmental aspects — State of knowledge and methodologies

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 14, *Environmental aspects*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 249, *Plastics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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.

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Introduction

Plastics materials are highly flexible and universally applicable. They can be found in a diversity of product areas and application sectors. In order to achieve a sustainable management and exploitation of products, safe and efficient manufacturing processes are compulsory within the value chain. In addition, an environmentally friendly use and handling across diverse applications is necessary during consumption, reuse and disposal. This ensures that an effective and qualified management at the product's end-of-life is addressed through proper performed procedures and evaluations.

If mismanagement happens at any of the above described life cycle stages, the use of plastics and plastics-containing products can create adverse effects to the environment. It has been proven, not least by the United Nations Environment Programme, that discarded products as well as microplastics are found in the environment around the globe, be it on land or water bodies including the sea. There are diverse causes for this such as inappropriate or inefficient waste management infrastructures, improper management of plastics products and their waste reuse or disposal, inefficient wastewater management, etc. Therefore, various types of entries into the environment and diverse constitutions and compositions of the microplastic particles in the environment are to be considered. Littered articles as well as microplastics consists of different kinds of products and come from different waste, e.g. bottles, films, fishing nets, tyres, cosmetics, clothing fibres, etc.

Over extended time in the environment, plastics products and their waste will breakdown into smaller items and finally disintegrate to microparticles. Microplastics also enter the environment directly through its intentional use in some product applications. Microparticles, be it via primary product use or via secondary fragmentation of macro articles, should be considered with special care since they can give rise to adverse environmental impact especially in the aquatic environment and its biota.

This document with its primary focus on plastics, rather than all the other materials, in the environment intends to provide a survey on the international situation of plastics and plastics in the environment with special attention to microplastics in the marine environment, its detection and determination. For this purpose, the document describes the state-of-the art testing methods as well as assessment approaches.

Although this document gives a representative overview of the current knowledge (up to early 2017) and activities about plastics and microplastics around the world, information is predominately generated from the Northern Hemisphere and activities in Europe and North America.

In this way, the document can be recognized as a contribution towards harmonized procedures and measures in order to provide a sound basis for a reliable and verifiable evaluation of the impact of plastics and microplastic in the environment. The document covers the following key items of interest.

— Status of plastics products and plastics in the environment: Facts about plastics use and proven findings about the occurrence of plastics and microplastics in the environmental matrix, be it on land and water bodies including the sea.

— Terminology: The terms "plastic particles", "plastic microparticles", "microplastics", "plastic nanoparticles" or "solid microparticle" are currently not defined in a consistent way and are, especially in an international context, being used differently. This document makes an attempt towards a globally harmonized terminology.

— Test methods: Methods for the detection, analysis and assessment of plastic particles present in the environment, such as aquatic litter, are neither harmonized nor standardized. Simple visual tests, in particular, have proved to be insufficient. This document will describe the sampling, its preparation of samples and further analytics, especially in waters as the main task of this document, since reproducible and verifiable procedures are indispensable to derive valid data for the environmental assessment and on this basis concluding appropriate measures to improve the environmental situation.

Not only has the plastics economy recognized the importance of this topic and started diverse action programmes, which are, for example, compiled through the Global Plastics Declaration Initiative,

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also political groups (e.g. G 7 and G 20), international organisations such as OECD, administrations of regions and individual countries are increasingly taking care about the serious issue of littered plastic waste and microparticles in the environment. In addition, numerous research activities have also been initiated. All these key stakeholders will highly benefit from a globally harmonized procedure.

This document includes references to studies and investigations in relation with plastics in the environmental matrix and biota, including microplastics. Important is the chapter terms and definitions. It presents the basis for future work in ISO. The description of the size classes is particularly relevant. Reference is made to other classifications of other organizations, for example in the area of Nanoparticles (see also OECD). The references selected within this document reflect the current knowledge without claiming to be complete or fully up-to-date. The content and conclusions of the different studies referenced in the bibliography are under the responsibility of their authors.

NOTE The document was developed under the scope of ISO/TC 61 *Plastics* and follows resulting requirements. Independent from these, terms are used in the text, which are in the scope of other ISO/TCs, such as:

— ISO/TC 38, *Textiles;*

— ISO/TC 45, *Rubber and rubber products;*

— ISO/TC 217, *Cosmetics*

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Plastics — Environmental aspects — State of knowledge and methodologies

1 Scope

This document summarizes current scientific literature on the occurrence of macroplastics and microplastics, in the environment and biota. It gives an overview of testing methods, including sampling from various environmental matrix, sample preparation and analysis. Further, chemical and physical testing methods for the identification and quantification of plastics are described.

This document gives recommendations for three steps necessary for the standardization of methods towards harmonized procedures for sampling, sample preparation and analysis.

This document does not apply indoor and health related aspects.

NOTE The collection of plastics or microplastics in the environment by citizen social monitoring projects is not in the scope of this document. Although such projects can help sensitize the society to environmental problems and can even reduce the entry and presence of plastics in the environment, this monitoring concept is not considered suitable for a robustly representative and scientific analysis of microplastics in the environment via standardization.

2 Normative references

There are no normative references in this document.

3 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 http://www.electropedia.org/

3.1
polymer
chemical compound or mixture of compounds consisting of repeating structural units created through polymerization

Note 1 to entry: In practice above 10 000 Dalton.

Note 2 to entry: Polymers comprise both plastics and elastomers. The latter is excluded from the scope of ISO/TC 61.

3.2
plastic
material which contains as an essential ingredient a high *polymer* (3.1) and which, at some stage in its processing into finished products, can be shaped by flow

Note 1 to entry: Plastics consists mainly polymers and minor contents of *additives* (3.7).

Note 2 to entry: Supplementary to the term “plastic”, “plastic product” is also used. According to ISO 472, a plastic 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 *thermoplastic* (3.3) and *thermoset* (3.4) materials.

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