

DIN CEN ISO/TR 21960



ICS 13.020.01; 83.080.01

**Kunststoffe in der Umwelt –
Aktueller Wissensstand und Methodik (ISO/TR 21960:2020);
Englische Fassung CEN ISO/TR 21960:2020**

Plastics –
Environmental aspects –
State of knowledge and methodologies (ISO/TR 21960:2020);
English version CEN ISO/TR 21960:2020

Plastiques –
Aspects liés à l'environnement –
État des connaissances et méthodologies (ISO/TR 21960:2020);
Version anglaise CEN ISO/TR 21960:2020

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DIN-Normenausschuss Kunststoffe (FNK)

Nationales Vorwort

Dieses Dokument (CEN ISO/TR 21960:2020) wurde vom Technischen Komitee ISO/TC 61 „Plastics“ in Zusammenarbeit mit dem Technischen Komitee CEN/TC 249 „Kunststoffe“ erarbeitet, dessen Sekretariat von NBN (Belgien) gehalten wird.

Das zuständige deutsche Normungsgremium ist der Arbeitsausschuss NA 054-03-01 AA „Kunststoffe und Umweltaspekte“ im DIN-Normenausschuss Kunststoffe (FNK).

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Erfahrungen mit diesem Technischen Report sind erbeten:

- vorzugsweise als Datei per E-Mail an fnk@din.de in Form einer Tabelle. Die Vorlage dieser Tabelle kann im Internet unter www.din.de/stellungnahme abgerufen werden;
- oder in Papierform an den DIN-Normenausschuss Kunststoffe, 10722 Berlin.

Kunststoffe sind sehr flexibel und universell einsetzbar. Sie sind in einer Vielzahl von Produktbereichen und Anwendungssektoren zu finden. Um ein nachhaltiges Management und eine nachhaltige Nutzung der Produkte zu erreichen, sind sichere und effiziente Herstellungsprozesse innerhalb der Wertschöpfungskette zwingend erforderlich. Zusätzlich ist bei Verwendung, Wiederverwendung und Entsorgung von Kunststoffen eine umweltschonende Nutzung und Handhabung über verschiedene Anwendungen hinweg notwendig. Dies stellt sicher, dass ein effektives und qualifiziertes Management am Ende des Produktlebens durch ordnungsgemäß durchgeführte Verfahren und Bewertungen gewährleistet ist.

Kommt es in einem der oben beschriebenen Lebenszyklusstadien zu Missmanagement, kann die Verwendung von Kunststoffen und kunststoffhaltigen Produkten negative Auswirkungen auf die Umwelt haben. Es ist erwiesen, nicht zuletzt durch das Umweltprogramm der Vereinten Nationen (UNEP, en: United Nations Environment Programme), dass sowohl weggeworfene Kunststoffprodukte als auch Mikrokunststoffe in der Umwelt rund um den Globus zu finden sind, sei es an Land oder in Gewässern einschließlich der Meere. Die Ursachen dafür sind vielfältig, wie z. B. ungeeignete Infrastrukturen der Abfall- oder Abwasserentsorgung, unsachgemäßes Management von Kunststoffprodukten und deren Wiederverwendung oder Entsorgung etc. Daher sind verschiedene Arten von Einträgen in die Umwelt sowie die unterschiedliche Beschaffenheit und Zusammensetzung von Mikrokunststoffpartikeln in der Umwelt zu berücksichtigen. Weggeworfene Gegenstände sowie Mikrokunststoffe stammen aus verschiedenen Arten von Produkten, z. B. Flaschen, Folien, Fischernetzen, Reifen, Kosmetika, Bekleidungsfasern usw.

Über einen längeren Zeitraum in der Umwelt zerfallen Kunststoffprodukte und ihre Abfälle in kleinere Teile und schließlich in Mikropartikel. Mikrokunststoffe gelangen auch durch ihren absichtlichen Einsatz in einigen Produktanwendungen direkt in die Umwelt. Mikropartikel, ob als primäre Mikrokunststoffe in Produkten eingesetzt oder entstanden über die sekundäre Fragmentierung von Makroteilen, sollten mit besonderer Sorgfalt betrachtet werden, da sie insbesondere in der aquatischen Umwelt und deren Biota zu negativen Umweltauswirkungen führen können.

Dieses Dokument, das sich primär auf Kunststoffe und nicht auf alle anderen Materialien in der Umwelt konzentriert, möchte einen Überblick über die globale Situation von Kunststoffen und Kunststoffen in der Umwelt geben, mit besonderem Augenmerk auf Mikrokunststoffen in der Meeresumwelt, deren Nachweis und deren Bestimmung. Zu diesem Zweck beschreibt das Dokument den Stand der Technik der Prüfverfahren sowie die Bewertungsansätze.

Obwohl dieses Dokument einen repräsentativen Überblick über den aktuellen Wissensstand (bis Anfang 2017) und die Aktivitäten zu Kunststoffen und Mikrokunststoffen weltweit gibt, stammen die enthaltenen Informationen überwiegend von der nördlichen Hemisphäre und Aktivitäten in Europa und Nordamerika.

So kann das Dokument als ein erster Beitrag zu harmonisierten Prozessen und Messverfahren gesehen werden, um eine solide Grundlage für eine zuverlässige und überprüfbare Bewertung der Auswirkungen von Kunststoffen und Mikrokunststoffen auf die Umwelt zu schaffen. Das Dokument behandelt die folgenden wichtigen Themen:

- Status von Kunststoffprodukten und Kunststoffen in der Umwelt: Fakten über die Verwendung von Kunststoffen und gesicherte Erkenntnisse über das Vorkommen von Kunststoffen und Mikrokunststoffen in der Umweltmatrix, sei es an Land oder in Gewässern einschließlich der Meere.
- Terminologie: Die Begriffe „plastic particles“, „plastic microparticles“, „microplastics“, „plastic nanoparticles“ oder „solid microparticle“ sind derzeit nicht einheitlich definiert und werden, insbesondere im internationalen Kontext, unterschiedlich verwendet. Dieses Dokument unternimmt den Versuch einer global harmonisierten Terminologie.
- Prüfverfahren: Verfahren für die Analyse und die Bewertung von in der Umwelt vorhandenen Kunststoffpartikeln, wie z. B. Abfälle in Gewässern, sind weder harmonisiert noch standardisiert. Vor allem einfache visuelle Tests haben sich als unzureichend erwiesen. Die Probenahme, die Probenaufbereitung und die weitere Detektion, insbesondere in Gewässern, wird in diesem Dokument als Hauptaufgabe beschrieben. Reproduzierbare und überprüfbare Verfahren sind unabdingbar, um valide Daten für die Umweltbewertung und auf dieser Grundlage geeignete Maßnahmen zur Verbesserung der Umweltsituation abzuleiten.

Nicht nur die Kunststoffwirtschaft hat die Bedeutung dieses Themas erkannt und verschiedene Aktionsprogramme gestartet, die z. B. durch die Global Plastics Declaration Initiative zusammengestellt wurden, auch politische Gruppierungen (z. B. die G7 und die G20), internationale Organisationen wie die OECD, Verwaltungen von Regionen und einzelnen Ländern beschäftigen sich zunehmend mit dem gravierenden Problem von weggeworfenem Kunststoffabfall und Mikropartikeln in der Umwelt. Darüber hinaus sind auch zahlreiche Forschungsaktivitäten initiiert worden. Alle diese Schlüsselakteure werden von einem global harmonisierten Verfahren in hohem Maße profitieren.

Dieses Dokument enthält Hinweise auf Studien und Untersuchungen im Zusammenhang mit Kunststoffen in der Umweltmatrix und Biota, einschließlich Mikrokunststoffen. Wichtig ist der Abschnitt „Terms and definitions“. Er stellt die Grundlage für zukünftige Arbeiten auf ISO- und CEN-Ebene dar. Von besonderer Bedeutung ist die Beschreibung der Größenklassen. Es wird auf andere Klassifikationen weiterer Organisationen verwiesen, z. B. im Bereich der Nanopartikel (siehe auch OECD). Die in diesem Dokument ausgewählten Verweisungen spiegeln den aktuellen Wissensstand wieder, ohne Anspruch auf Vollständigkeit oder Aktualität zu erheben. Die Inhalte und Schlussfolgerungen der verschiedenen Studien, auf die in den Literaturverzeichnis verwiesen wird, liegen in der Verantwortung der jeweiligen Autoren.

ANMERKUNG Das Dokument wurde im Rahmen der ISO/TC 61 „Plastics“ entwickelt und folgt den daraus resultierenden Anforderungen. Unabhängig davon werden im Text Begriffe verwendet, die in den Geltungsbereich anderer ISO/TCs fallen, wie z. B.:

- ISO/TC 38, „Textiles“;
- ISO/TC 45, „Rubber and rubber products“;
- ISO/TC 217, „Cosmetics“.

Für die in diesem Dokument zitierten internationalen Dokumente wird im Folgenden auf die entsprechenden deutschen Dokumente hingewiesen:

ISO 472	siehe	DIN EN ISO 472
ISO 1043-2	siehe	DIN EN ISO 1043-2
ISO 1043-3	siehe	DIN EN ISO 1043-3
ISO 1043-4	siehe	DIN EN ISO 1043-4

Aktuelle Informationen zu diesem Dokument können über die Internetseiten von DIN (www.din.de) durch eine Suche nach der Dokumentennummer aufgerufen werden.

Nationaler Anhang NA (informativ)

Literaturhinweise

DIN EN ISO 472, *Kunststoffe — Fachwörterverzeichnis*

DIN EN ISO 1043-2, *Kunststoffe— Kennbuchstaben und Kurzzeichen— Teil 2: Füllstoffe und Verstärkungsstoffe*

DIN EN ISO 1043-3, *Kunststoffe— Kennbuchstaben und Kurzzeichen— Teil 3: Weichmacher*

DIN EN ISO 1043-4, *Kunststoffe— Kennbuchstaben und Kurzzeichen— Teil 4: Flammschutzmittel*

TECHNICAL REPORT

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English Version

Plastics -
Environmental aspects -
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État des connaissances et méthodologies
(ISO/TR 21960:2020)

Kunststoffe in der Umwelt -
Aktueller Wissensstand und Methodik
(ISO/TR 21960:2020)

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (CEN ISO/TR 21960:2020) has been prepared by Technical Committee ISO/TC 61 "Plastics" in collaboration with Technical Committee CEN/TC 249 "Plastics" the secretariat of which is held by NBN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of ISO/TR 21960:2020 has been approved by CEN as CEN ISO/TR 21960:2020 without any modification.

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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).

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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.

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 properly 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,

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*

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.

[SOURCE: ISO 472:2013, 2.702, modified — Notes to entry have been replaced.]

3.3

thermoplastic

plastic (3.1) that has thermoplastic properties

[SOURCE: ISO 472:2013, 2.1178]

3.4

thermoset

plastic (3.1) which, when cured by heat or other means, changes into a substantially infusible and insoluble product

[SOURCE: ISO 472:2013, 2.1181]

3.5

elastomer

macromolecular material which returns rapidly to its initial dimensions and shape after substantial deformation by a weak stress and release of the stress

Note 1 to entry: The definition applies under room temperature test conditions.

[SOURCE: ISO 472:2013, 2.327]

3.6

composite

solid product consisting of two or more layers (often in a symmetrical assembly) of, for instance, plastic film or sheet, normal or syntactic cellular plastic, metal, wood or a composite with or without adhesive interlayers

[SOURCE: ISO 472:2013, 2.182.2, modified — The example has been omitted.]

3.7

additives

chemicals added to *polymers* (3.1) 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.

3.8

macroplastic

any solid plastic particle or object insoluble in water with any dimension above 5 mm

Note 1 to entry: Typically, a macroplastic object represents an article consisting of plastic or a part of an end-user product or a fragment of the respective article, such as cups, cup covers.

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

3.9

microplastic

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

Note 1 to entry: This term relates to plastic materials within the scope of ISO/TC 61. Rubber, fibres, cosmetic means, etc. are not within the scope.

Note 2 to entry: Typically, a microplastic object represents a particle intentionally added to end-user products, such as cosmetic means, coatings, paints, etc. A microplastic object can also result as a fragment of the respective article.

Note 3 to entry: Microplastics may show various shapes.

Note 4 to entry: The defined dimension is related to the longest distance of the particle.

3.10

large microplastic

any solid plastic particle insoluble in water with any dimension between 1 mm and 5 mm

Note 1 to entry: *Microplastics* (3.9) may show various shapes.

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

Note 3 to entry: Microplastics in this size range are, for example, plastic 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.

3.11

microparticle

solid particle insoluble in water in the dimension between 1 µm and 1 000 µm (=1 mm)

Note 1 to entry: There is currently no specific distinction between nanoparticles and microparticles.

3.12

macroparticle

solid particle not soluble in water in the dimension above 5 mm

3.13

nanoplastic

plastic particles smaller than 1 µm

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

3.14

litter

solid object disposed of or abandoned in the *environment* (3.17)

3.15

marine litter

litter (3.14) found in the marine or coastal *environment* (3.17)

3.16

waste

any material or object which the holder discards, or intends to discard, or is required to discard

[SOURCE: ISO 15270, 3.34]

3.17

environment

conditions and surroundings that might influence the behaviour of an item or biotic life

Note 1 to entry: Environmental matrices are: water, air and soil.

Note 2 to entry: The relation to the environment within this document does not refer to environmental aspects such as resource efficiency, energy consumption, climate protection, etc. rather this document focuses on the relevance with respect to potential releases into the environment on land or sea.

[SOURCE: ISO 472:2013, 2.1310, modified — The definition has been edited to specify biotic life and Notes to entry have been added.]

3.18

ageing

entirety of all irreversible chemical and physical processes occurring in a material in the course of time

Note 1 to entry: For testing purposes, ageing is often applied artificially.

3.19

biota

living organisms in the *environment* (3.17)

4 End-use applications of plastic materials and its relevance to the environment

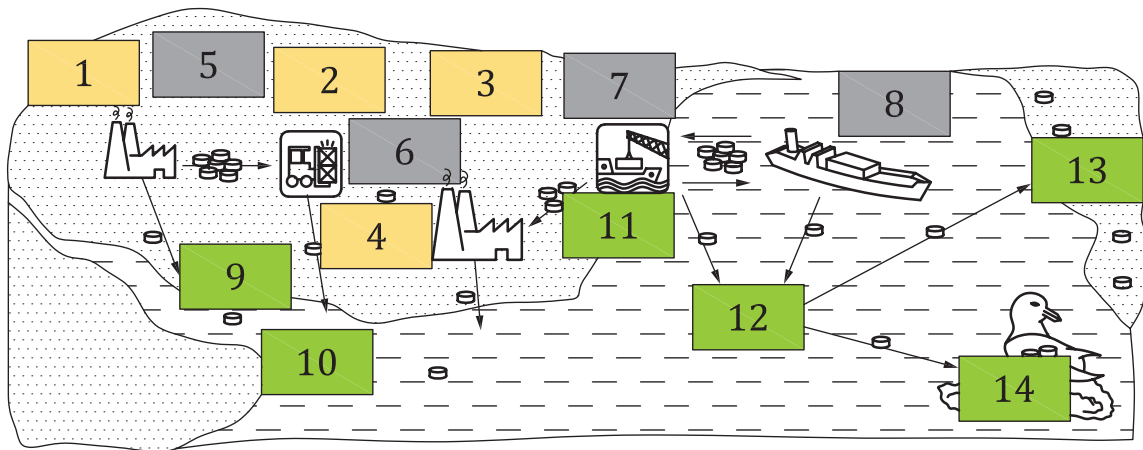
4.1 General

Plastics are important materials in today's modern life and play an integral role in both households and industries. Over recent years, the consumption of plastic materials has significantly increased and today they find diverse fields of areas of application such as packaging, building and construction, automotive, electrical and electronic equipment, etc. Depending on the performance requirements of the final end application, an article can contain plastics and/or composites.

The production of plastic materials is strictly regulated by legislative rules that translate into permit requirements for materials production by the chemical and plastics industry according to the Industry Emission Directive in Europe. In this way, emissions into air, water and soil can be well managed by applying the best available technologies for polymer production according to legislative rules and technical guidance.

The plastics value chain can be described as follows. Plastic materials are mostly manufactured from fossil raw materials like oil or gas and are mainly produced in the form of powders, flakes and pellets (a preformed moulding material). This material may further be compounded before its use in moulding and extrusion processes for its subsequent conversion into intermediate semi-finished products like sheets, profiles, films, etc. These will be shaped into a variety of final articles in the household, buildings, mobility sectors, etc. For the market relevant plastic materials used by the diverse application sectors, see 4.2 to 4.5, the term "plastics" comprises thermoplastic materials and thermosets.

Figure 1 shows how in the industrial value chain the various steps of production, logistics and distributions as well as entry pathways of plastics are distinguished.



Key

Yellow boxes: steps of the value chain

Grey boxes: logistics, distribution, trade, transfer

Green boxes: entry pathways

- 1 raw material producer
- 2 compounder/converter
- 3 OEM
- 4 supplier/tier
- 5 logistics on land
- 6 distribution/trade
- 7 transfer/shipment
- 8 logistics on sea
- 9 drain from municipality
- 10 river
- 11 port
- 12 ocean
- 13 beach/coast
- 14 biota

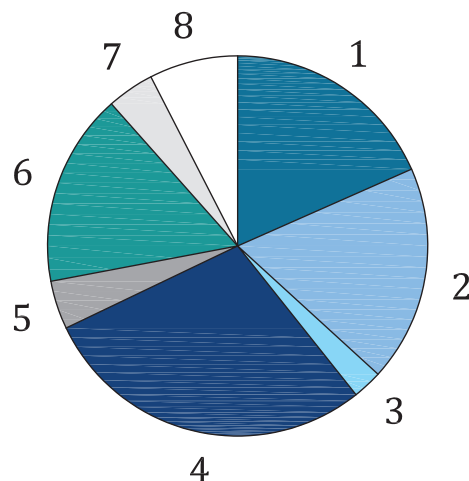
NOTE This figure is based on a graph of International Pellet Watch: www.tuat.ac.jp/~gaia/ipw/en/what.html

Figure 1 — Schematic illustration of the plastics value chain in the context within the environment after a graph of international pellet watch

NOTE Figure 1 represents a highly simplified illustration of the industrial value chain, the logistics and distribution as well as possible entry pathways into the environment. The reality is much more complex, thereby, with further interim steps, interlinkages, dependences or possible further aspects.

Both legislation as well as standardization, especially quality and environmental management like ISO 9000 group of standards and ISO 14000 group of standards, are in place and may be in principle considered as appropriate means to minimize eventual losses for each production step as well as logistics and distribution.

According to the European Market and Research Group of the European plastics manufacturers^[2], the total global production of plastic materials amounted to approx. 280 Mio tons in 2016 without other plastics i.e. thermosets, elastomers, adhesives, coatings, sealants and fibres. Asia accounts for about 50 % of the world-wide production with China leading with 29 % of global production. European production is less with 19 % and similar to NAFTA states (Canada, Mexico and the US) who have a share of 18 %. It is assumed that the strong growth in Asia will also continue over the next years reinforcing their leading role in worldwide plastics production.



Key

- 1 NAFTA 18 %
- 2 Europe (WE +CEE) 19 %
- 3 CIS 2 %
- 4 China 29 %
- 5 Japan 4 %
- 6 Rest of Asia 17 %
- 7 Latin America 4 %
- 8 Middle East, Africa 7 %

NOTE Graph according to Plastics Europe^[2].

Figure 2 — World Plastics Material Production in 2016 by country/region

Globally, the most important types of plastic materials are standard plastics. More than three quarters of the global plastics production consist of polyethylene, polypropylene, polyvinylchloride and polystyrene including expanded polystyrene, see Figure 3. Less than 10 % are considered as engineering plastics.