

BIODEGRADABILITY AND COMPOSTABILITY:

Definitions and standards toolkit for policymakers

(Based on Plastic SMEP Report “Reduction Management: Regional policies and standards on biodegradation and compostability in East and West Africa”)

Recommended definitions

The following list of recommended definitions has been developed based on our assessment of the most appropriate definitions in state-of-the-art standards, especially ISO standards (whose definitions are publicly available on ISO Online Browsing Platform) and CEN standards, as well as ambitious legislation relating to single-use plastics, looking at the European Union's legal framework. We have nevertheless not listed any definition of 'bioplastics' or 'biopolymers', which leave the door open to misunderstandings and inappropriate use to characterise bio-based plastics, biodegradable plastics or both.

bio-based product

product wholly or partly derived from biomass

Note 1 to entry: The bio-based product is typically characterised by the bio-based carbon content or the bio-based content.

[Source: ISO 16559:2022, 3.25]

bio-waste

biodegradable garden and park waste, food and kitchen waste from households, offices, restaurants, wholesale, canteens, caterers and retail premises and comparable waste from food processing plants

[Source: European Waste Framework Directive (EU) 2008/98/EC, 3.4]

community composting

controlled waste treatment process of organic waste collected from small neighbourhood or produced by centralised sources (e.g. hospitals, canteens, restaurants) usually at a scale bigger than home composting and smaller than industrial composting

[Source: EN 17427:2022]

compostable plastic

plastic that undergoes degradation by biological processes during composting to yield CO₂, water, inorganic compounds and biomass at a rate consistent with other known compostable materials and leave no visible, distinguishable or toxic residue

Note 1 to entry: "Hazardous" is used synonymously to "toxic"

[Source: ISO 17088:2021, 3.2]

composting

aerobic process designed to produce compost starting from biodegradable waste

Note 1 to entry: Composting is classified into industrial composting, home composting and worm composting.

[Source: ISO 17088:2021, 3.3]

disintegration

physical breakdown of a material into very small fragments

[Source: ISO 17088:2021, 3.4]

home composting

composting process performed by private individuals with the aim of producing compost for their own use

[Source: EN 17427:2022]

home compostable packaging

packaging that can biodegrade in non-controlled conditions that are not industrial scale composting facilities and the composting process of which is performed by private individuals with the aim of producing compost for their own use

[Source: European Packaging and Packaging Waste Regulation, 2024, article 3.42, publication pending]

industrial composting

composting process performed under controlled conditions on industrial scale with the aim of producing compost for the market

Note 1 to entry: In some regions industrial composting is referred to as professional composting.

Note 2 to entry: Industrial composting does not hinder or jeopardise the separate collection and the composting or anaerobic digestion process.

[Source: ISO 17088:2021, 3.13, modified – Note 2 to entry added based on the European Packaging and Packaging Waste Regulation, 2024, article 3.41]

laboratory scale composting

aerobic process designed to produce compost at laboratory scale under environmental conditions simulating those experienced in an industrial compost pile

[Source: ISO 20200:2023, 3.4]

organic constituent

chemical constituent that contains carbon covalently linked to other carbon atoms and to other elements, most commonly hydrogen, oxygen or nitrogen

Note 1 to entry: Inorganic carbonates, carbides, cyanides and simple oxides such as carbon monoxide and carbon dioxide are not classified as organic constituent.

Note 2 to entry: Allotropes of carbon, such as diamond, graphite, carbon black, fullerenes, and carbon nanotubes are also not regarded as organic constituent

[Source: EN 17427:2022]

organic recycling

aerobic (composting) or anaerobic (digestion) treatment of plastics waste under controlled conditions using micro-organisms to produce, in the presence of oxygen, stabilised organic residues (compost), carbon dioxide and water or, in the absence of oxygen, stabilised organic residues (compost), methane and carbon dioxide

Note 1 to entry: The term “biological recycling” is used synonymously.

[Source: ISO 17088:2021, 3.6]

oxo-degradable plastics

plastic materials that include additives which, through oxidation, lead to the fragmentation of the plastic material into micro-fragments or to chemical decomposition

Note 1 to entry: Oxo-degradable plastics are non-biodegradable. Once oxo-degradable plastics and their fragments are buried in the soil, out of sunlight, the degradation process stops or slows significantly and persistent small plastic particles remain intact, causing the release of microplastics. The resulting microplastics are made of oxidised non-biodegradable polymers.

[Source: Single-Use Plastic Directive (EU) 2019/904, 3.3, Note 1 to entry has been added]

plastics

synthetic material or modified natural material, either a polymer or combination of polymers of high molecular mass modified or compounded with additives such as fillers, plasticizers, stabilizers, flame retardants and colorants

[Source: UNEP, 2023. Technical guidelines on the environmentally sound management of plastic wastes, UNEP/CHW.16/6/Add.3/Rev.1]

recycling

any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes including the reprocessing of organic material, but excluding energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations

[Source: European Waste Framework Directive (EU) 2008/98/EC, 3.17]

reusable packaging

packaging or packaging component which has been designed to accomplish or proves its ability to accomplish a minimum number of trips or rotations in a system for reuse

[SOURCE: ISO 18603:2013, 3.2]

ultimate aerobic biodegradation

breakdown of an organic compound by microorganisms in the presence of oxygen into carbon dioxide, water and mineral salts of any other elements present (mineralisation) plus new biomass

[Source: ISO 17088:2021, 3.8]

volatile solid

solids obtained by subtracting the residue of a known volume of test material or compost after incineration at about 550 °C from the total dry solids (3.7) of the same sample

Note 1 to entry: The volatile-solids content is an indication of the amount of organic matter present.

[Source: ISO 17088:2021, 3.9]

well-managed industrial composting process

composting process performed under controlled conditions where the temperature, water content, aerobic conditions, carbon/ nitrogen ratio and other conditions are optimised

[Source: ISO 17088:2021, 3.12]

Standards specifications for industrial composting (and anaerobic digestion)

Standard specifications most commonly used for industrial composting (and anaerobic digestion).

Standard reference	Standard title
ISO 18606:2013	<i>Packaging and the environment - Organic recycling</i>
ISO 17088:2021	<i>Plastics - Organic recycling - Specifications for compostable plastics</i>
ISO 5412:2022	<i>Plastics - Industrial compostable plastic shopping bags</i>
ISO 5424:2022	<i>Plastics - Industrial compostable plastic drinking straws</i>
EN 13432:2000	<i>Requirements for packaging recoverable through composting and biodegradation - Test scheme and evaluation criteria for the final acceptance of packaging</i>
ASTM D6400:2023	<i>Standard Specification for Labelling of Plastics Designed to be Aerobically Composted in Municipal or Industrial Facilities</i>

ASTM D8410:2021	<i>Standard Specification for Evaluation of Cellulosic-Fiber-Based Packaging Materials and Products for Compostability in Municipal or Industrial Aerobic Composting Facilities</i>
ASTM D6868:2021	<i>Standard Specification for Labelling of End Items that Incorporate Plastics and Polymers as Coatings or Additives with Paper and Other Substrates Designed to be Aerobically Composted in Municipal or Industrial Facilities</i>
AS 4736:2006	<i>Biodegradable plastics – Biodegradable plastics suitable for composting and other microbial treatment (Australia)</i>
CAN/BNQ 0017-088: 2010	<i>Specifications for compostable plastics (Canada)</i>

Standard specifications for home composting

Standard specifications used for home composting.

Standard reference	Standard title
EN 17427:2022	<i>Packaging - Requirements and test scheme for carrier bags suitable for treatment in well-managed home composting installations</i>
NF T51-800: 2015	<i>Plastics - Specifications for plastics suitable for home composting (France)</i>
AS 5810:2010	<i>Biodegradable plastics – Biodegradable plastics suitable for home composting (Australia)</i>
NCh3726:2021	<i>Waste management - Plastics suitable for composting in domestic composters - Requirements (Chile)</i>

Standard specifications for mulch film biodegradability in soil

Standard specifications used for mulch film biodegradability in soil.

Standard reference	Standard title
ISO 23517:2021	<i>Plastics - Soil biodegradable materials for mulch films for use in agriculture and horticulture - Requirements and test methods regarding biodegradation, ecotoxicity and control of constituents</i>
EN 17033:2018	<i>Plastics - Biodegradable mulch films for use in agriculture and horticulture - Requirements and test methods</i>

Overview of the criteria of ISO 17088:2021

Overview of the criteria of ISO 17088:2021 *Plastics - Organic recycling - Specifications for compostable plastics.*

Parameter	Criteria	Test method
Control of constituents	Limit values for regulated metals and other elements	
	Per- and poly-fluorinated compounds (PFCs) may not be intentionally added	
	Hazardous substances may not be intentionally added	
	Minimum 50% volatile solids	
Aerobic biodegradation	At least 90% biodegradation (absolute or relative when compared to positive reference material cellulose) after 180 days for the final product and biodegradability of organic constituents, which are present in the material at a concentration between 1-15% (by dry mass), shall be proven separately. Biodegradation is preferably evaluated in compost at 58°C ± 2°C.	ISO 14855-1 ISO 14855-2 (compost) Alternative methods: ISO 14851 (freshwater)

		ISO 14852 (freshwater) ISO 17556 (soil)
Disintegration during composting	At least 90% disintegration after 12 weeks	ISO 16929 ISO 20200
No toxicity towards terrestrial organisms	Higher plants: At least 90% seedling germination and at least 90% plant biomass in the sample compost exposed to the test material when compared to the corresponding blank compost.	OECD 208 ISO 11269-2
	Earthworms: Option 1: Acute testing: Survival and biomass of the surviving adult earthworms in the sample compost exposed to the test material shall be more than 90% of those from the corresponding blank compost not exposed to the test material (after an incubation period of 14 days). Option 2: Chronic testing: After an incubation period of 28 days, the survival and the biomass of the surviving adult earthworms in the sample compost exposed to the test material shall be more than 90% of those from the corresponding blank compost not exposed to the test material. After an incubation period of 56 days, the observed number of offspring in sample compost exposed to the test material shall be more than 90% of those from the corresponding blank compost not exposed to the test material.	ISO 11268-1 (Acute) ISO 11268-2 (Chronic)
	Bacteria (optional): The nitrite formation in the sample compost exposed to the test material shall be more than 80% of those from the corresponding blank compost to which no test material was added at the start of testing.	ISO 15685 (optional)

Overview of the criteria of EN 17427:2022

Overview of the criteria of EN 17427:2022 *Packaging – Requirements and test scheme for carrier bags suitable for treatment in well-managed home composting installations.*

Parameter	Criteria	Test method
Control of constituents	Limit values for regulated metals and fluorine	
	Per- and polyfluoroalkyl substances (PFAS) may not be intentionally added	
	Substances hazardous to the environment and very high concern may not be intentionally added	
	Minimum 50% volatile solids	
Aerobic biodegradation	At least 90% biodegradation (absolute or relative when compared to positive reference material cellulose) after 365 days for the final product and biodegradability of organic constituents, which are present in the material	ISO 14855-1 ISO 14855-2 (compost)

	at a concentration between 1% and 15% (by dry mass), shall be proven separately. Biodegradation is preferably evaluated in compost at ambient temperature (25°C ± 5°C).	Alternative methods: ISO 14851 (freshwater) ISO 14852 (freshwater) ISO 17556 (soil)
Disintegration during composting	At least 90% disintegration after 180 days	EN 17428
No toxicity towards terrestrial organisms	Higher plants: At least 90% seedling germination and at least 90% plant biomass in the sample compost exposed to the test material when compared to the corresponding blank compost.	OECD 208 ISO 11269-2
	Earthworms: Option 1: Acute testing: Survival and biomass of the surviving adult earthworms in the sample compost exposed to the test material shall be more than 90% of those from the corresponding blank compost not exposed to the test material (after an incubation period of 14 days). Option 2: Chronic testing: After an incubation period of 28 days, survival and biomass of the surviving adult earthworms in the sample compost exposed to the test material shall be more than 90% of those from the corresponding blank compost not exposed to the test material. After an incubation period of 56 days, the observed number of offspring in sample compost exposed to the test material shall be more than 90% of those from the corresponding blank compost not exposed to the test material.	ISO 11268-1 (Acute) ISO 11268-2 (Chronic)
	Bacteria: The nitrite formation in the sample compost exposed to the test material shall be more than 80% of those from the corresponding blank compost to which no test material was added at the start of testing.	ISO 15685

Overview of the criteria of NF T51-800:2015

Overview of the criteria of NF T51-800:2015 *Plastics - Specifications for plastics suitable for home composting.*

Parameter	Criteria	Test method
Control of constituents	Limit values for regulated metals and fluorine	
	No endocrine disruptors, carcinogenic substances, mutagenic substances or substances that are toxic for the reproduction might be added.	
	Minimum 50% volatile solids	
Aerobic biodegradation	At least 90% biodegradation (absolute or relative when compared to positive reference material cellulose) after 365 days for the final product. Biodegradation is preferably evaluated in compost at ambient temperature (25°C ± 5°C).	ISO 14855-1 ISO 14855-2 (compost) Alternative methods:

		ISO 14851 (freshwater) ISO 14852 (freshwater)
Disintegration during composting	At least 90% disintegration after 180 days (quantitative testing in three replicates with exact determination of disintegration based on mass balance). At least 81% disintegration after 180 days (qualitative testing in two replicates with determination of disintegration based on surface area analysis; only allowed when a plastic fulfils the disintegration requirements at high temperature of EN 13432).	Modified ISO 20200 (at 25°C ± 5°C)
No toxicity towards terrestrial organisms	Higher plants: At least 90% seedling germination and at least 90% plant biomass in the sample compost exposed to the test material when compared to the corresponding blank compost.	OECD 208

Overview of the criteria of ISO 23517:2021

Overview of the criteria of ISO 23517:2021 *Plastics - Soil biodegradable materials for mulch films for use in agriculture and horticulture - Requirements and test methods regarding biodegradation, ecotoxicity and control of constituents.*

Parameter	Criteria	Test method
Control of constituents	Limit values for regulated metals and fluorine	
	Poly- and perfluoroalkyl substances (PFAS) and hazardous substances shall not be intentionally added	
	Minimum 60% volatile solids	
Aerobic biodegradation	At least 90% biodegradation (absolute or relative when compared to positive reference material cellulose) after two years for the final product (testing temperature: 20°C up to 28°C, preferably 25°C). Biodegradability of organic constituents, which are present in the material at a concentration between 1% and 15% (by dry mass), shall be proven separately ⁹ .	ISO 17556 (soil)
No toxicity towards terrestrial organisms	Higher plants: Germination rate and plant biomass of the tested plant species in the soil exposed to the test material shall be more than 90 % of those from the corresponding blank soil not exposed to the test material.	OECD 208 ISO 11269-2
	Earthworms: Option 1: Acute testing: Survival and biomass of the surviving adult earthworms in the soil exposed to the test material shall be more than 90% of those from the corresponding blank soil (after an incubation period of 14 days).	ISO 11268-1 (Acute) ISO 11268-2 (Chronic)

	Option 2: Chronic testing: Survival and biomass of the surviving adult earthworms in the soil exposed to the test material shall be more than 90% of those from the corresponding blank soil after an incubation period of 28 days. The observed number of offspring in soil exposed to the test material shall be more than 90% of those from the corresponding blank soil after an incubation time of 56 days.	
	Bacteria: Nitrite formation in soil exposed to the test material shall be more than 80% of those from the corresponding blank soil.	ISO 15685