

Chemicals and polymers of concern

Main messages

- “Chemicals and Polymers of Concern” typically refer to chemical additives or polymers that raise environmental or health concerns due to their properties, composition, or potential impact on ecosystems and human health. These polymers may exhibit characteristics such as persistence in the environment, toxicity to organisms, or propensity to accumulate in ecosystems.
- Additives are substances added to plastic during manufacture to improve properties and performance of plastics to meet specific application requirements and ensure their functionality, safety, and durability.
- Chemicals of concern in plastics include additives and Non-Intentionally Added Substances (NIAS).
- The range and toxicity of additives poses a risk to human and environmental health and acts as a barrier to a recycling and a circular economy.
- Limiting the use of chemicals and polymers of concern will streamline the management of plastic waste while protecting environmental and human health.

Background

Reducing or eliminating chemicals and polymers of concern play a part in mitigating plastic pollution through increasing circularity potential as well as reducing toxic impacts during usage, and when leaked.

Chemicals of concern within plastics include a plethora of substances that are intentionally added (additives, such as chemicals, colourants, fillers or reinforcement) or are Non-Intentionally Added Substances (NIAS), which form as byproducts of processing, degradation and contamination reactions. Here, we specifically focus on the additives as chemicals of concern.

Chemicals of concern

Additives are utilised to increase the functionality and aesthetics of plastics. The leakage of plastic additives into the environment is of growing concern. Surveys with experts demonstrated a lack of knowledge on additives including production, use, sources, pathways, analytical methods and ecotoxicity.¹ There is a lack of transparency on the number of additives and the volumes used within plastic products. However, the limited data that does exist show that there are thousands of different types of additives^{2,3,4,5} and suggests a production estimate of 27 megatonnes of additives in 2017.⁶ Non-fibre plastics contain, on average, 7% additives by mass. It is important to note that this is an average, with additive content increasing to 80% in Polyvinyl chloride (PVC), which is why PVC is so hazardous and difficult to recycle.⁷

The production of plastic products includes the inclusion of over 13,000 chemicals. These include additives, processing aids and Non-Intentionally Added Substances. Amongst these chemicals are more than 3,200 substances of concern, based on their hazardous properties as defined by

European Chemicals Agency (ECHA).⁸ This means that these additives have been identified as a risk to humans and the environment.^{9,10} Harmfulness to the environment or human health includes chemicals that are carcinogenic or have the potential to be carcinogenic, mutagenic, have reproductive toxicity, are endocrine disruptors or create similar concerns such as effects on the immune or neurological system or a specific organ. In addition, chemicals of concern may include bioaccumulative, or persistent elements, which could accumulate in living tissue, or do not breakdown in the environment, over time. Additive toxicity, bioaccumulation and persistence are highly variable given their diversity in form, concentration and exposure.¹¹

The lists of harmful additives utilised in plastics include substances identified as Substances of Very High Concern (SVHCs),¹² which are banned nationally or internationally.¹³ These are considered ‘legacy substances’ and are still in circulation through a lack of uniform management.^{14,15}

The most used additives are fillers and plasticisers.^{16,17,18} These are predominantly phthalates, which are linked to negative impacts on endocrine and reproductive systems.¹⁹ Functional additives may include harmful compounds such as aromatic amines, organophosphates, perfluoroalkyl and polyfluoroalkyl substances (PFAS), metals, organotins and polybrominated diphenyl ethers (PDBEs). Plastic products that are of particular concern are those with sensitive exposure potential, such as food contact and toys. Unfortunately, these plastic products are included in the wide range of consumer products that have a concerning level of additives.^{20,21,22}

The lack of transparency and sheer number of known additives complicate every stage of the plastic life cycle. Toxic additives, chemicals and polymers of concern are a barrier to recycling and a circular economy.²³ Recyclers often lack knowledge on material compositions creating challenges for reprocessing. Barriers to upscaling mechanical recycling efforts include the vast variety of additives, polymers, and combined contaminants. These barriers complicate sorting, increasing its costs.²⁴ Additionally, even recycling of high-quality plastic leads to an accumulation of unwanted substances that reduce the quality of recycled plastic, limit their applications and limit the number of times a product can be recycled.^{25,26} Lack of responsibility regarding waste streams has also led to the circulation of harmful legacy substances in recycled plastic products, for example when mixed waste and illicit electronic waste enter the recycling streams.²⁷

Some additives might serve particular needs but could still be avoidable. Replacing additives with less toxic alternatives should be considered (if sufficient life cycle analyses are completed on the alternatives). Using a specific additive consistently across products for a specific outcome, thus reducing the number of additives could also be considered. Restricting the use of harmful and unnecessary substances will help simplify plastic waste management, and protect the environment²⁸ and human health.

Polymers of concern

In polymers such as polyvinyl chloride (PVC),^{29,30} polyurethane (PUR),³¹ and polystyrene (PS),^{32,33,34} toxicity is a concern, to varying degrees, during use, recycling and other end-of-life scenarios. Some polymers are used for niche purposes including polycarbonate, acrylonitrile butadiene styrene (ABS) and others. These polymers are typically not recyclable due to a lack of transparency, economics of scale and potential toxicity.

The transition to removing chemicals and polymers of concern

Reducing or eliminating chemical and polymers of concern needs to be based on science and evidence.

Collaboration among scientists, industry, and stakeholders is vital for a safe and sustainable transition in additive use. Experts recognise the importance of regulation and legislation in mitigation strategies.³⁵ Life cycle assessments (LCAs) are important to examine alternatives or replacement methods for trade-offs and to avoid unintended consequences. In addition, research has demonstrated that many LCA evaluations incorrectly rank incineration or waste-to-energy above recycling as a preferred solution.³⁶ This is because assessments often do not consider the health, environmental or societal impacts of waste, and the associated additives that escape infrastructure.³⁷

Advantages to reducing or eliminating chemicals and polymers of concern

- Reducing or eliminating chemicals and polymers of concern would support design for circularity and the recycling industry.
- Chemical plants for additives are associated with exposing local communities and workers to harmful substances from processing and related emissions, and are generally built in low-income areas.^{38,39} Reducing and eliminating chemicals and polymers of concern will reduce health burdens on such communities.
- There are human and environmental risks associated with transporting additives, as the Ohio train derailment in 2023⁴⁰ highlights.

Disadvantages to reducing or eliminating chemicals and polymers of concern

- Additives are utilised for their functional value, the reduction or elimination of additives may carry functional and economic impacts.
- The existing legacy issue of chemicals and polymers of concern would not be solved by reducing or eliminating chemicals of concern, though it would be beneficial with regards to toxicity and circularity going forward.
- Enforcement for reducing or eliminating chemicals and polymers of concern, in a science-based manner, carries a logistical, financial and capacity burden. Potentially, the creation of a “green chemistry list” of chemicals deemed safe to use in certain applications, (rather than an individual banning approach that would need to test every new chemical on the market) could reduce the testing burden and divide the financial costs of this between industry and a “governing body” or convention.

The table below outlines the language of the revised draft of the Intergovernmental Negotiating Committee for a legal instrument to tackle plastic pollution, including in the marine environment (28 December 2023) and the simple language equivalent in relation to Chemicals and polymers of concern (Part II.2)

Zero draft text	Synopsis
Chemicals and polymers of concern	
<i>Alt. title: Hazardous chemicals of concern</i>	
0. No text.	
Option 1.1	Option 1.1
Each Party shall take the necessary measures [to prohibit or to regulate, as appropriate,] [to not allow and [progressively] to eliminate,] [at the latest by the dates provided in part II of annex A,] the use [or presence] of the chemicals, groups of chemicals and polymers listed in part II of annex A [in the production of plastic polymers, plastics and plastic products, except as provided in that annex.] [The measures taken to implement this provision shall be reflected in the national plan communicated pursuant to [Part IV.1 on national plans].	Shall include in the national action plan, measures to ban/prohibit/allow or eliminate , by a date agreed in Annex A, the production of chemicals, groups of chemicals and polymers listed in Annex A.
Option 1.2	Option 1.2
2. Each Party shall take the necessary measures to not allow and to [progressively] eliminate, at the latest by the dates provided in part II of annex A, the production, sale, distribution, import or export of plastic polymers, plastics and plastic products containing a chemical, group of chemicals, or polymer listed in part II of annex A, except as provided in that annex.	Shall prevent and eliminate , by a date agreed in Annex A, the production, sale, distribution, import or export of plastic polymers, plastics and plastic products containing a chemical, group of chemicals, or polymer listed in in Annex A.

Option 2.1	Option 2.1
Parties shall take the necessary measures, including those referred to in paragraph 2, to minimize, and as appropriate eliminate [at the latest by the dates provided in part II of annex A], [the use and presence in] [the production, sale, distribution, import and/or export of] [plastic polymers], plastics and plastic products of [hazardous] chemicals, groups of [hazardous] chemicals [and polymers] [plastic application] with the potential for adverse impacts on human health or the environment at any stage of the plastic life cycle, or with properties that may hinder their safe and environmentally sound management, including their reusability, reparability, recyclability and disposal.	Shall minimize and if appropriate eliminate, by a date agreed in Annex A, the use and presence in production, sale, distribution, import and/or export of plastics and plastics products of hazardous chemicals, groups of hazardous chemicals, and polymers or plastic application with negative impacts on humans and the environment at any stage of the plastic life cycle or with properties that would hinder a circular economy.
2. [Each Party shall take the necessary measures to not allow, or to regulate, as appropriate, [at the latest by the dates provided in part II of annex A] the use and presence in plastic polymers, plastics and plastic [including plastic] products of [hazardous] chemicals, groups of [hazardous] chemicals [and polymers] identified in part II [and any persistent organic pollutants (POPs) listed] [of annex A][in Annex A, B and C of the Stockholm Convention on Persistent Organic Pollutants]. The measures taken to implement this provision shall be reflected in the national plan communicated pursuant to [Part IV.1 on national plans].]	Shall include in the national action plan, measures to ban or regulate, if appropriate, by a date agreed in Annex A, the use and presence in plastic polymers, plastics and plastic, (including plastic) products of hazardous chemicals, groups of hazardous chemicals and polymers identified in this treaty and the Stockholm Convention.
Provisions common for options 1 and 2 above	
<i>[[3][2] Where production or use of a regulated [hazardous] chemical, group of [hazardous] chemicals [or polymer] listed in part II of annex A is permitted, each Party[, taking into consideration its socioeconomic context and national circumstances,] with such production or use shall:</i> a. Take appropriate measures to ensure that any such [production] or use is carried out in a manner that prevents and minimizes human exposure or release into the environment [throughout the life cycle of the [concerned hazardous] chemical, [[plastic] polymer] or [plastics including plastic] product [concerned]] and fosters the safe and environmentally sound management, including the recyclability and disposal, of the polymers, plastics, and plastic products containing them; <i>Each Party is encouraged to include in its reporting pursuant to [Part IV.3 on reporting on progress] any measures it has taken to not allow, or to restrict, the use in [plastics][plastic polymers] and [plastics including] plastic products of (hazardous] chemicals, groups of [hazardous] chemicals [and polymers] [not included in part II of annex A] that have the potential for adverse impacts on human health or the environment at any stage of the product life cycle, or to hinder the [safe and] environmentally sound management, including recyclability and disposal, of the final product.</i>	<i>Where production or use of a chemical or polymer named in Annex A is permitted with social economic and national consideration, production shall:</i> Take measures to prevent and limit exposure to humans and the environment through production and use throughout the life cycle of the concerned hazardous chemical, plastic polymer or plastics including plastic product concerned including through a circular economy and disposal. <i>Reporting is encouraged to report on measures used to mitigate adverse impacts on human and environmental health as well as circularity.</i>
<i>[[3][2] Where production or use of a regulated [hazardous] chemical, group of [hazardous] chemicals [or polymer] listed in part II of annex A is permitted, each Party[, taking into consideration its socioeconomic context and national circumstances,] with such production or use shall:</i> b. [Take appropriate measures to ensure that all such [hazardous] chemicals, groups of [hazardous] chemicals [[and] [as well as the plastic] polymers,] and [plastics including plastic] products containing them, are used in a manner consistent with part II of annex A and managed in a safe and environmentally sound manner throughout their life cycle, including for their [including for their reusability, reparability, recyclability and] final disposal;] <i>Each Party is encouraged to include in its reporting pursuant to [Part IV.3 on reporting on progress] any measures it has taken to not allow, or to restrict, the use in [plastics][plastic polymers] and [plastics including] plastic products of (hazardous] chemicals, groups of [hazardous] chemicals [and polymers] [not included in part II of annex A] that have the potential for adverse impacts on human health or the environment at any stage of the product life cycle, or to hinder the [safe and] environmentally sound management, including recyclability and disposal, of the final product.</i>	<i>Where production or use of a chemical or polymer named in Annex A is permitted with social economic and national consideration, production shall:</i> Take measures to ensure hazardous chemicals, groups of hazardous chemicals and the plastic polymers, and plastics including plastic products containing them, are used in a way that aligns with Annex A, including through a circular economy and disposal. <i>Reporting is encouraged to report on measures used to mitigate adverse impacts on human and environmental health as well as circularity.</i>

<i>[[3][2] Where production or use of a regulated [hazardous] chemical, group of [hazardous] chemicals [or polymer] listed in part II of annex A is permitted, each Party[, taking into consideration its socioeconomic context and national circumstances,] with such production or use shall:</i> c. Require producers and importers of such [hazardous] chemicals, groups of [hazardous] chemicals [(as well as plastic) polymers] and [plastics including plastic] products containing them to provide to government authorities, [in addition to the information required under] [Part II.14 on transparency, tracking, monitoring and labelling], complete information about the hazards to human health or the environment associated with the relevant chemical[, [plastic] polymer] or [plastic including plastic] product, and related implications for their safe use, recyclability and disposal[, based on the harmonized requirements contained in part II of annex A]; and <i>Each Party is encouraged to include in its reporting pursuant to [Part IV.3 on reporting on progress] any measures it has taken to not allow, or to restrict, the use in [plastics][plastic polymers] and [plastics including] plastic products of (hazardous) chemicals, groups of [hazardous] chemicals [and polymers] [not included in part II of annex A] that have the potential for adverse impacts on human health or the environment at any stage of the product life cycle, or to hinder the [safe and] environmentally sound management, including recyclability and disposal, of the final product.</i>	<i>Where production or use of a chemical or polymer named in Annex A is permitted with social economic and national consideration, production shall:</i> Require producers/importers of hazardous chemicals, groups of hazardous chemicals as well as plastic polymers and plastics including plastic products containing them provide the relevant government authority with all information laid out in the treaty which includes transparency, tracking, monitoring, labelling and risks for use including through recyclability and disposal. <i>Reporting is encouraged to report on measures used to mitigate adverse impacts on human and environmental health as well as circularity.</i>
<i>[[3][2] Where production or use of a regulated [hazardous] chemical, group of [hazardous] chemicals [or polymer] listed in part II of annex A is permitted, each Party[, taking into consideration its socioeconomic context and national circumstances,] with such production or use shall:</i> d. Require producers and importers of the relevant chemicals[, [plastic] polymers] or [plastics including plastic] products to appropriately mark and label them [based on the harmonized requirements contained in part II of annex A], to allow their safe and environmentally sound use and handling [throughout their life cycle], including their [reusability, repairability, recyclability and] final disposal. <i>Each Party is encouraged to include in its reporting pursuant to [Part IV.3 on reporting on progress] any measures it has taken to not allow, or to restrict, the use in [plastics][plastic polymers] and [plastics including] plastic products of (hazardous) chemicals, groups of [hazardous] chemicals [and polymers] [not included in part II of annex A] that have the potential for adverse impacts on human health or the environment at any stage of the product life cycle, or to hinder the [safe and] environmentally sound management, including recyclability and disposal, of the final product.</i>	<i>Where production or use of a chemical or polymer named in Annex A is permitted with social economic and national consideration, production shall:</i> Require producers/importers of relevant chemicals, plastic polymers or plastics including plastic products to label according to Annex A to allow safe use and handling through their life cycle including through a circular economy and disposal. <i>Reporting is encouraged to report on measures used to mitigate adverse impacts on human and environmental health as well as circularity.</i>
Option 3.1	Option 3.1
1. Each Party[, in accordance to its national circumstances and capabilities and subject to its national action plan,] shall take the necessary measures [to manage] [(to not allow, or] to regulate], the presence and use, in plastics and plastic products, [the risk] of chemicals[, groups of chemicals][and polymers] with the potential for adverse impacts on human health or the environment [,based on agreed scientific criteria, following a transparent and inclusive process decided by the governing body*] [in the production of plastic products] [[throughout][at any stage of the product]** life cycle,] or with properties that may hinder their safe and environmentally sound management[, including their reusability, repairability, recyclability and disposal, based on the criteria contained in annex A][provided alternatives or substitutes are available, accessible, affordable and environmental-friendly]. The measures taken to implement this provision shall be reflected in the national plan communicated pursuant to [Part IV.1 on national plans].	Shall include in the national action plan, as local context allows, to manage/ban/ regulate the risk of chemicals, groups of chemicals and polymers in plastics with a risk to human or environmental health. This would be supported by the governing body, following scientific principles, inclusivity and transparency covering the full life cycle of the plastics, including if there is a hinderance in a circular economy or disposal. This would be based on criteria in Annex A and includes consideration for alternatives.
OPI Alt. Each Party shall, consistent with its regulatory frameworks and processes, and based on scientific evidence, take appropriate measures to identify and control chemicals, groups of chemicals and polymers that present a demonstrated risk of concern to human health or the environment at any stage of the product life cycle, including consideration of risks relevant to their environmentally sound management, reusability, and recyclability.	Shall, in accordance with the country's laws and scientific evidence take measures to identify and control chemicals, groups of chemicals and polymers that present a risk to human health or the environment at any stage along the life cycle including circular economy.

OPI bis Alt. Each Party shall take measures, consistent with its regulatory frameworks and processes and based on scientific evidence, to prioritize and evaluate, as appropriate, polymers and chemicals used in plastic production that may present a risk of concern to human health or the environment.	Shall, in accordance with the country's laws and scientific evidence prioritise, and evaluate polymers and chemicals used in plastics that may be a risk to human health or the environment.
OPI ter Alt. Each Party shall take measures, consistent with its regulatory frameworks and processes, and based on scientific evidence, to test chemicals used or intended to be used in plastic production that may present a risk of concern to human health or the environment.	Shall, accordance with the country's laws and scientific evidence test chemicals used/intended to be used in plastic production that may be a risk to human health or the environment.
OPI bis. Any new chemicals of concern identified under paragraph 1 above shall be prohibited under the relevant chemical convention.	All chemicals identified under paragraph 1 shall be prohibited.
OPI ter. The cost of compliance of control measures shall be assessed for each country and funding shall be made available through the dedicated fund as per a procedure decided by the governing body* to enable compliance of control measures.	The cost of compliance shall be assessed per country and funding shall be made available.
Option 4 – Replace Part II, sections 2 and 3 with the following text:	
<i>Alt title: Control of Hazardous, Problematic and Avoidable Chemicals, Polymers, and Plastic Products, including single-use plastics and intentionally added microplastics</i>	
Option 4.1	Option 4.1
1. Each Party shall eliminate or not allow the production, sale, use, distribution, import or export of chemicals or polymers used in plastic production or plastic products that are hazardous to human health or the environment at any stage of the plastic lifecycle, as defined and listed in [annex], not later than the respective dates in the annex.	Shall eliminate or ban, by a date listed in Annex A, chemicals or polymers used in plastics that are hazardous to human health or the environment at any stage of the plastic lifecycle. These will be defined by Annex A
Option 4.2	Option 4.2
2. Each Party shall take measures, as appropriate, to not allow, to phase down or to otherwise regulate the production, sale, use, distribution, import or export of chemicals or polymers used in plastic production or plastic products that are problematic because they disproportionately contribute to plastic pollution, especially in the marine environment, or they have properties that may hinder their safe and environmentally sound management, including their reusability, repairability, recyclability and disposal, as defined and listed in [annex], except where the Party has a registered exemption for the relevant product(s) under [annex].	Shall take measures to ban/reduce/regulate chemicals or polymers used in plastics that are problematic as they disproportionately contribute to plastic and marine pollution, or their safe and environmentally sound management is hindered, including in a circular economy and disposal. Exemptions should be registered.
Option 4.3	Option 4.3
3. Each Party shall take measures, as appropriate, to not allow, to phase down or to otherwise regulate the production, sale, use, distribution, import or export of chemicals or polymers used in plastic production or plastic products that are avoidable because they can be easily substituted for more sustainable alternatives, as defined and listed in [annex], except where the Party has a registered exemption for the relevant product(s) under [annex].	Shall take measures to ban/reduce/regulate chemicals or polymers used in plastics that are avoidable through substitution by more sustainable alternatives as defined by Annex A. Exemptions should be registered.
Option 4.4	Option 4.4
4. Each Party shall eliminate or not allow the production, sale, use, distribution, import or export of plastics products containing intentionally added microplastics, as defined in [annex], except where an exception is specified in part IV of annex B.	Shall eliminate/ban products containing intentionally added microplastics as defined by Annex A. Exemptions listed in Annex B.

Option 4.5	Option 4.5
The Science, Technology and Economics Panels (STEPS) shall recommend to the Conference of the Parties by its first meeting, a list of the characteristics of hazardous, problematic, and avoidable chemicals, polymers or plastic products referred to in paragraphs 1 to 4 above. In preparing these recommendations, the STEPs shall consider sound scientific, socioeconomic, and sociocultural assessments and the availability of safe, accessible, efficient, economically feasible, environmentally friendly and sustainable substitutes, including those based on the knowledge and practices of Indigenous Peoples and local communities.	STEPS shall recommend a list of the characteristics of hazardous, problematic, and avoidable chemicals, polymers or plastic products. STEPS shall include scientific, socioeconomic, and sociocultural assessments, and availability of safe, accessible, efficient, economically feasible, environmentally friendly and sustainable substitutes , including those based on the knowledge and practices of Indigenous Peoples and local communities .
Option 4.6	Option 4.6
6. The STEPs shall recommend to the governing body* at each session, chemicals, polymers, or plastic products, their associated targets and timelines on the Annexes listed in paragraphs 1 to 4 above.	STEPS shall recommend to the governing body chemicals, polymers, or plastic products, targets and timelines .
Option 5 – Replace Part II, sections 2 and 3 with the following text:	
Option 5.1	Option 5.1
1. Parties shall decide at the governing body* on chemicals of concern used in the plastics industry, based on criteria defined in annex A, that should be regulated by the Stockholm or Rotterdam Conventions, according to their objectives. This making-decision process can be repeated at any moment when it would be necessary and decided by the governing body*.	Governing body decides on chemicals of concern using criteria in Annex A. This should be regulated by the Stockholm or Rotterdam Conventions .
Option 5.2	Option 5.2
2. Parties are encouraged to take measures to regulate polymers with potential adverse impacts on human health or the environment, based on criteria contained in annex A, which shall include the uses of the best scientific evidence.	Encouraged to regulate polymers with potential risks on human health or the environment , based on criteria in annex A.
Option 5.3	Option 5.3
3. Parties are encouraged to take measures to gradually reduce the use of problematic and avoidable plastic products, identified on the basis of relevant parameters, and based on the availability, accessibility and affordability of sustainable alternatives, in particular to developing countries, taking into account their national circumstances and capability	Encouraged to reduce problematic and avoidable plastic products, based on relevant parameters, availability, accessibility and affordability of sustainable alternatives , taking into account local context and developmental circumstances .
Option 5.4	Option 5.4
4. Each Party shall take the necessary measures to regulate the use of plastic products containing intentionally added microplastics, except where an exception is specified in part IV of annex B.	Shall regulate intentionally added microplastics . Exceptions listed in Annex B.

Further reading

^{8,23} United Nations Environment Programme & Secretariat of the Basel, Rotterdam and Stockholm Conventions. (2023). Chemicals in plastics: A technical report.

^{29,31,39} Allison, E., and Mandler, B., Air quality impacts of oil and gas Emissions from production processing refining and use. American Geosciences Institute, 2018. 18/24.