Transparency and traceability systems for plastics
Design and practicability considerations

Background

Avoiding toxic chemicals in plastics is essential for several reasons, including human health and environmental impacts, regulatory compliance, meeting consumer demands, increased awareness, and supporting innovation for a toxics-free circular economy.

Transparency and traceability for the chemical composition[1] of individual materials and products will, therefore, be key control measures in the Plastic Treaty to enable informed decision-making at each stage of their respective life cycles. **Transparency and traceability systems must go hand in hand. Without them jointly, no preconditions for a safe, toxic-free and resource-efficient circular economy for plastics exist.** Many of the issues that we see in circular economy operations today, such as the presence of unknown contaminants or legacy chemicals that are banned and cross-contamination of material flows, stem from the lack of such systems. Moreover, knowledge about chemical composition informs substitution work, which is essential for de-toxifying material cycles and design considerations.

Section II, Chapter 13 of the draft treaty text, contains paragraphs with language about mandatory and globally harmonized transparency and traceability for the chemical composition of plastic materials and products. It is crucial that the essence of that text stays in the Treaty. The function of the transparency and traceability control measure is of cross-cutting relevance to the effective operationalizability of provisions in several chapters of the Plastic Treaty, and this should also be reflected in all paragraphs concerned. This is currently not the case. For example, the draft Treaty text on design and performance lacks this.

This information document was created in response to questions and concerns encountered in discussions with country delegates and other stakeholders in the INC process. It is divided into five sub-chapters.

Information flows to support informed decision-making in plastic value chains

To ensure that information can flow uninterruptedly between all stakeholders along plastic value chains and throughout the life cycles of manufactured plastic materials and products, three basic conditions must be met:

- An agreed harmonized approach for disclosing the presence, identity and hazard class of plastic chemicals in materials and products;
- Linking of disclosed chemical composition information to individual manufactured plastic materials and products by labelling, to establish traceability;
- Stakeholder responsibilities when it comes to data collection, entry into a database and labelling are clearly defined.

1 Chemical composition here is defined as additives, processing chemicals, monomers, oligomers and polymers used in the manufacturing or recycling of plastic materials and products, and any non-intentional contaminants as relevant.

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The disclosure condition

Firstly, chemical identity and hazard information for processing chemicals, additives, monomers, oligomers, and polymers must be available.

INC delegates raised the question of whether the Globally Harmonized System for Hazard Classification and Labelling of Chemicals and Chemical Mixtures (GHS) would be a good tool for addressing the transparency of chemicals in plastic materials and plastic products. It is not, for various reasons, as explained below.

GHS has existed since 2003 as a non-binding tool, focusing on hazardous chemicals only.[2] It has instructions for how to report chemicals that meet the harmonized criteria for physical, health or environmental hazards, carcinogenicity, reprotoxicity or toxicity to specific target organs, in concentrations exceeding specified cut-off limits, in safety data sheets (SDS) created by suppliers of chemicals and chemical mixtures and shared with all downstream users.

Thus, GHS is for disclosing chemicals and chemical mixtures only; not for chemicals in manufactured materials and products.

Different jurisdictions have implemented GHS differently and unevenly:

- There are different approaches in different jurisdictions as to what hazards (health or environment, or both) are disclosed in SDSs;
- Concentration cut-offs triggering disclosure are not the same in different jurisdictions.

This may be a problem when information is shared in international supply chains across jurisdictions.

Moreover, GHS hazard classes do not include persistency, endocrine disruption, bioaccumulativity, and mobility, which are important hazard classes to consider for plastic chemicals. The most comprehensive and advanced approach to GHS implementation is established in the EU via the classification, labelling, and packaging of substances and mixtures regulation (CLP).[3] It includes the mentioned additional hazard classes since 2023.[4]

With the above-mentioned shortcomings, GHS does not support the desired level of disclosure. **Thus, an information-sharing system must be developed for the Plastic Treaty, specifically addressing manufactured plastic materials and products.** The system needs to be mandatory and globally harmonized, and suppliers of plastic chemicals provide data formatted according to the new system. Otherwise, it will not deliver properly, just like the GHS.

Some countries may wish to limit transparency and traceability to chemicals of concern, at least to begin with. However, if transparency and traceability are limited to chemicals of concern, the new system must account for both health and environmental hazards, including cover persistency, endocrine disruption, bioaccumulativity, and mobility. For disclosure of also other problematic and avoidable chemicals, additional disclosure criteria need to be developed, for example relating to impacts on recyclability. In the case of full information disclosure, only disclosure concentration thresholds need to be agreed upon.

The disclosure format could be in the form of a comprehensive SDS or something similar.

Manufacturers will further provide information about chemicals they are using in products, including chemical identity and hazard properties, to a publicly accessible database in the form of a globally harmonized and agreed electronic format. This information from the database is linked to a unique product identifier, which enables traceability of chemical information from the database in individual materials and products. This is explained in more detail under the heading "Marking/labelling condition".

The rationale for a global database solution is also elaborated below.

2 GHS (https://unece.org/fileadmin/DAM/trans/danger/publi/ghs/ghs_rev04/English/ST-SG-AC10-30-Rev4e.pdf)
3 EU CLP Regulation (https://echa.europa.eu/fr/regulations/clp/legislation)
4 New Classification Labelling and Packaging Regulation (CLP) Hazard Classes (https://www.intertek.com/blog/2023/05-30-clp-hazard-classes/)

Traceability is only possible if disclosed chemical information can be linked to individual manufactured plastic materials and products, by using data carriers with unique product identifiers.

There are multiple options for data carriers in plastic value chains, several of which are outlined with references to further reading in the review article "Information-Based Plastic Material Tracking for Circular Economy - A Review"[5].

Data carriers for traceability in plastic value chains can take various forms, ranging from chemical to physical markings. They include luminescent organic or metal-based inks, synthetic DNA codes, barcodes, QR codes, radio-frequency identification chips and watermarks.

A common feature for them all is that the information in them is linked to the part in the global database that contains information about chemical composition of individual materials/products based on their unique product identifier.

Inks have the disadvantage that they may interfere chemically with recycling, may affect usability for recyclates, and can only carry limited information, as there are limited combinations of inks to convey information. They may be helpful in some sorting operations preparing plastic materials for recycling and can be detected with relatively cheap optical technology.

Synthetic DNA can be produced in virtually unlimited combinations and can, therefore, theoretically be carriers of complex information about the plastic materials (chemical composition, origin of raw materials, information about composite layers, manufacturer, etc.). However, extracting artificially added DNA from plastic materials and detecting it requires expensive laboratory equipment and time, which limits applications. Currently, this technique is mainly used to secure products against forgery.

The simplest form of a physical marker is a barcode. They are two- or three-dimensional, globally standardized by the GS1 organization, and widely used. QR codes are also standardized and function in a similar way as barcodes. Radio-frequency chips are silicon-based physical markers incorporated into plastic matrices. Information from a database/databases can be retrieved using optical or radio readers that can be static or mobile (it can be an app on a cellphone). Such data carriers come with the disadvantage that they may interfere with recycling processes and the useability of recyclates.

Watermarks do not alter plastics chemically; they are created by subtly modulating the pixels that make up the design of the product's label artwork or are embossed in the plastic product mould, usually in a repeatedly tiled manner. Virtually unlimited combinations of patterns can be created in the watermarks, and they link to information stored in a database. Information from a database is retrieved using optical readers that can be static or mobile (can be an app on a cellphone). The European Brands Association and Alliance to End Plastic Waste have invested a lot in developing watermarks for plastics and showcasing their large-scale applicability in the EU. Important lessons can be learnt from the Holy Grail project, now in its second phase.[6]

Different "data carriers" are useful for different purposes, and a combination of "data carriers" can be applied to the same plastic item. For example, to provide consumers with easy access to information to inform purchases, barcodes or QR codes on the artworks of the packaging may be good, but such "data carriers" are lost when the packaging material is discarded and are not part of the plastic items to which they belong to. **To fully support informed decision-making in the waste handling and recycling industry, "data carriers" need to be an integral part of plastic items, including plastic packaging materials, and stay intact and readable as long as possible, throughout all life stages of the plastics**. For the latter purpose "watermarks" look particularly promising, because they can even be read from the surfaces of fragmented pieces of plastics.

However, once waste is disintegrated or is shredded or otherwise prepared for recycling all physical data carriers are ultimately destroyed. This is why keeping data on the chemical content of products in the database linked to unique product identifiers is crucial, as it saves data and facilitates decision-making for recycling.

The format in which data for individual materials, components or products is stored in the database, is in the rest of the information paper called "digital chemicals passports". A "digital chemicals passport" is registered with a product identifier and the data in the passport can be retrieved for the item that the passport covers, via the same product identifier linked to a data carrier, printed into or labelled onto the item. This is the basis for the traceability system that is outlined in the infographics in Figure 1.

5 Information-Based Plastic Material Tracking for Circular Economy - A Review (https://www.mdpi.com/2073-4360/15/7/1623/pdf?version=1679647694).
6 Holy Grail 2.0 (https://www.digitalwatermarks.eu/).

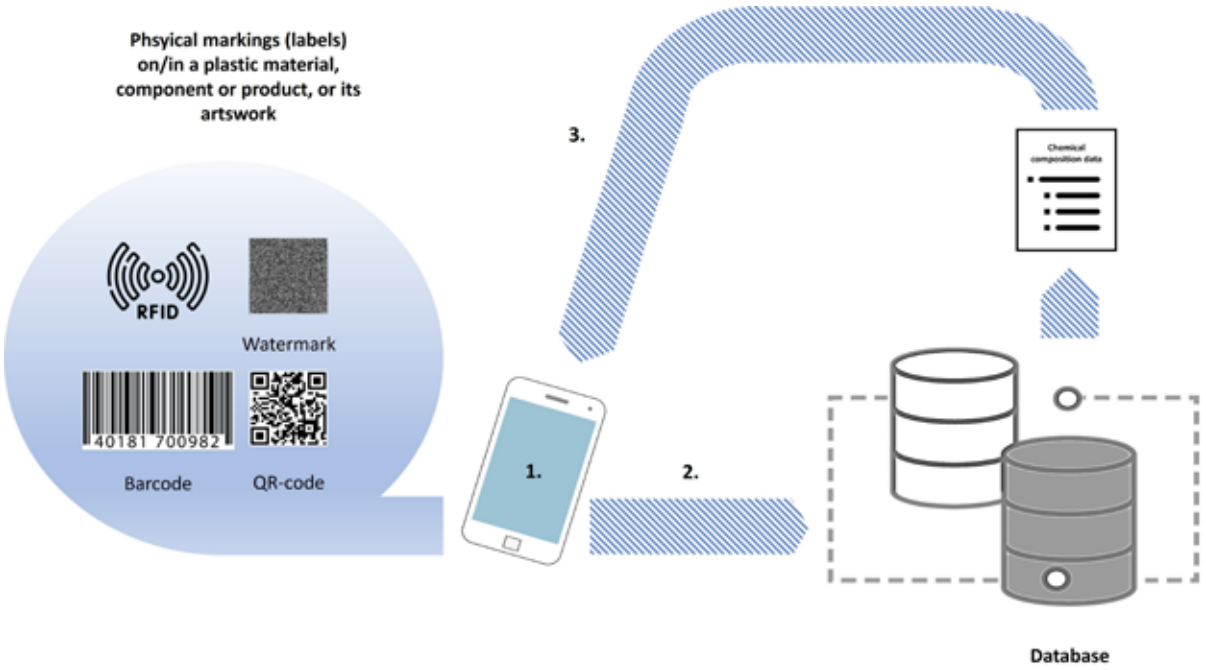

Figure 1: Examples of physical data carriers (markings/labels), and how chemical composition data stored in a material/product unique "digital chemicals passport" in a database is retrieved, by scanning/reading the physical data carriers.

When a data carrier of a material, component or product is scanned (1), the product identifier embedded in the data carrier enables the connection (2) to the „digital chemicals passport" with the same product identifier in the database. Chemical composition and hazard data retrieved from the „digital chemicals passport" is sent back to the user with the hand-held device, and will appear on screen (3).

Condition of defined stakeholder responsibilities

In an Annex to the Treaty, stakeholder responsibilities must be defined in relation to: data provisions; collection of information about the chemical content of plastic materials; components and products and associated hazards as applicable; registry of the data into "digital chemicals passports"; and marking or labelling of the items.

Suppliers of chemicals shall provide information about the chemical composition and hazard data, as applicable, to all users in the agreed binding and globally harmonized format for the purpose of the Plastic Treaty.

Any stakeholder that places plastic materials, components or products on the market, must ensure that these items are accompanied by unique "digital chemicals passports" in the database. Moreover, they must mark or label each item with an appropriate data carrier, standardized to be readable irrespective of jurisdiction.

Manufacturers of plastic resin, materials, components and products (see the stakeholders 1 and 2 in Figure 2), must be obliged to collect, compile and enter information on chemical identities and hazards, including concentration ranges if deemed valid, for all additives, monomers, oligomers and polymers used in the manufacturing processes, including for processing chemicals that leave traces in the manufactured items, into item-unique "digital chemicals passports".

If manufacturers use manufactured plastic components for a composite product, the chemical composition and hazard data for the individual plastic components has to be retrieved from the respective "digital chemicals passports" of the components and re-packaged into a new, item-unique "digital chemicals passport" for the composite product.

The Plastics Treaty will cover chemical information for plastic parts only. Consequently, if a composite product also contains non-plastic materials, chemical composition data for the non-plastic parts must be provided with a complementary data requirement for the "digital chemicals passport", to ensure that the complete chemical composition data for the product is available. Therefore, a cross-sectoral globally harmonized transparency and traceability system needs to be developed, at

the earliest time possible, in addition to and complementary to the Plastic Treaty requirements. The latter component is beyond the mandate for the Plastic Treaty and is a separate process for UNEA.

If several plastic materials are pooled in preparation for recycling, the operator carrying out this step (see the stakeholders 5 and 6 in Figure 2) must be responsible for ensuring that combined chemical information is retrieved from the "digital chemicals passports" of the constituent materials, and is registered into the database as a new, item-unique "digital chemicals passport." Any additives used in manufacturing the recyclates, as well as processing chemicals that leave traces in them, must also be included in the new, item-unique "digital chemicals passport".

With all mentioned conditions in place, the following stakeholders will benefit from access to chemical data of plastic products:

Regulators (see stakeholder 7 in Figure 2) will have full information about the chemicals in the products imported, exported, used, produced, discarded, reused and recycled in their countries from stakeholders at all levels. Based on this information, regulators can introduce or change relevant regulations.

Retailers (see stakeholder 3 in Figure 2) can retrieve "digital chemicals passport" information by scanning data carriers, e.g. using a dedicated cell phone app, and have access to information about the presence of chemicals in the product. Based on this information, retailers can make informed decisions about purchasing the product and how to handle it as waste.

Consumers (see stakeholder 4 in Figure 2) have the same level of access to information from "digital chemicals passports" as retailers and can make informed decisions about purchasing the product and how to handle it as waste and protect health.

To meet the obligations of Chapter 13, all Parties shall develop their national regulations accordingly, to ensure that all products on their markets, produced nationally and imported, are accompanied with "digital chemicals passports", available in the global database. Companies must comply with the national regulations by submitting information about the chemical content and hazard properties as applicable of individual materials, components and products into "digital chemicals passports" available in the global database.

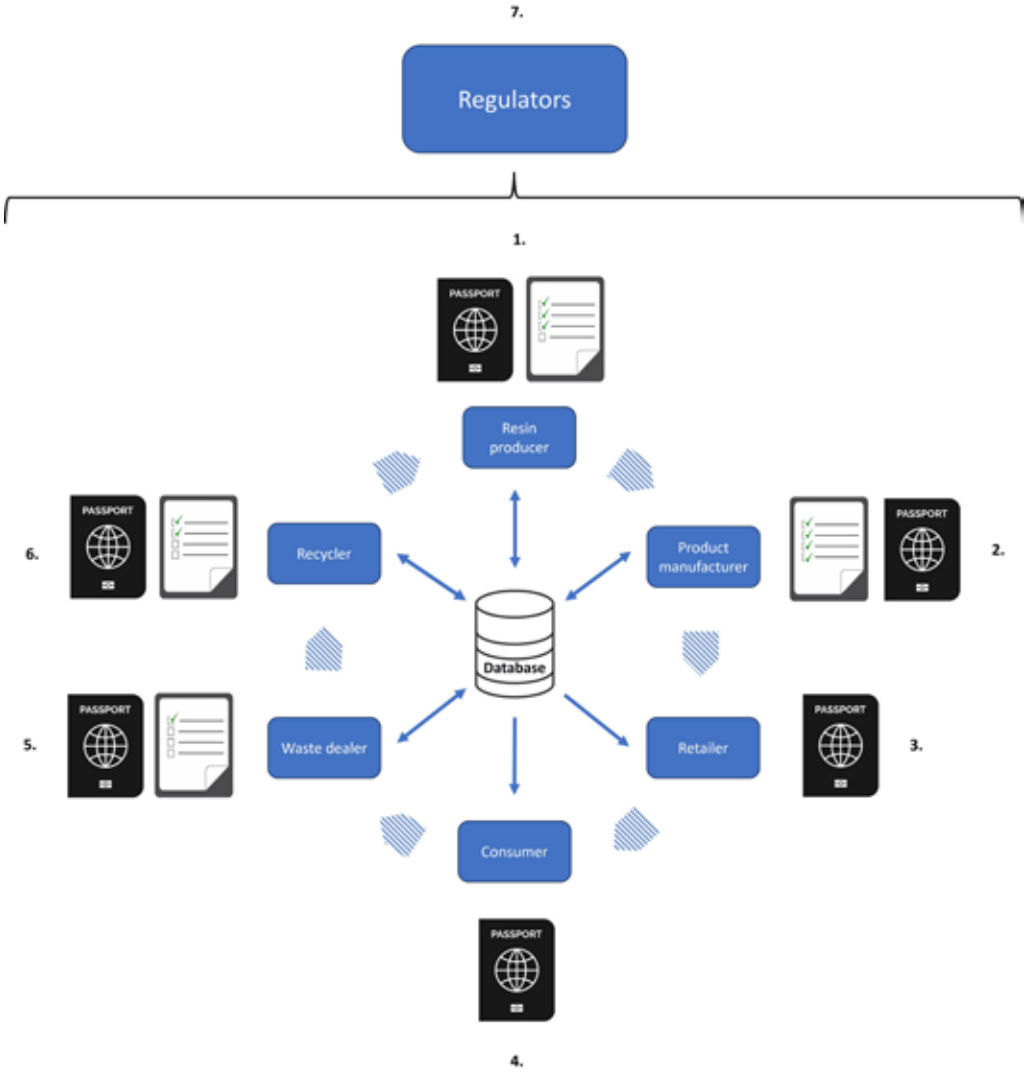

*Figure 2: Stakeholder access to chemical composition data, organized in "digital chemicals passports" in a database, and reporting obligations, starting with **(1)** producers of resins, maufacturers **(2)** of new plastic materials/products from resins, to **(3)** retailers and **(4)** consumers, from where waste eventually moves back to waste dealers, who sort and pool fractions of plastic waste materials, bound for **(5** and **6)** recycling. Regulators **(7)** monitor and control the whole process and have access to full chemical composition data in the "digital chemicals passports" from all levels and stakeholders.*

Two-headed narrow arrows between the database and stakeholders shows that the stakeholder can both retrieve information from a "digital passport" and enter information in it. A one-headed narrow arrow shows that the stakeholder can only retrieve information from a "digital passport". Thick arrows signify material flows between stakeholders in the plastic value chain.

Data management and concerns about intellectual properties

Companies involved in the production of plastics are expected to be knowledgeable about the chemicals used in their manufacturing processes. However, with reference to concerns about protection of intellectual properties and confidential business information (CBI), they are often reluctant to share this information outside supply chains, leaving recyclers and consumers largely unaware of the chemical content of products.

A competitor can only copy a product if the identities of its constituent chemicals are disclosed jointly with the exact concentrations of the respective chemicals. **It is well known that CBI claims do not make sense if only the presence and identity of chemicals, including monomers, oligomers and polymers, above agreed disclosure thresholds and their hazard classes as applicable, are reported.** Even sharing information about chemicals and their concentration ranges in individual materials and products, does not compromise CBI protection.

By providing information based on these approaches, manufacturers can successfully protect intellectual property and CBI and meet the globally agreed principle that "In making information available, information on chemicals relating to the health and safety of humans and the environment should not be regarded as confidential".[7]

Moreover, by making information about the chemical content transparent and traceable in individual materials, components and products, manufacturers contribute to sustainable economic development, including a resource-preserving circular economy free of harmful chemicals.

World Trade Organization (WTO) rules

A few delegations have raised concerns that Treaty provisions for transparency and traceability may be in conflict with WTO rules. The text below clarifies that these concerns are not legitimate, by making direct quotes to the WTO agreements.

WTO stands for non-discrimination and encourages countries to prepare technical regulations to protect health and the environment, actively participate in developing international standards and provide the necessary technical assistance to developing countries to enable them to participate in international trade and meet WTO provisions and international standards.

Article XX (twenty) of the WTO General Agreement on Tariffs and Trade (GATT), on general exceptions, states that any country may adopt and enforce rules to protect human health and the environment.[8] For example, the EU has binding transparency and traceability provisions for so-called "Substances of Very High Concern," basically corresponding to chemicals with inherent hazardous properties prioritized for information disclosure according to the SAICM Chemicals in Products Programme.[9] All manufacturers and importers in the EU, including non-EU exporters to the EU market, must disclose this information for individual materials and products, at the level of product components (EU-term "articles"), in a public database called the SCIP database, hosted by the EU Chemicals Agency ECHA. This requirement from the EU, also imposed on stakeholders who want to access the EU market but are not registered in the EU, has not caused any WTO concerns, and no complaints have been filed highlighting potential discrimination related to the SCIP process. This is because the rules that apply to domestic EU companies are the same as to non-EU companies. Before launching its disclosure provisions for "Substances of Very High Concern", the EU reviewed the WTO rules and provided arguments for the conclusion that it would not violate them or constitute an unnecessary obstacle to trade.[10]

As a general principle, as long as national or multilateral rules influencing international trade are non-discriminatory, that is to say, the same rules apply for the same kind of goods and services irrespective of country of origin, the concern is unwarranted, even in relation to non-parties.

7 §22 of the Dubai Declaration (https://www.saicm.org/Portals/12/documents/saicmtexts/SAICM-publication-EN.pdf)
8 GATT (https://www.wto.org/english/Docs_e/legal_e/gatt47_01_e.htm)
9 SAICM Chemicals in Products Programme (https://www.saicm.org/Portals/12/documents/meetings/ICCM4/doc/K1502319%20SAICM-ICCM4-10-e.pdf).
10 Schenten, J., Fűr, M., 2016. SVHC in imported articles: REACH authorization requirement justified under WTO rules. Environmental Sciences Europe, 28:21, 9 pp (https://enveurope.springeropen.com/articles/10.1186/s12302-016-0090-9)

Global harmonization of rules also helps eliminate barriers to international trade. This is acknowledged in the WTO Agreement on Technical Barriers to Trade (ATBT). Article 2.4. states that "Where technical regulations are required and relevant international standards exist or their completion is imminent, Members shall use them, or the relevant parts of them, as a basis for their technical regulations except when such international standards or relevant parts would be an ineffective or inappropriate means for the fulfilment of the legitimate objectives pursued, for instance because of fundamental climatic or geographical factors or fundamental technological problems".

Furthermore, article 2.6 says, "With a view to harmonizing technical regulations on as wide a basis as possible, Members shall play a full part, within the limits of their resources, in the preparation by appropriate international standardizing bodies of international standards for products for which they either have adopted, or expect to adopt, technical regulations."[11]

The quotes above explain that WTO recognizes the importance of avoiding unnecessary barriers to trade, and it encourages the use of international standards to facilitate global commerce.

Consequently, to comply with the WTO ATBT, we envision that transparency and traceability requirements in the Plastic Treaty will be globally harmonized. Transparency and traceability for the chemical composition of plastics are foundational pillars, necessary for effectively operationalizing several control measures that the Plastic Treaty will need.

However, developing countries may encounter difficulties in complying with international standards. WTO agreements give special consideration to developing countries' development, financial, and trade conditions. In particular, of relevance here is that they provide for technical assistance to countries in need of capacity building in meeting compliance with the new requirements, similar to the approach applied by the Stockholm Convention.

Article 11 of the ATBT has provisions for technical assistance to developing countries, to support them in meeting standards, while Article 12 is about special consideration of developing country needs that may influence the timeline by which developing countries meet standards. Article 12 must not be used as an excuse for developing weaker and less specific standards for the Plastic Treaty, with reference to national circumstances; the focus should be geared away from weak standards and country-specific exemptions toward technical assistance for helping countries in need to at the earliest time possible meet standards. That is ultimately a win-win situation for all stakeholders and the environment. The financing mechanism in the Plastic Treaty must take due consideration of this. In doing so, the WTO-led Aid-for-Trade Initiative encourages developing country governments and donors to recognize the role that trade can play in development.[12]

The ATBT further highlights that in the absence of a relevant international standard, Members willing to adopt a technical regulation should notify other Members in advance and consider their comments. There is no established procedure for what notification, receipt of comments and due consideration would entail to ensure even application in practice. It means that in the end, the country's technical regulation initiatives may not be supported by other Members, even if they aim to protect human health and the environment, as they may be considered an unnecessary obstacle to international trade. Thus, having international standards in place will remove potential adoption obstacles and secure a level playing field for all WTO Members.[13]

11 WTO Agreement to Technical Barriers to Trade (https://www.wto.org/english/docs_e/legal_e/17-tbt_e.htm)
12 WTO Aid-for-Trade initiative (https://www.wto.org/english/tratop_e/devel_e/a4t_e/aid4trade_e.htm)
13 WTO Aid-for-Trade initiative (https://www.wto.org/english/tratop_e/devel_e/a4t_e/aid4trade_e.htm)

What advantages and disadvantages come with different approaches for transparency and traceability of chemicals in plastics ?

In the previous INC meetings, we heard diverging approaches on how to establish transparency and traceability for plastics. Each approach – whether within the industry, at national, or global levels – has its advantages and challenges. Here is a breakdown of the considerations for each:

1. Industry-level transparency and traceability systems:

Advantages:

- Industry-led initiatives can better address specific sector needs, as standards and practices are tailored to their products.
- Allows for the development of best practices that are industry-specific.

Challenges:

- Promotes multiple parallel transparency and traceability standards, potentially with different priority chemicals and disclosure thresholds in different companies and industries.
- Small companies with limited resources may have challenges in setting up their own standards.
- Countries weak in resources, including financial and human, may have challenges in controlling that plastic products meet the Treaty provisions, based on var multiple parallel industry standards.
- Countries may have limited enforcement mechanisms, as compliance with industry standards is often voluntary.
- Chemical composition data may not be disclosed to the public and other stakeholders downstream of the supply chain, including consumers, regulators and recyclers, undermining the safety of the circular economy.
- Trade between countries may become too complicated.

2. National-level transparency and traceability system:

Advantages:

- National regulations can provide a standardized transparency and traceability framework for all industries within a country.
- Regulators may decide that chemical composition data shall be disclosed to stakeholders also downstream of supply chains.
- Governments can enforce compliance through legal mechanisms, ensuring adherence to the standardized framework and meeting Treaty provisions.
- It enables the integration of chemical transparency and traceability into broader environmental and public health policies.
- It can take national circumstances into consideration.

Challenges:

- Promotes multiple parallel transparency and traceability standards in different countries, potentially with different priority chemicals and disclosure thresholds in different companies and industries.
- National standards may be incomparable and create challenges for stakeholders in global supply chains, complicating trade as well as border control measures.

3. Global-Level Transparency and Traceability System:

Advantages:

- Establishes a standardized global framework for transparency and traceability, promoting consistency.
- Addresses challenges related to cross-border supply chains and international trade.
- Facilitates collaboration and knowledge-sharing among nations to tackle common issues.
- Supports net-importers and countries weak in resources, since it is mandatory for exporters to provide them with chemical composition information in harmonized format.
- It enables the integration of chemical transparency and traceability into broader environmental and public health policies, in support of meeting objectives in various multilateral environmental agreements.

Challenges:

- Achieving global consensus on standards may be challenging due to diverse interests and regulatory approaches.
- Implementation and enforcement can be complex, given the need for coordination among nations with varying capacities.

Ultimately, the most effective approach is a multi-stakeholder effort, with governments, industries, downstream stakeholders, and non-governmental and international organizations working together to establish a robust, transparent, and traceable system for the chemical composition of plastics at the global level. Plastic trade is globalized, and hazardous chemicals move with feedstock, materials and products across jurisdictions. No single country can address this overarching challenge effectively with their own standards; only complicate compliance and control mechanism and create various levels of trade barriers.

Global collaboration is essential, with international organizations playing a role in setting common standards. It can help harmonize regulations across nations and facilitate the exchange of information and best practices.

In the preamble to the WTO ATBT, the Parties recognize "the important contribution that international standards and conformity assessment systems can make in this regard by improving efficiency of production and facilitating the conduct of international trade".

The arguments for a global approach can also be extended to the database for the chemical composition of plastic materials, components and products, envisioned in Section II, Chapter 13 of the draft Treaty Text. Compared to multiple national or company-based databases, having just one point for data entry in the form of a global database hosted by the Treaty Secretariat will reduce costs for all stakeholders involved and simplify maintenance, audits and other control measures.

In establishing a global database, lessons can be drawn from the creation and management of the EU SCIP database – a public database to which the presence of substances of concern in any material or product is mandatory to report, at the level of product components, for manufacturers or importers placing materials and products on the EU market11. The EU SCIP database has been operational since the beginning of 2021.

Recommendations

With only two scheduled negotiation meetings in the INC process remaining, the following actions points are necessary:

- Secure treaty text that allows for the establishment of a mandatory globally harmonized transparency system for the chemical composition of plastic materials and products, so that we beyond the INC process in a treaty annex can define reporting requirements and format for the dissemination to stakeholders in plastic value chains.
- Secure treaty text that allows for the establishment of a mandatory globally harmonized traceability system, so that we beyond the INC process in an annex can set up guidelines for selection of labelling systems.
- Secure treaty text that allows us to establish a global database for management of transparency and traceability for chemical composition data of plastic materials and products, with the option to define details beyond the INC process.

Expert groups to develop proposals for reporting requirements, formats, marking and labelling guidelines and for suggesting how the global database should be organized can be set up in the interim period between finalization of the INC process and entering into force of the Plastic Treaty, at COP1 or later COPs, as suitable.

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