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by:
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On behalf of the German Environment Agency

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Abstract: Interpretation of the new entries for plastic waste in transboundary waste shipments

This report contains information that contributes to the description of plastic waste qualities in transboundary waste shipment. These support the interpretation of resolution BC-14/12 of the Basel Convention agreed during the conference of contracted states in May 2019. Through the implementation of the resolution in the European Waste Directive (Waste Shipment Regulation)[1], since January 1, 2021 the new entries for plastic waste B3011 and EU3011 including mixtures thereof in Annex IIIA have been enforced throughout the EU.

The technical foundations for the description of plastic waste qualities as well as relevant specifications, standards and regulations were researched for this purpose. This was supplemented by including the experiences and implementation guidance of other countries and regions. This research was combined with interviews with industry representatives from business and trade associations and with representatives of the relevant authorities. The results were discussed in workshops. In addition to the information from stakeholders, the focus was on how the stakeholders should deal with the imprecise legal terms, especially in the areas of sampling and control. The perspective of the sorting and processing plants was also considered.

This English summarized version was produced in addition to the German-language report “Auslegung der neuen Einträge für Kunststoffabfälle in der grenzüberschreitenden Abfallverbringung“. Furthermore, the following were produced a German- and English-language brochure "Grenzüberscheitende Abfallverbringung und die neuen Kunststoffeinträge" (Transboundary waste shipments and the new plastic entries) and an FAQ, which are all published on the website of the Federal Environment Agency.

[1] https://eur-lex.europa.eu/legal-content/DE/TXT/?uri=CELEX%3A02006R1013-20210111&qid=1663150694968

Kurzbeschreibung: Auslegung der neuen Einträge für Kunststoffabfälle in der grenzüberschreitenden Abfallverbringung Fehler! Verwenden Sie die Registerkarte 'Start', um UBA_Schmutztitel dem Text zuzuweisen, der hier angezeigt werden soll.

Dieser Bericht enthält Informationen, die zur Beschreibung von Kunststoffabfallqualitäten in der grenzüberschreitenden Abfallverbringung beitragen. Diese unterstützen die Auslegung der im Beschluss BC-14/12 der Vertragsstaatenkonferenz des Basler Übereinkommens im Mai 2019 festgelegten und gemäß Umsetzung in der europäischen Abfallverbringungsverordnung (VVA) ab 1.1.2021 EU-weit geltenden neuen Einträge für Kunststoffabfälle B3011 und EU3011 einschließlich der Gemische daraus in Anhang IIIA der VVA.

Hierfür wurden zum einen fachliche Grundlagen zur Beschreibung von Kunststoffabfallqualitäten sowie relevante Spezifikationen, Normen und Regelungen unter Einbeziehung der Erfahrungen und Umsetzungshilfen anderer Länder und Regionen recherchiert. Flankierend wurden Interviews mit Branchenvertretern und Branchenvertreterinnen aus der Wirtschaft und von Wirtschaftsverbänden sowie mit Vertretern und Vertreterinnen der zuständigen Behörden geführt. Die Ergebnisse wurden in Fachworkshops diskutiert. Im Zentrum stand neben der Information der Akteure, der Umgang von Akteuren mit den unbestimmten Rechtsbegriffen insbesondere in den Bereichen Probenahme und Kontrolle sowie auch in den jeweiligen Sortier- und Aufbereitungsanlagen.

Neben diesem Bericht entstanden im Forschungsprojekt eine englische Kurzfassung des Berichtes „Interpretation of the new entries for plastic waste in transboundary waste shipments“, eine deutsch- und englischsprachige Broschüre „Grenzüberscheitende Abfallverbringung und die neuen Kunststoffeinträge“ und ein FAQ, die auf der Website des Umweltbundesamtes veröffentlicht werden.

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List of abbreviations

COP	Conference of the Parties
DSD	Duales System Holding GmbH & Co. KG
EC	European Commission
EPRO	European Association of Plastics Recycling and Organisations
ERDE	Erntekunststoffe Recycling Deutschland
EUWID	Europäischer Wirtschaftsdienst GmbH
HDPE	High density Polyethylen
NIR	Near-Infrared
PET	Polyethylenterephthalat
PE	Polyethylen
PP	Polypropylen

Summary

At the 14th Conference of the Parties (COP) to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, a decision was taken on new plastic waste in shipments. Following transposition of the decision into Regulation (EC) No. 1013/2006[2] on shipments of waste, these entries have been in force in the European Union since January 1, 2021.

However, during the drafting of the Waste Shipment Regulation, imprecise legal terms were used, which initially made standardized implementation difficult.

In order to define these imprecise terms more clearly, it was necessary to develop a technical basis for interpretation.

With plastic waste exports of around one million metric tons in 2020, cross-border trade is very important for Germany. The main sectors in which plastic waste is generated are packaging, construction, vehicles and agriculture. However, industries such as electrical/electronic and medical also offer potential volumes for the cross-border shipment of plastic waste.

The Waste Shipment Regulation green list details plastic entries that can be shipped across borders without notification. Within the EU, this applies to EU3011 and mixtures thereof, which are named in Annex IIIA, No. 4. Outside the EU and within OECD countries, entry B3011 and mixtures of PE, PP and PET apply analogously. The mixtures of PE, PP and PET have to be intended for separate recycling.

In order to ship EU3011 or B3011 plastic waste across borders without notification, the waste must be "almost free of impurities and other types of waste."

The recently published Correspondents' Guidelines No. 12, clearly define the term "contamination". Contamination is specified as all non-hazardous foreign substances. This includes food residues (e.g. yogurt or margarine residues in both residue-empty and non-residue-empty pots or tubs) in plastic packaging or dirt (e.g. adhesions of soil, silage, or feed residues to plastic film). "Other types of wastes" include non-hazardous wastes such as paper, wood, and metals or plastic wastes, which are not listed in mixtures. Liquid residues after liquids have been emptied out (e.g. residues of water or other liquids from PET bottles) and caps, lids, and labels that are classified as ancillary components of the plastic products that have become waste (e.g. PET bottles) are excluded. These do not constitute contamination.

Correspondents' Guidelines No. 12[3] also clarified the discussion about the interpretation of the limit values. Where previously different interpretations were used at European level and within Germany with limit value definitions of between 0 and 6% by weight, a limit value of 6% by weight has now been defined in Correspondents' Guidelines No. 12 for EU3011 and mixtures thereof, which are named in Annex IIIA, No. 4. For transboundary shipments to and from non-EU countries, a limit value of 2% by weight has been set for entries B3011 and mixtures thereof.

[2] https://eur-lex.europa.eu/legal-content/DE/TXT/?uri=CELEX%3A02006R1013-20210111&qid=1663150694968

[3] https://environment.ec.europa.eu/system/files/2021-12/Correspondents'%20guidelines%20No%2012%20final%20Nov%202021%20corr1.pdf

In addition to researching technical basics, interviews were conducted with experts along the value chain. The interviews were with representatives from industry and trade associations as well as competent authorities. The views of stakeholders were obtained during the negotiation process for Correspondents' Guidelines No. 12 and reflect their wishes as to how to deal with the new transboundary waste shipment entries. There is a consensus that standardized definitions must be created for the imprecise legal terms such as "almost free of...", and also for different interpretations of terms such as "impurities". This is important for creating a legally stable basis for determining inputs according to EU3011 and B3011 and the resulting legal requirements. Prior to publication of Correspondents' Guidelines No. 12, industry representatives recommended defined percentages for plastic waste. For types of plastic with mostly positive market values in particular, limits of between 6 and 10 % by weight were recommended. The responsible authorities from different federal states that were interviewed set limits of 2-6% by weight. The industry representatives agree to the determination of a 2% by weight limit value for transboundary shipments of B3011 to and from third countries. This is important for preventing illegal waste shipments.

The Duales System Holding GmbH & Co. KG (DSD) specifications have been established in Europe and have been considered suitable for recycling for years, even with limit values of over 6 % by weight. Because of this, some industry representatives have distanced themselves from the limit value of 6 % by weight for EU3011 (DSD – Duales System Holding GmbH & Co. KG, 2016).

The question if there should be exemptions for certain material flows, such as films from agriculture or the type and form of conditioning (article or flake), was finally clarified in Correspondents' Guidelines No. 12. No exemptions to the limit value of 6 % by weight for transboundary waste shipments are allowed.

The carrying out of checks has not yet been standardized. This is technically very complex. Nevertheless, it would be preferable if the specifications for checks were clearly described and standardized in a transparent system.

Guidelines are necessary for creating safety for the industry and executive authorities. Possible inspection technology such as NIR handheld devices may make the work easier but must be examined with regard to manageability and the costs.

It is also suggested that inspections using a transparent, standardized system for senders, for example, should be developed and described. The sampling and sorting methods that are already used in practice can be used here. Finally, the responsibility for inspections and tests is addressed.

1 Background

At the 14th Conference of the Parties to the Basel Convention, it was decided, with the aim of maintaining environmentally sound treatment of waste, that controls and monitoring of transboundary shipments of plastic waste should be improved. The aim is to counteract illegal waste shipments. For this purpose, new plastic waste entries - A3210, Y48 and B3011 - were adopted. The new entries define which plastic wastes can be shipped as free trade goods and which are subject to reporting requirements. They also include specifications concerning the purity of the waste. However, these contain imprecise legal terms and therefore require interpretation by the implementing states and communities of states.

In the EU, the new entries for plastic waste were implemented in the Waste Shipment Regulation[4] from January 1, 2021. As a result, the new AC300, EU48, EU3011 and mixtures thereof entries for plastic waste are now applicable in Europe. For transboundary shipments to or from non-EU countries, entries A3210, Y48, B3011 and mixtures thereof apply.

Only B3011 or EU3011 and their respective mixtures in accordance with Annex IIIA No. 4 of the Waste Shipment Regulation may be shipped without notification (European Parliament and the Council of the European Union, 2007); these are only subject to the information requirements according to Art. 18 of the Waste Shipment Regulation. Stricter rules apply to transboundary shipments to and from non-OECD countries. For example, proof must be provided that the waste will be recycled in the destination country (European Parliament and the Council of the European Union, 2006).

The imprecise legal terms contained in these entries ("almost free of impurities and other types of waste" and "almost exclusively") need to be more firmly defined with regard to the qualitative requirements for plastic waste. To this end, clear limit values must be specified that indicate whether the waste meets these requirements or whether it is subject to a notification requirement. In this context, in 2020/2021 many discussions took place between stakeholders from industry, associations and the authorities in Germany.

At European level, negotiations were also held on this subject between the member states. As a result, the new Correspondents' Guidelines No. 12[5] came into force on December 3, 2021, which uniformly clarified the discussions on limit values (European Commission, 2021).

[4] https://eur-lex.europa.eu/legal-content/DE/TXT/?uri=CELEX%3A02006R1013-20210111&qid=1663150694968

[5] https://environment.ec.europa.eu/system/files/2021-12/Correspondents'%20guidelines%20No%2012%20final%20Nov%202021%20corr1.pdf

2 Aims and Procedure

The aim of this report is to present how the different stakeholders deal with the new plastic inputs, which limits were targeted before Correspondents' Guidelines No. 12 clearly clarified them and which opportunities and challenges arise from the new limits.

Research and interviews were carried out in order to produce this report. Depending on the specific subject area, statistics, definitions, specifications, standards and guidelines were consulted that contributed to the discussion of plastic waste and shipments thereof.

Interviews were also conducted with the aim of incorporating practical experience into the development of proposed solutions and verifying the results of the research. Representatives from all relevant sectors were considered (sorters, traders, operators of the dual system, recyclers, associations, consultants, logisticians, plant manufacturers and authorities). The entire value chain was thus represented by this selection.

The statements were then collated in bundled and anonymized form for the report.

The workshops with representatives of industry and trade associations as well as with authorities served both to verify/refute the results of the investigation and to inform the stakeholders, especially since Correspondents' Guidelines No. 12 had been adopted in the meantime.

For the discussion about the handling of controls and the current situation in sorting and recycling facilities, both data research and statements from the interviews were used throughout the report. To distinguish between the opinions of the interviewees and the data, the former are identified as such.

3 Results from the Interviews

The interview content is arranged by field of industry/association and authority (in enforcement and monitoring) in order to compare their different perspectives and experiences. The industry stakeholders include sorters, traders / system operators (Dual System), recyclers, associations, consultants, logisticians and equipment manufacturers, with the statements on sorters and recyclers being included in chapter 4.

The interviews were conducted before the publication of Correspondents' Guidelines No. 12 on November 12, 2021.

3.1 Stakeholders from the business community and associations

The discussions with industry stakeholders showed that in general, especially at the beginning of 2021, there was considerable uncertainty due to the adjustments to the regulation on shipments of waste to take into account the new plastic entries. There was consensus about the goal of increasing the level of control over transboundary shipments of these wastes and avoiding illegal waste shipments. The interviews showed that more stakeholders held the view that a distinction should be made between transboundary shipments of plastic waste within and outside of Europe. For waste streams destined for export out of the EU, a tightening of the limit to 2 % by weight would make sense. This would also affect the import of waste from non-European countries into the EU.

In the discussions, the view was also expressed that the new plastic entries present an obstacle for the secondary raw materials industry and that this does not support the goal of increasing recycling quotas in Europe. There would be a risk that trade in secondary raw materials beyond national borders could come to a standstill. As long as recycling capacities in individual countries are adequate and match the supply of the different qualities of plastic waste available domestically, no bottleneck should occur. However, specific material streams (see, for example, plastic waste from agriculture) are dependent on shipment to other countries because there is insufficient capacity to process them domestically. Being unable to export wastes could hinder the European goal of increasing recycling rates.

Some of the participants in the discussion were not able to understand the definition of a strict limit to impurities and the fact that failure to comply would result in a waste shipment being illegal. Reference was made to the preamble of Annex III of the Waste Shipment Regulation (green list). This clearly specifies which wastes are not part of the green list. This includes waste that is classified as hazardous to the environment or that cannot be guaranteed to be recycled in an environmentally sound manner.

Thus, the perception persists that if the general conditions are met but a strict percentage is missed within an appropriate and yet to be defined framework, nothing should stand in the way of the recycling. Unlike with illegal waste shipments, there is no risk to the environment. So, it can be assumed that for plastic wastes, especially those with a positive market value (i.e. the sender receives money for the material), the goal is recycling with an associated boost to the recycling rate. There is no intention to ship the waste illegally, rather the goal is to send the materials for mechanical recycling.

Following the amendment to the Waste Shipment Regulation, all stakeholders assumed that there would be an increase in the number of transports requiring notification. In practice, this has not yet proven to be the case either for recyclers, traders, sorters or enforcement. It has become apparent that in the case of exports, either the usual procedure is followed, or materials are no longer exported.

3.1.1 The Dual System

By sorting post-consumer waste from the dual system, secondary raw materials are enriched for recycling in accordance with DSD specifications as is common in the trade, with other types of waste being identified separately as impurities. Following these specifications, impurities of between 2 % by weight and 6 % by weight are permissible in the range of types of plastic (e.g. PP, HDPE). The 310 "Plastic films > DIN A4" and 350-352 "Mixed plastics" fractions are considered separately, since in their case, the permissible share of impurities is 8 - 10 % by weight according to the DSD specifications and thus subject to reporting. The specifications for plastic types or company-specific agreements based on them form a binding part of the contracts between the sender (sorter) and recipient (recycler).

In the case of transboundary waste shipments, since January 1, 2021, according to recyclers and traders, some materials are now classified as subject to the reporting requirement if they have an impurity content of more than 2 % by weight. This applies to states in Germany that specify a percentage of impurities of 2 % by weight in the context of the interpretation of the undefined legal term " almost free of ..." for enforcement purposes. With the implementation of Correspondents' Guidelines No. 12, an adjustment to 6 % by weight is to be expected here for waste shipments within Europe. An exception is the Netherlands, which makes use of the possibility of national derogation and continues to work with a figure of 2 % by weight.

3.1.1.1 Handling of and experience with impurities

Prior to the publication of the Correspondents' Guidelines No. 12 now in force, it was not clear from the Waste Shipment Regulation itself which materials were to be assessed as contaminants. Furthermore, a variety of different terms were used in communication in this context.

The interviewees stated that they felt the term "impurities" should be defined more precisely. For example, minor components and other types of waste that do not negatively affect the recycling process should be distinguished from substances that disrupt the process or prevent environmentally friendly recycling.

It should also be noted that the variance of impurities in the plastic fractions depends on the steps taken during sorting and the collection system (separate collection versus mixed collection, proportion of misdirected waste). The dual system in Germany, for example, is a mixed collection system, and depending on the collection area, may have varying qualities in the collected material. This is also dependent on consumers and their disposal behavior. Sorting is undertaken at article level purely according to physical properties in a continuous, automated process. So the opportunity to reduce the rate of impurities is limited.

On the other hand, after further processing of the sorted plastic fractions with additional shredding and possibly wet cleaning, the material is more broken down and impurities can be removed with a higher degree of efficiency.

3.1.1.2 Setting a percentage

The lack of a definition of the imprecise terms "almost free of impurities and other types of waste" and "almost exclusively" at the beginning of 2021 has resulted in varying interpretations in the meantime. In some German states, the interpretation was 2 % by weight, in others 6 % by weight. This was also the case for shipments to different EU countries. For example, as of 2021, the Netherlands allows a proportion of impurities and other types of waste of 2 % by weight, whilst in Poland it is 0 % by weight. There may be many diverse reasons for country-specific determinations. A wide range of interpretations is possible. For all interviewees, however, the different country-specific interpretations in particular posed difficulties. A percentage of 0 % by weight cannot be achieved with post-consumer plastic waste and hinders the goal of a Europe-wide increase in the recycling rate.

3.1.2 Agriculture

Agriculture is just one of the many sectors that deal with plastic waste. It is a good example for the economy in general and demonstrates the challenges that arise with the new limit values.

A new situation has arisen for the agricultural sector as a result of the new plastic entries and Correspondents' Guidelines No. 12. The interviewee from the European Association of Plastics Recycling and Organizations (EPRO[6]) stated that strict limits of 2 % by weight and 6 % by weight, plus a definition of soil adhesion as contamination would make notification obligatory for many films from the agricultural sector. This would lead to high financial costs and could mean that mechanical recycling would no longer be economically competitive. This applies in particular to agricultural films such as asparagus films or bale stretch and silage films, which, in under the current agreements, are delivered for recycling after dry mechanical cleaning on site with the aid of a broom, for example. These films are recycled into regrind or regranulates and can be used in new products, including in new films for agricultural use. A deeper clean on site would lead to an increase in processing costs of 25 % due to the effort involved. One consequence of increased processing costs would be that the goal of making mechanical recycling less expensive than energy recovery could no longer be achieved. Due to the specific properties of this group of materials, they cannot be processed together with other plastic streams without further preparation.

The ERDE[7] organization is currently forced to report the plastic waste or make use of the meager recycling capacities available in Germany. However, mechanical recycling capacities are insufficient nationally, which may lead to a decrease in the amount recycled in favor of energy recovery. The creation of national processing capacity was mentioned as an alternative in the interviews. However, given the overall low quantity of film from agriculture in Germany, the construction of further plants was not considered to be worthwhile. Bundling the waste from different countries in individual plants is more likely to be economically viable.

[6] https://www.epro-plasticsrecycling.org/

[7] https://www.erde-recycling.de/

3.2 Public authorities

A strong increase in notifications was expected at the beginning of 2021. However, according to the interviewees, this has not yet occurred in relation to the transboundary shipment of plastic waste.

The interviewees also stated that there is a need for clarification with regard to the focus on impurities, limits and controls. Until the publication of Correspondents' Guidelines No. 12, the situation was often not clear and was handled differently in the German federal states or EU member states. The respondents expressed a need for uniform and practicable nationwide and Europe-wide regulations.

For the authorities, the publication of Correspondents' Guidelines No. 12 answered a sizable proportion of their questions. The uniform implementation of controls is still unresolved. During the interviews, reference was made to the challenge of carrying out checks when many authorities are understaffed. In addition, a desire was expressed for professional training on the Waste Shipment Regulation, Correspondents' Guidelines No. 12 and their interpretation and implementation in enforcement practice.

4 Implementation of the Waste Shipment Regulation in industry

The report on the current situation in relation to the handling of the new plastic entries at sorting and recycling facilities is based on data research and statements from our interviews. Information and opinions from sorting and recycling plant operators have been identified as such.

4.1 Implementation at sorting plants

The revision of the Waste Shipment Regulation and its implementation in practice also initially caused irritation among sorting plant operators. Since there was no uniform solution prior to the publication of Correspondents' Guidelines No. 12, to begin with either the sorting plants continued as in 2020 or waste volumes were no longer shipped abroad. For the sorting facilities, the most important points were the interpretation of the limits and what constituted an illegal shipment.

Before Correspondents' Guidelines No. 12 specified limits, plant operators were uncertain of how to interpret imprecise legal terms such as " almost free from". Therefore, prior to Correspondents' Guidelines No. 12, the existing DSD specification continued to be implemented. Thus, for sorted plastic fractions, depending on the specification, limit values for impurities of 2 to 6 % by weight were implemented. If the limits were not complied with, an agreement was reached on the price. When limit values were greatly exceeded, the material was returned to the sorting or dispatching plant and if necessary, the contract was cancelled. Compliance with the limit values was in the interests of the sorting plants if they wished to avoid damaging their business. Failure to comply with the limit values was due to economic interest, poor input material and technical inefficiencies.

The battle for profitability and license volumes has increased greatly in recent years. Plants are operating under high pressure with high throughputs, which can occasionally have an impact on the quality of the output. In addition, sorting plants have experienced a decrease in input quantities due to, in some cases, insufficiently separate collection, which cannot be fully compensated for, even with high-specification sorting technology. This fact was mentioned by several sorting plant operators and also corresponds to the experience of the contractor (Gerke, 2022).

Depending on the fraction, the materials may already contain 2 % by weight of adhesions (cross-contamination) due to the mixed collection system. In addition, there are then unavoidable impurities and other wastes. Sorting processes have technical inefficiencies that always cause a certain amount of foreign matter to remain.

The DSD-specified limit values could not always be met. However, according to the companies interviewed, even if this were to occur, the shipment would not automatically be illegal. If it is a revenue fraction with a positive market value, it is in the economic interest of sorting plants to market it for the highest possible price. However, according to the industry interviewees, customers only pay this price for goods with a low level of impurities.

To avoid the plastic fractions from the sorting plants being classified as illegal shipments according to the Waste Shipment Regulation, many sorting plants have commissioned an audit

of the legality of their own actions (according to the information from an employee for material flow management at a larger disposal company). In the meantime, Correspondents' Guidelines No. 12 have established a degree of legal certainty in the transboundary shipment of plastic waste. The sorting plants now refer to the limit values for impurities from Correspondents' Guidelines No. 12 when they ship across borders. How long-term compliance with the limits will develop, how the quantities of exports will change, and how the Waste Shipment Regulation will influence the number of illegal shipments will become clear in the coming years.

For the industry representatives, the objective of stopping illegal waste shipments is understandable, but it is not necessary, especially when it comes to dual systems with their obligation to document the quantities of packaging waste and their recycling paths in the form of quantity flow records. Although the sorting specifications are of no legal significance, they are already firmly anchored and implemented in practice as the basis of quality agreements.

4.2 Implementation by recycling companies

At the beginning of the year, recycling companies had unanswered questions regarding the amended Waste Shipment Regulation and its implementation in practice. For example, there was uncertainty as to which waste streams needed to be reported, which adjustments had to be made to shipment contracts in accordance with the Waste Shipment Regulation, and which limits the authorities in Germany or other European countries would implement. As of the beginning of 2021, significantly less material has been shipped to foreign facilities, with the result that German facilities have fully utilized their capacities (EUWID, 2021).

In addition, recyclers noted that notification applications can take an extremely long time to process. This is made worse if the transit routes are very long and cross several countries. Long routes and crossing several countries also increase the probabilities of running into one or more checks, which can lead to further transport delays. Flexibility is ever more difficult to achieve for the senders and security of supply for the recipients is risked if deliveries are delayed or even fail completely due to time-consuming reporting requirements.

In accordance with German national packaging law, the recycling plants, as receiving plants for plastic packaging waste from the dual system, must be certified. In doing so, they prove that they comply with the required technical standards that are necessary to recycle input fractions that are clearly defined by a waste code. It is obligatory for the plants to verify the quantities and quality of recycling. According to the recyclers, high quality standards are already in place, which are linked to a strong basis of trust between sender and recipient. Although compliance with the individual purity specifications is not regulated by law, it is checked by regular internal inspections and, in the event of non-conformance, punished with measures such as price adjustments or termination of the business relationship. With a legal obligation to comply with limits on impurities from the Waste Shipment Regulation and Correspondents' Guidelines No. 12, controls also present a significant challenge for enforcement.

One proposed approach is to seek to implement a certification and verification requirement for sorting plants like the one that already exists for recycling plants for packaging waste under German packaging law. To do this, certain sorting results and levels of purity would have to become obligatory for the respective output fractions. Since the certification of sorting plants could only be derived to a very small extent from the system of certification for recyclers, it would not be possible without significant effort. In the view of the recyclers, certification in combination with clear specifications as part of the contract between sender and receiver would

lead to greater security on both sides. On the other hand, plants without a certificate should have to fulfil reporting requirements for their output materials.

The interviewees believed that to enable the waste to be processed to a high standard, the impurities in single-variety plastic fractions should be between a maximum of 6 and 10 % by weight. The decisive factor should be whether the receiving plant can process the material and what products are made. The quality requirements for the input material depend, for example, on whether wet or dry processing is used.

Another aspect still under discussion is the classification of materials according to the degree of conditioning. This includes the levels of bale conditioning and regrind production. In some cases, the output already no longer has the status of waste and can be declared as a product. In some cases, in practice, complaints still result during inspections, as has been reported. Likewise, the degrees of conditioning are also critical for determining impurities and other types of waste.

5 Conclusions

With the publication of Correspondents' Guidelines No. 12, many of the aims of this project, such as defining uniform limits for the new plastic entries (EU3011 and B3011) as well as the clarification of terms such as "contamination" and "other waste", were superseded. Aspects of the following conclusion still refer to the time before the publication of Correspondents' Guidelines No. 12.

A uniform approach to the definition of limit values is essential for the cross-border shipment of plastic waste. With local differences within the EU and even in Germany within the federal states, the market seems almost paralyzed. According to experts, major uncertainties among senders and receivers of plastic waste are leading to a decline in transboundary shipments. While the responsible authorities consider limits for impurities between–0 and 6 % by weight, depending on the federal state and the European country, the players in the industry would like to see limits between–6 and 10 % by weight. Reasons for this are seen in the different plastic waste streams, which are offered for transboundary shipment enriched in varying degrees of purity. For example, pure PET fractions from a closed cycle can achieve higher levels of purity than plastic waste from mixed collection systems or with an agricultural connection. According to feedback from the respondents, a further differentiation of the limit values is desirable at the processing level. Thus, low limit values for plastic waste can be realized at the regrind level, but at the article level, it is difficult to comply with limit values of less than 2 % by weight. A compromise between the responsible authorities and industry players of 6 % by weight is conceivable.

Correspondents' Guidelines No. 12 set a limit of 6% by weight for transboundary shipments of plastic waste within the EU, thus meeting expectations. However, for some plastic waste this will entail a reporting requirement in the future. There is a risk that this will also restrict functioning trade relations within the European area. This is the case, for example, with films from agriculture, which were often shipped to neighboring countries such as France due to a lack of capacity in Germany. According to feedback from industry players, in Germany there is now a fear of no longer being competitive with energy recovery. This would counteract the objective of the Waste Shipment Regulation. However, with exports of around one million metric tons of plastic waste in 2020, this probably only affects a small proportion.

This anticipated negative development could be remedied if the plastic waste streams were to be differentiated between according to conditioning and origin. However, since this is not planned under Correspondents' Guidelines No. 12, only more precisely defining the term "impurities" might help. The terms "impurity" and "other types of waste" were clearly defined in Correspondents' Guidelines No. 12. Thus, labels, lids or liquid residues (e.g. in bottles) are not to be classified as impurities, whereas food residues or soil adhesions are impurities. This also includes yogurt or ketchup residues that remain in the packaging when a product is emptied in a household and count as part of the 6% or 2%, respectively. This definition of impurities implies portions that can often be removed without difficulty during preparation for recycling at the receiving plant. Remaining with the example of agricultural films, brushing and cleaning on site is too cost-intensive. In addition, the definition of residual moisture as contamination requires further clarification. The examples in Correspondents' Guidelines No. 12 refer only to packaging waste and liquid residues in packaging. This means, you have to derive the impurities from the example of PET bottles with the other components such as lids, labels and liquid residues. The extent to which residual moisture from, for example, soil adhesions must also be counted among

the contaminants has not yet been adequately specified. There is potential here for sharpening the definitions with regard to impurity components that really disrupt the recycling process.

Further honing is also needed in the area of control methods. Since there is currently little knowledge and clarity available about the sampling of plastic waste, especially at article level, aspects of sampling and their shortcomings are listed. In this respect, Guideline LAGA PN-98 is currently one of the few foundations for carrying out the sampling of plastic waste (Länderarbeitsgemeinschaft Abfall (LAGA) Ministerium für Umwelt und Forsten Rheinland-Pfalz, 2001). However, the applicability of this guideline is also limited and dependent on the input material. In the case of plastic waste processed into regrind, LAGA PN-98 has proved to be an appropriate guideline for carrying out sampling both at the sender's and recipient's premises as well as for controls during transport. In the case of plastic waste at article level, sampling is problematic due to the significantly higher maximum grain size. Thus, the number of samples and quantities cannot be transferred, and sampling can also only be carried out in accordance with LAGA PN-98. With a maximum grain size of 120 mm, the guideline is not designed for plastic waste at article level. DSD has introduced a sampling system as an alternative to the guideline. This sampling procedure has been established in practice for many years and serves as an effective way of obtaining proof of quality for agreements between senders and recipients. However, this sampling procedure has no legal relevance and can therefore not be used as a basis for quality controls in sampling by authorities at national or European level. An extension to the generally applicable LAGA PN-98 guideline is therefore being considered as a possible solution. A foundation for enforcement could be created if the guideline were to be adapted for piece goods over 120 mm and included methods of sampling for plastic waste in bales. Here, the Austrian sampling procedure could also be adopted, which follows a similar approach to the DSD procedure DSD (DSD – Duales System Holding GmbH & Co. KG, 2016).

Another approach would be to transfer the sampling procedure established in practice into a uniform and standardized framework. The advantage here lies in the fact that the system for sampling has already been proven and is widely accepted in the industry. The systematic and representative resilience of the sample set has already been proven by research. Both proposals require a time-consuming and thorough transfer into German law and, for the greatest possible applicability and validity, also into European law. The challenges involved, however, allow for a significantly higher level of security in the handling of sampling in industry and enforcement.

Further potential for improvement in transport controls became apparent during the interviews and workshops with the authorities. During transport inspections, visual inspections of the plastic waste are carried out. The experience of the employees carrying out the inspections is essential for the detection of impurities or other waste. This also includes types of plastic that do not correspond to the relevant plastic inputs or a mixture of these. Hand-held near-infrared (NIR) devices can be used at this point to simplify the detection of plastic types. This allows a punctual, accurate and non-destructive detection of the polymer type in seconds. A rough impression of the quality of the plastic waste, even in the case of waste compressed in bales for transport, can be obtained by simple surface inspection. This form of examination is not to be classified in the same way as the results of sampling but can assist with enforcement.

As there are currently still doubts among industry stakeholders as to how proof of quality and compliance with the limit values is to be provided, an additional solution is proposed. This would entail external quality inspections by testing and monitoring companies, which, depending on the output material, would take samples directly in sorting plants or, at regular intervals, from the input at recycling companies. The samples would then be tested in terms of

quality and proof of compliance with the limit values would thus be provided. The quality test report could then be carried with the waste as proof during transport. To ensure uniform quality, expedient testing intervals will need to be established.

The results of this project and the information from Correspondents' Guidelines No. 12 are to be collated and summarized in an information guide and list of FAQs for the authorities and industry, thus making practical aids available for the implementation of the new provisions of the Waste Shipment Regulation concerning the new plastic waste entries in the context of transboundary waste shipments.

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