FEICA The European voice of the adhesive and sealant industry

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Labelling adhesives in the context of packaging recycling

Executive Summary

FEICA's goal regarding labelling adhesives in packaging recycling

FEICA would like to assist stakeholders in furthering a common understanding of labelling adhesives and related requirements which are important to recycling. To support a focused investigation of labelling adhesives and clear design recommendations, FEICA provides this report to all interested parties. This paper is part of a series on adhesives packaging recycling. Other papers from the same series[1] include:

- Laminating Adhesives in Flexible Plastic Packaging Recycling - report (2024)
- FAQ (2024)
- Adhesives in paper board recycling - report (2023)
- Terminology and definitions - guidance (2021)

State of play of labelling adhesives in the recycling of packaging

The right choice of labelling adhesives has the potential to support the recycling process, as they can potentially affect the efficiency of packaging recycling. With the EU Packaging and Packaging Waste Regulation (PPWR), recyclability will become a legal requirement for packaging placed on the market. In addition, the functioning of a circular economy depends on the high yield and quality of recycling of packaging waste.

To provide effective and clear guidance on the use of labelling adhesives in recyclable packaging, their behaviour during the recycling processes of the various packaging materials needs to be understood. The briefing paper **affords a high-level description of that behaviour and points to aspects which still require a better understanding or a better implementation into testing methods and design guidance**.

Recommendations: design for recycling guidelines, and testing protocols

FEICA offers recommendations on both design for recycling guidelines and testing protocols. As a general principle, **testing should be allowed to override guidelines**. It is crucial to **enhance the accuracy of discussions about labelling adhesives and their behaviour in recycling processes** by using correct and precise terminology, as well as the relevant recycling processes. Additionally, **adhesives should be specified based on the required properties of the adhesive application** as it enters waste management, rather than their function, chemistry, reactivity, or technology.

To ensure clarity, applicability and industry representation, the **recommendations for testing protocols** include the following: (1) Strive for a harmonisation of testing protocols in Europe; (2) Ensure that testing protocols adequately represent industrial processes; (3) Consider all relevant processes that can release labels; and (4) Provide detailed descriptions of all steps that can release labels.

[1] https://www.feica.eu/our-projects/paper-and-packaging

Contents

Background

Labels are essential for providing information and branding on a vast range of packaging, from small consumer goods to large industrial use. Packaging comes in very different sizes, materials, and formats. This includes every type of packaging from small flexible plastic candy wrappers to beverage bottles made from glass or plastic, paper-based packaging for consumer goods, and corrugated cardboard transport packaging all the way to large metal and plastic industrial packaging up to 1000 kg of content. Although labels represent a small part of the overall packaging material, they offer key advantages over direct printing in terms of versatility, recyclability and commercial and environmental benefits. Moreover, a label's ability to be released from various packaging substrates like plastics, glass and metal enables and facilitates the recycling of these materials. The release of the label is particularly important where the label material or some of its constituents are incompatible with the recycling process or degrade the quality of the recycled material.

With the exception of certain rigid plastic packaging types,[2] attaching a label to packaging requires the use of a **labelling adhesive**. Labelling adhesives are available in a variety of delivery forms, chemistries and performance categories. They are typically optimised for a given combination of label substrate[3] and packaging material as well as for the specific requirements of the application and the available printing and labelling equipment.

An active conversation is occurring regarding how to best design labels and, by extension, labelling adhesive applications for the existing and upcoming **packaging recycling** infrastructure in the European market. This discussion generally addresses two main aspects related to labelling adhesives: first, their **releasability**, i.e., the ability to release the label from the packaging under defined conditions, and, second, their **compatibility with the recycling processes** of various packaging materials.

This document seeks to summarize the current state of play in terms of how labelling adhesives are reflected in **design-for-recycling guidelines** and in **sortability and recyclability testing** for packaging. It includes suggestions on how the specification of labelling adhesives in these documents may be further improved, recognising both the importance of the adhesives for the manufacture of fit-for-purpose packaging and the needs of waste sorting and recycling operators.

This document focuses specifically on labelling adhesives and their compatibility with packaging recycling processes. It does not delve into other aspects of label design or application, such as the choice of label material, the size of labels, printing inks or other possible constituents of labels. Furthermore, while recognising that some adhesives may also be used for attaching sleeves and packaging supplements, these applications fall outside the scope of this document. Similarly, while labels are applied to various non-packaging items, such as stationery products, clothes, storage vessels, tyres, passports and vehicle components, this document exclusively addresses the use of labels on packaging and their impact on recyclability.

Labelling adhesives

The primary function of labelling adhesives is the **attachment of a label to a packaging (component)**, typically to the main component of a package. The label is generally required to remain reliably

[2] For certain PE and PP moulded rigid packaging formats, it is possible to bond a label during packaging production directly to the still-liquid plastic material without the use of an adhesive ('in mould labelling'). As the focus of this document is on adhesives rather than on labels and packaging designs overall, this technology is not further considered here.

[3] I.e., label material such as, for example, PE or PP.

attached under a set of defined **environmental** and **in-use conditions**. While all labelling adhesive applications are required to provide a basic resistance, certain applications require increased resistance. Conditions which the labelling adhesive must resist may include outdoor storage, cold storage (including, e.g., frozen foods), elevated temperatures (e.g., microwavable ready meals), contact with water (e.g., beverage bottles placed in ice buckets), contact with surfactants (e.g., shower gel packaging) and contact with chemicals (e.g., labelling of household chemicals, motor oil or industrial packaging). While the requirement for labels to remain reliably attached under such conditions is always a technical requirement of producers, it is in certain cases also a legal requirement.[4]

Types of labelling adhesives

Two fundamental approaches to the application of labels to packaging can be distinguished.[5]

One approach is to use **self-adhesive labels** ('pressure sensitive labels'), which are labels on which an adhesive has been applied already during their production. These can be attached to packaging by simply applying them with pressure. Typical adhesive technologies for pressure sensitive applications are acrylic dispersions, UV curable acrylic adhesives and rubber-based hotmelts.

Alternatively, labels can be attached to packaging by the **direct application of labelling adhesives** during the labelling process. In this approach, the adhesive is applied to either the label or the packaging just before the label is applied. Typical adhesive technologies for this labelling method include water-based adhesives based on starches, proteins or acrylic dispersions as well as non-pressure sensitive polyolefin or EVA hotmelts. These adhesives generally do not exhibit pressure-sensitivity ('tackiness) after they have been applied.

A more detailed description of various types of adhesives used in packaging can be found in the FEICA document 'Terminology and Definitions to Be Used in the Context of Adhesives in the Recycling of Packaging'[1].

Labelling adhesives in the context of the end-of-life of packaging

Labelling adhesives, like all packaging components, require careful considerations to support their end-of-life. While ensuring reliable adhesion through the packaging's lifecycle is crucial, end-of-life processing requires labels to be **releasable under defined conditions** or be compatible with recycling processes of various packaging materials. The two main reasons for the release of labels are the **reuse of packaging** and the **recycling of packaging**.

Regarding the **reuse of packaging**, in some countries, glass and some plastic beverage bottles are offered to the European market in reusable (refillable) form. During the process of cleaning and preparing returned bottles for refilling, the old labels are removed. The removal of labels before refilling serves practical needs.[6] It also allows a 'pooling' of bottles, meaning identical bottles can be used for various beverages and brands, including by multiple economic actors.[7] The success of these

[4] For example, labels containing legally required text and warning symbols on the packaging for hazardous goods are required to remain reliably attached to the packaging.

[5] As stated above, the third option of in-mould labelling is not in the scope of this document as no adhesive is involved.

[6] For example, the old label may no longer be aesthetically pleasing, and it will generally be required to provide a new production date, best-before date, batch code, etc.

[7] By keeping the bottles identical, except for their labels, improvements in return and refill logistics can be realised, which include environmental benefits.

long-standing reuse systems highlights the importance of clearly defined requirements for labelling adhesives, ensuring efficient label removal and compatibility with closed-loop systems between producers and (re)fillers.

Europe boasts a well-developed system for the **recycling of packaging,** including packaging made from glass, metal, paper and various plastic materials. In these systems, it is often beneficial for labels to be **releasable** as this allows a separation of materials where the label and the main packaging component are made of different materials. The separation allows for the high-quality recycling of the main packaging material as well as potentially the separate recycling of the label material.

However, the release of labels before or during recycling operations is not always a requirement; it is also not always practical or beneficial.[8] When the label and the main packaging material are identical (e.g., both made from paper or both made from the same type of plastic) or mutually compatible in recycling, label separation may not be required.[9] Where labels remain attached to the packaging or where they are not separated from the main packaging material after release, the labelling adhesive will be required to be **compatible with recycling** of the main packaging material. The exact requirements for labelling adhesives to support the recycling of packaging depend on the waste management and recycling processes in place.

Waste management and recycling processes

For any waste material to be successfully recycled and returned to the economy, it needs to flow through the three sequential steps of collection, sorting and recycling. The recycling process is mainly driven by the type of main material that the packaging is made of. Collecting and sorting approaches are typically shaped by the national and regional responsible bodies. This section presents a short and simplified description of the most common processes of packaging waste collection, sorting and recycling, with a focus on labelled packaging.

Collection

The collection pathway for discarded packaging depends on its application, type and the circumstances of disposal. The most widely deployed collection schemes are:

- Kerbside (household) collection
- In-store return / drop-off points[10]
- Municipal waste / recycling drop-off points[11]
- Municipal and public waste bins
- Commercial (i.e., back-of-store) and industrial collection

Packaging waste is typically collected with all labels still attached.[12]

Sorting

Depending on the pathway of collection, and depending on the national or regional setup, packaging waste will flow through different steps of sorting. The complexity of the sorting process may range from low to high. For example, the sorting process may be simple where a very selective separate collection or a deposit-refund system has already created a high purity waste stream at

[8] The recycling of metals is, notably, less affected by labels and labelling adhesives and therefore benefits less from a separation than other materials. See below for details.

[9] A separation of labels may still provide benefits also in this case, for example, in the form of removing printing inks from the recycling process together with the released label and thereby preventing colouration in the recycled material.

[10] Including both regular waste collection and deposit-return schemes.

[11] Typically, for glass but also for packaging of hazardous goods.

[12] The experience in the European market is that consumer-removable labels are commonly not removed by consumers.

the source. On the other hand, it may be more complex, especially for kerbside collected comingled recyclable waste streams.

While there remain a certain number of manual sorting operations, **packaging waste is today typically sorted automatically** in Europe. This automated sorting will include a combination of one or more of the following sorting techniques:

- Sieving (for size-based classification)
- Magnetic sorting (for steel packaging)
- Eddy current sorting (for aluminium packaging)
- Wind sifting (for large flexible films)
- Ballistic sorting (to separate rigid from flexible packaging)
- Sensor-based sorting (to differentiate different types of plastics and also paper)[13]

At the end of the sorting process, packaging waste is intended to have been sorted into a suitable **waste fraction**. The process of recycling depends on the waste fraction. The recycling processes for the largest fractions are described in simplified form below.

Simplified description of plastic packaging recycling processes

The aim of any recycling process is the recovery of a **target material** with the highest possible **yield** and **quality**. In the case of recycling of plastic packaging, the target material is generally a specific polymer type, most commonly **PET**, **PE**, **PP** or **PS**.[14]

The dominant recycling process for PET, PE and PP plastic packaging waste today is **mechanical recycling.** The individual process steps can vary between different facilities. In a simplified fashion, it can be described in terms of the sequential steps of:

1. Additional sorting of incoming waste bales[15]
2. **Shredding** of the waste materials into flakes to prepare them for further processing
3. **Metal separation** through magnetic and eddy current sorting
4. **Washing** of the plastic flakes, to remove contamination and, in some cases, labels
5. **Density-based separation** to remove non-target material[16]
6. **(Optional) Separation of light and heavy flakes**, typically to separate washed off label flakes from packaging flakes
7. **(Optional) Sensor-based sorting** to separate flakes that are made of other types of plastics than the target material or of a different colour[17]
8. **Extrusion** of the cleaned and sorted flakes into pellets of recycled plastic, including melt filtration[18] and vacuum degassing[19]

[13] With specific sensors, also metals and glass.

[14] In certain locations, mixtures of PE and PP may be recycled together. This stream is typically called 'mixed polyolefins' or 'mixed PO'.

[15] Similar to the sorting operations in waste sorting centres, including metal separation through eddy current and magnetic sorting.

[16] Typically, a separation is performed between materials which have a density that lets them float in water and materials which sink in water. Specialised and more advanced density sorting techniques have been developed but are not widely employed yet.

[17] Colour sorting may separate printed label flakes from natural packaging flakes but will not allow the separation of unprinted label flakes or a separation of printed label flakes from coloured container flakes.

[18] To remove non-thermoplastic materials and agglomerates.

[19] To remove volatile substances and gasses from the melt.

Simplified description of the recycling process of fibre-based packaging

The process of fibre-based packaging recycling can in a simplified fashion be subdivided into the sequential steps of:

1. **(Re)pulping**, to disintegrate recovered fibre-based products into a fibre slurry (the 'pulp')
2. **Screening** (filtration) of the pulp and optionally **additional cleaning steps** (e.g., flotation deinking and the use of hydrocyclones) to remove non-fibre components and materials[20]
3. **Papermaking**, which converts the cleaned pulp into reels of recycled paper

During the recycling process, side products and/or waste streams are created. The two main streams are: **reject material** collected on filter screens,[21] such as non-paper parts of input materials (metal clips, plastic parts, and films) and other materials such as adhesives if they can be retained on the filter screens,[22] and **wastewater.** Recyclability considerations may include these two side streams as well.

Simplified description of metal packaging recycling

The process of metal packaging recycling can in a simplified fashion be subdivided into the sequential steps of:

1. **(Optional) Additional sorting**, to remove non-metal materials from the input
2. **(Optional, in case of aluminium) Pyrolysis**, to decompose organic materials
3. **Melting/Smelting**, which converts the metal waste into the recycled metal

Simplified description of glass packaging recycling

The process of glass packaging recycling can in a simplified fashion be subdivided into the sequential steps of:

1. **Sorting**, to remove non-glass materials from the input, in particular metals
2. **Calibration**, i.e., crushing of glass waste into a defined shard size
3. **Screening**, to remove non-glass materials
4. **Wind sifting**, to remove labels and other light materials
5. **Sensor-based sorting**, especially sorting by glass colour[23]
6. **Melting**, which converts the glass waste into recycled glass

Recyclability of packaging

Recyclability of packaging is determined by factors that impact process steps in terms of their yield, productivity, and the achievable purity and quality of the output, i.e., the recycled plastic, paper or board, metal, or glass. Any material in the recycling input which is not target material should therefore either be **removed** during the process or be sufficiently **compatible with the recycling process and the target material** to not detrimentally affect processability or recyclate properties.

[20] While this step may remove filmic labels from fibre-based packaging, there is no dedicated step for label removal. Paper labels on fibre-based packaging may be released as such but rather repulp with the main packaging component(s).

[21] Or in other additional cleaning steps, if present.

[22] Reject material is often disposed of. Certain materials, especially ferromagnetic metals, may still be recovered from this waste stream. Efforts are underway to recover plastic films and aluminium foils from beverage carton rejects at scale.

[23] May also include further detection and removal of non-glass material.

Design-for-recycling guidelines for packaging

Over recent years, guidelines have been published which describe design-for-recycling principles and design requirements for recyclable packaging.[24]

These **design guidelines** describe which elements and features of a finished packaging, such as inks, coatings, decorations and adhesives, are considered either preferable, discouraged or unacceptable from the standpoint of recyclability in the considered recycling processes. Design guidance is typically provided in terms of categories of '(fully) compatible', 'limited/conditional compatibility' and 'not compatible'.[25]

Table 1 provides an overview of key entities that publish design guidelines for packaging in Europe and other regions.

Table 1: Non-exhaustive overview of design guidelines for packaging.

	Europe	Other regions
Plastic packaging	CEFLEX[4] CITEO[5] COTREP[3] EPBP[6] FH Campus Wien[7] German Mindeststandard[2] KIDV[8], [9] RECOUP[10] RecyClass[11]	APCO[12], [13] APR[14] Packaging SA[15] WPO[16]
Fibre-based packaging	4EverGreen[17] CEPI[18] CITEO[5] CPI[19] FEFCO[20] FH Campus Wien[7] FTI[21] KIDV[22] German Mindeststandard[2] WRAP[23]	APCO[24] Greenblue[25] Packaging SA[15] WEF[26] WPO[16]
Metal packaging	CITEO[5] FH Campus Wien[7] KIDV[27] German Mindeststandard[2]	APCO[28], [29] Greenblue[30], [31] WPO[16]
Glass packaging	CITEO[5] FH Campus Wien[7] German Mindeststandard[2] KIDV[32]	APCO[33] Greenblue[34] WPO[16]

[24] At the point of writing, no specific design guidance for the compatibility of plastic packaging designs with recycling technologies other than mechanical recycling is available publicly. Novel technologies such as physical (dissolution) recycling or chemical recycling may provide for wider windows of acceptance for certain non-target materials in plastic packaging (waste) but may also have specific requirements of their own. As mechanical recycling will remain a dominant, and often environmentally preferable, technology, and since a designer of packaging generally cannot freely choose or determine which recycling process their packaging will eventually enter, it is unlikely that separate guidance will be developed for physical and chemical recycling technologies, except where a specific separate collection route exists which does not feed into mechanical recycling. The specifications for packaging design in guidelines will most likely consider compatibility with all state-of-the-art recycling processes simultaneously.

[25] Other approaches do exist, for example, listing only disrupting elements (e.g., in the German Mindeststandard[2]) or the use of more than three categories/columns (e.g., in the COTREP guidelines[3]).

Design guidelines may contain generic statements on adhesives and also labelling adhesive-specific requirements. In terms of generic statements, several guidelines recommend the **minimisation of applied adhesive amounts**. The reduction of non-target materials to the functionally required minimum is a general principle in design-for-recycling to maximise yield and minimise burdens on cleaning steps. Table 4 (in the Annex) provides an overview of labelling adhesive-specific statements made in guidelines. These statements generally relate to the **releasability of labelling adhesive applications** and/or their **compatibility with the recycling of the main packaging material**.

Specifications of compatible **types or classes of adhesives** are described in these design guidelines. When suitably designed and applied within certain conditions, adhesives can be **fully compatible** with recycling of plastic packaging as published **adhesive grade-specific approvals** demonstrate.[26]

Evaluation (testing) of packaging recyclability

Several **test methods** have been established to assess the sortability and recyclability of packaging designs and to obtain a general or a product-specific confirmation (and approval) of the **technical recyclability**. These methods typically seek to mirror and simulate the processes of waste sorting centres and recycling[27] facilities (see simplified descriptions above). Test methods typically seek to assess the following characteristics of packaging designs:

1. Sortability
2. Processability
3. Technical properties and visual appearance of the recycled material

To assess sortability and recyclability, in addition to a test method, which provides the procedures and defines what results are to be reported, an **evaluation scheme** is required, which interprets the test data. The two may be contained in a single document or be published separately. The evaluation may also take the form of a committee decision rather than a written procedure or decision tree with specified characteristics.

Table 2 provides an overview of key test methods for packaging recyclability. Test methods that are specifically targeting the release of labels or labelling adhesives themselves are listed in Table 3.

[26] Examples are provided in the material-specific sections below.

[27] At the time of writing, no specific test method for determining the compatibility of plastic packaging designs with recycling technologies other than mechanical recycling is available publicly. Novel technologies such as physical (dissolution) recycling and especially chemical recycling differ strongly in their process from mechanical recycling and thus cannot reasonably be approximated by applying a test method that simulates mechanical recycling.

Table 2: Test methods for determining the sortability and recyclability of flexible plastic packaging (non-exhaustive list).

	Europe	Other regions
Sorting	cyclos-HTP[35] RecyClass[36]	APR[28]
PET bottle recycling	EPBP[37] RecyClass [38]	APR[29]
Other PET rigids	TCEP[30]	
HDPE rigids recycling	RecyClass[39]	APR[31]
PP rigids recycling	RecyClass[40]	APR[32]
PS rigids recycling	RecyClass[41]	
LDPE film recycling	COTREP[42],[43] cyclos-HTP[44] RecyClass[45]	APR[33]
PP film recycling	cyclos-HTP[46] RecyClass[47]	
Paper packaging	4EverGreen[48] UNI[49] ecopaperloop[50] CEPI[51] CTP-REC21[52] PTS-RH 021:2012[53]	FBA[54]
Glass packaging		
Metal packaging		

Table 3: Specific test methods that focus on the behaviour of labelling adhesives (non-exhaustive list).

	Europe	Other regions
PET bottles	RecyClass adhesive test[55] EPBP QT508[56] EPBP QT504[57] EPBP QT507[58] EPBP QT500[59] cyclos-HTP adhesive test[60]	APR PET-S-01 APR PET-S-02 APR PET-S-08 APR PET-S-09 APR PET-S-10
PET trays	petcore Europe test for trays[61]	
HDPE rigids	RecyClass adhesive test[62] cyclos-HTP adhesive test[63] FINAT FTM26[64] KIDV[65] RecyClass washing quick tests[66], [67]	APR HDPE-S-01 APR HDPE-S-02
PP rigids	cyclos-HTP adhesive test[63] FINAT FTM26[64] KIDV[65] RecyClass washing quick tests[66], [67]	

[28] Several documents from the APR-SORT series.

[29] https://plasticsrecycling.org/pet-test-methods

[30] https://www.tcep-europe.org/page/23/modus-operandi-and-testing-procedures

[31] https://plasticsrecycling.org/hdpe-test-methods

[32] https://plasticsrecycling.org/pp-test-methods

[33] https://plasticsrecycling.org/pe-film-test-methods

PS rigids	FINAT FTM26[64] RecyClass washing quick test[68]	
LDPE films	RecyClass washing quick tests[69], [70]	
PP films	RecyClass washing quick tests[69], [70]	
Paper packaging	INGEDE[71], [72], [73] FINAT FTM19[74] TAPPI T 227[75]	TLMI[76], [77], [78], [79]
Glass packaging	FINAT FTM26[64]	
Metal packaging		

State-of-play of labelling adhesives in the recycling of packaging

Labelling adhesives, much like any packaging component, have the potential to affect the efficiency of the recycling process of packaging. With the EU Regulation (EU) 2025/40, the so-called Packaging and Packaging Waste Regulation (PPWR), recyclability will become a legal requirement for packaging placed on the market. In addition, the functioning of a circular economy depends on the high yield and quality of recycling of packaging waste.

To provide effective and clear guidance on the use of labelling adhesives in recyclable packaging, their behaviour during the recycling processes of the various packaging materials needs to be understood. The following sections provide a high-level description of that behaviour and point to aspects which still require a better understanding or a better implementation into testing methods and design guidance.

Labelling adhesives in metal recycling processes

Metal packaging waste, unless governed by a deposit-return system, is generally collected in comingled form with other types of packaging waste. Given that metal packaging is generally sorted by magnetic sorting and/or eddy current sorting, it is unlikely for labels or labelling adhesives to affect sorting of metal packaging waste.

Labelling adhesives are mainly composed of organic polymers and can be expected to be disintegrated or pyrolysed at the temperatures of steel or aluminium recycling. Considering the small weight percentage of labelling adhesives in a packaging design, metal recycling is therefore unaffected by the presence of labelling adhesives[5], [27].

The limited impact of labelling adhesives on metal recycling processes is already well reflected in existing design guidelines. Testing is not required by design guidelines for metal packaging.

Labelling adhesives in glass recycling processes

Being mainly composed of organic polymers, adhesives can be expected to be combusted, and therefore removed, at the temperatures of a glass melting furnace.[34] The recycling of glass itself is generally not impacted by labelling adhesives but yield losses on the glass can occur during the preparatory steps depending on the labelling material[5], [32].

Labelling adhesives in recycling processes of fibre-based packaging

Paper packaging waste may be collected either with other paper waste (e.g., graphical paper) or in a comingled recyclable waste stream. The sorting operations applied to paper waste depend on the collection pathway. In the most prevalent case of labels on paper-based packaging also made of paper, no impact of the label or the labelling adhesive on sorting is expected.[35]

Large volumes of labelled paper-based packaging are recycled every year, notably a large volume of transport packaging. A removal of labelling adhesives during paper recycling may occur by mechanical separation (by screening or other processes such as hydrocyclones) or by removing the

[34] While in principle, the combustion of adhesives may influence the oxidation state of the glass melt, this effect is understood to be readily mitigated in practice, and only excessive amounts of organic materials would cause potential changes to the colour of the glass.

[35] If a plastic label were applied to a fibre-based packaging, it could impact sensor-based sorting operations, where they exist.

adhesive with the process water during papermaking (in the case of water-soluble or water-dispersible adhesive applications[36]).

If adhesive applications are not (fully) removed before or during papermaking, adhesive fragments may become part of the recycled paper. The key criteria for the acceptability of their presence in the formed paper are the optical appearance of the paper and its potential stickiness. If the formed paper exhibits stickiness, defects in the paper reel and/or processing issues such as reel breaks may occur. The impact of adhesive particles in both cases may depend, beyond their intrinsic properties, on the size of the adhesive application within the packaging item.

The impact of labelling adhesives on paper recycling and the specification of labelling adhesives in existing design guidelines are still evolving, as is their consideration in test methods. The amount of labelling adhesive used is determined by the number and size of the labels.

Labelling adhesives in plastic recycling processes

Most plastic packaging waste is collected as part of a comingled recyclable waste collection scheme.[37] This plastic packaging waste passes through the sorting steps applied to comingled recyclable waste streams. Labelling adhesives are generally found not to influence waste sorting operations. As a minority component, labelling adhesives are **not expected to affect size- and shape-based sorting operations**, such as sieving, wind shifting or ballistic sorting steps. As they do not contain metallic parts, labelling adhesives **will also not influence magnetic- or eddy-current-based sorting steps**.[38] Labelling adhesives are applied in **too thin a layer to expect to influence the outcome of near-infrared (NIR) sensor-based sorting**.[39]

In the **preparatory steps** of mechanical recycling, i.e., shredding/grinding, sensor-based (fine) sorting[40] and density-based sorting, labelling adhesives typically do not impact the processing of plastic packaging waste, as evidenced by the large number of specific approvals granted already (see Annex II). This includes pressure-sensitive adhesives, where no significant issues with the **shredding** of plastic packaging waste into flakes have been reported in the approvals.[41] With regard to **density-based sorting** of plastic waste, the weight share of labelling adhesives in a flexible plastic packaging is low, generally far less than 5% by weight. Therefore, even if the density of a labelling adhesive were to differ substantially from that of the plastic material, the adhesive's impact on the overall density of the packaging item would be negligible.

Washing processes for plastic packaging waste are the most severe for PET-based packaging (hot wash as standard, at up to 80 °C, with added caustic soda and detergents). For such conditions, labelling adhesives can be designed to be reliably released without leaving any residues on the PET packaging material.[42]

Other **rigid plastic packaging** is generally washed under milder conditions (lower temperatures, without caustic soda), although for higher quality recyclates, hot washing processes are applied. Flexible plastic packaging is typically washed under mild conditions (cold wash or up to 40 °C, with

[36] See [80] and [81] for details on terminology and technologies.

[37] A notable exception is deposit-return schemes for beverage bottles.

[38] Labelling adhesives will for the same reason also not influence metal-detector-based sorting, which is a more sensitive addition to magnetic or eddy current sorting. Metal-detector based sorting is not yet widely adopted in Europe.

[39] Compare for example the large NIR sorting study conducted by CEFLEX[82].

[40] Same principles as described above apply.

[41] It should be noted that industrial processes such as wet granulation can also be more efficient and effective than laboratory scale processing that is performed in typical test methods. See also [83].

[42] See Annex II for a number of approvals of labelling adhesives for PET bottles.

no added caustic soda or detergents). As the application requirements placed on packaging often require labelling adhesives to be resistant against liquids (such as the filling good), against warm water (such as used in the shower) and against detergents (such as home care and body care products), labelling adhesives can generally not be designed to be dissolved, dispersed or reliably released from packaging under mild washing conditions. However, as shown clearly by a recent study[84], other preparatory steps of recycling, such as **shredding** and **wet granulation**, which exert substantial mechanical force on labels, **can be very effective in releasing labels** already before any washing process occurs. Where such steps occur before washing, they may support the release during washing by already weakening the bond between the label and the packaging body. It is therefore important to consider all preparatory steps of plastic recycling as contributing to the release of labels, rather than only washing steps. **Current quick tests for labels and labelling adhesives may not prescribe wet grinding steps**, thereby potentially leading to results that underestimate the releasability of labelling adhesives due to a lack of mechanical force applied. This was corroborated by recent studies[84], [85].

In the case of **rigid plastic packaging**, the released labels may be separated from the target material stream to achieve a higher quality recyclate. This separation can be achieved by air elutriation (i.e., wind sifting) if label and packaging body are of the same material (Figure 1), and by density separation if label material and packaging body material differ sufficiently in density.

For **flexible plastic packaging,** a separation of released labels made from the same material as the packaging body is generally not feasible,[43] as the label and packaging body will be of similar thickness and often both coloured (Figure 2). Such labels are to be expected to enter the extrusion process together with the main packaging material, even if they are released. A releasable label of the same material[44] will therefore not benefit subsequent recycling steps.

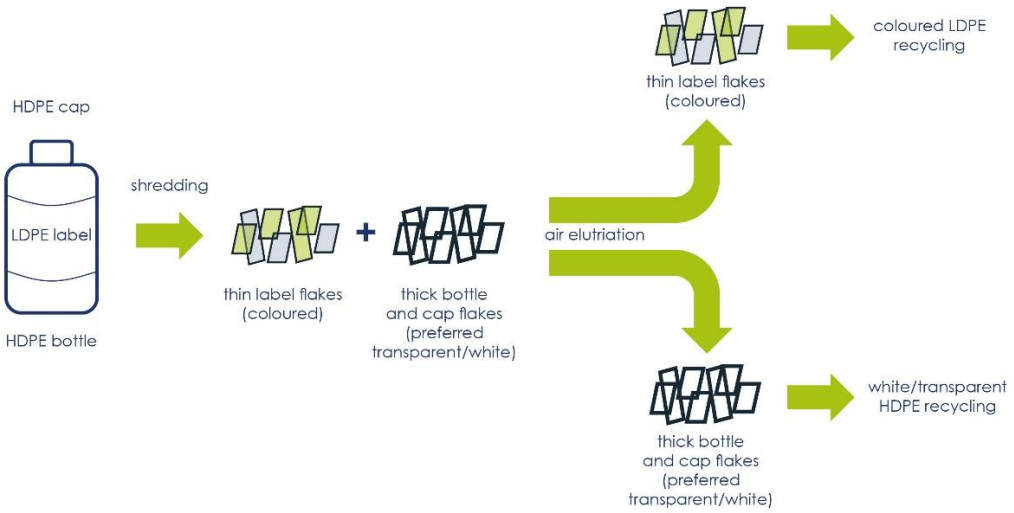

Figure 1: Separation of released same-material labels from rigid plastic packaging.

[43] Labels of opposite floating behaviour in water can be separated by density-based sorting.

[44] Labels of a material different from that of the packaging body, with a sufficiently different material density, may be separable by density separation after release.

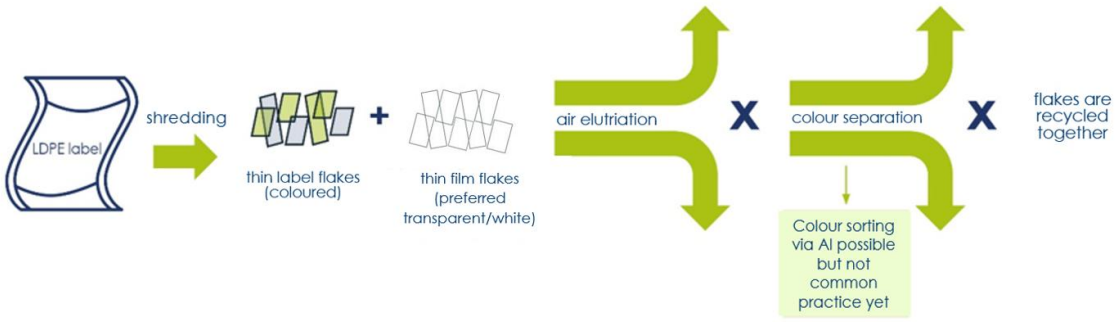

Figure 2: Inability to separate same-material released labels from flexible packaging.

The removal of labels before recycling is, however, not always a requirement. In particular, where the label and the main packaging material are identical or mutually compatible in recycling, a release of the label may not be required.[45]

Adhesives, just like other materials which are not removed before extrusion, are required to not negatively impact the **extrusion process**. Where labelling adhesives enter the extrusion process, they will likely pass the melt filtration and become part of the recycled plastic. The key criteria for the acceptability of the presence of labelling adhesives passing into the recyclate are, first, their impact on the **quality of the recyclate**[46] and, second, their ability to generate **undesirable degradation products**. Adhesives can be designed with suitable thermal resistance so as to not undergo substantial decomposition under the conditions of PE and PP extrusion.[47] While the number of labelling adhesives that have been tested is constantly growing (see Annex II for examples), it cannot automatically be assumed that all labelling adhesives (i.e., all possible chemistries and formulations) will be equally thermally resistant. Where thermal stability is in doubt, testing is recommended.

Recycling of released labels

The release of labels from the main component of packaging waste serves to maximise the value of the recycled material output. As such, the release of labels is not necessarily performed with the ambition to recycle the labels. Whether or not a recycling of released labels occurs differs from case to case. It should be noted that released and separated labels, which are generally thin and light-weight, and therefore contain a substantial weight share of printing ink and adhesive, may not be, on their own, as readily recyclable as the main packaging component(s).

[45] The typical thickness of labelling adhesive applied in between two films is in the range of below 20 micrometres. As this value lies substantially below the mesh size of melt filters used in the extrusion of PE and PP, it can be expected that labelling adhesives, even if they do not melt, **will pass melt filtration,** and become part of the recycled plastic. Depending on their flow behaviour and thermal stability, smaller quantities of labelling adhesives may deposit on the melt filter. Such behaviour would become clearly evident in established test methods. Considering the large number of approvals of labelling adhesives (see Annex II), this can, however, not be said to be a significant general recycling issue brought about by labelling adhesives. Note that the applied test methods, which operate on a laboratory scale, may not separate labels which will be separated under industrial conditions. In such cases, the testing that is performed represents a worst case, where all labelling adhesive enters the extrusion process, whereas this may not be the case in industrial practice.

[46] Mechanical performance, visual appearance and odour.

[47] As evidenced by the growing number of specific approvals (see Annex II). Note that the applied test methods, which operate on a laboratory scale, may not separate labels which will be separated under industrial conditions. In such cases, the testing that is performed represents a worst case, where all labelling adhesive enters the extrusion process, whereas this may not be the case in industrial practice.

FEICA RECOMMENDATIONS

Context

Regarding further development of design for recycling guidelines for packaging, certain elements should first be considered:

- **Recognise the purpose and benefits of labelling adhesives**, in particular their ability to allow the release of labels under defined conditions. The release of labels allows for the removal of incompatible materials, and in particular of colouration, from the recycling process. This benefits the quality of the recycling output, particularly in the case of plastic packaging. Discouraging or excluding the use of labelling adhesives, and thereby labels, may result in a higher level of direct printing or other decoration, whose impact recycling processes will have to manage

- **Distinguish labelling adhesives from other types of adhesives** in design guidelines and test methods, as they fulfil different functions, differ in their properties and are subject to different functional requirements

- **Acknowledge the minimisation approach for adhesive applications and ensure the approach is followed uniformly for any non-target material**, thereby recognising universally valid principles while ensuring that adhesives are not held against a higher standard than other material

- **Ensure that effects are attributed to adhesives only where a clear link can be established**. In particular, in plastics recycling, the formation of residues on melt filters, pressure increases and gas formation during extrusion, formation of gels, optical defects and odour may also all result from other components of plastic packaging. In fibre-based packaging recycling, the formation of 'stickies' can similarly also result from packaging elements other than the (labelling) adhesive. Unless the sample under investigation contains, aside from the labelling adhesive, only materials of known behaviour during recycling, avoid attributing effects to the adhesive without specific evidence

Recommendations: design for recycling guidelines

To further develop **design-for-recycling guidelines for packaging** in terms of clarity, applicability and benefit to the quality of recycled materials, while recognising the importance of labelling adhesives in packaging design and production, the following recommendations are made:

- Acknowledge that the behaviour of labelling adhesives in recycling processes is still under active investigation, and **knowledge is evolving**, as evidenced by studies and approvals occurring at a rapid pace. In view of this evolution of knowledge, care must be taken regarding the use of generalised statements, and **positive test results should be allowed to override guidelines**
    - First, ensure that single cases of impacts on processability or quality of the recyclate are not generalised to labelling adhesives as a whole. Refrain from translating results or requirements from one recycling process to another as there may be significant differences between processes and between materials
    - Second, **if a specific labelling adhesive application or product design can be shown to meet all criteria of an accepted test method and recyclability evaluation scheme, then this finding should override those more general statements**. For instance, if a specification under 'full compatibility' cannot be made in design guidelines for an entire group of labelling adhesives, provide options for obtaining 'full compatibility' for individual products that pass relevant testing[48]

[48] For example, if certain types of labelling adhesive applications overall are to be recognised only as 'limited compatibility' in a guideline, give consideration to recognising labelling adhesive applications that pass relevant testing as 'fully compatible'.

- **Use accurate terminology to improve the discussion of labelling adhesives and their behaviour in recycling processes. By adopting correct and precise terminology, as well as the corresponding recycling processes, the following examples (not exhaustive) are given:**

    - Adhesives should be specified in the form of **required properties of the adhesive application,**[49] rather than in the form of their function (e.g., 'wet labelling adhesive', 'pressure sensitive adhesive'), their chemistry (e.g., 'acrylic', 'polyolefin', 'EVA'), their reactivity (e.g., 'reactive adhesives', 'UV cure adhesives') or their technology (e.g., 'hotmelt', 'solvent-based', 'water-based'). For example, expressing required properties could state the release behaviour in a caustic environment at a certain temperature
    - It should be specified whether the adhesive needs to be water- or alkali-soluble or water- or alkali-releasable under the specified conditions in the recycling process. FEICA has created a supporting document related to the precise use of correct terminology [1]
    - 'Water-based'/'Solvent-based' or 'Reactive'/'curable' or 'thermoplastic'/'non-thermoplastic': neither the water nor the solvent contained in the adhesive's delivery form will be present in packaging waste when it enters recycling,[50] and this property does not predict the properties of the adhesive application in terms of solubility, softening point or surface tack
    - **As a consequence, avoid unnecessary requirements for label release, for example:**
      (1) Do not require labelling adhesives to allow for the release of labels of the same material as the main packaging body unless there is a specific need, e.g., preserving the natural or white colour of a plastic recycling stream. For coloured or directly printed plastic containers, no benefit may be realised from such separation. For fibre-based packaging, the amount of print on the label can be small compared to direct print that is present on paper and cardboard packaging
      (2) Do not require labelling adhesives to allow for the release of labels if the released labels cannot be separated from the recycling stream of the main packaging component.[51] No benefit would be realised from such a release
    - Ensure that the **technical data sheets or safety data sheets of a labelling adhesive** - which describe its delivery form - **are not used as the source of information on the (water) solubility, solvent content, melting behaviour or any other property of the final adhesive application.** The properties of an adhesive may change substantially between its delivery form and its final applied form in the packaging material, and it is the latter which enters recycling. Differences arise, for example, from removal of water, solvents and additives from adhesives during application and drying, as well as due to curing, setting and aging processes
    - **Do not require labelling adhesives to be water-soluble or water-dispersible unless there is a specific reason**, as the successful release of labels from the main packaging component is not based on the dissolution or dispersion of the adhesives into water. The friction generated during shredding/grinding and washing operations can be sufficient to release labels mechanically. Caustic soda and surfactants are utilised to improve the release of labelling adhesives from the main packaging component surface. Notably, labelling adhesives that are not water- soluble or water-dispersible can often be removed together with the label, the result being a lower process water loading

[49] Of the adhesive application as it enters waste management, not of the adhesive as delivered to the user.

[50] As there is no 1:1 or 1:N correlation between the delivery form of the adhesive and its polymer chemistry. For example, acrylic polymers may be applied from solvent or water. The impact on recycling will be determined by the adhesive application as present on the finished packaging.

[51] For example, while the separation of released labels from rigid plastics is routinely performed, such a separation is typically not feasible for labels released from thin, flexible plastic packaging, as both label and main packaging material are of similar thickness. While sensor-based flake colour sorting is possible in principle, it is today not routinely applied.

Recommendations: testing protocols

To further develop **testing protocols for packaging and for labelling adhesives** in terms of clarity, applicability and representation of the industrial reality of recycling, the following recommendations are made:

- **Strive for a harmonisation of testing protocols in Europe** to reduce the number of tests that need to be performed by packaging designers and adhesive producers
- **Ensure that testing protocols adequately represent industrial processes**, so that laboratory test protocols do not indicate issues where none exist on the industrial scale
- **Consider all relevant processes that can release labels, not only washing steps**. Other steps, such as shredding and grinding, can already release many labels from the main packaging component[84]. Alternative cleaning processes, such as dry cleaning, can also remove labels
- **Provide detailed descriptions of all steps that can release labels** to ensure that the mechanical forces (e.g., shear, agitation) which a test sample experiences are reproducible and consistent with industrial reality. When specifying shredding and grinding, provide details on geometry, speed and the use of wet processing. For washing processes, provide detailed descriptions of vessel geometry, stirrer geometry, loading and filling level of the vessel and speed of agitation

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Annex I. Labelling adhesive-related statements made in design guidelines

Table 4: Labelling adhesive-related statements found in design guidelines (excerpt).

Entity and material	Fully compatible	Limited compatibility	Low or not compatible
RecyClass – natural LDPE films*	Water soluble or water-releasable at less than 40°C		Adhesives non-soluble in water or non-releasable in water at less than 40°C
RecyClass – coloured LDPE films*	Water soluble or water-releasable at less than 40°C		Adhesives non-soluble in water or non-releasable in water at less than 40°C
COTREP – PE flexible*	Water releasable at room temperature and without residue on pack [Label:] PE with a water releasable adhesive (without covering conditions); Paper with a water releasable adhesive; PE with a not water releasable adhesive; Plastic d>1 with a water releasable adhesive (ex. PET, PETG, PS)	[Label:] Paper with a not water releasable adhesive	Not water releasable at room temperature [Label:] Other plastics d>1 with a not water releasable adhesive
CEFLEX – PE films			
FH Campus Wien – PE films transparent (Version 5)	adhesive application removable in cold wash (up to 40°C)		adhesive application not removable in cold wash (up to 40°C)
FH Campus Wien – PE films coloured (Version 5)	adhesive application removable in cold wash (up to 40°C)		adhesive application not removable in cold wash (up to 40°C)
CITEO – PE flexible	Water releasable at room temperature and without residue on the packaging		Non-water releasable at room temperature
RecyClass – natural PP films*	Water soluble or water-releasable at less than 40°C		Adhesives non-soluble in water or non-releasable in water at less than 40°C
RecyClass – coloured PP films*	Water soluble or water-releasable at less than 40°C		Adhesives non-soluble in water or non-releasable in water at less than 40°C
COTREP – PP and PE/PP flexible*			
CEFLEX – PP films			
FH Campus Wien – PP films transparent (Version 5)	adhesive application removable in cold wash (up to 40°C)		adhesive application not removable in cold wash (up to 40°C)
FH Campus Wien – PP films coloured	adhesive application removable in cold wash (up to 40°C)		adhesive application not removable in cold wash (up to 40°C)

RecyClass – natural and white HDPE containers*	Water soluble adhesive (@ less than 40°C); Water releasable adhesive (@ less than 40°C)		Non-water soluble adhesive (@ less than 40°C); Non-water releasable adhesive (@ less than 40°C)
RecyClass – coloured HDPE containers*	Water soluble adhesive (@ less than 40°C); Water releasable adhesive (@ less than 40°C)	Non-water soluble or non-releasable adhesive approved by RecyClass in combination with filmic PO labels; Acrylic emulsion; Hotmelt rubber	Non-water soluble adhesive (@ less than 40°C); Non-water releasable adhesive (@ less than 40°C)
COTREP – HDPE bottles*	Water releasable at room temperature and without residue on pack [Label:] PE with a water releasable adhesive (without covering conditions); PP, OPP with a water releasable adhesive; Paper with a water releasable adhesive; Paper wrapping with a line of not water releasable adhesive; PE with a not water releasable adhesive; Plastic d>1 with a water releasable adhesive (ex. PET, PETG, PS)	[Label:] PSL Paper with a not water releasable adhesive; PP, OPP with not water releasable adhesive	Not water releasable at room temperature [Label:] Other plastics d>1 with a not water releasable adhesive
COTREP – PE rigids*	Water releasable at room temperature and without residue on pack [Label on pack or cap:] PE with a water releasable adhesive (without covering conditions); PP, OPP with a water releasable adhesive; Paper with a water releasable adhesive; Paper wrapping with a line of not water releasable adhesive; PE with a not water releasable adhesive; Plastic d>1 with a water releasable adhesive (ex. PET, PETG, PS) [Label on mono or multi lid d>1:] Paper with a water releasable or not adhesive; Plastic d>1 (ex. PET, PETG, PS) with a water releasable or not adhesive; PP, OPP, PE with a water releasable adhesive [Label on lid d<1 in PE, PP, EVOH, surlyn, coating; peelable:] PP, OPP, PE with a water releasable or not adhesive; Paper with a water releasable adhesive; Plastic d>1 (ex. PET, PETG, PS) with a water releasable adhesive	[Label on pack or cap:] PSL Paper with a not water releasable adhesive; PP, OPP with a not water releasable adhesive	Not water releasable at room temperature [Label on pack or cap:] Other plastics d>1 with a not water releasable adhesive [Label on mono or multi lid d>1:] PP, OPP, PE with a not water releasable adhesive [Label on lid d<1 in PE, PP, EVOH, surlyn, coating; peelable:] Paper with a not water releasable adhesive; Plastic d>1 (ex. PET, PETG, PS) with a water releasable adhesive

FH Campus Wien – PE (HDPE) containers and tubes transparent (Version 5)	adhesive application removable in cold wash (up to 40°C)		adhesive application not removable in cold wash (up to 40°C)
FH Campus Wien – PE (HDPE) containers and tubes coloured and white (Version 5)	adhesive application removable in cold wash (up to 40°C)		adhesive application not removable in cold wash (up to 40°C)
RECOUP – HDPE (2022)	water releasable in ambient conditions	water soluble up to 80°C	not removable in water
CITEO – HDPE rigids	Water releasable at room temperature and without residue on the packaging		Non-water releasable at room temperature
RecyClass – natural and white PP containers*	Water soluble or water releasable adhesive (@ less than 40°C)		Non water soluble or non water releasable adhesives
RecyClass – coloured PP containers and tubes*	Water soluble or water releasable adhesive (@ less than 40°C)	Non-water soluble or non-releasable adhesive approved by RecyClass in combination with filmic PO labels	Non water soluble or non water releasable adhesives
COTREP – PP bottles*	Water releasable at room temperature and without residue on pack [Label:] PP, OPP with a water releasable adhesive (without covering conditions); PE with a water releasable adhesive; Paper with a water releasable adhesive; Paper wrapping with a line of not water releasable adhesive; PP, OPP with a not water releasable adhesive; Plastic d>1 with a water releasable adhesive (ex. PET, PETG, PS)	[Label:] PSL Paper with a not water releasable adhesive PE with a not water releasable adhesive	Not water releasable at room temperature [Label:] Other plastics d>1 with a not water releasable adhesive
COTREP – PP rigids*	Water releasable at room temperature and without residue on pack [Label on pack or cap:] PP, OPP with a water releasable adhesive (without covering conditions); PE with a water releasable adhesive; Paper with a water releasable adhesive; Paper wrapping with a line of not water releasable adhesive; PP, OPP with a not water releasable adhesive; Plastic d>1 with a water releasable adhesive (ex. PET, PETG, PS) [Label on mono or multi lid d>1:] Paper with a water releasable or not adhesive;	[Label on pack or cap:] PSL Paper with a not water releasable adhesive; PE with a not water releasable adhesive	Not water releasable at room temperature [Label on pack or cap:] Other plastics d>1 with a not water releasable adhesive [Label on mono or multi lid d>1:] PP, OPP, PE with a not water releasable adhesive [Label on lid d<1 in PE, PP, EVOH, surlyn, coating; peelable:] Paper with a not water releasable adhesive; Plastic d>1 (ex. PET, PETG, PS) with a not water releasable adhesive

	Plastic d>1 (ex. PET, PETG, PS) with a water releasable or not adhesive; PP, OPP, PE with a water releasable adhesive [Label on lid d<1 in PE, PP, EVOH, surlyn, coating; peelable:] PP, OPP, PE with a water releasable or not adhesive; Paper with a water releasable adhesive; Plastic d>1 (ex. PET, PETG, PS) with a water releasable adhesive		
FH Campus Wien – PP containers and tubes transparent (Version 5)	adhesive application removable in cold wash (up to 40°C)		adhesive application not removable in cold wash (up to 40°C)
FH Campus Wien – PP containers and tubes coloured and white (Version 5)	adhesive application removable in cold wash (up to 40°C)		adhesive application not removable in cold wash (up to 40°C)
RECOUP – PP (2022)	water releasable in ambient conditions	water soluble up to 80°C	not removable in water
CITEO – PP rigids	Water releasable at room temperature and without residue on the packaging		Non-water releasable at room temperature
RecyClass – natural and white PS containers*	Water soluble adhesive (@ less than 40°C); Water releasable adhesive (@ less than 40°C)		Non-water soluble adhesive (@ less than 40°C); Non-water releasable adhesive (@ less than 40°C)
RecyClass – coloured PS *	Water soluble adhesive (@ less than 40°C); Water releasable adhesive (@ less than 40°C)		Non-water soluble adhesive (@ less than 40°C); Non-water releasable adhesive (@ less than 40°C)
COTREP – PS rigids*			A decorative element with an adhesive that is not released during washing must not exceed the 'PS+decorative element' density value of 1.1.
FH Campus Wien – PS containers (Version 5)	adhesive application removable in cold wash (up to 40°C)		adhesive application not removable in cold wash (up to 40°C)
RECOUP – PS (2022)	water releasable in ambient conditions	water soluble up to 80°C	not removable in water
RecyClass – transparent clear & light blue PET bottles*	100% removable adhesives leaving no adhesive residuals on flakes at 70°C	100% removable adhesives leaving no adhesive residuals on flakes at 85°C	All other adhesives
EPBP – transparent clear & light blue PET bottles	alkali/water releasable at 60-80°C without reactivation		alkali/water soluble, non-releasable or releasable above 80°C

COTREP – clear PET bottles*	Water releasable adhesive at 60-80°C in alkaline conditions and residue-free [Label:] Plastic d<1 (ex. PP, OPP, PE) with a water releasable adhesive**; Paper with a water releasable adhesive**; Plastic d<1 (ex. PP, OPP, PE) wrapping with a line of not water releasable adhesive	[Label:] Paper wrapping with a line of not water releasable adhesive	Not water releasable adhesive at 60-80°C in alkaline conditions [Label:] Paper with a not water releasable adhesive; Plastic d<1(ex. PP, OPP, PE) with a not water releasable adhesive
FH Campus Wien – PET bottles transparent and light blue (Version 5)	in caustic soda solution – hot wash removable adhesive applications (at 60 - 80°C)		not in caustic soda solution – hot wash removable adhesive applications (at 60 - 80°C)
RECOUP – PET bottles (2022)	removable water releasable in 60–80°C		not removable in water
Mindeststandard (2023) – transparent PET bottles and other transparent rigid PET packaging			Non-removable washable adhesive applications (in water or alkaline at 80° C)
RecyClass – transparent coloured PET bottles*	Alkali/water releasable adhesive at 60-80°C without reactivation		Alkali/water soluble adhesive; Alkali/water non-soluble or non-releasable adhesive at 60-80°C
EPBP – transparent coloured PET bottles	alkali/water releasable at 60-80°C without reactivation		alkali/water soluble, non-releasable or releasable above 80°C
COTREP – coloured PET bottles*	Water releasable adhesive at 60-80°C in alkaline conditions and residue-free [Label:] Plastic d<1 (ex. PP, OPP, PE) with a water releasable adhesive**; Paper with a water releasable adhesive**; Plastic d<1 (ex. PP, OPP, PE) wrapping with a line of not water releasable adhesive	[Label:] Paper wrapping with a line of not water releasable adhesive	Not water releasable adhesive at 60-80°C in alkaline conditions [Label:] Paper with a not water releasable adhesive; Plastic d<1 (ex. PP, OPP, PE) with a not water releasable adhesive
FH Campus Wien – PET bottles coloured (Version 5)	in caustic soda solution – hot wash removable adhesive applications (at 60 - 80°C)		not in caustic soda solution – hot wash removable adhesive applications (at 60 - 80°C)
EPBP – opaque white PET bottles	alkali/water soluble and alkali/water releasable at 60-80°C without reactivation		alkali/water soluble, non-releasable or releasable above 80°C
EPBP – opaque not white PET bottles	alkali/water releasable at 60-80°C without reactivation		alkali/water soluble, non-releasable or releasable above 80°C
COTREP – coloured PET rigids*	Water releasable at 60-80°C in alkaline conditions and residue-free [Label on mono multi d<1, without metal, lid:] Plastic d<1		Not water releasable at 60-80°C in alkaline conditions [Label on mono multi d<1, without metal, lid:] Paper

	(ex. PP, OPP, PE) with a water releasable or not adhesive; Paper with a water releasable adhesive		with not water releasable adhesive
CITEO – clear, coloured, opaque PET	Water releasable at 60-80°C, in alkaline conditions (with soda) and without leaving residues on the packaging		Non-water releasable at 60-80°C in alkaline conditions (with soda)
RecyClass – transparent clear PET trays*	100% removable adhesives leaving no adhesive residuals on flakes at 70°C	100% removable adhesives leaving no adhesive residuals on flakes at 85°C	All other adhesives
Petcore/TCEP – clear transparent PET trays (Jan 2020)	adhesives with 100% removing ratio and no adhesive residuals on flakes @ 70°C testing temperature	adhesives with 100% removing ratio and no adhesive residuals on flakes @ 85°C testing temperature	All other adhesives
COTREP – clear PET rigids*	[Label on body or cap:] Paper partial with a water releasable adhesive; PP, OPP, PE partial with a water releasable adhesive [Label on not printed transparent PET lid:] Paper partial with a water releasable adhesive; PP, OPP, PE partial with a water releasable adhesive [Label on mono multi d<1, without metal, lid:] Paper partial with a water releasable adhesive	[Label on body or cap:] Paper total with a water releasable adhesive; PP, OPP, PE total with a water releasable adhesive [Label on not printed transparent PET lid:] Paper total with a water releasable adhesive; PP, OPP, PE total with a water releasable adhesive [Label on mono multi d<1, without metal, lid:] Paper total with a water releasable adhesive	[Label on body or cap:] Paper, PP, OPP, PE with not water releasable adhesive [Label on not printed transparent PET lid:] Paper, PP, OPP, PE with not water releasable adhesive Label on mono multi d<1, without metal, lid:] Paper with not water releasable adhesive
COTREP – clear PET/PE rigids*			
FH Campus Wien – PET trays (Version 5)	hot wash removable adhesive applications (at 60 - 80°C)		adhesive applications that cannot be removed in a hot wash (at 60 - 80°C)
RECOUP – PET trays (2022)	removable water releasable in 60–80°C		not removable in water
RecyClass – HDPE crates and pellets*	Water soluble adhesive (@ less than 40°C); Water releasable adhesive (@ less than 40°C)	Non-water soluble or non-releasable adhesive approved by RecyClass in combination with filmic PO labels	Non-water soluble adhesive (@ less than 40°C); Non-water releasable adhesive (@ less than 40°C)
RecyClass – PP crates and pellets*	Water soluble or water releasable adhesive (@ less than 40°C)	Non-water soluble or non-releasable adhesive approved by RecyClass in combination with filmic PO labels	Non water soluble or non water releasable adhesives
RecyClass – EPS fish boxes*	[...] water soluble or water releasable adhesive (at 40 °C)		

RecyClass – EPS white goods*			
FH Campus Wien – beverage cartons (Version 5)			
FH Campus Wien – paper/paperboard packaging (Version 5)	water-soluble adhesives; Hotmelt application of 2mm x 2 mm	Pressure-sensitive adhesives	
4evergreen	Pressure sensitive hotmelt [with positive test result]		
KIDV – Recycle Check paper and carton (2021)	Wate soluble; Shape retaining adhesives (cold-set, curing)	Shape changing adhesives (hot-melt*, pressure-sensitive)	
CITEO – paper/cardboard	Screenable/Removable (e.g. non-PSA hotmelt adhesives); Dispersible	Partially dispersible and/or non-screenable (e.g. PSA)	
Mindeststandard (2023) – Fibre-based packaging			Water-insoluble or non-redispersible adhesive applications and polymeric thermoplastic dispersion coatings, unless it is proven that they do not lead to incompatibilities in the recyclate. The exceptions granted for hotmelt adhesives in the ERPC Scorecard apply (softening temperature of the adhesive (according to R&B): ≥ 68°C, layer thickness (non-reactive adhesives): ≥ 120 µm, layer thickness (reactive adhesives): ≥ 60 µm, horizontal dimension of the adhesive application (in either direction): ≥ 1.6 mm).
FH Campus Wien – glass packaging (Version 5)		[Labels:] Permanently attached plastic labels	[Labels:] permanently adhesive and large-area plastic labels
CITEO – glass packaging			Ultra-adhesive (e.g. some PSA)
FH Campus Wien – tin plate packaging (Version 5)			
FH Campus Wien – aluminium packaging (Version 5)			

*) as of March 2024; **) based on EPBP QT508

Annex II. Specific approvals of labelling adhesives under the RecyClass and APR systems

As of March 2024.

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Contact

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FEICA Regulatory Affairs:
Jana Cohrs (j.cohrs@feica.eu)

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FEICA - Association of the European Adhesive & Sealant Industry
Rue Belliard 40 box 10, 1040 Brussels, Belgium
Tel: +32 (0)2 896 96 00
info@feica.eu | www.feica.eu

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