CIRCULAR PACKAGING DESIGN GUIDELINE

DESIGN RECOMMENDATIONS FOR RECYCLABLE PACKAGING

Version 02
July 2019
“It is up to us to achieve global sustainability goals!

Through international networking and harmonization of design criteria, we can promote sustainable packaging development and circularity.”

Johannes Bergmair, General Secretary of the World Packaging Organisation (WPO)
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### LIST OF ABBREVIATIONS

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<th>Description</th>
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<tr>
<td>AA blocker</td>
<td>acetaldehyde blocker</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>aluminium oxide</td>
</tr>
<tr>
<td>A-PET</td>
<td>amorphous polyethylene terephthalate</td>
</tr>
<tr>
<td>APR</td>
<td>The Association of Plastic Recyclers</td>
</tr>
<tr>
<td>CaCO₃</td>
<td>calcium carbonate (lime)</td>
</tr>
<tr>
<td>CO₂</td>
<td>carbon dioxide</td>
</tr>
<tr>
<td>C-PET</td>
<td>crystalline polyethylene terephthalate</td>
</tr>
<tr>
<td>CPI</td>
<td>Confederation of Paper Industries</td>
</tr>
<tr>
<td>DMD</td>
<td>date of minimum durability</td>
</tr>
<tr>
<td>EPS</td>
<td>expanded polystyrene</td>
</tr>
<tr>
<td>EPBP</td>
<td>The European PET Bottle Platform</td>
</tr>
<tr>
<td>ERPC</td>
<td>European Recovered Paper Council</td>
</tr>
<tr>
<td>EuPIA</td>
<td>European Printing Ink Association</td>
</tr>
<tr>
<td>EVA</td>
<td>ethylene vinyl acetate</td>
</tr>
<tr>
<td>EVOH</td>
<td>ethylene vinyl alcohol copolymer</td>
</tr>
<tr>
<td>FPO</td>
<td>filled polyolefin</td>
</tr>
<tr>
<td>HDPE</td>
<td>high-density polyethylene</td>
</tr>
<tr>
<td>INGEDE</td>
<td>Internationale Forschungsgemeinschaft Deinking-Technik e. V.</td>
</tr>
<tr>
<td>LDPE</td>
<td>low-density polyethylene</td>
</tr>
<tr>
<td>LLDPE</td>
<td>linear low-density polyethylene</td>
</tr>
<tr>
<td>MDPE</td>
<td>medium-density polyethylene</td>
</tr>
<tr>
<td>NIR</td>
<td>near-infrared (spectrometer)</td>
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<tr>
<td>OPP</td>
<td>oriented polypropylene</td>
</tr>
<tr>
<td>PA</td>
<td>polyamide</td>
</tr>
<tr>
<td>PC</td>
<td>polycarbonate</td>
</tr>
<tr>
<td>PCEP</td>
<td>Polyolefin Circular Economy Platform</td>
</tr>
<tr>
<td>PE</td>
<td>polyethylene</td>
</tr>
<tr>
<td>PET</td>
<td>polyethylene terephthalate</td>
</tr>
<tr>
<td>PETG</td>
<td>polyethylene terephthalate glycol</td>
</tr>
<tr>
<td>PLA</td>
<td>polylactic acid</td>
</tr>
<tr>
<td>PP</td>
<td>polypropylene</td>
</tr>
<tr>
<td>PS</td>
<td>polystyrene</td>
</tr>
<tr>
<td>PVC</td>
<td>polyvinyl chloride</td>
</tr>
<tr>
<td>PVDC</td>
<td>polyvinylidene chloride</td>
</tr>
<tr>
<td>SiOx</td>
<td>silicon oxide</td>
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REVISIONS

The Circular Packaging Design Guideline was reviewed. Following amendments are included in version 02:

- Updating the legal framework based on new EU regulations
- Further additions to the Design recommendations for recyclable packaging
- Removal of the criterion minimum dimension of plastic sheets
- Additions to the Recommendations for Packaging Aids (Plastic Packaging)
- Extension of the chapter on paper and cardboard
- Maximum permitted content of EVOH is 5 wt% for polyolefin packaging
- PET with up to 5 wt% PA is classified as recyclable
- Collection of opaque PET bottles and non-beverage bottles PET (if A-PET) in Austrian recycling system
OVERVIEW AND SCOPE OF APPLICATION

Packaging fulfils many essential roles; from protection, storage and transport functions to aspects such as easier use and the provision of product information. These functions essentially contribute to sustainability, as packaging prevents damage to sensitive products and loss of food. In addition, the environmental impact of producing the packaged good is, in many cases, considerably greater than the impact of producing the packaging itself. In other words, both sustainable packaging design, as well as the protection of products, must be given top priority.

Even though packaging can contribute to a sustainable economy, as a consumer good, its public reputation tends to be negative. Furthermore, problems such as littering, the generation of emissions and use of resources for packaging have been addressed. In recent years, a growing demand for greater sustainability in packaging design has definitely been apparent.

Sustainable packaging incorporates maximum functionality and the highest possible protection of products, while keeping its ecological footprint to a minimum and enabling maximum circularity. Circular aspects of packaging have become especially important, as the European Union, in the context of the Circular Economy Package, advocates greater resource efficiency and reuse of products, considerably higher material recycling rates and the use of recycling material as a secondary raw material. The Circular Economy Package also includes the demand for a reduction of food waste, the use of non-toxic substances, as well as the increased use of bio-based raw materials. A circular approach to materials will thus protect the environment while reducing emissions.

However, to achieve higher material recycling rates we need to rethink the design of packaging to improve its future recyclability while guaranteeing its functionality. In addition, we need to open up markets for the use of the secondary raw materials that are produced, which must be of a quality that enables full substitution for virgin material of the same type.

The Circular Packaging Design Guideline aims to provide recommendations for the recyclable design of packaging systems, and addresses all actors along the entire value chain. The Guideline will be updated continuously and amended in response to changes in collection, sorting and recycling technologies, as well as future material developments. Its text should by no means be regarded as an obstacle to innovation (e.g. bio-based materials, new barrier materials etc.), on the contrary, new technologies can contribute to improving ecological performance and need to be analysed separately.

Information from the following sources has been used as a basis for drawing up the present version of this Guideline.

- Design for Recycling Guidelines (Plastics Recyclers Europe)
- Verification and examination of recyclability (cyclos-HTP)
- Design Guidelines for PET bottles (European PET Bottle Platform)
- Recyclability by Design (Recycling of Used Plastics Limited: RECOUP)
- Design for Recycling (Packaging SA)
- APR Design Guide for Plastics Recyclability (The Association of Plastics Recyclers)
In addition, an expert council was involved for consultation. Even though the guideline focuses on the situation in Austria, it can also be used in Germany and other countries with similar waste management systems. An important goal is the international harmonisation of packaging design for recycling to increase the amount recyclable packaging material. Nonetheless, it is always necessary to consider the specific conditions in different regions. Therefore, work continues on the internationalisation of the Circular Packaging Design Guideline. Furthermore, testing procedures for examination of the recyclability of specific packaging materials already exist, inter alia, for PET bottles (European PET Bottle Platform) and plastic packaging in general (Association of Plastic Recyclers).

In addition to circular design, sustainability with regard to packaging also includes several other relevant aspects, which, even though they do not play a key role in this Guideline, are worthy of mention in order to present a complete picture. The Circular Packaging Design Guideline is structured as follows:

| Fundamentals of sustainable packaging design |
| Assessment of recyclable packaging |
| Holistic approach |

| Design recommendations | Material combinations |
| e.g., avoiding small parts and uncommon materials | e.g., no EVOH with PET |

| Plastics (PET, PP, PE) | Uncommon and compostable plastics | Composite materials with plastic constituents | Paper and board | Glass | Tinplate and aluminium |
FUNDAMENTALS
SUSTAINABLE PACKAGING DESIGN

The circular economy and its holistic approach to the product involved, which takes material recovery into account, presents a new challenge for product design and packaging conception. Packaging must meet manifold requirements and cover a variety of functions, and combine maximum functionality and protection of goods on the one hand with minimal ecological impacts on the other. In order to achieve sustainability in packaging, i.e. ecological value added over the entire life cycle, Verghese (2012) defined four basic design principles:

**Effective**

Packaging needs to be fit for purpose and add as much value as possible with regard to both the consumer and the product (e.g. retain shelf life). In order to assess effectiveness, detailed knowledge about the properties of the packaged good is required. The packaging must provide adequate protection against adverse environmental influences such as mechanical stress, oxygen, humidity or light. In addition, the packaging must ensure easy handling by the final consumer to the greatest possible extent. Finally, it can be empirically established that packaging has an influence on product loss.

**Efficient**

The use of raw materials, emissions, energy, and the generation of waste need to be minimised throughout the entire life cycle. Life-cycle assessment (LCA) is the standard instrument for assessing the efficiency and thus the ecological sustainability of packaging. It takes into account the environmental impact of the packaging over its entire life cycle. The life cycle starts with raw material extraction, and ends with the disposal of the packaging. The amount of CO₂ equivalents that are emitted throughout the entire life cycle is a well-known parameter for assessing the ecological impact of the packaging.

**Safe**

Safe packaging is designed to minimise health and safety risks to human beings and ecosystems throughout its life cycle. Regarding admissibility for food contact, the applicable legal requirements need to be met, and additional aspects such as consumer safety, environmental protection and tamper evidence need to be considered.

**Cyclic**

Cyclic packaging is designed to maximise the recovery of materials used. This is aimed at longevity of the life cycle, full substitution for virgin materials of the same type (closed-loop recycling) or use of renewable materials. Circular packaging design refers to the principle of cyclic approaches. Products should be designed and produced in a way which, after the period of use, permits the recovery, to a high degree, of the raw materials to be employed as secondary raw materials, the reuse of the packaging, or the manufacture of the packaging from renewable raw materials.
Recyclability in a circular economy

‘Design for recycling’ of packaging is a subarea of circular design and describes whether a packaging is fit for correct handling in a sorting process and for material recovery by means of recycling.

‘Design from recycling’ refers to the second sub-aspect of the circular approach. Here, the focus is on use of recycling material that can be used as a full substitute for virgin material of the same type. For this purpose, markets need to be opened up that permit the fully functional use of the secondary raw materials that have been recovered. In addition, regarding closed-loop packaging design (e.g. PET beverage bottle recycling), it is particularly relevant to take specific material properties into account in order to avoid possible manufacturing defects.

It is mainly due to legal requirements that the present focus of ecological sustainability in the packaging industry is on closing material and product loops. The Circular Economy Package of the EU that entered into force in July 2018 includes provisions for enhancing circular approaches to raw materials at the European level. It will bring about modifications of the EU Directive on packaging and packaging waste (94/62/EC), in combination with the Directive on landfill of waste (1999/31/EC), as well as the superordinate Waste Framework Directive (2008/98/EC). The Package also includes a specific paper on plastics – the European Strategy for Plastics in a Circular Economy (‘EU Plastics Strategy’), which focuses on increasing the recycling rates for all packaging materials, and on intensifying extended producer responsibility schemes, as well as limitations on marketing individual plastic articles. Producers of plastic packaging are facing important challenges, since mandatory recycling rates will be raised from 22.5% to 55% until 2030 (2018/852/EC amending Directive 94/62/EC).

The Single-Use Plastics Directive (2019/904/EC) bans selected single-use plastic products for which alternatives exist on the market (e.g. straws or cotton bud sticks). It also includes measures to reduce consumption of food containers and beverage cups, and prescribes a 90% separate collection target for plastic bottles by 2029 (77% by 2025). Caps and lids are to remain attached for all plastic beverage containers up to 3 litres by the year 2024. EPS take-out food packaging will be subject to market restrictions.

The diagram below provides an overview of the focuses of the Circular Economy Package (as at July 2019). The Package aims to reduce waste and improve preparation for reuse and recycling.
THE WASTE HIERARCHY

The waste hierarchy covers the fundamental aspects of an all-encompassing approach to sustainable packaging design. Its legal basis focuses on an order of preference regarding levels of protection of resources.

As a rule, solutions that avoid packaging waste – e.g. reusable packaging – are to be given priority. However, in all cases, the option with the best ecological result with regard to the entire life cycle should be chosen. Certain solutions may therefore deviate from the waste hierarchy.

Sustainability assessment of packaging solutions shall be based on up-to-date studies (data not older than 5 years), considering current regional waste management practices.

This Guideline primarily focuses on recyclability. However, the other aspects of the waste hierarchy also need to be taken into account when designing packaging.
ASSESSMENT OF RECYCLABLE PACKAGING

The term ‘recyclable packaging’ refers to packaging systems that enable industrial-scale recycling. In this context, the current state of recovery structures in the regions in question needs to be taken into account. For instance, in Austria PET bottles are recyclable as a recovery system is currently in place that permits the full reprocessing of PET for manufacturing food-contact packaging and for the full substitution for virgin materials of the same type. PP bottles for food packaging are also recyclable, but for legal reasons, the recycled PP can only be used for non-food-contact products, such as flower pots or detergent packaging. Generally, the recovery process must result in a product that can fully substitute virgin material of the same type, i.e. the secondary material must meet the quality and safety standards that permit its replacement of primary material.

Recycling in the sense of this Guideline does NOT include energy recovery, chemical recycling and composting.

Whenever packaging is classified as recyclable, this refers to a clearly defined geographical area and period of application. A PET bottle that is regarded as recyclable in Austria would be classified as non-recyclable in a country where the necessary collection and recovery systems do not exist.

In order to improve recyclability, the entire packaging system needs to be assessed. For this purpose, the packaging can be analysed in either qualitative or quantitative terms.

The table below outlines the differences between the two methods.

CURRENT METHODS OF RECYCLABILITY ASSESSMENT

<table>
<thead>
<tr>
<th>Type of assessment</th>
<th>Description</th>
<th>Type of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative</td>
<td>Calculation of the mass fraction of the packaging that, after the recovery process, can substitute virgin material of the same type.</td>
<td>Mass percentage (wt%)</td>
</tr>
<tr>
<td>Qualitative</td>
<td>Questionnaire-based assessment methods that survey product properties such as material composition, colour or full emptiability.</td>
<td>Scale (e.g. from A to F; or categories such as very good/good/limited/no recyclability)</td>
</tr>
</tbody>
</table>

In the case of a quantitative assessment, material loss due to sorting and recycling processes must be taken into account. In addition, extensive knowledge on specific sorting and recovery procedures is required.

In a qualitative assessment, data on the complete packaging are gathered, mostly by means of questionnaires, and assessed for subsequent assignment to a category.
HOLISTIC APPROACH

As described in the previous section, the assessment procedures that are currently available on the market differ with regard to interpretation and degrees of specialisation. Which system is better for a user depends on the individual case. One must bear in mind that the possibility of conflicting goals (e.g. recyclability v. efficient use of resources) requires an all-encompassing approach in order to enable sustainable product development. For instance, a packaging can have maximum recyclability if a certain barrier is eliminated — which, however, poses the risk of premature spoilage and thus negative environmental impacts.

When assessing a product’s packaging the following aspects thus need to be considered:

**Holistic approach to packaging design**

- Efficient use of materials and resources
- Technical feasibility
- Suitability for industrial packaging facilities and processes
- Product protection
- Consumer convenience
- Information for consumers

**Recyclability**

- Collection systems differing according to country and region
- State-of-the-art sorting technologies for the packaging
- State-of-the-art processing technologies for the (material) recycling process
- Market potential of the resulting secondary raw materials and their full substitution for virgin material of the same type

Packaging design can only contribute to sustainable development provided that all relevant influencing factors are taken into account along the entire supply chain, and that an all-encompassing ecological approach is pursued.
DESIGN

RECOMMENDATIONS
The diagram below illustrates the key steps in the design process of sustainable, recyclable packaging.

1. **Composition of the packaging system**
   - Primary packaging and complete packaging (e.g., bottle, label, closure...)
   - Secondary packaging (e.g., paperboard tray)
   - Tertiary packaging (e.g., transport unit)

2. **Collection and recovery requirements**
   - Quality and safety assessment
   - Existing secondary raw materials market

3. **Inspection of national collection and recycling structures**
   - Recovery structure in place
     - yes
     - no
   - Recovery technologically feasible
     - yes
     - no

4. **Recyclable packaging system**
   - yes
   - no

5. **Circular packaging system**
DESIGN RECOMMENDATIONS FOR RECYCLABLE PACKAGING

The complete packaging must be designed in a way that enables a high degree of collection and sorting. The main criteria for design refer to the material and additives used, the colour of the material and the printing ink, small packaging components, as well as full emptiability.

For sustainable and recyclable packaging design, the following basic recommendations thus apply:

- Optimally, reuse packaging, whereby such packaging should also be recyclable
- Reduce material consumption while maintaining best possible protection of packaged good
- Use recycled material if viable (depending on the product-specific approval and availability on the market)
- Use monomaterials or material combinations that permit recycling.
- Whenever possible, avoid additives that are not suitable for food contact (consider possible breakdown products resulting from the recycling process to avoid contamination of the recycled material. Here, further research is required)
- Minimise dyeing of packaging materials.
- Avoid materials and printing inks listed in the EuPIA Exclusion criteria.
- Use adhesives which do not interfere with the sorting and recycling process (further research is required).
- Design the packaging in a way that enables the entire product to be emptied out (full emptiability).
- Take measures that facilitate the good separation of individual components (e.g. by visible easy-to-use perforation) and waste separation according to type of material by easy-to-read information on the packaging for consumers (e.g. clear indication of material type).
- Openers/closures that are not integrated into the resealing process should remain attached to the packaging in order to avoid the separation of small parts.

Innovation to enhance recyclability

In order to enhance recyclability, in addition to a circular design that has been adapted to present-day structures and technologies, the existing sorting, separation and recycling technologies also need to be continually advanced. Furthermore, it is advisable to expand recovery structures in order to fulfil the planned recycling rates. Technological and structural developments must go hand in hand and complement each other through innovation in order to enable the progress of the circular economy.
However, the current design recommendations apply, irrespective of future developments. The table below explains the main criteria that are relevant for all packaging materials.

New developments on the market also require coordination with current and future sorting and recycling technologies as well as international guidelines and testing procedures.

THE MAIN CRITERIA FOR RECYCLABLE PACKAGING DESIGN

<table>
<thead>
<tr>
<th>Materials and additives</th>
<th>Material colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generally speaking, the material used should be as homogeneous as possible, free from additives, and produced in accordance with the applicable legal framework. In addition, access to, and availability of, region recovery streams is essential. For this reason, uncommon materials constitute a problem as due to lack of appropriate infrastructure, they often cannot enter a recovery stream. If different materials are combined in multilayer materials, recycling is often impossible (even though new barrier and recovery technologies are being continually developed and must also be taken into account).</td>
<td>As a rule, heavily dyed materials (particularly paper or plastics) can cause problems with regard to sorting, or the material value of the recyclates can, as a result, be reduced. As far as glass packaging is concerned, only standard dyes should be used. In addition, the colour black (carbon black) can, in the context of NIR detection during plastics sorting, lead to incorrect classification of the material, or the material is eliminated in the sorting process.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Printing inks and packaging components</th>
<th>Full emptiability and small parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>The printing inks used must be in conformity with the EuPIA Exclusion List.</td>
<td>Packaging should be disposed of in a fully drained condition. In the case of certain types of filled products, particularly high-viscosity materials, good emptiability can be difficult.</td>
</tr>
<tr>
<td>Direct printing applied by the bottling company to add the batch number or DMD should, whenever possible, be replaced by laser engraving in order to avoid contamination by solvents or dark pigments. The packaging system should be considered as a whole, and should consist of the smallest possible number of different materials. In addition, adhesives, sleeves and labels must be compatible with the material of the packaging and take into account the recycling procedure currently in use.</td>
<td>Depending on the shelf life of the food, residues in the packaging can have negative effects on recycling fractions and thus on recyclability. When designing packaging, particularly in the case of high-viscosity products, good emptiability should be the aim (e.g. by means of containers that can be placed upside down). For small parts, such as openers or closures, a system should be used that as far as possible prevents their complete removal by the consumer, in order to avoid their release into the environment. This can, for instance, be achieved by integration into the resealing process (e.g. screw caps) or attachment to the packaging (e.g. stay-on closures). Whenever possible, they should be mechanically attached, in order to enable their subsequent removal in the sorting process. Caps and lids have to remain attached to plastic beverage containers up to 3 litres and to beverage cartons during their use stage (2019/904/EC).</td>
</tr>
</tbody>
</table>
The following chapters present design recommendations for different types of packaging system. The factors taken into account for classification include the most important combinations of materials and the packaging components used with regard to their suitability for current state-of-the-art mechanical recycling procedures. Full recyclability means that the product obtained after mechanical recycling can be used as a full substitute for virgin material of the same type.

The classification is based on the following criteria:

**DEFINITION FOR ASSIGNMENT TO RECYCLABILITY CATEGORIES**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Good compatibility</th>
<th>Limited compatibility</th>
<th>Poor compatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The complete packaging is recyclable in the state-of-the-art sorting and recycling processes currently available, and a recovery structure is in place.</td>
<td>The complete packaging is, with certain restrictions, recyclable in the sorting and recycling processes currently used, and a recovery structure is in place.</td>
<td>The complete packaging is not recyclable in the sorting and recycling processes currently used, and/or no recovery structure is in place.</td>
</tr>
</tbody>
</table>

In addition, it is important to take into account the extent to which the individual packaging components interfere with the recycling process. The following three degrees of restriction have been defined as relevant:

- **Restrictions concerning individual packaging components**
  
  Individual components of the complete packaging cannot be recycled for technological and/or structural reasons, but do not have a negative impact on the recyclability of the basic packaging container (e.g. PET bottle with non-recyclable label material).

- **Restrictions due to insufficient sorting fitness**

  Certain design types and components of the complete packaging prevent the packaging being recycled or integrated into the intended recycling stream. However, if individual parts are separated before disposal, certain constituents can be recycled (e.g. PET bottle with a full-body OPS sleeve).

- **Restrictions due to the design of the complete packaging**

  The packaging is designed in a way as to prevent the recycling of both individual packaging components and the basic packaging material – the complete packaging must be redesigned in order to enable recycling (e.g. PET-EVOH multilayer bottles).

The effort required to design the packaging in a recyclable way thus depends on the degree of restrictions that have been identified.
PLASTIC PACKAGING

To begin with, in view of the wide range of materials used for plastic packaging, here are a few general design-related recommendations. They apply to all types of plastic material.

GENERAL DESIGN RECOMMENDATIONS

The efficient collection, sorting and recycling of plastic packaging essentially depends on the following criteria:

- Use the most common types of materials (e.g. polyolefins, PET).
- Only use new materials if they are compatible with the prevalent collection and recovery structures.
- Choose materials with good recyclability (taking material combinations into account).
- Avoid additives in the material whenever possible.
- Pay regard to the easy separation of the individual components in the sorting process.
- Colours should be as transparent as possible.
- Use inks, which will not containing the recycling stream
  (minimum standard: avoidance of inks meeting EuPIA exclusion criteria).
- Avoid using small parts that can be removed by the consumer.
- Use packaging aids and components that do not impair the recyclability of the main material.
POLYETHYLENE TEREPHTHALATE (PET)

CURRENT COLLECTION AND RECOVERY STRUCTURES

In Austria, almost all households have access to the collection system for PET hollow articles (yellow bin/yellow sack). In case of PET, recyclates can be used for producing high-quality products that can be used as a full substitute for virgin PET, even including closed-loop recycling, which also permits use for food-contact materials.

Directive 2019/904/EC defines targets for specific disposable plastic products. For example, PET bottles will have to contain at least 25% recycled plastic by 2025 (30% by 2030).

RECOMMENDATIONS FOR RECYCLABLE PET PACKAGING

<table>
<thead>
<tr>
<th>Component</th>
<th>Recyclability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Material and additives</strong></td>
<td><strong>Good</strong></td>
</tr>
<tr>
<td>PET</td>
<td>Multi-layer packaging, one type of material</td>
</tr>
<tr>
<td></td>
<td>Materials of a density of &gt; 1 g/cm³ (e.g. PVC, PS);</td>
</tr>
<tr>
<td></td>
<td>PETG, C-PET, PC; materials causing density changes;</td>
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<tr>
<td></td>
<td>nanoparticles, oxygen-, bio- or oxo-degradable additives</td>
</tr>
<tr>
<td><strong>Barrier</strong></td>
<td><strong>Limited</strong></td>
</tr>
<tr>
<td>No barrier layer, SiOx, Al₂O₃ barrier</td>
<td>UV stabilisers, AA blockers, optical brighteners, oxygen absorbers, max. 5 wt% PA, aluminium vapour deposition (metallizing)¹</td>
</tr>
<tr>
<td></td>
<td>Multilayer with EVOH and more than 5 wt% PA;</td>
</tr>
</tbody>
</table>

¹ as long as the metallization does not impair the sorting process
## Component

<table>
<thead>
<tr>
<th></th>
<th>Good</th>
<th>Limited</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Colour</strong></td>
<td>Transparent</td>
<td>Pale, light colours (e.g. blue or green), dark colours(^2)</td>
<td>Black (carbon black based), metallic or fluorescent colours</td>
</tr>
<tr>
<td><strong>Closures and seals</strong></td>
<td>PP, HDPE; materials with a density &lt; 1 g/cm(^3)</td>
<td>Silicone (density of &lt; 1 g/cm(^3))</td>
<td>Metals, thermosetting plastics, PS, PVC, seals or silicone that cannot be completely removed; glass and metal springs in pump systems; materials with a density &gt; 1 g/cm(^3)</td>
</tr>
<tr>
<td><strong>Labels and sleeves</strong></td>
<td>Max. 50% of the packaging is covered; material of a density of &lt; 1 g/cm(^3), e.g. PP, PE</td>
<td>PET in-mould labels; paper labels (wet-strength grade)</td>
<td>Full-body sleeves; sleeves made of PVC, OPS or PET, PETG; metallic layer with a thickness &gt; 5 µm</td>
</tr>
<tr>
<td><strong>Label adhesive</strong></td>
<td>Adhesives soluble in water/hot alkaline solution at 60–80 °C</td>
<td>Hotmelt glues for wrap around labels</td>
<td>Permanent adhesive</td>
</tr>
<tr>
<td><strong>Printing inks</strong></td>
<td>In conformity with EuPIA</td>
<td></td>
<td>Bleeding colours; non-conformity with EuPIA; highly metallic colours</td>
</tr>
<tr>
<td><strong>Direct printing by filler</strong></td>
<td>Embossing, minimal laser printing, non-bleeding colours</td>
<td>Minimal direct printing with other systems and food-compatible colours</td>
<td></td>
</tr>
</tbody>
</table>
Avoid polymers with a similar density or a density over 1 g/cm³, as they cannot be distinguished from PET – or PETG – in the sorting process. PLA melts at the same temperature at which PET dries, which can cause problems during processing.

The recycling of PET beverage bottles to PET as a secondary raw material that can again be used for food contact is already well established. Other PET types (e.g. PETG) are not compatible with PET bottle recycling. PET packaging produced by deep drawing, as well as PET sleeve films, are contaminants in the recycling stream.

The admissibility of PET additives, such as nucleating agents, fluorescent agents, opacifiers or absorbers, can interfere with the recycling process and needs to be assessed in each individual case.

The colour black primarily affects NIR detection, and dark colours also reduce the quality of recycling fractions. In addition, PET bottles with white pigments are contaminants in the recycling process due to non-existent recovery structures. Should PET recycling fractions be used for the production of micro-fibres, dyed granules can nevertheless be used. However, they should generally be avoided.

**PET TRAYS/CUPS**

Trays and cups are manufactured by thermoforming. The difference to stretch-blow moulding (e.g. bottles from injection moulding preforms) is in the composition of the polymer structure (e.g. PETG, C-PET). Moreover, they are often combined with layers of LDPE and polyamide, which could contaminate the recyclate.

PET trays and cups should thus not enter the recycling stream for PET bottles, as they are contaminants.

The further expansion of collection and recycling structures for thermoformed PET packaging is advisable, as the use of mono-PET can be an alternative to multilayer composite packaging for many foodstuffs with a short shelf-life. Therefore, recycling of thermoformed PET trays is promising. ³

In addition, improvements in the NIR detection system may, in future, enable the separation of bottles and trays or cups. A “Design for Recycling Guideline for PET thermoformed Trays” was issued in 2018 by the EPBP.

**PET FILM**

Do not use PET sleeves for PET bottles, as they interfere with recycling.

The use of PET in multilayer film and blister packs is not advisable, as it cannot be recycled.

Further information on multilayer materials is provided in a separate chapter.

---

³ collection of non-beverage bottles PET (if A-PET) established in Austria
DESIGN EXAMPLE OF RECYCLABLE COMPLETE PET PACKAGING

☑ Bottle or tray of 100 wt% PET without barrier
☑ Light colour/transparent blue
☑ HDPE closure of a density of < 1 g/cm³
☑ Label: PE label of a density of < 1 g/cm³
 or PE sleeve covering a maximum of 50% of the surface
☑ Batch number/DMD as laser marking
POLYPROPYLENE (PP)

CURRENT COLLECTION AND RECOVERY STRUCTURES

Everywhere in Austria, hollow articles made of PP can be disposed of through the light-packaging collection system (yellow bin/yellow sack). Regarding the collection of PP packaging other than hollow articles, the specifications of the individual waste disposal agencies apply.

The Polyolefin Circular Economy Platform (PCEP) strives for harmonisation of polyolefin recycling on the European level.

RECOMMENDATIONS FOR RECYCLABLE PP PACKAGING

<table>
<thead>
<tr>
<th>Component</th>
<th>Recyclability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good</td>
</tr>
<tr>
<td>Material and additives</td>
<td>PP</td>
</tr>
<tr>
<td>Barrier</td>
<td>No barrier layer; SiOₓ, Al₂O₃ barrier</td>
</tr>
<tr>
<td>Colour</td>
<td>Transparent, white</td>
</tr>
<tr>
<td>Closures</td>
<td>PP; Sealing lid, detachable without any residues</td>
</tr>
<tr>
<td>Labels and sleeves</td>
<td>PP label; PP sleeve covering max. 50% of the packaging</td>
</tr>
</tbody>
</table>

⁴ as long as the metallization does not interfere with the sorting process
<table>
<thead>
<tr>
<th>Component</th>
<th>Good</th>
<th>Limited</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Label adhesive</td>
<td>Adhesives soluble in water/hot alkaline solution at 60–80 °C</td>
<td></td>
<td>Permanent adhesive</td>
</tr>
<tr>
<td>Printing inks</td>
<td>In conformity with EuPIA</td>
<td></td>
<td>Bleeding colours; non-conformity with EuPIA; highly metallic colours</td>
</tr>
<tr>
<td>Direct printing by filler</td>
<td>Embossing, minimal laser printing</td>
<td>Minimal direct printing with other systems and food-compatible colours</td>
<td></td>
</tr>
</tbody>
</table>

**PP BOTTLES**

If barrier layers are needed, do not use PVDC or PA with PP packaging, as this interferes with the recycling process. The use of SiOx, and EVOH up to 5 wt % is admissible.

The bottle and its closures should preferably be of the same colour. Labels should be of the same material as the bottle or, in the case of paper, they should be soluble in water or a hot alkaline solution.

**PP CUPS/TRAYS**

If the cup/tray is covered with an aluminium sealing foil, the cover must be designed in a way that allows its complete removal, without leaving any adhesive residues on the cup/tray.

Whenever possible, any product-related information should be provided on the lid or foil in order to avoid contamination of the main packaging.

Paper labels should be used as sparingly as possible, and whenever they are used, they should be lightweight, wet-strength grade labels that are soluble in an alkaline solution.

**PP TUBES**

Avoid the use of fillers such as chalk (filled polyolefin/FPO) if this results in a density of over 0.995 g/cm³.

The tube itself and its closure, as well as the label, should preferably be made of the same material. If HDPE is used for the closure or the label, the proportion of HDPE should be as small as possible (under 5 % by weight of the entire packaging system).

Printing over the entire surface is admissible if in line with the EuPIA Exclusion List.
**PP FILM/BAGS**

The use of SiOx, and EVOH up to 5 wt %, is admissible in packaging film composite fractions in the recycling process.

**DESIGN EXAMPLE OF A RECYCLABLE COMPLETE PP PACKAGING**

- PP cup with PP lid without barrier
- Transparent or white pigment
- Minimum direct printing with inks in conformity with EuPIA
- Batch number/DMD as laser marking on lid
POLYETHYLENE (HDPE, LDPE, LLDPE)

CURRENT COLLECTION AND RECOVERY STRUCTURES

Everywhere in Austria, hollow articles made of polyethylene can be disposed of through the light-packaging collection system (yellow bin/yellow sack).

The Polyolefin Circular Economy Platform (PCEP) strives for harmonisation of polyolefin recycling on the European level.

RECOMMENDATIONS FOR RECYCLABLE PE PACKAGING

<table>
<thead>
<tr>
<th>Component</th>
<th>Good</th>
<th>Limited</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material and additives</td>
<td>PE</td>
<td>Multi-layer packaging from a single type of material; additives if density remains below &lt; 1 g/cm³</td>
<td>Additives that increase density to &gt; 1 g/cm³ (talcum, CaCO₃), oxo-degradable additives</td>
</tr>
<tr>
<td>Barrier</td>
<td>No barrier layer; SiOₓ, Al₂O₃ barrier</td>
<td>Up to 5 wt % EVOH; Metallizing⁵,</td>
<td>PVDC, PA</td>
</tr>
<tr>
<td>Colour</td>
<td>Transparent, white</td>
<td></td>
<td>Black, dark or opaque colours</td>
</tr>
<tr>
<td>Closures</td>
<td>HDPE, LDPE, LLDPE, MDPE; non-detaching closures without seals</td>
<td>PP, PS</td>
<td>Metals, thermosetting plastics, EPS, PVC; seals or silicone that cannot be removed completely; pump systems (particularly if including glass and metal springs), flip-top wires; removable pull strips</td>
</tr>
</tbody>
</table>

⁵ as long as the metallization does not interfere with the sorting process
<table>
<thead>
<tr>
<th>Component</th>
<th>Good</th>
<th>Limited</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labels and sleeves</td>
<td>Labels are preferable to sleeves;</td>
<td>PE in-mould labels, paper</td>
<td>Full-body sleeve, permanent adhesive,</td>
</tr>
<tr>
<td></td>
<td>HDPE /LDPE/ MDPE/ LLDPE;</td>
<td>labels (wet-strength grade);</td>
<td>metallized materials</td>
</tr>
<tr>
<td></td>
<td>HDPE sleeve covering max. 50 % of</td>
<td>PP/OPP, PET</td>
<td></td>
</tr>
<tr>
<td></td>
<td>packaging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Label adhesive</td>
<td>Adhesives soluble in water/hot alkaline</td>
<td></td>
<td>Permanent adhesive</td>
</tr>
<tr>
<td></td>
<td>solution at 60–80 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Printing inks</td>
<td>In conformity with EuPIA</td>
<td>Bleeding colours;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>non-conformity with EuPIA;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>highly metallic colours</td>
<td></td>
</tr>
<tr>
<td>Direct printing by filler</td>
<td>Embossing, minimal laser printing</td>
<td>Minimal direct printing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>with other systems and food-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>compatible colours</td>
<td></td>
</tr>
</tbody>
</table>

**PE BOTTLES**

Bottles made of HDPE should be non-pigmented whenever possible. Closures should preferably have the same colour as the bottle, the tamper evident closure should also be of the same material, of the same colour, and easily removable (in the recycling process).

PP is one of the main contaminants of HDPE bottles in recycling; however, PP is tolerable up to a proportion of 5 wt%.

Plastic labels should be of the same material as the bottle body. If paper labels are used, they should be of wet-strength grade.

**PE CUPS/TRAYS**

If the cup/tray is covered with an aluminium sealing foil, the cover must be designed in a way that allows its complete removal, without leaving any adhesive residues on the cup/tray.

Product-related information/printing and direct printing should preferably be provided on the lid or foil to avoid additional packaging components.

Paper labels should be used as sparingly as possible, and whenever they are used, they should be light-weight, wet-strength grade labels that are soluble in an alkaline solution.
PE TUBES

Avoid the use of fillers such as chalk (filled polyolefin/FPO) if this results is a density of over 0.995 g/cm³.

In addition, the closure and the tube itself should preferably be made of the same material (e.g. HDPE). The more PP is used, the lower the quality of the recycled polyethylene.

Printing over the entire surface is admissible if in conformity with the EuPIA Exclusion List.

PE FILM/BAGS

SiOx or Al₂O₃ barriers can be recycled without problems; EVOH barriers should account for a maximum of 5 wt %.

If PE film is combined with other types of plastics by means of co-extrusion, please take care that PE polymers are used whenever possible. LDPE, LLDPE, MDPE and HDPE combinations can be used.

DESIGN EXAMPLES OF RECYCLABLE COMPLETE PE PACKAGING

✓ Tube made of 100 wt% LDPE, without a barrier
✓ White pigment colour
✓ HDPE closure
✓ Minimal printing with inks in conformity with EuPIA
✓ Batch number/DMD as laser marking

✓ Bag packaging made of 100 % LDPE with SiOx barrier
✓ Transparent or white pigment
✓ Sealed closure
✓ Minimal printing with inks in conformity with EuPIA
✓ Batch number/DMD as laser marking
- Bottle made of 100 wt% HDPE with 5 wt% EVOH barrier
- Light/transparent or white colour
- HDPE closure without sealing foil
- PE label or PE sleeve soluble in hot alkaline solution
- Batch number/DMD as laser marking or on label
- Wide closure to allow bottle to be placed upside down.
RECOMMENDATIONS FOR PACKAGING AIDS – AN OVERVIEW

The following list provides an overview of advisable packaging components or component combinations which, in the current state of the art, do not have negative impacts on the recycling process. Additionally, it includes knockout criteria for certain components. This list will be updated at regular intervals.

CLOSURES

- From the year 2024, caps and lids have to remain attached to plastic beverage containers up to 3 litres and beverage cartons during the products’ intended use stage (2019/904/EC).
- Sealing lids should be removable by the consumer without any residues.
- In the case of PE or PP packaging, use closures of the same material whenever possible.
- In the case of PET packaging, use materials with a density of < 1 g/cm³.

SLEEVES

- Sleeves should never cover more than 50% of the packaging (an exception are sleeves of identical material, but different density to allow for separation, e.g. foamed PET on a PET bottle).
- In the case of PET packaging, use materials with a density of < 1 g/cm³.

LABELS

- Labels should never cover more than 50% of the packaging.
- Labels and adhesives used for plastic packaging must be separable. They should be soluble in water or hot caustic at 60 – 80° Celsius.
- In-mould labels should always be of the same material as the packaging.
- In the case of plastic labels on PET packaging, use materials with a density of < 1 g/cm³.
- In the case of paper labels on plastic and glass packaging, use wet-strength paper.
Labels and sleeves can be used in different designs and combinations. This results in different requirements for recycling. In addition, specific recommendations apply depending on the type of basic packaging.

**Sleeves**

If sleeves cover more than 50% of the packaging surface, they affect its sortability. Sleeves that can be removed by the consumer are a special case. As an example, there are recommendations from the EPBP to use double-perforated sleeves, which provide consumers with an indication on how to remove them. However, this rule only applies to care and cleaning products until 2022. From today’s view, it is not clear whether the national authorities agree with this view.

*In-Mould Labelling*

Ideally, In-Mould Labels should be of the same material as the packaging. Printing should be used as sparingly as possible. Carbon black based dyes should be avoided since they may absorb near infrared radiation and therefore impairing the sorting process.

*Self-adhesive Labels / Pressure Sensitive Labels*

Pressure sensitive labels stick to a surface by only applying pressure, without the need for solvents, water or heat.

Standard permanent adhesives are difficult to remove from the packaging material (such as PET bottles) during the washing process. Their removal require longer washing processes, higher lye concentrations and/or higher water temperatures.

Adhesives used for plastic packaging should be soluble in water or hot lye at 60 – 80°C Celsius. The EPBP published recommendations for admissible adhesives.

*Hotmelt Labels*

Hotmelt labels are frequently used for PET bottles. The adhesives are commonly based on solvent-free synthetic rubber and ethylene vinyl acetate. They melted and form thermoplastic bonds during the cooling process. In principle, they can be removed during the washing process with hot lye, but their removal requires additional effort and prolongs the process. The longer the separation in the washing process takes the worse is the suitability of these adhesives for the recycling process.

Polyurethane adhesives are problematic, since these cannot be remelted during the recycling process. Overall, hotmelt labels should only be used, if the glues are soluble in water or hot lye at 60 – 80°C Celsius.
**Adhesives in general**

Adhesives should not contaminate the recycled material. In the case of products made from plastic, for example, non-removable adhesives may stick to the base material and lead to undesired contaminations.

Furthermore, it is crucial that labels do not delaminate in the washing process. Thus, adhesive could remain on the base packaging material and only the label top material peels off.

In the recycling of plastic products, non-washable labels made of paper also affect the quality of recycled materials, since such fibres are contaminants in the recycling process. Therefore, only washable paper labels should be used. Excessive printing or varnishing may prevent the fibres from being effectively removed.

The decision for the right adhesive should be made in accordance with the application, its requirements, the basic packaging material and the corresponding recycling process.
RARE AND COMPOSTABLE PLASTICS

UNCOMMON PLASTICS

As a rule, recycling can only be efficient if the material to be recycled is available in large quantities and as homogeneous as possible. In the course of time, Austria’s recycling infrastructure has been adapted to the most frequently used materials. In the case of materials that are seldom used on the market, no appropriate recovery streams may be available, even though the material may have an excellent recycling potential. Recyclable packaging design should thus be oriented towards the use of a small number of frequently used materials. For instance, the Ellen MacArthur Foundation (2016) discourages the use of uncommon plastics such as polystyrene and polyvinyl chloride, in view of the low volumes that are put on the packaging market. According to the German Association for Plastics Packaging and Films (Industrievereinigung Kunststoffverpackungen (2018)), polystyrene only accounts for 2.3 % of the German packaging market, and expanded polystyrene, 0.8 %. According to a study conducted at TU Wien, in Austria the respective percentages are approximately 3 % for polystyrene and 2 % for expanded polystyrene (Van Eygen et al., 2017).

The following materials should thus not be used:
- polystyrene (PS)\(^6\)
- expanded polystyrene (EPS) (except large-volume mouldings)
- polycarbonate (PC) and
- polyvinyl chloride (PVC).

COMPOSTABLE PLASTICS

Bio-based plastics (e.g. bio-PE, bio-PP or bio-PET) must be treated in the same way as the materials listed in this Guideline, provided that they have the same technological properties. Compostable plastics (in accordance with DIN EN 13432) do, however, present a challenge in recycling. The goal of compostability runs counter to the recycling process because material of good compostability has often already suffered a quality loss when it enters the recovery stream. Polylactic acid (PLA) is an exception here: it is biodegradable and would also be easy to recycle. However, in the present situation, the use of PLA is not advisable in view of its small relevance in the market, and also due to the problems that PLA can cause in the context of PET recycling. If compostable plastics are disposed of through the Austrian separate collection system for organic waste, they are, at present, not distinguished from non-compostable plastics and are therefore eliminated in the sorting process and used as fuel for energy recovery. In the case of products that are excluded from material recycling, due to a risk of massive contamination or for other reasons, the use of bio-degradable materials could nevertheless be worthwhile (e.g. coffee capsules, fresh meat packaging) in future. However, evidence of industrial composting must be provided and communicated to the final consumers.

It is specially advised not to use oxo-degradable plastics. Apart from affect the quality of the recycled material, the incomplete decomposition of oxo-degradable plastics leads to the formation of

\(^6\) Polystyrene and large-volume EPS is collected separately in Austria and Germany

MULTILAYER MATERIALS WITH PLASTIC CONTENT

Composites or multilayer materials, i.e. materials with two or more different constituents, can combine the best properties of each constituent. They are frequently used for packaging film with a good barrier function and thus prolong the shelf life of food. Composites can enable good product protection while reducing the weight of the packaging, but can impede, or even prevent, recycling.

The following plastic composites are, however, deemed recyclable:

- coatings made of silicon oxide (SiOx) or aluminium oxide (Al₂O₃) for PP, PE and PET
- EVOH up to 5 wt % for PP and PE
- PA up to 5 wt % for PET
- metallized films, if they are not impair the sorting process

BEVERAGE CARTON

Liquid packaging board for beverages usually consists of paperboard with LDPE layers on one or both sides, and possibly an aluminium interim layer (for products with a longer shelf life). In Austria, beverage cartons are collected together with plastic packaging waste. The sorting takes place by means of NIR (near-infrared) sensors, which recognize the specific packaging material composition of beverage composite cartons. For this reason, sorting problems can occur if the outer layers are not made of LDPE and cardboard as usual.

The processing then takes place in special pulpers, in which the fibre content of the shredded packaging materials is separated and its use in new paper-based products is made possible. LDPE and aluminium fractions will usually be incinerated. However, the recycling process does not allow for the complete recovery of the fibres, as a small amount remains attached to the lamination and ends up in the reject. Therefore, the lower the non-fibre content of a beverage carton, the higher the efficiency of the recycling process.
PAPER AND BOARD PACKAGING

CURRENT COLLECTION AND RECOVERY STRUCTURES

Paper packaging in Austria is collected nationwide and consistently with other paper products (newspapers, magazines, etc.). Around three quarters of the paper used in Austria is currently being recycled. If packaging papers are collected in the household collection together with graphic papers, a waste paper sorting must be carried out. Only by sorting can the waste paper types (according to EN643) be provided, which can then be processed by the paper industry. Paper mills usually reprocess waste packaging paper into new packaging material, such as corrugated board or grey cardboard.

The recommendations summarized in the following table refer to the recyclability of paper packaging in a standard equipped paper mill, and are partly oriented towards the Paper and Board Packaging Recyclability Guidelines (Confederation of Paper Industries - CPI). The recycling of beverage cartons and silicone papers requires a special technology (see chapter Multilayer Materials with Plastic Content).

RECOMMENDATIONS FOR RECYCLABLE PAPER/PAPERBOARD PACKAGING

<table>
<thead>
<tr>
<th>Component</th>
<th>Recyclability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>good</td>
</tr>
<tr>
<td>Origin of fibers</td>
<td>Wood</td>
</tr>
<tr>
<td>Coatings &amp; Laminations</td>
<td>Without coating or lamination</td>
</tr>
<tr>
<td>Design &amp; Packaging aids</td>
<td>Minimal printing; Without non-fibrous components</td>
</tr>
<tr>
<td>Component</td>
<td>good</td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
</tr>
<tr>
<td>Adhesives</td>
<td>Hotmelts with a softening temperature &gt; 68 °C and a layer thickness &gt; 120 µm</td>
</tr>
<tr>
<td>Additives</td>
<td>Mineral fillers such as kaolin, talc, TiO₂ and calcium carbonate; Starch</td>
</tr>
<tr>
<td>Printing</td>
<td>EuPIA-conform inks</td>
</tr>
</tbody>
</table>

In principle, paper can be recycled well, but several factors affect its recyclability.

**Stickies**

A special challenge for paper recycling are so-called stickies. Stickies are non-paper, organic materials which cannot be separated from fibres. They are mostly used as adhesives for closing folding boxes or pressure-sensitive (self-adhesive) labels.

Such adhesives can clog nozzles and thus cause problems in the paper recycling process. Overall, this reduces the quality of the recycled paper. Stickies can cause holes in the paper and cause the paper web to tear.

Recycling-friendly adhesives are generally water-insoluble and separable early in the recycling process. In addition to the type of adhesive its application is also crucial. Compact adhesive films are very easy to sort out. However thin adhesive films or small dots of glue may not, even if the adhesive itself meets the requirements of the paper recycler (which means water-insoluble and as early as possible separable).

Macrostickies with a particle size of more than 2,000 µm do not cause problems in paper recycling, since they form relatively large stickies and can therefore be removed with fine sieves. They are produced by hotmelts with a softening point above 68 °C (e.g. ethylene-vinyl acetate or polyurethane) with a layer thickness of more than 120 µm.

In contrast, microstickies with a particle size of less than 2,000 µm lead to problems in the recycling process. This can be caused by hotmelts with a softening point below 68 °C and a layer thickness of less than 120 µm as well as by acrylic adhesive, polyvinyl acetate and styrene butadiene rubber.

In general, the smaller the stickies, the more problematic they are for the recycling process, as they cannot be separated by sieves.
Verification of adhesives for paper recycling is based on INGEDE methods 11 and 12, as well as verification by the ERPC (European Recovered Paper Council). The particle size is evaluated and determines whether the resulting stickies can be effectively separated from the fibre suspension.

Testing of adhesive applications and their suitability for the recycling process is also part of the criteria of the Blue Angel for recycled paper (DE-ZU 14).

**Deinking**

An important aspect of recycling graphic papers is the removability of colours (deinkability). The evaluation is based on the ERPC specifications, whereby deinkability is classified by a score card. However, deinkability is not a primary quality feature for the production of recycled packaging material, as deinking is not required in the production of corrugated board and gray cardboard. Therefore, this topic is not discussed further.

**Additives**

Some specialty paper packaging contains moisture-proofing additives that can also cause issues in the recycling process. Such “wet strength agents” prevent the fibres from being released during recycling. Wet-strength papers can be recycled if they make up only a small fraction of the total waste paper and if they are clean.

**Coatings**

Coatings and laminations affect the recyclability of paper packaging. Although the fibers in composite packaging can be separated and recovered in the pulping process, the recycling efficiency is reduced. The plastic (mainly PE) and other contaminants end up in the reject (waste), for which the disposal is associated with additional expense. In addition, there is a risk that plastic residues stick to the fibres, which reduces the yield. To ensure efficient paper recycling, plastic coatings should be avoided altogether. Since this is not practical, the industry recommends keeping the plastic content below 5 wt%. Where possible, integrated windows and other plastic components should be easily removable by the consumer.

Beverage composite cartons are discussed in the chapter ‘Composite materials with plastic content’.

Silicone papers (e.g. label carrier paper) cause problems in paper recycling because the silicone cannot be removed and significantly reduces the quality of the recycled paper. There are only a few, specialized paper factories that can effectively separate silicone from fibres and recycle such papers.

**Printing inks**

The use of toxic inks affects recyclability. Furthermore, their disposal is troublesome. Colours, to which the exclusion criteria of the European Printing Ink Association (EuPIA) apply, should be avoided. The use of mineral oil-containing inks is problematic as these substances can migrate into the filling good. In the recycling process, mineral oil residues cannot be completely removed, which is why there are restrictions on the use of recycled paper-based packaging for food. If a producer intends to use recycled paper-based packaging for food, an examination for suitability has to be conducted.
Non-woody fibres

It is not completely clear how paper from non-woody fibres affects the paper recycling process. However, a small portion of non-timber fibres in the waste paper stream is considered unproblematic.

DESIGN EXAMPLE OF RECYCLABLE COMPLETE PAPER/PAPERBOARD PACKAGING

- Undyed paper
- Plastic coating < 5 wt% by weight
- Minimal printing with inks in conformity with EuPIA
- Use of polyurethane adhesive

- Undyed corrugated board
- Use of hotmelts e.g. polyurethane based
- Minimal printing with inks in conformity with EuPIA
- Dividers also made of paperboard
GLASS PACKAGING

CURRENT COLLECTION AND RECOVERY STRUCTURES

Glass can be recycled almost infinitely while retaining its specific properties. Everywhere in Austria, glass packaging is collected in a uniform system, with separate bins for white glass and coloured glass. Glass manufacturing is highly energy-intensive, and with secondary material, the use of energy can be reduced by 2–3 % for every 10 % of cullet that is added. To produce green glass, almost any colour of glass can be used: therefore, the proportion of recycled glass is highest in green glass.

Labels with permanent adhesives, as well as heavily lacquered bottles, can cause detection errors so that the glass is eliminated from the recycling process. Ferromagnetic metals and aluminium can be eliminated in the sorting process.

RECOMMENDATIONS FOR RECYCLABLE GLASS PACKAGING

<table>
<thead>
<tr>
<th>Component</th>
<th>Recyclability</th>
<th>Good</th>
<th>Limited</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material and additives</td>
<td>Three-component packaging glass (silica, soda, lime); heavy metal concentration in conformity with Commission Decision 2001/171/EC</td>
<td>Glass not suitable for packaging, e.g. heat-resistant glass such as borosilicate glass; lead glass; cryolite glass; bottles with lacquer finish and enamel constituents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td>Green, brown and white (transparent)</td>
<td>Other hues; opaque colours and metallic colours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closures</td>
<td>Ferromagnetic metals (alloys); plastics; aluminium</td>
<td></td>
<td></td>
<td>Ceramics</td>
</tr>
<tr>
<td>Design details</td>
<td>engraving; sleeve covering max. 50 % of the packaging</td>
<td>full body colouring/coating</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Component</th>
<th>Good</th>
<th>Limited</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labels</td>
<td>Adhesives soluble in water/ hot alkaline solution at 60–80 °C;</td>
<td></td>
<td>Labels with permanent adhesive</td>
</tr>
<tr>
<td>Printing/direct printing by filler</td>
<td>Direct printing;</td>
<td>In conformity with EuPIA</td>
<td>Highly metallic colours non-conformity with EuPIA</td>
</tr>
</tbody>
</table>

**DESIGN EXAMPLE OF A RECYCLABLE COMPLETE GLASS PACKAGING**

- ✔ Bottle made of three-component packaging glass
- ✔ Transparent, green or brown colour
- ✔ Aluminium screw-caps
- ✔ Wet-strength grade paper label soluble in hot alkaline solution
TINPLATE PACKAGING

CURRENT COLLECTION AND RECOVERY STRUCTURES

In Austria, tinplate packaging is primarily collected in blue collection bins and, in exceptional cases, in the yellow sacks. The packaging is then transported to shredding plants or sorting facilities, where it is manually sorted out or segregated from other metal packaging by means of magnetic separators.

Tinplate can be recycled almost infinitely without quality losses. Aerosol cans (spray dispensers with propellant) with residues of highly flammable liquid can lead to accidents in recycling plants. For this reason, these packaging systems must either be emptied completely beforehand or removed from the recycling system by a separate collection or sorting process.

RECOMMENDATIONS FOR RECYCLABLE TINPLATE PACKAGING

<table>
<thead>
<tr>
<th>Component</th>
<th>Recyclability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good</td>
</tr>
<tr>
<td>Material and additives</td>
<td>Ferromagnetic metals (alloys);</td>
</tr>
<tr>
<td></td>
<td>Lacquer finish</td>
</tr>
<tr>
<td>Closures</td>
<td>Ferromagnetic metals (alloys);</td>
</tr>
<tr>
<td></td>
<td>plastics</td>
</tr>
<tr>
<td>Design details</td>
<td>Wet-glue paper label</td>
</tr>
<tr>
<td>Printing/direct printing</td>
<td>Lacquers and printing inks</td>
</tr>
<tr>
<td>by filler</td>
<td>in conformity with EuPIA</td>
</tr>
</tbody>
</table>

DESIGN EXAMPLE OF A RECYCLABLE COMPLETE TINPLATE PACKAGING

- Ferromagnetic metal can
- Protective coat on inside
- Paper label with small area of adhesive
ALUMINIUM PACKAGING

CURRENT COLLECTION AND RECOVERY STRUCTURES

In Austria, aluminium packaging is primarily collected in blue collection bins and, in exceptional cases, in the yellow sacks. The packaging is then transported to sorting facilities or shredding plants, where it is manually eliminated or segregated from other metal packaging by means of eddy-current separators. Aluminium packaging thus has good recyclability.

RECOMMENDATIONS FOR RECYCLABLE ALUMINIUM PACKAGING

<table>
<thead>
<tr>
<th>Component</th>
<th>Recyclability</th>
<th>Good</th>
<th>Limited</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material and additives</td>
<td></td>
<td>Non-ferrous metal constituents</td>
<td>Plastic closures and valve caps should be removed before recycling; EVA liners</td>
<td>Multilayer material</td>
</tr>
<tr>
<td>Closures</td>
<td></td>
<td>Aluminium screw-cap</td>
<td>Removable pull strips with aluminium constituents</td>
<td></td>
</tr>
<tr>
<td>Design details</td>
<td></td>
<td>Aluminium with direct printing</td>
<td>Aerosol cans; widget nitrogen balls in beer cans; plastic closures; spray systems</td>
<td>Plastic components in blister packaging</td>
</tr>
<tr>
<td>Printing/direct printing by filler</td>
<td></td>
<td>Lacquers and printing inks in conformity with EuPIA</td>
<td>Non-conformity with EuPIA</td>
<td></td>
</tr>
</tbody>
</table>

ALUMINIUM CANS

In most cases, aluminium cans are made of 3000-series alloy, whereas the opening tab usually consists of 5000-series aluminium alloy.

Full emptiability of aerosol aluminium cans should be ensured.

Major contaminations, as well as tinplate cans and plastics should be removed before the melting process. The use of plastics with cans reduces the quality and thus the price. Aerosol cans (spray dispensers with propellant) with residues of highly flammable liquid can lead to accidents in recycling plants; they are therefore collected separately and used as fuel for energy recovery. Part of the aluminium in the resulting slag can be recovered, but only with considerable losses.

7 possible exceptions must be tested in each individual case
ALUMINIUM TUBES

Aluminium tubes are usually made from 1000-series aluminium alloy. Due to the fast oxidation process, the thin ends of the tubes frequently do not melt, but oxidise instead.

ALUMINIUM FILM

Aluminium packaging film is usually made from 1000-series aluminium alloy. Frequently, the film is very thin and thus not suitable for the melting process. As a rule, very thin or contaminated film thus cannot and will not be recycled.\(^8\)

DESIGN EXAMPLES OF RECYCLABLE COMPLETE ALUMINIUM PACKAGING

- Aluminium can with direct printing
- Stay-on opening tab
- No plastic constituents

- Aluminium tube with direct printing
- Closure seal made in one casting
  (for piercing with spike in closure cap)
- No removable sealing foil

\(^8\) possible exceptions must be tested in each individual case
OUR SERVICES

The Circular Packaging Design Guideline was drawn up in the Section of Packaging and Resource Management at the Department of Applied Life Sciences of FH Campus Wien, and developed by the team at the Competence Centre for Sustainable and Future-Oriented Packaging Solutions.

The research of this team of experts focuses on the development of sustainable packaging, circular design, and the development of methods for assessing the sustainability and safety of packaging.

In order to enable packaging design that is recyclable, and as resource-efficient and environmentally friendly as possible while protecting the product, analyses are carried out on the basis of all-encompassing approaches.

If you are interested in a comprehensive assessment of your packaging, please don’t hesitate to contact our experts:

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T: +43 1 606 68 77-3576
ulla.guerlich@fh-campuswien.ac.at

www.fh-campuswien.ac.at/circular-design

CONSULTANCY AND ASSISTANCE

Packforce Austria: Austrian communication and information platform for the Austrian packaging industry

Circular Analytics: Strategies for a Transition to Circular Economy
## GLOSSARY

**Combined packaging**
Combined sales packaging that consists of a secondary packaging and one or several primary packaging units that are usually separated when used or consumed (e.g. cosmetic container in a paperboard box).

(Definition based on the specifications of Zentrale Stelle Verpackungsregister)

**Complete packaging**
Unit of primary packaging and all packaging components (auxiliary packaging materials), e.g. a cup with sleeve and sealing foil.

(Definition based on the specifications of Zentrale Stelle Verpackungsregister)

**Direct printing**
Printing that is applied directly to the primary packaging in the course of the packing or filling process; in most cases, the batch number and the date of minimum durability are applied in this way (do not confuse with direct printing processes such as offset print, flexography, screen printing or digital printing).

**Emptiability**
Suitability of a packaging with regard to complete removal of the filled product by the final consumer in the intended way.

**In-mould label**
A label that already carries print is placed inside the mould immediately before injection moulding, thermoforming or blow-moulding, without adding adhesion promoters. The label thus becomes an integral part of the finished product.

**Monomaterial**
Complete packaging that consists of only one type of packaging material.

This applies not only to different groups of packaging material such as plastic and paper, but also to different types of material of the same group, e.g. PP and EVOH in the plastics group.

**Multilayer/composite materials**
A combination of several packaging materials that cannot be separated manually, with none of the materials accounting for more than 95% of the packaging mass.

(Definition in accordance with the German Packaging Act.)

**Packaging components (packaging aids)**
Part of packaging that can be separated by hand or by using physical means. This includes, for instance, closures and labels.

(Definition in accordance with ÖNORM EN 13427:2000 12.)

**Packaging system**
The packaging system comprises the primary packaging (which envelops the product itself), secondary packaging (for grouping primary packaging) and tertiary packaging (transport unit).
Graphic visualisation of the packaging definitions

Complete packaging
(primary packaging including packaging aids such as labels or closures)

Combined packaging
(complete packaging in secondary packaging)

Tertiary packaging
(transportable unit)
The following bibliographical sources have been consulted for drawing up this Guideline:


Bundesgesetzblatt (2017): Gesetz über das Inverkehrbringen, die Rücknahme und die hochwertige Verwertung von Verpackungen (Verpackungsgesetz – VerpackG), Teil I Nr. 45.


ÖNORM EN 13427:2000 12 01: Packaging – Requirements for the use of European Standards in the field of packaging and packaging waste. (German version)


FURTHER READING


Foster, Stuart; Morgan, Steve; East, Paul (2013): Design of Rigid Plastic Packaging for Recycling. Guidance on how to design pots, tubs, trays and non-drink bottles so that they are as recyclable as possible. (Ed.): WRAP. Banbury, UK.

