Netherlands Institute
for Sustainable Packaging

Background document

KIDV Recycle Check Flexible Plastic Packaging 2023

Contents

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for Sustainable Packaging

KIDV Recycle Check Flexible Plastic Packaging - 2023
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This Recycle Check is updated when necessary. Please visit KIDV's website to consult the latest version.

If you have any questions about this Recycle Check, please contact KIDV.

KIDV would like to thank the sector organisations, producers and importers of packaged products and sorters and recyclers of rigid plastic packaging for their contributions to the realisation of this Recycle Check.

KIDV created this document with the utmost care and attention. Nevertheless, we would greatly appreciate it if you would let us know if the document is incomplete or incorrect in any way. KIDV assumes no liability for any damage resulting from or related in any way to the use of this document.

KIDV also rejects any responsibility for claims made as a result of this Recycle Check.

1. Introduction

Since 2019, the Netherlands Institute for Sustainable Packaging has been publishing Recycle Checks that allow businesses to relatively quickly and easily determine the recyclability of their packaging. In recent years, Recycle Checks have been published for rigid plastic packaging, flexible plastic packaging and packaging made of paper and cardboard, glass and metal. The KIDV Recycle Checks coincide with the recycle *checks and guidelines* drawn up by other countries and international organisations, such as Plastic Recyclers Europe (Recyclass) and Ceflex.

The KIDV Recycle Checks are based on the current system for the collection, sorting and recycling of packaging as it exists in the Netherlands. The processes examined are those used to process the largest tonnages of household waste: what happens to a packaging after a consumer disposes of it at home and how is this (household) waste processed in the sorting and recycling plants?

In some cases, local initiatives, market developments or innovations can affect the recyclability of packaging. KIDV monitors these developments and changes in the market as closely as possible. The Recycle Checks are updated in close conference with the relevant chain parties if and when new developments apply to the majority of the packaging released on the Dutch market.

The KIDV Recycle Checks apply to packaging that end up in the household waste or similar waste streams, such as waste from the hospitality sector, offices, retail stores and service companies. They do not apply to packaging that do not belong in the household waste stream, such as small chemical products (SCW, small chemical waste).

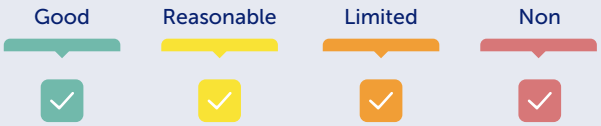
See also the clarification in chapter 2 - Definitions.

Updated KIDV Recycle Check Flexible Plastic Packaging

The 2023 edition of the KIDV Recycle Check Flexible Plastic Packaging has a new structure that makes it easier to use. It goes without saying that the contents have been updated as well. In this new format, the Recycle Check consists of two parts: the Recycle Check itself and a background document with information.

1

The Recycle Check to assess the recyclability (good, adequate, limited, none) of a packaging.

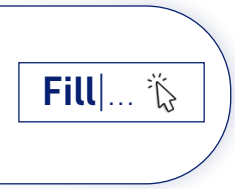


2

The background document with information on collection, sorting and recycling processes. This document also contains instructions on how to assess certain properties of a packaging. The background document can also be used as a reference as it contains guidelines for improving the recyclability of a packaging.

Legislation

This document is based on the applicable European and national legislation of late 2022. In late 2022, the European Commission published its proposal for a new packaging regulation, the so-called Packaging and Packaging Waste Regulation. This regulation has to be finalised before it can enter into force, which is expected to happen within the next two years. The proposal suggests that concrete guidelines will be introduced concerning the recyclability of packaging and the use of recycled content. Any businesses planning to invest in modifications to their packaging can already take these new guidelines into account. For an up-to-date overview of applicable laws and regulations, consult the Timeline packaging laws and regulations on KIDV's website (only available in Dutch).



User guideline

Step 1

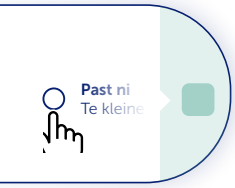
Open the checklist and enter some details concerning the product you want to evaluate.

Step 2

Continue to the overview page. Here, you can determine and select the disposable unit(s) that make(s) up the product-packaging combination you want to evaluate. Every disposable unit of the packaging must be evaluated separately.

Step 3

Next, you complete the checklist for each disposable unit. While doing so, you can consult the background document for more information. Note: this 2023 version of the Recycle Check can only be used to evaluate disposable units that are classified as 'flexible plastic packaging' or 'rigid plastic packaging.' For other packaging materials, you will be directed to the 'old' Recycle Checks until these have also been updated to the new format.



Step 4

After answering all questions on the checklist, you will automatically be taken back to the overview page, which will present the final recyclability score of the disposable unit you evaluated. If you selected multiple disposable units, you can continue with the next check. Note: the information you enter will be stored. If you have to stop while going through a checklist, you can come back later on the same device to continue where you left off. The information you entered previously will still be available.

Step 5

You have the option to export your results as a PDF file from the overview page.
You can then save this file and/or share it with other stakeholders.

Several questions from the checklist feature this symbol ! to indicate that they are complex. Here, it is more difficult to achieve the right score (optimal, adequate, limited or no recyclability) straight away. In these instances, further research can help to achieve a higher degree of recyclability. For example, it may be necessary to perform a test in order to answer one of these questions. Where possible, references to available protocols are provided; in some cases, such protocols have yet to be developed. Relevant updates can be found here.

Note: First answer all questions. Only then can you determine whether a test can help you improve your final score. Sometimes, criteria listed later on in the checklist mean that a test will not result in an improved recyclability score. For example, when a test has to do with a disposable unit's sortability and it does not score optimally on recyclability to begin with. However, it may still be useful to perform the test to learn how well your disposable unit scores on this specific aspect.

2. Definitions

For an overview of the terminology used in this document, consult the packaging glossary on KIDV's website. Several important terms and definitions are clarified below.

Recyclability

The purpose of the KIDV Recycle Checks is to help businesses make their packaging (more) circular. The vision set out by the Ellen MacArthur Foundation serves as the basis for this endeavour:

> *'A circular economy is one that is restorative and regenerative by design and aims to keep products, components and materials at their highest utility and value at all times'*
>
> MacArthur, 2015

KIDV has translated this into the following definition for packaging with good recyclability.

Disposable units of packaging (see chapter 3 of this background document) have to meet four requirements in order to have good recyclability:

1. The disposable unit must be made of materials that can be collected or picked up by approved waste collectors.
2. The disposable unit must be sorted and/or bundled into pre-defined streams for recycling processes.
3. During the recycling process, the material* is processed on an industrial scale** and is recovered into a raw material.
4. The recovered raw material has a uniform composition and can be used to produce new packaging or products.

* *For plastic, at least 70% of the disposable unit's material must be the target material for the recycling process.*

** *Industrial scale means that at least 50% of the collected packaging are correctly sorted and processed by at least two recyclers.*

Producers of innovative materials must be able to demonstrate that these materials can be collected and sorted in sufficient quantities and that they are compatible with existing industrial recycling processes or that new processes are available on an industrial scale.

The checklist makes a distinction between packaging with optimal recyclability, packaging with adequate recyclability and packaging with limited or no recyclability. The following categories are indicated using coloured-coded boxes:

Non-recyclable
Concerns packaging that contain a disruptor. These are substances that severely disrupt the recycling process.

Limited recyclability
Concerns packaging that have limited recyclability,
- because they end up in the mixed stream (i.e. a stream consisting of various types of plastic) during sorting; the granulate that is left after recycling has a limited scope of application.
- or because it is not always possible to sort them into the correct mono-stream.
- or because they contain components that disrupt the recycling process and are difficult to remove.

Reasonable recyclability
These questions concern packaging for which a small step still has to be taken before they can be classified as having 'good recyclability.' These packaging do end up with the recycler as a mono-stream, but something in their composition negatively affects the quality of the recyclate or the effectiveness of the recycling process.

Optimal recyclability
All properties of the packaging are optimally suited for recycling and give the packaging good recyclability according to the aforementioned definition used in the KIDV Recycle Check.

The KIDV Recycle Checks are based on the current (2023) system for the collection, sorting and recycling of flexible plastic packaging in the Netherlands. The focus is on the processes that are used to process at least 50% of the household waste.

Household waste and residual waste

The KIDV Recycle Checks apply to packaging that end up in the household waste or similar waste streams, such as waste from the hospitality sector, offices, retail stores and service companies. They do not apply to packaging that do not belong in the household waste stream, such as small chemical waste (SCW). Examples include packaging that have come into direct contact with medication, packaging made of EPS (polystyrene), filler and buffer materials and packaging used for paint, glue or caulk. Dutch municipalities can choose between source and subsequent separation, which determines how residents should dispose of their waste.

When using *source separation*, residents are asked to perform the initial sorting step themselves by disposing of paper and cardboard, glass and PMD (paper, beverage cartons and metal) in separate containers. Everything else is residual waste.

When using *subsequent separation*, residents can dispose of all their waste in the same bin. After being collected by the municipality, a specialist organisation sorts the waste for recycling. The Waste Separation Guide by Milieu Centraal is a tool that can be used to determine what packaging goes in what bin (only available in Dutch).

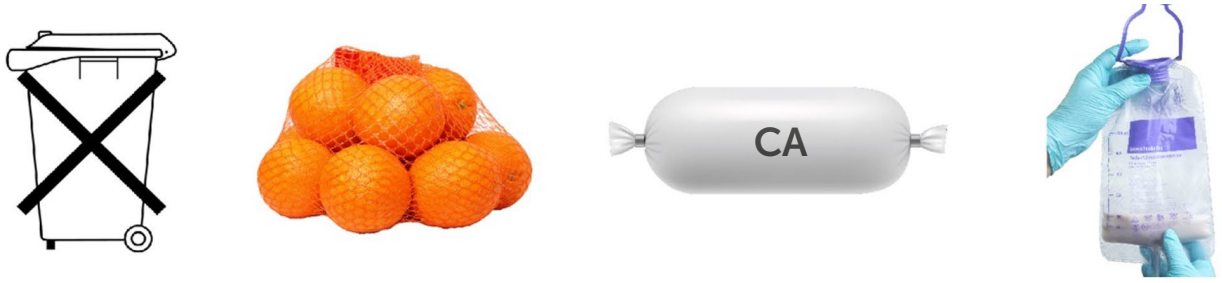


Figure 1 *Examples of packaging types that belong in the residual waste.*

Industrial waste

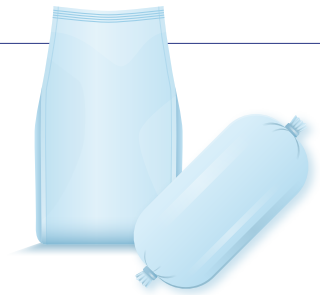
In most cases, specific agreements are made with waste management companies for the collection of Industrial waste. This waste is usually subject to additional quality requirements. The KIDV Recycle Checks do provide a good basis of information with regard to packaging that end up in this stream after use.

Flexible plastic packaging that end up as industrial waste and meet the requirements of this Recycle Check are also classified as having good recyclability.

Definition of a flexible plastic packaging

This Recycle Check covers flexible plastic packaging and/or packaging components that are made of flexible plastic and form a disposable unit (see chapter 3). Contrary to a rigid plastic packaging, a flexible plastic packaging can be crumpled up easily and without using much force.

The material of the main component generally has a thickness of less than 100 µm. They are more two-dimensional than three-dimensional.

Flexible packaging		
	Structure	**Specific characteristics**
	**Shaped packaging:** • Bags • Sausages • Flow wraps • Pouches • Pillow packs	**Interior and exterior** A shaped packaging has an interior and an exterior. If the interior and the exterior consist of different material layers, the exterior is scanned in the sorting facility and this determines the material identification.
	**Sheets, wraps and loose films:** • Top films • Wrapping paper • Wrap film • Middle sheets	**Front and back** In a sorting facility, the material is scanned from above. This means the material identification depends on the material's orientation on the sorting conveyor. If the front and back of a packaging's main component are made of different types of material, the packaging may be sorted incorrectly and disrupt the recycling process.

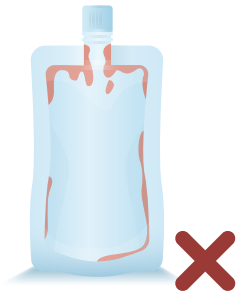
Flexible packaging that may also behave as rigid packaging during the recycling process and may therefore interfere with the recycling process.

	Structure	Specific characteristics
	**3D-shaped packaging:** • Trays • Blisters	Through vacuum forming, a relatively thin film can be given a 3D shape with greater rigidity. Extremely thin blisters and trays can behave as flexible packaging during the sorting process, while thicker designs behave like rigid packaging instead. It is impossible to determine the line between the two types theoretically; their behaviour must be assessed in practice.
	**Packaging with rigid components:** • Spouts • Valves • Zippers • Hangers	Flexible packaging with rigid components often behave differently during sorting and recycling than similar flexible packaging without such rigid components. Some lightweight rigid components made of the same material (e.g. zippers) are acceptable as long as their density is less than 1 g/cm^3 and their weight does not make up more than 5% of the packaging's total weight.

To assess the recyclability of flexible packaging that behave like rigid packaging during recycling, the Recycle Check Rigid Plastic Packaging must be used.

	Structure	Specific characteristics
	**Packaging that largely consist of flexible materials, yet behave like rigid packaging**: • Tubes	A plastic tube consists of a relatively flexible film, a spout and a cap. Its shape gives a tube more rigidity. It has a tendency to regain its original shape and behaves like a rigid packaging during the sorting process. The KIDV Recycle Check Rigid Plastic Packaging must be used for these types of packaging.

Flexible packaging that contain too much product residue

	Structure	Specific characteristics
	**Packaging with rigid components:** • Spouts	Too much product residue makes a packaging heavy. This changes its centre of gravity and can make it behave differently during sorting and end up in the wrong sorting stream as a result. Furthermore, the recycler will have to remove the product residue from the packaging, as it can disrupt the recycling process. This factor is not yet taken into consideration in the KIDV Recycle Check. KIDV is currently developing a robust assessment method. Recyclass has already drawn up a protocol. If the product residue weighs more than half of the total weight of the disposable unit, it is classified as 'not recyclable.'

3. Identifying disposable unit and components

Packaging may consist of a single disposable unit or of multiple disposable units that are discarded at different times. A disposable unit may consist of several components.

When a packaging is discarded after use, the entire packaging may be discarded at once (one disposal moment). In such cases, the packaging is a single disposable unit. It may consist of different components.

Distinguishing between the main component and subcomponents

To assess the recyclability of the packaging, its main component must first be identified. The material that the main component is made of is the so-called target material for recycling. This target material determines what Recycle Check must be used to assess the packaging's recyclability. Besides its main component, a packaging often also has one or more subcomponents.

***Example:** A bag (main component) of noodles that is discarded together with its adhesive seal (subcomponent) (one disposable unit).*

Example 1
A bag of noodles with an adhesive seal.

In many cases, a packaging is not discarded in its entirety all at once, but rather as separate components and at different times.

***Example**: A cardboard box with four granola bars that are individually packaged in a plastic film/wrapper. A consumer takes a granola bar out of the box at different times/in different places.The wrappers are therefore discarded at different times and in different places. Likewise, the box is discarded once all granola bars have been eaten. The packaging therefore consists of a box and four wrappers. In total, these make up five disposable units whose recyclability must be assessed separately. In this example, the Recycle Checks for disposable units made of paper and cardboard and for those made of flexible plastic must be used.*

The following conditions apply when determining the number of disposable units:

1. A packaging or packaging component consists of a single disposable unit if consumers will discard the packaging/component in its entirety. The packaging (component) consists of two or more disposable units if consumers can only use the product by first removing one of the components in its entirety.

2. Consumers can easily separate the components of a packaging without using any tools (e.g. scissors).

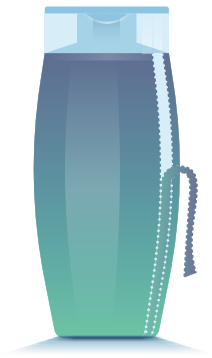
3. The packaging contains instructions to inform consumers on how to discard each component separately. The logos of the Disposal Guide worden gebruikt.

4. It can reasonably be assumed that the consumer will separate the packaging components and discard them separately. Compliance with this final condition can be demonstrated by studying the behaviour of users/consumers in practice. If it is impossible to demonstrate that consumers will separate the packaging components and discard them separately, the packaging will be considered a single disposable unit.

   In such cases, the KIDV Recycle Check for the main component of the packaging can be used for the packaging/disposable unit as a whole.

Example 2
A cardboard box with four granola bars.

Examples



1) Full-body sleeve with a tear strip

Rigid packaging with a full-body sleeve made of flexible plastic that features a tear strip to easily remove the sleeve. If removing the sleeve is not required in order to use the product, it is classified as a subcomponent of the rigid packaging. The sleeve must be assessed as a component of this packaging using the KIDV Recycle Check Rigid Plastic Packaging.

If the sleeve does have to be removed in order to use the product, the packaging consists of two disposable units: the rigid main component and the flexible main component. In that case, the respective Recycle Checks must be used to assess the packaging's recyclability.

2) Jars and trays with a cover film

For rigid packaging with a flexible cover film, it is often difficult to determine whether the film is a disposable unit in and of itself or whether it is part of a different disposable unit.

Some films have to be removed entirely in order to use the product. Then there are films that are easy to remove and/or which come off with minimal use of force after opening the packaging. They come off so easily that this may also happen during sorting. In both cases, the film is classified as a separate disposable unit. The film is a flexible plastic main component that must be assessed using the Recycle Check Flexible Plastic Packaging.

There are also films that require more force to remove and (part of) which will remain attached to the jar or tray after use. Think of e.g. meat packaging whose cover film is very difficult to remove. This cover film must be assessed as a subcomponent of a rigid packaging using the Recycle Check Rigid Plastic Packaging.

Dimensions of a disposable unit

In a sorting facility, disposable units are sorted by size. This is done using a large rotating drum with apertures of different sizes, which separates the disposable units by size. Using this technique, disposable units that are too small (if they can no longer be processed as part of the household waste stream) are separated from the rest of the material.

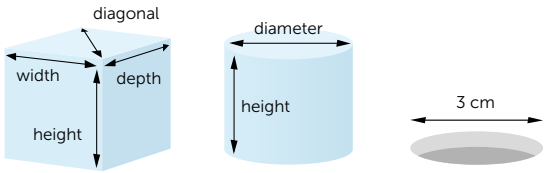
Smaller than 3 cm

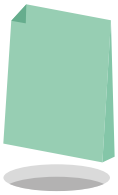
Disposable units are too small to be sorted when they can pass through a round aperture with a three-centimetre diameter, which are the smallest apertures in the screen drum. This concerns the disposable unit as it was used in flat (or filled) form. None of the sides can be smaller than 3 cm. These types of packaging are removed from the sorting stream, because this small fraction is often heavily contaminated. Furthermore, the fraction is made up of many different types of material, which are difficult to separate using conventional techniques.

In most cases, these smallest materials are incinerated with energy recovery.

A4 size

Previous editions of this Recycle Check specified a minimum required size (A4 size) for flexible packaging in order to have good recyclability. This requirement was included because large flexible plastics often concerned PE films that were fairly easy to sort using an extractor system. Nowadays, most sorters are also able to sort packaging with smaller dimensions using ballistic separators and modern NIR (near-infrared) technology. A packaging's size is therefore less relevant; flexible disposable units smaller than A4 size (but larger than 3x3 cm) are also classified as having good recyclability, provided that they meet the rest of the requirements.





Sortable Height,
Height, width, depth, diagonal and/or diameter larger than 3 cm

Not sortable Height,
Height, width, depth, diagonal and/or diameter smaller than 3 cm

4. Points of attention concerning the recyclability of the main component

This chapter describes the extent to which a packaging's main component is recyclable. A distinction is made here between PE and other plastics. The difference between mono- and multi-materials is also explained.

The material composition of the main component:

The material composition of the main component affects the recyclability of the disposable unit in question. Different material types, coatings, fillers and additives all affect how well recyclers can process the material.

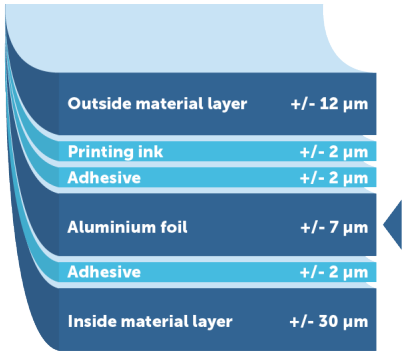
If a main component contains layers of different materials or additions such as coatings, barriers or additives, their impact on recyclability must be assessed.

To do so, it is important to make a distinction between material layers and material additions. A layer generally has a thickness of more than 1 micrometre (1 µm=10-6 m). A coating usually has a thickness of just a few nanometres (1 nm=10-9 m). This is important in order to determine whether a material is a mono-material. This is explained in more detail in the next chapter.

When determining the recyclability of a flexible packaging, the material composition of the main component must be carefully assessed. For this assessment, it is important to distinguish between a material layer and a material addition.

Table 1
Schematic representation of the material composition of a flexible packaging.

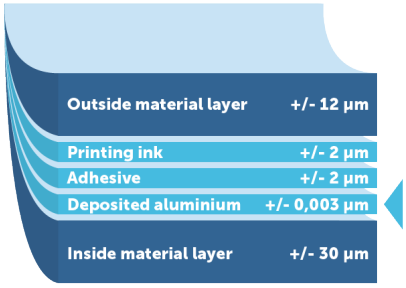
Material layer



A packaging film can consist of one or more material layers. A material layer consists of a single main material or type of polymer that forms a layer of the film by itself and usually has a thickness of more than 1 micrometre (1 µm=10-6 m).

In the example on the left, the aluminium barrier forms a material layer.

Material addition



An addition is a component that does not form a layer of the film by itself, but which is added to a material layer instead. These can be additives included in the layer, as well as additions to the surface of a material layer. The latter category includes: vapour-deposited materials, printing, connective layers of adhesive and coatings. Such additions usually have a thickness of just a few nanometres (1 nm=10-9 m).

In the example on the left, the laminating adhesive, the printing ink and the vapour-deposited aluminium are all additions.

To assess the recyclability, a distinction must then be made between single-layer films (consisting of one material layer) and multi-layer films (consisting of two or more material layers).

Figure 2
Choice diagram for single-layer and multi-layer films.

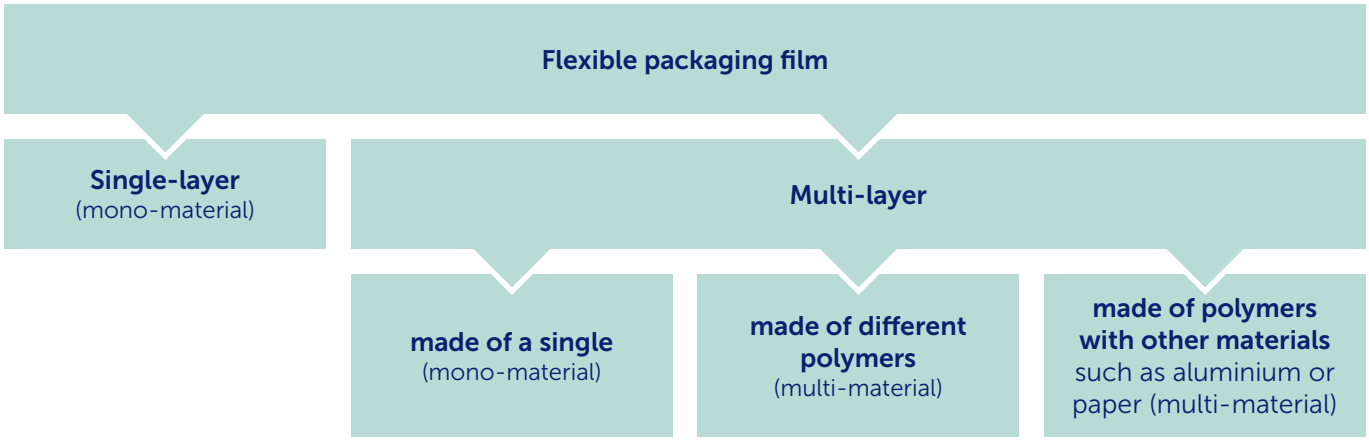
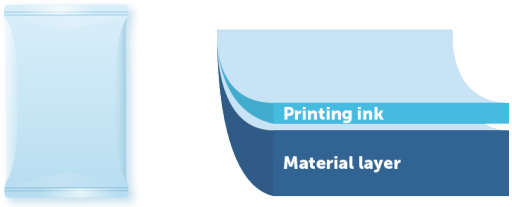
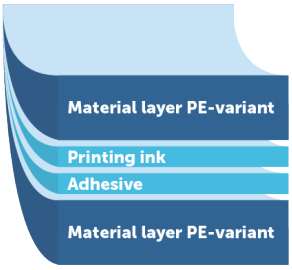


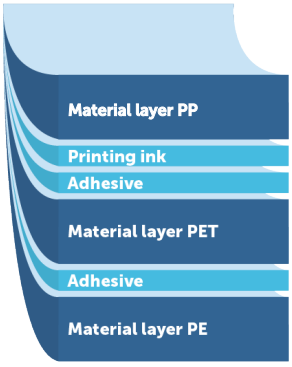
Table 2
Schematic representation of the material composition of a flexible packaging.

Single-layer film	
	A single-layer film consists of a layer made of a single type of polymer (mono-material). Material additions such as printing may be added to the layer.

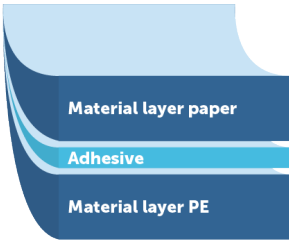
Multi-layer film



A multilayer film can consist of multiple layers made of a single type of polymer (mono-material). An example of this is a multilayer film made of different variants of PE, such as CPE, BOPE, HDPE and LDPE.

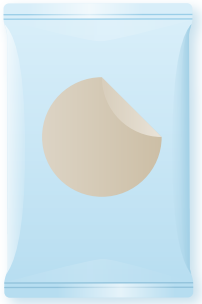


A multilayer film can also consist of multiple layers made of different types of polymer (multi-material). An example of this is a multilayer film made of a combination of LDPE, PET and PP.



There are also multi-layer materials that consist of layers made of non-polymer materials. Examples of this are multi-layer films that consist of combinations of LDPE and paper and/or combinations of OPP with a 7 µm thick layer of aluminium foil.

Sub-component



When evaluating a disposable unit for this Recycle Check, a distinction is made between a material layer and the label. A label is added to the packaging using an adhesive at a later stage of the packaging process.

A label never covers the entire surface of the disposable unit and is not an integral part of the main component. The label and the adhesive used to attach it to the packaging are classified as subcomponents.

PE and PP mono-materials without additions

A main component made of PE or PP as a pure mono-material - without any additions such as coatings, barriers or additives - generally will not disrupt the recycling process.

In plastic sorting installations, disposable units are sorted by shape (flexible or rigid), by type of material (plastic, metal, beverage carton) and then by type of plastic.

Through identification of the main component, flexible plastic disposable units are sorted by type of plastic into a PE stream and, in some cases, a PP stream.

Bio-PE and bio-PP also fall into these categories, as they share the same molecular structure as PE and PP, respectively.

Flexible plastic disposable units that are not made of PE or PP are sorted into a mixed stream. These types of packaging are not classified as having good recyclability. Examples include PET, PA and PLA. The percentage of these materials in the total volume of the household waste stream is relatively small. Due to how difficult it is to sort and recycle these materials in a cost-effective manner, this is not done on a large scale.

A main component that consists for at least 90% of (variants of) PE or PP

Even in relatively small quantities, additions to flexible plastic disposable units can negatively affect the quality of the recyclate. Examples include barrier layers (such as EVOH or vapour-deposited aluminium), inks, coatings and/or fillers. There are many possible combinations of these applications. Only disposable units that consist for at least 90% of PE are a good source for recycling.

If a film consists for more than 10% of other materials, it cannot receive a score of 'good recyclability' in the Recycle Check. Depending on the other materials, however, it may receive a score of 'reasonable recyclability.'

PE is the only flexible material that is recycled on a large scale into new film; the material is primarily used to make garbage bags. For the quality of the PE recycler's sorting process, it is important that foreign materials can be identified as non-PE. These materials can then be sorted into the mixed fraction or the residual fraction.

Biobased PE and biobased PP (also known as bio-PE and bio-PP) have the same properties as fossil PE and PP. This Recycle Check therefore does not distinguish between biobased and fossil PE and PP.

Various organisations, such as Recyclass, CEFLEX and the National Test Centre Circular Plastics (NTCP), assess the impact of different material additions on the quality of the recyclate. Examples include the addition of a limited quantity of EVOH or the impact of vapour-deposited aluminium on the recycling of PE and PP.

The aforementioned organisations are conducting studies to determine what material additions are permissible and in what quantities, without negatively affecting the recycling of plastic packaging. When more knowledge on this subject becomes available, KIDV will update this Recycle Check accordingly.

After PE, PP makes up a relatively large percentage of the flexible plastic stream. The Community of Practice Flexible Plastics is working to determine whether PP can become a separate sorting stream of flexible plastic mono-material. A sorting stream and a separate Recycle Check for flexible PP have been introduced. Given that no separate recycling stream currently exists, flexible PP packaging can at best be classified as having 'adequate recyclability' at the moment.

Materials that affect the recycling process

A disposable unit's main material may contain substances that disrupt the recycling process. While some substances only have a negative impact, others are classified as genuine disruptors.

Barriers, fillers and additives

Barriers, fillers and additives are substances that have been added to the plastic to give the material certain properties. Examples of barriers are EVOH, SiOX, AlOX and vapour-deposited aluminium (metallised).
Examples of fillers are minerals (e.g. *lime or tallow for barrier properties*), fibres (e.g. paper, glass or grass for added strength), mica (for a decorative pearlescent effect), metal flakes (for a decorative metallic effect) and iron oxide (for a decorative terracotta colour).

These additions are not always plastics and have different properties, e.g. with regard to their melting behaviour. These differing properties inhibit the recycling process, e.g. because melt filters get clogged. They may also affect the properties of the recycled material, making it less suitable as a raw material for the production of new packaging or products. These additions affect the quality of the recyclate to a greater or lesser extent.

Coatings

A coating is usually a thin layer with a thickness of a few nanometres (1 nm=10-9 m) that is made of a different material than the main component. The coating is so thin and usually applied in such a manner that separating both material types is impossible. In films, coatings are primarily used to add a barrier or to protect the printing on the film. During recycling, coatings may cause colour deviations or form tiny crystals in the recycled plastic.

How barriers, fillers and additives affect the density

All materials have an base density. For example, plastics such as PP and PE will float in water (density <1 g/cm^3). Plastics such as PET, PS and PLA will sink in water (density > 1 g/cm^3). Recyclers make effective use of this property during the separation process with the help of a so-called sink-float tank. These tanks make it easy to separate e.g. PE and PET. A disposable unit's behaviour in a sink-float tank can easily be determined by submerging it in water and seeing if it floats.

By e.g. adding gas bubbles to PET (foaming), the material's density is altered, causing it to float. As a result, the sink-float method loses its effectiveness and the PET will end up in the wrong material stream. In this example, the foamed PET will contaminate the PE stream.

Similarly, the density of PE and PP can be increased by adding a lot of tallow or lime, causing these materials to sink. That will result in PE and PP contaminating the PET stream.

Examples of disruptors are PVC, PVdC, oxo-degradable materials, elastomers, silicones and other rubber-like substances.

Adhesives

Adhesives between lamination layers can disrupt the recycling process. The severity of the disruption differs per type of adhesive. Recyclass' Design for Recycling Guidelines state that certain types of adhesive are permissible in specific quantities, as these will not disrupt the recycling process. KIDV is in the process of quantifying this and will update this Recycle Check accordingly.

Adhesives between the different layers of a laminate (also known as tie-layers) can disrupt the recycling process. The exact impact differs per type of adhesive and also depends on the presence of additions that help to apply the layer of adhesive (so-called 'compatibilisers'). KIDV is collaborating with its partners to assess the impact of adhesives. The goal is to draw up a robust protocol that can be used to determine when adhesives have good recyclability.

Disruptors

PVC and PVdC

When PVC and PVdC are used in packaging material, they will disrupt the recycling of other plastics. PVC in the recycling stream of other plastics (e.g. in the form of labels) will cause an undesired chemical reaction. The formation of hydrochloric acid will damage the recycling equipment. The same goes for PVdC, which is mainly used as a barrier in films.

Oxo-degradable

Oxo-degradable or oxo-biodegradable plastics are plastics containing additives that disintegrate into small pieces of plastics (microplastics) when exposed to ultraviolet light and oxygen. These additives can be added to all types of plastic. Oxo-degradable plastics are mainly used in carrier bags and bags, but they can also be found in flexible plastic applications.

When oxo-degradable plastics end up in recycling streams, they affect the quality of the plastic recyclate. They are therefore classified as a disruptor.

Oxo-degradable packaging were banned in the Netherlands with the introduction of the Packaging Management Decree 2014 (in Dutch). Per 3 July 2021, the European Union has banned the use of oxo-degradable material in packaging that fall under the scope of the Single-Use Plastics Directive.

Elastomers, silicones and other rubber-like substances
Disposable units with components made of elastomers, silicones, acrylates and other rubber-like plastics may disrupt the recycling process. This is also the case when the content of the disposable unit contains silicones.

Elastomers and silicones, acrylates and other rubber-like plastics are used to produce components whose elasticity, resilience and tensile strength are important. They are found in packaging as components of closures, valves and dosing systems. For example, the cap of a squeeze bottle may contain a silicone membrane that helps to properly dose the product. These silicone components will disrupt the recycling process.

Generally speaking, elastomers cause various types of damage, such as imperfections and defects in the surface of products made from recycled plastic.

Another form of silicones may be added to the material in the form of *slip additives* during the production of packaging to alter the friction factor and make the material easier to process. In this case, the silicones are not classified as a packaging component, but as a processing aid used to produce and fill packaging.

Non-plastic material layers in flexible plastic packaging

In general, non-plastic materials such as paper and aluminium must not be allowed to end up in the recycling stream for flexible plastic packaging. These materials are undesired because they will not melt during the recycling process. The materials may accumulate in the sorting filters, while paper fibres may be incinerated.

It is often difficult to remove these materials entirely during the sorting process. Paper fibres in particular will stick to the plastic and end up in the recycling stream after all.

Colour

Plastic packaging with no added colourants have more possible applications after recycling than coloured variants. Colourless transparent packaging can even be used to produce new transparent packaging. After recycling, white packaging can be used to produce new packaging in a variety of bright colours.

Colouring the main component of a packaging can be done by mixing a colourant into the material or by decorating the packaging's exterior with coatings or inks. These colours may affect the material's sortability and recyclability.

Coloured PET, PE or PP
When coloured plastics are mixed with uncoloured plastics, the material will become discoloured. Once discoloured, it is not possible to restore the material to its colourless or transparent state using conventional mechanical recycling techniques. This then limits the possible applications of this material.

Opaque PET
Opaque PET is non-translucent. It is often coloured white using e.g. titanium oxide, calcium oxide, calcium carbonate or tin oxide as a colourant. In large quantities, these colourants may inhibit the recycling process.

Black packaging
The most commonly used sorting technique utilises near-infrared (NIR) cameras. The type of plastic that a packaging consists of is determined by analysing the spectrum of the reflected infrared light. Black disposable units absorb the infrared light instead of reflecting it.
This prevents the NIR scanner from 'reading' the reflection. As the type of plastic cannot be identified, the disposable unit is not sorted (properly). This is especially true if the material of the main component is fully coloured. Likewise, there is a significant risk of sorting errors if the main component has black printing or if a majority of its surface is covered with a black (printed) label or a black sleeve. If a disposable unit has a (small) black cap or lid, this will not affect the detection process, as the NIR system will scan the main component of the disposable unit.

Carbon black (soot) is a cheap colourant that is commonly used to produce black and dark-coloured packaging. Carbon black is undetectable using NIR technology. Although there are black colourants that affect a packaging's sortability to a lesser extent, the risk of sorting errors is still significant.

Shiny packaging
If a disposable unit has a shiny surface (e.g. as a result of metallisation), NIR camera may not be able to properly identify the material. If the shiny surface is covered with a layer of ink or plastic, the material can usually be identified correctly.

TIP
One advantage of black packaging is that it is easy to use recycled content for their production, as the original colour of the recycled material is less relevant. However, the odds are slim that the packaging is properly sorted and then recycled during the next waste cycle. Packaging with a colour other than black are more likely to be sorted properly. Consequently, the odds of the packaging in question being recycled are also greater. In other words, if it is necessary to use black in a packaging, the producer should strive to use as much recycled material as possible for its production.

Future development

There are ongoing developments involving the use of new technologies to sort black plastic. Although these make it possible to detect black disposable units, they still cannot be sorted by material type. As the type of plastic cannot be identified, the packaging will end in the mixed stream.

To improve the sorting of plastics, new methods for marking packaging materials are being developed. Two examples are:

1. HolyGrail uses digital watermarks (changes to the surface or in the printing of the plastic that are nearly invisible to the naked eye).
2. Curvecode uses a small visible code embedded in the artwork on the plastic.

5. Labels and printing

If a disposable unit does not contain any labels or direct printing, these will not affect the packaging's recyclability.

For optimal recycling, it is best to use a label made of the same material as a disposable unit's main component.

The size of the label also affects sortability. If a label fully or largely covers the material of the disposable unit, it is more difficult to correctly identify the main component's material type.

Depending on the label's material type, a sorter may not be able to sort the disposable unit into the correct material stream, which means it will end up with the wrong recycler.

During recycling, the material type will affect recyclability. Certain material combinations of the main component and the label are easier or harder to separate.

Not all materials affect the quality of the recycling to the same degree.

With paper labels, fibres may come off when the material is shredded or washed. These fibres are hard or impossible to separate from the material of the main component. The fibres may clog the filters in the recycling facility or incinerate during the extrusion process. This disrupts the recycling process, as it creates impurities in the recycled plastic.

Like metallised flexible disposable units, metallised labels contain vapour-deposited aluminium. These labels may inhibit both sorting (their reflectiveness disrupts material identification) and recycling (by causing discolouration of the recyclate).

In certain cases, the same is true for the inks used for direct printing. If these inks end up in the recycling process, they can significantly affect the quality of the recyclate.

In the Recycle Check, the extent to which labels or direct printing affect both sorting and recycling is determined one step at a time.

Label size

Labels made of different materials than the main component are hard to separate from the main component, even if these labels are washable at low temperature. On a PE film, it is therefore best to use labels made of PE, not PP or PET. When labels made of alternative materials are used, they should cover no more than thirty percent of the surface to which they are affixed. This ensures that the NIR scanner will be able to identify the material of the main component.

When are large labels still sortable?

Large labels and sleeves are sortable if they are made of the same material as the main component. This ensures the subcomponent is sorted into the stream of the main component and the main component ends up with the right recycler.

If consumers can only use a product by fully removing the label, this label is classified as a separate disposable unit. In such cases, the material will not affect the sortability of the main component.

In other cases, it cannot be assumed that consumers will remove the label, which is therefore classified as a subcomponent that will inhibit the sorting process if it is too large.

Non-plastic materials in labels

In general, non-plastic materials such as paper and aluminium must not be allowed to end up in the recycling stream for flexible plastic packaging. These materials are undesired because they will not melt during the recycling process. The materials may accumulate in the sorting filters, while paper fibres may be incinerated. It is often difficult to remove these materials entirely during the sorting process. Paper fibres in particular will stick to the plastic and end up in the recycling stream after all.

Thermal paper may contain the disruptor bisphenol A, which also causes problems during recycling.

Foamed labels

Foaming a plastic, i.e. injecting gas bubbles into the material to alter its texture, will change the material's density. This may affect the sink-float process, as foamed PET is more difficult to separate from the PE or PP of the main component.

Future innovation

It is becoming common practice to take subcomponents such as labels and closures into account when assessing the recyclability of packaging. The focus is shifting from removing undesired materials to isolate the main component to producing subcomponents out of materials that can be recycled in and of themselves as a secondary stream.

Adhesives and inks also play an increasingly large role in this. As time goes on, more information is becoming available about how adhesives and inks affect recycling. More information on this can be found in chapter 7.

TIP on the use of inks on labels and direct printing

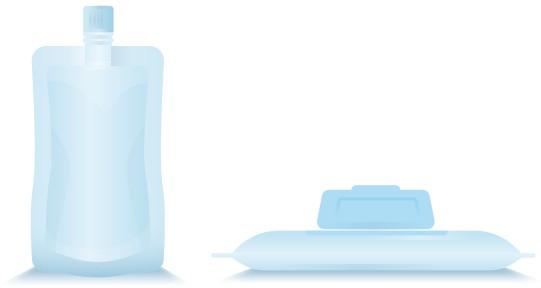
- Minimise the use of inks.
- Make sure the inks and the labels can be separated from the material of the main component. Inks that dissolve in the washing water may settle on the target material as it dries, which can cause discolouration.
- Use inks that meet the requirements of the EuPIA guidelines.*
- It is best to use laser coding to include information directly on the main component itself.

6. Closures and other components

Is it a disposable unit without any rigid components?

Rigid components that form part of a packaging - such as caps, spouts, valves, lids, zippers, handles or hooks - sometimes consist of a different material than the main component. This alternative material inhibits the recycling of the flexible plastic materials. Furthermore, these disposable units may behave like rigid disposable units during the sorting process, which means they often end up in the wrong sorting stream and can therefore not be recycled properly.

There are many types of packaging that contain rigid components. The ratio between the flexible component and the rigid component can vary significantly. For example, consider the small ventilation valve on a one-kilogram bag of coffee beans or the plastic lid on a flow wrap with wet wipes. It is therefore difficult to define a clear limit for ratios that can be properly sorted and those that cannot.



A small rigid component only has good recyclability if it is made of the same material as the rest of the main component. All other cases are classified as risks.

General influences

Enclosed metal components

Enclosed metal components such as closures, clips and RFID (Radio Frequency Identification) chips inhibit the recycling process.

Metal components may not be properly separated from the plastic because they are non-magnetic or because they are enclosed in or attached to the packaging. Think of e.g. the metal clips on the ends of a sausage packaging.

Such components cannot be removed with the help of eddy currents. They end up in the sorting stream with flexible materials, which are then shredded into smaller flakes. The metal components can damage the blades and the small metal particles contaminate the extrusion process. As a result, disposable units with enclosed metal components have poor recyclability.

Non-plastic materials

There are many examples of non-plastic materials that are used in laminates and other components which are attached to the disposable unit. For example:

- aluminium in the cover seals of bottles and trays
- shrink film with cardboard inserts
- a plastic bag with aluminium press studs

Paper is also an undesired material in the recycling of plastic disposable units. As paper fibres will not melt, they may accumulate in the sorting filters and incinerate. The incinerated particles can negatively affect the quality of the recyclate. It is often difficult to remove these materials entirely during the sorting process. Paper fibres in particular will stick to the plastic Similarly, parts of aluminium seals may adhere to the adhesive edge of the main component and end up in the recycling stream after all.

Wood, aluminium and paper or cardboard that can be removed may reduce the processability of the secondary stream (which is not a target material for the recycler).

Closures containing disruptors such as PVC and PVdC

When PVC and PVdC are used in packaging material, they will disrupt the recycling of other plastics. PVC in the recycling stream of other plastics (e.g. in the form of labels) will cause an undesired chemical reaction. The formation of hydrochloric acid will damage the recycling equipment. The same goes for PVdC, which is mainly used as a barrier in films.

PVC is often used in (imported) products and in transparent plastic boxes. It is also commonly used as tamper evidence on e.g. closures, in blisters or as a sleeve around rigid packaging. PVC used for applications other than packaging, also known as vinyl, has good recyclability when it is processed as a separate waste stream. The recyclate has many applications, e.g. in PVC sewer pipes.

Closures that contain disruptors such as silicones and/or elastomers

Elastomers and silicones, acrylates and other rubber-like plastics are used to produce components whose elasticity, resilience and tensile strength are important. They are used in packaging as components of closures, valves and dosing systems. For example, the cap of a squeeze bottle may contain a silicone membrane that helps to properly dose the product. These silicone components will disrupt the recycling process. Generally speaking, elastomers cause various types of damage, such as imperfections and defects in the surface of products made from recycled plastic.

See chapter 5 for more information about label seals/adhesive seals.

On the recycling of PE or PP packaging

PE- and/or PP-based material with a density <1 g/cm³

Sink-float baths are used to separate PE and PP (which have a lower density than water) from heavier plastics such as PET and PS.

PE and PP can be processed together during recycling. PE closures and components of PE disposable units are allowed in the PP recycling stream to a limited degree. However, stricter requirements apply to the presence of PP closures and components of PE disposable units. Sorting processes are therefore designed to prevent too much PP from ending up in the PE stream.

Other plastics such as PET, PS, PC or PE and/or PP with a density >1 g/cm³

If closures or other subcomponents with a higher density increase the weight of the flakes of the disposable unit to around or over 1 g/cm³, these flakes will at best end up in the mixed plastic stream.

Future innovation

It is becoming common practice to take the raw materials of subcomponents into account when assessing the recyclability of disposable units. The focus is shifting from removing undesired materials to isolate the main component to producing subcomponents out of materials that can be recycled in and of themselves as a secondary stream.

Adhesives and inks also play an increasingly large role in this. As time goes on, more information is becoming available about how adhesives and inks affect recycling. More information on this can be found in chapter 7.

7. Adhesion

Packaging without adhered labels or other components

Disposable units without adhered labels or other components have good recyclability.

The impact of adhesives on recycling

If the disposable unit does contain adhered labels or other components, their impact on the recyclability of the main component must be assessed:

- The type of adhesive used determines whether labels or other components will come off the packaging's main component during the recycling process.
- If the subcomponents come off, it is important that the adhesive is removed along with the washing water or with the material of the subcomponents.
- If the subcomponents are also recycled, it is important that the adhesive itself does not affect the quality of the recycling.

The recyclability of more and more adhesive combinations is being tested. KIDV is collaborating with its partners to assess the impact of adhesives. The goal is to draw up a robust protocol that can be used to determine when adhesives have good recyclability.

Cold- and warm-washable adhesives

Most recyclers of flexible PE packaging use cold-washing processes. To recycle sorted disposable units, the packaging are shredded into flakes. The flakes are washed at a low temperature (20-25° C) to remove as many contaminants, labels and adhesives as possible.

Fewer studies have been conducted of the impact of adhesives used on flexible disposable units than of their impact on rigid disposable units. However, Recyclass recently published a washing protocol that can be used to determine an adhesive's washability. Visit KIDV's website for up-to-date information on protocols.

Adhesives between laminated layers

If a film consists of different layers, an adhesive may be used to connect the layers. These adhesives may disrupt the recycling process. At the moment, insufficient information is available on the impact of these adhesives. Various organisations are studying their effect. For example, Recyclass published a study of adhesives in January 2023: Technical-Review-Laminating-Adhesive.

Another method to connect lamination layers is by using coextrusion. With this method, the layers are melted together and no adhesive is needed.

Future innovation

Adhesives are used to ensure that the main component and the subcomponents of a flexible plastic packaging remain attached for as long as the packaging's functionality requires it. They also ensure that a packaging's various components can be separated with minimal effort at the time of use.

A recent development is delamination primer. This is a printed layer between different layers of plastic, which ensures that the layers separate easily during recycling and each layer can be recycled separately.

8. Appendices

Glossary

Additives
Plastics may contain additives; substances that are added to optimise the properties of the material. This may concern the production, the processing or the properties of the plastic itself. Examples of additives are anti-block, anti-condensation or antifog, antioxidant, colourants and fillers (see also the definition of "Filler").

CEFLEX
CEFLEX is a European initiative of more than 190 participating businesses that form a representative representation of the entire value chain for flexible packaging. CEFLEX's mission is to improve the circularity of flexible packaging by designing flexible materials and the related processes. Its goal is to achieve a 100% collection rate for flexible packaging in Europe by 2025 and ensure that 80% of this collected material can be recycled.

Coextrusion
Coextrusion is a design technique that involves combining two or more materials in a coextrusion head to form a multi-layer composite material. If different variants of the same type of material are used, the result is often classified as a mono-material. One example is a coextrudate of LDPE-HDPE-LLDPE. This material can be recycled into a film with different properties.

EVOH
Ethylene vinyl alcohol. This is used as a gas barrier to provide extra/longer protection for packaged products.

Single-layer film
A single-layer film consists of a layer made of a single type of polymer (mono-material).

Metallised packaging material
Packaging material with a metal coating can consist of various base materials to which metal is added on one side. This usually concerns aluminium, which is added using vapour deposition or a thermotransfer layer to serve as a barrier or decoration.

Laminates
Multi-layer flexible multi-materials that are used for the production of plastic packaging. The laminate consists of various layers made of different flexible materials. These layers may consist of different types of materials (e.g. paper and polyethylene) or different variants of the same material, e.g. cast polypropylene (CPP) and oriented polypropylene (OPP). The layers are produced separately and then combined - either immediately or at a later stage - through lamination.

Lamination
Lamination is a technique used to stack multiple layers of the same or different materials on top of each other and connect them together using an adhesive or through coextrusion.

Material layer
A packaging film can consist of one or more material layers. A material layer consists of a single main material or type of polymer that forms a layer of the film by itself and usually has a thickness of more than 1 micrometre (1 µm=10-6 m).

8. Appendices

Glosssary

Material addition
An addition is a component that does not form a layer of the film by itself, but which must be added to a carrier layer instead. These can be additives included in the layer, as well as additions to the surface of a material layer, such as vapour-deposited materials, printing, connective layers of adhesive or coatings. Such additions usually have a thickness of just a few nanometres (1 nm=10-9 m).

Mono-materials
These are materials that consist for more than 90% of a single type of material. These can also be laminates and multi-layer plastic materials whose layers are made of the same base polymer.

Multi-materials
Multi-materials consist of different types of material, none of which make up more than 90% of the total. The different layers can be joined together by mixing them or using a lamination or (co)extrusion process.

Near-infrared (NIR)
A part of the spectrum of light that is just barely invisible to the human eye. NIR scanners use near-infrared light to distinguish between different materials. This technique is used to separate different types of plastic in a waste stream.

PE
Polyethylene, a plastic from the group of polyolefins that only consists of carbon and hydrogen.
The most common variants are:
- HDPE: high-density PE, mostly used for rigid applications.
- LDPE: low-density PE, mostly used for films.
- LLDPE: linear low-density PE, mostly used for films.
- CPE: Cast PE.
- BOPE biaxially oriented PE.
- Bio-PE.

PET
Polyethylene terephthalate, a plastic from the polyester group. PET consists of carbon, hydrogen and oxygen.
It is commonly used in rigid packaging (e.g. bottles, jars and trays), but also in films.

PP
Polypropylene is a plastic from the group of polyolefins that only consists of carbon and hydrogen. Common variants are:
- PP: mostly used for rigid applications such as bottles and caps.
- CPP: cast PP.
- OPP: oriented PP, mostly used for films.

PVC
Polyvinyl chloride. A polymer that consists of carbon, hydrogen and chloride.

PVdC
Polyvinylidene chloride. A polymer that consists of carbon, hydrogen and chloride.
It is mostly used as a barrier material in packaging.

A more comprehensive glossary is available here.

Additional sources of information

KIDV

- Community of Practice Flexible Packaging

Recyclass

Founded by Plastic Recyclers Europe and a cross-industry initiative that advances plastic packaging recyclability while promoting the traceability of plastic waste and recycled plastic content in Europe.

- Design For Recycling Guidelines
- Cold-washing protocol
- Recyclass Recyclability Methodology

CEFLEX

CEFLEX is a European initiative with over 190 participating businesses that form a representative representation of the entire value chain for flexible packaging.

- Design for Recycling Guidelines

Wageningen University Food & Biobased Research

- Recyclability of packaging on the Dutch market (in Dutch)

Plato product consultants

- Zakboek Verpakkingen (in Dutch)

FH Campus Wien

- Circular Packaging Design Guideline

Citeo

- French EPR Organisation

Other options to make packaging more sustainable, other than improving its recyclability

Tips for sustainable packaging

KIDV has drawn up seven tips that outline the key points of attention for more sustainable packaging. Recyclability is one of these aspects; it is covered in tip 4:
Create a clean material stream that has good recyclability. Besides recyclability, there are other points of attention that relate to sustainable packaging, such as tip 5 on the use of recycled content. If you use recycled content in a packaging with good recyclability, you contribute to the closing of the loop. When developing a packaging, it is advisable to take all seven tips into account and ensure you meet the Essential Requirements (only available in Dutch).

Tip 5 also mentions renewable resources, such as biobased plastics. This is an alternative option if it is not possible to use recycled content, e.g. due to food safety concerns. Consult the KIDV fact sheet Biobased plastic packaging for more information.

Tip 7 helps you ensure your packaging actually ends up with a recycler. In addition to designing the packaging to be recyclable, it is important that users of the packaged product properly dispose of the empty packaging after use. You can use the Disposal Guide to inform consumers about the correct way to dispose of a packaging.

Sustainable Packaging Compass

KIDV has introduced the Sustainable Packaging Compass. This tool consists of three modules that provide insight into the recyclability, circularity and environmental impact of a packaging. The modules are complementary. They not only indicate whether a packaging is recyclable, but also the extent to which it is circular. Additionally, the tool offers an indication of the packaging's environmental impact.

Businesses can use this information to compare different (types of) packaging and assess their respective performance in relation to the various sustainability aspects.

This helps them define targets for making packaging more sustainable and measure the effects of their packaging optimisation efforts. This free tool is available via this link.

Courses

Do you need help to get started on making your packaging portfolio, packaging or strategy more sustainable or have you already begun this process and could you use some fresh insights? KIDV offers training programmes that provide theoretical and practical insight into the world of sustainable packaging. This programme is based around KIDV's knowledge and tools, such as KIDV's Five perspectives on sustainable packaging® model and the Recycle Checks. The programme is complemented by relevant current themes and practical examples. You can use the acquired knowledge and skills to help you formulate a strategy to make your packaging more sustainable and to apply our practical tools in your own professional practice. More information can be found here.

The State of Sustainable Packaging

This publication offers a strategic perspective on the required short-, medium- and long-term collaboration and innovations with regard to sustainable packaging.
The State of Sustainable Packaging offers a strategic perspective on the required collaboration and innovations with regard to sustainable packaging. The publication identifies the social and economic bottlenecks that stand in the way of sustainable packaging. To tackle these bottlenecks, KIDV has developed a strategy with three innovation tracks that offer short-, medium- and long-term effects. These range from more and better recycling - which has already been achieved in some countries - to increased circularity and - ultimately - intrinsic sustainability.

More information

If you have any questions about the Recycle Check or about making your packaging more sustainable, please contact KIDV. You can also find more information about making packaging more sustainable here.

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