



Kenya
Plastics
Pact

KENYA PLASTICS PACT

DESIGN GUIDELINES FOR RECYCLABILITY IN KENYA

PET BOTTLES AND HDPE BOTTLES & JARS

*Version 1
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- **AA scavengers:** These are substances or compounds used to remove or reduce the presence of oxygen in a given environment or system.
- **ABS:** Acrylonitrile Butadiene Styrene
- **CaCO₃:** Calcium carbonate
- **EVOH:** Ethylene Vinyl Alcohol
- **HDPE:** High-Density Polyethylene
- **OPS:** Oriented Polystyrene
- **PA:** Polyamalyde
- **PE:** Polyethylene
- **PET:** Polyethylene Terephthalate
- **PETG:** Polyethylene Terephthalate Glycol
- **PP:** Polypropylene
- **PLA:** Polylactic Acid
- **PVdc:** Polyvinylidene chloride
- **PVC:** Polyvinyl chloride
- **Recyclate:** recycled materials that are obtained from the recycling process.
- **Recycling plant:** A facility where the recycling process takes place, including the separation, cleaning, and processing of recyclable materials.
- **Thermoplastic:** A material that can be melted and re-moulded multiple times without undergoing significant chemical change.
- **UV:** ultraviolet radiation
- **UV-curable coatings:** Water-based coatings that are cured by exposure to ultraviolet light, providing protection against abrasion and other types of damage.
- **UV stabilizers:** UV stabilizers are additives used in plastics to protect them from the harmful effects of ultraviolet (UV) radiation from the sun.



TABLE OF CONTENTS

2	GLOSSARY
4	INTRODUCTION
5	RECYCLABILITY EXPLAINED
5	PURPOSE OF THE DESIGN GUIDELINES FOR RECYCLABILITY IN KENYA
5	DESIGN GUIDELINES RATINGS
7	PET
7	CURRENT PET BOTTLES RECYCLING PROCESS IN KENYA
8	Material and Material Combination
8	Barriers and Coatings
8	Closures (caps, seals and liners)
9	Colour
9	Decorations (labels, adhesives, sleeves, inks, direct printing)
11	Additives
12	SUMMARY OF DESIGN GUIDELINES FOR RECYCLABILITY FOR PET BOTTLES
14	HDPE BOTTLES AND JARS
14	Current HDPE bottles and jars recycling process in Kenya
15	Material and material combination
15	Barriers and coatings
16	Colour
17	Closures (caps, seals and liners)
18	Decorations (labels, adhesives, sleeves, inks, direct printing)
20	Additives
21	SUMMARY OF DESIGN GUIDELINES FOR RECYCALBILITY FOR HDPE BOTTLES & JARS
22	APPENDICES
22	APPENDIX 1: OVERVIEW OF KENYA PLASTICS PACT
23	CONTACTS

INTRODUCTION

Our heavy reliance on plastics packaging has long been of growing concern. Over the years, plastics packaging has become an essential material for many industries and indeed for the economy fulfilling many essential roles; from protection, storage and transport functions.

These functions essentially contribute to sustainability, as packaging prevents damage to sensitive products and loss of food.

In many cases, the environmental impact of producing the packaged good is considerably greater than the impact of producing the packaging itself. In other words, when designing sustainable packaging, the protection of products must also be considered.

The unregulated dumping and plastics packaging ending up in landfills pose a critical and often immediate threat to countless endangered species, ecosystems and dependent socio-economic systems all over the country. The systemic challenge raised by this environmental crisis lies at the heart of the Kenya Plastics Pact (KPP).

In recent years, a growing demand for greater sustainability in packaging design has been apparent. Sustainable packaging incorporates functionality and the protection of products while keeping its ecological footprint to a minimum and enabling reuse and recycling.

To achieve higher material recycling rates, and move towards circularity, we need to rethink the design of packaging to improve its future recyclability while guaranteeing its functionality; as also outlined in the Extended Producer Responsibility (EPR) Regulations.

The aim of the regulations is to provide a framework for the establishment of mandatory EPR Schemes in the country to enhance resource use efficiency, stimulate innovation, spur recycling and reduce the amount of waste destined for final disposal.

In Kenya, approximately 80% of plastic packaging materials used locally are made of imported virgin polymers (processed into packaging domestically) and, to a lesser extent, domestically recycled materials with only around 20% of packaging being imported in the form of packed/made products.

Additionally, of the total plastics produced in Kenya, approximately 36% are used in packaging, with approximately 85% (of the 36%) destined for landfills and unregulated dumpsites.

Plastic packaging being dumped or ending up in landfills poses a critical and often immediate threat to countless endangered species, ecosystems and dependent socio-economic systems all over the country. The systemic challenge raised by this environmental crisis lies at the heart of the Kenya Plastics Pact (KPP).

80%

of plastic packaging materials of imported virgin polymers

20%

of packaging being imported in the form of packed/made products

36%

of the total plastics are used in packaging

85%

Approximately 85% (of the 36%) end up in landfills

¹Eunomia (2018). Plastic Packaging Waste Flows in Kenya. [pdf] The Danish Environmental Protection Agency, Copenhagen.

²United Nations Environment Programme & Consumers International (2020). "Can I Recycle This?" A Global Mapping and Assessment of Standards, Labels and Claims on Plastic Packaging.

● ● ● RECYCLABILITY EXPLAINED

The current legislation related to Sustainable Waste Management Act 2022 in Kenya does not provide a clear definition of recyclable. Due to a lack of a harmonised definition of recyclability, recyclability claims are not necessarily based on real-life conditions such as the availability of recycling infrastructure, market conditions and the financial viability of recycling operations.

Simply, plastic packaging is recyclable when it can be recycled. Based on the Ellen MacArthur Foundation's Global Commitment, the Kenya Plastics Pact explains the definition as follows: **a packaging or a packaging component is recyclable if post-consumer collection, sorting, and recycling are proven to work in practice and at scale**³.

● ● ● PURPOSE OF THE DESIGN GUIDELINES FOR RECYCALBILITY ● FOR PLASTIC PACKAGING

These design for recycling guidelines for plastic packaging aim to provide clear recommendations to decision-makers on how to design plastic packaging to be compatible with current (and future projection of) mechanical recycling infrastructure.

These guidelines will be regularly updated and amended in response to changes in collection, sorting, recycling technologies and infrastructure within Kenya.

● ● ● DESIGN GUIDELINES RATINGS

The design guidelines are presented in three categories, signifying compatibility with recycling:

Green	Yellow	Red
Green denotes packaging features that are generally compatible with or separable from the main material and is acceptable in recycling processes in large volumes.	Yellow denotes packaging materials that are recyclable in some applications, but could contaminate the recycling process.	Red denotes packaging items and materials that are generally not compatible with the current recycling systems or not separable from the main material in current processes and will contaminate the recycling process.

³Ellen MacArthur Foundation (2018). New Plastics Economy Global Commitment, 25 October. [Ellenmacarthurfoundation.org: https://www.ellenmacarthurfoundation.org/assets/downloads/Global-Commitment-Documents-to-download-on-website-2.pdf](https://www.ellenmacarthurfoundation.org/assets/downloads/Global-Commitment-Documents-to-download-on-website-2.pdf).



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DESIGN GUIDELINES FOR RECYCLABILITY IN KENYA

PET BOTTLES



Polyethylene terephthalate (PET) is widely used for food and beverage packaging applications as it is clear, strong and lightweight with good barrier properties which provide improved shelf life. Additionally, PET offers excellent water resistance which makes it great for containers carrying liquid. With its clear appearance, it's perfect for allowing consumers to see the contents and enhance product presentation. PET plastic packaging can be recycled into different products and its status as one of the most used plastic packaging materials in the world is due to its performance qualities and its highly recyclable nature. Due to its high value much of it is recycled hence less likely to end up being dumped. An average of 25% of all PET packaging is recycled in Kenya , making it the most locally recycled plastic packaging material.

Its high recyclability makes it less likely to end up in landfill and an average of 25% of all PET packaging is recycled in Kenya⁴, making it the most recycled plastic packaging material.

CURRENT PET BOTTLES RECYCLING PROCESS IN KENYA

Recycling of PET bottles starts with separation usually at the collection centre or at the recycling plant. The various recyclable materials are separated out, with glass, paper and metal moving into their own recycling streams. Once all the non-plastic waste has been removed, high-value recyclable plastics like PET bottles are separated by hand. Once the PET bottles have been collected and separated according to colour, they are compressed into bales for ease of transport. At the recycling plant, PET is shredded into small, crushed flakes.



BOTTLE TO FIBRE

The flake material is melted and solid contaminants are removed using a melt filter. Recyclers in Kenya spin the melted PET into recycled polyester yarn. This is then turned into fabrics that can be used in seat belts, bags, carpets, roofing insulation, clothing etc.



BOTTLE TO BOTTLE

Part of the recycling process is also converting the melt into PET pellets for export for the production of PET bottles. There is currently no PET bottle-to-bottle recycling in Kenya, but it is desirable.

⁴Eunomia (2018). Plastic Packaging Waste Flows in Kenya. [pdf]The Danish Environmental Protection Agency, Copenhagen.

MATERIAL AND MATERIAL COMBINATION

Material and Material Combination PET (polyethylene terephthalate) bottles can be effectively recycled when they are made of compatible materials or combinations of materials. High-density polyethylene (HDPE) is another common plastic used in packaging. When PET bottles and HDPE bottles are separated and recycled separately, they can be effectively recycled without issues.

Polyvinyl chloride (PVC) is a plastic that is not compatible with PET recycling. When PVC is melted with PET, it can produce harmful gases that are dangerous to workers and the environment. PS has a lower melting point than PET and can cause problems during the recycling process of PET bottles.

Materials such as metal, paper, and cardboard are not compatible with PET recycling. They can damage recycling equipment or contaminate the recycled PET, leading to lower-quality recycled material.

CLOSURES (CAPS, SEALS AND LINERS)



Metal Closures on PET bottles

BARRIERS AND COATINGS

A coating is a covering that is applied to the surface of an object. The purpose of applying the coating may be decorative, functional or both⁵. They are applied to rigid plastics to improve the barrier properties.

PET bottles already have some barrier properties but different applications may require different barriers

There are three general steps for coating applications:

- Surface preparation;
- Application of the coating;
- Drying of the coating⁶.



HDPE closures common on PET bottles

Closure systems without liners are preferred. PP or HDPE closures on PET bottles are preferred as they separate from PET in a float/sink tank.

Closures made of metal, aluminium-containing materials (with a layer thickness greater than 5 μm), PS, Acetal plastic, also called polyacetal and polyoxymethylene (POM) and PVC are considered contaminating materials, as they interfere with the sorting and reprocessing of the material and can damage extruders and equipment, among other things.

⁵Luísa Reis Gonçalves. (2014). Development and Application of Barrier Coating on PET (dissertation). <https://core.ac.uk/download/302934381.pdf>

⁶Luísa Reis Gonçalves (2014). Development and Application of Barrier Coating on PET. <https://core.ac.uk/download/302934381.pdf>

COLOUR

PET can be pigmented in many colours. Clear bottles are fully recyclable with light blue bottles being acceptable as they can be blended in small amounts with clear bottles for recycling. Green and brown bottles are also recycled but have a much lower value than clear bottles. Pale, light, dark or opaque material can be collected and recycled, but has a lower end market value than transparent material.



Heavily pigmented PET bottle



Clear/transparent PET bottle



Light blue PET bottle

DECORATIONS (LABELS, ADHESIVES, SLEEVES, INKS, DIRECT PRINTING)

LABELS

If using paper labels, these should not delaminate in the washing process. PE and PP labels are preferred. Paper labels can be more difficult to remove in the recycling process and bits of paper fibre and glue that remain on PET after the separation process can burn and cause black marks when the flake is later heated. PE and PP labels from the PET flakes are easily and accurately removed by passing the PET flakes through a sink float separation tank through which separation occurs due to the difference in density between PET and PE/PP labels, PET sinks whereas PE/PP labels remain on top.



Paper label on PET bottles

SLEEVES



Shrink sleeve labels on PET bottles

The use of PET sleeves with PET bottles should be avoided. Although made of the same material, PET sleeves are usually highly pigmented and are not easily separated. Furthermore, Sleeves should be designed to completely detach from the container or else they become contaminants.

Research shows that shrink sleeve films made of PVC, PETG, PLA & OPS are incompatible with PET recycling. First, if PVC shrink label films are used on PET bottles, it causes black speck contamination and discolouration during recycling of PET bottles making the container non-recyclable. Secondly, If PVC is recycled at PET processing temperatures it will begin to break down and can produce HCl gas, which is poisonous and corrosive. Third, shrink sleeves made of PVC, PETG, PLA & OPS sink in water together with PET during the sink-float separation hence making it difficult to separate

INKS

During the water-based separation process, bleeding inks can contaminate recycled flake and cause discoloration of recycled plastic. Inks containing heavy metals should not be used for printing as they may contaminate the recovered plastic. Inks that would dye the wash solution should be avoided as this may discolour the recovered plastic diminishing its value.

ADHESIVES

Adhesives that are water soluble at between 60 - 80 degrees Celsius and hot melt alkali soluble adhesives are the most readily removed during the recycling process. For most plastic bonding applications cyanoacrylate adhesives, UV curable adhesives as well as some epoxy and structural adhesives can be used.

DIRECT PRINTING

Direct printing, with the exception of date and batch coding, onto PET bottles should be avoided as direct printing contaminates the PET recycling stream and discolours the resultant material.



Direct printing on PET bottle

⁷The Association of Plastic Recyclers (2021). Shrink Sleeve Labels on PET Containers APR Resource.

⁸Recoup (2009) Plastics Packaging - Recyclability by Design, 2009 revised edition

⁹World Packaging Organization (2020). A global recommendation for circular packaging design.

ADDITIVES

AA blockers, also known as AA scavengers or AA absorbers, are added to the PET resin during the production process to prevent the formation of acetaldehyde. Acetaldehyde (AA) blockers are compatible with PET (Polyethylene terephthalate) recycling because they are specifically designed to prevent the formation of acetaldehyde, which is a by-product that can be formed during the production and storage of PET bottles .

UV stabilizers are often added to PET plastics to protect them from degradation caused by exposure to sunlight. However, UV stabilizers can also make it more difficult to recycle PET plastics because they can interfere with the chemical processes used to break down and melt PET for recycling . Specifically, UV stabilizers can create a residue on the surface of the PET that can cause problems during the recycling process, such as discoloration and poor quality of the recycled material.



SUMMARY OF DESIGN GUIDELINES FOR RECYCLABILITY FOR PET BOTTLES

ITEMS	GREEN	YELLOW	RED
MATERIAL & MATERIAL COMBINATION	- PET		- PVC - PS - Metal - Paper - Cardboard
BARRIERS AND COATINGS	- EVOH < 5%	- PA-MXD6 multilayer with <6wt%	- EVOH / PA >5% monolayer blends - PA-Polyamalyde multilayer with >6wt% - PVdc
CLOSURES	- Closures made of PP, HDPE or other materials with a density of less than 1 g/cm ³ . - Closure systems without liners.	- Ethylene-vinyl acetate (EVA) or Thermoplastic elastomers (TPE) liners	- Closures made of metal, aluminium-containing materials (with a layer thickness greater than 5 µm), PS, Acetal plastic, also called polyacetal and polyoxymethylene (POM) and PVC.
COLOUR	- Transparent clear and transparent light blue are fully recyclable.	- Other transparent colours	- Opaque colours
LABELS	- PE and PP labels	- Conventional paper labels. During the washing process of conventional paper labels, fibres come out that contaminate the recycle.	- Large-scale decorations covering more than 50% of the packaging surface can impair the sorting of the packaging. - Full body label. - PET as well as non-wet-strength paper labels can contaminate the PET fraction. - PS labels.
SLEEVES	- If sleeves are used, they should cover a maximum of 40% of the packaging and be made of a material (e.g. PP and PE) with a density of less than 1g/cm ³ to enable ease of separation in the sink float separation process.		- Sleeves made of a material with a density greater than 1 g/cm ³ (e.g., PVC, Oriented Polystyrene (OPS), Polylactic acid (PLA) should be avoided.
INKS	- Non-bleeding inks are preferable to avoid potential contamination.		- Bleeding inks.
ADHESIVES	- Cyanoacrylate adhesives, - - UV curable adhesives as well as some epoxy and structural adhesives ¹ .		- Adhesive materials containing metal or aluminium (with a layer thickness of greater than 5 microns µm) can lead to unwanted sorting into the metal fraction.
DIRECT PRINTING	- The batch coding and the indication of the best-before date should ideally be carried out in the form of an embossing or laser marking.	- The batch coding and indication of the best-before date done by means of minimal direct printing with other coding systems (e.g., ink-jet), provided that food-grade inks are used.	- Extensive direct printing on the packaging is disadvantageous, as released printing inks can impair the clarity of the recycle or contaminate the recycling stream via released printing inks in the wash water.
ADDITIVES		- Ultraviolet (UV) stabilizers - Acetaldehyde (AA) blockers	- Acrylonitrile Butadiene Styrene (ABS).

¹⁰Silva SM, Medeiros ES, Galvão LS, Santos ASF. Characterization of adhesive content in post-consumer poly (ethylene terephthalate) bottles and assessment of its impact on poly (ethylene terephthalate) recyclability. Progress in Rubber, Plastics and Recycling Technology. 2023;0(0). doi:[10.1177/14777606231152507](https://doi.org/10.1177/14777606231152507)



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HDPE BOTTLES AND JARS



HDPE BOTTLES AND JARS

High Density Polyethylene (HDPE) is a thermoplastic with a high strength-to-density ratio which makes it the perfect material for plastic bottles and jars. HDPE bottles and jars are also lightweight and food-and-beverage safe and the translucent nature of HDPE bottles makes it possible for consumers to view the amount of product still inside. Additionally, HDPE bottles come in all shapes, sizes and colours. Because HDPE has moisture-barrier properties and chemical resistance, it has been found to be a perfect fit for many different bottling applications and available in different types including; milk bottles; and bottles designed to hold industrial chemicals, household cleaners and detergents.

Of all 38,000 tonnes per year plastic packaging recycled in Kenya, 19% is HDPE plastic packaging



HDPE Bottle photo

CURRENT HDPE BOTTLES AND JARS RECYCLING PROCESS IN KENYA

Recycling of HDPE starts at separation either at a collection centre/aggregation point or at the recycling plant. The recycling process for HDPE can vary, but the general process remains the same.

HDPE is separated out by grade as HDPE can vary by thickness and durability. The plastic will then be thoroughly cleaned to remove any debris or residual contaminants, such as dirt or liquid. Any impurities mixed in with the plastic would compromise the end product.

Sorting separates out the HDPE products with other materials and polymers so that any other plastics mixed with it do not inhibit HDPE-specific recycling.

Sorting can be done through several methods. For instance, PET plastic can be isolated from HDPE through sink-float separation, where the different densities of these materials will have them float at different levels in a liquid.

With the HDPE properly removed from other plastics and debris, it then undergoes granulation in which machines shred the HDPE and melt it down before reforming it into uniform granules, the basic building blocks of HDPE recycled products.



HDPE Bottle photo

¹¹Eunomia (2018). Plastic Packaging Waste Flows in Kenya. [pdf]The Danish Environmental Protection Agency, Copenhagen.

¹²<https://www.letsrecycleit.eu/hdpe-recycling/>

● MATERIAL AND MATERIAL COMBINATION

HDPE bottles can be easily recycled into a wide range of products, including new HDPE bottles and plastic lumber. Similarly, some manufacturers use a combination of HDPE and PP materials to create bottles that are strong and flexible. These bottles are also generally compatible with HDPE recycling, as long as the PP layer is separated from the HDPE during the recycling process.

It's important to avoid using materials or material combinations that are not compatible with HDPE recycling, such as PVC or other types of plastics including PLA and PS that may contaminate the HDPE plastic and reduce the quality of the recycled material.

● BARRIERS AND COATINGS

EVOH barriers are highly effective at preventing the penetration of oxygen and other gases, making them useful for packaging products that require a longer shelf life.

When HDPE bottles with high concentrations of EVOH are recycled, they tend to create impurities and lower the overall quality of the recycled material.

As such, an EVOH concentration of more than 5% can create issues such as increased melt viscosity, reduced melt strength, and increased sensitivity to temperature variations. These factors can make it more challenging to process the recycled HDPE material effectively, leading to reduced quality and potential production issues. In that regard, an EVOH concentration of less than or equal to 5% concentration is recommended.

Water-based coatings are used in HDPE bottles to improve their appearance or provide additional protection against scratches and other types of damage. These coatings are generally clear and can be applied to the surface of the bottle to create a smooth and glossy finish and are compatible with HDPE bottle recycling.



Some examples include:

Acrylic coatings are clear, water-based coatings that are often used in HDPE bottles to provide a smooth and glossy finish. These coatings are durable and resistant to scratches and other types of damage, making them ideal for packaging products that require a high level of protection.

Polyurethane coatings are water-based coatings that are often used in HDPE bottles to provide a glossy and protective finish.

These coatings are durable and resistant to abrasion, making them ideal for packaging products that require a high level of protection.

Epoxy coatings are water-based coatings that are often used in HDPE bottles to provide a high level of chemical resistance and protection against abrasion. These coatings are ideal for packaging products that contain harsh chemicals or other substances that could damage the bottle.

UV-curable coatings are water-based coatings that are cured by exposure to ultraviolet light. These coatings provide a high level of protection against abrasion and other types of damage, making them ideal for packaging products that require a high level of protection.

● COLOUR



In Kenya, most recycling facilities accept HDPE bottles in natural or clear colour (translucent) for recycling. This is because clear or natural HDPE bottles are easier to recycle and can be used to make a wider range of products compared to coloured HDPE bottles. It is financially affordable to recycle clear bottles and the recyclate is of high economic value.

Additionally, recycling facilities in Kenya also accept coloured HDPE bottles for recycling, but only certain colours. The most commonly accepted colours for recycling in Kenya are blue, green, and brown. These colours are easier to sort and can be recycled into a range of products such as flower pots, outdoor furniture, and other household items. However, coloured plastic packaging is much harder to recycle financially than clear plastic because there is very small need for the resulting recyclate that occurs when containers of all colours are combined.

CAPS

PP is a contaminate to the HDPE stream, but is marginally compatible with HDPE after melt blending and so HDPE-based tubes that employ a PP closure are considered recyclable, but with a detrimental feature. HDPE caps are also commonly used with HDPE bottles because they are made from the same material and have similar properties. They are compatible with recycling because they can be easily separated from the HDPE bottles during the recycling process.

It's important to note that caps made from materials such as PVC, PS, or PET are generally not compatible with HDPE bottle recycling and should be avoided. These materials can contaminate the recycled material and reduce its quality.

Caps that are compatible with HDPE bottle recycling should have a similar density to HDPE plastic, which is between 0.940 and 0.965 grams per cubic centimeter (g/cm^3). This means that caps made from materials with a density outside of this range may not be compatible with HDPE bottle recycling.

For example, caps made from high-density polyethylene (HDPE) have a similar density to HDPE bottles and are therefore compatible with recycling.

On the other hand, caps made from materials such as polyethylene terephthalate (PET) or polystyrene (PS) have densities that are outside of the range of HDPE plastic and are generally not compatible with HDPE bottles recycling.

SEALS

Seals are an important component of HDPE bottles and it's important to choose ones that are compatible with recycling. Here are some types of seals that are commonly used with HDPE bottles and are considered to be compatible with recycling:

Induction seals are a type of liner that is heat-sealed to the top of a bottle using an electromagnetic field. Induction seals are often made of aluminium foil or other materials that can be easily separated from the HDPE bottle during the recycling process.

Foam seals are often used with HDPE bottles to provide a tight seal and prevent leakage. Foam seals are typically made from polyethylene foam, which is compatible with recycling.

Pressure-sensitive seals are a type of liner that is adhered to the top of a bottle using pressure. Pressure-sensitive seals are often made from materials such as polypropylene or polyethylene, which are compatible with recycling.

Expanded Polyethylene (EPE) seals are often used with HDPE bottles to provide a tight seal and prevent leakage. EPE seals are typically made from expanded polyethylene foam, which is compatible with recycling.

It's important to note that seals made from materials such as PVC or PET are generally not compatible with HDPE bottles recycling and should be avoided. These materials can contaminate the recycled material and reduce its quality.



LINERS

Liners are commonly used in HDPE bottles to provide a seal and protect the contents of the bottle.

PE liners are often used in HDPE bottles because they are made from the same material and have similar properties. They are compatible with recycling because they can be easily separated from the HDPE bottles during the recycling process.

PP liners are also commonly used with HDPE bottles because they have a high melting point and are resistant to moisture and chemicals. They are compatible with recycling because they can be easily separated from the HDPE bottles during the recycling process.

It's important to note that liners made from materials such as PVC or PET are generally not compatible with HDPE bottles recycling and should be avoided. These materials can contaminate the recycled material and reduce its quality.



DECORATIONS (LABELS, ADHESIVES, SLEEVES, INKS, DIRECT PRINTING)

LABELS

Choosing the right label for HDPE plastic bottles is important to ensure that the label does not interfere with the quality of the recycled plastic. It's important to consider the type of adhesive, density as well as the label material, when choosing a label for HDPE plastic bottles. Labels that are compatible with HDPE bottles recycling should be designed to be easily removed during the recycling process, without leaving any adhesive residue or contaminants that could interfere with the quality of the recycled plastic.

The PE labels are compatible because they are made of similar material, PP labels can be a contaminant (although probably yellow rather than red) as would labels with a density >1 because they can be separated easily (sink-float), manual separation of labels is an extremely labour-intensive process.

If non-PO materials are foamed they can have a lower density, this would also cause an issue. The density of labels used on HDPE bottles can affect their compatibility with recycling.

In general, labels with lower density are considered to be more compatible with HDPE bottles recycling. PE labels typically have a density range of $0.91-0.96 \text{ g/cm}^3$, which is similar to HDPE plastic bottles.

PE labels are highly compatible with HDPE bottles recycling and can be easily recycled along with the bottles. PP labels typically have a density range of $0.89-0.91 \text{ g/cm}^3$, which is lower than HDPE plastic bottles.

This makes PP labels compatible with HDPE bottles recycling and can be easily removed during the recycling process.

ADHESIVES

Water soluble and water releasable adhesives are commonly used in packaging applications and can bond well to HDPE plastic. They can be easily removed during the recycling process. Water-based adhesives are also a good option for HDPE plastic bottles as they do not contain solvents that can interfere with the recycling process. They can be washed off during the recycling process without leaving any residue.

Polyvinyl chloride (PVC) based adhesives should be avoided for HDPE plastic bottles because they contain harmful chemicals that can contaminate the plastic and make it difficult to recycle.

Pressure-sensitive adhesives are commonly used for labels and other materials on HDPE plastic bottles, but they can be difficult to remove during the recycling process. These adhesives are designed to stick firmly to surfaces, so they can leave behind residue that can contaminate the plastic and make it harder to recycle.

Rubber-based adhesives can also be difficult to remove during the recycling process and can contaminate the HDPE plastic. These adhesives are often used for labels or to seal the cap to the bottle.

SLEEVES

Sleeves are commonly used as labels or decorations on HDPE bottles. PE sleeves made from the same material as HDPE bottles are compatible with recycling. They can be easily separated from the HDPE bottles during the recycling process. PP sleeves have a similar density to HDPE bottles and are therefore compatible with recycling. They can be easily separated from the HDPE bottles during the recycling process.

Sleeves made from PVC are generally not compatible with HDPE bottles recycling and should be avoided. These materials can contaminate the recycled material and reduce its quality.

INKS

Water-based inks are made from pigments that are suspended in water and are a popular choice for printing on HDPE bottles. They are compatible with recycling as they can be easily separated from the HDPE bottles during the recycling process.

Solvent-based inks are made from pigments that are suspended in solvents such as ethanol or acetone. They are also compatible with recycling as they can be easily separated from the HDPE bottles during the recycling process.

UV-cured inks are cured by exposure to ultraviolet light and are a popular choice for printing on HDPE bottles. They are also compatible with recycling as they can be easily separated from the HDPE bottles during the recycling process.

Oil-based inks are made from pigments that are suspended in oil and are not recommended for printing on HDPE bottles. They can contaminate the recycled material and reduce its quality. Metallic inks contain metallic particles and are not recommended for printing on HDPE bottles. Inks containing heavy metals such as lead, cadmium, and mercury are not recommended for printing on HDPE bottles. They can contaminate the recycled material and pose a health hazard. Inks containing halogens such as chlorine and bromine are not recommended for printing on HDPE bottles. They can create toxic by-products during the recycling process and reduce the quality of the recycled material.



DIRECT PRINTING

Direct printing on HDPE bottles is a process in which ink is applied directly to the surface of the bottle without using a label or sleeve. This process is used to add text, graphics, or other design elements to the bottle, and is often used for branding or product identification. Direct printing on HDPE bottles can be done using various printing methods, including screen printing, pad printing, and digital printing.

Each method has its own advantages and disadvantages, depending on the desired outcome and the production requirements. Direct ink printing on HDPE bottles can affect recycling in several ways. First, direct ink printing can leave residual ink on the surface of the HDPE bottles, which can contaminate the recycled material.

This can reduce the quality of the recycled material and limit its usability. Secondly, direct ink printing can make it difficult to sort HDPE bottles by colour, which is necessary for many recycling processes.

If the ink colour is the same as the HDPE colour, it can be difficult to distinguish between different types of HDPE bottles.

Thirdly, direct ink printing can make it difficult to separate the HDPE bottles from other materials during the recycling process. This can reduce the efficiency of the recycling process and increase the cost of recycling. Lastly, direct ink printing may use inks that are not compatible with the recycling process. For example, inks containing heavy metals can contaminate the recycled material and reduce its quality.

ADDITIVES

Additives are often added to HDPE bottles to enhance their properties and performance. UV stabilizers help to protect the plastic from UV radiation, which can cause degradation and discoloration. UV stabilizers can be added to HDPE (high-density polyethylene) bottles during the manufacturing process to protect the plastic material from the damaging effects of UV radiation.

Calcium carbonate (CaCO_3) is commonly used as a filler or extender in HDPE plastic bottles and jars. While the addition of CaCO_3 can provide benefits such as improved stiffness, impact resistance, and reduced material costs, it can also have a negative impact on HDPE recycling. The presence of CaCO_3 in HDPE can affect the mechanical and physical properties of the recycled material, including its melt flow rate, tensile strength, and impact resistance. Additionally, the presence of CaCO_3 in HDPE can complicate the recycling process by causing equipment wear and tear, increasing energy consumption, and decreasing the efficiency of the recycling process.



SUMMARY OF DESIGN GUIDELINES FOR RECYCLABILITY FOR HDPE BOTTLES AND JARS

ITEM		GREEN	YELLOW	RED
MATERIAL AND MATERIAL COMBINATION		- Multi-layered HDPE, PP and PET.		- Multi-layered PLA, PVC and PS.
BARRIERS AND COATINGS		- EVOH barriers less or equal to 5% concentration. - Water-based coatings (Acrylic coatings, Polyurethane coatings, Epoxy coatings, UV-curable coatings).		- EVOH more than 5% concentration.
CLOSURES	Caps	- HDPE.		- PVC. - PS. - PET.
	Seals	- Form Seals. - Induction seals. - Pressure-sensitive. - Expanded Polyethylene (EPE).		- PVC. - PET.
	Liners	- PE.		- PVC. - PET.
COLOUR		- Clear colours. - Green. - Blue. - Brown.		- Dark /Black colours.
DECORATIONS	Labels	- PVOH (polyvinyl alcohol) labels or other water-soluble materials. - Thermal transfer printed labels. - Pressure-sensitive labels with removable adhesive.	- PP labels.	- PVC labels.
	Sleeves	- Sleeves in PE &PP (all with density < 1 g/cm ³).	- Sleeves in PE, PLA, (all with density > 1 g/cm ³).	- Aluminium sleeves. - Metallized sleeves. - PVC sleeves.
	Inks	- Water-based inks. - Solvent-based inks. - UV-cured inks. - Non-bleeding inks.		- Oil-based inks. - Metallic inks. - Inks containing heavy metals such as lead, cadmium, and mercury. - Inks containing halogens such as chlorine and bromine. - Inks that bleed.
	Adhesives	- Water soluble and water releasable adhesives.		- Pressure-sensitive adhesives. - Rubber-based adhesives. - Polyvinyl chloride (PVC) based adhesives.
	Direct Printing	- Production or best-before date.		- Any other direct printing.
ADDITIVES		- UV Stabilizers.	- Calcium Carbonate (CaCO ₃).	

APPENDIX 1: OVERVIEW OF KENYA PLASTICS PACT

The Kenya Plastics Pact is an ambitious, collaborative initiative that brings together businesses, governments, researchers, NGOs and other stakeholders across the whole plastic value chain to set time bound commitments to transform the current linear plastics system into a circular plastics economy.

This Plastics Pact aims to ensure that plastics never become waste by eliminating the plastics we don't need, innovating to ensure that the plastics we do need are reusable or recyclable, and circulating all the plastic packaging items we use to keep them in the economy and out of the environment.

The Kenya Plastics Pact has proposed a set of targets which serve as a framework and are derived from the overarching targets in the Ellen MacArthur Foundation's New Plastics Economy Global Commitment and adapted to the national context.

The following are the proposed targets to be achieved by 2030 in Kenya:



Eliminate unnecessary or problematic single-use plastic packaging items through redesign, innovation, and reuse delivery models.



100% of plastic packaging is reusable or recyclable.



40% of plastic packaging is effectively recycled.



15% average recycled content across all plastic packaging.

Note: This is a live document which will constantly evolve to fulfil its purpose, as policies, technological innovations, and research advances.

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