Working together for a world without waste

Guidance Document

Design of Rigid Plastic Packaging for Recycling

Guidance on how to design pots, tubs, trays and non-drink bottles so that they are as recyclable as possible.

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WRAP's vision is a world without waste, where resources are used sustainably.

We work with businesses, individuals and communities to help them reap the benefits of reducing waste, developing sustainable products and using resources in an efficient way.

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Front cover photography: [Plastic pots, and tubs]

Contents

Glossary

APET	Amorphous form of Polyethylene Terephthalate
$CaCO_3$	Calcium Carbonate
CPET	Crystallised form of Polyethylene Terephthalate
EPS	Expanded Polystyrene
EVOH	Ethylene Vinyl Alcohol Polymer
HDPE	High-density polyethylene.
LDPE	Low Density Polyethylene
NIR	Near Infrared
OPP	Oriented Polypropylene
PA	Polyamide (Nylon)
PC	Polycarbonate
PEN	Polyethylene naphthalate
PET	Polyethylene terephthalate
PMMA	Polymethyl methacrylate
PP	Polypropylene
PS	Polystyrene
PU	Polyurethane
PVC	Polyvinyl chloride
PVdC	Polyvinylidene chloride

1.0 Introduction

There are numerous elements of rigid plastic pack design that affect recyclability. WRAP has worked with key industry players including trade associations, pack manufacturers, retailers and plastic reprocessors to develop matrices of recyclability for polymers used in rigid plastic packaging including polypropylene (PP), polyethylene terephthalate (PET), polyethylene (PE) and polystyrene (PS). Polyvinyl chloride (PVC) packaging does not have a specific recyclability matrix as it is not currently sorted and reprocessed. The matrices are primarily focussed on pots, tubs and trays in the food grocery sector plus non-food packaging from the grocery and DIY sectors including non-drinks bottles.

Please note this guidance does not apply to PET drinks bottles or HDPE milk bottles as WRAP has already produced the following recyclability guidance and tools:

- PET soft drinks bottles: http://www.wrap.org.uk/content/pet-bottle-categorisation-tool
- HDPE milk bottles: http://www.wrap.org.uk/content/hdpe-categorisation-tool

The work covers three areas: the guiding principles (written to put the matrices in context), the matrices, and the results of a test categorisation of 50 commonly used packs.

Mixed plastics collections are rapidly evolving in the UK, and the sorting and reprocessing infrastructure is beginning to grow. This guidance is based on the best currently available information and may change in the future to reflect further developments in the recycling industry.

2.0 Guiding principles

2.1 Primary principles

- Where there is clear evidence that the environmental benefit of including a certain component, article or additive outweighs the environmental benefit of recycling, that benefit should take priority over this guidance when informing pack design.
- Use as few components, polymer types and materials as possible.
- The packaging must be fit for purpose. It must deliver the product from producer to retailer to consumer in such a way that the product is fit for use or consumption as intended.

In addition to the primary principles, the following guidelines should be taken into account:

2.1.1 Polymer

- Single polymer items are inherently more recyclable than multilayer products.
- Poly-olefins are often sorted by density from other polymers for recycling. Therefore, avoid the use of foaming agents or fillers which change the density of polymers and can lead to them being wrongly sorted in a water-based float sink system.
- Avoid the use of expanded polystyrene (EPS), oxo-degradable or bio-degradable polymers as they are not currently compatible within existing household plastic sorting or reprocessing systems. For more information please refer to the WRAP information on biopolymer packaging in the UK grocery market[1].

[1] *http://www.wrap.org.uk/content/information-sheet-biopolymer-packaging-uk-grocery-market*

- Pack light-weighting activities may alter the behaviour of flaked plastic within reprocessing systems so as to prevent its recovery. For example, excessively lightweight packs may be sorted with film. Note that there may be greater environmental benefits to light weighting even when reduced reprocessor efficiency is taken into account.

PVC packaging does not have a specific recyclability matrix as it is not currently widely collected, sorted or reprocessed.

2.1.2 Colour

- Natural and lightly tinted plastics retain more value when recycled and so are preferable to heavily pigmented, dark colours.
- Carbon black coloured items are not compatible with sorting equipment in most UK facilities and as a result are often left un-recycled.

2.1.3 Components and adhesives

- The lower the label coverage, the more likely that an item will be correctly sorted. Technology providers have advised that label coverage below 60% of the pack surface will enable an item to be detected and correctly sorted, in the majority of cases.
- Barrier layers in general will render the item less recyclable as the barrier is not made from the same plastic type as the main body of the pack, and is often difficult to separate.
- Consider opportunities to minimise product contamination of the packaging at the point of disposal.
- Triggers and nozzles should not contain any glass parts as they are not compatible with plastic reprocessing systems and can cause significant damage to equipment. Metal components are also undesirable. Consider opportunities for re-fillable systems where the trigger or nozzle can be re-used.

2.1.4 Pack characteristics

- Very shallow trays or flattened plastics may be mis-sorted in automated sorting facilities with other flat materials such as paper, contaminating the paper fraction.
- Any items which have a diameter or width of less than 40mm may be treated as a fines fraction which is more likely to be landfilled.

3.0 Recyclability Categorisation Matrices

The matrix relating to each of the main polymers (PET, PP, PE, PS) is based on cross-referencing the various pack components against an ideal, not ideal or detrimental classification.

Ideal	Not Ideal	Detrimental
Generally the material is compatible with or separable from the main material and is acceptable in industrialised recycling processes in large volumes.	Use of material in general is undesirable and could cause severe recycling issues if used in large volumes. Under certain specific conditions the material may be recyclable, but this would need to be confirmed with the appropriate recycling organisations and / or recyclers.	Material is generally not compatible with or separable from the main material in current industrialised recycling processes and will therefore cause severe recycling issues / cause rejection of recyclate if present even at low volumes.

3.1 PP Recyclability Categorisation Matrix

Category	Sub Item	IDEAL	NOT IDEAL	DETRIMENTAL
Body	Barrier coatings & layers	None	Nylon if less than 1% of total pack weight EVOH if less than 10% of total pack weight	Nylon if above 1% of total pack weight EVOH if above 10% of total pack weight PVdC (polyvinylidene chloride)
	Colour	Natural or lightly tinted colours	Heavy or solid colours including detectable black (affects recyclability in terms of value, not technical properties)	Carbon black
	Foamers & fillers	None		Fillers that increase the density of the pack beyond 0.995g/cm³ (talc, $CaCO_3$, other fillers)
Decoration	Labels and sleeves	No label PE or PP or OPP label with less than 60% coverage Removable in-mould label	Coverage over 60% PET label Paper label Permanent in-mould label	PVC or metallised label
	Adhesives	No adhesive, or, if necessary, adhesive which is water or alkali soluble in ambient conditions	Adhesive removed in water or alkali between ambient and 80°C	Adhesive not removed in water or alkali up to 80°C

Category	Sub Item	IDEAL	NOT IDEAL	DETRIMENTAL
	Direct printing	Minimum to meet legal requirements including production or use by / best before date		Other direct printing
	Ink	EuPIA compliant inks Please refer to www.eupia.org EuPIA is the printing ink group within the European Council of Paint, Printing Ink and Artists' Colour Industry (CEPE)		Inks that bleed and dye wash solution Non-EuPIA compliant inks
Closures	Caps, liners and seals	PP or HDPE or LDPE	PET or paper	PS or PVC or silicone or EVOH or thermoset plastics or metals
Lidding film / foil		Totally removable (by consumer) with no residue or top film of same polymer as body of the pack (PP)		
Trigger Sprays		PP or HDPE or LDPE	Metal springs & Ball-bearings, acetal or acrylic based components	Glass components
Other Components	Inserts (e.g. meat & fruit tray pads), sheets or strips which extend the life of the product or other additions to the pack such as base cups	PP or HDPE or LDPE	PET or paper	PVC or EPS or PU or PA (nylon) or PC (polycarbonate) or PMMA (acrylic) or thermoset plastics or metals

3.2 PET Recyclability Categorisation Matrix

Category	Sub Item	IDEAL	NOT IDEAL	DETRIMENTAL
Body	Barrier coatings & layers or other blended additives or processing aids	None	EVOH/PEN barrier layer if 1% to 5% of total pack weight	EVOH/PEN barrier layer if above approximately 5% of total pack weight PE barrier layer
	Colour	Clear, light-blue, green or other light tints	Strong tints: dark blue or green or brown or detectable black	Solid colours including opaque white or carbon black or metallic colours and use of fillers
	Foamers & fillers	None		Any foamer or filler which causes the PET material to float in water
Decoration	Labels and Sleeves	Label with coverage of less than 60% made of PE or PP or OPP Density <1g/cm3. Shrink sleeves with perforations and revealing a significant % of the item Removable in-mould label	PET label. Note that PET sleeves/labels may not be compatible with PET used in pack. Paper label Permanent in-mould label	PVC or PS or metallised Sleeves with heavy ink coverage which are difficult to remove and/or NIR sort
	Adhesives	No adhesive on body, water-soluble adhesive or alkali soluble adhesives (<80°C)		Adhesive not removed in water or alkali at 80°C
	Direct printing	Minimum to meet legal requirements including production or use by / best before date		Other direct printing
	Ink	EuPIA compliant		Inks that bleed and

Category	Sub Item	IDEAL	NOT IDEAL	DETRIMENTAL
		inks Please refer to www.eupia.org EuPIA is the printing ink group within the European Council of Paint, Printing Ink and Artists' Colour Industry (CEPE)		dye wash solution Non-EuPIA compliant inks
Closures	Caps, liners and seals	PP or PE	PET or EVOH or Paper	Metals or PS or PVC or silicone; any materials density higher than1g/cm^3
Lidding film / foil		Totally removable (by consumer) with no residue or top film of same polymer as body of the pack (PET)		
Trigger Sprays		PP or HDPE or LDPE	Metal springs & ball bearings, acetal or acrylic based components	Glass components
Other Components	Inserts (e.g. meat & fruit tray pads), sheets or strips which extend the life of the product or other additions to the pack such as base cups	HDPE or LDPE or PP	PET or paper	PVC or PS or EPS or PU or PA (nylon) or PC (polycarbonate) or PMMA (acrylic) or thermoset plastics or metallic

3.3 PE Recyclability Categorisation Matrix

Category	Sub Item	IDEAL	NOT IDEAL	DETRIMENTAL
Body	Barrier coatings & layers	None	Nylon if less than 5% of total pack weight	Nylon if above 5% of total pack weight EVOH PVdC (polyvinylidene chloride)
	Colour	Natural or lightly tinted colours	Heavy or solid colours including detectable black (affects recyclability in terms of value, not technical properties)	Carbon black
	Foamers and fillers	None		Fillers that increase the density of the pack beyond 0.995g/cm^3 (talc, $CaCO_3$,other fillers)
Decoration	Labels and sleeves	Less than 60% coverage and made of PE or PP or OPP Removable in-mould label	Coverage over 60% PET Label Paper label Permanent in-mould label	PVC or metallised label Sleeves with heavy ink coverage which are difficult to remove and/or NIR sort
	Adhesives	No adhesive or, if necessary, adhesive which is water or alkali soluble in ambient conditions	Adhesive removed in water or alkali between ambient and 80°C	Adhesive not removed in water or alkali at over 80°C
	Direct printing	Minimum to meet legal requirements including production or use by / best before date		Other direct printing

Category	Sub Item	IDEAL	NOT IDEAL	DETRIMENTAL
	Ink	EuPIA compliant inks Please refer to www.eupia.org EuPIA is the printing ink group within the European Council of Paint, Printing Ink and Artists' Colour Industry (CEPE)		Inks that bleed and dye wash solution Non-EuPIA compliant inks
Closure	Caps, liners and seals	PP or HDPE or LDPE	PET / paper	PS or PVC or Silicone or EVOH or thermoset plastics or metals
Lidding film / foil		Totally removable (by consumer) with no residue or top film of same polymer as body of the pack		
Trigger Sprays		PP or HDPE or LDPE	Metal springs & ball-bearings, acetal or acrylic based components	Glass components
Other Components	Inserts (e.g. meat & fruit tray pads), sheets or strips which extend the life of the product or other additions to the pack such as base cups	PP or HDPE or LDPE	PET or paper	PVC or EPS or PU or PA (nylon) or PC (polycarbonate) or PMMA (acrylic) or thermoset plastics or metals

3.4 PS Recyclability Categorisation Matrix

There was generally less information and reference points available for polystyrene compared to the other common polymers. This also refers only to pots, tubs and trays as household bottles do not use PS material.

Category	Sub Item	IDEAL	NOT IDEAL	DETRIMENTAL
Body	Barrier coatings & layers	None	Nylon if less than 1% of total pack weight EVOH if less 10% of total pack weight	Nylon if above 1% of total pack weight PVdC (polyvinylidene chloride) EVOH if above 10% of total pack weight
	Colour	Natural colours	Heavy or solid colours (affects recyclability in terms of value, not technical properties)	Carbon black
	Foamers & fillers	None		Any foamer or filler which causes the item to float in water
Decoration	Labels and sleeves	Less than 60% PE or PP or OPP or PS or OPS Removable in-mould label	Label coverage over 60% Paper label Permanent in-mould label	PET or PVC or metallised label
	Adhesives	No adhesive or if necessary, adhesive which is water or alkali soluble in ambient conditions.	Adhesive removed in water or alkali between ambient and 80°C	Adhesive not removed in water or alkali at 80°C
	Direct printing	Minimum to meet legal requirements including production or use by / best before		Other direct printing

Category	Sub Item	IDEAL	NOT IDEAL	DETRIMENTAL
		date		
	Ink	EuPIA compliant inks Please refer to www.eupia.org EuPIA is the printing ink group within the European Council of Paint, Printing Ink and Artists' Colour Industry (CEPE)		Inks that bleed and dye wash solution Non-EuPIA compliant inks
Lidding film / foil		Totally removable (by consumer) with no residue or top film of same polymer as body of the pack		
Closure	Lid	PS or OPS	PE or PP or Paper	PET or PVC
Other Components	Inserts (e.g. meat & fruit tray pads), sheets or strips which extend the life of the product or other additions to the pack such as base cups	PS or OPS	PE or PP or paper	EPS or PVC or PU or PA (nylon) or PC (polycarbonate) or PMMA (acrylic) or thermoset plastics or metallic.

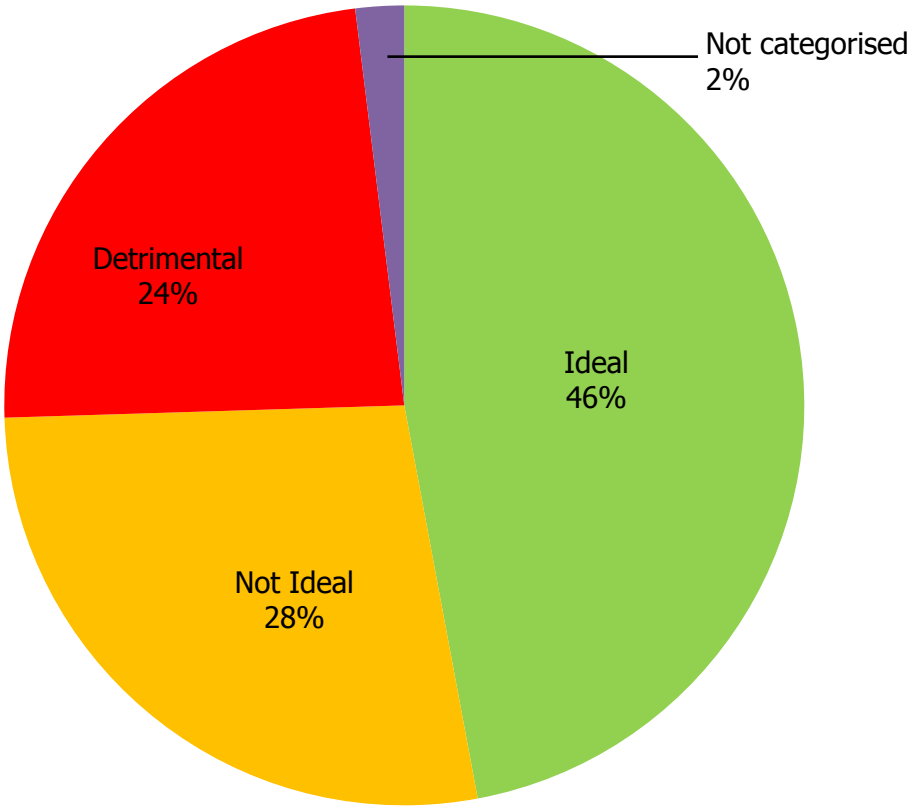
4.0 Results of the test categorisation of 50 commonly used packs

50 commonly used rigid plastic packs were categorised using the matrices to ensure they could be practically applied and to help identify any additional amendments or considerations.

This assessment was completed using visual assessment of some components (e.g. colour, labels, and inserts), applying a controlled polymer test including float sink testing on pack samples, and using the accompanying specification sheet, where available, to identify other parameters such as barriers, adhesives and ink types.

Of the 50 commonly used packs tested, 23 were classified as ideal for recycling, 14 not ideal for recycling, and 12 detrimental to recycling. One pack was not categorised as it was a PVC item. The results of the assessment are shown in Figure 1.

Figure 1 Split of the recyclability of the 50 commonly used rigid plastic packs



Of the fourteen categorised as not ideal for recycling (some were flagged up for more than one reason), twelve fell into this category because of the colour, four due to the liner or seal, and seven due to the label.

Of the twelve categorised as detrimental for recycling (some were flagged up for more than one reason), seven were because of the colour, one due to the liner, four due to a wrong reaction in a float sink test, and two due to barrier layers.

Waste & Resources Action Programme

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