


DESIGNING FOR A CIRCULAR ECONOMY

Guidelines summary

Recyclability of polyolefin-based flexible packaging

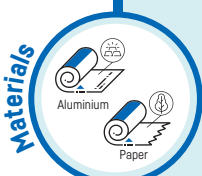
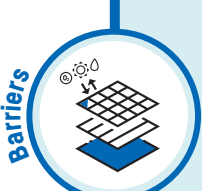

CEFLEX's Designing for a Circular Economy Guidelines give practical support and advice on circular economy design principles. The comprehensive guidelines have been developed to help anyone working in the flexible packaging value chain design packaging solutions which are recyclable.

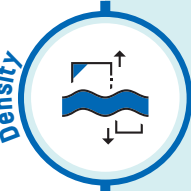
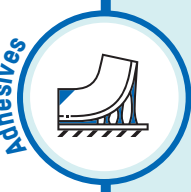

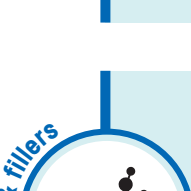
This table summarises the guidelines for the key elements of a flexible packaging structure. For each element, guidance is given in terms of compatibility with a PE or PP mechanical recycling process. Reasons are provided for the guidance, along with general design advice. The table also identifies the materials and elements to be investigated by CEFLEX in phase 2. Please refer to the full technical report of the guidelines for full details.

	Guidance			Reasons	Advice	Materials and components for investigation in phase 2
	Compatible with PE or PP mechanical recycling	Limited compatibility with PE or PP mechanical recycling	Not compatible with PE or PP mechanical recycling			
 <p>Materials Plastics</p>	<p>Mono-PE and mono-PP including co-extruded, orientated, co-polymers</p> <p>Laminated PE/PE or PP/PP with or without barrier layers and coatings as indicated below</p>	<p>Co-extruded or laminated PE/PP (mixed PO) with or without barrier layers and coatings as indicated below</p>	<p>PET layers</p> <p>Non-PE and non-PP foamed polymer layers</p> <p>PVC layers</p> <p>Biodegradable and compostable materials</p>	<p>Facilitates higher value recycle. Materials may move towards being more compatible as technology and infrastructure evolve.</p> <p>Foamed polymers alter the density of the material and impacts the flotation sorting within mechanical recycling plants.</p> <p>Biodegradable and compostable materials are known to disrupt the mechanical recycling of PE, PP, mixed PO materials and should be diverted from mechanical recycling collection streams and should not be used in any packaging designed for mechanical recyclability</p>	<p>It is recognised that the materials in the limited compatibility and not compatible columns have a role to play in packaging in some applications and should not be replaced if there is a negative impact on product protection (there is often a greater environmental impact in product waste than the packaging).</p>	<p>Impact of PET in polyolefin-based mechanical recycling processes</p> <p>PA</p>
<p>MATERIAL COMPOSITION THRESHOLDS FOR MONO-PE AND MONO-PP STRUCTURES</p>	<p>Greater than 90% PE</p> <p>Greater than 90% PP</p>	<p>80-90% PE</p> <p>80-90% PP</p>	<p>Less than 80% PE</p> <p>Less than 80% PP</p>	<p>Facilitates higher yields and higher value recycle</p>		<p>Impact of material composition</p>
<p>MATERIAL COMPOSITION THRESHOLDS FOR MIXED PO STRUCTURES*</p>	<p>Greater than 90% PO</p>	<p>80-90% PO</p>	<p>Less than 80% PO</p>			





* The information in this row of the table relates specifically to the material composition of mixed PO structures in relation to compatibility to PO mechanical recycling processes rather than compatibility with PE and PP mechanical recycling processes.

Guidance

	Compatible with PE or PP mechanical recycling	Limited compatibility with PE or PP mechanical recycling	Not compatible with PE or PP mechanical recycling	Reasons	Advice	Materials and components for investigation in phase 2
Materials 	n/a	n/a	Paper Aluminium foil	Paper in the plastic mechanical recycling process is a serious disruptor as any remaining fibres carbonise during the extrusion process negatively affecting the recycled plastic quality	If paper properties are needed in a flexible packaging structure, then it should represent the dominant material by weight and be able to be identified as paper in the sorting process and be sorted into the paper fraction for recycling. Although aluminium foil is not compatible with a plastic mechanical recycling process, these structures can be identified and removed in the sorting process by using eddy current separation technology. Sorted structures containing aluminium foil can be recycled via a pyrolysis process although the plastic proportion will not yet be recycled via this type of process	-
Barriers 	For each barrier layer and coating maximum 5% of total packaging structure weight - AIOx, SiOx, EVOH, PVOH, Acrylic Laminated and printed metallised layers	For each barrier layer and coatings over 5% of total packaging structure weight - AIOx, SiOx, EVOH, PVOH, Acrylic	To be determined	Facilitates higher yields and higher value recycle. Materials may move towards being more compatible as technology and infrastructure evolve.	Barrier materials have a role to play in providing light-weight high-performance packaging in some applications and should not be replaced if there is a negative impact on product protection (there is often a greater environmental impact in product waste than the packaging).	Impact of barrier layers and coatings above 5% of total packaging structure weight PVDC coatings PA layers Surface metallised films
Size & shape 	The minimum viable amount of material should be used			Prevention and reduction of packaging in all its forms should always remain the priority in design of flexible packaging.	Increasing material thickness to improve recyclability of the packaging is not encouraged - waste prevention and reduction should always be a priority.	
MATERIAL THICKNESS						
PACK SIZE	Above 20mm x 20mm	Above 20mm x 20mm	Below 20mm x 20mm	Waste sorting facilities use screens to separate larger 'oversized' items from smaller 'undersized' items. Smaller items fall through the holes of the screen and the material will usually be classed as a residual stream and not be recycled.	Pack size should not be increased to improve recyclability; waste prevention and reduction should always be a priority.	n/a
PRODUCT RESIDUE IN PACK	Low quantities of product residue	Moderate quantities of product residue	Large quantities of product residue	The pack should be designed to leave as little amount of product residue as possible to facilitate higher yield of recycle.	-	

	Guidance			Reasons	Advice	Materials and components for investigation in phase 2
	Compatible with PE or PP mechanical recycling	Limited compatibility with PE or PP mechanical recycling	Not compatible with PE or PP mechanical recycling			
 <p>Density</p>	< 1 g/cm ³	< 1 g/cm ³	> 1 g/cm ³	Density separation is commonly used to separate polyolefins from other materials. Polyolefins have a density of < 1 g/cm ³ and will float in the process, whereas material with a density of > 1 g/cm ³ will sink and not be included in the PO-based recycling process.	-	n/a
 <p>Adhesives</p>	Polyurethane, acrylic or natural rubber latex adhesives, as well as non-PE or non-PP based tie-layers, are permitted to a maximum of 5% by weight of the total packaging structure	Above 5% of total packaging structure weight	To be determined	Facilitates higher quality recycle.	-	Impact of adhesives on recyclability
 <p>Pigments</p>	Clear, natural or paler colours	Black and darker colours	Carbon black containing masterbatch	Facilitates higher value recycle as more natural/ lighter colour. The paler the polymer colour the less cross colour contamination when being recycled. As plastics are recycled it is known that the colour becomes greyer over time. Carbon black containing masterbatch is not recognisable by NIR optical sorting technology.	If black is required, NIR detectable pigments should be used.	n/a
 <p>Additives & fillers</p>	Additives and fillers are permitted but usage should be minimised. This includes thermal stabilisers, UV (ultraviolet) stabilisers, nucleating agents, mineral and polymer cavitating agents, antistatic agents, impact modifiers, chemical blowing agents and tackifiers.	To be determined	Fillers in non-PE and non-PP structures which modify the density to be < 1 g/cm ³ ▴ Substances of very high concern (SVHC) ▴ Oxo-degradability additives ▴ Foamed thermoplastic non-polyolefin elastomers	Facilitates higher value recycle. Materials may move towards being more compatible as technology and infrastructure evolve. SVHC are not permitted to allow the recycle to be suitable for the greatest range of end market applications Oxo-degradability additives are not permitted to maintain the quality and mechanical properties of the final recycle	-	Impact of additives, fillers, tie layers and compatibilisers on sortability and recyclability

Guidance

			Compatible with PE or PP mechanical recycling	Limited compatibility with PE or PP mechanical recycling	Not compatible with PE or PP mechanical recycling	Reasons	Advice	Materials and components for investigation in phase 2
 Inks & lacquers	COLOUR		Lighter, paler ink colours	Darker ink colours	n/a	Facilitates higher value recycle as more natural/paler colour and avoids disruption of mechanical recycling process. PVC binders are known to disrupt the recycling process.		Impact of inks, lacquers and varnishes on sortability and recyclability
	TYPE AND COVERAGE		Lacquers and inks (without PVC binders) up to a maximum 5% of total packaging structure weight	Lacquers and inks (without PVC binders) above 5% of total packaging structure weight	Lacquers and inks containing PVC binders			
	PRINTING SURFACE		Surface printing Lamination printing	To be determined	n/a			
 Labels			Same as the main material i.e. mono-PE or mono-PP	If the label is of a different material to the main material, then a maximum size of 30% of each packaging face and should be easily removable	Above 30% of the total surface area of the pack if material is different to the main material	Ensures correct sorting and facilitates higher quality recycle.		n/a
 Additional features	ZIPPERS, SPOUTS, CLOSURES, VALVES AND TAPS		The material type used is the same as the main pack material	If the pack contains different materials, then these parts should be easy to separate. However, the ideal design should not require the consumer to separate parts and different materials should be avoided wherever possible.		Facilitates higher yield of recycle.		n/a
 Recycled content	<p>The use of recycled content in flexible packaging to reduce the use of virgin material and create markets for recycled materials is encouraged.</p> <p><i>Note: this is for non-food applications. For food contact and indirect food contact applications all materials must adhere to food safety regulations and at this time recycled materials from polyolefin-based flexible packaging are not approved as food safe.</i></p>							