

Corrugated Packaging Recyclability Guidelines Design for circularity



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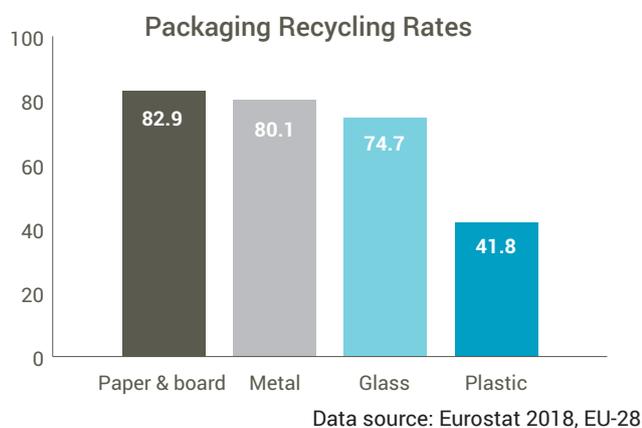
Acknowledgement

This document is based on the CPI Recyclability Guidelines as a source and adapted to include the FEFCO scope.



Corrugated Packaging Recyclability Guidelines Design for circularity

Paper and board is a sustainable, renewable and ecologically sound choice for packaging because paper and board is recyclable. In practice, the recyclability of packaging products will be determined by composition and design, and the way they are collected, sorted and presented for reprocessing. The corrugated products are easily recyclable.



Paper & board is the **most recycled** packaging material in Europe!

Paper recycling in the EU is a success story, with over 80% of paper and board packaging recovered for recycling. Paper for recycling is collected primarily for use in manufacturing processes and is used as an alternative to virgin materials e.g. wood pulp.

As society evolves, different applications are found for corrugated which sometimes require changes to its functionality. This is done for good reasons to increase product life by creating moisture or gas

barriers. This is often achieved by combining the fibre substrate with another material to form a composite multi-layer laminate providing properties such as water resistance or a gas barrier. These changes may provide challenges for recycling, and in some instances can increase the costs of reprocessing and of waste disposal. In some cases, they may also cause damage to process machinery or lower the quality of the finished product.

The potential for increases in this type of material in the future places demands on pack designers to look for creative design alternatives, and explore the future potential for new materials and techniques to be developed to make all paper & board easier to recycle.

These guidelines are produced to help retailers and brands and corrugated companies specify and design packaging that can be reprocessed in high volume paper mills with current “standard” pulping technology.¹ They are not intended for use by the public. The vast majority of paper for recycling collected for recycling is reprocessed in high-speed

¹ Pulping is the means by which solid paper and board sheet is reduced to individual fibres in suspension prior to being reformed into a new sheet, and is a prelude to the papermaking process.

paper mills. Only a very small proportion of the material presented creates challenges for recycling and has to be separated for specialist treatment.

This document is intended to optimise the quality and quantity of paper recycling by improving the recyclability of more challenging material and over time, through technological development and better design, to reduce the amount of unwanted material passing into the papermaking process.

These guidelines reflect the European quality standard EN643.

Plastic

How much can the Paper and Board mills handle?

The paper and board mills would prefer not to receive any plastic in the fibre stream since it affects reprocessing and negatively impacts the economics of paper recycling, particularly because plastic is a contaminant and will be rejected from the process. Currently, the limit in EN643 for non paper components in the delivered most common grades of paper for recycling for corrugated is 1,5% (plastics, metals etc). This implies an average across all material delivered to the mill, but in practice is assessed by sampling individual loads upon delivery at the mill. Non-paper components are not a constituent part of the product and can be separated by dry sorting.

Verdict

- Plastic content attached to any paper or board packaging product should be minimised.



What percentage per pack?

The industry would prefer that laminated paper material be collected separately and sold as a distinct and separate grade to mills with the specialist facility to reprocess it effectively. However, it understands that currently in most cases this is not practicable.

In order to encourage specifiers and designers to minimise plastic content, the industry suggests a guideline of not more than 5% of pack weight on single-sided laminates.

Designers should also look to ensure the consumer can remove laminate faces and dispose of them into the waste stream. They should minimise the adhesion between laminate face and board so that material passing into the reprocessing system is easily separated either by the consumer or by the water-based separation process.

Verdict

- Most paper mills would prefer not to receive plastic laminated board
- Designers should minimise plastic content to below 5% of pack weight as a maximum, although the industry would prefer 3% by weight



How much tonnage overall – Industry cap?

If collected separately and presented appropriately, almost all paper and board can be recycled. The amount of composite, non-fibrous material the industry can absorb is dependent on how and where it is presented. So,

- Laminated products can be reprocessed if collected and presented in baled form to mills that can handle them
- Similar material, when presented in high concentrations to “standard” mills will be removed as contamination in the papermaking process, as it undermines the integrity of the process and passes into the waste stream for energy from waste or landfill. When presented in low concentrations it is extracted for disposal and does not harm the process.

In practice, the majority of composite and laminated paper is likely to be collected and presented for recycling as “Mixed Papers”. This is traditionally the lowest grade of paper for recycling and is used by packaging mills as a significant proportion of feedstock.

Are some plastics best avoided or preferred?

Papermakers would prefer all plastics be avoided. It makes little difference in the recycling process if plastic is conventional, biodegradable, compostable or oxo-degradable, as the degradation mechanism will not have sufficient time to cause any significant degradation of the material before it passes through the papermaking process.

Mills would particularly wish that plastic that has potential to cause environmental harm or damage to recovery systems is designed out. For instance, polymers with low shear strength that break down in the pulper should be avoided to prevent possible contamination of the finished product or discharge with the waste water.

In addition, PVC (Polyvinyl chloride) has potential to release toxins into the air during energy recovery and should be avoided.

In simple terms, plastic should be:

- Designed out altogether (or reduced to an absolute minimum)
- Designed to peel off by the consumer and marked as such
- Designed to be easily separated by sorting or recycling so it can be rejected in the system at the beginning of the papermaking process
- Designed to deliver minimal impact, both to the environment and to existing recovery systems.

If plastics are to be included, it would be better for them to be of a type that does not readily degenerate or break because:

- During repulping, plastics can disintegrate into sizes that will pass through screening elements in stock preparation. They may also be too “flexible” and thin – “two dimensional” (foil particles), and so pass through even low slot width screens
- Plastic with the same density as fibre can create problems. For example, material with a density in a range of 0.95 to 1.15 g/cm³, e.g. the same density as fibres and similar to water are impossible to separate with the hydro cleaners that are used in paper mills.

The development of fully soluble, bio-digestible barrier systems would be welcomed.

Verdict

- The industry would like to avoid all biodegradable and conventional plastics.



Coatings

'Coatings' is a term used to describe a variety of materials applied to a sheet of paper to impart specific properties. These can create different challenges in the recycling process. Coatings can be either inorganic inclusions or printed or varnished coatings and can be applied at different stages in the paper and box making process.²

Films / Laminates:

These occur when a sheet of a non-paper material (such as a plastic or foil film) is combined with a sheet of paper or board, usually with some form of adhesive or binder to adhere the two materials together.

Depending on the strength of the adhesion between the film and paper, fibre may or may not be released. For preference, the industry would wish they be lightly bonded with a water-soluble adhesive agent so that the plastic layer separates easily in the paper pulping process.

Providing the film does not interfere with the separation of the fibre (such as occurs with two-sided laminates, etc.) some fibre should be recovered. This will be determined by the degree of adhesion between film and fibre.

If the plastic film can be separated as relatively large particles, it can be removed using conventional mill technology. However, the removal and disposal adds cost.

Metallised films/Aluminium films are usually less tightly bound to the paper substrate (in some cases a plastic film may be applied over the surface for durability) and fibre can be recovered from them. However, in sufficient quantities, the small 'metallic' particles produced can interfere with equipment used to measure flows in paper mills and be deleterious to the end use in packaging due to metal contamination (both visual and metal detector activation).

Verdict

As above:

- Paper mills would prefer not to receive plastic or metallised laminated board
- Designers should minimise plastic content with a recommended maximum 5% of pack weight



Varnishes, Curable Varnishes and UV Curable Varnishes

These are thin layers of a non-fibrous sealant coated onto the surface of paper that has usually been printed with water-based inks. They are typically used to protect the ink film and provide a degree of robustness to the print.

The 'active component' (typically a resin) is thinly spread onto the surface of the paper and a carrier

² In printing: lacquering, coating or varnishing refers to the application of a liquid or paste, unpigmented ink like product, which after drying is mostly transparent. Thereby, certain surface properties are obtained, as for example protection against mechanical damage, gloss or matt surface effects, and/or specific slip or adhesion properties.

medium evaporates or is absorbed into the sheet leaving a film of the active component. In some cases, where a more robust surface is required, the resin may then be cured by the application of heat and/or UV radiation.

Depending on the resin used, the thickness of resin applied and the degree of curing that takes place, these films can vary from very easy to very difficult to remove. Even if the film is detached, the resin particles may be problematic in further processing.

In some cases, the film may contain extremely fine dispersions of solid materials to provide key properties and some varnishes are known to contain finely dispersed polymers/plastics which may or may not cause a problem during reprocessing and may or may not pass into the product or mill effluent.

UV Inks and Varnishes

UV varnishes can cause issues within some papermaking processes, as they are not readily removed by conventional de-inking technology. Where it is used in packaging it can be recycled, albeit it can cause flecking on the new paper sheet. For this reason, the industry would prefer to keep to a minimum the quantities of cured varnished material (either conventional or UV cured) specified in packaging products.

Verdict

- The industry prefers not to receive cured UV varnished material and varnishes that break down into small particles. Coatings that are soluble in water can generally be treated in a paper mill effluent treatment processes and are preferred.



Alternative Barriers

The industry welcomes and supports research to develop alternative barrier technologies. By its nature, and because Intellectual Property considerations prevent description here, it is impossible to list or judge the recyclability of these technologies. However, in general terms, recyclability in any alternative barrier system will be achieved where:

- The board or paper within the packaging, when exposed to water, is capable of breaking down into single fibres in suspension
- Polymers and other sealing agents can be removed from the fibre during the papermaking process
- Polymers and sealing agents can be dealt with efficiently by paper mill effluent systems and do not compromise the finished product, the production process or the environment whilst being recycled.

Fillers and Binders

Fillers comprise inorganic materials (known to the industry as “Ash”), which are added to paper and board to provide enhanced surface qualities. In order to achieve proper adhesion to the surface of the paper, they are often combined with “binders”.

- “Ash” is often comprised of Calcium Carbonate and is typically used to improve printability in graphics papers and a percentage will be removed in the papermaking process, producing a sludge. Calcium Carbonate (CaCO_3) coating does not add strength to recycling fibres, and so should be kept to a minimum
- “Binders” used with some coatings can create “stickies” which will affect the runnability of the paper both at production and converting machines (“black spots”).

Verdict

- Fillers and binders are normal constituents of the papermaking process and can usually be dealt with by paper mills.





Peelable Solutions

Peelable laminates are preferred as they provide an opportunity for the consumer to remove the laminate before recycling, and they imply a loose bond between laminated face and base substrate. With encouragement, the public will be able to separate contaminated plastic liners for disposal and recycle the paper fibre layer. Every opportunity should be taken to encourage consumers to peel off or remove laminated coatings, or linings.

Verdict

- The industry would favour peelable liners
- Consumers should be encouraged to remove liners



Other Fibrous Materials

Bagasse, Palm Fibre, Rice Straw, Wheat Straw, Barley Straw, Oat Straw, and other plant fibres

Most paper mills are set up to reprocess cellulose fibre derived from trees. The industry acknowledges that there is increasing pressure to use alternative fibre sources, particularly those derived from agricultural residues. Subject to fibre having been prepared for use in papermaking and presented in a form suitable to be utilised in the papermaking process, these fibres can be recycled.

However, the Industry recognises the urgent need to investigate the impact of these fibres when they are returned into a conventional papermaking process. The varying properties of alternative fibres could mean they are to be separated out in the process at the mill and may be discarded in the waste stream.

Pulp products such as egg boxes and pulp packaging can be recycled and should be placed with paper and board for recycling.

Verdict

- Specifiers are encouraged to use cellulose fibre derived from trees. Other fibres can be recycled, subject to having been prepared for use in papermaking and presented in a form suitable for use. Alternative fibre research will continue.



Suitably prepared and presented alternative fibres can be recycled along with other paper for recycling but designers and specifiers are asked to consider carefully what benefits derive from using these fibres. Fibrous matter which is neither prepared for papermaking nor able to be presented for recycling in an appropriate manner should be discarded with general waste.



Paper Products

Silicone, Waxed, Greaseproof, Wax coated, Glassine paper

In general, however, translucent papers for use in food related applications are likely to have “wet strength” or water resistance and are more difficult to recycle. Specifically,

- Waxed or waxed coated papers should be avoided. Wax cannot be removed by mill cleaning systems and passes onto the finished product
- Greaseproof papers, whilst not damaging to the process, cannot readily be pulped and therefore pass into the mill waste stream.
- (Hard)-sized products are papers and boards treated with starch to make them moisture resistant. A typical example is the surfaces of some frozen food packaging. These products are slow to pulp but can be recycled in most standard paper mills.

Verdict

Waxed papers should be minimised. Moisture resistant papers can be dealt with by mill systems but are not preferred feedstock and may not be fully recycled unless separately collected and presented.



Acceptable levels of Food Contamination

Food Contamination is prohibited in Paper for Recycling in EN643.

There is a the difference between contamination by food, and staining. Surface staining of paper is acceptable, but food waste sitting in the pack (Free Moving Food) or food attached to the surface (3D Residue) is regarded as unacceptable.

Careful consideration should be given to the proposed application of fibre-based packaging to prevent inadvertent contamination by food substances.

Verdict

- Packaging should be scraped clean of food by users prior to recycling
- It should be clearly marked to encourage consumers to clean it prior to recycling
- Tear off or peelable surfaces would help reduce potential contamination.



Other Contaminants

Packaging intended to be in direct contact with potentially harmful contaminants such as medical waste, animal products or toxins should be considered unrecyclable and discarded with general waste.



Adhesives

Adhesives are integral to the manufacture of packaging and standard paper mill technology is designed to separate and remove these during the papermaking process. However, some adhesives found on some tape, labels and in the binding of packaging have potential to soften or plasticise in the heat of the process to form “stickies” that can end up on the finished paper, spoiling the performance and appearance of the paper.³

Hot Melt and pressure sensitive adhesives are generally **insoluble** in **water** and very difficult to disperse during the pulping process. They soften in the pulper to form jelly like globules that travel through mill filter systems and stick to the finished paper product. Hot melt glues that are not fully water soluble should be avoided if possible.

Water soluble adhesives are preferred assuming that the chemicals formed when the glue dissolves are not detrimental to the mill waste water treatment system. These should be assessed from information provided on the data sheet of the proposed adhesive in conjunction with the Paper Industry.

Verdict

- The industry prefers to receive adhesives that do not plasticise at temperatures above 35 degrees celsius (a typical pulper temperature). This means that the industry favours cold set, curable or water-soluble adhesives over hot melt adhesives.



Biodegradable Paper Packaging

The process of remanufacturing paper through a “standard” mill takes a matter of minutes, so degradation of the fibre or liner is unlikely to occur in this time. If a package is marketed as biodegradable but is likely to pass into the paper recycling stream and through a paper mill it should meet these guidelines. All cellulose fibre is potentially biodegradable in the right conditions, so whether paper and board packaging is marked “Biodegradable” is irrelevant for the purpose of recyclability.

Where Polylactic Acid (PLA) liners are used, PLA is unlikely to degrade in standard processes and will behave like all other plastic contaminants.

Verdict

- Whether packaging is marked “biodegradable” or not is largely irrelevant for recyclability.



Verification

Who decides?

It is not practicable for the industry to evaluate the recyclability of individual packaging products on a case for case basis. Rather, this document is intended to provide design parameters, which if adhered to, should deliver recyclable paper-based packaging for the industry and improved environmental and social responsibility in the supply chain.

It is anticipated that this document should provide sufficient guidance for packaging designers and specifiers to make appropriate decisions about the recyclability of products and drive developments in design and technology to improve the general recyclability of corrugated packaging over the medium to long term.

³ “Stickies” are a tacky substance contained in the paper and pulp and process water systems of paper machines. They have potential to contaminate machinery and the finished sheet and are transported within the pulp and can agglomerate causing problematic deposits.

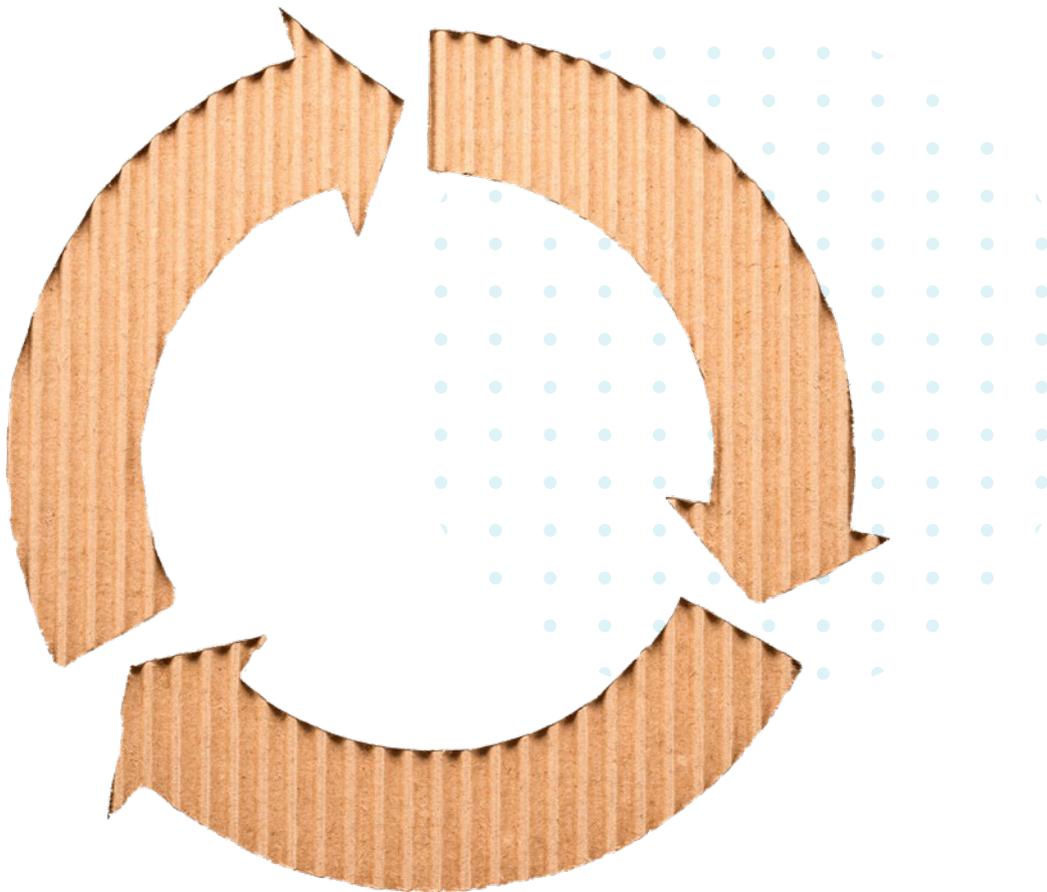
Standards, Tests or Protocols for Recyclability

The industry is aware of a number of test protocols, standards and laboratories all claiming authority in determining recyclability. In many cases the acceptability of a product for recycling depends upon a wider range of factors such as the way it is collected and presented, its application and the likelihood of contamination.

The paper & board industry has undertaken to identify a suitable widely agreeable protocol for measuring recyclability.

Conclusion

These guidelines are intended to provide broad direction and point the way towards a resource efficient recycling of corrugated packaging. FEFCO would like to acknowledge the work done by The Confederation of Paper Industries (CPI) in the creation of these guidelines.





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