



How paper recycling works  
Axchem Group Solutions to be successful

# Paper-based packaging is RECYCLABLE

In European Union the recycling of paper-based packaging rate in 1991 was 40%, this was seen to increase to 72.3% in EU28+Norway in 2017 (Source: CEPI Elaboration).

**FACT: recycled paper fibres can be reused 5 to 7 times to make new products** (Source: AF&AP)

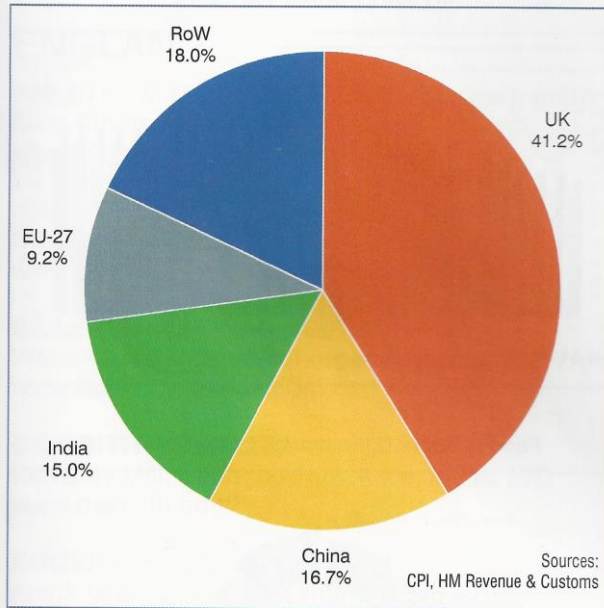
The American Forest & Paper Association (AF&PA) announced 66.2% of paper consumed in the United States was recovered for recycling in 2019. If you consider only OCC this percentage increases to 92%. (Source: AF&PA "U.S. Paper Industry Achieves Consistently High Recycling Rate" by Clara Cozort | May 12, 2020)

Recovered paper is the most important raw material for the UK paper and board industry, representing over 70% of the fibre used to manufacture paper and board in the UK in 2019. (Source: paper.org.uk).

**FACT: In 2018, Italy recovered 7 millions tons of paper** (Source: "L'industria della carta riparte e riconverte verso gli imballaggi e il riciclo" di Jacopo Giliberto 18 maggio 2018, Il Sole 24ore)

# Paper-based packaging is RECYCLABLE

## *Recovered Paper Market 2019*



Paper is collected as part of municipal and commercial recycling systems at homes, schools and businesses.

Collection systems are tailored by type, such as residential and commercial.

After the paper is collected, it is transferred to a recycling centre.

Recycled materials are sorted to remove glass, plastics and metals, or even food waste.

Paper is further sorted by type, baled and transported to paper mills where the recycling process begins

## ***STEP 1: Pulping and contaminants removal***

At the paper mill, recycled paper is fed into large pulpers where it is mixed with water and agitated to release individual fibres.

Contaminants like staples, plastic liners, coatings, tape and adhesives are separated and sent for disposal. The remaining fibres is in a solution of 99% water and ready for papermaking.

**FACT:** in this phase, an appropriated AXFIX® treatment can permit to remove most of the anionic trash in the pulp increasing the quality of the final paper sheet.

## ***STEP 2: pulp and water lay the foundation***

The water-saturated pulp slurry, known as furnish, is a blend of fibre lengths that are optimized for the strength and optical properties suited for each individual product. The papermaking process begins with a layer of furnish consisting of 99% water and 1% pulped fibre that is dispersed evenly over a continuously moving wire screen.

**FACT:** An appropriated AXFLOC® retention program produces a sheet with high quality and great dry/wet strength properties.

### *STEP 3: Additives in, water out*

As the furnish moves through the machine, more and more water is removed, and paper is formed as it progresses through a series of rollers and dryers. Water is reused throughout the process and the finished sheets contain about 8% water, depending on the paper type. Some coatings and additives, such as starch, sizing, and clay coatings, can be added during the papermaking process to meet desired product qualities.

**FACT:** AXCHEM GROUP can provide treatments increasing the final quality in terms of water/fat resistance and mechanical characteristics with its AXSTRENGTH® and AXSIZE® products.

*Finally the paper is ready to use*

***Ease of recyclability: it does depend on the quantity of non-fibre elements. If they are more than 33%, the recycle becomes a challenge (Source: AF&PA)***

*Consumers awareness is the best ally for the paper makers: the more people know how to do separate collection well, more the quality of collected paper is good.*

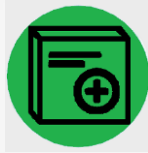
*But, once in the paper mill, chemistry is the greatest help to remove contaminants which can decrease the final quality of the product.*

## Ease of recyclability

# Recyclable paper-based packaging

**Corrugated packaging** is strong, convenient and sustainable. It is the single most recycled packaging material. The recycling rate for corrugated packaging is nearly 100% in Germany.

Walls of corrugated packaging consist of two parts: linerboard (or facing) on the exterior and corrugated medium (fluted paper) between layers of facing. Various layers can be used to increase the packaging's strength.



**Bleached paperboard** is a premium paperboard grade that is white in color. It is an excellent packaging choice for food, cosmetics, pharmaceuticals and countless other products. Clay coating increases the printability of the carton's surface; other coatings can improve wet strength protection.

The name Kraft comes from the German word meaning "strong". And **Kraft paper bags** are a popular choice due to their superior strength as well as the versatility they offer in size and shape. They are also an eco-friendly choice, being both biodegradable and 100% recyclable.



**Boxboard designates** the type of paperboard used for making boxes. Recycled/unbleached boxboard cartons are highly versatile, offering superior strength for protecting products such as cereal and food products, dry household and commercial products, gameboards and shoeboxes, etc.

**FACT: In 2019, the Belgian recycling rate was 85,3%, the highest in Europe**  
(Source: Eurostat)



## Ease of recyclability

### Easy To Recycle

water-based inks  
water soluble dyes  
UV EB inks  
water soluble adhesives  
paper tape  
polymer tape  
pressure sensitive labels  
clay coatings  
varnish coatings  
polymer barriers  
wet strength resins  
non-tree fibres

## Non-fiber elements

*33% or more of respondents rated these non-fibre elements as a challenge in mills. Being a challenge does not make something not recyclable. This non-fibre element does not adversely impact the recyclability of this item in mills*

*\*Definitions for non-fibre elements appear in the appendix.*

metalized foils  
wet strength resins  
non-tree fibres  
polymer windows  
laminated foils  
stamped foils  
metals  
plastics  
wet strength resins

Not  
Always  
Easy To  
Recycle

Not  
Easy To  
Recycle

hot melt adhesives  
wax coatings  
bioplastic barriers



# Appendix

## Recyclable

Packaging is recyclable if it can be collected, sorted, reprocessed and reused in manufacturing or making another item (Source: SustainablePackaging.org).

The term “recyclable” should only be used when there is evidence that the right recycling infrastructure exists (Source: UKCPI.org).

## Biodegradable

Anything biodegradable will break down quickly and safely into mostly harmless compounds, this includes anything which is plant-based, animal-based or natural mineral-based products. This also includes anything that undergoes degradation resulting from the action of naturally occurring microorganisms (Source: naturespath.com and ASTM).

## Compostable

Product is capable of breaking down into natural element in a compost environment. The breakdown process usually requires approximately 90 days. ASTM defines compostable as anything that undergoes degradation by biological processes during composting to yield CO<sub>2</sub>, H<sub>2</sub>O, inorganic compounds and biomass at a rate consistent with other compostable materials and leaves no visible, distinguishable or toxic residue (Source: naturespath.com and ASTM).



“The Green Dot” shows compliance with an authorised packaging recovery scheme in EU member states, showing packaging in the UK is exported to EU countries

(Source: UKCPI.org).



The Möbius loop symbol is used to show a product is recyclable in the UK. The specific requirements governing the use of the symbol are outlined in ISO standard ISO7000.

(Source: UKCPI.org).

# Appendix

## Definitions of non-fibre elements

### Water-based Inks

*an ink made with water rather than plastic or PVC.*

*These inks can be split into two main ingredients; water and pigment.*

### Water Soluble Dyes

*A dye is a coloured substance which chemically bonds to paper-based substrates when applied in an aqueous solution.*

### UV & EB Inks

*Curing of these inks typically describes the use of electron beam (EB), ultraviolet (UV) or visible light to polymerise a combination of monomers and oligomers onto a paper-based substrate. This material can be formulated into an ink, coating, adhesive or other products.*

### Paper Tape

*Gummed kraft paper tape is strong and durable. It has a water-activated bond and is ideal for use with corrugated boxes. This tape keeps goods secure during transit and storage.*

### Water Soluble Adhesives

*These products are supplied as pre-mixed solutions or are formulated as dry powders ready to be mixed with water for adhesive properties. The strength of the adhesive is then obtained when water is driven off by evaporation or absorption by the paper-based substrate. As these polymers are water soluble, bonds made using these adhesives have limited resistance to moisture and water.*

### Hot Melt Adhesives

*These are polymer based and are thermoplastic, meaning they are solid at room temperature. Ethylene-vinyl acetate (EVA), polyolefin and metallocene are the most popular types of hot melt adhesives. These products are usually applied as molten films or in a series of beads which are converted to a solid form once the materials cool. These products do not require water or solvents, therefore, have a very fast set time, thus making them a popular packaging adhesive.*

### Polymer tape

*Polypropylene tape is used for sealing light-weight packaged goods which are put under little to no stress during shipping.*

### *Pressure Sensitive Labels*

*Also known as a self-adhesive label is made up of two layers: a face stock and an adhesive. The face stock is the main part of the label which could be made up of paper, poly film or metallic foil. For specific applications, a topcoat or laminate may be applied to protect the label artwork or enhance certain areas of the design. The adhesive allows for the label to stick to the surface of a paper-based substrate. The strength of the adhesive depends on the application, for example, a label that is only used once such as on a carton, a strong adhesive is not required.*

### *Clay Coatings*

*Used on unbleached or natural Kraft paperboard, by which a thin layer of kaolin coated onto paperboard for an improved printing surface.*

### *Varnish Coatings*

*Can be gloss, satin or a matte clear ink, used for both protection or improved aesthetic appearance.*

### *Wax Coatings*

*These are traditionally used as a moisture barrier preserving the strength of a corrugated container which is being used for wet or iced products such as vegetables and meat or fish.*

### *Polymer Barriers*

*For barriers against water, oil and grease migration, **polyolefins** can be used on paper-based packaging. The most commonly used barrier coating is **polyethylene (PE)**. The end uses of these paper-based packaging products is drinking cups and frozen food packaging. Paperboard can be coated in **HDPE** for moisture-sensitive dry foods. **Polyethylene terephthalate (PET)**, provides a barrier and performs other functions such as heat resistance, this product is also an excellent grease barrier. The typical end use for this product would be ovenable trays and re-heatable products. **Polypropylene (PP)** is a heat resistant coating used for microwave oven packaging and has the ability to be deep frozen.*

### *Bioplastic Barriers*

*Renewable biopolymers used as barrier coatings on paper-based packaging prevent moisture transfer to food products, they work as good oxygen and oil barriers and are biodegradable. Biopolymer-based packaging materials are sourced from naturally renewable resources such as polysaccharides, proteins, lipids or a combination of these components.*

*The choice of materials for coatings and barriers depends on the desired function of the product.*

### *Metals*

*Handles on package and ends on composite spiral paperboard cans are typically made of metal. Staples are also made of metal, however, are not typically considered a challenge as they are easily removed during the recycling process.*

### *Plastics*

*Used as ends on composite spiral paperboard cans and as caps or spouts for liquid packaging. Plastic coatings are defined separately under polymer and bioplastic barriers.*

### *Polymer Windows*

*Materials used to make these windows are typically PET and polyvinyl chloride (PVC) plastics. Packaging with polymer windows need to combine strength and stability in the same way corrugated, solid paperboard or folding cardboard boxes do, whilst allowing the consumer to see what they are buying through a visibility panel.*

### *Laminated Foils*

*Laminates are multi-layers of foil, paper and/or plastics typically used for specific food packaging needs. These laminates provide an increase in strength and barrier protection in comparison to individual material (monofilm). Heat sealing is required for laminates such as paper, foil or polyethylene composition. Aluminium foil can be used for a barrier against moisture, gas and light.*

### *Stamped Foils*

*Is used as a decorative relief printing method, using high temperature the foils are transferred to a surface. The high temperature and pressure causes the foil to detach from the carrier and bond with the printing surface.*

### *Metalised Foils*

*These products are decorative polymer films which are coated with a thin layer of metal, usually aluminium. These foils are similar to aluminum foil in that they provide a glossy and metallic appearance, however, this is achieved as a reduced weight and cost. They are widely used for decorative purposes.*

### *Wet Strength Resins*

*This product is a critical papermaking additive across many grades of paper-based products. The efficiency of wet strength resins can be greatly impacted by operational variables such as the amount of fibre, filler and refining. Other wet end additives can also interfere with the efficiency of wet strength resins.*

### *Non-tree Fibres*

*“Tree-free” and “alternative fibre” products are generally made of hemp, kenaf, bamboo or agricultural residue from sources such as sugarcane or straw.*

# Appendix

## Insights from mills

Insights from mills into recycling packaging with foil treatments

The Foil Stamping & Embossing Association (FSEA) published a study which confirms that foil-decorated paper and board can be recycled and repulped.

PIRA International, Surrey, UK was commissioned to conduct the study and produce the findings.

The study found that neither hot or cold foil-decorated products would give rise to problems found in other decorating processes that would lead to the decorated paper products to be unsuitable for recycling.

(Source: [packagingimpressions.com](http://packagingimpressions.com))

The foil treatments used are typically less than 2.5 microns thick, this allows for the foil to completely dissipate within the repulping process.

Foil used on recyclable material can be re-pulped in normal waste streams.

(Source: [sapc.co.uk](http://sapc.co.uk))

# ***Paper and Board Packaging Recyclability Guidelines***

## ***Foils***

*Metalised films/aluminium films are usually less tightly bonded to paper-based substrate and fibre can be recovered from them.*

*Metallic Block Printing can be dealt with by paper mills.*

*Cartons printed with not more than 30% of the external surface area metallic block should be considered recyclable.*

*(Source: euagenda.eu)*

# Appendix

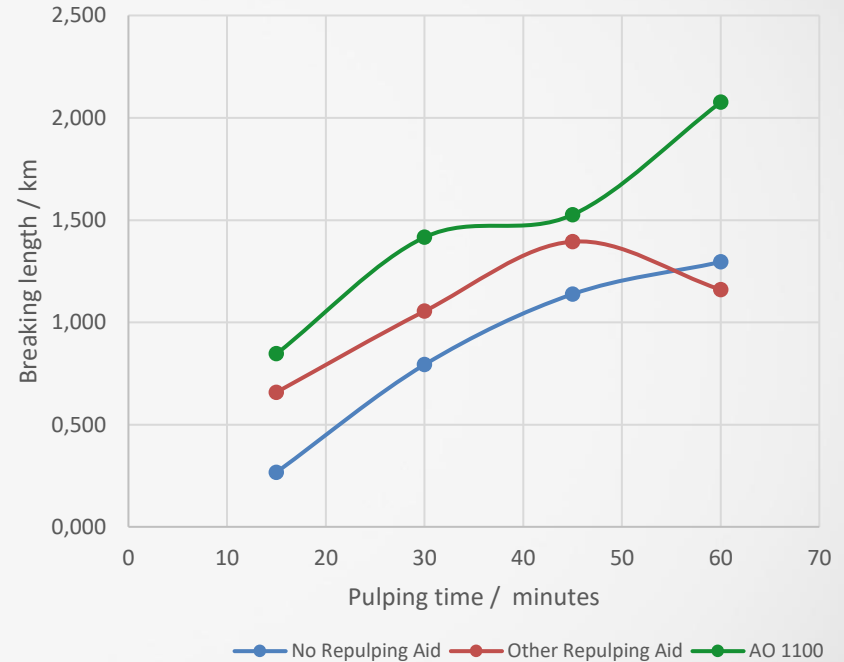
## Insights from mills

Insights into recycling packaging with wet strength resins

*Axchem completed a study and found that a higher degree of repulpability of towel products containing wet strength resin can be achieved through the aid of AO 1100.*

*This can be observed in this graph showing that a higher breaking length can be achieved, with reformed sheets after the same amount of pulping time, with AO 1100 in comparison to other repulping products.*

*The increase in breaking length indicates an increase in repulping and break down of wet strength resins, showing the AO 1100 repulping allows for a more uniform sheet to be produced.*



# How paper recycling works

## Axchem Group Solutions to be successful

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