American Forest & Paper Association

design guidance for recyclability

a resource for paper-based packaging designers

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introduction

Paper-based packaging is recyclable. Some non-fiber elements that are applied to paper-based packaging, like barrier coatings or adhesives, may create challenges for paper mills to recycle. With increased interest among consumer products companies to provide more recyclable packaging for their customers, the paper-based packaging industry recognizes the opportunity to bring clarity to how packaging gets recycled in paper mills and how various non-fiber elements affect the recyclability of paper-based packaging.

The American Forest & Paper Association (AF&PA) developed the Design Guidance for Recyclability for Paper-based Packaging for members of the paper-based packaging manufacturing supply chain to use in designing and manufacturing packaging to meet customers' needs in terms of recyclability.

The findings in this report were the result of an AF&PA survey of member company mills in a range of sectors in the United States and Canada.

The technical guidance is not meant to be mandatory or a standard for the packaging industry.

While there are other uses for paper-based packaging in making new products other than paper and paperboard, the objective of this report is to present research-based findings on the impact of various non-fiber elements frequently found on paper-based packaging on recyclability in paper mills.

AF&PA hopes that this guidance will prove to be useful to members of the paper-based packaging manufacturing supply chain — consumer products companies that desire more recyclable packaging, designers that specify it, and the manufacturers and converters who make it — to better achieve their goals.

scope

methodology

A survey was sent to AF&PA member company mills in a range of sectors that use recovered paper grades likely to include the various types of recyclable paper-based packaging found in the Scope. A total of 65 surveys were sent to mills in the United States and Canada. Of those, 49 completed surveys were returned, for a response rate of 75 percent.

In total, data for 86 mills was reported. Those 86 mills represent 74 percent of the total amount of recovered fiber grades likely to include the types of recyclable paper-based packaging found in the Scope that our members consume. The survey was conducted online and with some follow-up interviews, and was open between June 15 and June 30, 2020.

The following types of recyclable paper-based packaging were identified as the focus of the study:

- Corrugated packaging
- Bleached paperboard cartons
- Recycled/unbleached boxboard cartons
- Carrier stock cartons
- Kraft paper bags
- Multiwall shipping sacks
- Molded fiber containers

Three other types of recyclable paper-based packaging were targeted for the study, but the research did not return enough mill survey responses:

- Paper cups
- Aseptic cartons
- Gable-top cartons

The following kinds of non-fiber elements frequently found on recyclable paper-based packaging are included in the study:

- Adhesives (water soluble; hot-melt)
- Barriers (polymer; bioplastic)
- Coatings (clay; varnish; wax)
- Dyes (water soluble)
- Foils (metalized; stamped; laminated)
- Inks (water-based; UV EB)
- Metals
- Non-tree fibers
- Plastics
- Polymer windows
- Pressure-sensitive labels
- Tapes (paper; polymer)
- Wet strength resins
- Wax

This report identifies non-fiber elements that may become recycling "challenges". Something becomes a challenge when it slows down a mill's pulping process, plugs screening systems or leaves residue on finished paper or paperboard.

How much of a non-fiber element can make it a recycling "challenge"? It is highly dependent on each mill's repulping capability. When asked this question, fewer than half of respondents provided data. For those that did, the numbers varied widely. For example, responses for the amount of one non-fiber element that presented a challenge ranged from "any amount" to "more than 20%".

NOTE:
Being a challenge does not make something not recyclable. It is important to note that each non-fiber element applied to each kind of packaging was rated by some mills as not a challenge.

how paper recycling works:

More than 90% of Americans have access to community paper and paperboard recycling.[1] 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 center or Material Recovery Facility (MRF). 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.

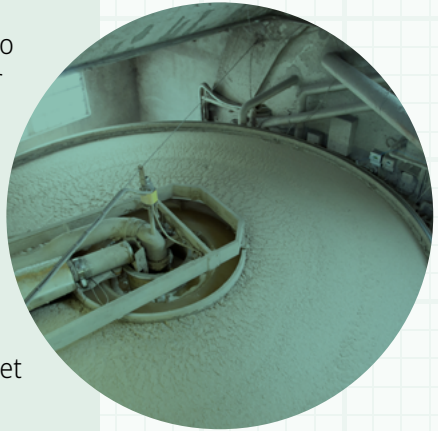
click here to download AF&PA's Papermaking Process infographic

STEP 1: pulping and contaminant removal

At the paper mill, recycled paper is fed into large pulpers where it is mixed with water and agitated to release individual fibers. Contaminants like staples, plastic liners, coatings, tape and adhesives are separated and sent for disposal. The remaining fiber is in a solution of 99% water and ready for papermaking.

In 2019, the U.S. paper recycling rate was 66.2% and the paper recycling rate has met or exceeded 63% for the last 11 years.

FACT: Recycled paper fibers can be reused 5 to 7 times to make new products. [2]



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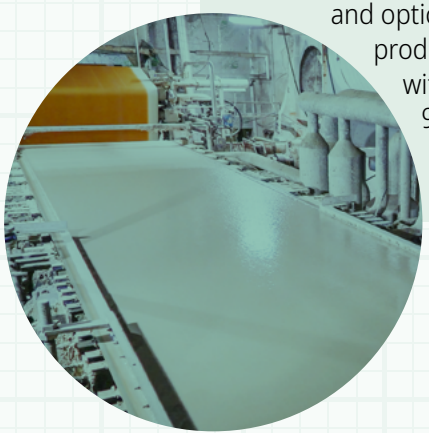
FACT: More than 80% of all U.S. paper mills use some recovered fiber. [3]

STEP 2: pulp and water lay the foundation

The water-saturated pulp slurry, known as furnish, is a blend of fiber 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 fiber that is dispersed evenly over a continuously moving wire screen.



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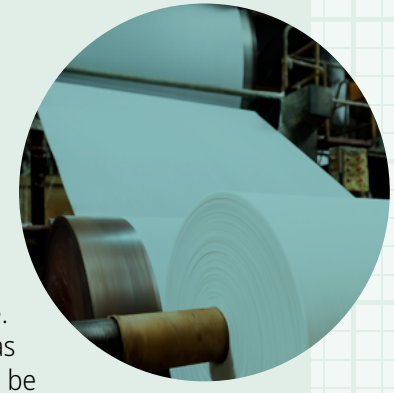
STEP 3: additives go in, water comes out



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: North American paper mills would run out of fiber in about six months without the constant input of virgin fiber. [4]

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a finely calibrated process

Both the mill operations and the necessary feedstock are optimized for a particular range of recycled content, from zero to 100%. Altering the type of paper produced and the amount of recycled content it contains may require substantial changes to operations and equipment, as well as expenses costing millions of dollars, each time a switch is made to new equipment.

KEY TERMS:

- **Virgin pulp and paper mills:** *Mills that use predominantly (80% or more) wood fiber to manufacture new pulp, paper or paperboard.*
- **Recycled mills:** *These pulp and paper mills use predominantly (80% or more) recovered paper in manufacturing.*
- **Swing mills:** *These paper mills operate in the middle range, using between 20-80% recovered paper in manufacturing.*

ease of recyclability *inks, dyes, adhesives, tapes & labels*

● *This non-fiber element does not adversely impact the recyclability of this item in mills.*

● *33% or more of respondents rated this non-fiber element as a challenge in mills. Being a challenge does not make something not recyclable.*

○ *This non-fiber element is typically not found on this product.*

	corrugated packaging	bleached paperboard cartons	recycled/ unbleached boxboard *coated/uncoated*	carrier stock cartons *unbleached Kraft paperboard*	kraft paper bags	multiwall shipping sacks	molded fiber containers
inks & dyes							
water-based inks	●	●	●	●	●	●	●
water soluble dyes	●	●	●	●	●	●	●
UV EB inks	●	●	●	●	●	●	●
adhesives							
water soluble adhesives	●	●	●	●	●	●	●
hot melt adhesives	●	●	●	●	●	●	○
tapes & labels							
paper tape	●	○	○	○	○	○	○
polymer tape	●	○	○	○	○	○	○
pressure sensitive labels	●	○	○	○	○	○	○

ease of recyclability *coatings, barriers, metals & plastics*

● *This non-fiber element does not adversely impact the recyclability of this item in mills.*

● *33% or more of respondents rated this non-fiber element as a challenge in mills. Being a challenge does not make something not recyclable.*

○ *This non-fiber element is typically not found on this product.*

	corrugated packaging	bleached paperboard cartons	recycled/ unbleached boxboard *coated/uncoated*	carrier stock cartons *unbleached Kraft paperboard*	kraft paper bags	multiwall shipping sacks	molded fiber containers
coatings & barriers							
clay coatings	●	●	●	●	●	●	●
varnish coatings	●	●	●	●	●	●	●
wax coatings	●	○	○	○	○	○	○
polymer barriers	●	●	●	●	●	●	●
bioplastic barriers	●	●	●	●	●	●	●
metals & plastics							
metals	●	●	●	●	●	●	○
plastics	●	●	●	●	●	●	○
polymer windows	●	●	●	●	●	●	○

ease of recyclability *foils, wet strength resins & non-tree fibers*

● *This non-fiber element does not adversely impact the recyclability of this item in mills.*

● *33% or more of respondents rated this non-fiber element as a challenge in mills. Being a challenge does not make something not recyclable.*

○ *This non-fiber element is typically not found on this product.*

	corrugated packaging	bleached paperboard cartons	recycled/ unbleached boxboard *coated/uncoated*	carrier stock cartons *unbleached Kraft paperboard*	kraft paper bags	multiwall shipping sacks	molded fiber containers
foils							
laminated foils *	●	●	●	●	●	●	●
stamped foils *	●	●	●	●	●	●	●
metallized foils *	●	●	●	●	●	●	●
other							
wet strength resins **	●	●	●	●	●	○	●
non-tree fibers	●	●	●	●	●	●	●

* *This guide includes additional insights from mills on the recyclability of foils on page 24.*

** *This guide includes additional insights from mills on the recyclability of wet strength resins on page 26.*

corrugated packaging

Corrugated packaging is strong, convenient and sustainable. It is the single most recycled packaging material. In 2019, the U.S. recycling rate for corrugated packaging was 92%. 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.

Easier 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
- polymer windows
- metalized foils
- non-tree fibers

Definitions for non-fiber elements appear in the appendix.

THE BOTTOM LINE:

- Water soluble inks, dyes and adhesives, UV EB inks, paper and polymer tapes, clay coatings and varnish cause few problems.

Recycling challenges

- hot melt adhesives
- wax coatings
- bioplastic barriers
- metals
- plastics
- laminated foils
- stamped foils
- wet strength resins

● *33% or more of respondents rated these non-fiber elements as a challenge in mills. Being a challenge does not make something not recyclable.*

bleached paperboard cartons

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.

Easier to recycle

- water-based inks
- water soluble dyes
- UV EB inks
- water soluble adhesives
- clay coatings
- varnish coatings
- polymer barriers
- metals
- non-tree fibers

Definitions for non-fiber elements appear in the appendix.

THE BOTTOM LINE:

- Water soluble inks, dyes and adhesives, clay coatings and UV EB inks are no problem.
- Foils, wet strength resins and polymer windows can create challenges.

Recycling challenges

- hot melt adhesives
- polymer windows
- laminated foils
- stamped foils
- metalized foils
- wet strength resins

● *33% or more of respondents rated these non-fiber elements as a challenge in mills. Being a challenge does not make something not recyclable.*

recycled/ unbleached boxboard cartons

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.

Easier to recycle

- water-based inks
- water soluble dyes
- UV EB inks
- water soluble adhesives
- clay coatings
- varnish coatings
- polymer barriers
- bioplastic barriers
- metals
- plastics
- polymer windows
- non-tree fibers

Definitions for non-fiber elements appear in the appendix.

THE BOTTOM LINE:

- Water soluble inks, adhesives and dyes, UV EB inks, clay coatings and varnish cause few problems.
- Some mills are challenged by wet strength resins and foils.

Recycling challenges

- hot melt adhesives
- laminated foils
- stamped foils
- metalized foils
- wet strength resins

● *33% or more of respondents rated these non-fiber elements as a challenge in mills. Being a challenge does not make something not recyclable.*

carrier stock cartons

Kraft paperboard cartons that provide superior product protection and maintain structural integrity when wet. They are the preferred choice for beer and soft drink multipacks, and other food and non-food uses that require durability and excellent printability.

Easier to recycle

- water-based inks
- water soluble dyes
- UV EB inks
- water soluble adhesives
- clay coatings
- varnish coatings
- polymer barriers
- bioplastic barriers
- metals
- plastics
- polymer windows
- non-tree fibers

Definitions for non-fiber elements appear in the appendix.

THE BOTTOM LINE:

- Water soluble inks, adhesives and dyes, UV EB inks and clay coatings cause few problems.
- Some mills are challenged by wet strength resins, foils and hot melt adhesives.

Recycling challenges

- hot melt adhesives
- laminated foils
- stamped foils
- metalized foils
- wet strength resins

● *33% or more of respondents rated these non-fiber elements as a challenge in mills. Being a challenge does not make something not recyclable.*

kraft paper bags

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.

Easier to recycle

- water-based inks
- water soluble dyes
- UV EB inks
- water soluble adhesives
- varnish coatings
- metals
- plastics
- polymer windows
- laminated foils
- stamped foils
- metalized foils
- non-tree fibers

Definitions for non-fiber elements appear in the appendix.

THE BOTTOM LINE:

- Water soluble dyes, inks and UV EB inks are no problem.
- Water soluble adhesives, metals, plastics and non-tree fibers can be managed easily.

Recycling challenges

- hot melt adhesives
- polymer barriers
- bioplastic barriers
- wet strength resins

● *33% or more of respondents rated these non-fiber elements as a challenge in mills. Being a challenge does not make something not recyclable.*

multiwall shipping sacks

Paper shipping sacks are used as packaging for a variety of bulk dry food, agricultural and industrial materials. As a packaging material, multiwall shipping sacks are safe, durable, efficient and economical. Paper shipping sacks also offer an excellent backdrop for print graphics.

Easier to recycle

- water-based inks
- water soluble dyes
- UV EB inks
- water soluble adhesives
- clay coatings
- varnish coatings
- polymer barriers
- metals

Definitions for non-fiber elements appear in the appendix.

THE BOTTOM LINE:

- Consistent with other packaging types, water soluble dyes, both types of inks and water soluble adhesives are no problem.
- Clay coatings, polymer barriers and varnish are manageable.

Recycling challenges

- hot melt adhesives
- bioplastic barriers
- plastics
- polymer windows
- laminated foils
- stamped foils
- metalized foils
- non-tree fibers

● *33% or more of respondents rated these non-fiber elements as a challenge in mills. Being a challenge does not make something not recyclable.*

molded fiber containers

Molded fiber containers are commonly used as packaging for food products such as egg cartons, fast food containers, and more. The packaging material is resistant to both heat and cold and non-fiber elements can be added to further increase performance based on the need of the packaging's contents.

Easier to recycle

- water-based inks
- water soluble dyes
- UV EB inks
- water soluble adhesives
- clay coatings
- varnish coatings
- polymer barriers
- bioplastic barriers
- non-tree fibers

Definitions for non-fiber elements appear in the appendix.

THE BOTTOM LINE:

- Consistent with other packaging types, water soluble dyes and both types of inks are no problem.
- Foils and wet strength resins are the greatest concern.

Recycling challenges

- laminated foils
- stamped foils
- metalized foils
- wet strength resins

● *33% or more of respondents rated these non-fiber elements as a challenge in mills. Being a challenge does not make something not recyclable.*

appendix *definitions of "recyclable"*

The following definition of "Recyclability" was approved by AF&PA members in 2019:

Recyclability means the ability of a paper-based product to be recycled into new paper, paperboard or other products. A paper-based product is recyclable if it can be collected, separated or otherwise recovered from the waste stream through recycling programs for use in manufacturing or assembling another item.

U.S. Federal Trade Commission Green Guides

Part 260 - Guides for the Use of Environmental Marketing Claims

§ 260.12 Recyclable Claims.

(a) It is deceptive to misrepresent, directly or by implication, that a product or package is recyclable. A product or package should not be marketed as recyclable unless it can be collected, separated, or otherwise recovered from the waste stream through an established recycling program for reuse or use in manufacturing or assembling another item.

Note: The complete text of this section, including examples, is available at: https://www.ftc.gov/sites/default/files/attachments/press-releases/ftc-issues-revised-green-guides/greenguidesstatement.pdf

(b) Marketers should clearly and prominently qualify recyclable claims to the extent necessary to avoid deception about the availability of recycling programs and collection sites to consumers.

(1) When recycling facilities are available to a substantial majority of consumers or communities where the item is sold, marketers can make unqualified recyclable claims. The term "substantial majority," as used in this context, means at least 60 percent.

(2) When recycling facilities are available to less than a substantial majority of consumers or communities where the item is sold, marketers should qualify all recyclable claims. Marketers may always qualify recyclable claims by stating the percentage of consumers or communities that have access to facilities that recycle the item. Alternatively, marketers may use qualifications that vary in strength depending on facility availability. The lower the level of access to an appropriate facility is, the more strongly the marketer should emphasize the limited availability of recycling for the product.

(c) Marketers can make unqualified recyclable claims for a product or package if the entire product or package, excluding minor incidental components, is recyclable. For items that are partially made of recyclable components, marketers should clearly and prominently qualify the recyclable claim to avoid deception about which portions are recyclable.

(d) If any component significantly limits the ability to recycle the item, any recyclable claim would be deceptive. An item that is made from recyclable material, but, because of its shape, size, or some other attribute, is not accepted in recycling programs, should not be marketed as recyclable.

appendix *definitions of non-fiber elements*

water-based inks
Water-based ink is an ink made with water rather than plastic or PVC. Water-based inks can be split into two main ingredients, water and pigment. [5]

water soluble dyes
A dye is a colored substance that chemically bonds to the paper-based substrate to which it is being applied. The dye is applied in an aqueous solution. [6]

UV and EB inks
UV and EB curing typically describes the use of electron beam (EB), ultraviolet (UV) or visible light to polymerize a combination of monomers and oligomers onto a paper-based substrate. The UV and EB material may be formulated into an ink, coating, adhesive or other product. [7]

water soluble adhesives
Water soluble adhesives are supplied as pre-mixed solutions, or are formulated as dry powders, which must then be mixed with water in order to obtain its adhesive properties. The strength of the adhesive is attained when water is lost from the glue line by evaporation or absorption by the paper-based substrate. Because the polymers are water soluble, bonds made using these adhesives have limited resistance to moisture and water. [8]

hot melt adhesives
Hot melt adhesives are polymer based, and are thermoplastic in nature, meaning they are solid at room temperature. The two most popular types of hot melt adhesives are ethylene-vinyl acetate (EVA) and polyolefin, or metallocene. These are generally applied as either a molten film or in a series of beads that is converted to a solid form when the materials cool and set. Because hot melt adhesives do not utilize water or solvents, they also have a very fast set time, which makes them a popular kind of packaging adhesive. [9]

paper tape
Gummed kraft paper tape is strong and durable. It has a water-activated bond and is ideal for use with corrugated shipping boxes. Paper tape keeps goods totally secure while in transit and storage. [10]

polymer tape
Polypropylene tape is ideal for sealing light-weight packaged goods that put little to no stress on a box during shipping. [11]

pressure sensitive labels
A pressure-sensitive label, or 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. The material could be 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 is what makes the label stick to the surface of the paper-based packaging. The adhesive type will depend on the application that the label will be used for. For a label that is only going to be used once, as on a paper-based shipping carton, a strong adhesive isn't necessary. [12]

clay coatings
A thin layer of kaolin coated onto paperboard in order to improve its printing surface. Used on unbleached or natural Kraft paperboard. [13]

varnish coatings
A clear ink which can be either gloss, satin or matte which can be used for protection or to improve aesthetic appearance. [14]

wax coatings
Wax [curtain] coatings on boxes have traditionally been used as a moisture barrier to preserve the strength of a corrugated container holding wet or iced products such as fresh fruits and vegetables, meat, poultry, and seafood. [15]

polymer barriers
Polyolefins provide functional and sustainable barrier effects against water, oil and grease migration on paper-based packaging. PE, or polyethylene, is the most commonly used barrier coating. Typical end uses are: drinking cups and packages for frozen food, ice cream and yogurt. HDPE-coated paperboard is used for moisture-sensitive dry foods. PET, or polyethylene terephthalate, provides a barrier and performs other functions, such as heat resistance and act as an excellent grease barrier. Typical end uses include: ovenable trays, reheatable product packages and bakery products. PP, or polypropylene, coating offers heat resistance for microwave oven and is also suitable for deep freezing. Typical end uses are: cups and trays for microwave oven and frozen food. [16]

bioplastic barriers
Renewable biopolymers used as barrier coatings on paper-based packaging retard moisture transfer in food products, are good oxygen and oil barriers, and are biodegradable. The choice of materials for a coating is largely dependent on its desired function. Biopolymer-based packaging materials originate from naturally renewable resources such as polysaccharides, proteins, and lipids or combinations of those components. [17]

metals
Metals are used as handles on packaging and as ends on composite spiral paperboard cans. Metal staples are generally not considered a challenge and are easily removed during the recycling process.

plastics
Plastics are used as ends on composite spiral paperboard cans and as caps and spouts for liquid packaging. Plastic coatings are defined separately (polymer barriers and bioplastic barriers) and are not considered in this category.

polymer windows
Packaging with polymer windows combine the strength and stability of corrugated, solid paperboard or folding carton boxes with a visibility panel that allows the consumer to see what they are buying. The materials most often used in windows are polyethylene terephthalate (PET) and polyvinyl chloride (PVC) plastics. [18]

laminated foils
Laminates are multi-layers of foil, paper and/or plastics that may be utilized selectively according to the specific food packaging need. In combination, the various laminates provide more strength and barrier protection than the individual material (monofilm). Laminates of paper/foil/polyethylene composition rely on plastic layers for heat sealing (forming leak-tight containers). Aluminum foil provides a barrier to moisture, gases and light, whereas paper provides stiffness, strength and shape. [19]

stamped foils
Foil stamping is a decorative relief printing method in which foils are transferred to a surface at high temperatures. Pressure and heat cause the relevant sections of the foil to become detached from the carrier material and become bonded with the printing surface.

metalized foils
Metalized films are decorative polymer films coated with a thin layer of metal, usually aluminum. They offer the glossy metallic appearance of an aluminum foil at a reduced weight and cost. They are widely used for decorative purposes.

wet strength resins
Wet strength resins are a necessary and critical papermaking additive for many grades of paperboard and specialty packaging. Operational variables like the amount and type of recycled fiber and filler, refining, and other wet end additives, can impact the efficiency of wet strength resins. [20]

non-tree fibers
“Tree-free” and “alternative fiber” products are generally made of hemp, kenaf (a plant similar to cotton), bamboo, or agricultural residue from sugarcane or straw. [21]

appendix *insights from mills*

insights from mills into recycling packaging with foil treatments

Improvements in recycling technology and the ability to use thinner foils have made foil treatments easier to recycle than they have been historically.

A majority of mills reported that there is no meaningful difference between how the different kinds of foil treatments are managed.

An analysis of responses to the mill questionnaire that rated one or more of the foil treatments as easier to recycle showed the following:

Recovered fiber use in manufacturing:

- The majority of mills in this group use predominantly recovered fiber for furnish (76-100 percent). Among them:
  - 55 percent rate “stamped foils” as easier to recycle
  - 60 percent rate “metalized foils” as easier to recycle
  - 56 percent rate “laminated foils” as easier to recycle
- A sizeable minority of mills (26-50 percent) use less recovered fiber for furnish. Among them:
  - 32 percent rate “stamped foils” as easier to recycle
  - 25 percent rate “metalized foils” as easier to recycle
  - 26 percent rate “laminated foils” as easier to recycle

insights from mills into recycling packaging with foil treatments (cont'd)

Products manufactured:

- Nearly three-fourths of the mills manufacture Containerboard.
- A minority (14 percent) manufacture Uncoated Recycled Boxboard.

Pulping process:

- The great majority (approximately 80 percent) of these mills utilize Continuous-Low Consistency pulping.
- Mills in this group utilized other pulping process to: 9 percent of mills reported utilizing Batch, Continuous-High Consistency and/or Drum pulping.

  NOTE: Mills were able to select more than one response option for this question.

Observations about the different kinds of foil treatments:

- Metal on poly is easier to deal with. It's easier to get the poly off the board than metal and very thin metal will stick to the poly.
- Stamped foil is not as severe [because] stamping tends to involve less foil.
- Metalized coatings are more problematic than stamping.
- Metalized films are very thin, and the plastic backing is difficult to separate.

insights from mills into recycling packaging with wet strength resins

Respondents are sure that wet strength resins are acceptable in small amounts. How much is "too much" varies, anywhere from "less than 2 percent" to "less than 5 percent" to "less than 10 percent" of the bale.

Wet strength resins create significant yield loss and higher waste, presenting a higher cost to process while generating less output for mills.

An analysis of responses to the mill questionnaire that rated wet strength resins as easier to recycle showed the following:

Recovered fiber use in manufacturing:

- More than half of these mills use predominantly (76-100 percent) recovered fiber as furnish.
- More than one-third use less (26-50 percent) recovered fiber as furnish.

Products manufactured:

- Nearly two-thirds of the mills manufacture Containerboard.
- The next most frequent product made by this group of mills (14 percent) is Uncoated Recycled Boxboard.

Pulping process:

- Nearly all (86 percent) of the mills in this group utilize Continuous-Low Consistency Pulping.
- More than one-fourth (29 percent) utilize Batch pulping.

  NOTE: Mills were able to select more than one response option for this question.

appendix *recyclability standards & testing facilities*

This Appendix provides an inventory of existing recyclability standard and testing facilities that are available for paper-based packaging. As designers and manufacturers of paper-based packaging consider how recyclable their current packaging is, and design new packages, there are resources in this guide that may be of assistance.

For each standard and testing facility, a brief overview and a link to the organization's website is provided for further detail and contact information.

Fibre Box Association® – Corrugated Box Alternative Coating Standard

500 Park Boulevard, Suite 985, Itasca, IL 60143
Phone: 847-364-9600 **E-mail:** fba@fibrebox.org
URL: fibrebox.org

Certain coating treatments used on corrugated boxes to provide a practical and economical way of shipping perishable products such as meat, seafood, produce. The same coatings can also make recycling the containers a challenge, imposing financial and logistical burdens on mills. The Fibre Box Association (FBA) and the American Forest & Paper Association (AF&PA) formed a joint committee to find alternatives to improve the recyclability of corrugated containers by providing an alternative to the historically used wax coatings.

The working group evaluated the repulpability and recyclability of various moisture barrier treatments in order to establish a minimum threshold for moisture barrier coatings. The "Voluntary Standard for Repulping and Recycling Corrugated Fiberboard" published in 2013 contains a test method and test report.

Part 1 determines the repulpability of treated corrugated by determining fiber-on-fiber yield when the treated corrugated container is processed in accordance with this standard.

Part 2 determines the recyclability of the treated corrugated container by evaluating its effect on mill operations and finished products when it is added to untreated corrugated in the amounts specified.

Full details on the test method and test report can be found at: https://www.corrugated.org/wp-content/uploads/PDFs/Recycling/Vol_Std_Protocol_2013.pdf

Box manufacturers can register treatments and coated board combinations with the Fibre Box Association on an ongoing basis if they have a lab approved by the FBA (3rd party or internal) certify that treatment has passed the test protocol. Three approved labs are discussed in the next section: WMU, NC State, and WIST at University of Wisconsin.

Western Michigan University – Recycling Pilot Plants

4651 Campus Drive, Kalamazoo, MI 49008
Phone: 269-276-3533 **URL:** wmupilotplant.com

The Recycling Pilot Plants at Western Michigan University (WMU) in Kalamazoo, MI provides an outlet for companies to test new paper types, fibers, chemistries and equipment on a smaller scale, without having to interrupt their own production lines. The Pilot Plants also does R&D on paper and related products, and provides recyclability certifications. The website at http://wmupilotplant.com/recycling provides further information.

The Pilot Plants is a large scale facility that can recycle, repulp and de-ink a wide variety of post-consumer waste items including mixed office papers, magazines, food service packaging, and a variety of packaging including old corrugated containers (OCC). To date, WMU has tested hundreds of pulp and paper products and developed approved certifications for a number of types of packaging.

WMU has taken a leading role in the testing methods for the recyclability of foodservice containers. WMU partnered with Global Green (an industry working group that helps businesses increase profits by transforming waste into assets) in 2009 to develop a recyclability and repulpability protocol for fiber-based hot cups. This testing determined that considerable volumes of usable fiber from cup stock was being landfilled and that cups designed for repulpability could be integrated within the OCC or Mixed Paper streams and recycled.

WMU has offered certifications since the mid-2000s that reflect voluntary and generally agreed upon standards in the industry. WMU was approved to provide certification for the Fibre Box Voluntary Standard in 2007. By 2009 it had developed a testing protocol and certification of recyclability for OCC (or recovered corrugated). WMU has offered a certification for SBS-E materials since 2013. To qualify for certification, a material typically needs to produce 80% yield when repulped.

WMU has partnered with several industry associations to provide certifications that meet their specific requirements such as the Fibre Box Association and How2Recycle.

NC State University – Pulp and Paper Technical Services Program

411 Dan Allen Drive, Raleigh, NC 27695
Phone: 919-515-5790 **E-mail:** med_byrd@ncsu.edu
URL: cnr.ncsu.edu/fb/facilities-and-services/fiber-recycling-technical-services/

Within the School of Forest Biomaterials, NC State conducts R&D and provides technical services to the pulp and paper industry. Research areas include: fiber recycling, including stickies identification and removal; repulpability and recyclability of barrier-treated (e.g. waxed) and other difficult materials; and enzymatic and agglomeration de-inking.

The Pulp and Paper Technical Services group supports pulp and paper and allied industries with high quality, cost-effective technical services on a project basis. The group provides all types of testing from small-scale laboratory testing to pilot-scale production of large quantities of pulp or paper.

The group offers an assortment of equipment, described below, that can be used to treat small samples at bench scale or large samples at pilot scale.

Bench-Scale Testing

- Adirondack 1-gallon (3.8-liter) Low-Consistency Benchtop Pulper
- Adirondack 2-gallon (7.6-liter) High-Consistency Benchtop Pulper
- 3-gallon (11.4-liter) Benchtop Low-Consistency Pulper
- Voith Laboratory Flat Screen
- Pulmac Master Screen
- Modular Centrifugal Cleaner System
- Shinhama Laboratory Kneader

Pilot-Scale Testing

- Black Clawson 200-gallon (760-liter) Hydrapulper
- 50-gallon (190-liter) Pilot Pulper
- Ahlstrom M200 Centrisorter Centrifugal Pressure Screen
- Gauld Periflow 140 Centrifugal Pressure Screen
- Beloit Pressurized Deinking Module
- Voith Atmospheric Flotation Cell
- Bauer Hydrasieve Slanting Screen
- Renneberg Pilot Screw Press
- Filtration Engineers Pilot Rotary Drum Filter Washer
- Sunds CD-300 Mechanical Pulping Pilot Plant

University of Wisconsin, Stevens Point, Wisconsin Institute for Sustainable Technology – Paper Testing Services

D274 SCI, 2001 Fourth Avenue, University of Wisconsin - Stevens Point, Stevens Point, WI 54481-3897
Contacts: Lindsey Hoffman, 715-346-3796 or Lindsey.Hoffman@uwsp.edu; Brian Bandow, 715-346-3733, Brian.Bandow@uwsp.edu
URL: uwsp.edu/wist/Pages/laboratory-services/testing-services.aspx

At the University of Wisconsin, Stevens Point, the Wisconsin Institute for Sustainable Technology (WIST) in the College of Natural Resources, provides routine testing and analysis for the pulp and paper industry. The paper testing and development unit has dedicated laboratories, offering services for pulping, bleaching, paper making, coating, laminating, repulpability and recyclability. Testing is carried out according to TAPPI, ASTM or ISO methods, as well as How2Recycle and Fibre Box Association guidance and protocols.

WIST offers an extensive line of testing:

- ABC Pulping Liquor Test
- Absorption, Water Drop (T432)
- Ash Testing 525 degC (T211)
- Ash Testing 900 degC (T413)
- Automated Solvent Extraction
- Basis Weight, Paper and Paperboard (T410)
- Brightness (T525, T571)
- Brit Jar, Fines (Pulp) (T261)
- Bulk/Density (T220)
- Burst (T403)
- Caliper (T411)
- Carbohydrate analysis
- Carbohydrate analysis and Klason Lignin
- Carboxymethylcellulose substitution
- Cobb Size Test (T441)
- Consistency (T240)
- Dirt Count with Handsheets (T205 and T563)
- Fatty Acid Analysis - Short Chain
- Fatty Acid Analysis - Long Chain (2-20 Carbons)

WIST testing *(cont'd)*

- Fiber Length Distribution: MorFi
- Fiber Length Distribution - Morfi w/shives or coarseness
- Folding/Endurance (T511)
- Formation Analysis (Optest Micro-Scanner)
- Freeness (T227)
- Gloss (T480)
- Gurley Porosity (T460)
- Handsheet Preparation and Physical Testing Package (T220)
- Handsheet Preparation Only (T 205)
- Kappa Number (T 236)
- Klason Lignin (TAPPI 60(10):143(1977)
- Moisture Analysis - Halogen Balance
- Odor analysis
- Opacity (T519)
- Parker Print Surf (T555)
- PFI Mill: 5 pt. curve including freeness, handsheets and standard testing (T248)
- Pulmac Master Screen Shive Analysis (T274)
- Repulpability - Modified UWSP Version (UM 212 + Formation)
- Repulpability - TAPPI UM Method Only (UM 212)
- Ring Crush (T818)
- Sheffield Smoothness (T538)
- Sommerville Flat Screen (T278)
- Starch Analysis (T419)
- Stiffness: Taber (T566)
- Tear (T414) Tensile: stretch, TEA, modulus (T494)
- TSO Test
- Valley Beater (T200)
- Viscosity (T230)
- Water Retention Value (UM 256)
- Wax Extraction Test (T405, T574)
- Wax Pick Test (T459)
- Zero-Span Tensile (T231)

SGS Integrated Paper Services – Paper Testing Services

3211 E Capitol Dr., Appleton, WI 54911
Phone: 920-749-3040 **URL:** ipstesting.com

Integrated Paper Services (IPS), Inc. is an independent testing lab for pulp and paper, packaging, nonwovens, personal care products, medical supplies and allied industries. IPS was founded in Appleton, WI in 1989 and is an offshoot of the Institute of Paper Chemistry. IPS combines physical and analytical testing with interpretive data analysis to offer testing services that help improve and ensure the quality of paper-based products and packaging.
More information can be found at:
https://ipstesting.com/overview-about/

Focusing exclusively on paper and nonwoven products, IPS has recently added services addressing product stewardship which include regulatory testing, recyclability and/or repulpability, and flushability testing.

IPS closely follows ISO, ASTM, INDA and TAPPI test method standards. The following are examples of sustainability and regulatory related testing services:

- Determination of recycled content or Mixed Tropical Hardwoods in paper-based materials
- Analytical testing of substrates, inks and adhesives for known “bad actors”
- Recyclability/repulpability testing
- Physical testing for material reduction or evaluation of green alternatives

In partnership, IPS and WIST are approved to provide certification for the Corrugated Packaging Alliance/Fiber Box Voluntary Standard for Repulping and Recycling Corrugated Fiberboard.

appendix *additional resources from other industry associations*

Foil & Specialty Effects Association (FSEA)

The Foil & Specialty Effects Association (FSEA) has released a new study on the repulpability of paper/board decorated with transfer foils, produced in conjunction with the Georgia Tech Renewable Bioproducts Institute. The association has been proactive in working to separate the decorated products that FSEA members provide (produced via hot foil, cold foil or digital foil transfer processes, as well as transfer metallization of board or paper), from the use of foil laminated paper or board, which includes the plastic film and can be more difficult to recycle or repulp. The study demonstrates that transfer foil decorated paper and board do not create problems in the recyclability/repulpability of paper and/or board in a common repulping process. To receive a copy of the new study visit https://www.postpressmag.com/articles/2020/sustainability

RadTech: Recyclability of UV and EB Printed Paper

There is a general perception that paper and/or board products printed with UV or EB-cured inks and coatings cannot be recycled as compared to conventionally cured systems. From the paper mills to the waste brokers, the consensus is that landfill or incineration are the only ways to deal with such waste. In an effort to respond to these perceptions, RadTech, the industry group for companies involved in UV and EB processing, commissioned the Beloit Corporation to do a "blind" study of various printed and coated papers to help understand ink and coating behavior relative to repulping and deinking. Ultimately the study found that UV- and EB-printed and coated paper can be recycled into tissue and/or fine paper grades using commercially available equipment. Download the full study at: https://www.radtech.org/images/sustainability_pdfs/Recyclability.pdf

Carton Council: Gable Top and Aseptic Carton Recycling

Gable top and aseptic cartons can be recycled in many residential recycling programs. The Carton Council is committed to building a sustainable infrastructure for carton recycling nationwide and works to add access to carton recycling throughout the U.S. For more information, visit https://www.cartonopportunities.org

Foodservice Packaging Institute (FPI): Recyclability of Paper Cups

Paper cups can be recycled, and a number of leading cities are successfully recovering paper cups in residential recycling programs. FPI is working to increase paper cup recycling in the U.S. and offers resources for the paper-based packaging industry, as well as consumers. Visit https://www.recyclepapercups.org

appendix *endnotes*

1 AF&PA (2014) 2014 AF&PA Community Survey

2 TAPPI, *How is Paper Recycled?* (Paper U, Earth Answers: 2001). https://tappi.org

3 AF&PA (2020): Paper Industry Capacity & Fiber Consumption Survey (2019-2020)

4 National Council on Air and Stream Improvement. (2019). Fiber cycle longevity and fresh fiber requirements for the North American paper and board industry.

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7 RadTech

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19 Kirwan, M., Plant, S. & Strawbridge. J. (2011). Plastics in food packaging. In R. Coles & M. Kirwan (Eds.), *Food packaging technology* (2nd ed., pp. 157-212). Wiley-Blackwell. ISBN 978-1-4051-8910-1

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