

# Barrier coatings

## The hero of demanding packaging applications



# What can barriers do?

**How does a paper cup hold hot coffee without falling apart? And how can brand owners guarantee food safety with a fiber-based tray of ready-made lasagna? The answer is barrier coatings – the hero of demanding packaging applications.**

To enable the use of fiber-based materials, i.e., board and paper, for a range of demanding and sensitive packaging end-uses like food and liquids, barrier coatings are essential. Barriers appear most often in primary packaging and directly contact the product. Their key task is to enhance the protective properties of the fiber-based material so that it can serve in various demanding end uses, including exciting new applications where plastic packaging is replaced. In the example of fruit packaging, barriers prevent loss by controlling ethylene gas exposure.

In this guide, we will explain barrier coatings in detail, sustainability considerations, innovation insights, our wide range of barrier solutions, and a few product examples. If you are new to packaging food and liquid, or if you are curious about replacing plastic in your current packaging, this is a great place to start.





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# A primer on barriers

**Barriers are like plant leaves: depending on where they grow and the features needed to survive, leaves can be thick or thin, and waxy or not. The right combination of paperboard and barrier coating yields a high-quality finished package, ensures optimal performance, saves material, and simplifies the package manufacturing process. On top of this, fiber-based materials and barriers together – referred to as “barrier boards” - are a sustainable solution that increase the share of renewable material in packaging and prevent food waste.**

**In the next section, we begin with a comprehensive discussion on common types of barriers, how they are made, and how they function.**

These highly functional coatings can offer several benefits including:

- Moisture resistance
- Gas (oxygen and CO<sub>2</sub>) and aroma barrier
- Grease-proofing and resistance
- Light protection
- Sealing properties
- Additional heat resistance
- Peelability





# What are barriers?

**Barriers expand the packaging potential of paperboard by supporting sensitive and demanding products, e.g., food and liquids, improving packaging integrity and structure, and increasing shelf life and preventing food waste. Barrier-coated boards are used in several non-food applications, but in this guidebook, we will focus on barriers in food and liquid packaging.**

## **Barrier boards are ideal for:**

- Food service packaging: clamshells, salad bowls, hot and cold beverages cups, and lids
- Liquid packaging: milk, juice, and soup cartons
- Frozen and chilled food: tray-packaged ready meals for oven or microwave heating, and cartons for frozen vegetables
- Flexible packaging: paper-based pouches and sachets



# Beneficial properties of barriers

Barriers support high performance packaging by preserving food quality and preventing waste. The following are a few important examples of barrier coating properties.

## Moisture protection

Barrier coatings prevent food from losing moisture, protect against moisture that can affect dry food by causing it to change texture or spoil, and protect the paperboard from absorbing moisture that would otherwise damage the integrity of the package.

Paperboard can be coated with barriers on one or both sides of the packaging, depending on the customer's needs. For example, a paper cup intended for hot liquids requires a barrier on the inside of the cup while a paper cup for cold liquid requires a two-sided coating due to condensation on the outside.

## Grease resistance and grease-proofing

Foods like some ready meals easily transfer grease to its packaging. To prevent damage to the packaging and to uphold hygiene, barriers are necessary. As described on page 12, certain coatings are especially well-suited for preventing grease transfer.

## Gas and aroma barrier

Barriers prevent gasses from penetrating the package, such as oxygen that could cause spoilage. They also can prevent gasses from escaping, like in modified atmosphere packaging where products are packaged with CO<sub>2</sub> or nitrogen. Barriers also create good sealing qualities.

## Additional heat resistance

For conventional and microwave oven-safe fiber-based trays, barriers ensure food safety. A polypropylene (PP) coating is well-suited for microwave oven applications, while a PET coating can also withstand conventional oven heat. This enables brand owners to replace a significant share of plastic in trays with renewable fiber-based material.

## Other properties

Barrier coatings offer much more. They help seal packages and can lock in aromas (or prevent aromas from affecting the packaged contents). Sensitive food products might also need protection from light to prevent discoloration and other changes, which barrier coatings offer.



# Types of barriers

There are wide range of barrier coatings for paperboard on the market, and in this guidebook, we have placed barriers in three categories, **extruded**, **dispersion**, and **laminated barrier coatings**.



## Extruded barrier coatings

**Extruded barrier coating** are produced by applying barrier material, i.e., melted polymer, i.e., plastic, directly onto the surface of paperboard. In a mechanical recycling process after use, barriers can be separated from the board material. We will discuss recyclability further in the End-of-Life section.

**Polyethylene (PE)** is the most widely used polymer in extrusion coating with common applications for PE barriers including beverage cartons, cups, and frozen food packaging. Different end-uses require different coating weights, e.g., whether the packaged food product is in contact with the material for a short period of time as in the case of foodservice containers.

**Other extrusion coatings for a variety of demanding packaging applications include PET and PP:**

### **PET (polyethylene terephthalate):**

Offers high heat resistance for conventional oven use and superior grease resistance.

### **PP (polypropylene):**

Suitable for microwave oven use; also offers grease resistance and supplies an improved barrier against gasses e.g., CO<sub>2</sub>, compared to PE.



## Dispersion coatings

These innovative coatings are produced via a water-based dispersion technology that achieves barrier functionality without an extrusion method, therefore replacing traditional plastic coatings. Dispersion barriers are advantageous because they reduce the amount of plastic, enable faster repulping of barrier coated board in standard recycling, and increase the amount of fibers recovered.

## Laminated barrier coatings

### Multilayer coatings

Combines several different barrier material layers and offers excellent moisture, oxygen, grease and aroma protection.

### Film lamination

Two materials are combined with melted polymer binding them together. Materials like aluminum foil or metalized PET film can achieve more advanced barrier properties for coated board and paper.

## Bio-based coatings

For customers seeking an alternative to fossil-based coatings, coatings produced with renewable bio-based ingredients can be a suitable drop-in alternative. These solutions include PE produced with ethanol derived from sugarcane. In the following section, we highlight examples of bio-based extrusion coatings from Stora Enso's portfolio and discuss considerations like recyclability, compostability, and biodegradability.



### Corona treatment:

If a customer's packaging requirement involves printing on coatings, (typically PE and PP, and PET in some cases) a corona treatment is necessary. Corona treatment increases the surface energy to improve printability and heat-sealability or glue adhesion.



# How to choose?

Choosing the right board and barrier combination depends on your product, the level of protection needed, and how you want the packaging to perform.

In the following section, we introduce our barrier board offering and walk through the benefits and functionality of each.

# Our barrier offering

According to our recent survey of European consumers, 73% prefer fiber-based carton over plastic for its environmental benefits, and 70% always choose products with as little plastic packaging as possible. To support brand owners in satisfying these consumer demands, Stora Enso works to replace fossil-based materials with renewable fiber-based solutions where possible. In food packaging, fiber-based barrier boards can play a key role in reducing the amount of plastic.

Stora Enso offers a wide range of barrier coatings that help our customers achieve superior product protection, improved shelf life, and enhance recyclability. When combined with the right paperboard, customers can expect a durable material that performs well in printing, package manufacturing, filling, transportation, storage, and recycling.

Our barriers are perfected to reduce plastic as much as possible. For example, in 2021 we introduced our technological innovation, UltraThinPE Tec, to offer the thinnest polymer coating for foodservice board products on the market. Read more about UltraThinPE Tec on page 14.



# Guide: Our barrier offerings

Depending on your product and specifications, the options below offered by Stora Enso can be applied for enhanced sustainability performance.

Coating Type								
Extrusion coating						Lamination		Dispersion
PE	PET	PP	Barr (high barrier)	PE Green	Bio	Metallized film	Oxy Barr Al (high barrier)	Aqua/Aqua+
Description								
Excellent humidity protection	Heat resistance, grease barrier, humidity protection and sealability	Heat resistance, grease resistance and humidity protection	Multilayer structure with excellent oxygen, humidity, and aroma protection; greaseproof	Renewable with excellent humidity protection	Biodegradable and industrially-compostable; liquid barrier; grease protection; sealability; also fully compatible with paperboard recycling	Combination of polymer film (e.g., PET) and a thin aluminum coating; offers sealability; oxygen and humidity protection	Oxygen barrier with aluminum lamination on one side	New barrier choice without traditional plastic layers. Good sealability; liquid and grease-resistant; enables improved repulpability fiber recovery



Applications								
Drinking cups, frozen food, ice cream, and yogurt; moisture-sensitive dry foods	Conventional oven-heated trays, re-heatable products, and bakery products	Microwave oven-heated trays and cups, and frozen food	Delicate foods, chocolate, dairy products, dry foods (cereals, sweets, savory and processed snacks, coffee and tea, and cocoa powders), and liquid products (milk, juices, soft drinks, green tea, water, soups, desserts, and wines)	Drinking cups, frozen food, ice cream, and yogurt; moisture-sensitive dry foods	Drinking cups, plates, trays and cartons for fresh foods, salads, sandwiches, and dairy products	Snack foods (e.g., savory and processed snacks bag), chocolate, dry foods (cereals, sweets, coffee and tea, and cocoa powders)	Coffee and other very sensitive products	Short food contact applications including fast food, liquid, and moist food packaging; long-term applications like frozen and dry food
								

# Barrier innovation

Barriers have come a long way to the highly functional coatings that they are today. Innovation has made barriers thinner, and lighter, and more circular; has increased end-use possibilities; and has given customers 100% renewable options.

The efficient combination of fiber-based materials and renewable barriers demonstrates that scalable amounts of fully renewable solutions are possible. As the smallest component, the barrier is only needed its critical purposes while the board provides other functions.

When brand owners choose barrier-coated paperboard over fully plastic alternatives, they prevent a substantial amount of plastic from entering the market. However, many value chain stakeholders are demanding further plastic reduction due to, for example, increasingly ambitious sustainability targets, new regulations, producer fees (e.g., EPR fees), and consumer demand.



**At Stora Enso, we are driven to develop fully circular solutions that expand the use of fiber and make customer ambitions a reality. Our innovation unit works year-round to:**

- Improve barrier recyclability through, for example, water-based dispersion coatings
- Reduce the climate impact of our barriers
- Minimise coating thickness and reduce barrier weight
- Support more packaging end-uses by creating new possibilities for barrier boards
- Increase bio-based content of barriers and replace aluminum with innovative materials



### **UltraThinPE Tec – the thinnest food service barrier on the market**

Thanks to this technological innovation, Stora Enso has developed the thinnest polymer coating for foodservice board (FSB) available to customers today that helps to reduce a package's overall share of plastic and climate impact. In paper cups, this achievement reduces the plastic share to less than 5% – an important step in helping packaging manufacturers, brand-owners, and retailers meet their plastics reduction targets.

### **Developing dispersion barriers in Forshaga, Sweden**

In 2021, Stora Enso began production of dispersion-coated boards at its Forshaga, Sweden site after a EUR 10 million investment to implement the technology. This site is further tasked with developing and producing new bio-based materials and products.

### **What if barriers could also come from a tree?**

With microfibrillated cellulose, or MFC, it's possible. MFC is a 100% wood fiber-based product with potential for developing into renewable barriers (i.e., films) that protect against gas, grease and oil, enabling preservation of the packaged food's flavors and aromas. MFC-based barriers have the potential to replace plastics and aluminum, and Stora Enso is actively innovating with this material.

# End-of-life

Depending on the type of coating, and end use barrier boards can be easily recycled or composted, and some are biodegradable. In this section, we explain these end-of-life options.

## Recycling

This is the preferred end-of-life option for barrier boards as fibers are kept in a circular system of reuse, ultimately re-used up to 20 times. Ultimately, a barrier board's recyclability in standard recycling processes depends on the type of coating used.

In the recycling process, fiber-based materials are repulped to recover fibers. The board is mixed with warm water and the fibers are separated from the barriers. Impurities are removed from the pulp through screening and cleaning processes.

**Barriers can be separated from the underlying paperboard and collected via a reject stream; however, a small amount of fibers will remain attached to the barrier and rejected as well. Dispersion barrier innovations, like Aqua/Aqua+ by Stora Enso, enable easier repulpability in the recycling process, yielding a higher quantity of recovered fiber.**

Recycling capacity and acceptance in standard mill processes for barrier board are on the rise. More specialised recycling systems are being established that maximize fiber recovery, such as for beverage cartons. The barrier materials used for beverage cartons, PE and aluminium, are already today recycled at scale, for example, at our [production unit in Ostrołęka, Poland](#).



When recycling traditional barrier boards, plastic, metal, or both is separated from fiber and collected through a separate “reject” stream. Dispersion barrier boards, with less rejected material and fiber loss in the recycling process, are more valuable for recyclers and important for brand owners who want to improve the recyclability of their packaging.

## Composting and biodegradation

Biodegradability in a composting environment can be an important attribute if the packaging is used in an area without adequate recycling infrastructure, if it is contaminated with food residue. It's important to note that barrier boards that are biodegradable in a composting environment can be made with coatings that are bio-based or fossil-based, but some bio-based coatings are not biodegradable in any environment.

Compostable materials, under the right conditions, break down into nutrient-rich soil. This can be achieved through either simple composting at home or via a more complex industrial process involving precise conditions and measurement. Importantly, polymers commonly used in compostable barrier boards are often not suitable for home composting.

Different markets have varying expectations for packaging's end-of-life, and some place emphasis on composting and arrange it.

### Industrially compostable examples from our portfolio include:

- Cupforma Natura Bio
- Trayforma Bio

### An industrially-compostable example from our portfolio is our Bio coating, offering:

- Sealability
- Humidity barrier
- Oxygen barrier
- Grease barrier

This coating is fully compatible with paperboard recycling.





# Paper cups are circular!

**Greater than 81%<sup>1</sup> of paper and board in Europe is recycled. Despite a common misconception that paper cups cannot be recycled due to their barrier, they can be included in the recycling stream where the infrastructure is in place.**

Paper cups are accepted in existing recycling systems, and by recycling them, we can secure their valuable fiber for various new products. For example, at Stora Enso's Varkaus site, paper cups – along with beverage carton and other barrier boards – are recycled and repurposed as high-quality containerboard.

With dispersion and ultrathin coating technology by Stora Enso, like Aqua and UltraThinPE Tec, cup circularity is constantly improving. Read more about our quest to improve cup circularity [here](#).

More than  
**80%<sup>1</sup>** of fiber-based  
packaging is  
recycled in Europe.



1. <https://www.paperforrecycling.eu/download/1471/?tmstv=1691163445>

# Product cases: Frozen and chilled food

Frozen food products require packaging that can withstand challenging conditions, like subzero temperatures and moisture, and fluctuations in climate as when transferring the product from the grocery store to home freezers. Paperboard is a highly dependable material for frozen applications and helps to limit food waste, but it needs the right barrier.

On top of this, brand owners, package manufacturers, and retailers prioritize food safety and sustainability – both of which can be guaranteed with the right board and barrier combination.

On the following pages, we highlight a few examples of barrier boards by Stora Enso that support frozen and chilled end-uses.



# Cupforma Dairy

Cupforma Dairy is specifically designed for dairy cups and guarantees protection for chilled and frozen foods. Produced from Stora Enso's virgin fiber-based uncoated SBS board, Cupforma Dairy helps packagers preserve taste and freshness, offer superior customer convenience, and extend shelf life.

The material features an advanced multilayer construction that lends to excellent formability and process efficiency in converting lines.



**Ideal products for packaging with Cupforma Dairy include:**

- Milk and cream
- Cheese
- Yoghurt
- Ice cream
- Desserts
- Butter

# Trayforma BarrPeel

Stora Enso's Trayforma is a recyclable, fiber-based pressed tray material that helps brand owners lower the climate impact of chilled, frozen, and oven- and microwave-heated food packaging by replacing plastic and aluminum with barrier-coated paperboard.

Our latest addition to the lineup, Trayforma BarrPeel, with its easy-peeling board materials, is designed for vacuum skin packs.

Trayforma BarrPeel supports brand owners' sustainability ambitions by reducing plastic to less than 10% of the tray. It consists of 90% renewable wood fibers, keeping plastic usage to a minimum and significantly reducing the packaging's carbon footprint.

Trayforma BarrPeel features a special surface that allows the skin to be easily peeled.

Excellent products for vacuum packing with Trayforma BarrPeel include:

- Cold cuts
- Cheese
- Fish
- Single portion meats

# Tambrite Aqua+

A new folding boxboard solution with excellent properties for frozen applications, Tambrite Aqua+™ features an innovative water-based dispersion barrier coating that replaces traditional fossil-based PE and PP layers.

The dispersion coating facilitates easier recycling of the package during the repulping process, maximizing the amount of fiber recovered. As a substitution for plastic packaging, Tambrite Aqua+™ helps avoid costs incurred by packagers such as extended producer responsibility (EPR) fees.

Tambrite offers excellent stiffness, printability, and runnability, and is easily recyclable with normal paper and board waste streams.



## Ideal products for packaging with Tambrite Aqua+ include:

- Frozen vegetables
- Frozen fruits
- Frozen ready meals
- Pasta and rice
- Cereals
- Dry soups



For more information please visit:  
[storaenso.com/barrier-coatings](https://storaenso.com/barrier-coatings)

# Finding the right fit

When it comes to barrier coatings, it's all about finding the right fit for the packaged product. Where demands like functionality and recyclability or biodegradability overlap, turning to the right expert partner is critical. Stora Enso works with brand owners by bringing together our product, technical, design, and sustainability professionals to

deliver packaging that addresses the most intricate requirements. Barrier coatings might seem complex, but finding the optimal barrier solution for your packaging does not have to be.

**To learn more about our barrier coating offering and to find the right fit for your packaging project, talk to us.**



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