Manufacturing Virgin Paper and Board

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21st & 22nd October 2025

Agenda

1. Virgin Paper & Board
2. Cartonboard production at a glance
3. Virgin fibre raw materials
4. Non-fibrous raw materials
5. Stock preparation
6. Cartonboard machine
7. Finishing

Guiding documents

- CEPI/CITPA Food contact guidelines for the compliance of paper and board materials and articles http://www.citpa-europe.org/sites/default/files/Food%20Contact%20Guidelines_2019_final.pdf
- CEPI Guideline on good manufacturing practice for the manufacture of paper and board for food contact https://www.cepi.org/updated-good-manufacturing-practice-gmp-guidelines-for-the-manufacture-of-paper- board-for-food-contact/
- CEPI Eurokraft / EUROSAC Food Contact Guideline https://www.eurosac.org/fileadmin/pdf/pdf_food_contact/2025_Food_Contact_Guideline_EN.pdf
- ECMA Good Manufacturing Practice for Food Safety https://ecma.org/industry-topics/guidelines-and-gmp/ecma-good-manufacturing-practice-for-food-safety/
- FEFCO Good Manufacturing Practice (GMP) standard https://www.fefco.org/sites/default/files/2020-2019/March/FEFCO%20GMP%20FINAL%202020.pdf
- PIJITF GUIDANCE Information and Transparency in the Printed Food Packaging Supply Chain https://www.eupia.org/wp-content/uploads/2025/03/PIJITF-Guidance-on-Information-Flow-and-Transparency-in-the-Supply-Chain_Final-March-2024.pdf
- EDQM Technical guide on documentation supporting compliance and safety of food contact materials and articles – 1st edition, 2024 Documentation supporting the compliance and safety of food contact materials and articles - European Directorate for the Quality of Medicines & HealthCare
- EDQM Paper and board used in food contact materials and articles https://www.edqm.eu/en/paper-and-board-used-in-food-contact-materials-and-articles
- CoE Resolution CM/Res(2020)9 on the safety and quality of materials and articles for contact with food https://rm.coe.int/09000016809fe04a
- EuPIA documents on the use of printing inks on food contact materials and articles https://www.eupia.org/key-topics/food-contact-materials/general-overview-of-fcm/
- BfR Recommendations on Food Contact Materials https://www.bfr.bund.de/service/datenbanken/bfr-empfehlungen-zu-materialien-fuer-den-lebensmittelkontakt/
- BfR Methodensammlung Papier, Karton und Pappe https://www.bfr.bund.de/service/datenbanken/bfr-empfehlungen-zu-materialien-fuer-den-lebensmittelkontakt/methodensammlung-papier-karton-und-pappe/

1.

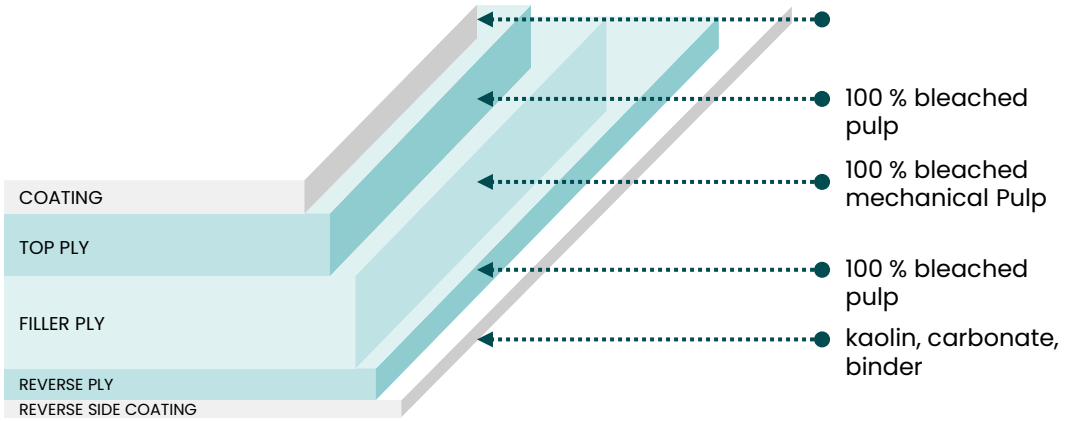
Virgin Paper & Board

Paper & Board (P&B) – more than a layer of cellulose fibres

1. The main raw materials for paper and board are **cellulose fibres (~90%) , mineral fillers and starch (~10%)**, all naturally occuring materials.
2. Functional chemicals are added in only very small quantities **(<2%)**.
3. The P&B-production process itself is predominantly mechanical rather than chemical, involving the suspension of fibres in large volumes of water, subsequent sheet forming and drying.

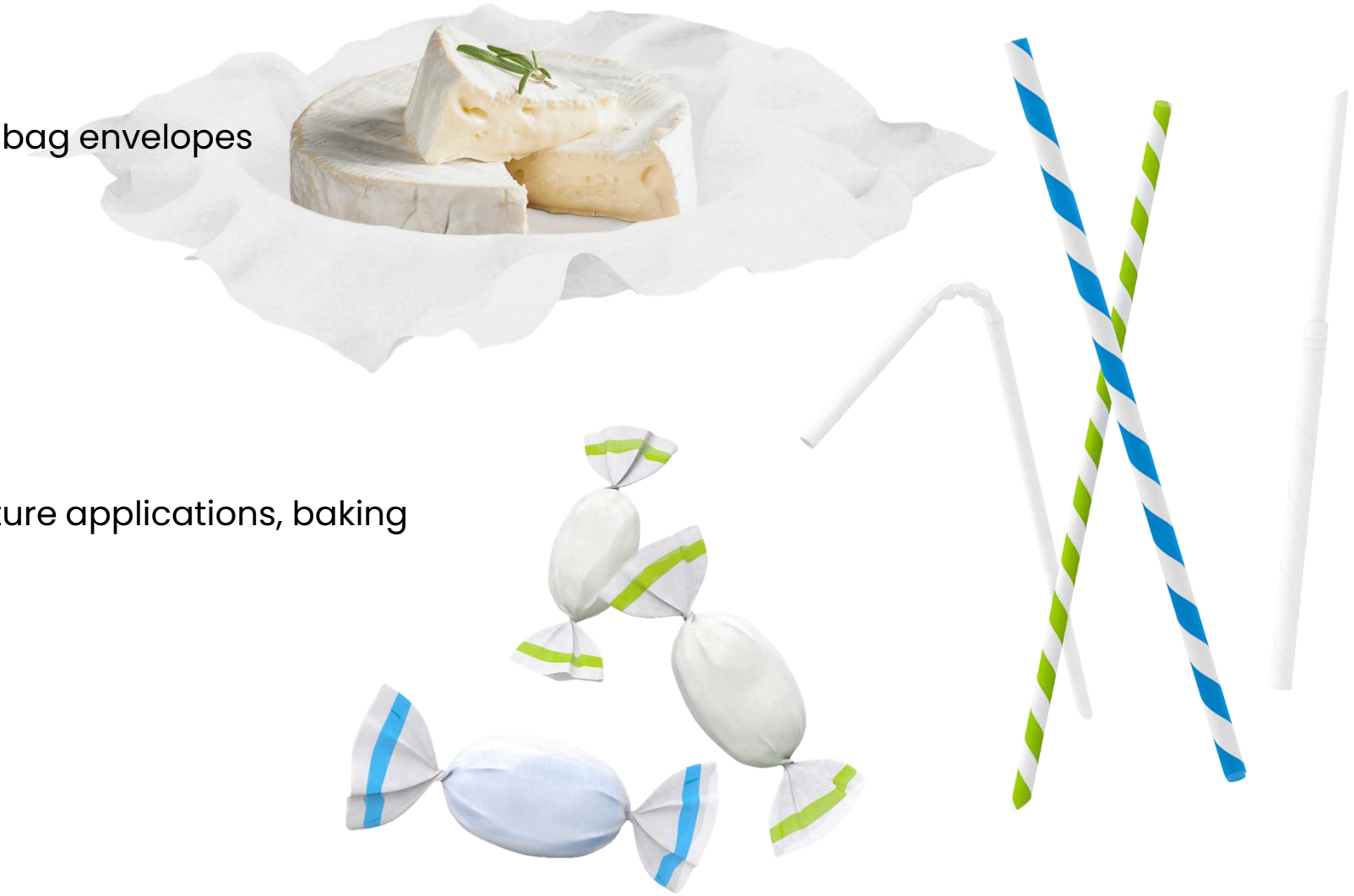
Example:
White reverse side FBB = folding boxboard (GC1)

- **Coating:** calcium carbonate , kaolin, binder
- **Top ply:** bleached chemical pulp
- **Filler ply:** bleached mechanical pulp
- **Reverse ply:** bleached pulp
- **Application examples:** chocolate



P&B Qualities for FCM – Examples

- **Paper (coated and uncoated)**: Tea bag envelopes
- **Cartonboard**: Folding boxes, trays
- **Liner**: for corrugated board
- **Kraft paper**: Sacks, bags
- **Filter paper**: Tea bags, coffee filters
- **Parchment paper**: for hot temperature applications, baking
- **Tissue paper**: Paper towels
- **Paper straws**
- …



2.

Cartonboard production at a glance

Cartonboard production is a multi-stage process

Raw Materials

Selection of the fibre and non-fibre raw materials.

Stock Preparation

Mixing and dilution of raw materials with water followed by screening to remove the impurities.

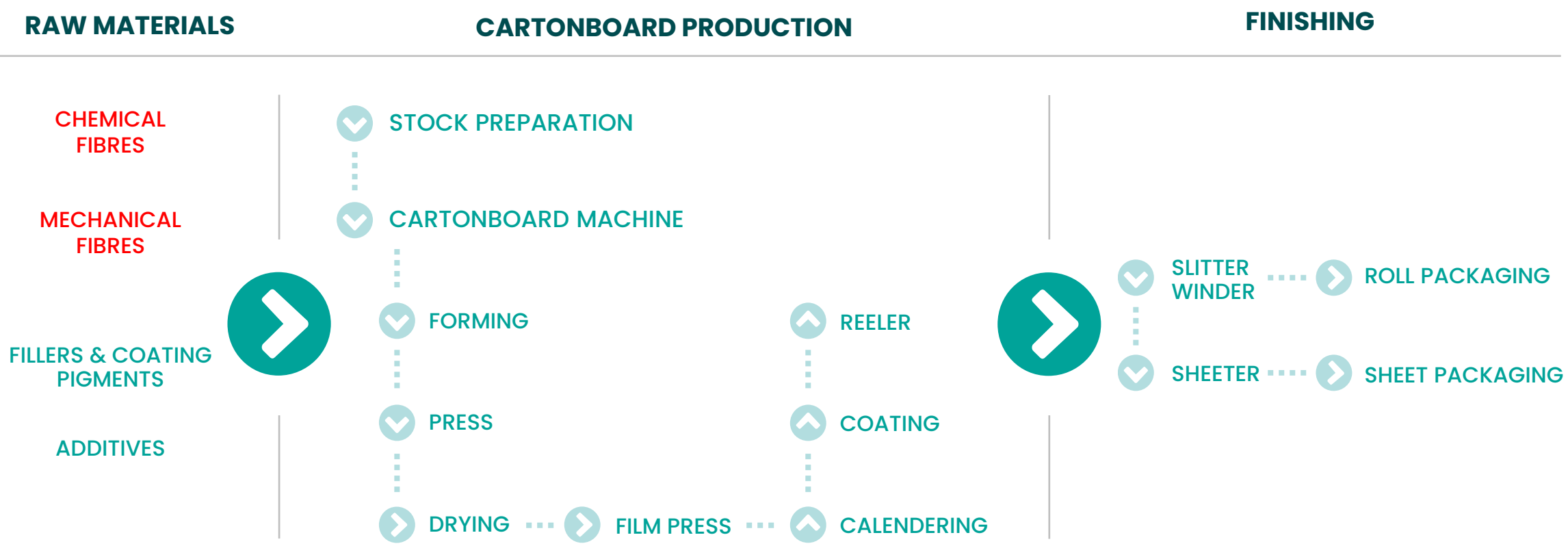
Cartonboard Machine

Raw material mix (“furnish”) is fed to headboxes of the cartonboard machine where it undergoes several production stages from forming to coating.

Finishing

In the finishing department the board reel (tambour or jumbo reel) is cut into smaller rolls or sheets according to the customer's requirements.

Cartonboard production at a glance



3.

Virgin fibre raw materials

Virgin fibre raw materials

Wood: 40% Cellulose, 30 % Hemicellulose, 27% Lignin; 3% Extractive substances

VIRGIN FIBRE

from softwood* or hardwood**

CHEMICAL PULP (lignin removed)

- Wood chips are processed in heated alkaline/acidic medium in pressurised vessel (cooking process)
- Yield: 40 – 60%
- Lower fibre yield: Majority of lignin removed from fibres***
- High strength and density, robust
- Used for top and reverse ply

MECHANICAL PULP (lignin containing)

- Fibres are separated mechanically from the wood structure
- Yield: 95-97%
- High stiffness and volume
- Used for filler ply

*) Softwood -> coniferous tree (with needles) > e.g. pine, spruce > long fibres (~ 2 to 3 mm) => stability
**) Hardwood -> deciduous tree (with leaves) > e.g. beech, eucalyptus, birch > short fibres (~ 1,5 to 2,0 mm) => smoothness
***) Black liquor (non-fibre wood components and cooking chemicals) are burned in recovery boiler to produce electricity & steam

The preparation of chemical fibres

Debarking and grinding of wood

Wood chips:

Washing and Sorting

Removal of lignin containing solutions.

Removal of big (splints, barks) and very fine particles (sand)

Dewatering

Pulping Process

Solubilization of lignin in wood using a suitable cooking liquid (strongly alkaline or acidic solutions)

Bleaching Process

Removal or modification, to a greater or lesser extent, of colored components of pulp with a view to increasing its brightness (with Oxygen, Cl2O, Ozone, Peroxide)

- ECF = Elemental Chlorine Free
- TCF = Total Chlorine Free

4.
Non-fibrous raw materials (“Chemicals”)

Added Chemicals

Chemicals are added during steps of **stock preparation**, on the **paper machine** and via the **coating process**

Functional and Coating chemicals:

- **Fillers**: insoluble minerals; calcium carbonates, kaolin, Ca-sulfate…
- **Sizing* agents**: Starch, AKD, ASA…
- **Colorants**
- **Optical brighteners**
- **Surface** refining and coating **agents**
- **Binders**
- **Wet-strength** agents
- **Humectants****

Process chemicals:

- **Precipitating**, **fixing** agents
- **Retention** agents***
- **Dewatering** accelerators
- **Dispersion** and **flotation** agents
- **Defoamers**
- **Slimicides**
- **Preservatives**

Not supposed to stay in the final product!

* *Sizing*: increase resistance to penetration and spreading of aqueous liquids (e.g. ink); may also be used to increase the surface strength of P&B.
** used to attract and retain moisture; improving the paper's pliability, flexibility, and processability
*** for holding back the fibres on the wire

Selection of Chemicals 1/2

- Must be approved by competent European authorities,

or

- their use is in **compliance** with material-specific provisions in **EU or national legislation** or official recommendations,

or

- **absence of their release into food** and with a limit of detection not higher than 0.01 mg/kg.
- specific **risk assessment** needed for:
  - substances in **nano-form**;
  - substances classified as **CMR**

Positive lists (with specific purity criteria, limits of contents in final product, extraction limits per liter, limits per dm^2, migration limit per 1 kg foodstuff):

- German BfR XXXVI (and /1 and /2): most recent und updated one, but "historical" problems
- Italian Decree of 21 March 1973: hasn't been updated since 2007 in terms of paper
- Dutch Warenwet: not evaluated by international suppliers
- Resolution ResAP (2002) 1 - Technical document No. 1 - (Version 3 - 12.02.2009)
- FDA CFR 21 §§ 176.170 and 176.180
- Chinese Standard GB 4806.8-2022

Selection of Chemicals 2/2

Most essential step:

Communication along the value chain

Paper industry's suppliers' knowledge and competence in regulatory requirements is usually high

- Chemicals are evaluated at P&B producer based on information from suppliers =>

  extensive questionnaires from P&B producers to suppliers in terms of ingredients, limitations, etc. (not only on European regulations!)

- => Main reference on substance specific limits or commodity-based limits for products usually BfR XXXVI and FDA CFR 21 § 176.170 & 176.180

5.
Stock preparation

Addition of water to wood pulp and subsequent homogenization and cleaning operations prior to processing on the board- or paper machine.

Stock preparation for mechanical & chemical fibres

Biggest influence on paper and board quality:

Fibre selection + Stock composition + Refining + Chemical Additives

Dispersing of fibres in water (pulping)

Pulp is mixed with water under the intense agitation to separate single fibres. This process is performed in continuous or batch pulpers.

Refining

Refining is done to develop fibre properties (fibre length and fibrillation) to achieve the needed strength and board properties.

Mechanical cleaning (screening)

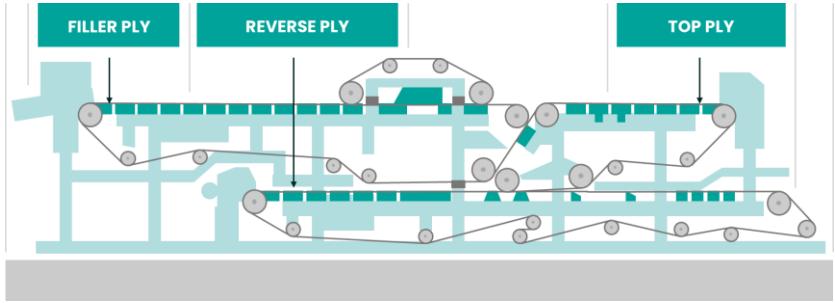
The fibre-water mix goes through several screens and hydrocyclones to remove non-fibre particles.

6.

Cartonboard machine

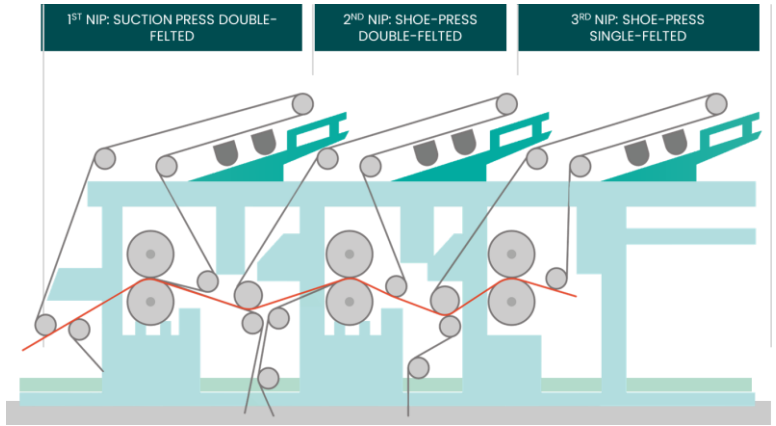
Forming section

1. The headbox is **feeding** pulp suspension to the continuously running dewatering fabric – moving wire (**0,3–1,5 % fibre in water pulp consistency**)
2. Water is removed by hydrodynamic forces (hydrofoil boxes) and vacuum (suction boxes).
   - Fiber alignment (affects paper strength and texture)
   - Initial sheet thickness
3. Web forming is completed when the consistency reaches 5–10 % fibres.
4. Separate fibre webs are couched together at a consistency of 12–14 % to form the board structure.



Press section

1. The board web (still **80% water**) passes through felted press nips to further remove water.
2. The last nip is typically unfelted on top side or on both sides to improve board smoothness.
3. Web dryness increases from 18-20 % before to 45-55 % after press section.

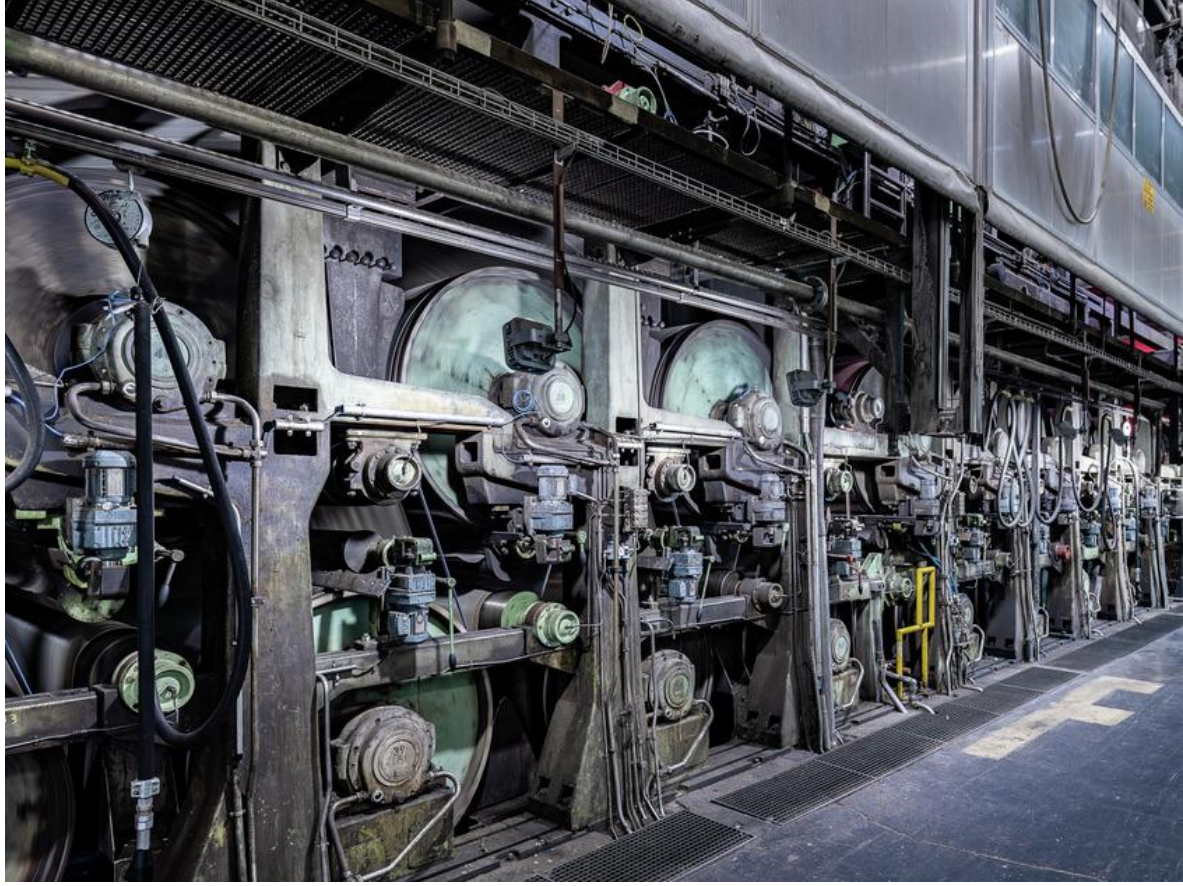


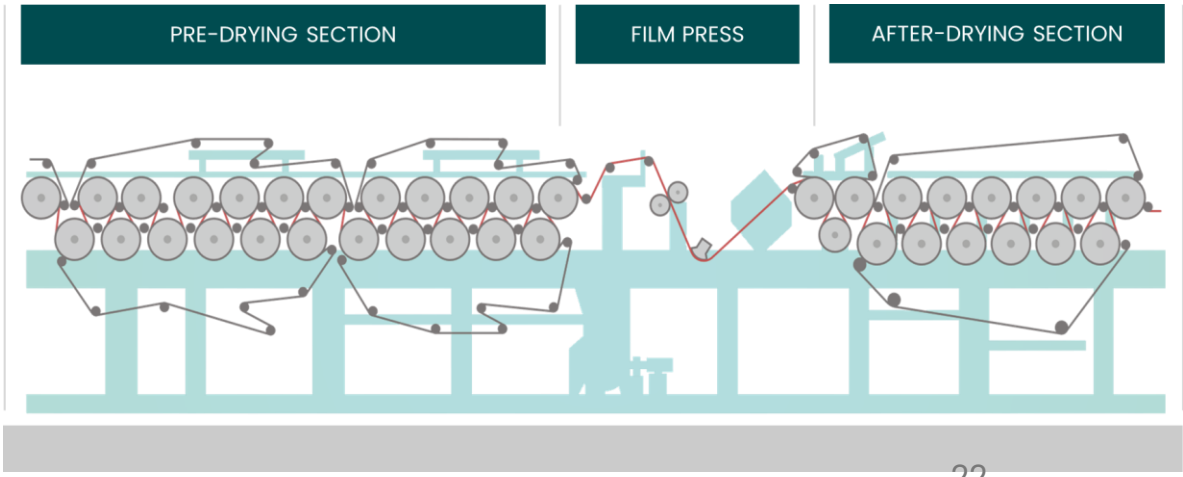
Drying section and film press

1. Pre-drying section: The pre-drying section consists of steam heated drying cylinders to evaporate the water remaining after press section. The board web is fed between the drying cylinders, which are heated to over 125 °C.
2. Film press: The board web is treated on both sides with starch to improve stiffness.
3. After-drying section: The after-drying section is used to remove the water applied with starch.
4. Dryness of the cartonboard is increased from around 45-55 % to about **92-95 %.** All drying sections are equipped with a hood and heat recovery systems for efficient energy use.

⇒ Final paper strength

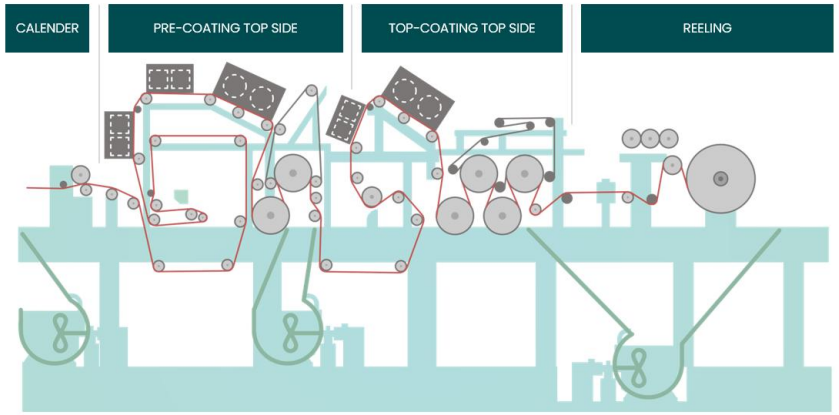
⇒ Dimensional stability





Optional Surface Finishing – Calendering and coating section

- **Calendering** with hot calender provides smoothness and even caliper profiles.
- Pigment **coatings** are applied in several layers for coverage, brightness, gloss and smoothness. The coating is also essential for excellent printability and codeability.
- Also **polymer coatings** can be applied (moisture and grease barrier)
- Depending on the board grade the top side is typically coated with 2-3 layers and the reverse side with one layer. For barrier grades also more than one functional reverse side coating may be applied.



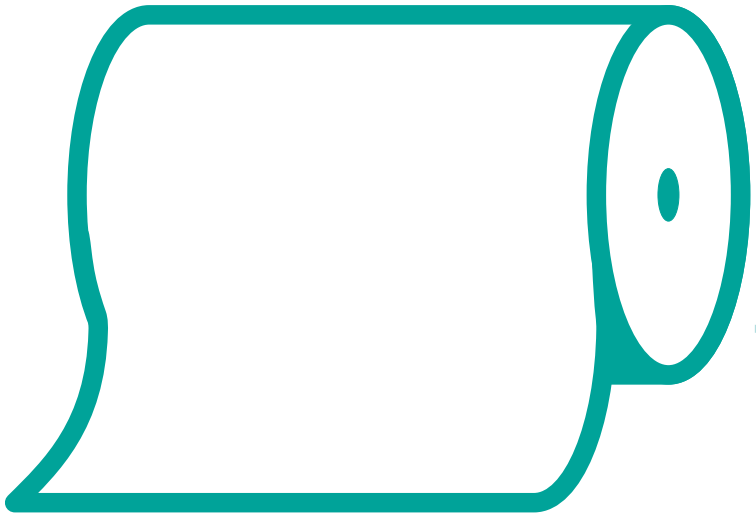
7.
Finishing

Finishing

- In the finishing department the board reel (tambour or jumbo reel) is cut into smaller rolls or sheets according to customers requirements.

- Rolls or sheets on pallets are protected with outer packaging and delivered to customers by rail, ship or truck.

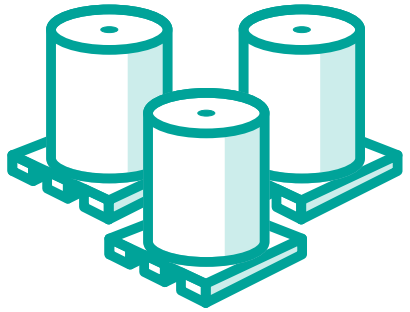
Finishing



JUMBO REEL

(3-6 m wide and
up to 5 m in diameter)

SLITTER
WINDER



REELS

PACKAGING
AND SHIPPING

SHEETER

SHEETER

SHEETS

PACKAGING
AND SHIPPING

Any questions?

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