Ecodesign In Food Packaging

UNIT 9: Paper and cardboard packaging

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After learning this unit, the student will be able to:
– Objective 1: To know the main types of paper and cardboard used in food packaging;
– Objective 2: To learn the importance and possibilities of recycling, re-use of waste from paper and cardboard;
– Objective 3: To know the bases of technologies of obtaining containers of paper and paperboard;
– Objective 4: To be able to use the knowledge of designing plastic packaging in the current work of eco-design.

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9.1 Definition, classification, use

Paper and cardboard are sheet - shaped materials, interweaved cellulose fibers. These materials can be printed. They have physical properties that allow them to produce flexible or rigid packaging by cutting, shredding, folding, forming, gluing, etc. There are many different types of paper and cardboard. These vary in appearance, strength and other properties depending on the type (s) and amount of fiber used, and how the fibers are processed in the paper and cardboard manufacture. Although the most popular papermaking materials are wood pulp of softwood species, especially coniferous trees, due to the existence of cellulose fibers in the structure of many plants, from herbs to trees, many other fibers can be used, such as those of cotton, hemp, or rice plants.

The amount of fiber is expressed by the mass of fibers per unit area (grams per square meter, g / m2), thickness (microns, 1 µm = 0.001 mm, dots (1 point = 0.001 inch) and appearance(color) and surface finish. Carton is thicker than paper and has a higher weight per unit area. Paper over 200 g / m2 is defined by ISO, cardboard. However, some products are known as cardboard, even if they are manufactured with weight less than 200 g / m2.

- **Paper**

Advantages:

– lightweight material;
– can be folded and glued;
– good flexibility, not brittle;
– excellent substrate for printing;
– can be resistant to fats;
– absorb liquids and vapours;
– can be broken/torn easily.

Disadvantages:

- weak barrier properties (no coating or laminating);
- weak mechanical properties (especially after moistening).

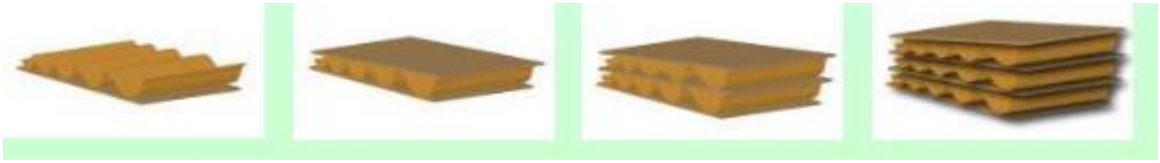
Types of paper used in the field of packaging:

- untreated paper for non-resilient inferior packaging;
- paper containing synthetic fibers;
- chemically treated paper for packaging (waxed paper, lacquered) paper coated with aluminum, cellophane, polyethylene.

➢ Cardboard

Types of cardboard used for packaging:

- laminated cardboard with wax, LDPE or compounds added in the composition that lead to increased barrier properties;
- cardboard duplex (normal) for packaging printed by offset (cellulosic Material with a gray face and a white face. Good capability of processing. After laser cutting the edge remains carbonized, dark brown);
- cardboard triplex for transport packaging, presents high resistance to bursting;
- corrugated paper, with high mechanical strength and good elasticity, mechanical protection used especially for secondary and tertiary packaging. (See UNIT V, 5.2.1).



CO2 CO3 CO5 CO7

Fig. 1: Types of cardboard
http://www.tsocm.pub.ro/educatie/cepa/Ambalaje%20-%20CEPA%20-%20Curs%202.pdf

The advantages of packaging in corrugated cardboard:

- the most inexpensive material as a barrier to light is the cardboard;
- good mechanical protection of the products;
- have a pleasing appearance and can be custom printed;
- low weight;
- protection to the temperature variations;
- production price, much lower than the other categories of packaging;
- transported folded;
- lends itself to transport palletized;
- it can be reused several times;
- they are fully recovered, being biodegradable.

Examples of packaging based on paper and cardboard: paper bags, paper packing, ex. tea and bags of coffee, envelopes, bags, paper cover, bags of sugar and flour, carrier bags, paper bags laminated boxes, folding cardboard and rigid boxes, corrugated packaging (shipping boxes), tubes and paper containers, packaging of liquids, containers, formats, labels, sealing tapes, cushioning materials, sealing caps (membrane, sealing) and diaphragms.

Fig.2: Paper and cardboard packaging materials, http://benecopackaging.com/products/

Paper and paperboard can, acquire barrier properties and extended functionality such as welding to hot for the packaging of liquids, by coating and lamination with plastics, such as polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET or PETE) and ethylene alcohol vinyl (EVOH) and aluminium foil, wax and other treatments. Packaging made solely from paperboard can provide a wide range of barrier properties by coating with a film sealed to the hot, such as chloride, polyvinylidene (PVdC) coated polypropylene (OPP or BOPP) or a regenerated cellulose coated in a similar manner**.**

The functions of the layers that make up the packaging material from which the common cardboards is manufactured are the following*:*

- the outer layer of polyethylene (LDPE) protects the printing (layer ink) and allows the flaps of the pack to be welded;
- paper bleached is support for printing;
- paper unbleached (kraft), provides the necessary mechanical rigidity to the packaging;

– the interior polyethylene layer provides barrier properties towards liquids and allows the manufacturing of the pack by joining the edges by thermal bonding.

➢ Aseptic Cardboard

The following positive aspects have been highlighted for the packaging made of complex materials based on cardboard with aluminum foil embedded in the structure:

- aseptically packaged products can be stored at ambient temperature without affecting the quality characteristics and without losing in weight;
- the concentration of oxygen in aseptic cardboards ramain almost unchanged, about 1 ppm, while in ordinary cardboards the product is saturated with oxygen after a few days (8-9 ppm);
- the aroma of the products is preserved much better when packaged in aseptic cardboards rather than packaged in normal cardboards as the latter are more gas permeable.[1]

9.2 The Eco-design for recovery and recycling of paper and cardboard

Eco-design of packaging from cardboard was presented in UNIT 5, section 5.3.

Although the paragraph refers to the eco-design of packaging logistics, the procedures and programs of the design presented are also used for paper and cardboard packaging primary.

Paper packaging is a source too valuable to lose. Increasing the degree of recycling and compostability of paper packaging means that it is more likely to recover effectively and to be used in biological cycles and / or industrial closed-it being a measure of sustainable development in the field of packaging. Designers play a crucial role in the subsequent recovery of packaging. Although there is no doubt that the packaging must be designed so as to observe the performance of the stringent safety criteria and cost, the designers would have to raise the recyclability at the same level of importance with them, in their company.

[1] LILIANA GÎTIN, AMBALAJE ŞI DESIGN ÎN INDUSTRIA ALIMENTARĂ, UNIVERSITATEA DUNĂREA DE JOS DIN GALAŢI - 2010

European declaration of paper recycling - the EUROPEAN DECLARATION ON PAPER RECYCLING 2016-2020 covers all paper products and cardboard, in it take part the 28 EU member states plus Switzerland and Norway. They will draw up the annual statistics on the consumption of paper and cardboard as well as the quantities recycled. The declaration aims to ensure complementary measures designed to ensure a chain of sustainable environmental protection for paper and a good communication between the interested parties.
Below is presented the chart of recycling paper in Europe for 1991-2015

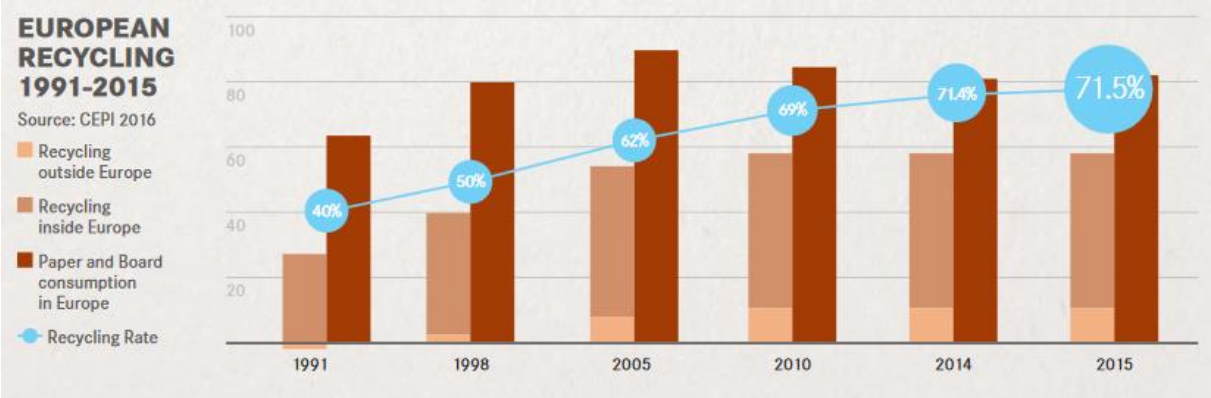


Fig. 3: Paper and board recycling chart in the EU
http://www.cepi.org/system/files/public/documents/publications/recycling/2017/European Declaration Paper Recycling_20170410_compressed.pd

Among the objectives and targets of the Declaration are:

- On the waste of paper
  - By 2020, there should be a ban on landfill storage of recyclable paper.
  - The waste hierarchy, including energy from waste and renewable energy, must be implemented.

- With regard to waste collection: Mixed waste was found to be less efficient on the quality and cost of the complete paper recycling process compared to separate paper collection causing the risk of lower recovery. The European Commission must take action against countries where selective waste collection is not carried out.
- Concerning Eco-design, it is convenient to exclude materials known to be carcinogenic, mutagenic or toxic for reproduction, as well as hazardous adhesives and inks according to www.paperforrecycling.eu/publications.
- Also on waste prevention: Consider reducing the amount of waste, including by reducing the mass of the product, re-using packaging or extending its life, reducing the environmental impact of generated waste, reducing harmful and hazardous substances in materials and products

The information communicated by the suppliers of the materials used for the production of corrugated board, showing that they don't include banned substances.

Layers of paper are glued together with glue made from starch that is produced from plant sources. Ideally, the life cycle total for the materials of the corrugated cardboard includes everything from the fiber production up to the recycling several times, and, in the end, when it becomes a waste.

Abiotic resource depletion (raw materials, energy resources) is the greatest impact on the environment caused by the use of pulp renewable wood as raw material. Cardboard is one of the most recycled materials from around the world. The materials of the corrugated cardboard are biodegradable and requires a lot of storage space.

It is a waste of money to send a cardboard box to a landfill.

When biodegradable products are exposed in nature, including oxygen and humidity, they decompose relatively effective. Cardboard (without wax) – breaks down naturally in 3 months (assuming an adequate amount of oxygen and moisture). (Ecolife, 2011).

Corrugated panel may contain a very small amount of lead. This is due to the fact that it is often printed with ink with lead, and due to the pollution accumulated in the environment. Lead in packaging or its components shall not exceed 0.01% of the mass of the pack. There are almost always some prints in the box, for example the marking of recycling is mandatory. Lead can be avoided if perforation is used for marking. Perforation however requires adequate technology that does not exist at all suppliers. The punching technique can not be used for all packaging items.

Current design of container Nokia Siemens Networks includes a box of two parts, an inner part and one outer separate part. The total weight could be reduced by combining the two parts. Structures with two pieces allow you to change the box's exterior while the inner box is reused. They allow the replacement of the outer box if it is dirty or damaged, while the inner part can be reused several times.

Paper recycling not only saves energy but also saves trees, reducing the amount of carbon dioxide present in the atmosphere. EPA estimates that producing a product from recycled paper requires only 60% of the energy needed to create the same product from the pulp of the fresh wood, and the reports of the Energy Administration Information, show that recycling one ton of paper can save 10-17 trees leading to saving the rain forest. Paper recycling also requires about half the water normally used for processing paper from virgin timber [2] . Other authors estimated that paper and cardboard is recycled about 10 times, and the waste water would have a loading of 3-4 times lower in pollutants.

[2] Pirjo Honkimo, ASSESSMENT OF PACKAGING MATERIAL LIFE CYCLE, Master's thesis, Spring 2013, Degree program in Industrial Management, Oulu University of Applied Sciences

Most scenarios included in the analysed LCA[3] studies indicate that recycling of waste paper has a lower environmental impact compared to alternatives storage at landfill or incineration. The result is very clear in the comparison between recycling and storage, and less pronounced, but clear in the comparison of recycling versus incineration.

However, the recovery of 100% is not possible because some of the quality features of the use of pulp wood can not be recovered and also, since after multiple recycling processes fibers deteriorate and can no longer be recycled.

Therefore, there is a continuing need for virgin fibers. Energy is another major resource consumed in paper production. It is therefore encouraged to use the biomass resulting from the cellulose manufacturing process to obtain the energy needed to produce it.

9.3 Technologies for paper and paperboard packaging

a) Fibers processing

Plant cells are made up of connected cellulose fibers. During the process of extraction of the pulp cellulose, these microscopic fibers are separated from each other, and where the polimolecular chain was broken chemically or mechanically, the "free"surfaces come in contact with one another by creating hydrogenated bridges which give the hardness and elasticity of the future material.

The chemical process

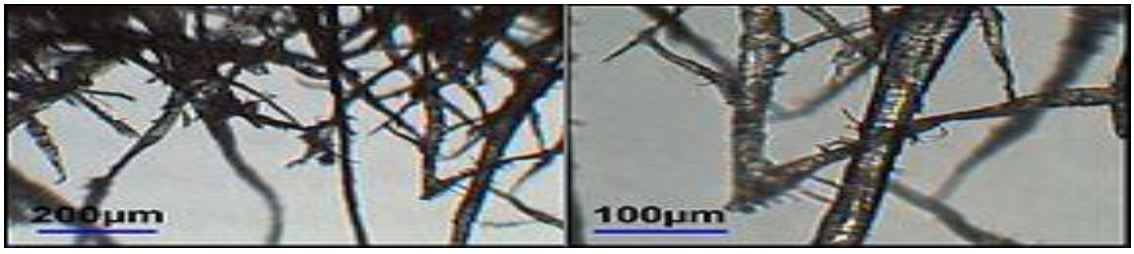


Fig. 4: The micro fibres structure of the paper

b) The chemical process

It is used today on a large scale by a chemical treatment complex called Kraft Process. The purpose of the chemical treatment is the elimination of the lignin structure (from pulp subjected to the process), which is the organic binder that keeps the fibers

[3] Europan Environment Agency, Paper and cardboard — recovery or disposal, Review of life cycle assessment and cost-benefit analysis on the recovery and disposal of paper and cardboard -2005, EEA Technical report No 5/2006

together, by using a mixture that dissolves it. After removal, the remaining fibers can be used to produce an unfinished brown paper that is used to make paper bags or cardboard boxes. The raw material thus obtained can be further utilized by an intense purification of the remaining lignin, leading to the production of high quality pulp, for white paper for writing and printing.

Although the chemical process is more expensive than mechanical, allowing a maximum of 45-50% of the original pulp to be used, it is a widely used process due to the quality of the final product and the almost unaltered maintenance of the initial fiber length of the material used wich is a factor for maintaining high mechanical paper grades. Another advantage of this process is the integral use of the lignin rezulted from the process as a fuel for heating and electricity needed for the process[4].

The process of manufacturing with sulphate or sulphur, is the process used most in the entire world due to the superior properties of resistance to cellulose and can be applied to all species of wood. In the production of sulphate pulp, effluents emitted into the waste water, emissions to air which include foul-smelling gases and energy consumption are the main environmental aspects, of interest. Also, the waste produced from manufacturing have become an environmental problem. The main raw materials are the resources (water and wood) and chemicals for cooking and bleaching. Emissions in water are mainly the organic substances. Effluents from the bleaching, where it is used for chemical bleaching agents that contain chlorine, containing chlorine compounds.

Some compounds discharged from factories manifested toxic effects on aquatic organisms. Emissions of coloured substances may affect negatively the species from the environment. Emissions of nutrients (nitrogen and phosphorus) can contribute to eutrophication[5] of waters in the environment. The metals extracted from the wood are discharged in low concentrations but due to the flow amount it can be significant. Significant reduction of both the organic substances with chlorine and the ones without chlorine from the effluent of the factories of cellulose can be obtained on a large scale through measures in the process.

a) The mechanical process

There are two mechanical processes that are important for the pulp manufacturing: pulp thermomechanical (Thermomechanical pulp - TMP) and wood pulp grinding (Groundwood pulp - GW). In the process the TMP, wood is chipped and then fed into the refinery with heated steam, where the chips are squeezed and made into

[4] https://ro.wikipedia.org/wiki/H%C3%A2rtie

[5] Proces natural sau artificial de îmbogățire cu materii organice și cu substanțe nutritive (nitrați, fosfați etc.) a apelor lacurilor si a bălților. Prin acțiunea sa pe termen lung, acest fenomen face ca apele să fie din ce în ce mai sărace în oxigen, distrugând în final fauna acvatică (pești etc.)

fibres between two steel disks. In the wood milling process, debarked logs are fed into grinding machines if they are pressed onto rotating stones to be turned into fibers. Mechanical spraying does not remove lignin, so the yield is very high,> 95%, however it causes the paper thus produced to become yellow and become fragile over time. The mechanical process produces rather short fibers, producing poor quality paper. Although large amounts of electricity are needed to produce mechanical pulp, it costs less than the chemically produced cellulose.[6]

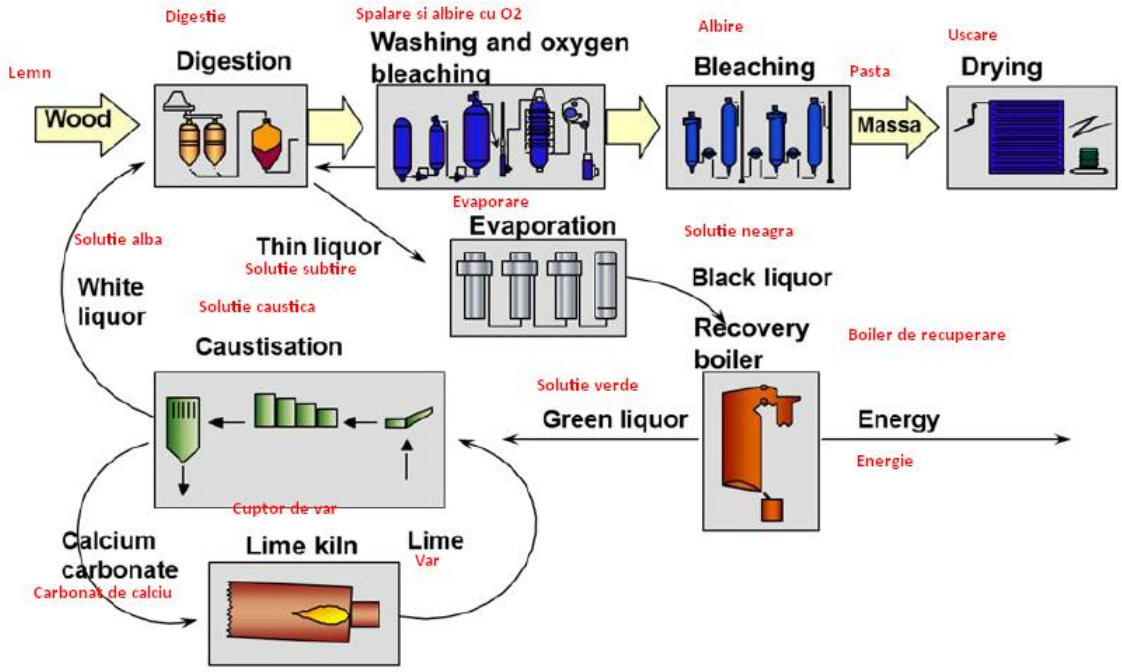


Fig. 5: The scheme of the chemical process by https://www.researchgate.net/figure/272121953_fig6_Figure-9-Overview-of-the-Kraft-pulping-process-Source-Sodra-Skogsagarna-ekonomisk

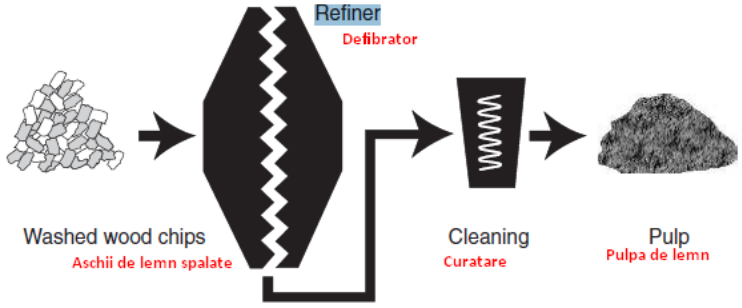


Fig. 6: The scheme of the mechanical process by Paper and Cardboard Packaging

[6] https://en.wikipedia.org/wiki/Paper

M.J. Kirwan

The characteristics of the pulp:

Mechanical wood pulp:
• high Efficiency of wood use;
• the Presence of lignin makes the fibres hard and rigid;
• limited Degree of consolidation of the fibers in the pulp results in paper with large volume (low density), stiffness in bending and dimensional stability;
• a sheet made exclusively of mechanical pulp is relatively weak (as resistance), but relatively rigid.

Chemical Pulp:
• Keep the length of the fiber;
• Develops a high degree of consolidation, so, high density;
• Flexible fiber and soft, so, resistance to bending, engraving, can be stamped;
• High whitening, glossy and bright, with high stability;
• High purity, good smell and protection from infection.

Permeated cellulose

The process of recycling paper can use the pulp produced chemically or mechanically; by mixing it with water and mechanically acting, the hydrogen bonds in the paper can be broken and fibres separated again. Most recycled paper contains a proportion of virgin fibres in the interests of quality; in general, the pulp of the permeated-wood is of the same quality or lower than the component of the paper collected from which it was obtained.

Recycled waste can be classified thus:
Internal waste - These include any paper that does not meet the standard or low-grade carried out inside the paper factory, which is then reintroduced in the paper manufacturer. This paper, is not classified as recycled cellulose, but most paper factories are reusing their own cellulose waste long before recycling became popular.

Pre consumer waste - These are the wastes arising from cut-outs and processing of paper products in the factory, are generated outside the paper factory and could go to landfill and are a true source of recycled fibres; they are waste products produced by consumers which processes the paper bought from the paper factory (printed paper, but which has not reached the intended final destination, such as waste from printers and unsold publications).

Post-consumer waste - Is paper that has been used for its final destination, and include packaging waste, office waste, magazines and newspapers waste. Because the vast majority of these materials have been printed either digitally or by more

conventional means such as lithography or rotogravure - they will be recycled as printed paper or will first pass through a process of decalcification.

Recycled paper can be made from materials 100% recycled or mixed with the wood virgin pulp, and they are not (in general) so resistant and not glossy like the papers made from the virgin wood pulp.

b) Obtaining paper from pulp

The preparation of paper paste

If the pulp is bought in bundle, it is first dispersed in water in a hydraulic grinding device also referred to as the "'holendru" (hydrapulper).

All the pulp, including the pulp that comes directly from the installations of preparation without drying, is then treated to prepare it to be used in the paper or cardboard machine. Reinforcing fiber interwoven can be increased by mechanical processing in the presence of water, in which the surface structure of the fibre is modified by swelling the fiber in water and the increase of it's surface. The degree of processing that also influences the rate of drainage to the next manufacturing step, is adjusted to suit the desired properties of the product of paper or cardboard. Additives, such as alum or synthetic resins, are used to enhance the water resistance of the fiber. To make the product more waterproof, you can add resins resistant to moisture. Fluorescent agents for whitening (Fluorescent whitening agents-FWA), also known as agents, optical brightening (optical brightening agents-OBA) [7]may be added at this stage to increase the bleaching and brightness.

Forming paper sheets

The fiber in suspension of water, roughly 2% fibre and 98% water, is formed into a uniform layer. This operation is done for getting the paper in the form of a continuous strip.

Obtaining the actual paper is made on machines with long sieve, cylindrical sieve or with combined sieves and it consists of:

I. pouring the paper paste on a endless sieve with the help of special devices, as well as by shaking continuosly of the grid;

II. the partial removal of water from the paper pulp, by means of absorption special, as well as by shaking the grid continuously;

III. forming the paper band, due to the needling of the materials contained by the paper as the loss of water occurs;

IV. dehydration of the paper band through pressing and heating;

V. smoothing, cutting, and possibly winding of the paper on the roll.

[7] M.J. Kirwan, Paper and Paperboard Packaging

The paper machine is actually a big dehydration device. Currently the most used design is the forming process Fourdrinier, in which the sheet is formed on a continuous horizontal fabric on wich the suspension of fiber is injected in the tank.

The paper machine has two main parts (see annex 1, Fig. A1):
- wet section;
- dry section.

The wet section contains:
- the preparation part (the tank end under pressure) (headbox), in which the paper paste that comes from the hollander is pumped under pressure and homogenized, it adjusts the consistency and is cleaned of impurities;
- the grid in which the paper paste is distributed evenly on the sieve of the machine with the help of a distributor (headbox). In this phase, by draining the water through the sieve, the fibrous material and a part of the filling material is provided on its surface in a thin uniform layer, forming the strip of paper;
- the wet press part serves to dehydrate by squeezing the paper band; this part of the machine is provided with a variable number of rollers.

The dry section of the machine consists of:
- dryers made of cylinders of cast iron naked in the interior and heated with steam. Here, the paper reaches 95% dry substance;
- the finishing part that has the role to improve the smoothing of the paper, as well as to cut the edges of the paper. The paper is then fed onto reels if it is intended for use on printing presses of the web or cut into sheets for other printing processes or other purposes.

The paper can be produced with a surface strengthened on the one side and on the other the cylinder of the Mg is used to produce a smooth surface, while retaining the thickness, thus giving greater rigidity for a given weight time. Sometimes a solution of starch at the end of the drying section is aplied, on one or both sides of the sheet. This is known as surface sizing. Improves the strength and finish of the sheet and firmly anchors the fibers in the sheet.

The raising of the sheet through a series of steel rollers can enhance the surface smoothness and

The uniformity of thickness. This process is called calendering. The paper may be calendered at high speed in a separate process, known as super -calendering.

Coatings

The white pigmented coatings are applied on one or both sides of several types of paper and cardboard on the car.

The coatings include mineral pigments, such as kaolin, calcium carbonate, and synthetic binders (adhesives) dispersed in water. Apply the coating in excess, it is smoothed and the excess is removed by several techniques[8] - measurement bar, knife with compressed air etc. (Annex 1 fig A1.3 and A1.4).

One, two or three coating layers can be applied. The coatings are dried by radiant heat and by passing the sheet over the drying rollers by heating with steam. They can be polished (burnished) according to the appearance, color, smoothing, gloss and properties of printing required. Coating materials can be applied off-line. In the process of coating by pouring, pour a coating wet on a cylinder heated, chrome plated, highly polished. When dried, the coating layer is separated from the metal surface leaving the coating with a smoothness and high gloss.

c) Forming the cardboard

The technology of manufacturing cardboard is similar to papermaking. Fibers for cardboard are the same as for paper, with the exception of using more mechanical wood paste and semicellulose. Filling, sizing and coloring materials used for cardboards are those used for paper making. The same technologies are applied and machines similar to papermaking machines or cylindrical machines are used. Mucavaua, a stationery product weighing between 500 - 750 g / m2, is identical to cardboard. Cardboard finishing is similar to paper finishing.[9]

d) Lamination

This process applies another functional or decorative material, in sheets or rolls, on paper or on the surface of the cardboard by means of an adhesive. The examples are:

– Aluminium foil applied on one or both sides, provides a barrier for moisture, aroma, common gas, such as oxygen and UV light. Aluminum foil laminated on paper and cardboard is also used for the direct contact and easy separation for the foods that will be cooked or reheated in the oven. Aluminum foil is also used as a decorative material, for example, on cardboard boxes for sweets or chocolate;
– Waterproof paper laminated on cardboard: good resistance to fat, resistance to temperature up to 180◦C for packaging of cooking / reheating. In addition, if it is grease-resistant the paper has a layer of detachment and can be used for packing of sticky products;

[8] http://www.tciinc.com/capabilities/
[9] Buletin informativ Nr. 4 / 11.04.2006, www.afaceri-poligrafice.ro

– Glossy paper laminated on cardboard: resistance to fat for products with moderate content of fat, such as cookies or baking in the box applications. If the glossy paper is colored, it can't be used in reheat applications, but approved qualities may be used in direct contact with foods such as chocolate.

Adhesives used for lamination include emulsions of the PVA type, starch based, on the basis of resin / solvent, the compounds of crosslinking, molten wax or PE depending on the particular needs of lamination. The wax and PE improve the barrier against water vapor. When PE is used as an adhesive, the process would be described as rolling - extrusion.

e) Extrusion and lamination with plastic material (See Fig. A1.5)

Polyethylene (PE) - insulating moisture barrier. Low density polyethylene (LDPE) is widely used in the extrusion of plastics for coating and lamination of paper and cardboard. When PE is modified with EVA (ethylene vinyl acetate) results in a behavior easier to the welding of heat-sealing. Medium PE and of high density has a limit of higher temperature, a better abrasion resistance and higher barrier properties than LDPE. It can cover one or both sides[10] .

Polypropylene (PP) - thermal insulation, moisture and fat barrier. Can withstand high temperatures up to 140◦C and is used for the packaging of food which must be reheated in ovens up to this temperature. It can cover one or both sides.

Polyethylene terephthalate (PET) - thermal insulation, moisture and fat barrier. Can withstand temperatures up to 200◦C in the oven. Cover only on the non-printing side.

Polimethylpentene (PMP) - moisture and fat barrier and cannot be welded thermally. Therefore, it is used as flat sheets, deep trays and trays with corners mechanically fastened. Cover only on the non-printing side.

Ethylene vinyl alcohol (EVOH) and polyamide (PA) - thermal insulatable, fats barrier, oxygen and light barrier. EVOH is sensitive to moisture and must be placed between the material hydrophobic, like PE. Can be used as alternative non-metallic layer of aluminum foil.

Ionomeric resin (Surlyn®R), a polyolefin with high resistance to fats, including the essential oils of citrus fruit, and to moisture with very good sealant properties, it is used as a tie layer on the aluminum foil when applying PE on the foil.

The layers of bioplastics extrusion are now available as an alternative to the PE. This starch-based material is durable and complies with EN13432 for compostability. The extrusion process is often extended to include lamination by extrusion such that a structure such as paper or cardboard / PE / aluminum foil can be produced in a single machine operation with two extrusion units.

[10] M.J. Kirwan, Paper and Paperboard Packaging

f) Printing and dyeing

All major printing processes are used - engraving, flexography, printing, screening and lithography. Paper and cardboard can also be printed through the digital process.The choice is influenced by the needs of appearance and performance (functional) and commercial aspects, such as size of the order, the delivery time and price.

Inks and varnishes can be described as traditional for the process, based on pigment, resin and vehicle. The vehicle, which carries the pigment and resin from the reservoir to the substrate on the printing plate, varnish roller, etc., it can be an organic solvent, water or a drying oil. For some processes, pigments are replaced with dyes. In recent years, inks and varnishes cured by UV radiation have also become popular and these materials are extremely inert. They offer good resistance to rubbing in wet and dry conditions and are resistant to the absorption of the product. The inks contain pigments, cross-linked resins and

Photo-initiator; they are 100% solids and are dry immediately after printing.

The functional requirements include compliance with the standards for color, resistance to light, resistance to rubbing, printing on printing and printing on the packaging and stability under the conditions of use.

For some food products, in which printing is located in the vicinity of the food, ex. chocolate, it is important not to be residual solvents from inks and varnishes, or any other interaction between the print and product that affects the food product.

g) Formation of the 3D[11]

Currently, there are two types of forming processes for cardboard for commercial use: stamping (pressing the tray, forming by pressing) for the production of trays and plates, as well as the Multivac® type (the formation of air with vacuum by thermoforming) the production process of sealing trays for sliced cut cheeses. Emerging technologies in the formation of paper include: profiling, hydroforming and hot pressing (stamping with a preform (blank) fix) industrial processes and training can be classified as shown in Fig 7.

[11] Alexey Vishtal, Formability of paper and its improvement, VTT Technical Research Centre of Finland Ltd

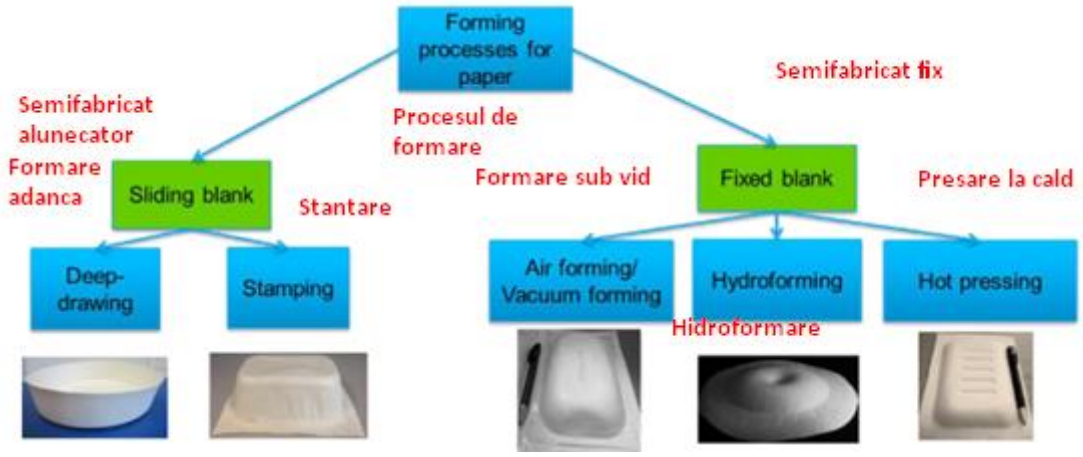


Fig. 7: 3D Formation

Usually, industrial stamping machines have several units, starting with a feeder; the next unit is the plate cutting and the cutting unit in which the cardboard is cut into blanks and, respectively, lines of notching are made; and in the end, the punch, where the blanks are formed with the aid of punches operated electromechanical or hydrodynamic.

The deep and fixed formation are presented in annex 1, fig A1.6, Fig A1.7. The deep formation is performed between the punch and forming cavity, while the counter - punch, can be presented as a support or used for the printing of the bottom part of the form. The main difference between the forming processes of the fixed and sliding elements is the deformation of the paper. In the fixed blank process, stretch deformation predominates over compressive deformation. The forming process of fixed fixtures produces forms that are narrow in depth (2-3 cm maximum depending on the rays of curvature), but with smooth and uniform edges and precise shapes, they can be sealed with barrier films.

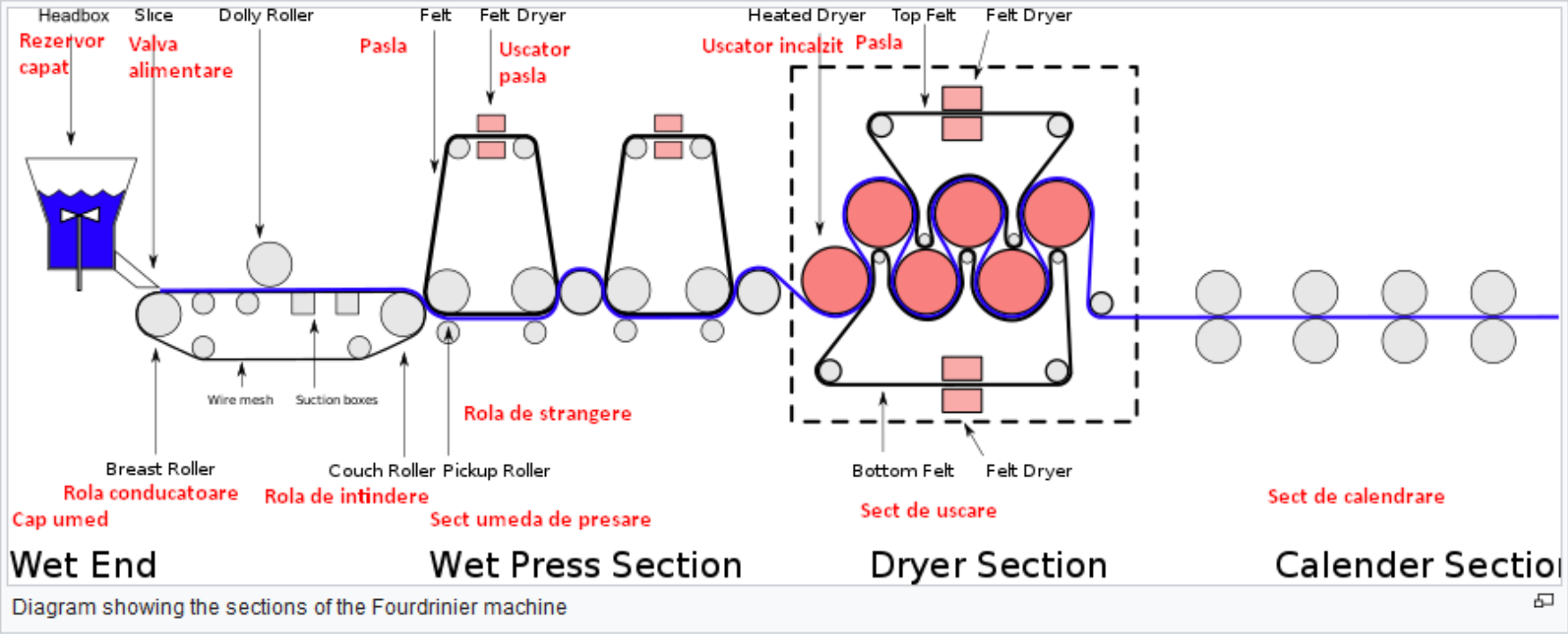


Fig. A 1.1 The paper machine type Fourdrinier https://en.wikipedia.org/wiki/Paper_machine

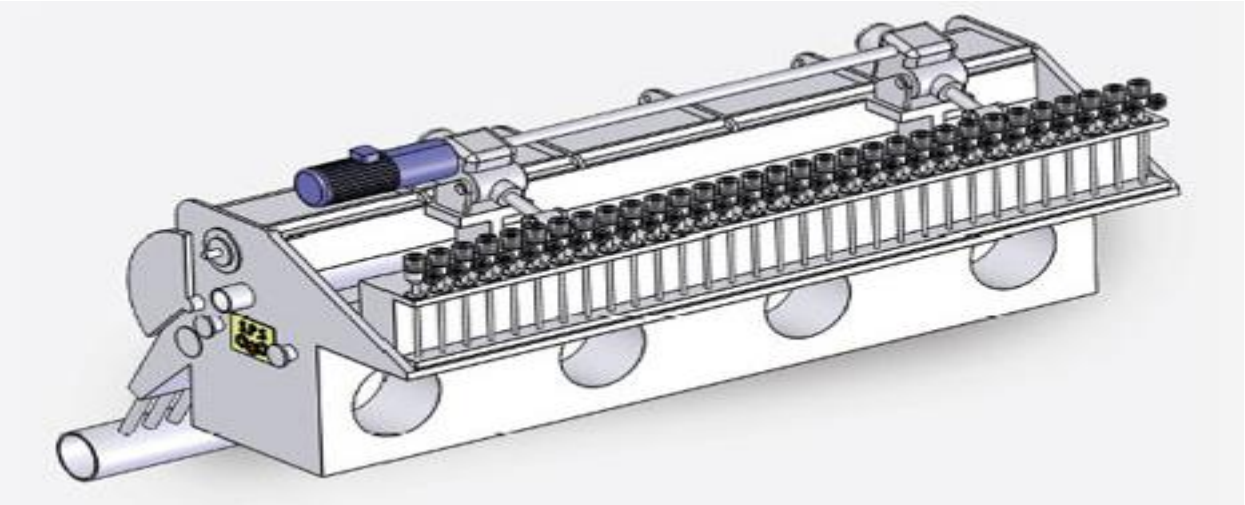


Fig. A1.2 Headbox from (Shimi Pajouhesh Sanat) http://sps-co.com/products/prodset02/p2.asp

Technical Information :

Calitatea hartiei	Paper grades	GSM	40 ~170
Consistenta pulpei intrate	Pulp inlet consistency	%	0.5- 1.0
Viteza	Velocity	m/min	Up to 350
Deschidere	Deckle size	mm	up to 2800
Ajustarea ajutajului	Slice lips adjustment	Prin valve pneumatice	By air valves
Material	Material of construction	Inox	Stainless steel

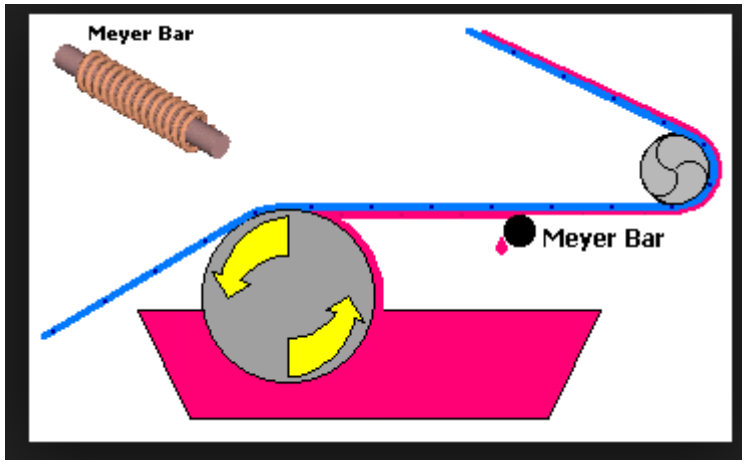


Fig. A1.3 Measuring bar (metering / Meyer bar)
http://www.tciinc.com/capabilities/

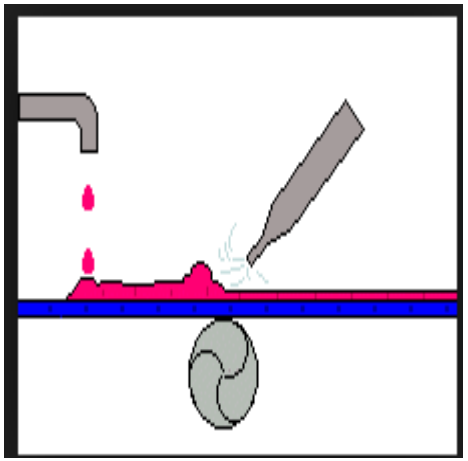


Fig. A1.4 The air knife (Air Knife Coating) after

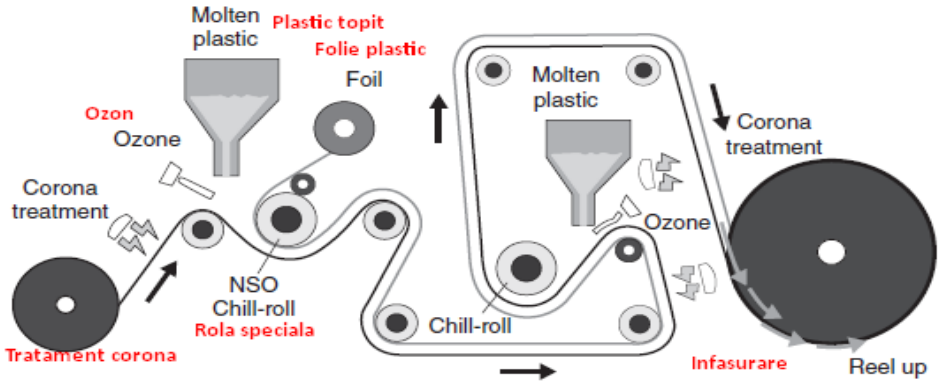


Fig. A1.5 The process of extrusion and extrusion - lamination

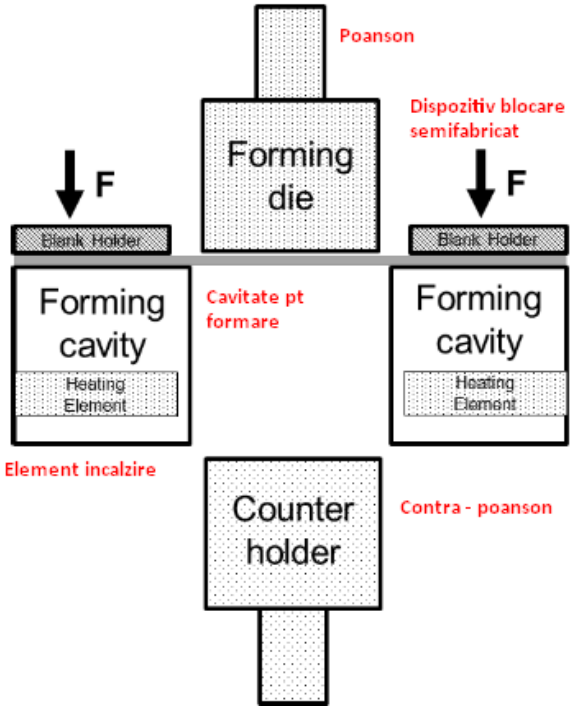


Fig. A 1.6 (deep-drawing process)

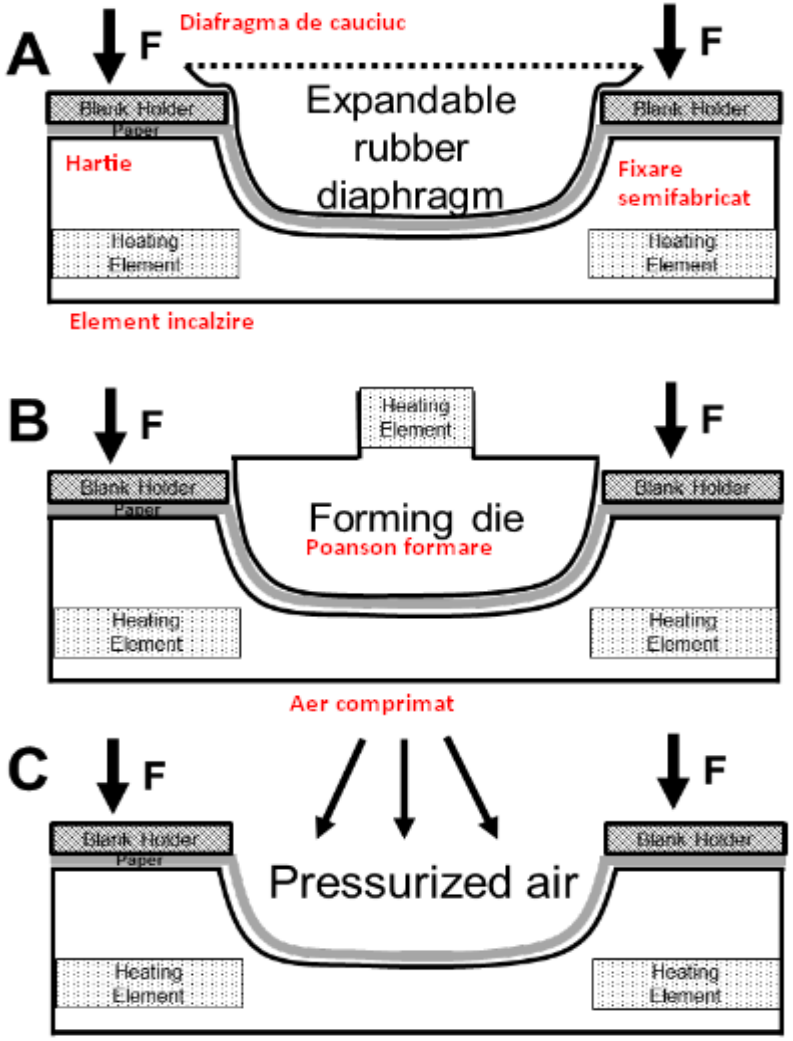


Fig. A1.7 Fixed blank forming processes A (hydroforming), B (hot pressing), C (air forming)