Ecodesign for food packaging

UNIT 9: Paper and cardboard packaging

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Content unit 9, Ecodesign for food packaging

Contents

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After learning this unit, the student will be able to:

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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 Ecodesign.

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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.

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.

Paper over 200 g / m2 is defined by the ISO as cardboard.

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.

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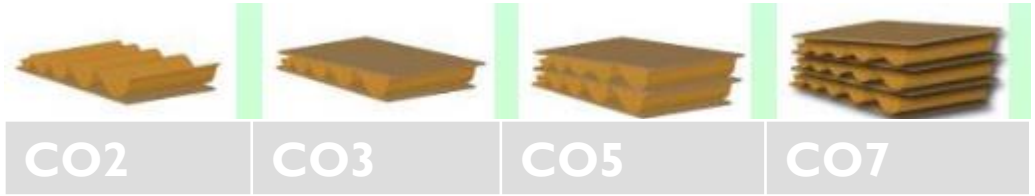

Fig.1 Types of corrugated cardboard
http://www.tsocm.pub.ro/educatie/cepa/Ambalaje%20-%20CEPA%20-%20Curs%202.pdf

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.

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.

Paper Tubes
http://www.tinkoff.ro/

Paper packaging http://www.greif.com

Fig.2 Paper and cardboard packagingmaterials http://benecopackaging.com/products/

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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.

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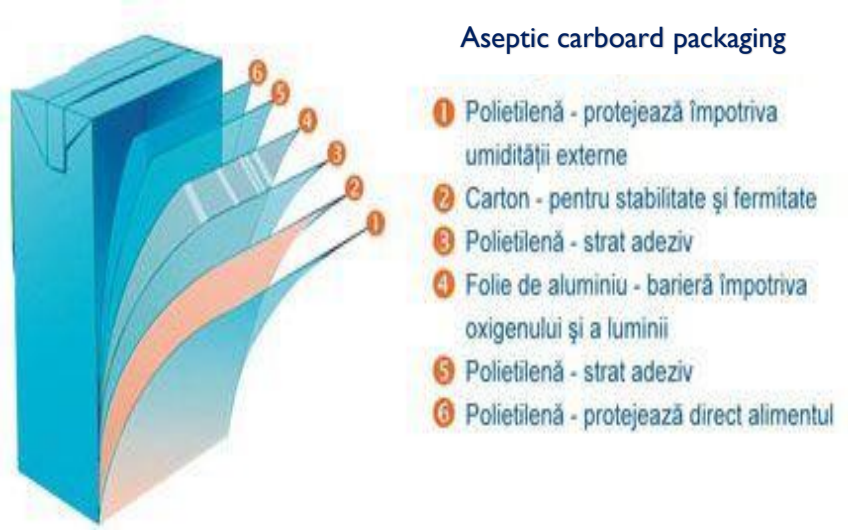
The functions of the layers from which are manufactured the common cards :

- 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.



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9.2 The Ecodesign for recovery and recycling of paper and cardboard

Ecodesign of packaging from cardboard was presented in UNIT V, section 5.3.

Although the paragraph refers to the Ecodesign of packaging logistics, the procedures and programs of the design presented are also used for Paper and cardboard packagingprimary.

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.

Among the objectives and targets of the Declaration are:
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.

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Concerning Ecodesign, 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 cardboard 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.

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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 . 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.

Most scenarios included in the analysed LCA 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.

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9.3 Technologies for paper and paperboard packaging

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 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 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.

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

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.

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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.

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 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.

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.

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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.

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Obtaining paper from pulp

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.

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).

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;

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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.

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.

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. 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.

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.

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Lamination

- Aluminium foil applied on one or both sides, provides a barrier for moisture, aroma, common gas, such as oxygen and UV light.
- Waterproof paper laminated on cardboard: good resistance to fat, resistance to temperature up to 180◦C for packaging of cooking / reheating.
- Glossy paper laminated on cardboard: resistance to fat for products with moderate content of fat, such as cookies or baking in the box applications.

Extrusion and lamination with plastic material

- **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.
- **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.
- **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.

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- **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.

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.

Formation of the 3D

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.

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