Report

Industrial Packaging

For Date Syrup Products

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01

Introduction to Packaging

Packaging Definition

Packaging is defined as —the enclosure of products, items, or packages in a wrapped pouch, bag, box, cup, or other container to perform the following functions:

- Containment
- Protection or preservation
- Communication
- Utility or performance

If the device or container performs one or more of these functions, it is considered a package. This definition implies that packaging serves more than one function; i.e., it is multifunctional.

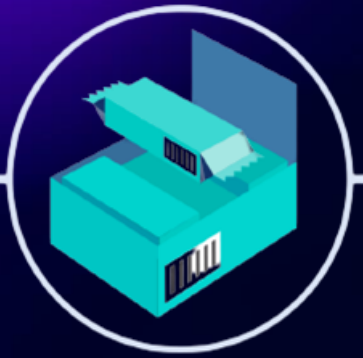
Packaging Levels

Primary Packaging

1

It is the smallest unit of distribution and is in direct contact with the contents.

Secondary Packaging



2

This is the outside of the primary packaging. It is used to group primary packages together.

Tertiary Packaging

3

It is used for bulk handling, warehouse storage and transport shipping.

Technical Purposes of Packaging

Food Containment

Hold the contents and keep them clean and secure without leakage or breakage until they are used.

Food Protection

To protect foods against a range of hazards during distribution and storage (dirt, contaminants, insects…).

Convenient Handling

Easy opening, dispensing and re-sealing, and being suitable for easy disposal, recycling or reuse.

Consumer Friendly

To enable the consumer to identify the food, and give instructions so that the food is stored and used correctly.

02

Packaging Development

Considerations for Selecting a Packaging Material

01

Technical Suitability

How well the package protects a food for the required shelf life?

02

Availability

Is the packaging material already in use or do we have to invest more on manufacturing equipment and expertise?

03

Cost

How cheap can we manufacture the package without compromising its technical integrities?

04

Marketing

Marketing considerations that favor choosing a certain type of package over another.

Packaging as a Medium of Communication

An important function of any food package is to:

- Identify the product and its origin,
- Inform the consumer how to use the contents,
- Provide any other information needed or required,
- Attract the user and encourage purchase of the product.

The information a package can convey to the consumer may include the following:

- Product manufacturing and best buy dates
- Proper storage conditions
- Nutritional information per serving
- Manufacturer‘s name and address
- Cost
- Suggested recipes
- Country of origin
- Information transmission - Packages and labels communicate how to use, transport, recycle, or dispose of the package or product

Packaging as a Salesman

No.	Functional Property	Specific Factors
1	Gas permeability	§ O_2, CO_2, N_2, H_2O vapor
2	Protection against environmental factors	§ Light, odor, microorganisms, moisture
3	Mechanical properties	§ Weight, elasticity, heat-sealability, mechanical sealability, strength (tensile, tear, impact, bursting)
4	Reactivity with food	§ Grease, acid, water, color
5	Marketing-related properties	§ Attractiveness, printability, cost
6	Convenience	§ Disposability, repeated use, resealability, secondary use
7	Aroma	§ Aroma compound barrier property

Functional Requirements of Packaging Materials

Source: Jelen, P. 1985. Food packaging technology. In Introduction to Food Processing, Reston Publishing, Reston, VA, pp. 249–266.

"A package must protect what it sells and sell what it protects."

—Robertson (1992)

Considerations for producing a successful Package

1. Compatible with product.
2. Protection from Mechanical hazards especially transportation. climatic hazards, microorganisms : Packaging do not harbour bacteria, restrict their growth3. Fit into a production line.
4. Advertising potential.
5. Attractive appearance.
6. Easy to handle during…Production, storage and Distribution
7. Moisture proof/resistance.
8. Sufficient mechanical strength to withstand drop, vibration, compression etc.
9. Acid, alkali resistance.
10. Grease & oil resistance.
11. Resistance to photo-chemical changes in product.
12. Resistance to insects and rodents.
13. Fire proof resistant to smoke, fume and water.
14. Pilfer proof (malpractice).
15. Inert: No effect on flavour/aroma.
16. Not injurious to health.
17. Economic.
18. Easy availability.
19. Protect against climatic hazards.
20. Protect against microorganisms. It should not harbour microbes rather restrict their growth by controlling growth factor like.

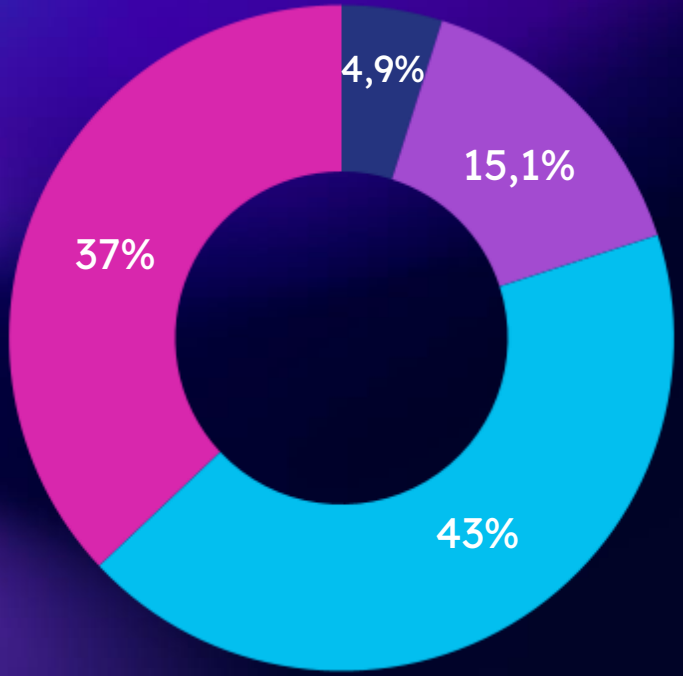
SN	Storage	Hazard	Damage	Protection
I	Handling and transportation	Drop, shunting, shocks, vibrations, stack load, compression etc.	Breakage, loss of shape, dusting, seepage	Cushioning, blocking.
II	Storage	Stack load, compression, Attack by rodents and insects	Crushing, distortion sticking, spillage, contamination, spoilage	Adequate compression strength of package. resistance and repulsiveness to insects
III	Environment during storage transportation and distribution	Biological or otherwise	Contamination	Toughness of packaging material (to resist penetration).
		High/low humidity moisture/water.	Physical, chemical and biological deterioration due to loss/gain of moisture	Efficiency of closure providing. Water vapour barrier properties.Package desiccant etc.
		O_2	Oxidative rancidity	O_2 BARRIER VACUUM – O_2 N_2/CO_2 flushing packaging in impermeable package
		Light U.V. rays	Vitamin Destruction, Off flavour development, Oxidative	Use of opaque or colour like Yellow, red, brown, etc. for packaging material.

03

Material Comparison

Between the Most Common
Industrial Packaging Materials

Industrial Food Packaging Materials: 4 Main Types



U.S. Packaging Materials
Source: Annual Survey of Manufacturers
U.S. Census Bureau 2013-2017

Metal

Made from tinplated steel or aluminum and is the result of mined bauxite that is smelted into alumina.

Plastic

Polypropylene, polystyrene, polyvinyl chloride, polyethylene terephthalate and polyethylene, all of which are derived from fossil fuels and are used in food packaging.

Glass

Made of three natural ingredients: silica sand, soda ash and limestone.

Paper

Uses plant fibers like cotton, linen and hemp, as well as grasses like straw, wheat and kenaf

Aluminum Advantages & Drawbacks

Total Protection

of contents when sealed with a double-seam.

Tamperproof

Designed to resist access to the product contained within the package

Versatility

Can be made in a wide range of shapes and sizes.

High cost

High manufacturing costs make metal packages expensive compared to other containers.

Heavier

They are heavier than plastic containers and therefore have higher transport costs.

Unavailability

Lack of can-making factories in developing countries and small-scale food processors.

Glass Advantages & Drawbacks

Total Protection

Impervious to micro-organisms, pests, moisture, oxygen and odors

Heat Processable

Subjecting the annealed glass to a thermal process to increase its resistance, and to make it safer in case of breakage.

Recyclable & Re-usable

100% recyclable and can be reused for an extremely long time.

Higher weight

Higher weight than most other types of packaging, which incurs higher transport costs;

Fragility

Containers are easily broken, especially when transported over rough roads.

Hazards

There are potentially serious hazards from glass splinters or fragments that can contaminate foods.

Plastic Advantages & Drawbacks

Durable

Durable plastics consume less energy during the production process than metals, too, in part due to how light they are.

Lightweight

The lightness of plastic is closely tied to its superior sustainability. Its comparatively low weight contributes to its lower energy consumption and greenhouse gas emissions over other materials.

Versatile

You can mold plastic into essentially limitless shapes. Think of the vast variety of plastics packaging you see all the time.

Degradation

Plastics are non-degradable materials. The decay of this material is not easy. It might take centuries and cause pollution in the environment.

Harmful

The plastic material that is used in means of human consumption purposes, such as food packaging bags contains harmful components.

Low Melting Point

Plastic packaging doesn't withstand in an area where the temperature is a little high.

Paper Advantages & Drawbacks

Biodegradable

Has higher biodegradation rates when compared to other kinds of packaging. It breaks down in natural environments quickly when exposed to bacteria, yeast, and other organisms.

Bio-based

Paper is primarily composed of forestry materials found in nature (i.e., fiber). When the material decomposes, it reverts back to natural materials from our environment.

Better for the Environment

Paper is one of the lowest industrial emitters in the world. It can be better for the environment when managed in a sustainable way

Fills up Landfills

Even though paper is very recyclable and reusable, it still fills up landfills.

Poor Barrier Properties

Paper offers less of a barrier to oxygen, light, and microbes than other packaging materials. As a result, the items it stores have shorter shelf lives.

Less Dense

Paper takes up less space than the same weight of plastic in landfills because it's less dense than other types of waste.

Breakdown Comparison Between Food Packaging Materials

Paperboard	Glass	Steel	Plastics
Selection			
Easily machined and folded	Product visibility	Strong, stiff	Fabricability
Easy to bond	Impervious, inert	Malleable	Variety of forms
Composites well	Image of high quality	Retortable	Tough, lightweight
Printability	Ovenable, Reusablity	Permanence, Reusablity	Wide range of properties
Rejection			
Chances of water absorption	Shatters, Scratability	Corrodes	Thermal limit
Penetrable	High weight-to-strength ratio	Limits shapes	Permeable
Image	Limited shapes	Appearance	Absorbs flavors
Tears, punctures	Large sizes	Flavor distortion	Distortion and creep

Comparison Between Plastic Food Packaging

Table 1: Properties of selected packaging materials

Film	Coating	Barrier to		Strength	Clarity	Thickness (µm)
		Moisture	Air/odours			
Cellulose	PvDC	*	***	*	***	21-40
	Aluminium	***	***	*	***	19-42
	Nitro-cellulose	***	***	*	-	21-42
LDPE	-	**	*	**	*	25-200
HDPE	-	***	**	***	*	350-1000
Polypropylene	-	***	***	***	***	20-40
	PvDC	***	***	***	***	18-34
	Aluminium	***	***	***	-	20-30
Polyester	-	**	**	***	**	12-23
	-	***	***	***	-	20-30

* = low, ** = medium, *** = high. PvDC = polyvinylidene chloride, LPDE = low density polyethylene, HDPE = High density polyethylene.
Thicker films of each type have better barrier properties than thinner films.

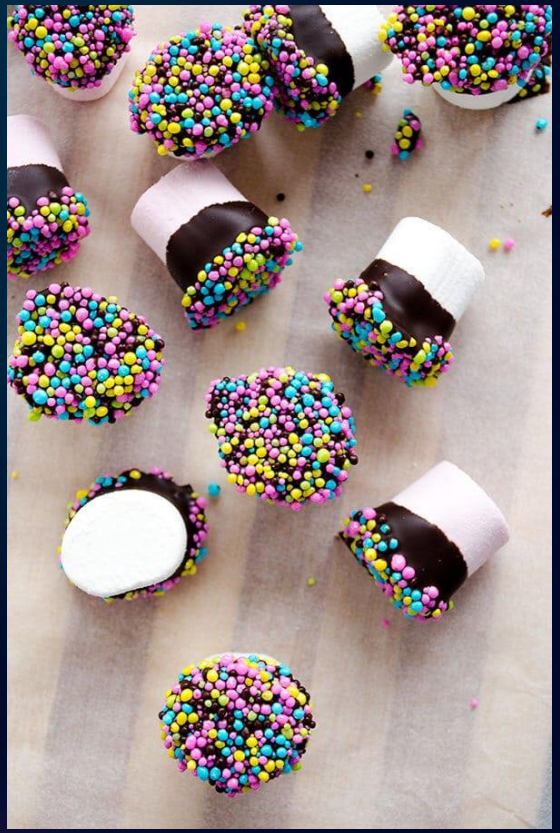
Coextruded film	Typical food applications
High impact polystyrene-PET	Margarine, butter tubs
Polystyrene- polystyrene-PvDC- polystyrene	Juice and milk bottles
Polystyrene- polystyrene-PvDC-polyethylene	Tubs for butter, cheese, margarine, bottles for coffee, mayonnaise, sauces.

04

Snack Products

Based on Date Syrups

Marshmallow



Choice of the Packaging Material

3 main Pressure Points:

- -Eco-friendliness
- -Ergonomic features
- -Target pleasing design

Why Polypropylene?

1. **Ideal food-safe plastic**

Environmental Protection Agency (EPA): a safer choice than some other types of plastics.
Not cancerous.
Less flammable than most plastics
-> absence of **Bisphenol A**

2. **Low density**

It can withstand a lot of stretching before it actually breaks -> useful for applications like plastic bags, bin bags and other plastic films.

3. **Lightweight**

4

Durable

It will not wear away over time and does not rust or react in any way with water, acid, detergents or non-oxidizing organic compounds.

5

High heat resistance

Maximum recommended operating temperature is 180°F (82.2°C).

6

Recyclable

A widely accepted material for recycling.

One of the most widely recycled non-bottle rigid plastic material.

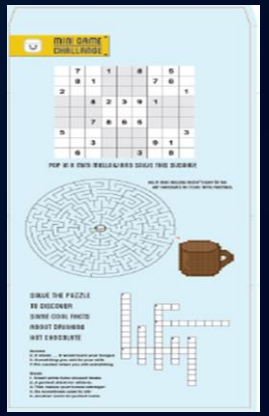
Packaging Technical Requirements

- Re-sealability: to ensure that the marshmallows inside remain spongy and soft.
- Transparency : the content inside will be clearly visible and more inviting to the buyer.

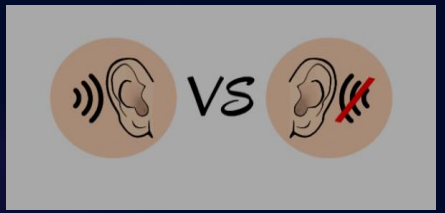
Marketing Requirements

- Fun gentle colors

- Diverse games on the packaging’s back : Riddles, labyrinths, crosswords, spot the differences games…



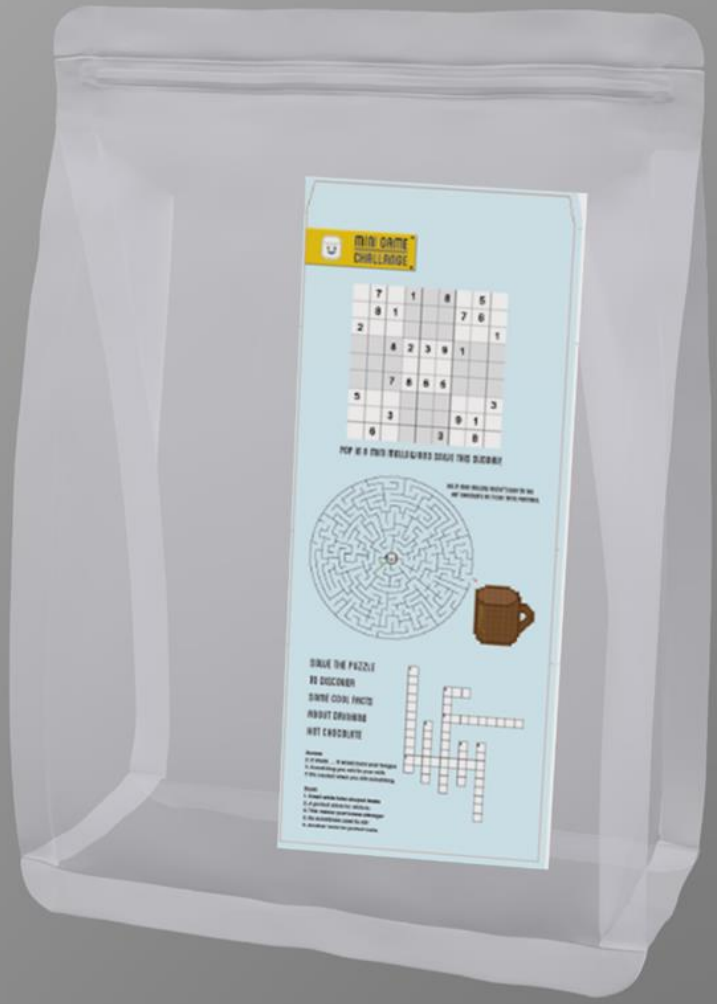
- Packaging that makes a crisp cracking sound -> more inviting and exciting.



A bag is the best choice. Why?

- Better visibility of the product
- A zipped bag is better for the preservation of the product after it’s been opened.
- Better audible features (cracking...)


MALLOW-DATE
MARSHMALLOW
MADE WITH
DATE SYRUP

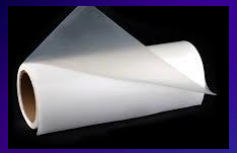

MINI GAME CHALLENGE
SOLVE THE PUZZLE
TO DISCOVER
SOME COOL FACTS
ABOUT DRINKING
HOT CHOCOLATE

Industrial Manufacturing of the Packaging

Milk Drink

Sequence of Layers of a Bottle

- 2 Layers of HDPE (Polymers)
- Aluminium layer
- EVA « ethylene-vinyl acetate »
- Paperboard: eco-friendly

The product	Aluminium	EVA	HDPE	Paperboard	HDPE
			2 HDPE		2 HDPE

Factors Behind the Polymer (HDPE) Selection

- Moisture in the atmosphere
- Gas permeability
- Preservation and safety of the product
- Barrier properties
- Cost

We have chosen HDPE layers over the PP (Polypropylene) mainly for these properties :

- Chemical resistance
- Crystallinity
- Moisture protection
- Gas permeability

EVA « ethylene-vinyl acetate »

- EVA is a copolymer
- It has excellent sticking properties
- Used here as a tie-layer

Aluminium

- Aluminum foil acts as a barrier to light ,oxygen ,odors flavors, moisture, and bacteria
- A good choice for dairy products

Notes

- The packaging materials proposed for this product aims to minimize losses and wastages of the product caused by its transportation or because of the environmental hazards.

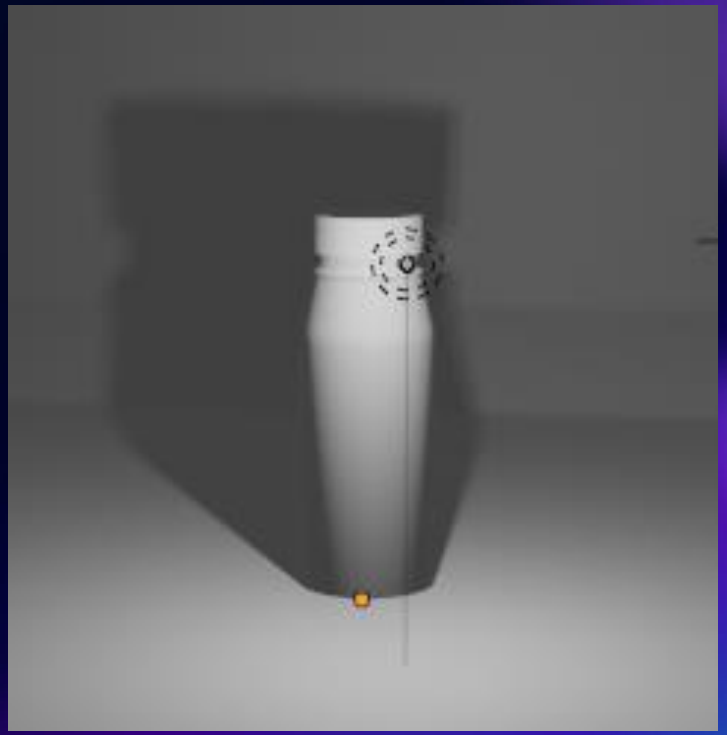
- This product is not a recyclable product because of the complexity of the recycling of multilayer packaging compared to monolayer packaging.

The Bottle Cap

We have chosen high density polyethylene (HDPE) because of its strength and its excellent properties .

Label Design

Package Design



Lamination Technique used in the Manufacturing of the Product Packaging

What is lamination?

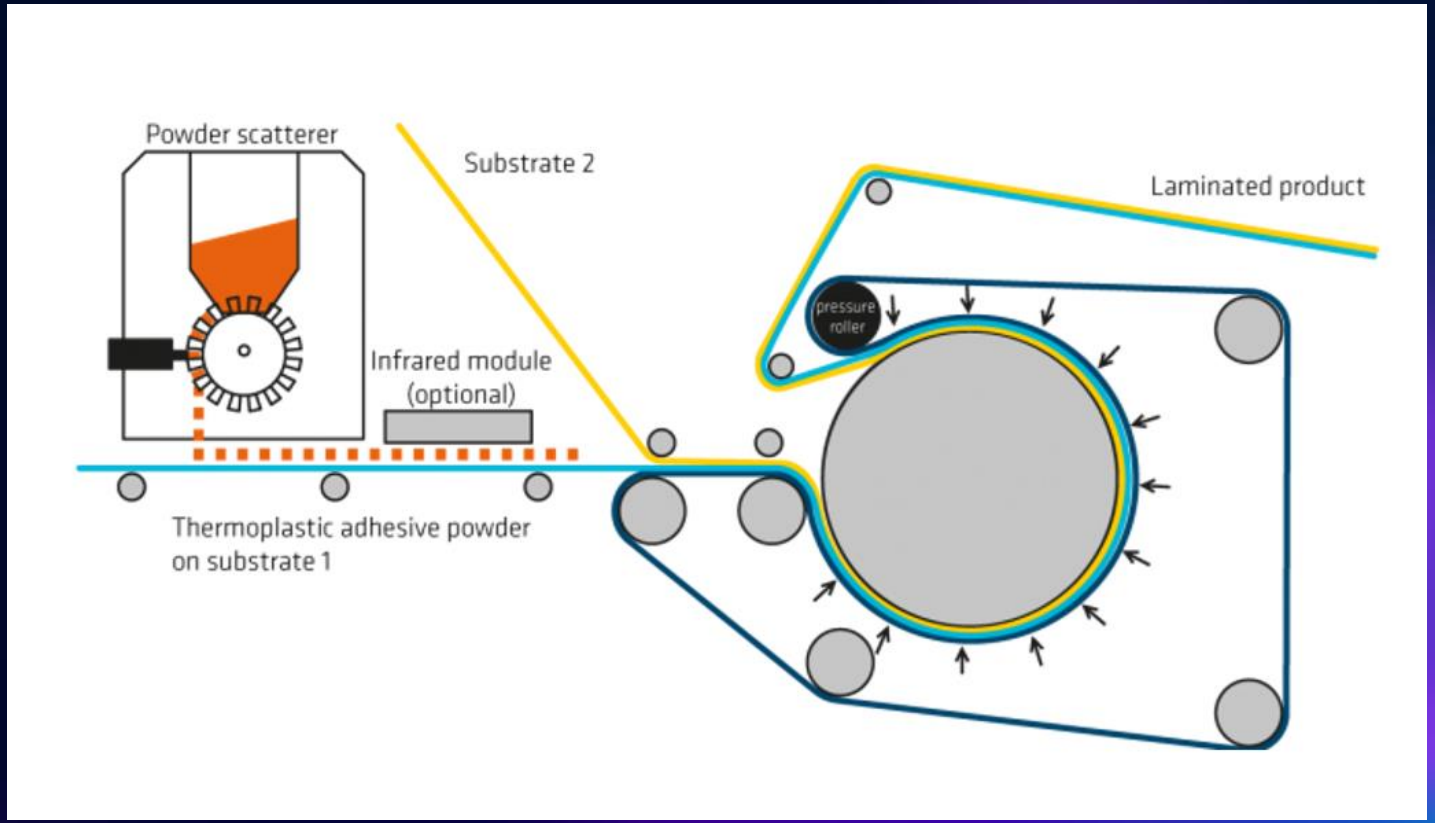
Lamination is the process through which two or more flexible packaging webs are joined together using a bonding agent. The substrates making up the webs may consist of films, papers or aluminum foils.

Advantages of the Lamination Technique

Lamination of paperboard with polymers serves following purposes:

- Provides protection to the food and to the paperboard against hazardous environmental effects like sunshine, moisture, air, dust and oxygen.

- These layers give extra strength and stiffness to the packaging.



Typical lay-out for laminating with thermoadhesive powder on a LFC calender and the use of a Powder Scattering Devise

NOUGAT

Product Description

Sequence of layers of the Product :

- Aluminium foil layer to wrap the chocolate nougat bar
- Paper wrapping for the label
- Plastic foil layer for the protection of the label

Requirements of the product:

- The package should be attractive to customers (bright colors)
- The material must protect the product
- Package easy to open and not dangerous for childrens
- The design must include the marcos of the product

Material Choice

Benefits

Aluminum foil

- Approved for direct food contact
- Corrosions Resistant
- Brightness that comes with colors :great choice to attract kids
- Impermeable and odorless
- Protects products from moisture, damage, heat and humidity.
- The recycling, smelting and recasting of aluminum consumes less energy
- Doesn’t change the aroma and flavor of chocolate

Paper Wrap

- The paper used is biodegradable since it’s made from wood pulp
- Easy to print the design on it
- Easy to remove

Plastic layer

- Protection of the label
- Longer shelf life
- Makes the paper texture silky and more attractive to the touch

Drawbacks

- The production process of aluminum is a very high energy consuming process.
- Aluminum foil turns out to be difficult to recycle because of its thin thickness which will make it burn in the smelting process.
- It can get toxic from reaction with other products which hard to recycle as well ,the solution to this problem is to separate aluminum foil from other materials

What will happen if we increase the layers like most of chocholate packaging?

The package extremely difficult to recycle:

1) Flexible film, in general, is terrible for curbside recycling programs.

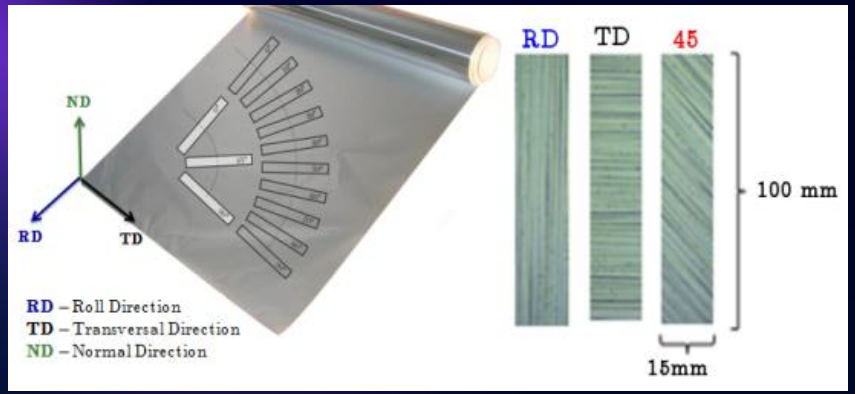
2) Multi-layered films can make it harder to recycle, the different layers have to be separated, equipment has been developed that can separate some types of metalized film. However, the process is energy-intensive and expensive

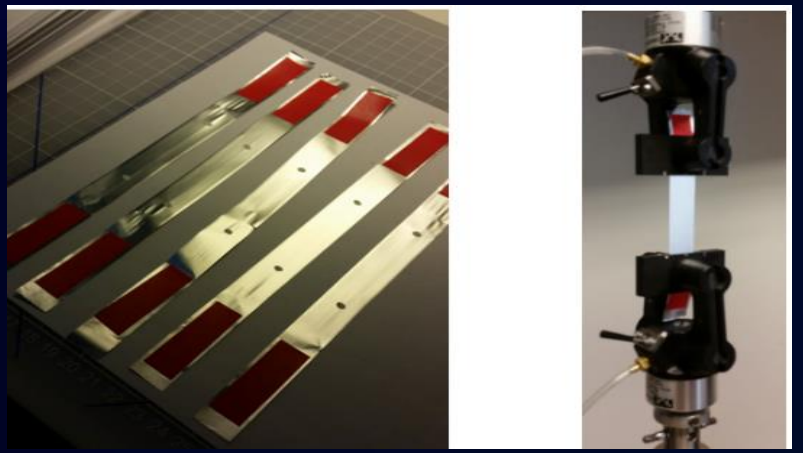
Mechanical Test on the Foil

Experimental Tensile Test

Test Purpose

The test was to find the complete mechanical characteristics in different material orientations and to study the anisotropic behaviour of aluminium foil.

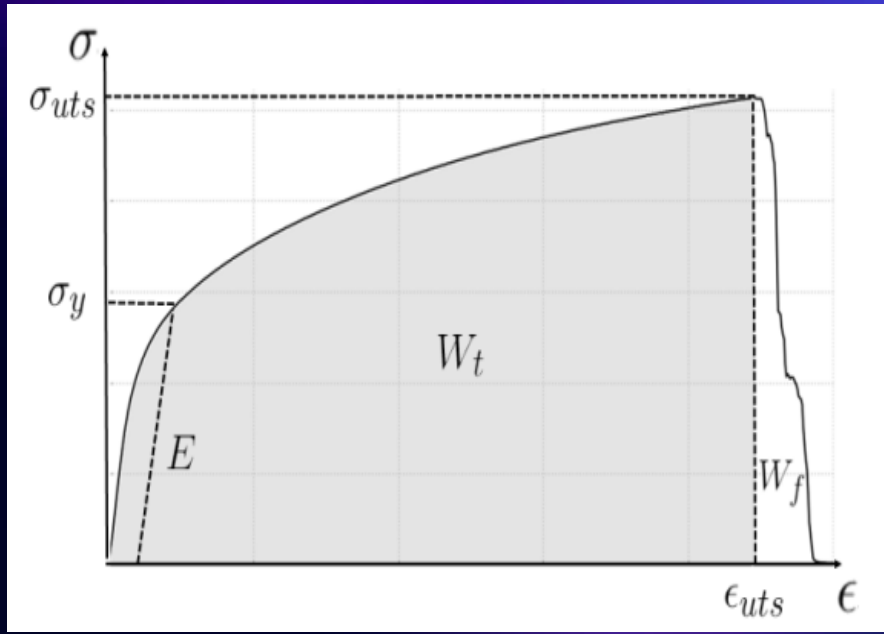




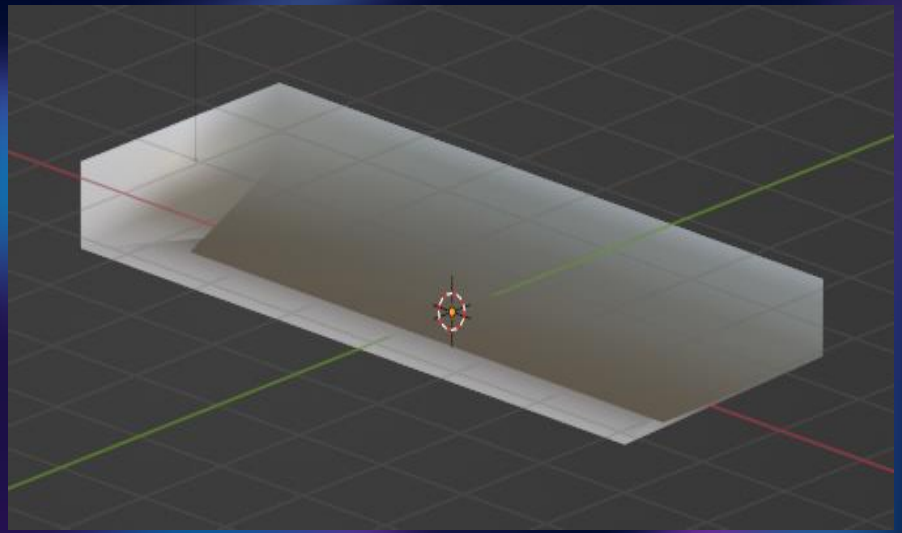
The tensile test was performed with an Instron tensile tester with 50 mm wide and smooth rubber grips and a 100 N load cell.

Test Results

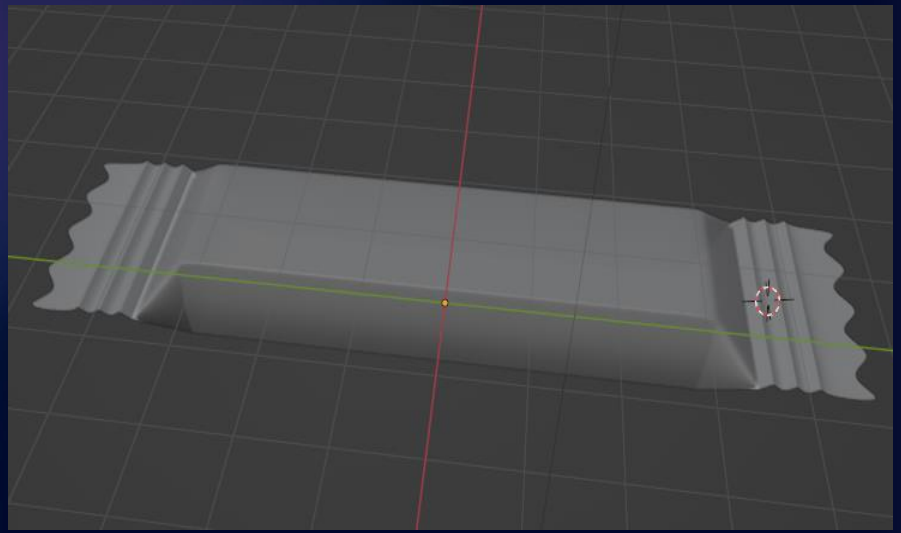
E is the slope on the dotted line shown in the Figure. The ultimate tensile stress (force de traction) σuts and the ultimate tensile strain (contrainte de traction) εuts is the maximum strain and stress before break. The yield stress, σy, is the stress-value where the material starts to yield. Tensile absorption energy, Wt is the shaded area and the failure energy, Wf , is area under the failure part of the curve.



Package 3D Designs

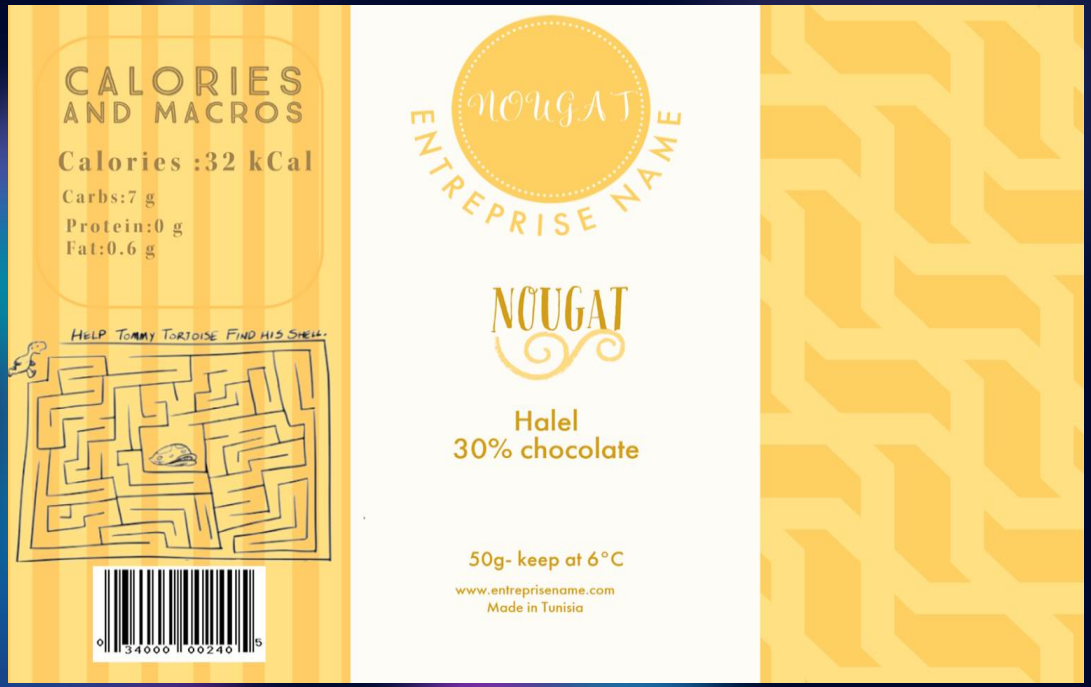


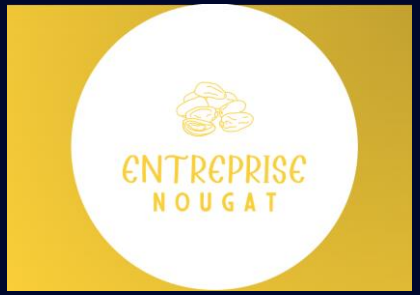
Version 1



Version 2

Package Label





Logo

Version 1

Package Label

Version 2

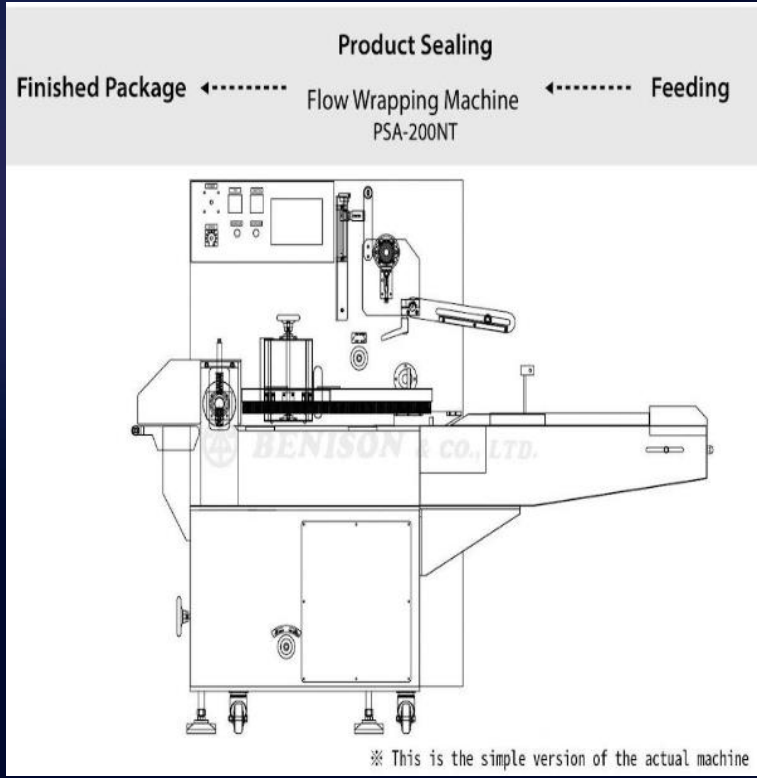
Industrial Study

Material

In this case, we're going to use aluminium foil for the wrapping of the nougat chocolate bar, plastic foil to wrap the external part of the paper designed for label protection

Machine Specifications

- Flow Wrapper Machine PSA-200 NT
- Packaging Capacity: 125packs/minute (depends on product size)



Industrial Study

Features

- Easy to operate.
- Printing sensor can be installed to make sure printed packs be in the right position
- Two-side knife sealer can double the machine speed comparing to standard model
- Enable to pack different size of products, with easy adjustment
- Suitable for food and non-food industries
- All machinery and equipment comply with food safety production regulations

Juice Drink

Packaging Material Choice

What is a Tetra Pack?

- Tetra pack is the most common name for aseptic cartons used for liquid food items which have to be stored for up to one year without refrigeration.
- Aseptic here means “free from pathogenic micro-organisms”, so this packaging process eliminates the food and packages from harmful elements.
- This type of packaging also blocks light completely to preserve vitamins A, B2, B6, B12, C and K, which are all photosensitive and would become damaged in the presence of light.

A tetra pack comes under the category of aseptic packages. For a material to be aseptic, it should have the following features:

Product Compatibility

01

The packaging material must be compatible with the product intended to be packed.

Sterilization

02

The packaging material must be able to withstand sterilization and be compatible with the methods of sterilization.

Physical Integrity

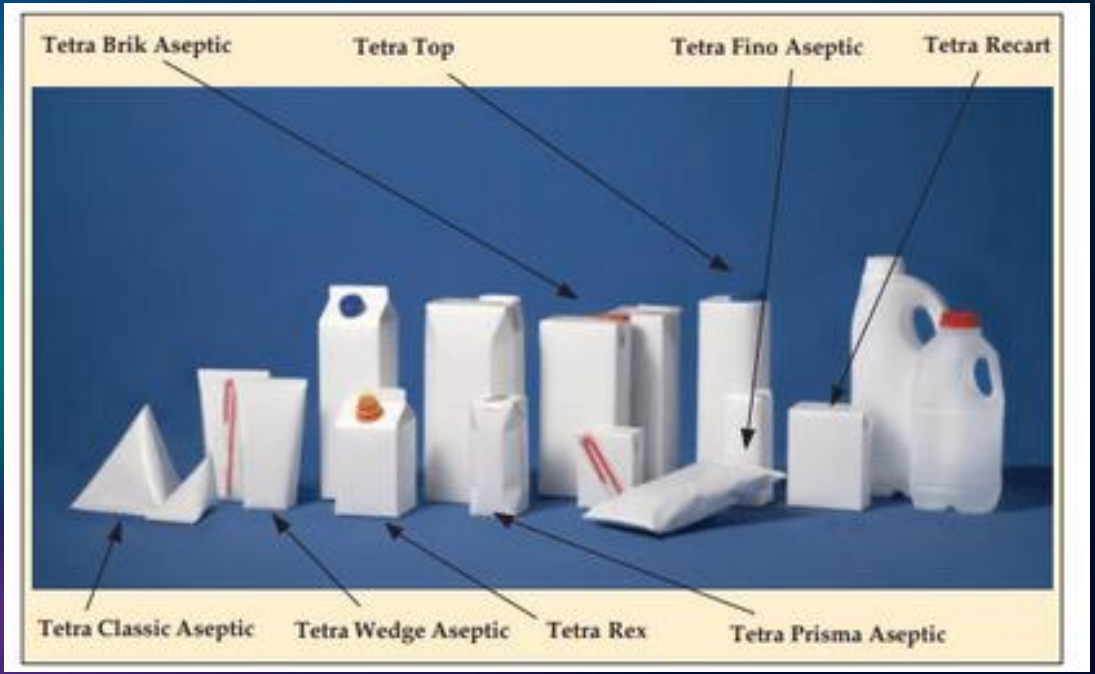
03

The physical integrity of the package is necessary to assume containment of the product and maintenance of sterility.

Protection

04

The package must protect the product from oxygen; also, the package must retain the product’s aroma.



Types of Tetra Packs

Laminate Structure of a Tetra Pack

1. PE: Contributes 15% of the total packaging; it's water proof, anti-corrosive, and protects the printing from outside moisture.

Bonding layer: Reinforcing the lamination of PE and paper.

2. Paper: Substrate for printing and a support layer that contributes 80% of the total packaging providing strength, stability, smoothness, tenacity and stiffness.

3. PE: Acts as an adhesive bonding paper layer. It's water proof, and moisture proof.

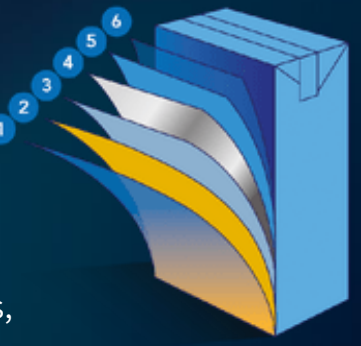
Bonding layer: Reinforce the lamination of PE and aluminum foil.

4. Aluminum foil: Contributes 5% of the total packaging. It forms a barrier against light, flavor, and oxygen, eliminating the need for refrigeration and preventing spoilage without using preservatives.

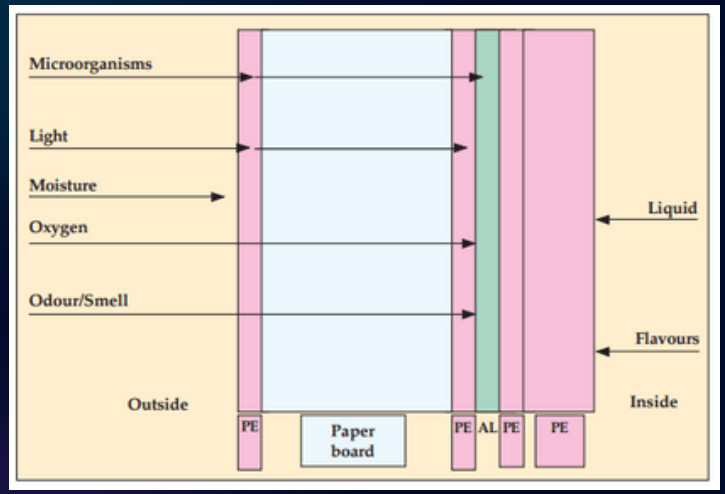
Bonding layer: Reinforce the lamination of PE and aluminum foil.

5. PE: Acts as an adhesion layer. Increases strength of laminate and thickness.

6. Modified PE: Modifying heat sealing performance, increase sealing quality.

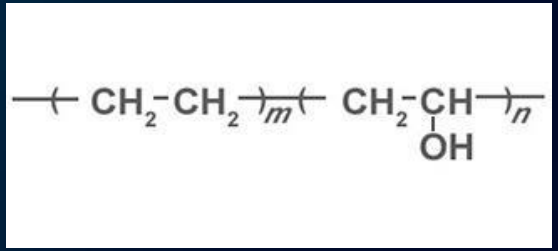


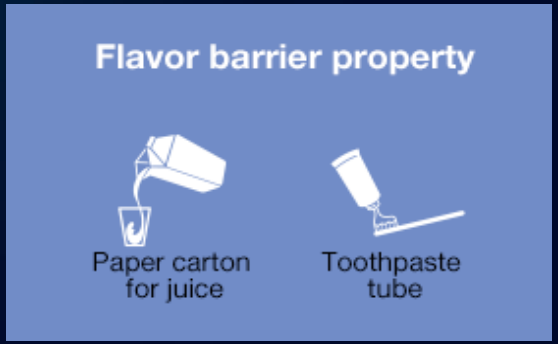
1	Polyethylene - protects against outside moisture
2	Paper - for stability and strength
3	Polyethylene - adhesion layer
4	Aluminium foil - oxygen, flavour and light barrier
5	Polyethylene - adhesion layer
6	Polyethylene - seals in the liquid



Co-extrusion coating with Soarnol

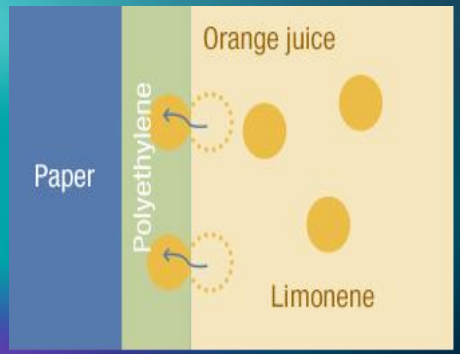
- Soarnol is an ethylene-vinyl alcohol copolymer developed by Mitsubishi Chemical's own technology.
- It has high gas barrier properties, oil resistance and high transparency derived from vinyl alcohol structure as well as moisture resistance and extrudability comes from ethylene unit.
- Additionally, Soarnol is consist of carbon, oxygen and hydrogen so no harmful gases is generated when incineration and its combustion heat is a half of polyethylene.

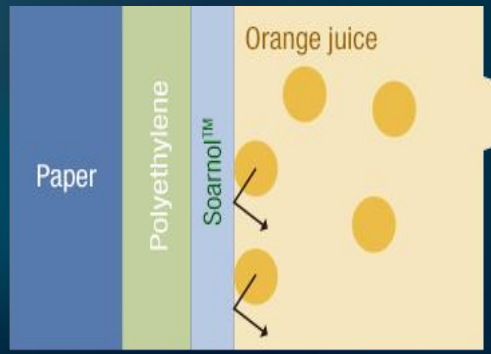




Co-extrusion coating with Soarnol

Soarnol can be coated onto base film and paper.





Orange juice, fruit juice seasoning

Example: Orange juice

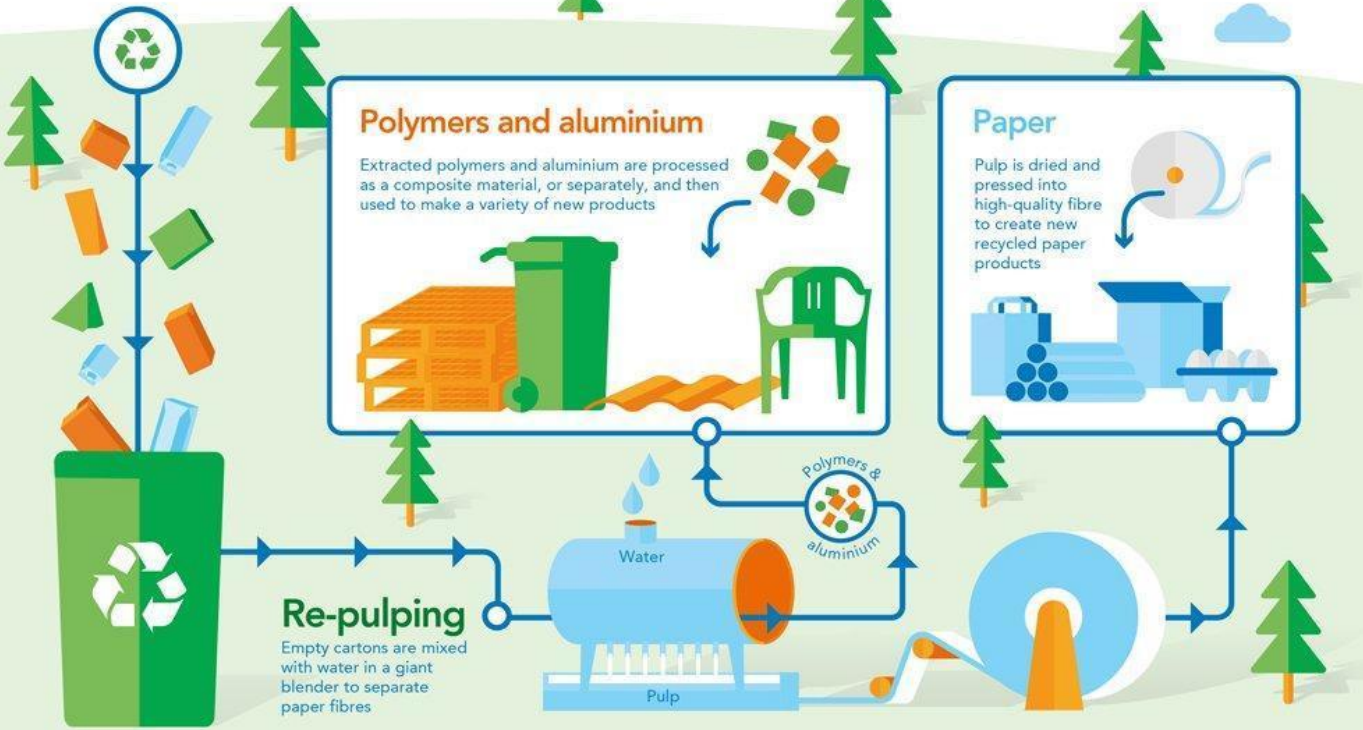
Conventional paper carton has polyethylene as innermost layer but it absorbs limonene which is a main substrate of orange flavor so that it loses original taste. On the other hands, Soarnol has abilities to protect such absorption and migration so by coating Soarnol, it’s possible to reduce a deterioration of a taste. Additionally, Soarnol prevent an oxidation of vitamin C and this keeps original taste of orange juice longer.

Recyclability & Sustainability:

- The Tetra pack carton is the future packaging – being primarily made using paperboard (a renewable forest-based resource) and fully recyclable. Not only this it offers consumers convenience, easy opening, optimal shelf life

- Tetra packs are recycled, but the recycled part is not used for manufacturing of tetra packs, hence they are said as non-sustainable. It is unclear whether this is because their paperboard needs to come from virgin sources to avoid contamination, or whether the quality of the recycled paperboard isn't high enough to make new cartons, or there is some other reason. Whatever the reason, it is turned into office paper.

The recycling journey



Material of the Cap: HDPE

- HDPE is a high-density plastic with a semi- to non-porous surface that is very stiff, has a good temperature resistance and water vapor barrier.
- It makes for excellent push fit caps and plugs, offering smooth and simple assembly, and can protect package contents from damage.
- As one of the most versatile plastic materials around, HDPE is used in many different applications, including plastic bottles, milk jugs, shampoo bottles, bleach bottles, cutting boards, and piping. Known for its outstanding tensile strength and large strength-to-density ratio, this plastic has a high-impact resistance.

Packaging 3D Design

Packaging Label

Thank you for your attention!