CONSEIL NATIONAL DE L'EMBALLAGE

DES PARTENAIRES POUR LE MEILLEUR DE L'EMBALLAGE

PACKAGING… WHAT FOR?
Packaging is crucial in the manufacturing of certain products

Table of contents

1 Introduction

A word from the President

Among all its features, the one related to the product's production is probably the one that no consumer knows about nor even imagines. And yet, this "process" feature is twice as important.

Technically speaking at first, as it allows the manufacturing of the product during the packaging's first life stage. Even before the packaging protects, transports, informs, and so on, we can effectively talk about a first life stage because, at that point, the packaging is subjected to temperatures, radiation, pressures, and so on, that have nothing to do with its official future life. It begins to serve, always keeping the obligation to be perfectly neutral for the product it contains. At this point, the packaging is associated with one or several tools. It is in fact a packaging–machine pairing that participates in the product's manufacturing.

The second aspect of this feature is economic. The packaging design and the production tools linked to it allow for an optimization of the product cost. It is often this economic performance that allows mass production and manufacturing costs that enable access to competitive "market" prices. A well-thought process is vital to the product's very existence.

The examples given in this document have been chosen in an emblematic way to make easily understood this "process" feature. But in real life, all products made on an industrial scale obey without exception to this obligation to see packaging and conditioning tools technically and economically enable the product's life. This "process" feature is crucial and essential.

Michel Fontaine

Summary

This document offers to demonstrate that packaging is important in the manufacturing of a large number of products. Indeed, there is a large category of packaging that, beyond its usual roles, plays an important part in the product's manufacturing and production processes. In other words, no packaging, no available product.

Therefore, without claiming to be exhaustive, this document goes over product-packaging pairings that illustrate the topic and are categorized according to the process's nature:

- The packaging contributes to the product's shaping and to the process that can follow (cooking), this is for example the case of cooked ham, pastry products, etc.
- The packaging becomes the unavoidable support for certain fermentation or ripening processes, like firm yoghurt or Champagne, for example.
- The packaging is an important actor for the establishing of certain products' organoleptic properties, like Mont d'Or cheese or Cognac.
- The packaging contributes to the consumer or user getting, at last, the final product, for example shaving creams in cosmetics or certain beers with foam production.

Goals

The goals of this document are:

- To remind that packaging is necessary to make some products into being, be it for technical, regulatory, or other reasons.
- To show that the packaging works as a support for the product's manufacturing. This function of packaging is unknown to the public, it is rarely mentioned compared to the usual functions of preservation, information, transport, etc. This function often fades behind the product.
  This document wants to demonstrate the motto: no packaging, no product.
  Design must be more advanced for these types of product-packaging pairings, as it often requires specific technologies (compression, cooking, propulsion, etc.).
- To popularize the topic with examples of product-packaging pairings and to show that the implementation of the "product-process" benefits the user.

2. Product manufacturing: packaging is important

Preamble

Packaging is not there by accident, it provides various functions for the product, the user, or the consumer, and more generally for the actors of the packaged product's value chain (cf. functions of packaging in the Annex).

In addition, there are functions dedicated to the packaging that one cannot guess, beyond its usual functions (protection, transport, information, use, etc.): as a matter of fact, a big packaging category plays a role in the manufacturing process of certain products; without the packaging, it is hard to imagine the very existence of the product.

Packaging is a production support that can be categorized in the next pages as follows:

- Contribute to the shaping of the product
- Participate in the organoleptic and taste properties of the product
- Accommodate certain fermentation or ripening processes of the product
- Contribute to the consumer getting, at last, the final product

In our societies where we talk about consumer goods, meaning products that are effectively produced in large quantities, this allows a cost optimization that guarantees the economic accessibility of the packaged product to the greatest number of people.

And for some of the products that the reader will discover, packaging is essential within the industrial processes of the product.

2.1. Packaging contributes to the shaping of the product

By shaping of the product, one must understand the set of operations that shape a material in order to reach the final product. This shaping process, with the support of packaging, allows to give the product its final characteristics (shape, texture, taste, etc.); in the examples below, we will speak of molding in particular.

2.1.1. Processed cheese[1] is molded in its packaging

Some processed cheeses are available in the shape of aluminum portions. In this process, the cheese is heated at a high temperature to be sterilized.

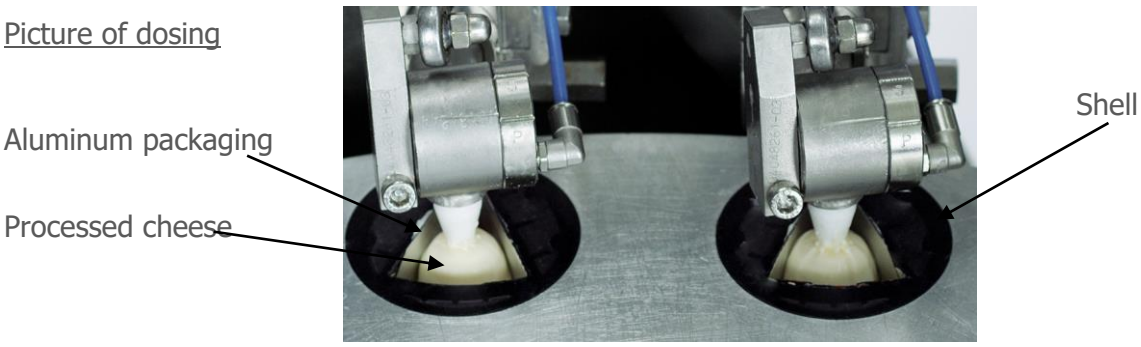
Processed cheese definition[2]:

"The term 'processed cheese' is reserved for the product obtained by melting and emulsifying, using heat (with a temperature of at least 70 °C for 30 seconds or any other equivalent combination), cheese or a mix of cheeses, potentially added to other dairy products. Processed cheese has a minimum dry matter content of 40 grams per 100 grams of finished product."

A 12-micron thick aluminum[3] foil is folded to form a mold within a cavity, the shell, which will receive the product while still hot at a temperature of 72 °C to avoid any recontamination. The packaging then gets closed and sealed.

The pre-shaped aluminum packaging will determine the geometry of the portion, as the product is still liquid at the time of dosing.

Picture of dosing



Packaging makes it possible to obtain products that can be preserved for a long time without any health risk, even without refrigeration, which has contributed to their development in regions where the refrigerator equipment is poor.

This technology, which uses a lightweight aluminum packaging, eliminates the need for molds and thus allows a two-in-one solution (molding and packaging the product at the same time).

Packaging is crucial to achieve both the product's shape and preservation.

[1] With the participation of Bel Group.
[2] Article 5 of the French Decree No. 2013-1010 of November 12, 2013 modifying the decree No. 2007-628 of April 27, 2007 on cheeses and cheese specialties.
[3] Example of a filling machine: https://www.youtube.com/watch?v=U1c5hQw40BA

2.1.2. Cooked ham is molded in its packaging[4]

Cooked ham accounts for the largest production of cold cuts in France today.
In 2019, around 185,000 tons of it were consumed at home[5]. This represents an average consumption of 3 kg/year/inhabitant in France.
Its production is very strictly regulated: only meat coming from the hind leg of the pig can be used in the preparation of cooked ham, in accordance with the code of practice.
Cooked ham is produced in France and is made essentially (85%) of superior quality cooked ham, meaning that it contains no gelling agent, no polyphosphate and no flavor enhancer, which is unique in Europe.

Except in the case of hams cooked with bones, the production steps of cooked ham are[6]:

- The rind (epidermis) is removed as well as the superficial layer of fat
- The ham gets boned
- The muscles are then selected, their fat gets removed, as well as their superficial aponeuroses
- Contact with a brine containing salting agents (including salt) and seasoning.
- Kneading in a churn for 20 hours in order to make these components penetrate homogeneously into the heart of the muscles.
- The cooking must be done under vacuum in order to obtain homogeneous slices with joined muscular masses even after slicing:

Muscles are placed in a plastic mold (blue plastic bag on the adjacent picture) **depending on their anatomical position** (after being wrapped, when applicable, in a cloth: cloth cooking and/or with a vegetable broth: broth cooking) in which, in order to keep muscles tight, vacuum is made with aspiration before the hermetic sealing of the plastic bag.
The vacuum-molded product is cooked for a long time (9 to 10 hours) at low temperature (around 65 °C) in order to preserve the taste and the softness of the product.

At the end of the cooking, 3 situations are possible:

1. The product intended for certain professional markets (B to B), is cooled in its mold and is shipped in its cooking packaging as it is.

The manufacturing mold (plastic bag) of the cooked ham is in this case a necessary packaging in the manufacturing process. Without this element, the cooked ham would not be what it is and would probably not have been as attractive to French consumers.

2. The product is unwrapped from its cooking bag and its exudation jelly is removed:
   - 2.1 Repackaged and sold whole (traditional network, supermarket sales stand, restaurants, etc.)
   - 2.2 Sliced, packaged and sold (self-service or fresh-packed departments in supermarkets).

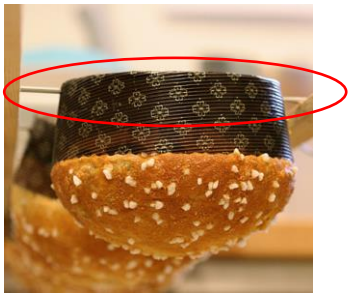
[4] Source: FICT, and for more details: https://www.lescharcuteries.fr/produits/jambons-cuits/ https://www.youtube.com/watch?v=8RlDzv8VBzg&feature=emb_logo
[5] Source: France AgriMer 2019.
[6] For more details: https://www.francetvinfo.fr/economie/les-secrets-de-la-preparation-du-jambon_1150679.html

2.1.3. Pastries are baked in their baking mold

Some pastries, because of mechanical strength and the intrinsic fragility of the product, need to be baked in a baking mold, which is generally made of paper. This baking mold will accompany the product during its whole life. This baking mold is a packaging which is designed to contain the product and to participate in the logistics of the product to the final consumer.

Some baking molds are an integral part of the bill of specifications (as in the case of Italian panettone) because:

- They provide a recognizable identity to the final product (even if the geographical protection of panettone is not yet finalized).
- They are decisive in the stages of baking-cooling of the products (panettone must be cooled upside down so that when the product comes out of the oven, it does not collapse. For this reason, the baking mold is pricked with steel rods – see below)



These molds, as long as they accompany the product and are sold with the product, are considered packaging within the meaning of Directive 94/62 and its annex1.

Nota bene:
Other pastry products are made in cardboard or aluminum molds which are the necessary packaging for the manufacturing of the product (dosing of the dough and baking/cooling in the mold)

Packaging hence plays a major role in the manufacturing of this type of product.

2.1.4. Liquefied gases in bottles

It is essential to liquefy certain gases in order to deliver them in gas bottles. This liquefaction and filling can only be done with gas bottles.

Indeed, liquefied gas is an unstable state, **the only way to preserve it without risk is to put it under pressure during the filling** in a cylinder which will have to be pressure and explosion proof.

Most gas bottles are pressurized between 160 and 200 bar, a pressure that can be calculated with the ideal gas law: PV=nRT
Where:

- P is the pressure (Pa);
- V is the volume of the gas (m^3);
- n is the amount of substance (mole);
- R is the universal gas constant (≈ 8.314 J K−1 mole−1);
- T is the absolute temperature (K)

There are AFNOR (French Standardization Association) standardization commissions on that topic:
Commission E29E (standards for gas bottles, their accessories, and any other type of transportable pressurized containers, apart from tanks, road tanks, cryogenic containers or aerosols).
All sectors and all types of gas except for the following gases:

- hydrogen (covered by the AFNOR/CN E29D commission),
- natural gas (covered by the BNG/326 commission),
- cryogenic gases (covered by the AFNOR/CN E29P commission).

2.2. Packaging, a support for the fermentation and the ripening of the product

2.2.1. Firm yoghurt

There are several technologies to make yoghurt:

- Stirred yoghurt: it is not made in pots but in vats. The curds obtained after fermentation are stirred, then cooled, before being packed in pots and stored in cold storage. This type of product can also be sold in bulk.
- Firm or steamed yoghurt can only be made in a pot, which will accompany the product from its manufacture to its consumption.

Considering the quantities of yoghurt consumed per year by the French population, this product-packaging pairing is made at the most convenient cost (optimization of industrial processes) allowing the accessibility of price for the consumer. This type of product cannot be sold in bulk, but it can be made in a yoghurt maker at home (but this is another topic: DIY).

Eight thousand yoghurt pots are produced in France[7] each year, which represents a bit less than one million pots per hour. Among them, around **2.5 billion pots** of firm steamed yoghurt[8] are produced each year; these yoghurts are called "firm" because they were fermented in the pot.

No matter the material used, firm yoghurts are made this way[9]:
The milk is successively pasteurized, homogenized, cooled to the ideal temperature of fermentation, previously dosed into the pot and inoculated with two ferments: the *Lactobacillus bulgaricus* and the *Streptococcus thermophilus*. The pot is then hermetically sealed with a cap.

The yoghurts are then put into boxes and undergo a passage in a tunnel oven at a temperature of approximately 43 °C for three to five hours, this operation is called "lactic fermentation": the ferments multiply by millions and digest part of the lactose, producing lactic acid and causing the precipitation of certain milk proteins, the caseins: the milk takes in mass, and we obtain firm yoghurt in the pot.

After fermentation, the yoghurts are quickly refrigerated and stored in a cold room: the temperature must be between 0° and 6° in order to block the activity of the lactic ferments. These phases of drying and cooling are done in complete pallets. The thermal exchanges between the ambient air (hot and then cold) and the pot are carried out through the transport box, which generally has holes.

To be able to call the finished product "yoghurt", in accordance with French regulations, the two strains of ferments must remain alive in the finished product, at a rate of at least 10 million bacteria per gram, until the expiration date.

The packaging system is important in the manufacturing of the product, as it ensures:

- The lactic fermentation in the primary packaging: the pot
- The thermal exchanges in order to control the temperature curves of the fermentation process (steaming then cooling): the box
- That the population of lactic ferments is kept alive

[7] French Packaging Council document: https://conseil-emballage.org/pourquoi-les-produits-sont-ils-emballes-ainsi-2/
[8] French Packaging Council estimate.
[9] Source: https://www.syndifrais.com/produits-yaourts-et-laits-fermentes-fabrication.html

2.2.2. Cheeses in ripening bags

For more than twenty years, ripening bags have been used to ripen industrial cheeses.

This technique allows to:

- limit water loss during the ripening process of the cheeses
- obtain a more homogeneous and creamy texture.
- limit the formation of a rind and therefore the loss of products by eliminating the rind-removing step,
- control more efficiently the microorganisms growing on the surface of cheeses.

The products resulting from this process are more stable, which makes it possible to avoid the addition of preservatives for their preservation afterwards. This principle is used to produce cheese slices, pre-packaged Emmental blocks or grated cheese.

Ripening bags use highly technical materials with a particular permeability, which is adjusted in such a way that humidity remains in the packaging, while allowing the gases necessary for the breathing of the cheese to pass in the right quantity, in order to make the lactic ferments work and to allow the right ripening of the cheese.

This type of industrial packaging is essential to the ripening process.

2.2.3. Wax-coated cheeses

Some cheeses are packaged with wax. This traditional process was invented several centuries ago in Holland to allow the export of cheese to distant countries. Covering the cheese with a layer of wax reduces the loss of water from the cheese, the formation of a rind, and slows down the ripening process. This allows for a longer shelf life and has allowed Holland to spread its cheeses around the world.

These less ripened products have been liked by consumers and have become a type of cheese in their own right, protected by designations of origin, the Edam[10]

This type of conditioning has been adopted by modern products in order to achieve the same effects: to produce pressed cheeses according to a traditional cheese-making process, but to avoid rind formation and to keep a young cheese product longer.

Nota bene:
Annex I of Directive 94/62/CE considers that these wax coatings are not packaging. This Packaging Directive is divided into texts devoted to eco-design, end of life, reduction at source and contribution to eco-organizations.

[10] https://en.wikipedia.org/wiki/Edam_cheese

2.2.4. Wines and spirits: Champagne

Fermentation[11] in a bottle is meant to make the wine sparkling and "foaming", hence the designation "prise de mousse" (foam taking, i.e. sparkling process).

The bottling – the drawing – cannot take place before the first January following the grape harvest.
To achieve this fermentation, we add to the wine a liqueur of "drawing", composed of sugar, levain and a stirring additive. Beet or cane sugar, previously dissolved in wine, is added at a rate of 20 to 24 g/l depending on the desired pressure, i.e. 5 to 6 kg/cm^2 at the end of fermentation. The levain is a culture of selected yeasts, previously acclimatized in the wine environment.

The wine will be sold in the same bottle in which it was made. The bottle of Champagne, which can only be made of glass, meets specific requirements because it must, among other things, resist a very high internal pressure and numerous manipulations in the cellar (stirring).

The corking of drawing

After filling, the bottles are hermetically sealed with a polyethylene stopper called a "bidule" and a crown cap, and then taken down to the cellars where they are laid out "on slats", i.e. lying on top of each other and stacked, row upon row. Many wine makers now store the bottles in wire pallet crates. A few still use corks as corking of drawing.

During the second fermentation, which lasts 6 to 8 weeks, the yeasts consume the sugar and release into the wine, in addition to alcohol and carbon dioxide, esters and higher alcohols that will also contribute to the sensory characteristics of the wine.

Extract from Article IX of Decree No. 2010-1441 of November 22, 2010 on the Protected Designation of Origin "Champagne":

"[…] 3º Provisions in regard to conditioning:
a) The wines are ***made and marketed in the bottle in which the sparkling process was conducted****, with the exception of wines sold in bottles with a volume of less than 37.5 centiliters or more than 300 centiliters. However, except for vintage wines, the decanting into half-bottles (37.5 centiliters) of wine after the sparkling process is authorized within the annual limit of 20% of the quantity produced in half-bottles during the previous calendar year.*
b) ***As of January 1, 2015, the wines are made and sold in bottles bought new. Other supplies of capping or intended for production are new supplies*** *[…]"*

The bottle of Champagne is an essential part of the fermentation process for several weeks, the yeasts are then extracted, and the final corking is done. This packaging will then go to the consumer: **it is capital in the elaboration of the wine of Champagne**; the glass bottle must meet characteristics of resistance to the operations in the cellar as well as to the internal pressure of the bottle which can go up to 6 bars.

In other words, no bottle, no Champagne.

[11] Source: https://www.champagne.fr/fr/vigne-vin/elaboration/tirage-en-bouteille-et-prise-de-mousse

2.3. The packaging's contribution to the organoleptic properties of the product

2.3.1. Mont d'Or cheese[12]

The Protected Designation of Origin specifications bill of some products includes the packaging. It is the case with Mont d'Or cheese.

Geographical area for the designation of Mont d'Or cheese:

The milk production, the manufacturing, the ripening, and the packaging in wooden boxes of the cheeses must be carried out at an altitude of at least 700 meters in the geographical area encompassing the communes of the department of Doubs listed by decree.

Extract of the designation's specifications:

"'Mont d'Or' is a cheese exclusively made with full-cream cow milk in its raw and renneted state. It is a soft, uncooked, slightly pressed cheese with a creamy consistency, shaped like a flat cylinder. The paste is white to ivory in color and slightly salty. The washed, slightly refurbished rind is yellow to light brown in color.
2.2 It contains a minimum of 45 grams of fat for 100 grams of cheese after complete desiccation. Its dampness in the cheese after fat skimming should not exceed 75%.

2.3 ***"Mont d'Or" cheese is encased in a spruce strap and inserted in a spruce wood box. Both strap and box are an integral part of production conditions of the 'Mont d'Or' or 'Vacherin du Haut-Doubs' protected designation of origin".*** *The cheese's weight, box included, varies from 480 grams to 3.2 kilograms."*

As we can see, both the strap and the box are part of the PDO, but the specifications do not explicitly mention "packaging".

The packaging of this product placed under PDO is a typical example of the importance of the latter in the manufacture of the product[13], not only for technical production reasons but also by conferring gustatory characteristics to the product thanks to the very nature of the material (spruce) used.

In addition, the packaging is a sign of identification, of recognition of the product among many other cheeses by the specifications of the "Mont d'Or" PDO.

[12] Specifications for the "Mont d'Or" or "Vacherin de Haut-Doubs" Designation of Origin approved by Decree No. 2012-754 of May 7, 2012, JORF of May 10, 2012-Official bulletin of the Ministry in charge of agriculture No. 20-2012.
[13] More details about manufacturing, ripening and conditioning: https://www.youtube.com/watch?v=yWG2yNQKUgA

2.3.2. Wines and spirits: Cognac[14]

The Cognac protected designation of origin is subject to specifications approved by decree which include the geographical areas of production, the process of grape harvesting, vinification, distillation, and aging.

About aging:

"The aging of brandies is the process that allows brandies to reach their maturity, i.e. the stage of evolution meeting their most harmonious organoleptic characteristics. It is carried out exclusively in oak containers, which are the only ones that allow the maturation of the products. To be delivered for direct human consumption, the brandies must be aged for at least two years. […]
Its duration is determined by the characteristics of the brandies to be aged, by the sought quality profile of the product, and also by the type and age of the oak containers used for aging. This includes the extraction of wood compounds as well as oxidation phenomena and numerous physical-chemical evolutions that are essential to obtain the sensory characteristics of aged brandies, including the color.

The fine grain oak (Tronçais) or coarse grain oak (Limousin), Quercus petraea (sessile or English oak) or Quercus robur (pedunculate), depending on the use, was chosen because of its ability to allow exchanges between the brandy, the external environment, and the wood over long periods of time.

During the aging process, the brandy will remain for several years (sometimes several decades) in oak wood, as soon as it leaves the still; then various physical and chemical phenomena will take place: evaporation of water and alcohol, concentration of different substances, extraction of compounds from the wood, oxidation, etc. These phenomena are guided by the initial characteristics of the brandy (alcoholic strength and acidity), by the type of container in which it is kept and by the physical characteristics of the cellar in which the container is placed (temperature, humidity and ventilation)."

A bit of history:

Historically, "*Cognac*[15] *was only shipped in barrels until around 1860, and it is only from this date that houses took the habit of delivering it to the consumer in original bottles, with their name and their label"* so, before, it used to be sold by the volume by local merchants, and the barrel was a packaging meaning that it was present at the distribution point.

The specific characteristics of these containers and vinification barrels contribute to the development of the product throughout the aging process in the cellar and give the Cognac its organoleptic properties.

[14] Specifications for the "Cognac" or "Eau-de-vie de Cognac" protected designation of origin approved by Decree No. 2015-10 of January 7, 2015 modified by an order of November 8, 2018, released in the JORF on November 14, 2018.
[15] Source: "Histoire du Cognac", by Robert Delamain.

2.4. The packaging's contribution to the finalization of the product by the consumer

2.4.1. Foam production for certain beers

The example of the Widget in the Bitter or Stout beer: foam production at the consumer's home

The consumer is responsible for the final presentation of the product as it should be with its foam: thanks to the packaging, the consumer is part of the final stage of the product's manufacture at the time of its consumption.

The United Kingdom as well as Ireland produce, in addition to lager beers, beers called Stout or Bitter. Unlike beers produced on the European continent, these beers have the particularity of containing less carbon dioxide than Lagers and they are saturated in nitrogen (about 40 ppm). These beers, which are commonly consumed in pubs, had a different aspect when they were packaged because when the packaging was opened, in this case the metal drink can, the fine, dear to our English friends, foam was not present.

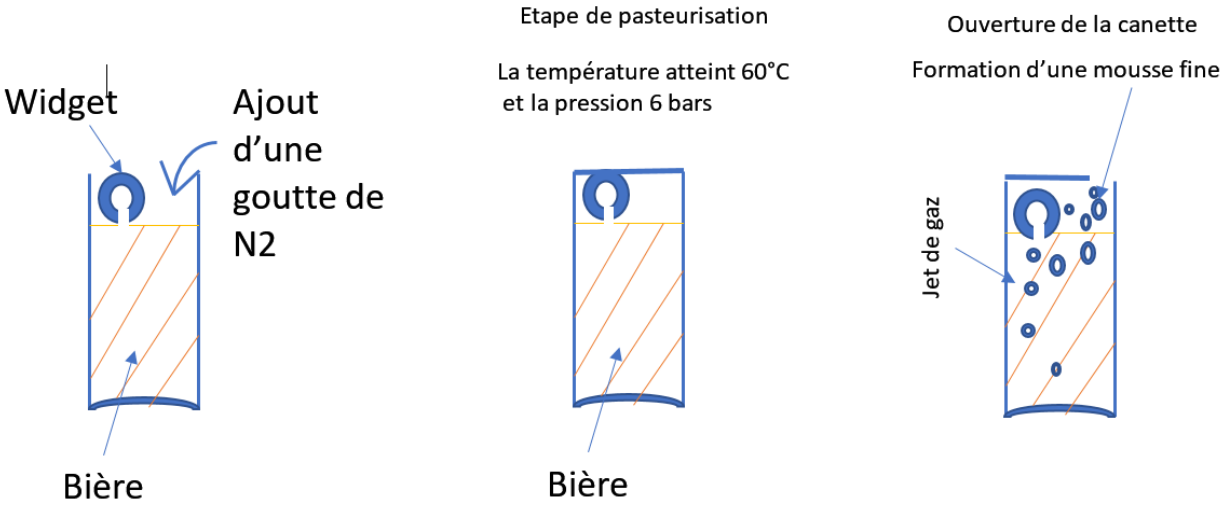
At the end of the '70s, the first widgets were developed, and their use was generalized to all these beers in the '90s. You have to imagine the widget as a small ping-pong ball bearing a small hole that always remains turned towards the liquid, i.e. the bottom of the can.

How the widget works

Once the beer is made, the cans are filled with the beverage at a temperature of about 2 °C. A drop of liquid nitrogen is then introduced, and the lid is placed and fastened on the can. The cans then go through the pasteurizer to reach a temperature of 60 °C and an internal pressure of 6 bars.
In this step, the widget, which is pierced by definition, is maintained at the same temperature and pressure as those in the can. When these beers are stored in a refrigerator, their pressure drops to 2.5 bars.

When the can is opened, the pressure spontaneously drops to the ambient value and a spurt of gas (nitrogen + CO2) is expelled from the widget for a few seconds, which leads to the generation of fine bubbles in the beer and the creation of a fine and smooth foam that the consumer can enjoy when pouring the beer into a glass. The beer then has the same appearance as the one that comes from a pub tap.

Explanatory diagram



2.4.2. Aerosol foam production

The example of shaving cream

The consumer, thanks to the packaging, is an actor of the product's finalization at the time of use.

History

The first shaving cream aerosol was put on the market in 1949. The product contained 80% water, and the other ingredients included soap fat and glycerol. Then, this form of packaging became very popular and has become the most used form for products that have evolved both in foam and in gel.

Figures[16]

Despite a change in hair fashion and the emergence of "hipsters", the annual production of shaving cream in aerosols in France is constant. In 2019, this production was estimated at 50 million units, a progression of 1% compared to 2018.

Technology

At the aerosol actuator *outlet, the foam is generated by a propellant gas emulsion within the liquid phase.*

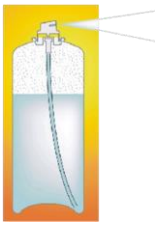
The foam is produced thanks to the **stabilization of the propellant gas's dispersion** in the aqueous phase by surfactants, whose role is to reduce the interfacial tension: solution / butane

Their expansion (or proliferation), as well as their sensory characteristics (dry or greasy touch) depend to a large extent on the **saturating vapor pressure** of the propellants (as low as possible) and their **rate** (generally from a few % to 20%, more for crackling foam).

Benefits are brought by the fact that the gas isn't forced through the liquid but is generated by the change of state within it.

The importance of packaging to achieve the product. It is only system allowing:

- such a foam stability
- such a precise control of the foam's smoothness, by playing on the concentration of propellant
- such different shapes, which can go from the dry crunchy foam to the smooth foam with a creamy texture.
- to associate the properties of the formula with particular physical properties:
    - Cold input
    - "Perfuming explosion" for crackling foam.



The technology of the aerosol generator makes it possible to contain this formulation in an aerosol can, whose interior surface is covered with a protective varnish, which guarantees the integrity of the mixture and on which a valve is dug. This valve fixated on the can makes the packaging airtight.

The effect of the propellant gas is to create an internal pressure.

After use, the aerosol generator can be discarded in the recycle bin to be collected and recycled forever.

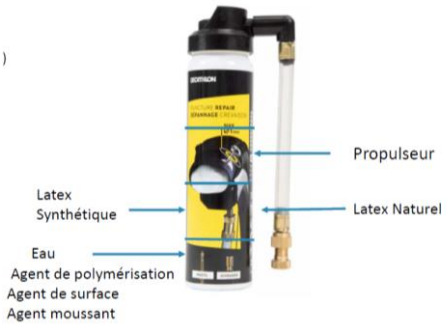
[16] Source: CFA.

2.4.3. Aerosol cans for tire inflation[17]

A tire inflation product used in case of flat tire is composed of the following materials:

- Water
- Latex (synthetic and/or natural)
- Polymerization agent
- Propeller
- Surface agent(s) (Foam inducing, …)

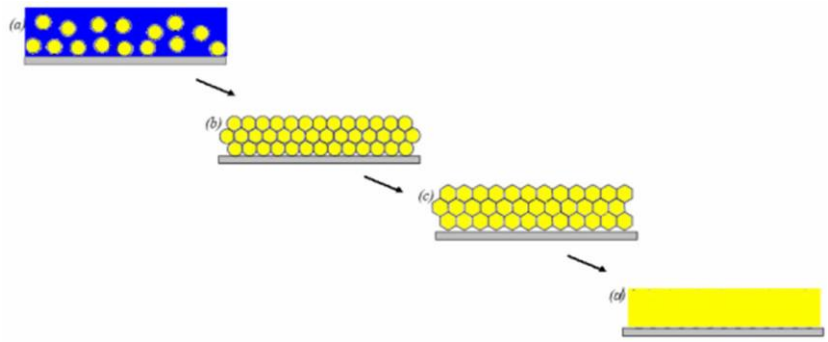
The tire re-inflator is composed of a suspension of spherical latex particles in water thanks to the presence of surfactants.



These particles are subjected to different forces: repellent forces because of the negative charges present in the environment (basic pH), gravitational forces, Brownian motion (thermal agitation), solvation … which keep them in suspension and avoid coalescence. Once the tire re-inflator is emptied into the wheel, the product spreads evenly while driving at low speed and the evaporation of the water allows the formation of a continuous film of latex.
During this step, the concentration of latex particles increases leading to a piling up of these latex particles.

Then, as the drying process continues, the particles come closer together and reach their maximum compactness and gradually deform until they form the continuous film. The kinetics of water evaporation must be slow enough to give the particles time to form a compact network.

Diagram of the filmification of a latex
(a) water evaporation, (b) maximum compactness, (c) deformation of the balls and (d) formation of a continuous polymer film.



[17] Source CFA and FAREVA.

3. Annex

3.1. Definition of packaging

Packaging[18] means any object, regardless of the nature of the materials of which it is made, intended to contain and protect goods, to enable their handling and transportation from the producer to the consumer or user, and to ensure their appearance. All "disposable" items used for the same purpose must be considered as packaging.

"Packaging[19] is only composed of:

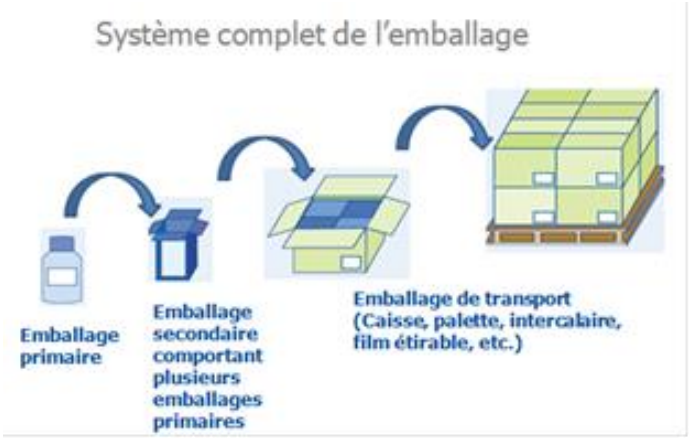
*1° **Sales packaging or primary packaging (I),** i.e. packaging designed in order to constitute, at the sales outlet, an item intended for the final user or consumer;*

*2° **Grouped packaging or secondary packaging (II),** i.e. packaging designed in order to constitute, at the sales outlet, a group of a certain number of items, whether it is sold to the final user or consumer, or it is only used to line the displays at the sales outlets. It can be separated from the goods it contains or protects without changing their characteristics;*

*3° **Transport packaging or tertiary packaging (III),** i.e. packaging designed to facilitate handling and transportation of a certain number of items or grouped packaging in order to avoid physical handling of those, and damage during transport. Transport packaging does not include road, rail, river, sea or air transport containers."*
For more information, the reader can refer to Directive 2013/2/EU.[20]

Editor's Note:
• Primary packaging can be composed of various elements. It protects the product and its characteristics throughout the chain until the product's consumption (for example: conditioning packet, box and film).
• The item is understood as a primary sales unit or a consumption unit.
• The group is understood as the aggregation of several primary sales units.

The packaging[21] system usually combines all three types of packaging, but the primary packaging may, in some cases, perform the functions of the other two types. The packaging system must be capable of meeting all the operating characteristics of these subsystems.



[18] French Environmental Code (Book V, title IV, chapter III, section 5, Article R543-43).
[19] Directive No. 94/62/CE on packaging and packaging waste.
[20] Directive 2003/2/UE from the Commission of February 7, 2013 modifying annex 1 of Directive 94/62/CE.
[21] Complete packaging system: it is composed of primary, secondary, and tertiary packaging.
French Packaging Council December 2010.

Packaging can also be differentiated according to the final holder when it comes to responsibilities regarding the management of their end of life. We then speak of:

Household and similar packaging (local circuit)

They correspond to all the packaging which, after unpacking and consumption of the product, are abandoned by households.

Non-household packaging

They concern all packaging that are not household: packaging linked to industrial activities (B to B packaging, grouping and transport packaging, packaging used in collective catering circuits or by traditional cafés, hotels, and restaurants).

3.2. Functions of packaging

- **Containing and preserving the content**

It is about protecting:

- the integrity of the contained product from external constraints (limit deterioration by mechanical shocks, reduce the transfer of taste and parasitic odors, preserve from alteration by air or oxygen, act as a barrier against any germs, insects, or unwanted products, prevent theft or consumption of the contents before the act of purchase, optimize the shelf life of perishable products, etc.)
- if need be, the external environment of the contained product.

- **Informing**

- provide general and legal information (expiry date, storage temperature, instructions for use, dosage/unit dosing, composition, presence of allergens, price, quantity, weight, etc.),
- provide information on production traceability conditions of the product (Ecolabel, Label Rouge, fair trade, protected designation of origin, etc.),
- distribute information related to the specific characteristics of the product in its market universe (brand, nutrition and/or health claims, recipes, cooking methods, product history, etc.).

- **Regrouping**

- group together several consumption units in order to match the consumption of products with the frequency of the act of purchase (pack of yoghurts, packs of beer bottles),
- gather products in manageable units (packets of several cookies) in order to take on the various modes of consumption (nomadism, etc.),
- ensure the promotion of the products (promotional batch),
- allow the consumer to grip and carry the product,
- facilitate shelving or any handling operation by the operators.

- **Transporting/Storing**

- ensure the delivery from the place of production to the place of sale without damage (protection against mechanical damage to the product/packaging pairing) by means of wooden pallets, corrugated cardboard tops, edge protectors, metal or plastic ties, stretch or shrink film, etc.,
- protect against any malicious damage,
- inform logistics centers of the contents of the transport boxes (logo, brand, contents, barcode, etc.),
- ensure the transportability of the products to the consumer's home,
- allow for storage possibilities at the consumer's home.

- **Facilitating the use**

The use of the product goes hand in hand with its packaging, both being often inseparable:

- easy or facilitated opening for various consumer groups (seniors, children, nomadic teenagers, athletes, etc.)
- reclosing mechanism for deferred consumption of the product,
- multi-portions for split consumption or nomadic use,
- ergonomics of the product's grip ensuring an optimal adequacy between weight, size, shape, and frequency of use,
- dosing to the right need to limit losses,
- return of the product: empty the contents of its packaging as much as possible,
- use the container-content pairing for any storage method (freezing) or preparation method (cooking in a traditional oven, microwave oven, bain-marie, etc.).

- **Facilitating the conditioning operation of the product**

- be in accordance with mechanization,
- guarantee the safety of the employees working on the manufacturing lines of packaging and conditioning of the products,
- resistance to unitary conditioning operations (shock, heat, flow, vibration, sealing, hygiene, sterilization…).

- **Make the product visible and convey the values of the product and/or those of the brand, of the company**

- encourage the act of purchase via the packaging, which constitutes a beacon within a shelf display (the consumer spends only a few seconds in a section), by a color reference, by the shape of the product, by the material used and the universe that we want to evoke, the graphics and the typography for an immediate recognition of the product,
- convey the assets and values of the brand and the company (corporate social responsibility),
- guarantee acceptability for the consumer, during the purchase and consumption phases of the product.[22]

[22] "Acceptability of the packaging, for the product, for the consumer, and for the user", French Packaging Council, October 2010.

Acknowledgements

Participants and contributors

3M FRANCE	ANDRIEUX Guillaume
3M FRANCE	DE VINZELLES Françoise
ANIA	MATHIEU FIGUEIREDO Léa
AVOCAT SCM MADELEX	MARTIN Sylvain
BEL GROUP	VERNIER Alexandre
CFA	BLOTTIERE Jean
CITEO	FOURNEL Valentin
CITEO	DE LOS LLANOS Carlos
COF	DESBOUIS Kareen
ELIPSO	MORVAN Christophe
FAMILLES DE FRANCE	CHAMBERT-LOIR Camille
FAR	ABOULFARAJ Mostafa
FEBEA	VICENTE Carlota
FLINT GROUP	LACOUTIERE Yves
FPC	PELTIER Fabrice
FS PACK	FRUCHARD Jérôme
KNAUF INDUSTRIES	LE BERRIGAUD Arnaud
POLYPACK	GUEDOUAR Séryne
POLYVIA	MADEC Marc
REVIPAC	MANGIN Noël
SIEL	DE LAGAUSIE Olivier
SLEEVER INTERNATIONAL	FRESNEL Albert
SLEEVER INTERNATIONAL	RAY LALANNE Lucie

French Packaging Council	Bruno SIRI
French Packaging Council	Michel FONTAINE
French Packaging Council	Maryse BRICOUT

Board of directors

Michel Fontaine, President
Kareen Desbouis, CLIFE, Vice-president
Noël Mangin, InterEmballage, Treasurer
Kaméra Vésic, PIK PIK Environment, Secretary

Evangeline Baeyens, ILEC
Jacques Bordat, InterEmballage
Charly Hée, Familles de France
Olivier de Lagausie, CLIFE
Adeline Vancauwelaert, Comexposium
Carlos de Los Llanos, CITEO
Fabrice Peltier, INDP
Antoine Robichon, CITEO
Arnaud Rolland, ILEC

Bruno Siri, General Delegate

The nine colleges of the French Packaging Council

Packaging materials manufacturers,
Packaging manufacturers,
Consumer goods manufacturers,
Distribution companies,
Authorized companies and operators in the recovery and re-use sector,
Consumer associations,
Environmental protection organizations,
Local authorities.
Other federations, other companies

All our publications are available online on our website:
www.conseil-emballage.org

For more information, please contact:
Bruno Siri, General Delegate
French Packaging Council
Via telephone: 01.53.64.80.30.
Via email: info@conseil-emballage.org