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ALUMINIUM FOIL IN FLEXIBLE PACKAGING.
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ALUMINIUM FOIL IN FLEXIBLE PACKAGING

by

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In this paper we will deal with the aluminium foil application in the flexible packaging.
The success encountered by the use of aluminium foil in this area is obviously due to its outstanding and not replaceable properties. In fact, the main characteristics of the aluminium for the packaging are the following:

Absence of toxicity.

In general, every material that comes into contact with a solution (in this case foodstuffs) releases greater or smaller quantities of particles that pass from the container to the contents. This also takes place with the containers and packaging of aluminium, in greater or smaller degree depending on the chemical characteristics (the Ph) of its environment. The human organism assimilates therefore, with food, particles of various materials that have passed from the container into the contents.
But aluminium and its salts are not toxic. They can be assimilated by the human organism in large quantities without causing damage or alteration to its vital functions.

Absence of smells and tastes.

The aluminium foil does not give to the foodstuffs any smell or taste that can affect it original ones.

Aspect.

No other material of those used for flexible packaging attracts the attention of consumers as much as aluminium foil with its characteristic shine.
The appearance of aluminium foil is so attractive that firstly it was used for applications, all based primarly on his aesthetical appearance.
For this reason the foil was considered a luxury packaging material.
Today the foil is no more considered a luxury item but it is employed for his functional properties.
In many laminates today, the alu foil is inside the structure and is no more visible.

Barrier to water, vapour and gases.

With modern techniques or rolling it is possible to obtain a foil that even with thickness smaller than one hundredth of a millimeter, as required by the more interesting application of packaging, has a very reduces WVTR i.e. speed of passage of water vapour.
This is due to the fact that both the number as well as the sizes of the discontinuity in the foil (microscopic holes) are very small.
Normally, the commonly accepted figure for a 9 my (9/1000 mm) foil is 200 pinholes per square meter.
The mechanism of moisture transmission for plain aluminium foil is by flow through these pinholes.
For plastic films, paper, the mechanism is by diffusion through the material.

The plastic films, in fact are made of large molecules that for their dimensions have interspaces, through which by osmosis or capillarity, moisture diffuses.

As a consequence the alu-foil also of low thickness, has better barrier properties than plastic films, like it is confirmed by the below reported date (from modern packaging) in which the WVTR of many films with the WVTR of a 9 my Alufoil we composed:

MATERIAL	THICKNESS my	W V T K g/100 sq.in. x 24 H
PELD	25	1.16
PEHD	25	0,3 ÷ 0,6
OPP	25	0,25
PP	25	0,5 ÷ 0,65
PVDC	25	0,1 ÷ 0,3
All 99,5	9	0,075

Alufoil and laminates in which it is a component' has the best barrier properties through the range of flexible packaging materials.
This property of aluminium foil is taken advantage of in the packaging of frozen foods to prevent fluctation of the humidity degree at which the product is kept and in case of dry products to prevent the external humidity from penetrating the packaging and damaging the contents.
Furthermore, for the same reason, the foil offers a perfect barrier to gases and assures a good protection preventing the contents from becoming rancid through oxidation.

<u>Resistance to oils, fats and greases.</u>

The aluminium is resistant to oils, fats and greases.
At high temperatures and even in prolonged contact with these substances the aluminium foil is not stained and is not subject to alteration.

Reflective power.

This property is very important for products that must be protected against the radiant heat. When frozen products are arranged in a shop-window they are exposed to the radiant heat from the ambient.
When the products are wrapped with alufoil, the reflective power is so high that the absorbtion of heat by the product is practically negligible.

Barrier against visible and ultra violet rays.

It is known that luminous radiation is harmful to many foodstuffs such as chocolate, sweets, butter, cheese, ham etc.
Ultra violet rays, in particular, can make them rancid, destroyed the vitamins, change their colour and their taste.
Alufoil in this case is particularly efficacious as it protects completely the contents and prolonges their period of preservation.

Thermic conductivity.

The aluminium foil has high termic conductivity. This is very useful in the packaging of foodstuffs which are frozen or backed.

All these above expressed characteristics make the aluminium foil one of the most important and not replaceable base materiai in the flexible packaging, mainly for long preservation of foodstuffs. No other base material has so outstanding characteristics.
The aluminium foil utilization in packaging is quite a wide argument and a detailed examination of the same would require a time larger than we are allowed.

It would be undoubtedly necessary to consider all the product that can be obtained from the aluminium foil. We will therefore limit ourselves to describe shortly and we hope clearly the most important applications of the aluminium foil.
We will start examing what is the so called aluminium foil, we also will make a short analysis of its production process.

The foil used for flexible packaging is made from metal containing a minimum of 99,5% aluminium, which is cold rolled in consecutive passes to a thickness of 4 my (4/1000 mm) to 50 my (50/1000 mm).
The raw materials are strips of aluminium, having a thickness from 6 to 7/10 mm, in coils which can weight depending on their widtn (1000 ÷ 800 mm) and gauge from 2000 to 6000 kgs;

The aluminium strip is hard and has to be firstly annealed for many hours (a. 8 hours) in special furnaces at a suitable temperature to make it malleable for the rolling process.
At this point, the rolling process starts. This working process is performed on different rolling mills reducing foil-stock thickness in consecutive passes till the finishing pass during which the foil gets the required thickness.

The rolling mills pressure varies according to the required thickness. In other words, the rolling process requires high pressure rolling mills for the first pass, but the consecutive passes will be performed on machinery with decreasing pressure.
Generally, the mills used have 4 cylinders: two wich come into contact with the metal and are of smaller diameter are called "work rolls" while the other two, of greater diameter are called "back up rolls".
The latter reduce to the minimum the flexion the rolling operation causes in the work rolls.

The rolling process is necessarely a cold working, which needs proper lubricants that have to be completely eliminated at the end of the working process.

We wish to recall that actual rolling mills have special electronic devices helping to keep gauge constant, by controlling automatically every change that may occur in the process.
Out of curiosity, we want to say that rolling mills can reach speeds up to 1800 mpm.

It could be of interest to note that in the case very low foil thicknesses are needed, for example 5 my (5/1000 mm), on the last rolling pass two webs and not one are simultaneously pressed on the rolling mill. To this purpose two coils are mounted at the entry of the finishing mill, for example of 10,5 my (10,5/1000 mm) to obtain at the end one coil of two foils, the one laid upon the other, of 5 my (5/1000 mm). In this case, gauge reduction of 40-50% can be normally got in every pass of the rolling process.
The two foils are rolled simultaneously in order to still give them a mechanical resistance and so achieve a high production speed.
This is the reason why thin aluminium foil have normally one side bright or glossy and the other one mat. In fact, in the last pass of the two foils, the one laid upon the other, the two sides in contact will result mat, and the external ones in contact with the rolling cylinders will be more glossy or less according to the required finishing.
However, it is possible to have both surfaces shiny when in the last pass it is rolled one foil only, provided that its gauge is not inferior to 10 to 12 my (10-12/1000 mm). Working speed is lower, and different type of lubricating oils are used, when this type of aluminium bright or glossy on the two sides is required.
This metal bright on the two sides is called "Grand Brillant".

It is clear that this special material has higher prices and will be employed for special uses, for example: laminates for metallo plastic yarns which are used for the preparation of particular and fine quality textiles as the "lamè".

Reverting to the coil containing the two combined aluminium webs, they must be separated by mean of the so called "Separating Machines" which simultaneously divide and rewind the webs on two different spindles.
It may happen that during the rolling operation this very thin foil breaks.
These machines are therefore equipped with ultrasonic welding equipment.
Once completed the separating operation of the foil, we will have two coils of the pre-set thickness. At this stage, the residual lubricants have to be completely eliminated by annealing.

The annealing will completely degrease the alufoil before the following converting operations and will also soften the aluminium hardened by the rolling process and therefore hard and brittle.
It could be interesting to note that during the rolling process which reduces its gauge, the aluminium foil, due to the natural property of the metal, increases its length in the winding direction, only, and never in the transverse direction.
For instance, a coil of aluminium stripe of 7/10 mm having a width 1000 mm and a weight of 2500 Kg measures approx. 1300 l.m. The same coil after the processing will always have a weight of 2500 Kg, but it is interesting to note that whilst its width is always 1000 mm the length will be approx. 180.000 l.m.

After the annealing process the foil is ready for use.
We will now consider its main utilizations.
Two are the main areas for the aluminium foil:

1. - Electronic and electric industry

2. - Converting industry in all its applications.

The first area of utilization is outside the interest of this relation.
Therefore, we will not consider it.
We will instead examine which are the aluminium utilizations in the second field we are considering here, i. e. the converting and namely the converting for flexible packaging purposes.
The aluminium foil after being rolled as above described, is usually furthermore worked on for packaging purposes.
This work can be classified as follows:

FIRST GROUP
The aluminium foil can be used plane in the state it is produced or undergo operations like:

- colouring
- printing
- embossing
- drilling
- slitting etc.

which do not modify the packaging characteristics of the metal itself i.e. the alufoil remains, with its properties, the "basic support".

Plain alufoil is used for instance for:

- domestic household
- chocolate wrapping
- salami wrapping
- florist use

The coloured foil for:

- packaging of confectionary products
- automatic crown-cap of beer, wine and champagne bottles
- packaging of pharmaceutical and sanitary products
- wine bottle caps
- yogurt or milk bottle caps
- metallo plastic yarns

SECOND GROUP

The aluminium foil undergoes a converting operation which improves its functional properties.
These converting operations are:

- coating operation
- laminating operation

COATING OPERATION

Coating is the application of a continuous layer of a lacquer on one side or two sides of the alufoil web.
The operation is carried out with the lacquering or multilacquering machines.
Their operation is very simple.
The web fed continuously by a reel stand goes through a coating station where the coating medium is deposited continuously on the web.
The web then arrives to drying tunnel where the coating is solidified (i.e. all traces of the solvent are espirated or the chemical curing of the coating takes place).
After cooling (on chilling rollers) the web goes inside a second coating station, if a two side coating is required, or goes directly to the rewinder to be rewound in reels.

A coating machine can be therefore devided in three main systems:

1) the coating application system
2) the coating solidification system
3) the web tensioning and transporting system

Many different techniques are used for the continuous deposition of the coating medium on the web (gravure, offset gravure, reverse roll, kiss roll, two rolls, three rolls, depping etc. etc.).
The selection of the system depends on the quantity of the coating medium to be applied and on its characteristics.

The metering of the deposit is made with two main techniques:

a) applying an excess amount of coating to the web and metering the surplus either with a blade, knife bar or roll

b) applying a total predetermined amount of coating to the web

The coating of foil is normally intended for:

a) improve the mechanical properties of the thin foil. For instance, a single 3.5 gsm lacquering on a 10 my foil, improves the tensile stress from 5 to 9 Kg/mm2.

b) apply to the foil a heat sealing lacquer

c) protect the alufoil against the corrosion of special substances

One side lacquered aluminium is employed for instance for packaging:

chocolate bars
bouillon cubes
pharmaceutical products
yogurt

multilacquered alufoil is used for instance for melt-cheese packaging.

This is a 12 to 14 my (12/1000 to 14/1000 mm) alufoil lacquered 3 times (two times on one side and one time on the other) and sometimes coloured or printed.

LAMINATION

Lamination is the process of combining (glueing) two or more materials together to form a multi-ply structure.
The reason of joining different substrates together is due to the exigences of summing up some features of each single component in order to obtain a multi-lacquered lamination having characteristics more adequate (than the one of each single base material) to the requirements needed for the packaging of the specific product to be protected.
In fact, it is not possible to find a single material which have from the optical (haze, gloss, transparence) mechanical (elongation, tensile strength, tear strength, impact resistance, coefficient of friction etc.) and technological (heat sealing properties, moisture vapour, gas barrier, light barrier etc.) point of view all the properties needed to get the high characteristics required by the elaborate packaging materials used today.
The purpose of the laminating process is therefore to build-up more qualified materials starting from components of an inferior quality.
The bounding agents used for joining together the various materials of a multi-ply structure can be of different nature:

- hot adhesives like wax and hot melts
- water based adhesives
- solvent based adhesives
- solventless adhesives
- extruded plastics

each of these different types of bounding agents require different process technologies that we will very rapidly examine.

a) WAX LAMINATION:

The production technology of wax lamination of foil to the support is also very simple.
One unbacked aluminium coil and one reel of the required

support material are mounted at the entry side of the machine.
One of the two supports is coated by wax (or micro wax) at melting temperature (a. 60 °C), the two foils are joined together and then cooled by a chilling drum of large diameter.
The wax cooling down gets hard again and bounds together the alufoil and the backing material. After cooling the two layered structure is wound in reels.
In practice there are no limits to the type of backing material that can be laminated to the aluminium with this method.
Normally a wax laminated product can be obtained by using foil of 7 my (7/1000) or more, and a support that can change from paper of 15 to 18 g/m2 up to board of 500/700 g/m2, or plastic films of various type, cellophane, etc.
The wax laminated material is normally soft and plastic.
The adhesive provides a barrier against moisture and gas transmission. The wax can be laid in various quantities from 5 g/m2 up to a max. of 30 to 40 g/m2 and more. The wax laminate is a flexible material where the paper strength and the adhesive water-tightness are added to the foil properties.
Obviously, the aluminium foil used in this structure could have been previously treated with colours, and lacquers, when better aesthetic and technical characteristics are required.
The most part of the wax laminated foil is used by confectionary industry for:

- chocolate wrapping
- bonbons wrapping

and in the packaging of:

- yogurt
- butter and margarine
- meat extracts.

We would say first to come to a conclusion of the information on wax and plastic laminates that this material is not suitable for packaging which must stand high climate temperatures. It appears that in this case the glueing material can melt, compromising the foil/support stability.

For overcoming this inconvenience, are used hot melt substances, instead of wax.
Hot melts are thermoplastic substances (a blend of wax, polymers (EVA) and other additives) which melts at higher temperature (150°-160°C) than the wax and are more viscous than wax when liquified.

b) WET LAMINATION

The wet lamination is one of the oldest and simplest methods of converting.
This process consists in coating a water based glue on one side of the aluminium web, continuously unwound by a reel.
After coating the aluminium web is bounded to a paper web (also this one coming from an unwinder).
The two webs are joined using two rolls, one in steel, the other rubber covered which press the two webs together.
Afterwards the laminated structure passes into a drying tunnel where the water contained in the adhesive is evaporated through the paper-web pores.
In fact, this technique can be used only when the substrate to be laminated to the foil is porous so that the water solvent can escape by vaporization through it.
At the exit of the oven, the laminate is chilled and rewound.
A typical wet structure is the paper-alufoil laminate which is used for the internal packaging of the cigarettes.
Furthermore wet laminated substrate (paper-alufoil, board-alufoil) are largely used to make pouches, bags, cans, labels. These laminates are also requested by paper converting industries for die-cutting sweet boxes and trays.
The foil wet laminates are also used, for example, for covering prefabricated panels for building industry, for boxes etc, for good quality wrapping papers, gift papers, or christmas papers, decorations and hanging in general.
It is clear that also in this case the foil to be laminated to the support can be coloured, lacquered as previously explained.

c) DRY LAMINATION

The dry lamination is commonly used when a non-porous web has to be bonded to the alufoil.
To bond these non-porous webs to the alufoil solvent-based adhesives are used.
The adhesive is normally applied to the alufoil then all solvent is removed by running the web through a drying tunnel.
At the exhit from the tunnel, the coated alufoil is brought into contact with the second web, in a heated nip.
After the bonding the laminate is chilled and rewound.
The selection of the adhesive to be used depends on the end use requirement of the structure.
The normal system for adhesive application in dry lamination is the rotogravure system.
"Dry bonding" is particularly expensive in differentiating the process from "web bonding" wherein the two webs are combined while the adhesive is still wet.

d) SOLVENTLESS ADHESIVES

There are sound arguments to believe that solventless adhesives will be the future in the field of film coating.
"Solventless adhesives" are a range of special products, up to now a limited one, which replaces solvent adhesives for dry lamination. The laminates obtained with these solvent adhesives have same features of transparency and adhesion of laminates obtained with traditional solvent adhesives. The study of these new adhesives has practically begun in 1973 and they appeared on the market one yea later.

The first appeared type was a single, hot coatable, single component. The viscosity at 100 °C (operative temperature) was approximately 1000 cps. At room temperature, viscosity increased of several tens thousands of cps. Coating difficulties appeared immediately great, particularly because of high viscosity, in connection with the very low quantity needed (0,6 ÷ 0,8 Gsm), and this required the set-up of particular transferring systems, composed with several rolls.

Hot-coating created quite a lot of problems, especially for films very sensitive to heat; furthermore,toxic vapours (volatile parts of T I) developping at that temperature, required the use of exhausting hoods on coating stations; nevertheless toxicity problem for operators of coating adjustments and tanks feeding has not been completely eliminated.

The use of single components, pre-net adhesives did not always grant identical adhesion results and adhesive polimerizing times changed following the max. or min. materials impermeableness.

After a "boom" lasted all 1976 long, these adhesives gradually lost their interest, while everybody understand that only the set-up of cold adhesives, with a viscosity very near or very similar to that one of traditional solvent adhesives could solve this pro - blem.

In 1977 first cold adhesives appeared (some single components, the others, double components), at the beginning with a rather high viscosity (1500 cps) at 20 °C, then gradually, always more liquid.
The last types appeared on the market have a viscosity of 300-400 cps and are perfectly coatable with traditional system as well with rotogravure system (1,5÷2 Gsm). The most important thing however, it is that they remain absolutely steady at room temperature, with no emission of toxic vapours.
In comparison with the traditional solvent adhesives,these adhesives offer a wide range of advantages such as:

1) coating machines are more compact, simples and less expensive.

2) It is not necessary to evaporate solvents, therefore there is no need of heating ovens with relevant tubes for feeding and exhaust: it is not necessary to consume energy for air heating.

3) Air is not polluted so there is no need of plants for solvents burn or recovery.

4) Films are not technically stressed, therefore there are no "curling" problems.

5) As there are no solvents, there is an absolute certainty that into the laminated product, after polimerization, there will not be toxic volatile components for package product.

6) As no heat is used, cooling system before rewinding is useless.

7) The absence of solvents eliminates all danger of explosion or fire.

e) EXTRUSION COATING - EXTRUSION LAMINATING

This coating method is used for applying a melted film of low density polyethylene (or other thermoplastic resin) directly on the alufoil web.
The film solidifies on the web, coating it.
The pellets of resin are fed through a hopper in a heated barrel in which a screw rotates.
The pellets under the heat and pression melt and are forced by the screw through a narrow slot orefice of an extrusion die located at the exhit of the barrel.
The emerging hot film has the form of curtain of molten plastic.
The die is placed at right angle to the flow of alufoil being coated.
Upon leaving the die the film is drown down into a nip, between two rolls (a water cooled chill drum and a heat-resistant rubber covered pressure roll) below the die.
Here while coming into contact with the faster moving alufoil, the hot film is drawn out to the desired gauge and forced on to the alufoil, when both layers are pressed together by the two rolls.
The combination of alufoil and polyethylene film is then rapidly cooled by chill roll and the plastic film then becomes a solidified coating on the substrate.
A highly pulished chilling drum will produce a shiny appearance while a mat (raugh) finished drum will create coatings that have a dull appearance.

This alufoil coating technique is employed by producing for instance:

- pharmaceutical packaging
- electric and telephone cable wrapping

The same machine as described above (completed with other components) can be used for the manufacture of extrusion coating laminates.

The melted resin can be used like an adheisve for bonding together to substrates.
The extruder polymer replaces advantageously the traditional water-base or solvent-base adhesives. Furthermore it transmits waterproofness to the laminated products.
The extrusion coating technique is used when large quantities of laminate have to be produced, since the extrusion coating equipment has long starting times and therefore must produce continuously without any stopping to be economical.
For short runs wet or dry bounding are more convenient.

We have very shortly illustrated the basic operations employed in flexible packaging converting.
With the above described base converting operations, it is possible to produce a wide range of flexible packaging structures, someone of which of very sophisticated characteristics and may require the use of a combina - tion of the above converting techniques for the same product.
Among the sophisticated structures, we will indicate hereunder some of the most interesting ones.
A very usual packing that could exemplify the sophisticated converting is a special biscuits wrapping. This is a structure which is heat-sealable by percolation.
From the most external components this material is composed as follows:
aluminium 7-9 my (7-9/1000 mm) glue laminated to paper 20-30 g/m2.
The first structure is rotogravure printed in various colours and sometimes varnished for granting colours gloss and inalterability.
The so obtained structure is wax laminated (wax 30 to 35 g/m2) to a thin and highly porous paper (19 g/m2) called "tissue paper".

The main characteristic of this structure is that the sealing of the same is made by means of the internal wax which percolate through the tissue paper, when is heated in the wrapping machines.
The above structure is then cut in reels of the requested dimensions and delivered to the end users.
Another high characteristic structure is the one used for sterizable pouches.
It is made by polyester 12,5 my (12,5/1000 mm), alufoil 9 to 12 my (9 to 12/1000 mm) and polyolephine (PP or HDPE) 70 to 80 my.

For bounding of these three layers are used solvent adhesives, that are resistant to the high temperatures required by sterilization.
The polyester (pre-printed on the same side on which the solvent will be applied so to protect the printing from the sterilization effects and from the handling of containers) is employed for its high mechanical resistance, the alufoil for its high protective characteristics and the polyolephine for the sealing requirements.
This structure is used for making pouches in which the cooked food is filled and sealed.
These pouches then undergo a sterilization at a temperature of 120-130 °C for a period far shorter than the one needed by the canned food, due to the flat shape of the flexible containers if compared with the metallic cans.

The advantage of the employ of these flexible cans is that each part of the content not only is closer to the heat source but also the different in the distance are kept to a minimum, so it is possible to obtain an uniform quality in the final product.
Furthermore, the shorter period needed for the sterilization allows to keep the original taste and smell of the processed food.
The retourt pouches have also advantages if compared with frozen foods since they do not need all the organization required by frozen foods distribution.

In those countries where frozen foods processing, worehousing transportation and marketing are not yet developed the employ of the soft cans could be of great advantage.

The food packaged in the retourt pouches can be preserved with any particular care for very long period of time (years).
The pouches can be also used for heating the foodstuff before its utilization.

Few words on long preservation milk packaging, another sophysticated packaging.
For long time, many tests have been carried out to preserve the pasturized milk.
Perfect opaque containers were tried with no success.
They were made of cardboard with layers of polyethylene, special waxes and lacquers.
Dark polyethylene was also used to prevent light from entring.
The problem could be solved only where foil was introduced in the structure.
Today, a container for long preservation for milk is made with the following structure:

PE 10 g/m2 / Printed board (500 g/m2) / PE 10 g/m2 / alufoil 15 my / PE 30 g/m2.

Also for the preservation of coffee, good results have been reached with employing the positive characteristic of alufoil.
At first, a combination of paper with aluminium was used.

An improvement was obtained when, later, these bags were made heat-sealable.
Today, we can buy good coffee, as flavoured as it was just roasted, packed in structure of cellophane XXS 28 g / alufoil 9 my / PE 65 my or polyester 12 my / alufoil 12 my / PE 100 my

which permits a complete insulation of the coffee and grants a complete protection, giving also the possibility of creating vacuum condition inside the packing.

As you will note from the above information, the alufoil has a really wide range of utilization in the packaging field and many are the industries that are interested (if not obliged) to employ this material for the preservation of their products.

Hereunder, it is a list of these industries with indication of the relevant type of alufoil packaging utilized:

PLAIN FOIL

- Household
- Florist

FOIL COLOURED, PRINTED AND / OR EMBOSSED, HEAT SEALING LACQUERED

- Confectionary industries (chocolates, chocolate bars, eastern eggs, christmas paper, etc.)
- Food and drink industries (cheese, processed cheese, jams, yogurt, margarine, wine, spirits, water etc.)
- Pharmaceutical and sanitary industries

WAX LAMINATED FOIL PLAIN OR COLOURED, PRINTED

- Confectionary industries (bonbons, chocolate, chocolate or nugat bars, biscuits etc).
- Food industries (butter, margarine, soup cubes etc.)
- Tobacco and cigarette industries
- Ice-cream industries

FOIL WAX LAMINATED TO PAPER AND POLYETHYLENE - PLAIN OR COLOURED - PRINTED

- Confectionary industries (chocolate, sweets, backery products etc.)
- Food industries (soup cubes, meat extract, soluble powders etc).
- Sanitary industries (soaps, powders etc).

FOIL WET LAMINATED TO PAPER PLAIN OR COLOURED, PRINTED

- Confectionary industries
- Food industries
- Sanitary industries (soaps, powders, detergents etc).
- Tobacco and cigarette industries
- Cartotechnic industries (labels, boxes, embossed boxes, bags, etc).

FOIL DRY LAMINATED TO PLASTIC FILMS IN DUPLEX OR MULTIPLE-PLAY STRUCTURES PLAIN OR COLOURED-PRINTED

For all the special preservation requirements of the:

- Confectionary industries
- Food industries
- Pharmaceutical industries

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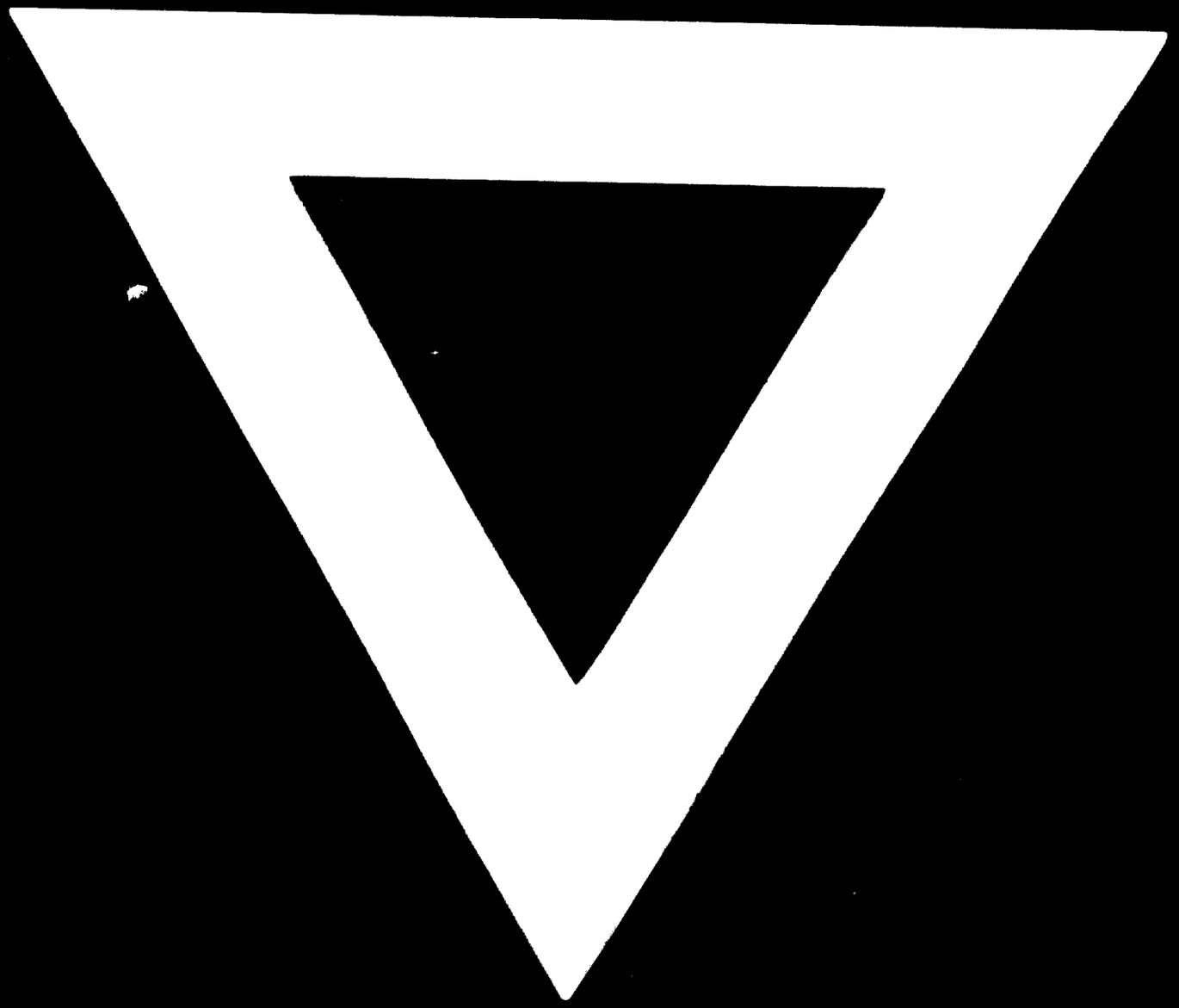

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