



FOILS, LAMINATES RETORT POUCHES - CHARACTERISTICS AND IMPORTANCE IN FOOD INDUSTRY

Soma Maji
Department of Dairy
Technology



Aluminum Foil

Aluminum foil is sheet metal of a very thin gauge. It is produced by the cold reduction process through which pure aluminum is pressed to reduce its thickness to less than 0.152 mm and to give folding properties. Aluminum foil is used in the form of cups and trays, laminated foil pouches as alternatives to cans or jars, collapsible aluminum tubes for pastes, and aluminum barrels.

The **advantages** of foil as a packaging material

1. Good appearance
2. Excellent dead-folding properties
3. Ability to reflect radiant energy
4. Excellent barrier to moisture, gases, and odors
5. Nonabsorbent and nontoxic



Various use of aluminium foil depending upon the thickness:

Use	Thickness
Confectionary wrapping	0.009 - 0.012 mm
Cheese wrapping	0.012 - 0.015 mm
Strip packaging, milk bottle caps	0.018 - 0.038 mm
Semi - rigid containers	0.03 - 0.15 mm
Fat Products	0.009 mm
Household Foil	0.0018 mm
Plated food stuff & pie dish containers	0.03 - 0.12 mm

The **disadvantages** of aluminum foil are:

1. Low strength due to its thin gauges
2. Readily attacked by high-acid products
3. Not heat-sealable

Laminated Films

Laminates are the combination of two or more layers of packaging films. They are used when required properties are not achieved in single packaging material.

Laminates are used for:

1. Good water vapour barrier properties
2. Good gas barrier properties
3. Good grease resistance
4. Heat sealing facility
5. To provide strength to the base film
6. To improve toughness
7. To improve tear resistance
8. To improve abrasion resistance
9. To improve machinability
10. To improve printability

- Lamination of two or more films improves the appearance, barrier properties, or mechanical strength of a package. Materials that can be laminated to each other include
- Plastic to plastic,
- Paper to plastic,
- Paper to aluminum foil, and
- Paper to aluminum foil and then to plastic.



Several methods can be used to laminate materials

(A) Adhesive Lamination:

The webs are bonded by means of a suitable adhesive which may be (i) Aqueous, (ii) Lacquer or (iii) Hot melt. The adhesive is applied to the web which is subsequently brought in to contact with another by passing through two rollers.

- *Aqueous adhesives:* Dextrin, Starch, Casein, Sodium silicate
- *Lacquers:* Polymethanes, urea formaldehyde, nylons, vinyls.
- *Hot melts:* Wax and wax blends.

(B) Extrusion Lamination:

A thermoplastic web is directly extruded on to a suitable substrate web. Extrusion coating could also be achieved. It is a cheap process. A thermal extrusion or co-extrusion can be used.

(C) Direct Heat Lamination:

A thermoplastic web maybe bonded to a second one by heat and pressure without the use of an adhesive.

Characteristics of Laminated films

- Laminated materials are used when high gas and moisture characteristics are required for a long shelf life.
- Laminated structures usually consist of an outer protective tougher layer, e.g., nylon or polypropylene, a middle high gas barrier layer, e.g., EVOH or PVDC, and an inner heat sealant layer.
- LDPE is commonly used as a heat-sealant layer because of its low melting temperature; however, it sometimes does not give a good seal with starchy or greasy food products.
- The choice of sealant layer for these food products is either EVA or Surlyn.

Laminated packaging material

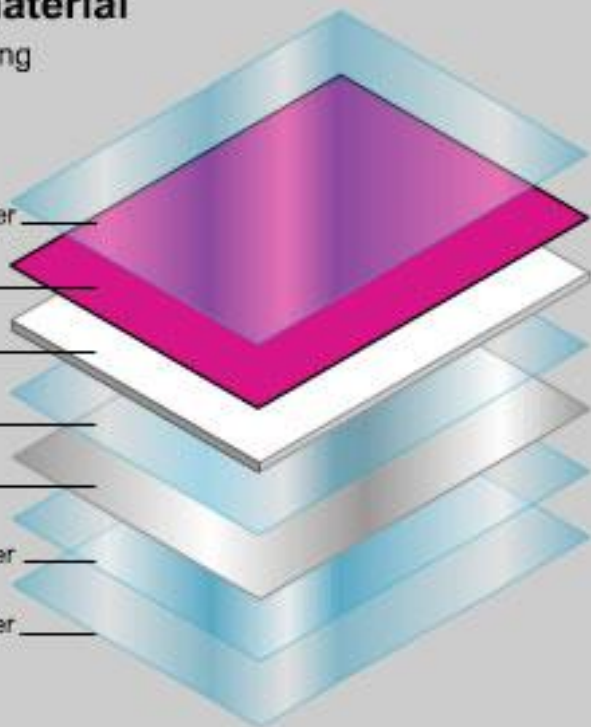
- A laminated packaging material suitable for use in flexible containers for potato chips, corn chips, and have an excellent moisture resistance and sealing properties.
- It can comprise:
 1. As an outer surface: a transparent sheet of nylon, polyester, cellophane, or polypropylene,
 2. A coextruded laminate: A pigmented polyethylene and ethylene acrylic acid copolymer,
 3. A metallic foil: Preferably aluminum
 4. An inner surface: A heat-sealable polyolefin.



Laminated material

Tetra Brik Packaging

- Polyethylene outer layer _____
- Ink _____
- Board _____
- Polyethylene layer _____
- Aluminium layer _____
- Polyethylene inner layer _____
- Polyethylene inner layer _____



Compatibility of various packaging materials to work as a layer in laminates

	LDPE	HDPE	PP	EVA	Nylon	PVDC	Ionomer
LDPE	Good	Good	Fair	Good	Poor	Poor	Good
HDPE	Good	Good	Fair	Good	Poor	Poor	Good
PP	Fair	Fair	Good	Good	Poor	Poor	Fair
EVA	Good	Good	Good	Good	Poor	Good	--
Nylon	Poor	Poor	Poor	Poor	Good	Poor	Good
PVDC	Poor	Poor	Poor	Good	Poor	Good	Poor
Ionomer	Good	Good	Fair	--	Good	Poor	Good

Composite Containers

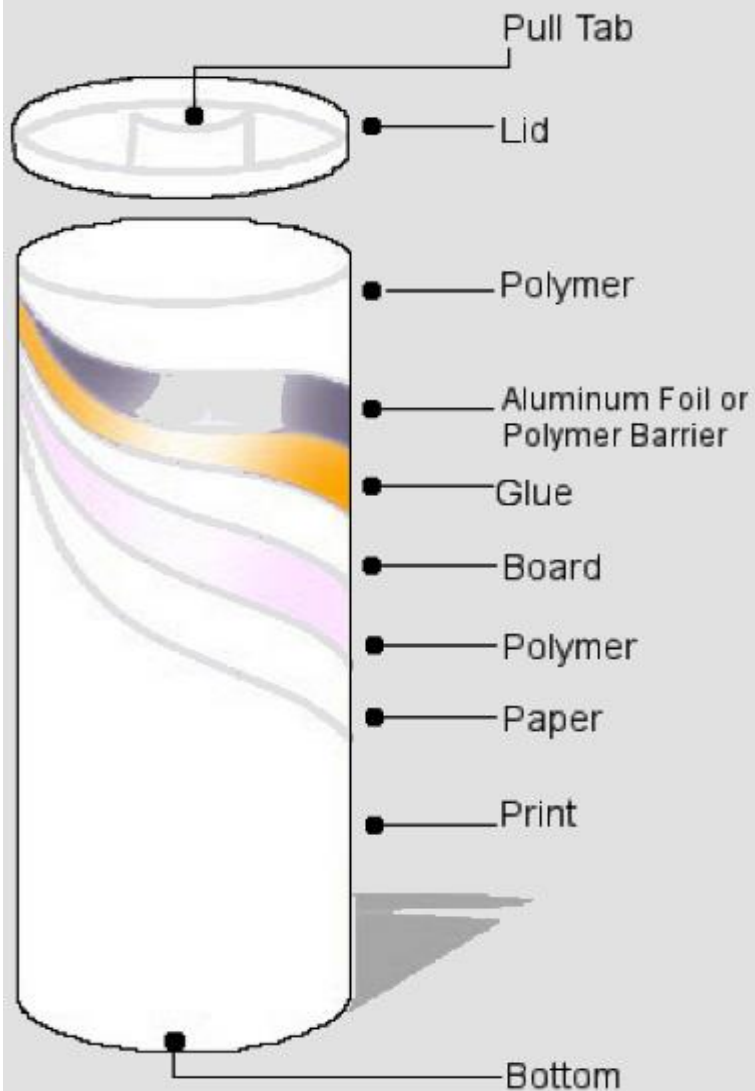
- Recently due to **development of laminates with metalized films which are having similar properties of a metal container with less cost**, the use of metal containers is decreasing.
- Therefore, **cans made from a combination of paperboard, foil, and plastic** are now used in place of metal cans.
- **Kraft paper** is the main component in the can body. **The inside of the can is plastic** (low-density polyethylene, polypropylene, or ionomer) often **backed by foil** for added barrier properties. **End closures can be made of metal, plastic, paper, or a combination of these materials.**
- Composite cans are manufactured by a spin convolute wound method, with spiral cans dominating the market due to their superior barrier characteristics.
- Composite cans are widely used to package shortening, powdered and dehydrated baby foods, aseptically packaged single-strength fruit juices, and frozen dough.



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Composite Can Construction Details



Double Seaming of Aluminium Full Panel Easy Open Aluminium End
 双重弯曲封口易拉盖

Central Container Body
 Multi Layer Structure
 High Strength
 积层罐体之结构

Sealed Inside Liner
 内衬层
 AL with PE film are good nature of interception
 遮断性良好之铝或PE膜

Metal End
 罐底

Label 标签
 Impervious to moisture
 High impact resistance
 Easily printable
 防水耐冲击之材料印刷性能良好

Barrier Properties of Packaging Materials

Many materials can be selected for packaging food products. When choosing the appropriate packaging material, the following factors should be considered:

1. Gas barrier properties
2. Moisture barrier properties
3. Antifog properties
4. Machinability
5. Mechanical strength
6. Sealability
7. Performance vs. cost

- One of the most important characteristics is the barrier properties to both oxygen and moisture vapor, which varies greatly from material to material. Because tin plate and glass are excellent gas barriers
- High-barrier materials usually provide high barriers to both moisture and oxygen, e.g., glass, tin plate, and aluminum foil.
- However, the barrier properties to oxygen and moisture may be different and may also vary as a function of the relative humidity and temperature of the storage conditions.

E.g. EVOH, a hygroscopic film that is an excellent oxygen barrier at low relative humidity. At higher relative humidity, it absorbs moisture that has a plasticizing effect and reduces the barrier characteristics to oxygen.

- Some films have mixed barrier properties, i.e., low oxygen barrier characteristics and high-moisture vapor barriers. E.g. LDPE, which explains why this film is selected for packaging fresh meat and produce and for frozen stored products to prevent freezer burn.

Barrier properties of packaging materials

- **Glass**

This was the preferred material for food packaging due to its inertness and non-toxic nature. Moreover, it has very high barrier properties to water vapour, gases and odours and hence acts as an excellent material for preserving the aroma of its contents and also protecting the food from external influences. A clear glass bottle is transparent to visible light. This is why light sensitive food should be packaged in coloured glass.

- **Plastic**

Barrier properties of plastic can be improved by biaxial orientation processes. It also results increased toughness, increased stiffness, enhanced clarity, improved oil and grease resistance, and enhanced barrier properties to water vapour and oxygen. This process is performed for many polymers, such as: biaxially oriented polypropylene (PP-BO), biaxially oriented polyethylene terephthalate (PET-BO), and biaxially oriented polyamide (PA-BO).

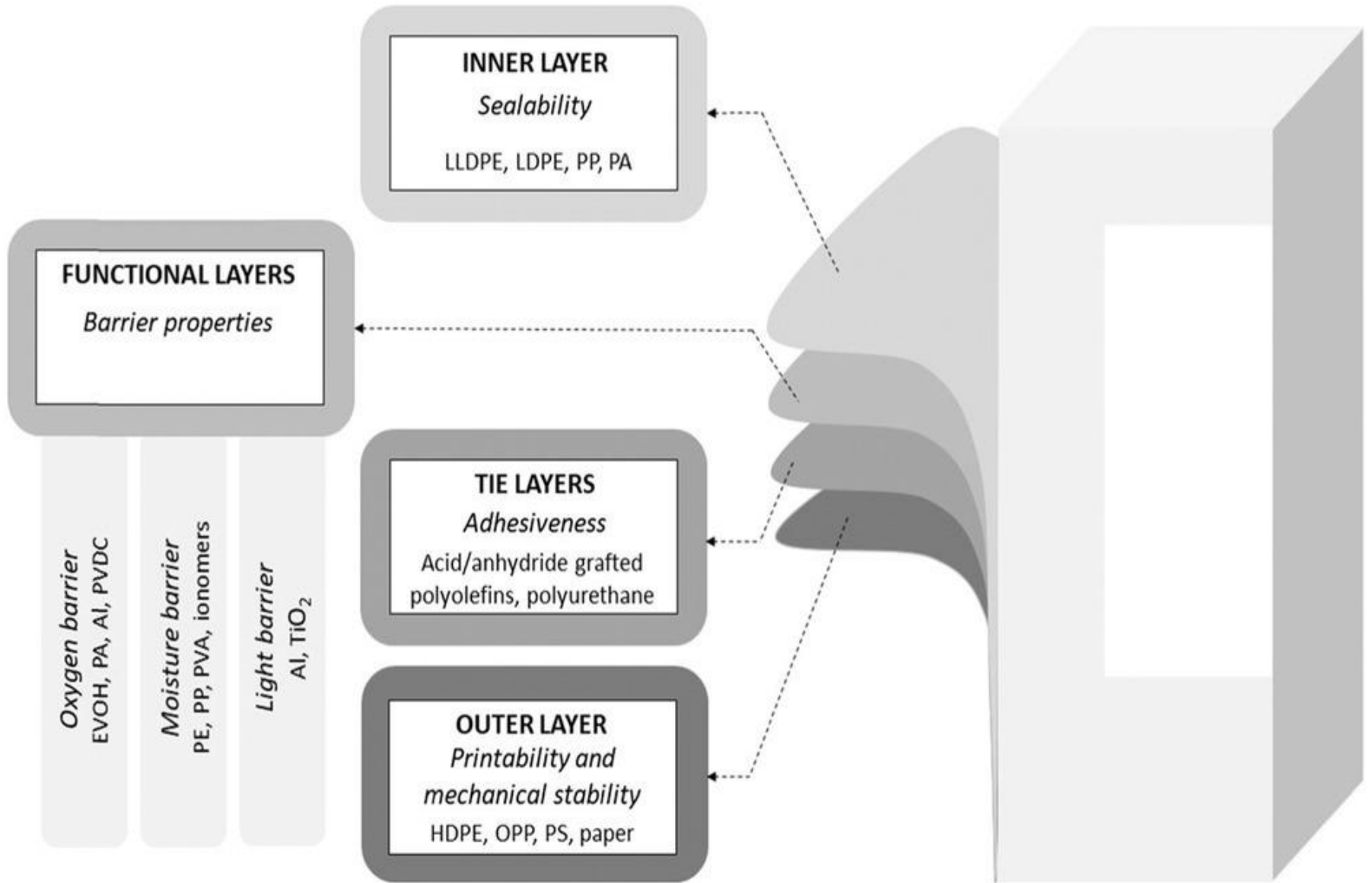
As it is difficult to obtain all the desirable barrier properties from a single polymeric film, multi-layered, laminated, coextruded, coated, and metallised films are manufactured to meet the varied barrier requirements of food packaging.

- **Laminates**

Laminates are multi-layers of foil, paper and/or plastics that may be utilised selectively according to the specific food packaging need. In combination, the various laminates provide more strength and barrier protection than the individual material (monofilm). Laminates of paper/foil/polyethylene composition rely on plastic layers for heat sealing (forming leak-tight containers). Aluminium foil provides a barrier to moisture, gases and light, whereas paper provides stiffness, strength and shape. This pack format is used in the fruit juice and milk sectors.

- **Metals**

Metals such as tinfoil (tin coated steel) and aluminium are used in can and tray manufacture. Metal packaging offers the longest shelf life and superior safety for foods and beverages by preventing microbes, light and oxygen from damaging the product inside the container.



Multilayer films used for dairy products packaging

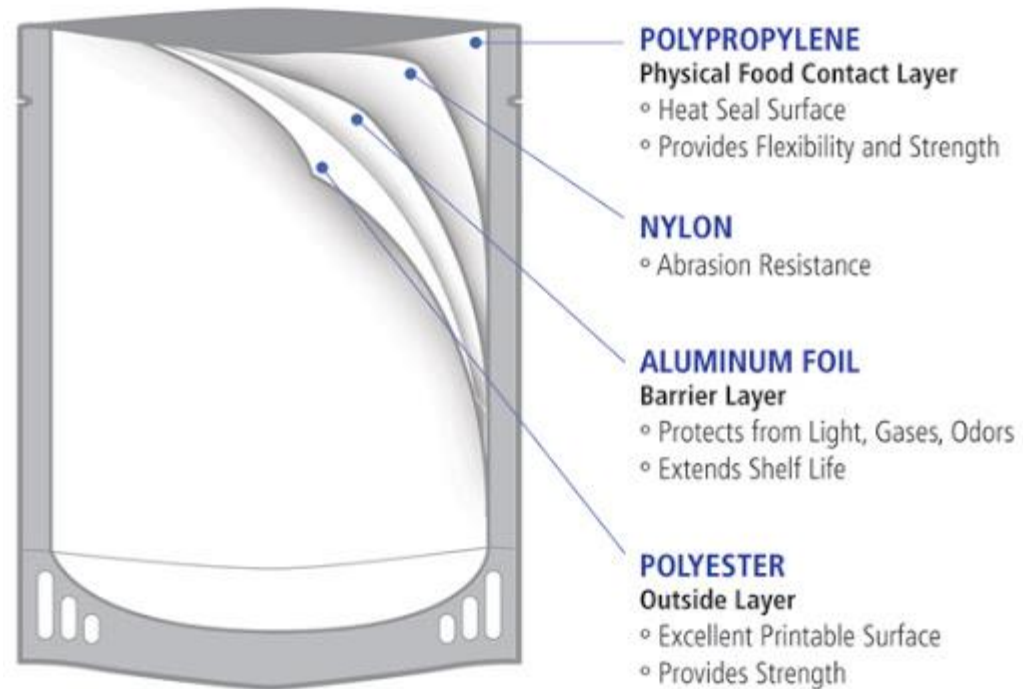
No	Product	Structure	Characteristics
1	Milk	LDPE/LDPE LD/LLDPE	Sealability, moisture barrier, 2 colour (light barrier)
		Paper or paperboard/ EVA/LDPE/EVA/Al-foil/ LDPE	Aseptic packaging, moisture barrier, sealability, release
2	Cheese	PP/EVA/LDPE	Moisture barrier sealability, release
		PA/Tie/LDPE/Ionomer	Gas and moisture barrier, sealable.
3	Baby Food	PP/Tie/LDPE or Ionomer	Moisture barrier sealability
		PP/Tie/EVOH/Tie/PP PET/Met PET/PE	Gas and moisture barrier, sealability
4	Yoghurt	HIPS/HIPS, PP	Thermoformable
		HIPS/GPPS	2 colour, gloss, strength, Rigidity
5	Cream	PP/PP	Thermoformable, moisture barrier, strength, Rigidity
6	Butter	PA/TIE/LLDPE	Good gas, moisture barrier, sealability
		PS/TIE/EVOH/TIE/LDPE	Thermoformable, good gas and moisture and odour barrier.



Characteristics of Retort Pouches



- Retort is a cooking process that uses heat and pressure to cook food in its sealed package. Retort Pouches conditions are quite demanding with temperatures typically ranging from 120°C to 130°C.



Characteristics

- Retort pouches have thinner dimensions, it takes less time to cook food in a flexible retort pouch than in other forms of rigid packaging such as cans and jars. This reduced retort time results in foods that have superior taste in retort pouches.
- Retort Pouch packaging has superior barrier and printing qualities and can be supplied as stand-up, flat or in roll form.
- Retort pouches are suitable to pack a variety of food products.
- The laminated material has a high puncture resistance.
- It offers a variety of styles of retort packaging such as foil based or completely transparent.
- Flexible retort pouches offer a variety of additional benefits over rigid packaging to both retailers and consumers that include:
 1. Superior taste due to reduced retort time
 2. Extended shelf life in **retort pouches**
 3. Reduced storage space, both in warehouse and pantries
 4. Reduced transportation costs
 5. Easier and safer tear-open/disposal consumer experience
 6. Microwave convenience

Retort Pouch processing foods

- Retort processing of foods in rigid, semi-rigid and flexible packaging systems is the most acceptable form of food preservation.
- It represents unique combination of package, process and product technology with potential economic benefits.
- Traditionally, tin containers have contributed to a large extent in building the confidence in processed foods.
- The increasing public awareness have offered a vast scope for retort processing of foods.
- Different retort grade films are **laminated** together to provide the strength, toughness, puncture and burst resistance.
- A number of different virgin, multilayer and co-extruded packaging materials such as polypropylene, nylon (pp/nylon/pp), polyester cast propylene (pet/cpp) and polyester aluminum foil cast polypropylene (PET/A foil/cpp) have been evaluated and are in use for their mechanical strength to withstand retort conditions at temperature up to 135 °C, optimum oxygen barrier properties, compatibility with the food products and required shelf-life of 12 months under ambient conditions.

- Retort pouches and packaging are available in two variants one is aluminum foil laminated and another transparent see through **retort pouches**.
- When the retortable pouch is heated in a microwave oven, the laminated cover film having the aluminum foil is removed from the laminated base film, whereby microwaves generated by a magnetron are not intercepted, and cooked food packaged in the retortable pouch can be heated adequately

Common Structures used for retort processing

1. Retortable pouch and packaging material for the retortable pouch comprises

- A laminated base film formed by laminating together a polyester film and an in elastic polypropylene film,
- A laminated cover film formed by laminating together a polyester film and an aluminum foil, and
- An adhesive layer detachably bonding the polyester film of the laminated base film to the aluminum foil of the laminated cover film, thereby laminately bonding the laminated cover film to the laminated base film.

2. Common flexible retort pouch structures include the following:

- PET / NYLON / LLDPE,
- PET / NYLON / CPP,
- PET / FOIL / Nylon / CPP,
- PET / Nylon / FOIL / CPP,
- PET-SiO_x or
- AlO_x / Nylon / CPP

3. PET / NY / AL / Retortable CPP:

- High Retort (Under 125 °C), High Barrier (OTR, MVTR) Non-Microwaveable.
- High temperature sterilization, Excellent sealing capability, Excellent up to 8 colors gravure printing, Lower OTR, WTR and Longer shelf life, Optional laminated layers for better barriers against moisture, humidity, puncturing are the major characteristics.

4. Alox-PET / NY / Retortable CPP:

- High Retort (Under 125 °C), High Barrier (OTR, MVTR) Microwaveable.
- Microwavable pouch is advanced version of regular retort pouch.
- It is very convenient to use and microwavable pouch started to replace retort pouch lately.
- Microwavable pouch does not contain aluminum and barrier comes from special polyester film.
- It can be used in seafood, stew, meat, curry, rice, and other processed foods.
- Normally, microwavable pouch is standup pouch because end user wants to put pouch in to the microwave and eat right out of the pouch.

Retortable pouches

- A typical laminate for retortable pouch is 0.0005 polyester / 0.00035 foil / 0.003 polypropylene, with the outer ply designated first as is customary for pouch material.
- Filled pouches are sterilized at 115-121⁰ C, with overriding air pressure of ~ 2 kg/cm² to prevent bursting.
- Pouch material that will not delaminate at these temperatures must be selected, and the seals should withstand a tensile test of 0.08 kg/m of width, internal pressure of 1 kg/cm² for 30 s, pinhole strength of 0.6 kg and a drop test of 1.22 m.

THANK YOU