EASY-OPENABLE POUCH AND ORIENTED MULTI-LAYER THERMOPLASTIC FILM SUITABLY EMPLOYED IN THE MANUFACTURE THEREOF

Abstract: An easy openable pouch (1) obtained by folding and sealing a thermoplastic multi-layer film, said pouch comprising a longitudinal lap seal (2) and at least one transverse fin seal (4), and being characterised in that the thermoplastic multi-layer film comprises at least the following layers: a first outer heat-sealing layer (a), that in the end package will be the innermost layer of the package, i.e. the layer closest to the packaged product; a second outer heat-sealing layer (b), that in the end package will be the outermost layer of the package, i.e. the layer which is furthest from the product relative to the other layers of the multi-layer film; and an intermediate layer (c), the outermost surface of which is at a distance from the outer surface of the heat-sealing layer (b) of less than 10 µm, said intermediate layer (c) comprising a blend of at least two thermoplastic polymers and exhibiting cohesive failure. Also claimed is the package of a product in an easy openable pouch and the oriented and preferably heat-shrinkable film that can be used in the manufacture of the easy openable pouch.
EASY-OPENABLE POUÇH AND ORIENTED MULTI-LAYER THERMOPLASTIC FILM SUITABLY EMPLOYED IN THE MANUFACTURE THEREOF

The present invention relates to an easy openable pouch made by folding and sealing a flexible multi-layer thermoplastic film and to the oriented multi-layer thermoplastic film that can be employed in the manufacture thereof.

Multi-layer thermoplastic films are typically employed for the packaging of food and non-food products.

One method for the packaging of products by means of a thermoplastic film provides for the use of pre-made bags of the suitable size, where the product to be packaged is loaded either manually or automatically. The loaded bags are optionally vacuumized, and/or gas-flushed and then the open mouth is sealed. If the packaging material is an oriented heat-shrinking film, the vacuumized pouch can then be heat treated and shrunk.

The pre-made bags can be ES bags (end-seal bags), obtained from a flattened tubing of thermoplastic material by transversely sealing and severing the bottom end of the bag, or TS bags (transverse seal bags), typically obtained by folding longitudinally a flat film and sealing and severing it transversely. In both the ES and TS bags currently available on the market, the seals are fin seals i.e. seals where one surface of the packaging film is always sealed to itself.

Another method of packaging food and non-food products is by means of a form-fill-seal machine, such as a Horizontal Form-Fill-Seal (HFFS) or a Vertical Form-Fill-Seal (VFFS) machine.

A FFS machine, either Horizontal or Vertical, typically includes a former for forming a flat web of film into a tubular configuration, a longitudinal sealer to seal the overlapped longitudinal edges of the film in the tubular configuration, a conveyor for feeding the products into the tubular film one after the other in suitably spaced configuration, or a feeding tube in case of a VFFS machine, and a transverse sealer for sealing the tubular film in a cross-wise direction to separate the products into discrete packages.
The transverse sealer may be operated to simultaneously seal the bottom of the leading pouch and the front of the following pouch and sever the two seals as well as the leading package from the front sealed tubing.

Alternatively, in the HFFS process, the transverse seal may be operated to sever the leading package from the following tubular portion and sealing the front of said tubular portion thus creating the sealed bottom of the next leading pouch. In this way the leading pouch containing the product to be packaged has a longitudinal seal and only one transverse seal. It can then be vacuumized before a second transverse seal hermetically closes it. Also in this case, if desired, an oriented heat-shrinkable thermoplastic film may be employed as the packaging material and the vacuumized package can then be shrunk to achieve the desired presentation/appearance.

In the FFS processes, while the transverse seals are always fin seals, the longitudinal seal can be either a fin seal or a lap seal, i.e. a seal where the innermost layer of the film is sealed to the outermost layer of the same film.

Also in this case, as in the manufacture of ES or TS bags, the resins used for the thermoplastic packaging material and in particular for the outer sealing layers are selected in such a way to provide high seal strengths. This in fact guarantees that the final flexible container will suitably protect the packaged product from the outside environment, without accidental openings or leakers.

A drawback of the prior art packages is that it is difficult for the end user to open them and knives, scissors or other sharp tools are generally needed for this purpose.

This problem is particularly relevant when the packaging material is an oriented heat-shrinkable film and the product is vacuum packaged. In such a case particularly strong seals are required as they should withstand not only the conventional handling process but also the solicitations induced by the shrink. Furthermore the packaging material, after the shrinking step, will be tightly conforming to the packaged product and opening of the package will be difficult also with the aid of knives or scissors.

It has now been found that it is possible to obtain an easy openable and at the same time reliable pouch, i.e. a pouch where the seals do withstand the stress and
solicitations induced by handling, and optionally by shrinking, maintaining their hermeticity, but where at least one of the seals can be easily opened if suitably acted upon, by providing the pouch with a longitudinal lap seal and using for its manufacture a thermoplastic multi-layer film with a particular structure.

In particular the thermoplastic multi-layer film suitable for the manufacture of the easy openable pouches of the present invention will be characterised by the presence of heat-sealable outer layers required to guarantee resistant seals and by the presence of an intermediate layer, exhibiting cohesive failure, close to the outermost heat-sealing layer to provide for the easy openability of the lap seal.

Opening of the pouch will thus occur by tearing the overlapping film edge of the longitudinal lap seal in a direction perpendicular to the lap seal itself. Tear of the heat-sealing layer accompanied by de-cohesion of the intermediate layer will lead to the opening of the pouch with an acceptable effort.

In particular it has been found that this suitable balance between strong seals and easy openability can be achieved when the shear strength of the lap seal is higher than the peel strength thereof, and preferably when it is at least 500 g/25 mm higher.

A first object of the present invention is therefore an easy openable pouch.

A second object is a package of a product in an easy openable pouch.

A third object is a method of packaging a product in an easy openable pouch.

A fourth object is the oriented and preferably heat-shrinkable film that can suitably be employed in the manufacture of the easy openable pouch.

SUMMARY OF THE INVENTION

A first object of the present invention is an easy openable pouch obtained by folding and sealing a thermoplastic multi-layer film, said pouch comprising a longitudinal lap seal and at least one transverse fin seal, and being characterised in that the thermoplastic multi-layer film comprises at least the following layers:

- a first outer heat-sealing layer (a), that in the end package will be the innermost layer of the package, i.e. the layer closest to the packaged product;
• a second outer heat-sealing layer (b), that in the end package will be the outermost layer of the package, i.e. the layer which is furthest from the product relative to the other layers of the multi-layer film; and

• an intermediate layer (c), the outermost surface of which is at a distance from the outer surface of the heat-sealing layer (b) of less than 10 µm, said intermediate layer (c) comprising a blend of at least two thermoplastic polymers and exhibiting cohesive failure.

The pouch of the present invention may be manufactured in a conventional bag-making machine by transversely sealing and cutting a flattened tube obtained from a suitably selected thermoplastic film by longitudinally lap sealing a web thereof.

Empty pouches of the suitably selected size, having a longitudinal lap seal and only one transverse fin seal, at one end, can thus be manufactured and sold as pre-made pouches to be employed in conventional packaging processes wherein the product to be packaged is loaded into the pouch, either manually or automatically, the pouch is optionally vacuumized and/or gas-flushed, and the pouch mouth is then closed by a second transverse fin seal.

Preferably the longitudinal lap seal in the easy openable pouch of the present invention will not seal exactly the two terminal edges of the longitudinally folded film but it will leave an outer longitudinal strip of the overlapping film free to be grasped by the fingers of the end user to facilitate opening of the pouch.

A second object of the present invention is a package comprising a product in an easy openable pouch of a multi-layer thermoplastic film, said pouch comprising a longitudinal lap seal and two transverse seals at the two pouch ends and being characterized in that the thermoplastic multi-layer film comprises at least the following layers:

• a first outer heat-sealing layer (a), that in the end package will be the innermost layer of the package, i.e. the layer closest to the packaged product;
• a second outer heat-sealing layer (b), that in the end package will be the outermost layer of the package, i.e. the layer which is furthest from the product relative to the other layers of the multi-layer film; and

• an intermediate layer (c), the outermost surface of which is at a distance from the outer surface of the heat-sealing layer (b) of less than 10 μm, said intermediate layer (c) comprising a blend of at least two thermoplastic polymers and exhibiting cohesive failure.

The above package can be manufactured by any conventional packaging process, including vacuum packaging and modified atmosphere packaging, starting from a pre-made pouch as indicated above. Alternatively the pouch may be construed around the product to be packaged by using any commercially available HFFS or VFFS machine providing for a longitudinal lap seal.

The easy openable package obtained by using a conventional HFFS or VFFS machine, may contain air, a reduced volume of air obtained by squeezing out air from the package by means of a pressing pad, or a modified atmosphere that is introduced to replace air by a gas flushing step.

Any type of product can be packaged therein and in particular, using a VFFS, flowable and pumpable products can also be easily packaged.

Alternatively, the easy openable package can be obtained by the HFFS-like process/machine described in US-A-4,640,081, the whole content of which is herein incorporated by reference. Said process leads to an intermediate partially sealed pouch containing the product that can then be suitably further processed to give vacuum or modified atmosphere packages as desired.

A third object of the present invention is a method of packaging a product in an easy openable pouch which method comprises folding longitudinally a web of a thermoplastic multi-layer film and lap-sealing it to form a tube, introducing the products to be packaged into the tube, during or after its formation, and transverse sealing the tube to severe the pouches, said method being characterised in that the thermoplastic multi-layer film comprises at least the following layers:
• a first outer heat-sealing layer (a), that in the end package will be the innermost layer of the package, i.e. the layer closest to the packaged product;

• a second outer heat-sealing layer (b), that in the end package will be the outermost layer of the package, i.e. the layer which is furthest from the product relative to the other layers of the multi-layer film; and

• an intermediate layer (c), the outermost surface of which is at a distance from the outer surface of the heat-sealing layer (b) of less than 10 μm, said intermediate layer (c) comprising a blend of at least two thermoplastic polymers and exhibiting cohesive failure.

A fourth object of the present invention is the multi-layer, oriented, and preferably heat-shrinkable, thermoplastic film comprising at least the following layers:

• a first outer heat-sealing layer (a)

• a second outer heat-sealing layer (b) and

• an intermediate layer (c) which is at a distance from the outer surface of one of the heat-sealing layers (a) or (b) of less than 10 μm, said intermediate layer (c) comprising a blend of at least two thermoplastic polymers and exhibiting cohesive failure.

The above oriented film can be suitably employed in the manufacture of the easy openable pouch described above by folding the film in such a way that the intermediate layer (c) is at a distance of less than 10 μm from the outer surface of the outermost sealing layer.

DEFINITIONS

In this specification and the accompanying claims:

the term “film” refers to a flat or tubular flexible structure of thermoplastic material having a thickness up to about 150 μm;

the term “oriented” identifies a film that has been mono- or bi-axially stretched at a temperature higher than the glass transition temperature (T_g) of the resins which make up the film and lower than the melting point of at least one polymer of the film, i.e., at
a temperature where at least some of the resins from which the film is made are not in the molten state;

the term “heat-shrinkable” refers to a film that has been oriented and shrinks by at least 15% of its original dimensions, in at least one of the longitudinal and transverse directions, when heated to 90°C for 4 seconds. The quantitative determination is carried out according to ASTM D 2732, as set forth in the 1990 Annual Book of ASTM Standards, Vol. 08.02, pp. 368-371;

the phrase “longitudinal direction” or “machine direction”, herein abbreviated “MD”, refers to a direction “along the length” of the film, i.e., in the direction of the film as the film is formed during extrusion and/or coating;

the phrase “transverse direction”, herein abbreviated “TD”, refers to a direction across the film, perpendicular to the machine direction;

the phrase “outer layer” refers to any film layer having only one of its principal surfaces directly adhered to another layer of the film;

the phrases “sealing-layer”, “heat-sealable layer” and “heat sealing layer”, refer to the outer film layer involved in the sealing of the film;

the phrase “innermost heat-sealing layer” refers to the outer heat-sealing layer of the multilayer film which, with respect to the packaged product, is the inside layer of the package, i.e. the layer being in direct contact with the packaged product;

the phrase “outermost heat-sealing layer” refers to the outer heat-sealing layer of the multilayer film which, with respect to the packaged product, is the outside layer of the package, i.e. the layer furthest from the packaged product;

the phrases “intermediate layer” and “internal layer” refer to any film layer having both of its principal surfaces directly adhered to another layer of the film;

the phrase “tie layer” refers to any internal layer having the primary purpose of adhering two layers to one another;

the term "core", and the phrase "core layer" refer to any internal layer which preferably has a function other than serving as a tie or compatibilizer for adhering two layers to one another;
the term "barrier", and the phrase "barrier layer", as applied to films and/or layers, is used with reference to the ability of a film or layer to serve as a barrier to one or more gases. In the packaging art oxygen (i.e., gaseous O₂) barrier layers have, in general, included, for example, ethylene/vinyl alcohol copolymer (polymerized ethylene vinyl alcohol), polyvinylidene chloride (PVDC), polyalkylene carbonate, polyamide, polyethylene naphthalate, polyester, polyacrylonitrile, etc., as known to those of skill in the art. However, in the present invention the O₂-barrier layer preferably comprises either EVOH or polyvinylidene chloride, the PVDC optionally comprising a thermal stabilizer (i.e., HCl scavenger, e.g., epoxidized soybean oil) and a lubricating processing aid, such as, for example, one or more acrylates;

the phrase “directly adhered”, as applied to film layers, is defined as adhesion of the subject film layer to the object film layer, without a tie layer, adhesive, or other layer there-between. In contrast, as used herein, the word “between”, as applied to a film layer expressed as being between two other specific layers, includes both direct adherence of the subject layer to the two other layers it is between, as well as a lack of direct adherence to either or both of the two other layers the subject layer is between, i.e., one or more additional layers can be imposed between the subject layer and one or more of the layers the subject layer is between;

the term “homopolymer” is used with reference to a polymer resulting from the polymerization of a single monomer, i.e., a polymer consisting essentially of a single type of repeating unit;

the term “copolymer” refers to polymers formed by the polymerization reaction of at least two different monomers;

the term “polymer” refers to both homo-polymers and co-polymers as defined above;

the term “polyolefin” is used with reference to any thermoplastic polymer of simple olefins such as ethylene, propylene, and butene, and co-polymer comprising a major proportion of a simple olefin and a minor proportion of one or more comonomers copolymerisable therewith such as typically another olefin, vinyl acetate, alkyl
(meth)acrylate, (meth)acrylic acid, maleic anhydride, and the like, as well as modifications thereof. The term "polyolefin" specifically includes polyethylene, ethylene co-and ter-polymers, polybutene, propylene-butene co-polymer, and the like; the terms "polyethylene" and "ethylene homopolymer" identify polymers consisting essentially of an ethylene-repeating unit. Depending on the polymerization process employed, polymers with a different degree of branching and a different density can be obtained. Those characterized by a low degree of branching and showing a density higher than 0.940 g/cm³ are called HDPE while those with a higher level of branching and a density up to 0.940 g/cm³ are called LDPE;

the term "ethylene copolymer" refers to the copolymers of ethylene with one or more other olefins and/or with a non-olefinic comonomer copolymerizable with ethylene, such as vinyl monomers, modified polymers thereof, and the like. Specific examples include ethylene/α-olefin copolymers, ethylene/vinyl acetate copolymers, ethylene/ethyl acrylate copolymers, ethylene/butyl acrylate copolymers, ethylene/methyl acrylate copolymers, ethylene/acrylic acid copolymers, ethylene/methacrylic acid copolymers, ionomer resins, ethylene/alkyl acrylate/maleic anhydride ter-polymers, etc.;

as used herein, the phrase "heterogeneous polymer" refers to polymerization reaction products of relatively wide variation in molecular weight and relatively wide variation in composition distribution, i.e., polymers made, for example, using conventional Ziegler-Natta catalysts. Such polymers typically contain a relatively wide variety of chain lengths and comonomer percentages;

as used herein, the phrase "homogeneous polymer" refers to polymerization reaction products of relatively narrow molecular weight distribution and relatively narrow composition distribution. Homogeneous polymers exhibit a relatively even sequencing of comonomers within a chain, the mirroring of sequence distribution in all chains, and the similarity of length of all chains, and are typically prepared using metalloocene, or other single-site type catalysis.
More particularly, homogeneous ethylene/α-olefin copolymers may be characterized by one or more methods known to those of skill in the art, such as molecular weight distribution (Mw/Mn), composition distribution breadth index (CDBI), and narrow melting point range and single melt point behavior.

A homogeneous ethylene/α-olefin copolymer can, in general, be prepared by the copolymerization of ethylene and any one or more α-olefin. Preferably, the α-olefin is a C₃-C₂₀-α-mono-olefin, more preferably, a C₄-C₁₂-α-mono-olefin, still more preferably, a C₄-C₈-α-mono-olefin. Still more preferably, the α-olefin comprises at least one member selected from the group consisting of butene-1, hexene-1, and octene-1. Most preferably, the α-olefin comprises octene-1, and/or a blend of hexene-1 and butene-1.


As used herein, the phrase “ethylene/α-olefin copolymers”, “ethylene/α-olefin copolymers”, refer to such heterogeneous materials as linear low density polyethylene (LLDPE), linear medium density polyethylene (LMDPE) and very low and ultra low density polyethylene (VLDPE and ULDPE); and homogeneous polymers such as metallocene catalyzed polymers such as EXACT™ materials supplied by Exxon, AFFINITY™ and ENGAGE™ materials supplied by Dow, LUFLEXEN™ materials supplied by BASF and TAFMER™ materials supplied by Mitsui Petrochemical Corporation. These materials generally include copolymers of ethylene with one or
more comonomers selected from C₄-C₁₀-α-olefins such as butene-1, hexene-1, octene-1, etc..

As used herein the term “modified polyolefin” is inclusive of modified polymer prepared by copolymerizing the homopolymer of the olefin or copolymer thereof with an unsaturated carboxylic acid, e.g., maleic acid, fumaric acid or the like, or a derivative thereof such as the anhydride, ester or metal salt or the like; as well as of modified polymer obtained by incorporating, into the olefin homopolymer or copolymer, an unsaturated carboxylic acid, e.g. maleic acid, fumaric acid, or the like, or a derivative thereof such as the anhydride, ester or metal salt or the like. Examples of said modified polyolefins are graft copolymers of maleic acid or anhydride onto ethylene/α-olefin copolymers, graft copolymers of fused ring carboxylic anhydrides onto polyethylene, resin mixtures of these and mixtures with polyethylene or ethylene/α-olefin copolymers.

As used herein the term “ethylene-alkyl (meth)acrylate copolymers” refers to copolymers of ethylene with alkyl (meth)acrylates, e.g. methyl (meth)acrylate, butyl (meth)acrylate, and iso-butyl (meth)acrylate wherein the ethylene derived units in the copolymer are present in major amounts and the alkyl (meth)acrylate derived units in the copolymer are present in minor amounts, preferably between about 2% and about 28% by weight.

As used herein the term “ethylene-acrylic acid and ethylene-methacrylic acid copolymers” refers to copolymers of ethylene with a copolymerisable ethylenically unsaturated carboxylic acidic monomer selected from acrylic acid and methacrylic acid. The copolymer typically contains from about 4 to about 18% by weight of acrylic or methacrylic acid units. Said copolymer can also contain, copolymerised therein an alkyl (meth)acrylate, such as n-butyl acrylate or methacrylate or isobutyl acrylate or methacrylate. Said copolymer can be in the free acid form as well as in the ionized or partially ionized form wherein the neutralizing cation can be any suitable metal ion, e.g. an alkali metal ion, a zinc ion or other multivalent metal ions; in this latter case the copolymer is also termed “ionomer”.
As used herein the term “ethylene-vinyl acetate copolymer” or “EVA” is intended to refer to a copolymer formed from ethylene and vinyl acetate monomers wherein the ethylene derived units in the copolymer are present in major amounts; preferably between about 60% and 98% by weight and the vinyl acetate derived units in the copolymer are present in minor amounts, preferably between about 2% and about 40% by weight.

As used herein the term EVOH refers to saponified products of ethylene-vinyl ester copolymers, generally of ethylene-vinyl acetate copolymers, wherein the ethylene content is typically comprised between 20 and 60% by mole and the degree of saponification is generally higher than 85% preferably higher than 95%.

As used herein, the term “polyamide” is intended to refer to both polyamides and co- or ter-polyamides. Said term also includes crystalline or partially crystalline, aromatic or partially aromatic, polyamides.

Melting information by DSC are reported as second heating data, i.e., the sample is heated at a programmed rate of 10°C/min to a temperature below its critical range, cooled down and then reheated (2nd heating) still at a programmed rate of 10°C/min.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a diagrammatic front view of a pre-made pouch according to the present invention.

Figure 2 is a diagrammatic front view of a product packaged in a pouch according to the present invention.

Figure 3 is a diagrammatic cross-sectional view of a pouch of the present invention.

Figure 4 represents an enlarged cross-sectional view of the lap seal area of the pouch of the invention wherein a 6-layer film as in Figure 5 is employed.

Figure 5 shows a cross-section of a film according to the present invention.

Figure 6 is a diagrammatic cross-section of the pouch of the present invention showing the opening of the pouch in progress.

Figure 7 is a diagrammatic cross-section of the pouch of the present invention showing the pouch fully opened for access to contents therein.
DETAILED DESCRIPTION OF THE INVENTION

With reference to Figure 1, that represents a diagrammatic front view of a pouch (1) according to the present invention, (2) indicates the longitudinal lap seal, wherein (3) is the free edge of the overlapping film which can be grasped by the fingers to initiate the opening, by pulling it apart in the direction of the arrow, (4) indicates the bottom transverse fin seal, and (5) is the pouch open mouth.

The thermoplastic multi-layer film used in the manufacture of said pouch comprises at least the following layers:

- a first outer heat-sealing layer (a), that in the end package will be the innermost layer of the package, i.e. the layer closest to the packaged product;
- a second outer heat-sealing layer (b), that in the end package will be the outermost layer of the package, i.e. the layer which is furthest from the product relative to the other layers of the multi-layer film; and
- an intermediate layer (c), the outermost surface of which is at a distance from the outer surface of the heat-sealing layer (b) of less than 10 μm, wherein said intermediate layer (c) comprises a blend of at least two thermoplastic polymers and exhibits cohesive failure, suitable for the manufacture of an easy openable pouch.

The pouch of the present invention as indicated above can be manufactured in any bag-making machine starting from a flattened lap-sealed tubing and then used as a pre-made pouch in any packaging process where actually pre-made bags are employed.

Preferably the lap-sealed tubing is flattened in such a way to keep the longitudinal lap seal as well as the gripping strip in the central portion of the flattened tubing surfaces.

The lap seal in the tubing can be obtained by any suitable sealing system such as by means of a couple of heated wheels, one inside the tubing and the other one outside, that press the two film edges together thus forming the longitudinal heat seal; by an ultrasonic head or, if the polymers used in the sealing layers are RF-susceptible, also by radiofrequency.
Alternatively, the pouch may be construed around the product to be packaged by means of any commercially available HFFS or VFFS machine providing for a longitudinal lap seal. Also in this case the device used for the longitudinal lap seal may be based on any acceptable sealing system.

Figure 2 represents a package as it may be obtained by e.g. a conventional FFS process. The numbers correspond to those used in connection with Figure 1 wherein (6) is the second transverse seal and (7) is the packaged product inside the pouch.

For use in the manufacture of the easy openable pouch and package of the present invention, the thermoplastic multi-layer film may be a cast film, an oriented film, either heat-shrinkable or heat-set, or a laminate of an oriented, heat-set sheet with a cast or oriented film.

When, according to a preferred embodiment, a vacuumized package is desired, e.g. in the packaging of oxygen sensible food products where the absence of air may prolong the product shelf-life considerably, either a pre-made pouch is employed in a conventional vacuum packaging system or the film is run on a HFFS machine such as that described in US-A-4,640,081, equipped however with a longitudinal lap sealer.

In such a case, if an oriented heat-shrinkable film is employed as the packaging material, the vacuumized pouch can then be submitted to an heat-shrinking step and provide the desired, shrunk, easy openable, vacuum package.

The pouch and package according to the present invention will be characterized by a shear strength of the lap seal higher than the peel strength thereof, and preferably at least 500 g/25 mm higher.

In particular while the peel strength of the lap seal in the pouch and package of the present invention will generally be lower than 2,200 g/25 mm, preferably lower than 2,000 g/25 mm, and even more preferably lower than 1,800 g/25 mm, to provide for the easy openability of the pouch, the shear strength thereof will be higher than 2,300 g/25 mm, preferably higher than 2,500 g/25 mm, more preferably higher than 2,700 g/25 mm, and even more preferably higher than 3,000 g/25 mm, to guarantee that the seals will withstand conventional handling and, if needed, also the shrinking step.
For a preliminary screening of the thermoplastic multi-layer films that are preferably employed in the manufacture of the easy openable pouch and package according to the present invention, specimens of the films are lap-sealed and the shear and peel seal strengths are evaluated. In these tests, lap seals are made by overlapping the surface of the heat-sealing layer (a) to the surface of the heat-sealing layer (b) and sealing them by means of a suitably set heat-sealing bar.

Strips of 25 mm are then cut perpendicularly to the lap seal, and the shear and peel strengths of the lap seal are measured with an Instron type tensile strength tester operated in a conventional manner.

In particular the shear strength of the lap seal is measured by fixing in the two jaws of the Instron dynamometer the edges indicated in Figure 4 with (8) and (9), while the peel strength of the same lap seal is measured by fixing in the two jaws of the dynamometer the two edges indicated in Figure 4 with (8) and (10). The seal strength, either shear or peel, is the maximum tensile load per unit width, expressed in g/25 mm, required to break the seal (obtained at a given temperature) of a test specimen.

In our tests the sealed specimens are prepared by using a Cryovac® VS 90 sealing machine equipped with a sealing bar having an upper sealing bar electrically heated, about 460 mm long, with a trapezoidal cross-section having the minor base (the sealing one) 5.5 mm wide, and a counter bar of silicon rubber, 55 Shore A hard, covered with Teflon™ tape, with a sealing time set at 1.5 sec and a sealing pressure set at 3 ± 0.3 bar. The Cryovac® VS 90 sealing machine was set at “300”. This corresponds, for a sealing time of 1.5 sec, to a maximum sealing temperature of 155 ± 5 °C.

The heat-sealing layers, (a) and (b), in the pouch and in the oriented film according to the present invention typically comprise heat-sealable polyolefins.

They can comprise the same polymer or polymer blend, or, preferably, they will comprise different polymers or polymer blends, provided a lap seal with a shear strength higher than the peel strength thereof is obtained.
Polyolefins suitable for the heat-sealing layers (a) and (b) include polyolefin resin(s) with a melting point < 140 °C, and preferably < 130°C. Preferably they will have a melting point comprised between about 80°C and about 128 °C.

Examples of suitable polyolefins are for example heterogeneous or homogeneous ethylene-\((C_2-C_8)\)-α-olefin copolymers having a density ≤ 0.915 g/cm³; blends thereof with minor amount of polyethylene homopolymers; heterogeneous or homogeneous ethylene-\((C_2-C_8)\)-α-olefin copolymers having a density of from 0.915 g/cm³ to 0.935 g/cm³; ethylene-vinyl acetate copolymers; ethylene-acrylic or methacrylic acid copolymers including ionomers; blends of heterogeneous or homogeneous ethylene-\((C_2-C_8)\)-α-olefin copolymers having a density from about 0.915 g/cm³ to about 0.935 g/cm³ with heterogeneous or homogeneous ethylene-(\(C_4-C_8\))-α-olefin copolymers having a density ≤ 0.915 g/cm³; ethylene-vinyl acetate copolymers or ethylene-alkyl (meth)acrylate copolymers; ethylene-propylene copolymers; ethylene-propylene-butene ter-polymers; ethylene-alkyl acrylate-maleic anhydride ter-polymers; and the like polymers.

In a preferred embodiment of the present invention the heat-sealing layer (a) will comprise a polyolefin selected from ethylene-vinyl acetate copolymers and heterogeneous or homogeneous ethylene-(\(C_4-C_8\))-α-olefin copolymers having a density ≤ 0.915 g/cm³, and even more preferably a heterogeneous or homogeneous ethylene-(\(C_4-C_8\))-α-olefin copolymer having a density comprised between about 0.895 g/cm³ and about 0.912 g/cm³. The Melt Index of said heterogeneous or homogeneous ethylene-(\(C_4-C_8\))-α-olefin copolymer may range from about 0.1 to about 15 g/10 min (measured by ASTM D-1238, Condition E). However, preferred values are in the range 0.5-10 g/10 min and still more preferred values are in the range 1.0-7.0 g/10 min.

Preferred polyolefins for the outermost heat-sealing layer (b) are heterogeneous or homogeneous ethylene-\((C_4-C_8)\)-α-olefin copolymers having a density ≤ 0.915 g/cm³; blends thereof with minor amount of polyethylene homopolymers; heterogeneous or homogeneous ethylene-\((C_4-C_8)\)-α-olefin copolymers having a density of from 0.915 g/cm³ to 0.935 g/cm³; ethylene-vinyl acetate copolymers; blends of heterogeneous or
homogeneous ethylene-(C₄-C₈)-α-olefin copolymers having a density from about 0.915 g/cm³ to about 0.935 g/cm³ with heterogeneous or homogeneous ethylene-(C₄-C₈)-α-olefin copolymers having a density ≤ 0.915 g/cm³, ethylene-vinyl acetate copolymers or ethylene-alkyl (meth)acrylate copolymers.

The intermediate layer (c) will comprise a blend of polymers exhibiting cohesive failure. Suitable blends are those heterogeneous mixtures of polymers that, when subjected to a tear force along the plane of the layer, separate by de-cohesion leading to the internal breakage of the layer.


Alternatively, blends of polymers having highly different coefficients of viscosity, such as for instance those blends of highly viscous ionomer and more fluid modified ethylene-vinyl acetate described in EP-A-192,131 or those blends of highly viscous polystyrene and more fluid polyethylene described in US-A-5,175,035 can suitably be employed.

In general, any blend of at least two different polymers that can be extruded and exhibits cohesive failure can suitably be employed for the intermediate layer (c). Preferably the blend components are compatible so that the optical properties thereof will not be impaired and a transparent film can be obtained.

The thickness of the cohesive failure intermediate layer (c) is typically comprised between about 3 and about 8 μm, preferably between about 4 and about 7 μm. A thicker layer (c) may also be employed but due to the cost of these resin blends it is preferred to control its thickness.
Figure 6 and Figure 7 illustrate the way the pouch can be opened.

For the sake of clarity a 6-layer film, as in Figures 4 and 5, is used also in these figures. The letters (a), (b), and (c) are used to indicate the innermost heat-sealing, the outermost heat-sealing, and the intermediate cohesive failure layers respectively. The good seal between the outermost heat-sealing layer (b) of the inner web (12) and the innermost heat-sealing layer (a) of the overlapping edge (13), provides that upon tearing of the free edge (3) of the overlapping film (13) in the direction indicated by the arrow (11), the outermost heat-sealing layer (b) of the inner web (12) will break across its limited thickness and that the breakage will continue along the plane of the adjacent intermediate layer (c) as indicated by the dotted line (14).

The intermediate layer (c) will have two major surfaces, one closer to the innermost heat-sealing layer (a) that will be hereinafter referred to as the innermost surface of the intermediate layer (c) and the other one closer to the outermost heat-sealing layer (b) that will be hereinafter referred to as the outermost surface of the intermediate layer (c).

The distance between said outermost surface of the intermediate layer (c) and the outer surface of the outermost heat-sealing layer (b) will be less than 10 μm, preferably it will be comprised between about 3 μm and about 8 μm, and even more preferably between about 4 μm and about 6 μm. Said distance corresponds to the thickness of the outermost heat-sealing layer (b) plus the thickness of any intermediate layer positioned between layer (c) and layer (b).

The intermediate layer (c) in fact does not need to adhere directly to the outermost heat-sealing layer (b) but other intermediate layers may be positioned between the two provided the distance between the outermost surface of the intermediate layer (c) and the outer surface of the outermost heat-sealing layer (b) is less than 10 μm.

Additional layers, such as for instance shrink layers, comprising resins endowed with good shrink properties, or bulk layers, comprising resins endowed with good mechanical properties, can be present in the overall film as intermediate layers.

Suitable resins for said additional intermediate layer include for instance ethylene copolymers, particularly ethylene-vinyl acetate copolymers, ethylene-alkyl acrylate
copolymers, ionomers, ethylene-\(\alpha\)-olefin copolymers with a very low density, and the like resins.

In a preferred embodiment, and in particular when high gas-barrier properties are required, the film will also comprise an intermediate gas-barrier layer (d), typically comprising PVDC, EVOH, or, particularly when medium gas barrier properties are desired or sufficient, a polyamide.

In a preferred embodiment said layer (d) will comprise PVDC or EVOH. EVOH may be used alone or optionally blended with the resins and/or additives known in the field. As an example it can be blended with the conventional plasticisers such as crystalline or amorphous polyamides.

In a more preferred embodiment the barrier layer (d) will comprise PVDC and even more preferably a vinylidene chloride-methyl acrylate copolymer, or a vinylidene chloride-methyl methacrylate copolymer, or a blend of vinylidene chloride-vinyl chloride copolymer and vinylidene chloride-methyl acrylate copolymer.

The thickness of the intermediate gas barrier layer (d) will generally be comprised between about 2 and about 15 \(\mu\)m, as thicker gas barrier layers will not bring about any appreciable increase in barrier properties worth the additional costs involved, while thinner gas barrier layers cannot guarantee the desired low level of gas permeability. Preferably the thickness of the intermediate gas barrier layer (d) will be comprised between about 3 and about 12 \(\mu\)m, and even more preferably between about 4 and about 10 \(\mu\)m.

Said gas-barrier layer is typically positioned between the innermost heat-sealing layer (a) and the intermediate layer (c).

To improve the adhesion between the different layers, tie layers can be present in the structure according to the invention. Tie layers typically comprise a modified polyolefin or preferably a blend of a modified polyolefin with a polyolefin, such as for instance a blend of an acid or anhydride modified EVA with EVA or LLDPE.

The resins used not only in the innermost heat-sealing (a) but also in the outermost heat-sealing layer (b) and in any of the intermediate layers, can be suitably additivated
as known in the art in order to improve the properties of the film or the manufacturing process thereof.

As an example the resins may contain stabilizers, anti oxidants, pigments, UV absorbers, cross-linking enhancers or cross-linking inhibitors, anti-fog agents, slip and anti-blocking agents, etc., as conventionally used in this field.

In one preferred embodiment, a film suitable for the manufacture of the easy openable pouch and package of the invention comprises five layers wherein the intermediate layer (c) is directly adhered to the outermost heat-sealing layer (b), a gas barrier layer (d) is positioned between the intermediate layer (c) and the innermost heat-sealing layer (a), and a layer (e) is positioned between the gas barrier layer (d) and the innermost heat-sealing layer (a).

In another preferred embodiment, that is described in particular in Figure 5, a film suitable for the manufacture of the easy openable pouch and package of the invention comprises six layers wherein the intermediate layer (c) is directly adhered to the outermost heat-sealing layer (b), a gas barrier layer (d) is directly adhered to the intermediate layer (c), a layer (e) is adhered to the other surface of the gas-barrier layer (d), and a layer (f) is positioned between layer (e) and the innermost heat-sealing layer (a).

In another preferred embodiment, a film suitable for the manufacture of the easy openable pouch and package of the invention comprises six layers wherein the intermediate layer (c) is directly adhered to the outermost heat-sealing layer (b), a layer (e) is positioned between the intermediate layer (c) and an inner gas barrier layer (d), and a layer (f) is positioned between the gas barrier layer (d) and the innermost heat-sealing layer (a).

In still another embodiment of the present invention the film suitable for the manufacture of the easy openable pouch and package of the invention comprises at least seven layers wherein the intermediate layer (c) is adhered to the outermost heat-sealing layer (b) through a layer (e), a gas barrier layer (d) is positioned between the intermediate layer (c) and the innermost heat-sealing layer (a), a layer (f) is positioned
between the gas barrier layer (d) and the innermost heat-scaling layer (a) and another layer (g) is positioned between the intermediate layer (c) and the gas barrier layer (d).

As indicated above the easy openable pouch and package according to the present invention can be manufactured using e.g. cast films, mono- or bi-axially oriented heat-shrinkable films, or mono- or bi-axially oriented heat-set films.

Cast films may be manufactured by the blown (or hot blown) film process wherein a multi-layer tube is formed and then, while it is still molten, is blown up like a bubble to generate a large diameter tube from a relatively small circular die. Alternatively, and preferably, the cast films are manufactured by cast co-extrusion or extrusion coating, using either a flat or a circular film die that allows to shape the polymer melt into a thin film or tube.

Oriented films can be manufactured by the so-called trapped-bubble process, which is a widely known process typically used for the manufacture of heat-shrinkable films. According to said process, the multilayer film is co-extruded through a round die to obtain a tube of molten polymer which is quenched immediately after extrusion without being expanded, optionally cross-linked, then heated to a temperature which is above the T_g of all the resins employed and below the melting temperature of at least one of the resins employed, typically by passing it through a hot water bath or heating it with an IR oven or with hot air, and expanded, still at this temperature by internal air pressure to get the transversal orientation and by a differential speed of the pinch rolls which hold the thus obtained “trapped bubble” to provide the longitudinal orientation. The film is then rapidly cooled to somehow freeze the molecules of the film in their oriented state and wound.

To obtain an oriented but heat-stable, non heat-shrinkable film, before the cooling down step, the oriented film is heated up, while restrained from shrinking, until crystallization has occurred to the desired degree (heat-set).

This may be particularly useful to improve the film machinability when the thermoplastic film is used e.g. in a VFFS machine.
Furthermore in some instances it may be desirable to submit the oriented structure to a controlled heating-cooling treatment (so-called annealing) that is aimed at having a better control on low temperature dimensional stability of the heat-shrinkable film.

While orientation is typically carried out in both directions, mono-oriented films or preferentially oriented films can be obtained by avoiding or controlling transversal or longitudinal orientation.

Alternatively the oriented film may also be prepared by flat co-extrusion followed by orientation in one or both directions via tenter-frame and optionally heat-setting or annealing. Orientation may be carried out in such a case either sequentially or simultaneously.

Depending on the number of layers in the final structure it may be advisable or necessary to split the co-extrusion step: in such a case a tube or a sheet is first formed of a limited number of layers; this tube or sheet is then quenched quickly and before submitting it to the orientation step it is extrusion-coated with the remaining layers.

The coating step can be simultaneous, by coextruding all the remaining layers altogether, so as to simultaneously adhere all of them, one over the other, to the quenched tube or sheet obtained in the first extrusion step, or this coating step can be repeated as many times as the layers which are to be added.

If desired, the film may be cross-linked, either chemically or, preferably, by irradiation. Typically to produce cross-linking, an extrudate is treated with a suitable radiation dosage of high energy electrons, preferably using an electron accelerator, with the dosage level being determined by standard dosimetry methods. A suitable radiation dosage of high-energy electrons is in the range of up to about 120 kGy, more preferably about 16-80 kGy, and still more preferably about 34-64 kGy. Other accelerators such as a Van der Graff generator or resonating transformer may be used. The radiation is not limited to electrons from an accelerator since any ionizing radiation may be used.

In case of oriented films, irradiation is most preferably performed prior to orientation, and it is carried out either on the overall co-extruded or extrusion-coated
tape, or on the primary extruded tape before extrusion coating. Irradiation could however be performed also after orientation.

Laminates of a biaxially oriented heat-set sheet with a suitable multi-layer film can also be employed for the manufacture of the easy openable pouch and package of the present invention.

Examples of said laminates include for instance a biaxially oriented heat-set polypropylene sheet coated on at least one side with a polyolefin sealing layer, e.g. an ethylene-propylene copolymer or an ethylene-propylene-butene terpolymer, that will correspond to sealing layer (a) in the end structure, said polypropylene sheet being heat or glue laminated to a multilayer film that comprises an outer sealing layer (b) and an intermediate layer (c) as indicated above.

Thickness of the film according to the present invention is not a critical parameter, the only critical thickness being that of the outermost heat-sealing layer (b) and of the intermediate layers positioned between said layer and intermediate layer (c). Generally, however, films with an overall thickness in the range of from about 10 to about 120 μm, preferably from about 15 to about 70 μm, and more preferably of from about 25 to about 60 μm, are employed in the manufacture of the easy openable pouch and package according to the present invention.

The thickness of the outer heat-sealing layer (b) will be typically comprised between about 2 and less than about 10 μm, whereas a preferred thickness will be comprised between about 3 and about 8 μm, and an even more preferred thickness will be comprised between about 4 and about 6 μm.

The thickness of the outer heat-sealing layer (a) typically depends on the overall thickness of the film and on the number of layers present in the end structure. In case of thin films it generally ranges from about 2 μm to e.g. about 6, or 8, or 10 μm. In case of thicker films, it is typically greater than 4 μm, preferably greater than 5 μm, and even more preferably greater than 6 μm, and up to about 20, 30, 40 μm or even more.
An additional object of the present invention is an oriented film comprising at least the following layers:

- a first outer heat-sealing layer (a), that in the end package will be the innermost layer of the package, i.e. the layer closest to the packaged product;
- a second outer heat-sealing layer (b), that in the end package will be the outermost layer of the package, i.e. the layer which is furthest from the product relative to the other layers of the multi-layer film; and
- an intermediate layer (c), the outermost surface of which is at a distance from the outer surface of the heat-sealing layer (b) of less than 10 µm, wherein said intermediate layer (c) comprises a blend of at least two thermoplastic polymers and exhibits cohesive failure, suitable for the manufacture of an easy openable pouch according to the present invention.

In a preferred embodiment the film is heat-shrinkable.

The present invention will now be described in more detail with particular reference to the following Examples:

Example 1

A seven-layer film has been prepared by extrusion coating through a round die.

A substrate formed of the following layers (a)/(e)/(f)/(g), wherein the heat-sealing layer (a) is the innermost layer of the tube, has been co-extruded, quickly quenched with a water cascade, irradiated at a dosage level of 42 kGy and coated with the sequence of three layers, (d)/(c)/(b), wherein layer (b) is the outermost layer of the overall tube. The extrusion coated tape has then been quenched, re-heated by passing it through a water bath at about 95 °C-98 °C, and oriented at this temperature (with orientation ratios of about 3.6 : 1 in the longitudinal direction and about 3.2 : 1 in the transverse direction) by the trapped-bubble process.

The sequence of layers (from the innermost heat-sealing layer (a) to the outermost heat-sealing layer (b) is as follows:

(a)/(e)/(f)/(g)/(d)/(c)/(b)
wherin the resins used for the different layers and, between parentheses, the thickness of each layer are reported below:

(a) heterogeneous ethylene-octene-1 copolymer - \( d = 0.910 \text{ g/cm}^3 \) - m.p. = 101.5°C (DSC - 2nd heating) - MI = 2.2 g/10 min (measured by ASTM D1238 - Condition E (190°C, 2.16 kg) - Stamylex™ 08-026F by DSM (16 µm)

(e) ethylene-vinyl acetate copolymer [14 % VA, MI = 0.25 g/10 min (measured by ASTM D1238 - Condition E (190 °C, 2.16 kg)) – Escorene™ Ultra Fl00014 by Exxon – (10 µm)

(f) ethylene-methacrylic acid copolymer, 12 % MAA, MI = 1.5 g/10 min (measured by ASTM D1238 - Condition E (190 °C, 2.16 kg)) – Nucrel™ 1202 by DuPont (7 µm)

(g) ethylene-vinyl acetate copolymer [14 % VA, MI = 0.25 g/10 min (measured by ASTM D1238 - Condition E (190 °C, 2.16 kg)) – Escorene™ Ultra Fl00014 by Exxon – (10 µm)

(d) a blend of 30 % by weight of vinylidene chloride-methyl acrylate copolymer, 68 % by weight of vinylidene chloride-vinyl chloride and 2 % by weight of epoxidised soybean oil (6 µm)

(c) a blend of 27 % by weight of modified ethylene-vinyl acetate copolymer, 24 % VA, MI 35 g/10 min (measured by ASTM D1238 - Condition E (190 °C, 2.16 kg), Elvaloy™ 741A by DuPont and 73 % by weight of ionomer with MI 1.3 g/10 min, Surlyn™ 1601 by DuPont (5 µm)

(b) homogeneous ethylene-octene-1 copolymer - \( d = 0.904 \text{ g/cm}^3 \) - m.p. = 100 °C (DSC - 2nd heating) - MI = 1 g/10 min (measured by ASTM D1238 - Condition E (190 °C, 2.16 kg) - Affinity™ PL1881 by Dow (6 µm)

Example 2

The tube of oriented heat-shrinkable film of Example 1 was then slit and used for the manufacture of a tubing with a longitudinal lap seal, wherein the heat-sealing layer (b) was used as the outermost layer. By flattening the tubing with the longitudinal seal almost in the middle of one of the flattened surfaces, and transversely heat-sealing and
severing said tubing, pouches with one open end were obtained. The pouches were 20 cm wide and 30 cm long. The longitudinal lap seal was obtained by using a VS90 Cryovac® machine set at 300. The sealing time was 1.5 sec. The transverse seals were made by means of a conventional impulse sealer with a sealing temperature of 190 °C, sealing pressure of 6 bar, and sealing time of 75 msec. A mock product was introduced in each pouch and after vacuumization the open mouth thereof was heat-sealed. The package was then passed in a hot air shrinking tunnel and shrunk.

Example 3

A seven-layer film having the same sequence described in Example 1 is prepared by the same method described in Example 1 but avoiding the irradiation step.

Example 4

A seven-layer film is prepared essentially as described in Example 1 but replacing the blend used in the intermediate layer (c) with the following one:

- a blend of 24 % by weight of modified ethylene-vinyl acetate copolymer, 24 % VA, MI 35 g/10 min (measured by ASTM D1238 - Condition E (190 °C, 2.16 kg), Elvaloy™ 741A by DuPont, 66 % by weight of ionomer with MI 1.3 g/10 min (measured by ASTM D1238 Condition E (190 °C, 2.16 kg), Surlyn™ 1601 by DuPont, and 10 % by weight of ethylene-butene-1 copolymer with MI 1 g/10 min (measured by ASTM D1238 - Condition E (190 °C, 2.16 kg) (5 μm)

Example 5

A seven-layer film is prepared essentially as described in Example 1 but increasing the thickness of the heat-sealing layer (b) to 8 μm.

Example 6

A five layer film is prepared by co-extrusion through a round die, quenching, irradiation of the quenched tape at a dosage level of 42 kGy, re-heating at about 95 °C-98 °C, and orientation (with orientation ratios of about 3.6 : 1 in the longitudinal direction and about 3.2 : 1 in the transverse direction) by the trapped-bubble process.

The sequence of layers (from the innermost heat-sealing layer (a) to the outermost heat-sealing layer (b) is as follows:
(a)/(e)/(d)/(c)/(b)

wherein the resins used for the different layers and, between parentheses, the thickness of each layer are reported below:

(a) heterogeneous ethylene-octene-1 copolymer - \( d = 0.910 \text{ g/cm}^3 \) - m.p. = 101.5°C (DSC- 2nd heating) - MI = 2.2 g/10 min (measured by ASTM D1238 - Condition E (190°C, 2.16 kg) - Stamyllex™ 08-026F by DSM (16 µm)

(e) ethylene-vinyl acetate copolymer [14 % VA, MI = 0.25 g/10 min (measured by ASTM D1238 - Condition E (190 °C, 2.16 kg)) – Escorone™ Ultra Fl00014 by Exxon – (24 µm)

(d) a blend of 30 % by weight of vinylidene chloride-methyl acrylate copolymer, 68 % by weight of vinylidene chloride-vinyl chloride and 2 % by weight of epoxidised soybean oil (6 µm)

(c) a blend of 27 % by weight of modified ethylene-vinyl acetate copolymer, 24 % VA, MI 35 g/10 min (measured by ASTM D1238 - Condition E (190 °C, 2.16 kg), Elvaloy™ 741A by DuPont and 73 % by weight of ionomer with MI 1.3 g/10 min, Surlyn™ 1601 by DuPont (7µm)

(b) homogeneous ethylene-octene-1 copolymer - \( d = 0.904 \text{ g/cm}^3 \) - m.p. = 100 °C (DSC - 2nd heating) - MI = 1 g/10 min (measured by ASTM D1238 - Condition E (190 °C, 2.16 kg) - Affinity™ PL1881 by Dow (7 µm).

Example 7

A seven-layer film is prepared essentially as described in Example 1 but replacing the resin used for the innermost heat-sealing layer (a) with the following one:

homogeneous ethylene-octene-1 copolymer - \( d = 0.895 \text{ g/cm}^3 \) - m.p. = 92°C (DSC- 2nd heating) - MI = 1.6 g/10 min (measured by ASTM D1238 - Condition E (190°C, 2.16 kg) - Affinity™ PF 1140 by Dow,

and increasing the thickness of said layer (a) to 22 µm while reducing that of the intermediate layer (f) to 4 µm.

Example 8
A seven layer film is prepared essentially as described in Example 1 but replacing
the resin used for the outermost heat-sealing layer (b) with the following one:
ethylene-vinyl acetate copolymer with 9 % VA and MI 3.0 g/10 min – Evatane™
1020 VN (6 μm) by Elf Atochem.

Example 9

Twenty pouches prepared as in Example 2 have been submitted to a series of
internal tests aimed at evaluating the presence of leakers and the ability of said pouches
to maintain seal hermeticity and integrity under conventional handling. None of the
pouches revealed any leakers and the whole set survived the simulated distribution
cycle without any loss of hermeticity of the seals.

Once these tests were completed, the easy openability thereof was evaluated.

The tests qualitatively showed that opening of the packages could be initiated, by
hand, without any considerable effort.

The packages were not completely opened as specimens of the lap seals were cut
therefrom and the peel and shear seal strengths were evaluated by means of an Instron
instrument as indicated in the description.

For the pouches of Example 2 the following values of the peel and shear seal
strength have been determined (as the average of 18 packages):

Peel seal strength = 1960 g/25 cm

Shear seal strength = 3200 g/25 cm
Claims

1. An easy openable pouch obtained by folding and sealing a thermoplastic multi-layer film, said pouch comprising a longitudinal lap seal and at least one transverse fin seal, and being characterized in that the thermoplastic multi-layer film comprises at least the following layers:
   - a first outer heat-sealing layer (a), that in the end package will be the innermost layer of the package, i.e. the layer closest to the packaged product;
   - a second outer heat-sealing layer (b), that in the end package will be the outermost layer of the package, i.e. the layer which is furthest from the product relative to the other layers of the multi-layer film; and
   - an intermediate layer (c), the outermost surface of which is at a distance from the outer surface of the heat-sealing layer (b) of less than 10 μm, said intermediate layer (c) comprising a blend of at least two thermoplastic polymers and exhibiting cohesive failure.

2. The pouch of claim 1 wherein the outermost surface of the intermediate layer (c) in the thermoplastic multi-layer film is at a distance from the outer surface of the heat-sealing layer (b) of from about 3 to about 8 μm, preferably of from about 4 to about 6 μm.

3. The pouch of claim 1 wherein the heat-sealing layers (a) and (b) comprise heat-sealable polyolefins.

4. The pouch of claim 3 wherein the heat-sealing layers (a) and (b) may comprise the same polymer or polymer blend, or, preferably, they comprise different polymers or polymer blends, provided a lap seal with a shear strength higher than the peel strength thereof is obtained.

5. The pouch of claim 3 wherein the polyolefins for the heat-sealing layers (a) and (b) are selected from the group consisting of polyolefin resins with a melting point < 140 °C, preferably < 130°C, and more preferably comprised between about 80°C and about 128 °C.
6. The pouch of claim 1 wherein the intermediate layer (c) comprises a polymer blend exhibiting cohesive failure selected from the group consisting of blends of an ethylene terpolymer with an ionomer; blends of an ethylene polymer and a propylene polymer; blends comprising butene-1 and ethylene copolymers, ethylene homo- or co-polymers, an inorganic filler and optionally a propylene homo- or co-polymer; blends of copolymers of acrylic acid or methacrylic acid, modified ethylene vinyl acetate, and polybutylene; blends of highly viscous ionomer and more fluid modified ethylene-vinyl acetate; and blends of highly viscous polystyrene and more fluid polyethylene.

7. A package comprising a product in an easy openable pouch of a multi-layer thermoplastic film, said pouch comprising a longitudinal lap seal and two transverse seals at the two pouch ends and being characterized in that the thermoplastic multi-layer film comprises at least the following layers:

- a first outer heat-sealing layer (a), that in the end package will be the innermost layer of the package, i.e. the layer closest to the packaged product;
- a second outer heat-sealing layer (b), that in the end package will be the outermost layer of the package, i.e. the layer which is furthest from the product relative to the other layers of the multi-layer film; and
- an intermediate layer (c), the outermost surface of which is at a distance from the outer surface of the heat-sealing layer (b) of less than 10 µm, said intermediate layer (c) comprising a blend of at least two thermoplastic polymers and exhibiting cohesive failure.

8. The package of claim 7 characterised in that the multi-layer thermoplastic film is an oriented heat-shrinkable film and the package is a shrunk vacuum package.

9. A method of packaging a product in an easy openable pouch which method comprises folding longitudinally a web of a thermoplastic multi-layer film and lap-sealing it to form a tube, introducing the products to be packaged into the tube, during or after its formation, and transverse sealing the tube to severe the pouches,
said method being characterised in that the thermoplastic multi-layer film comprises at least the following layers:

- a first outer heat-sealing layer (a), that in the end package will be the innermost layer of the package, i.e. the layer closest to the packaged product;
- a second outer heat-sealing layer (b), that in the end package will be the outermost layer of the package, i.e. the layer which is furthest from the product relative to the other layers of the multi-layer film; and
- an intermediate layer (c), the outermost surface of which is at a distance from the outer surface of the heat-sealing layer (b) of less than 10 μm, said intermediate layer (c) comprising a blend of at least two thermoplastic polymers and exhibiting cohesive failure.

10. A multi-layer, oriented, and preferably heat-shrinkable, thermoplastic film comprising at least the following layers:

- a first outer heat-sealing layer (a)
- a second outer heat-sealing layer (b) and
- an intermediate layer (c) which is at a distance from the outer surface of one of the heat-sealing layers (a) or (b) of less than 10 μm, said intermediate layer (c) comprising a blend of at least two thermoplastic polymers and exhibiting cohesive failure.

11. Use of the film of claim 10 in the manufacture of an easy openable pouch by folding the film in such a way that the intermediate layer (c) is at a distance of less than 10 μm from the outer surface of the outermost sealing layer.
### INTERNATIONAL SEARCH REPORT

**International Application No**

PCT/EP 00/05699

### A. CLASSIFICATION OF SUBJECT MATTER

**IPC** 7 B32B27/32 B32B7/06 B65D75/44

According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

**Minimum documentation searched (classification system followed by classification symbols)**

IPC 7 B32B B65D

**Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched**

Electronic data base consulted during the international search (name of data base and where practical, search terms used)

EP0-Internal, WPI Data

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>WO 98 45115 A (REXAM MEDICAL PACKAGING LTD; STELL DAVID (GB); CHRISTOPHERSON ROY) 15 October 1998 (1998-10-15) claims 1,2,4,7,9,10,12,20,21 page 4, line 8 - line 16 page 5, line 9 - line 22 page 7, line 1 - line 7 page 7, line 25 - page 9, line 3 page 9, line 18 - page 10, line 28 page 14, line 17 - line 21 page 15, line 6 - line 20</td>
<td>1-11</td>
</tr>
<tr>
<td>X</td>
<td>GB 2 296 466 A (COURTAULDS FILMS) 3 July 1996 (1996-07-03) claims 1,2 page 7, line 1 - page 8, line 2 example 1</td>
<td>10</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of box C. Patent family members are listed in annex.

### Date of the actual completion of the international search

20 September 2000

### Date of mailing of the international search report

04/10/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk. Tel. (+31-70) 340-2040, Tx. 31 651 epos nl, Facs (+31-70) 340-3018

Authorized officer

Girard, S

Form PCT/ISA/210 (second sheet) (July 1992)
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>BR 9807929 A</td>
<td>22-02-2000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GB 2323812 A,B</td>
<td>07-10-1998</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 5965254 A</td>
<td>12-10-1999</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZA 9802653 A</td>
<td>30-09-1998</td>
</tr>
<tr>
<td>GB 2296466 A</td>
<td>03-07-1996</td>
<td>AU 700614 B</td>
<td>07-01-1999</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AU 4271396 A</td>
<td>19-07-1996</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA 2183087 A</td>
<td>04-07-1996</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 0746468 A</td>
<td>11-12-1996</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 9620085 A</td>
<td>04-07-1996</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 5773136 A</td>
<td>30-06-1998</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZA 9510672 A</td>
<td>30-05-1996</td>
</tr>
</tbody>
</table>