A patch bag has a heat-shrinkable patch adhered to a heat-shrinkable bag and a skirt between a heat seal and an edge of the bag. The bag is made from a multilayer film with at least one film layer comprising an incompatible polymer blend so that after shrinking the film exhibits controlled tear direction. The bag skirt has a bag tear initiator for initiating a controlled direction tear to the opposite side of the bag. The patch has an edge with a patch tear initiator separated from the bag tear initiator but positioned along a tear line emanating from bag tear initiator, so that upon tearing the shrunk bag, the controlled tear propagates into the patch tear initiator and thereafter the shrunk bag and the shrunk patch tear together towards an opposite edge of the patch.
The present invention pertains to heat-shrinkable patch bags that are easy to open, particularly for the packaging of bone-in meat products. For several decades, heat-shrinkable bags have been used for the packaging of a variety of products, particularly food. Patch bags came into use over twenty years ago for the packaging of bone-in meat products. A patch bag has a patch adhered to the bag, with the patch providing additional reinforcement where a bone end contacts the bag. The bone end can be aggressive with respect to package integrity. Supplementing the bag with a patch has proven to be effective in reducing leakier rates for the packaging of bone-in meat products.

Heat shrinkable bags used in the meat packaging industry have, over time, developed higher impact strength and higher seal strength, while simultaneously becoming easier to seal, having improved oxygen and moisture barrier properties, and having higher total free shrink at lower temperatures. High seal strength, high impact strength, and high puncture-resistance are particularly important for the packaging of fresh meat products, as leaking packages are undesirable to consumers and retailers. Moreover, leaking packages reduce shelf life by allowing atmospheric oxygen and microbes to enter the package.

As a result, the bags used for food packaging, particularly meat packaging, have become tougher and more difficult to open. Typically, knives and scissors are used for opening the bags that have been evacuated, sealed around, and shrinkwrapped against the food product in the package. The use of knives and scissors to open these tough bags increases the risk of injury for consumers and retailers. Moreover, the opening of such tough packaging requires more time and effort due to the toughness of the shrinkwrapped bag.

Tough heat shrinkable bags with tear initiators and controlled tear direction have entered the marketplace over the last few years. While these bags allow for easy opening without the problems arising from the use of knives or scissors, such bags having thereon have had a bag tear initiator placed along the side edge of the bag, i.e., so that the tear does not run into the patch, but runs along the side of the patch, and also along the side edge of the bag. It has been found that such tearing does not open the bag wide enough to facilitate removal of the product from the bag. However, if a more centrally-positioned bag tear initiator is positioned so that the bag tear propagates into the patch adhered to the bag, the patch does not tear with the bag, and as a result the tear force must be increased considerably as bag continues to tear, with the stressed portion of the patch initially stretching, and the application of further tearing force resulting in a substantial portion of the patch delaminating from the bag. It would be desirable to provide a heat shrinkable patch bag with a bag tear initiator not covered by the patch, that after shrinking can be opened by the manual initiation and propagation of a controlled direction tear that propagates into the patch and thereafter tears the patch and bag together down the length of the bag to the opposite edge of the bag in such a manner that the product can be easily removed from the bag.

The heat-shrinkable patch bag of the invention has a bag tear initiator that can be used to concentrate tearing force for initiating a manual tear of the bag, with the tear direction being controlled by an incompatible polymer blend in at least one layer of the multilayer bag film. The bag tear initiator is separated from the patch, i.e., the patch does not extend to or cover the bag tear initiator. As the bag is torn, the controlled direction bag tear propagates towards the patch and more particularly, towards the patch tear initiator, along a line extending into the patch tear initiator. Unlike the making of a patch bag having a tear initiator that passes through both the bag and the patch, the separation of the patch tear initiator from the bag tear initiator requires the patch to be provided with its tear initiator before the patch is adhered to the bag. Moreover, the patch tear initiator must be placed along the bag tear line so that the bag tear propagates into the patch tear initiator. Once the bag tear propagates into the patch tear initiator, thereafter the bag and patch tear together, with the patch tearing to an edge opposite the patch edge having the patch tear initiator, and the bag tearing to an edge opposite the bag edge having the bag tear initiator.

A first aspect is directed to a patch bag comprising a heat-shrinkable patch adhered to a heat-shrinkable bag. The bag has an open top and a top edge, a closed bottom and a bottom edge, a first side edge, a second side edge, a first lay-flat side, a second lay-flat side, a heat seal of a region of the first lay-flat side to a region of the second lay-flat side, a first tear initiator in the first lay-flat side in a bag skirt outward of the heat seal or in a bag header between the patch and the top edge of the bag, a second tear initiator in the second lay-flat side in the bag skirt outward of the heat seal or in a bag header between the patch and the top edge of the bag. At least a portion of the heat-shrinkable patch is adhered to an outside surface of the first lay-flat side of the bag. The patch has a patch tear initiator located on an edge of the patch in a location separated from the first bag tear initiator. The patch tear initiator is aligned with an MD or TD tear line extending from the first bag tear initiator. The heat shrinkable bag comprising a multilayer film having at least one layer comprising an incompatible polymer blend.

In an embodiment, the incompatible polymer blend comprises at least one member selected from the group consisting of: (A) a blend of from 90 to 30 wt % ethylene homopolymer and/or ethylene/α-olefin copolymer with from 10 to 70 wt % ethylene/unsaturated ester copolymer having an unsaturated ester content of at least 10 wt %; (B) a blend of ionomer resin with ethylene/unsaturated ester copolymer, and/or polybutylene, and/or propylene homopolymer and/or propylene copolymer; (C) a blend of homogeneous ethylene/α-olefin copolymer with recycled polymer blend comprising ethylene homopolymer, propylene homopolymer, ethylene copolymer, propylene copolymer, polyamide, ethylene/vinyl alcohol copolymer, ionomer resin, anhydride-modified ethylene/α-olefin copolymer, and/or antblock; (D) a blend of from 10 to 75 wt % ethylene/unsaturated ester copolymer with from 90 to 15 wt % polypropylene and/or propylene/ethylene copolymer, and/or polybutylene, and/or modified ethylene/α-olefin copolymer, and/or styrene homopolymer, and/or styrene/butadiene copolymer; (E) a blend of ethylene/norbornene copolymer with ethylene/unsaturated ester copolymer and/or polypropylene and/or polybutylene; (F) a blend of from 90 to 15 wt % ethylene/α-olefin copolymer with from 10 to 75 wt % polypropylene and/or polybutylene and/or ethylene/norbornene; (G) a blend of from 90 to 25 wt % homogeneous propylene homopolymer and/or homogeneous propylene copolymer with from 10 to 75 wt % homo-
geneous ethylene/α-olefin copolymer and/or ethylene/unsaturated ester copolymer; (H) a blend of propylene homopolymer and/or propylene/ethylene copolymer and/or polybutylene with ethylene/methyl acrylate copolymer and/or ethylene/acrylic acid copolymer and/or ethylene/butyl acrylate copolymer; (I) a blend of polyamide with polyamide and/or ethylene/α-olefin copolymer and/or ethylene/vinyl acetate copolymer and/or styrene/butadiene copolymer; (J) a blend of polyamide 6 and polyamide 66/66; (K) a blend of a thermoplastic polyurethane and a filler, wherein the filler is present in an amount of at least 5 wt %, based on layer weight.

In an embodiment, the bag is an end-seal bag comprising a seamless tubing with the first and second bag side edges being folded edges, with the heat seal being an end seal across a bottom of the bag, with the skirt being outward of the end seal, with the patch tear initiator being aligned with the MD tear line extending from the first tear initiator.

In another embodiment, the bag is a side-seal bag having an open top, a folded bottom edge, first side seal along the first side edge, second side seal along the second side edge, with respective first and second bag skirts outward of respective first and second side seals, with the first and second tear initiators being in the first bag skirt and outward of the first side seal, with the patch tear initiator being aligned with the MD tear line extending from the first tear initiator.

In another embodiment, the bag is a pouch having a bottom seal which is a heat seal of the first lay-flat side to the second lay-flat side along the bottom edge, with a skirt between the bottom edge and the bottom seal, and a first side seal which is a heat seal of the first lay-flat side to the second lay-flat side along the first side edge with a first side skirt between the first side seal and the first side edge, a second side seal which is a heat seal of the first lay-flat side to the second lay-flat side along the second side edge with a second side skirt between the second side seal and the second side edge, with the first and second tear initiators being in the same skirt.

In another embodiment, the bag is a backseamed bag having a bottom seal which is a heat seal of the first lay-flat side to the second lay-flat side along the bottom edge, with a skirt between the bottom edge and the bottom seal, with the backseamed bag having a backseamed seal which is a heat seal of the multilayer film to itself, with the backseam seal being on the second lay-flat side of the bag and the backseam running from the bottom edge of the bag to the top edge of the bag.

In an embodiment, the patch comprises a plurality of tear initiators, with one of the tear initiators being aligned with an MD or TD tear line extending from the first tear initiator. In an embodiment, the patch tear initiator is V-shaped or Y-shaped.

In an embodiment, the bag film is a multilayer film comprising an outer seal and meat contact layer which is an inside layer of the bag and which comprises ethylene/α-olefin copolymer, an outer abuse layer which is an outside layer of the bag and which comprises ethylene/α-olefin copolymer, an internal O₂-barrier layer, a first tie layer between the seal layer and the O₂-barrier layer, a second tie layer between the O₂-barrier layer and the abuse layer, a first incompatible polymer blend layer between the seal layer and the first tie layer, and a second incompatible polymer blend layer between the abuse layer and the second tie layer, wherein first and second incompatible polymer blend layers comprise a blend of from 60 to 80 wt % ethylene/α-olefin copolymer and 40 to 20 wt % ethylene/unsaturated ester copolymer having an unsaturated ester content of at least 10 wt %, based on polymer weight, with the amount of incompatible polymer blend in the film being from 30 to 70 wt %, based on total film weight, and the patch comprises self-welded multilayer film having an outer layer comprising ethylene/α-olefin copolymer, self-weld layer comprising an ethylene unsaturated ester or ethylene/unsaturated acid copolymer, and an intermediate layer between the self-weld layer and the outer layer comprising ethylene/α-olefin copolymer.

In an embodiment, the entirety of the patch is positioned inward of the heat seal, with no portion of the patch extending to the heat seal. In an alternative embodiment, the patch covers at least a portion of the heat seal and a portion of the patch covers a portion of the skirt, with the portion of the patch covering the skirt having an edge which is inside an outer edge of the skirt.

In an embodiment, the skirt further comprises a grip assist and, at least a portion of the skirt or header is heatset in order to reduce the shrinkage of the skirt or header upon shrinking the film around the product. In an embodiment, the heatset portion comprises at least one supplemental heat seal of at least a portion of the first lay-flat side of the skirt to a portion of the second lay-flat second side of the skirt.

In an embodiment, the multilayer film has Peak Load Impact Strength, determined using ASTM D 3763-95A, of at least 50 Newtons per mil, and the multilayer film has thickness of from 1.5 to 5 mils.

In an embodiment, the patch is provided with a line of weakness aligned along a tear line aligned with and extending from the patch tear initiator. In another embodiment, the patch does not have a line of weakness aligned with the patch tear initiator. In another embodiment, the bag does not have a line of weakness aligned and extending from the bag tear initiator. In an embodiment, neither the bag nor the patch has a line of weakness aligned with and extending from the respective bag and patch tear initiators.

In an embodiment, the first tear initiator and the second tear initiator are coincident (directly on top of one another when the bag is in its lay-flat configuration) or substantially coincident. Alternatively, the first tear initiator can overlap the second tear initiator to at least some extent when the bag is in its lay-flat configuration.

In an embodiment, the patch comprises a heat shrinkable film that does not comprise an incompatible polymer blend and does not comprise a filler. In an alternative embodiment, the patch comprises a heat shrinkable film containing an incompatible polymer blend.

A second aspect is directed to a process for making an easy-open packaged product, comprising: (A) inserting a product into a lay-flat packaging article in accordance with the first aspect, and any specific embodiments thereof; (B) evacuating the atmosphere from inside the packaging article; (C) sealing the packaging article closed with at least one heat seal, thereby forming a packaged product in which a package surrounds the product; and (D) shrinking the heat-shrinkable film to shrink the package around the product.

In an embodiment, the process further comprises manually opening the package by manually initiating tears from the first and second tear initiators.

In an embodiment, the process can be carried out on a plurality of heat-shrinkable patch bags in a continuous strand, each of the patch bags being connected to an adjacent patch bag along a weakened tear line.
In an embodiment, the tear initiator can be placed in the top edge of the bag before or after the product is placed into the bag. In an embodiment, the tear initiator can be placed in the top edge of the bag during or after the sealing to close the bag with the product inside the bag. In an embodiment, the tear initiator can be placed in a top edge of the bag as the top edge is made during cutting to remove excess bag header after the bag is sealed closed with the product inside the bag.

A third aspect is directed to a process carried out on a continuous strand of the multilayer film from which the bag is made, the strand having patches adhered to intermittently. The strand with patches thereof is wrapped around a bone-in meat product and a backseam heat seal (fin-type or lap-type) made followed by making the transverse bottom seal, with the resulting patch bag (having the meat product therein) being separated from the strand and the atmosphere thereafter evacuated from inside of the bag and the bag sealed closed and shrunk around the meat product. The patch bag can be in accordance with any of the embodiments in accordance with the first aspect, above.

A fourth aspect is directed to a process for making a package and manually opening the package, by (A) placing a product inside a heat-shrinkable patch bag according to the first aspect above, (B) sealing the bag closed so that a package is formed, and (C) manually initiating and manually propagating a first tear in the first side of the bag, and a second tear in the second side of the bag, with the first tear propagating to an edge of a patch adhered to the bag, with the first tear propagating into a tear initiator along the edge of the patch, with the bag and patch tearing together to an opposite edge of the patch, so that the so that the product can be readily removed from the bag. The process can be carried out with or without the additional steps of (D) evacuating the atmosphere from inside of the bag before sealing the bag closed, and/or (E) shrinking the package around the product after sealing the bag closed. The patch bag can be in accordance with any of the embodiments in accordance with the first aspect, above.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0027] FIG. 1. is a schematic of a heat-shrinkable end-seal patch bag in lay-flat configuration.

[0028] FIG. 2 is a schematic of a cross-sectional view of the patch bag of FIG. 1, taken through section 2-2 of FIG. 1.

[0029] FIG. 3 is a schematic of a heat-shrinkable side-seal bag in lay-flat configuration.

[0030] FIG. 4 is a schematic of a cross-sectional view of the patch bag of FIG. 3, taken through section 4-4 of FIG. 3.

[0031] FIG. 5 is a schematic of a heat-shrinkable pouch-style patch bag in lay-flat configuration.

[0032] FIG. 6A is a schematic of a heat-shrinkable back-seamed patch bag in lay-flat configuration.

[0033] FIG. 6B is a schematic of a cross-sectional view of the patch bag of FIG. 6A, taken through section 6B-6B of FIG. 6A.

[0034] FIG. 7 is a schematic of an alternative heat-shrinkable end-seal patch bag in lay-flat configuration.

[0035] FIG. 8 is a perspective view of a packaged product made from a heat-shrinkable end-seal patch bag.

[0036] FIG. 9 is a schematic view of an extrusion coating process used to make multilayer heat-shrinkable films.

[0037] FIG. 10 is a schematic view of a coextrusion process used to make multilayer heat-shrinkable films.

**DETAILED DESCRIPTION**

As used herein, the term “film” is inclusive of plastic web, regardless of whether it is film or sheet. The film from which the bag is made can have a total thickness of 0.25 mm or less, or a thickness of from 1.5 mils to 10 mils, or from 1.5 to 5 mils, or from 1.8 mils to 4 mils, or from 2 mils to 3 mils. The film from which the patch is made can have a thickness of from 2 to 10 mils, or from 2 to 8 mils, or from 2 to 6 mils, or from 3 to 5 mils.

The multilayer, heat-shrinkable film from which the bag is made can exhibit a Peak Load Impact Strength, determined using ASTM D 3763-95A, of at least 50 Newtons per mil. ASTM D 3763-95A is hereby incorporated, in its entirety, by reference thereto. The heat-shrinkable bag film can have a Peak Load Impact Strength, determined using ASTM D 3763-95A, of from 50 to 250 Newtons per mil, or from 60 to 200 Newtons per mil, or from 70 to 170 Newtons per mil; or from 80 to 150 Newtons per mil; or from 85 to 140 Newtons per mil; or from 95 to 135 Newtons per mil.

As used herein, the phrase “machine direction” refers to the direction in which the film emerges from the die. Of course, this direction corresponds with the direction the extrudate is forwarded during the film production process. The phrase “machine direction” corresponds with “longitudinal direction”. Machine direction and longitudinal direction are abbreviated as “MD” and “LD”, respectively. However, as used herein, the phrase “machine direction” includes not only the direction along a film that corresponds with the direction the film traveled as it passed over idler rollers in the film production process, it also includes directions that deviate up to 44 degrees from the direction the film traveled as it passed over idler rollers in the production process.

As used herein, the phrase “transverse direction” refers to a direction perpendicular to the machine direction. Transverse direction is abbreviated as “TD”. The transverse direction also includes directions that deviate up to 44 degrees from the direction the film traveled as it passed over idler rollers in the production process.

As used herein, the term “bag” refers to a packaging article having an open top, side edges, and a bottom edge. The term “bag” encompasses lay-flat bags, pouches, casings (seamless casings and backseamed casings, including lip-sealed casings, fin-sealed casings, and butt-sealed backseamed casings having backseaming tape thereon). Various casing configurations are disclosed in U.S. Pat. No. 6,764,729 B2, to Ramesh et al, entitled “Backseamed Casing and Packaged Product Incorporating Same”, which is hereby incorporated in its entirety, by reference thereto.

The term “bag” also includes that portion of a package that is derived from a bag. That is, once a product is placed inside a bag, the bag is sealed closed so that it surrounds the product. Excess bag length (i.e., the “bag tail”), or “bag header”) can optionally be cut off along a line close to the seal made across the bag to enclose the product within the bag, and thereafter optionally the film can be shrunk around the product. The portion of the bag that remains and is configured around the product is herein also within the term “bag”. The phrase “an opposite bag edge” refers to the edge of the bag that is directly across from the bag edge having the tear initiator. For example, a bag top edge is opposite the bag bottom edge; a first bag side edge is opposite the second bag side edge. As used herein, the phrase “a side of the bag” is...
used with reference to each of the first and second sides of a lay-flat bag, as well as each of the two principal, flat sides of a gusseted bag.

[0044] As used herein, the phrase “bag skirt,” and the term “skirt,” refer to that portion of a bag that is outward of a heat seal, i.e., the excess bag length or width on the non-product side of the heat seal. In an end-seal bag, the bag skirt is short in the machine direction and long in the transverse direction. In a side-seal bag, the bag skirt is also long in the transverse direction and short in the machine direction, due to the manner in which side-seal bags are made from extruded heat-shrinkable film tubing. In either case, the “width” of the bag skirt is the shorter dimension of the skirt, and the “length” of the bag skirt is the longer dimension of the skirt. A bag skirt can have a width, before the film is shrunk, of at least 5 millimeters, or at least 10 millimeters, or at least 15 millimeters, or at least 20 millimeters, or at least 25 millimeters, or at least 30 millimeters. The bag skirt can have a width of from 5 to 100 millimeters, or from 10 to 50 millimeters, or from 15 to 40 millimeters, or from 20 to 35 millimeters.

[0045] As used herein, the phrase “lay-flat bag” refers generically to bags used for the packaging of a variety of products, particularly food products. More specifically, the phrase “lay-flat bag” includes side seal bag, end-seal bag, L-seal bag, U-seal bag. The bag skirt can have a length-to-width ratio of from 1:1 to 20:1; or from 1:5:1 to 8:1; or from 1:8:1 to 6:1; or from 2:1 to 4:1.

[0046] The tear initiator can be a cut in the bag skirt. As used herein, the term “cut” refers to the penetration through the film, or shearing through the film, e.g., with scissors, knife, sharpened punch, etc. The term “cut” is inclusive of both slits and notches. As used herein, the term “slit” refers to a cut through the film without the separation and removal of a piece of film from the bag. A slit can be from the edge of the bag (i.e., an “edge slit”) or internal, i.e., not extending to an edge (i.e., “internal slit”) also referred to as a “slit hole”). The slit can be straight or curved or wavy. Both “V” shaped and “Y” shaped tear initiators are useful in both the bag and the patch. The Y-shaped tear initiator is a combination of a notch and a slit.

[0047] The term “hole”, as used herein, includes both an internal puncture (i.e., internal hole) or internal cut (i.e., an internal slit) through the packaging article, as well as an internal cut that removes a piece of film from the article. The hole can utilize a straight cut or a curved cut. The hole can be round or square or rectangular or irregular in shape.

[0048] A “notch” is formed by a cut that removes a piece of film along an otherwise straight or smooth curved edge of a bag skirt or a bag tail, producing a point for stress concentration during the subsequent manual application of tearing force. A notch can be V-shaped or round or square or rectangular or oval or of any regular or irregular profile.

[0049] The slit or notch or hole in the bag skirt can extend across at least 10 percent of the width of the bag skirt before the bag is shrunk, or at least 20 percent, or at least 30 percent or at least 40 percent, or at least 50 percent, or at least 60 percent, or at least 70 percent, or at least 80 percent, or at least 90 percent, of the width of the bag skirt or bag tail. The slit or notch or hole can angle toward, toward the bag center.

[0050] In end-seal and side-seal bags, a portion of a bag skirt is in a first lay-flat side of the bag, and a portion of the same bag skirt is in a second lay-flat side of the bag. The first lay-flat side of the bag skirt can have a first tear initiator, and the second lay-flat side of the bag can have a second tear initiator.

[0051] The first tear initiator can overlap the second tear initiator when the end-seal or side-seal bag (or any other bag) is in its lay-flat configuration, as well as in the shrunk package. Overlapping enhances the ease of simultaneously initiating and propagating the tears in the first and second sides of the bags. Moreover, the first tear initiator can coincide (i.e., be positioned directly over, and correspond in length and shape) with the second tear initiator when the bag is in its lay-flat configuration.

[0052] As used herein, the verb “to tear” refers to pulling an object apart by force. The noun “tear” refers to the resulting break in the object being torn. The tearing of the film results from placing the film under enough tension that it is pulled apart by the force. The pulling force is concentrated by the tear initiator, which allows a smaller pulling force to pull the film apart, i.e., tear the film. It is not easy to manually tear a high impact strength heat-shrinkable film in the absence of a tear initiator. In the heat-shrinkable bag, the high impact strength multilayer film undergoes tearing from the tear initiator toward the opposite edge of the bag. The tearing is carried out by gripping the skirt and exerting a manual tearing force, without regripping the package during the process of tearing, so that the tear direction is determined by the direction the bag and patch naturally tear along. The tear direction is controlled by the presence of the incompatible polymer blend in the film. The incompatible polymer blend causes a controlled tear of the bag, and thereafter of the patch, towards their respective opposite edges. As used herein, the phrase “to the opposite edge” is used with respect to a controlled direction tear which, in the ordinary course of tearing as described herein, naturally propagates towards the opposite edge of the bag or patch. Moreover, a tear which naturally propagates towards the opposite edge is a tear which propagates to the opposite edge if the tear is propagated to the extent that the film or package is torn into two discrete pieces.

[0053] The phrase “tear initiator”, as used herein, refers to any one or more of a variety of notches or cuts that can be located in the bag skirt or along the edge of the patch. Tear initiators allow manual tearing force to be concentrated on a point or small region of the film(s), so that tear initiation and tear propagation can be produced manually. A slit in the bag skirt and/or patch can serve as the tear initiator. Alternatively, the tear initiators include U-shaped notch (and multiple U-shaped notches such as from two to fifty U-shaped notches spaced close to one another), V-shaped notch (and multiple V-shaped notches such as from two to fifty V-shaped notches side-by-side, for example as the zigzag or saw tooth pattern produced with, for example, pinking shears), or Y-shaped notch-cut combination (and multiples thereof, such as two to fifty Y-shaped notches), as well as a wide variety of tear initiator embodiments useful in both bags and patches, are disclosed in US 2009/0116768 A1, published 7 May 2009, entitled “Easy Opening Packaging Article Made From Heat Shrinkable Film Exhibiting Directional Tear,” hereby incorporated, in its entirety, by reference thereto.

[0054] If the tear initiator is placed in a location of the bag so that the tear is initiated and propagated into a portion of the bag not covered by the patch, then the patch need not have a tear initiator. However, because most patch bags have large patches extending over a majority of the bag, locating the bag
tear initiators along a side edge of an end-seal bag, or along a bottom edge of a side-seal bag, etc., i.e., to produce a tear along a tear line that propagates into the region of the bag covered by the patch, results in the tearing off of only a small strip of film (because the tears in each lay-flat side of the bag are close to one another), with the product being difficult to remove from the package after the tear is complete. Rounded products, such as whole birds (turkeys, chickens, etc), hams, etc., are particularly difficult to remove if only a small strip of film is torn off of the package.

[0055] This problem could be addressed by moving the bag tear initiator to the center of the bag with the bag and patch tear initiators being coincident, so that the tear of the patch and bag together results, in effect, in the bag tearing into halves, making it easier to remove the product from the package, particularly rounded products such as whole birds, hams, etc. However, this solution requires the patch to tear with the bag. If the tear initiators of the patch and bag are coincident, the patch must cover the heat seal, which produces further challenges as it is difficult, and slower, to make a heat seal of the bag to itself by applying heat through the patch. Having the patch tear initiator separated from, but aligned with, the bag tear initiator allows for the desirable combination of (i) a patch which does not cover the heat seal (so that the heat seal need not be made through the patch), and (ii) a bag tear initiator positioned at a location for tearing the bag down a centerline (or central region of the package) in order that the product can be easily removed from the torn-open package.

[0056] A tear line is down a centerline of an end-seal bag or pouch if the tear line is an MD tear line located 50% of the distance across the width of a package made from the end-seal bag or pouch. A tear line is down a centerline of a side-seal bag if the tear line is an MD tear line located 50% of the distance between the folded bottom edge and the top seal of a package made from the side-seal bag. A tear line is down a centerline of a pouch if the tear line is a TD tear line located 50% of the distance between the bottom seal and top seal of the package made from a pouch.

[0057] As used herein, the phrase “central region” refers to a region broader than the centerline, i.e., a region running the length of the centerline, centered over the centerline, and extending outwardly from the centerline for a total distance of up to 10% of the full bag or pouch dimension transverse to the centerline (i.e., up to 5% on each side of the centerline), or up to 20%, or up to 30%, or up to 40%, or up to 50%, or up to 60%, or up to 70% of the full bag or pouch dimension transverse to the centerline. The placement of the bag tear initiator in the central region, and the alignment of the patch tear initiator with the bag tear initiator, allows tearing of the bag and patch so that upon tearing the package open the product can be readily removed. Of course, the patch tears with the bag as a result of the alignment of the patch tear initiator with the tear line extending from the bag tear initiator.

[0058] In addition to the tear initiator, the bag can be provided with one or more grip assisters. Grip assisters enhance the ease of tearing of the bag, and with the propagation of the tear to the patch, the grip assisters enhance the ease of tearing the bag and patch together. The grip assisters can be in one lay-flat side of the bag, but preferably are in both lay-flat sides of the bag. The grip assisters can be a hole in the bag skirt (and/or in the bag tail), in an extension of the bag skirt (and/or the bag tail), or a separate film tab fastened to the bag skirt (and/or the bag tail). A hole can be made in the bag skirt by making a cut that completely surrounds and separates that portion of the film inside the hole, or by making a cut that partially surrounds a portion of the film, leaving a hanging chad in place. In the latter grip assister, there is no need to remove the piece of film, and thereby less chance of contaminating the product with a relatively small, separated piece of film. If a separate film tab is used as the grip assister, the tab can be made from a thermoplastic polymer, paper, or other material, and can be heat-shrinkable, but is preferably non-heat-shrinkable. Various grip assisters are also disclosed in US 2009/0116768 A1.

[0059] With respect to the tearing of the film from which the bag is made, as used herein the phrase “the tear is capable of being propagated . . .” refers to the manner in which the film tends to propagate the tear when the bag is subjected to an ordinary manual opening thereof, i.e., the bag being “gripped and ripped” in the ordinary course of opening. The bag tends to exhibit linear tear. Usually, the tear is substantially in line with the machine direction or substantially in line with the transverse direction.

[0060] If the tear is being made in the machine direction of the film, the tear may be within from 0 to 44 degrees of the actual machine direction of the film, i.e., so long as the tear can be propagated toward and to the opposite side edge of the bag; or the tear may be within from 0 to 20 degrees, or within from 0 to 15 degrees, or within from 1 to 20 degrees, or within from 0 to 10 degrees; or within from 0 to 5 degrees, or within from 0 to 2 degrees of the machine direction of the film or within 0 to 1 degree. The same holds true of transverse direction tearing, i.e., the tear may be within from 0 to 44 degrees of the actual transverse direction of the film; or the tear may be within from 0 to 20 degrees, or within from 1 to 20 degrees, or within from 0 to 10 degrees; or within from 0 to 5 degrees, or within from 0 to 2 degrees of the transverse direction of the film; or within from 0 to 1 degree.

[0061] The combination of the tear initiators and the presence of at least one film layer comprising an incompatible polymer blend provides the bag film with the capability of having a manually-initiated, manually-propagated first tear in the first side of the bag, and a manually-initiated and manually-propagated second tear in the second side of the bag, the first tear and the second tear each being capable of being propagated from the respective first and second tear initiators, with each tear being propagated across the bag, or down the length of the bag, with the tears being capable of being manually propagated through and to an opposite bag edge. At least one of the tears propagates along a tear line extending into a patch tear initiator along an edge of a patch adhered to the bag, with the patch and bag thereafter tearing together, so that upon making a package by placing a product inside the bag, sealing the bag closed so that a package is formed, and shrinking the film around the product, the resulting package can be manually opened, and the product readily removed from the bag, by manually initiating tears from the first and second tear initiators and the patch tear initiator, with the bag tears being manually propagated through the heat seal, to the opposite edge of the patch, and to the opposite edge of the bag, and with the patch tear being manually propagated to the opposite edge of the patch.

[0062] As used herein, the phrases “seal layer,” “sealing layer,” “heat seal layer,” and “sealant layer,” refer to an outer film layer, or layers, involved in heat sealing of a first region of the film to: (i) a second region of the same film (which in a multilayer film can be the same outer layer, e.g., fin seal, or the
opposite outer layer, e.g., lap seal), (ii) a region of another film, and/or (iii) another article which is not a film.

[0063] Heat sealing can be performed in any one or more of a wide variety of manners, such as melt-bond sealing, thermal sealing, impulse sealing, ultrasonic sealing, hot air sealing, hot wire sealing, infrared radiation sealing, ultraviolet radiation sealing, electron beam sealing, etc.). A heat seal is usually a relatively narrow seal (e.g., 0.02 inch to 1 inch wide) across a film. An impulse sealer uses a combination of heat and pressure to form the heat seal, with the heating means providing a brief pulse of heat while pressure is being applied to the film by a seal bar or seal wire, followed by rapid cooling.

[0064] In some embodiments, the seal layer can comprise a polyolefin, particularly an ethylene/α-olefin copolymer. For example, the seal layer can contain a polyolefin having a density of from 0.88 g/cc to 0.917 g/cc, or from 0.90 g/cc to 0.917 g/cc. The polyolefin can be an ethylene/α-olefin copolymer. More particularly, the seal layer can comprise at least one member selected from the group consisting of very low density polyethylene and homogeneous ethylene/α-olefin copolymer. Very low density polyethylene is a species of heterogeneous ethylene/α-olefin copolymer. The heterogeneous ethylene/α-olefin (e.g., very low density polyethylene) can have a density of from 0.900 to 0.917 g/cc, and the homogeneous ethylene/α-olefin copolymer can have a density of from 0.900 g/cc to 0.910 g/cc, or from 0.900 g/cc to 0.917 g/cc. The polyolefin can be an ionomer resin or an ethylene/α-olefin copolymer. Metallocene-catalyzed sealants with densities of 0.917 g/cc or less, as well as a very low density polyethylene having a density of 0.912 g/cc, provided excellent optics. Plastomer-type metallocene sealants with densities less than 0.910 g/cc also provided excellent optics.

[0065] In an embodiment, the bag can have a heat seal capable of withstanding a temperature of at least 70° C. for a period of at least 4 hours, with the patch being adhered to the bag with an adhesive capable of maintaining adhesion of the patch to the bag at a temperature of at least 85° C. for a period of at least 10 minutes, as disclosed in U.S. Pat. No. 7,388,691 B2, entitled “Cook-In Patch Bag and Process for Using Same,” which is hereby incorporated, in its entirety, by reference thereto.

[0066] As used herein, the term “barrier”, and the phrase “barrier layer”, as applied to films and/or film layers, are used with reference to the ability of a film or film layer to serve as a barrier to one or more gases. In the packaging art, oxygen (i.e., gaseous O2) barrier layers can comprise, for example, at least one member selected from the group consisting of hydrolyzed ethylene/vinyl acetate copolymer (designated by the abbreviations “EVOH” and “HEVA”), and also referred to as “saponified ethylene/vinyl acetate copolymer” and “ethylene/vinyl alcohol copolymer”), polyvinylidene chloride, amorphous polyamide, polyamide MXD6 (particularly MXD6/MXD1 copolymer), polyester, polyacrylonitrile, etc., as known to those of skill in the art. In addition to the first and second layers, the heat-shrinkable film may further comprise at least one barrier layer.

[0067] The heat-shrinkable multilayer film from which the bag is made can exhibit O2-transmission rate of from 1 to 20 cc/m² day atm at 23°C and 100% relative humidity, or from 2 to 15 cc/m² day atm at 23°C and 100% relative humidity, or from 3 to 12 cc/m² day atm at 25°C and 100% relative humidity, or from 4 to 10 cc/m² day atm at 25°C and 100% relative humidity. Alternatively, the heat-shrinkable film can exhibit an O2-transmission rate of from 21 cc/m² day atm to 15,000 cc/m² day atm, or from 500 cc/m² day atm to 10,000 cc/m² day atm, or from 2000 cc/m² day atm to 6,000 cc/m² day atm.

[0068] As used herein, the phrase “tie layer” refers to any internal layer having the primary purpose of adhering two layers to one another. Tie layers can comprise any polymer having a polar group grafted thereon. Such polymers adhere to both nonpolar polymers such as polyolefin, as well as polar polymers such as polyamide and ethylene/vinyl alcohol copolymer. Tie layers can comprise at least one member selected from the group consisting of polyolefin (particularly homogeneous ethylene/α-olefin copolymer), anhydride-modified polyolefin, ethylene/vinyl acetate copolymer, and anhydride-modified ethylene/vinyl acetate copolymer, ethylene acrylic acid copolymer, and ethylene/methyl acrylate copolymer. Typical tie layer polymers comprise at least one member selected from the group consisting of anhydride modified linear low density polyethylene, anhydride modified low density polyethylene, anhydride modified polypropylene, anhydride modified methyl acrylate copolymer, anhydride modified butyl acrylate copolymer, homogeneous ethylene/α-olefin copolymer, and anhydride modified ethylene/vinyl acetate copolymer.

[0069] As used herein, the phrases “inner layer” and “interlayer” refer to any layer of a multilayer film, having both of its principal surfaces directly adhered to another layer of the film.

[0070] As used herein, the phrase “outer layer” refers to any film layer having less than two of its principal surfaces directly adhered to another layer of the film. A multilayer film has two outer layers, each of which has a principal surface adhered to only one other layer of the multilayer film.

[0071] Once a multilayer film is heat sealed to itself or another member of the package being produced (i.e., is converted into a packaging article, e.g., a bag, pouch, or casing), one outer layer of the film is an inside layer of the packaging article and the other outer layer becomes the outside layer of the packaging article. The inside layer can be referred to as an “inside heat seal/product contact layer”, because this is the film layer that is sealed to itself or another article, and it is the film layer closest to the product, relative to the other layers of the film. The other outer layer can be referred to as the “outside layer” and/or as the “outer abuse layer” or “outer skin layer”, as it is the film layer furthest from the product, relative to the other layers of the multilayer film. Likewise, the “outside surface” of a packaging article (i.e., bag) is the surface away from the product being packaged within the bag.

[0072] The heat-shrinkable patch film is laminated to the outside surface of the film from which the bag is made. The patch can be laminated in any known manner, for example using an adhesive or a heat seal or corona treatment. A liquid adhesive is applied to the surface of the patch which is to be adhered to the outside surface of the bag. A preferred adhesive is a thermoplastic acrylic emulsion known as RHOCLEX N619™ thermoplastic acrylic emulsion, obtained from the Rohm & Haas Company, at Dominion Plaza Suite 545, 17304 Preston Rd., Dallas, Tex. 75252, Rohm & Haas having headquarters at 7th floor, Independence Mall West, Philadelphia, Pa. 19105. The laminating of the patch to the bag can be carried out as described in U.S. Pat. No. 6,790,468, to Mize et al, entitled “Patch Bag and Process of Making Same”, which is hereby incorporated, in its entirety, by reference thereto.
The patch film can be heat-shrinkable, and can have a total free shrink at 185°F of at least 35 percent, measured in accordance with ASTM D-2732. The bag film and the patch film can have a total free shrink at 185°F that are within 50 percent of one another, or within 20 percent of one another, or with 10 percent of one another, or within 5 percent of one another, or within 2 percent of one another. The patch may be sized and positioned so that it is inward of the seal and does not extend to the heat seal; alternatively, the patch may be sized and positioned so that it covers one or more heat seals. If the patch covers a heat seal, optionally the heat seal may be made through the patch, or the seal may be made through the bag film only, with the patch being adhered over the seal after the seal is made. The bag can have a curved seal and the patch can extend into and through the region of the curved seal and over and past the curved seal. If the bottom edge of the bag is curved, a bottom edge of the patch can also be curved. The patch bag can have any desired configuration of patch on bag as disclosed in any one or more of U.S. Pat. Nos. 4,755,403, 5,540,646, 5,545,419, 6,296,886, 6,383,537, 6,663,905, and 6,790,468, each of which is hereby incorporated, in its entirety, by reference thereto.

The patch can be monolayer or multilayer. In an embodiment, the patch is made from a heat-shrinkable film tubing that is collapsed onto itself into flat configuration with the inside surface of the tubing self-welding to form a multilayer flat patch film having a symmetrical cross-sectional layer arrangement. In this process, a sufficient amount of powdered cornstarch or other inert powder is applied to the interior of the tubular extrudate so that upon collapsing, the tube will not self adhere, but after opening, heating, and stretching the tube to biaxially orient the tube material and thereafter collapsing and flattening the oriented tubing, the oriented tubing adheres to itself, i.e., self-welded. The resulting self-welded multilayer film is thereafter cut into a plurality of patches. This method for making the patch is disclosed in U.S. Pat. No. 4,770,731, entitled “Method of Making a Patch for a Shrinkable Bag”, which is hereby incorporated, in its entirety, by reference thereto.

The patch bag can be provided with just one patch, or with more than one patch. A bag can have a first patch adhered to a first lay-flat side and a second patch adhered to a second lay-flat side. The patches can be the same size or of different sizes. For example, one patch can be large and on the first lay-flat side of the bag, and the second patch can be small and on the second lay-flat side of the bag. One, both, or all of the patches can be provided patch tear initiators aligned with respective bag tear initiators.

The bag tear initiator is separated from the patch tear initiator by a distance of at least 0.5 inch. A tear propagation line for a controlled direction tear extends from bag tear initiator into the patch tear initiator. The bag tear initiator can be separated from the patch tear initiator by a distance of at least 1 inch, or at least 1.5 inches, or at least 2 inches, or at least 2.5 inches, or at least 3 inches, or at least 3.5 inches, or at least 4 inches, or at least 4.5 inches, or at least 5 inches, or at least 5.5 inches, or at least 6 inches, etc. The bag tear initiator can be separated from the patch tear initiator by a distance of from 0.5 to 10 inches, or from 0.5 to 6 inches, or from 1 to 6 inches, or from 2 to 6 inches, or from 2 to 5 inches.

The patch tear initiator is located along an edge of the patch and preferably comprises a notch. A “V-shape” notch is preferred because it concentrates the tear force at the base of the “V”. The included angle of the V can be, for example, an angle within the range of from 5 degrees to 150 degrees, or from 10 degrees to 120 degrees, or from 20 degrees to 90 degrees, or from 40 to 90 degrees, or from 50 to 80 degrees. The depth of the notch can be from 2 mm to 50 mm, or from 3 mm to 25 mm, or from 4 mm to 20 mm, or from 5 mm to 15 mm. The patch tear initiator can have a V-notch in combination with a slit at the base of the V-notch, with this combination being referred to as a “Y-notch”. The edge of the patch can be provided with a plurality of tear initiators so that if the tear line from the bag tear initiator deviates from an MD or TD line between the bag tear initiator and the patch tear initiator, the deviating tear line will still propagate into a patch tear initiator so that the bag and patch will tear together along a tear line to the opposite edge of the patch and to the opposite edge of the bag. The distance between the bag tear initiator and the patch tear initiator aligned therewith can be from 1 inch to 10 inches, or from 1 inch to 5 inches, or from 1 inch to 4 inches, or from 1.5 inches to 3.5 inches.

End-seal bags with curved heat seals, and end-seal patch bags with curved heat seals, can be designed for manual tear initiation and manual directional tear propagation. While the end-seal may be curved, the bottom edge of the bag may be straight across the tubing, or may also be curved. A curved bottom heat seal and a straight across bag bottom edge leaves room at the bottom corners of the bag for providing the tear initiator, and also for a grip assist to facilitate gripping of the bag for the tearing operation. Patch bags with curved end seals are disclosed in U.S. Pat. No. 6,270,819, to Wiese, which is hereby incorporated, in its entirety, by reference thereto.

The term “polymer”, as used herein, is inclusive of homopolymer, copolymer, terpolymer, etc. “Copolymer” includes copolymer, terpolymer, etc.

Blends of incompatible polymers in one or more film layers provide controlled direction tear and enhance the tear initiation, tear propagation, and linear tear properties of the film, including the ability to manually tear down the full length or across the full width of a package made from a patch bag, i.e., tearing through a heat seal and through the patch and to the opposite edge of the patch and the opposite edge of the bag. For a package made from an end-seal patch bag, the tear can be initiated in the bag bottom skirt, and the tear can be manually extended for up to the full length of the bag and the full length of the patch, i.e., to that portion of the package that corresponds with the opposite edge of the bag after the bag is used to make the package. For a package made from a side-seal patch bag, the tear can be initiated in the bag side skirt, and the tear can be manually extended across the full width of the package (i.e., corresponding with the full machine direction dimension of the bag) and across the entirety of the patch and across the entirety of the bag, for up to the full width of the package, i.e., to that portion of the package that corresponds with the opposite edge of the side-seal patch bag after the patch bag is used to make the package.

As used herein, the phrase “incompatible polymer blend” includes (i) a blend of a polymer with a non-polymeric material (e.g., inorganic filler) in which the polymer is not capable of forming a solution or a stable two-phase blend and that tend to separate after mixing, as well as (ii) a blend of a first polymer with a second polymer in which the two polymers are not capable of forming a solution or a stable two-phase blend and that tend to separate after mixing. As used herein, the phrase “incompatible polymers” refers to two polymers (i.e., a blend of at least two polymers) that are
incapable of forming a solution or even a stable two-phase blend, and that tend to separate after being mixed. When blended, incompatible polymers are not miscible with one another, and phase separate into a continuous domain and a discontinuous domain that may be finely dispersed. The presence of one or more film layers comprising a blend of incompatible polymers may assist, enhance, or even cause the linear tear property of the multilayer heat-shrinkable film used to make the heat-shrinkable bag.

In an embodiment, a two-polymer incompatible polymer blend can comprise a 60 to 85 wt % of a first polymer and 15 to 40 wt % of a second polymer which is incompatible with the first polymer. In an embodiment, the film can comprise the incompatible polymer blend in an amount of from 25 to 100 wt %, based on the total weight of the film.

The blend of incompatible polymers can comprise at least one blend selected from the group consisting of:

(A) a blend of ethylene/α-olefin copolymer with ethylene/vinyl acetate copolymer (particularly EVA with at least 10 wt % vinyl acetate, or at least 15 wt % vinyl acetate, or at least 20 wt % vinyl acetate, or at least 25 wt % vinyl acetate);

(B) a blend of ionomer resin with ethylene/vinyl acetate copolymer, and/or polypropylene, and/or polypropylene (particularly propylene copolymer);

(C) a blend of homogeneous ethylene/α-olefin copolymer with recycled polymer blend comprising ethylene homopolymer, propylene homopolymer, ethylene copolymer, propylene copolymer, polyamide, ethylene/ vinyl alcohol copolymer, ionomer resin, anhydride-modified ethylene/α-olefin copolymer, and/or anti-block; and/or propylene/ethylene copolymer (particularly propylene/ethylene copolymer), and/or polybutene, and/or modified ethylene/vinyl acetate copolymer, and/or polysyrene (particularly random and/or block styrene/butadiene copolymer);

(E) a blend of ethylene/norbornene copolymer with ethylene/vinyl acetate copolymer and/or polypropylene and/or polybutene;

(F) a blend of ethylene/α-olefin copolymer with polypropylene (particularly propylene/ethylene copolymer) and/or polybutene and/or ethylene/norbornene;

(G) a blend of single site catalyzed polypropylene (i.e., homogeneous polypropylene) with homogeneous ethylene/α-olefin copolymer and/or ethylene/vinyl acetate;

(H) a blend of polypropylene and/or ethylene/propylene copolymer and/or polybutene with ethylene/methyl acrylate copolymer and/or ethylene/ acrylic acid copolymer and/or ethylene/butyl acrylate copolymer; and

(I) a blend of polyamide with polystyrene and/or ethylene/α-olefin copolymer and/or ethylene/vinyl acetate copolymer and/or styrene/butadiene copolymer (random and/or block copolymer).

The tear initiation, tear propagation, and linear tear property of a multilayer heat-shrinkable film from which the bag is made, and/or the film from which the patch is made, may also be enhanced by providing one or more layers of the film with a filler material, such as an inorganic filler. Polymeric systems that incorporate high filler concentrations may also enhance linear tear behavior. Depending on the particle size and dispersion, a filler concentration as low as 5 wt %

filler (i.e., based on total layer weight) in ethylene/α-olefin copolymer, polypropylene, propylene/ethylene copolymer, polybutylene, poly styrene/butadiene copolymer, ionomer resin, ethylene/vinyl acetate copolymer, ethylene/butyl acrylate copolymer, ethylene/methyl acrylate copolymer, ethylene/ acrylic acid copolymer, polyester, polyamide, etc., may contribute to the linear tear behavior. More particularly, the presence of filler in an amount of from 5 to 95 wt %, or in an amount of from 5 to 50 wt %, or in an amount of from 10 to 40 wt %, or from 20 to 35 wt %, may be used.

Suitable fillers include silicates (particularly sodium silicate, potassium silicate, and aluminum silicate, kaolino alumino silicate), silica (particularly amorphous silica), siloxane, silicone resin, zinc sulfide, wollastonite, microspheres, glass fiber, metal oxide (particularly oxides of titanium, zinc, antimony, magnesium, iron, and aluminum), calcium carbonate, sulfite (particularly barium sulfate and calcium sulfate), aluminum trihydrate, feldspar, perlite, gypsum, iron, fluoropolymer, crosslinked polyvinylmethacrylate, talc, diatomaceous earth, zeolites, mica, kaolin, carbon black, and graphite.

The filler concentration required to achieve low tear initiation force is dependent on particle geometry, particle size, particle aspect ratio, and compatibility of the filler and the polymer matrix. Some fillers are chemically treated to improve the compatibility of the particle and the polymer into which it is dispersed.

The tear initiation, tear propagation, and linear tear property of a multilayer heat-shrinkable film may also be enhanced by providing one or more layers of the film with a polymer that provides the film with a relatively high Young’s modulus, e.g., a polymer having a Young’s modulus of at least 80,000 psi. Such polymers can comprise at least one member selected from the group consisting of high density polyethylene, ultra high molecular weight polyethylene, polypropylene (particularly propylene homopolymer), styrene copolymer (particularly styrene/butadiene block copolymer), ethylene/norbornene copolymer, semi-crystalline polyamide, amorphous polyamide (including polyamide 6/6 T), polycarbonate, and polyester. The multilayer heat-shrinkable film may have a Young’s Modulus of at least 80,000 psi.

Young’s modulus may be measured in accordance with one or more of the following ASTM procedures: D638, D882, D5026-95a; D3406-89, each of which is incorporated herein in its entirety by reference. The film may have a Young’s modulus of at least 150,000 psi and/or 300,000 psi; 350,000 psi; and/or 400,000 pounds/square inch, measured at a temperature of 73° F. The film may have any of the foregoing ranges of Young’s modulus in at least one direction (e.g., in the machine direction or in the transverse direction) or in both directions (i.e., the machine (i.e., longitudinal) and the transverse directions).

As used herein, terms such as “polyamide”, “polyolefin”, “polyester”, etc are inclusive of homopolymers of the genus, copolymers of the genus, terpolymers of the genus, etc, as well as graft polymers of the genus and substituted polymers of the genus (e.g., polymers of the genus having substituents groups thereon).

As used herein, the phrase “polypropylene/ethylene copolymer” refers to a copolymer of propylene and ethylene wherein the propylene content is greater than the ethylene content. Polypropylene/ethylene copolymer is not a species of “ethylene/α-olefin copolymer”.
The phrase “ethylene/α-olefin copolymer” is particularly directed to heterogeneous copolymers such as linear low density polyethylene (LLDPE), very low and ultra low density polyethylene (VLDPE and ULDPE), as well as homogeneous polymers such as metalloocene catalyzed polymers such as EXACT® resins obtainable from the Exxon Chemical Company, and TAFMER® resins obtainable from the Mitsui Petrochemical Corporation. All these latter copolymers include copolymers of ethylene with one or more comonomers selected from C₂ to C₁₀ α-olefin such as butene-1 (i.e., 1-butene), hexene-1, octene-1, etc. in which the molecules of the copolymers comprise long chains with relatively few side chain branches or cross-linked structures. This molecular structure is to be contrasted with conventional low or medium density polyethylenes which are more highly branched than their respective counterparts. The heterogeneous ethylene/α-olefins commonly known as LLDPE have a density usually in the range of from about 0.91 grams per cubic centimeter to about 0.94 grams per cubic centimeter. Other ethylene/α-olefin copolymers, such as the long chain branched homogeneous ethylene/α-olefin copolymers available from the Dow Chemical Company, known as AFFINITY® resins, are also included as another type of heterogeneous ethylene/α-olefin copolymer useful in the film and process described herein.

The film from which the bag is made is a multilayer heat-shrinkable film. The patch also comprises a heat-shrinkable film. Heat-shrinkable films can be produced monoxially or biaxially oriented. As used herein, the phrase “heat-shrinkable” is used with reference to films which exhibit a total free shrink (i.e., the sum of the free shrink in both the machine and transverse directions) of at least 10% at 185°F, as measured by ASTM D 2732, which is hereby incorporated, in its entirety, by reference thereto. All films exhibiting a total free shrink of less than 10% at 185°F are herein designated as being non-heat-shrinkable. The heat-shrinkable film multilayer film from which the bag is made, and the heat-shrinkable film from which the patch is made, can have a total free shrink at 185°F of from 10 percent to 150 percent, or from 15 percent to 120 percent, or from 20 percent to 100 percent, or from 30 percent to 80 percent, or from 35 percent to 60 percent, as measured by ASTM D 2732.

Heat-shrinkability is achieved by carrying out orientation in the solid state (i.e., at a temperature below the glass transition temperature of the polymer). The total orientation factor employed (i.e., stretching in the transverse direction and drawing in the machine direction) can be any desired factor, such as at least 2x, at least 3x, at least 4x, at least 5x, at least 6x, at least 7x, at least 8x, at least 9x, at least 10x, at least 16x, or from 1.5x to 20x, from 2x to 16x, from 3x to 12x, or from 4x to 9x.

In the multilayer, heat-shrinkable film, all of the film layers can be arranged symmetrically with respect to the polymeric composition of each film layer. In addition, all of the film layers can be arranged symmetrically with respect to both composition and thickness. In one embodiment, the seal layer is thicker than the second outer layer. The seal layer can have a thickness of from 110% to 300% of the thickness of the second outer layer, or from 150% to 250% of the thickness of the second outer layer.

FIG. 1 and FIG. 2 together illustrate a schematic of end-seal patch bag 10, in a lay-flat position. End-seal patch bag 10 is made from a seamless film tubing, with the machine direction running from open top edge 14 to bottom edge 20. View FIGS. 1 and 2 together, end-seal patch bag 10 comprises bag 12 made from a multilayer heat-shrinkable film, with bag top edge 14 defining an open top, folded first side edge 16, folded second side edge 18, bottom edge 20, and end seal 22 running in the transverse direction. Bag 12 has first lay-flat side 24 and second lay-flat side 26. Adhered to bag 12 is patch 28. Bag 12 further comprises skirt 30 outward of end seal 22, i.e., “outward” in that bag skirt 30 is exterior of the product-containing cavity within patch bag 10. Bag skirt 30 extends all the way around the bottom of bag 12, and can be considered as first bag skirt on first lay-flat side 28 and second bag skirt on second lay-flat side 26. Bag skirt 30 has first tear initiator 32 on first lay-flat side 24, second tear-initiator 34 in second lay-flat side 26. Patch 28 has Y-shaped patch tear initiator 36. Patch tear initiator 36 is positioned along a machine direction tear line extending from first tear initiator 32. Skirt 30 also contains first grip assister 38 and second grip assister 40, each of which pass through both first lay-flat side 24 and second lay-flat side 26 of skirt 30. Thus, first grip assister 38 in FIG. 1 is actually a pair of grip assisters, i.e., one in first lay-flat side 24 and another directly beneath, in lay-flat side 26. In the same manner, second grip assister 40 is also a pair of grip assisters. First grip assister 38 has hanging chads 42 therein, and second grip assister has hanging chads 44 therein.

Skirt 30 also contains supplemental heat seal 46 of first lay-flat side 12 to second lay-flat side 26, which serves to enhance user accessibility to tear initiators 32 and 34 as well as grip assisters 38 and 40. Supplemental heat seal 46 anneals and/or heat sets a portion of skirt 30, thereby reducing curling and shrinking of skirt 30 during the shrinking of bag 12 around the bone-in meat product sealed inside of bag 12. Reduced curling and reduced shrinking of skirt 30 enhances end user detection and utilization of tear initiators 32 and 34, as well as grip assisters 38 and 40. The absence of supplemental seal 46 results in more shrinking a curling of skirt 30 during the heat shrinking of patch bag 10 around the meat product, making skirt 30 more difficult to detect and use for opening the package made from patch bag 10.

Patch bag 10 can be used to prepare a packaged product, by placing a product inside patch bag 10, evacuating the atmosphere from within patch bag 10, sealing the bag closed, and shrinking bag 12 and patch 28 around the product inside bag 12. Thereafter, now shrunkened bag 12 can be manually opened without the use of a knife or scissors, by initiating manual tears from first tear initiator 32 and second tear initiator 34. The design of the multilayer film from which bag 12 is made is such that upon grasping shrunkened bag 12 in the skirt region on each side of tear initiators 32 and 34, as a first tear is initiated and propagated from first tear initiator 32, the tear direction is controlled so that the tear naturally travels up first lay-flat side 24 in the machine direction, along a line intersecting now shrunkened patch 28 at patch tear initiator 36. Once the tear line meets patch tear initiator 36, the continued exertion of the tearing force causes patch 28 to tear in the machine direction together along the same tear line as the further tearing of bag 12. The adhesion of patch 28 to bag 12 causes further tearing in the machine direction by both shrunkened bag 12 and shrunkened patch 28. Moreover, the tearing in the machine direction is a tear from the bottom edge 20 of bag 12, all the way to top edge 14 of patch bag 10, including tearing of patch 28 from tear initiator 36 through to opposite edge 48 of patch 28.
Patch tear initiator 36 is important to achieving machine direction tear of shrunken bag 12 and shrunken patch 28. Without the presence of patch tear initiator 36, a machine direction tear is not initiated and propagated in shrunken patch 28. Rather, without patch tear initiator 36 a machine direction tear propagating up shrunken bag 12, if continued onward after the tear meets the edge of patch 28, will continue through bag 12 but will cause shrunken patch 28 to delaminate from bag 12 rather than tear. Without patch tear initiator 36, a large manual force is required to both delaminate shrunken patch 28 from shrunken bag 12 in order to continue the machine direction tear of shrunken bag 12 to open the package. The presence of patch tear initiator 36 allows force to be concentrated on patch 28 at patch tear initiator 36, resulting in the simultaneous tearing of both bag 12 and patch 28, with patch 28 tearing through to opposite edge 48 and bag 12 tearing through to opposite edge 14.

FIGS. 3 and FIG. 4 together illustrate a schematic of heat-shrinkable side-seal patch bag 50, in a lay-flat position. Side-seal patch bag 50 is made from a single piece of film, with the film having machine direction of film manufacture running from first side edge 58 to second side edge 60, and with the transverse direction of film manufacture running from top edge 54 of the open top, to folded bottom edge 56. Side-seal patch bag 50 comprises bag 52 made from a multilayer heat-shrinkable film, with bag 52 having first lay-flat side 66, second lay-flat side 68, top edge 54 defining an open top, folded bottom edge 56, first side edge 58, second side edge 60, first side seal 62, second side seal 64. Bag 52 further comprises first skirt 82 outward of first side seal 62. First bag skirt 82 extends all the way around the bottom of bag 50, and can be considered as including both that portion of the skirt on first lay-flat side 66 as well as the portion of the skirt on second lay-flat side 68. First bag skirt 82 has first tear initiator 70 on first lay-flat side 66, and second tear initiator 72 on second lay-flat side 68. Patch 86 has Y-shaped patch tear initiator 88. Patch tear initiator 88 is positioned along a machine direction tear line extending from first tear initiator 70, so that a tear initiated and propagated from tear initiator 70 propagated to patch tear initiator 88, with further tearing resulting in the tear in bag 52 propagating to second side edge 60 while concurrently a tear is propagated across patch 86 from tear initiator 88 to opposite patch edge 90. First skirt 82 also contains first grip assisters 74 and second grip assisters 78, each of which pass through both first lay-flat side 66 and second lay-flat side 68 of skirt 82. First grip assisters 74 have respective hanging chads 76 therein, and second grip assisters 78 have respective hanging chads 44 therein. First skirt 82 also contains supplemental heat seal 92 outward of tear initiators 70 and 72 and parallel to first side edge 58. Supplemental heat seal 92 is a heat seal of the first lay-flat side of skirt 82 to the second lay-flat side of skirt 82. Supplemental heat seal 92 reduces curling and shrinking of skirt 82, thereby enhancing end user detection and utilization of tear initiators 70 and 72, as well as grip assisters 74 and 78.

FIG. 5 illustrates a schematic of heat-shrinkable pouch-style patch bag 100, in lay-flat position. Pouch-style patch bag 100 is made from two pieces of film, with each piece of film having machine direction of film manufacture running from top edge 102 to bottom edge 104. Pouch-style patch bag 100 comprises heat shrinkable pouch 106 made from two pieces of a multilayer heat-shrinkable film, with pouch 106 having first lay-flat side 108, second lay-flat side 110, top edge 102, bottom edge 104, first side edge 112, second side edge 114, first side seal 116 (a heat seal), second side seal 118 (a heat seal), bottom seal 120 (a heat seal), first side skirt 122, second side skirt 124, bottom skirt 126, first tear initiator 128 in first lay-flat side 108, second tear initiator 130 in second lay-flat side 110, first grip assisters 132 having hanging chads 134, second grip assisters 136 having hanging chads 138, and supplemental heat seal 140. Patch 142 is adhered to pouch 106, with patch 142 having Y-shaped patch tear initiator 144 on a first edge, with patch tear initiator 144 aligned with first tear initiator 128 for the propagation of a controlled direction tear through patch 142 to opposite patch edge 146. First side skirt 122 includes two discrete skirts joined at first side seal 116, i.e., the side skirt outward of first side seal 116 on first lay-flat side 108, as well as the side skirt outward of heat seal 118 on first lay-flat side 108, as well as the skirt outward of heat seal 118 on second lay-flat side 110. Second side skirt 124 includes two discrete skirts joined at heat seal 118, i.e., the skirt outward of heat seal 118 on first lay-flat side 108, and second lay-flat side 110. Bottom skirt 126 has first tear initiator 128 on first lay-flat side 108, and second tear-initiator 130 on second lay-flat side 110. Patch 142 has Y-shaped patch tear initiator 144. Patch tear initiator 144 is positioned along a machine direction tear line extending from first tear initiator 128, so that a tear initiated and propagated from tear initiator 128 can be propagated to patch tear initiator 144, with further tearing resulting in the tear in pouch 106 propagating to second opposite edge 102 while concurrently a tear is propagated up patch 142 from patch tear initiator 144 to opposite patch edge 146. Bottom skirt 126 also contains first grip assisters 132 and second grip assisters 136, each of which pass through both first lay-flat side 108 and second lay-flat side 110 of skirt 126. First grip assisters 132 have respective hanging chads 134 therein, and second grip assisters 136 have respective hanging chads 138 therein. Bottom skirt 126 also contains supplemental heat seal 140 outward of tear initiators 132 and 136 and parallel to bottom edge 104. Supplemental heat seal 140 is a heat seal of the first lay-flat side of bottom skirt 126 to the second lay-flat side of bottom skirt 126. Supplemental heat seal 140 reduces curling and shrinking of skirt 126, thereby enhancing end user detection and utilization of tear initiators 128 and 130, as well as grip assisters 132 and 136.
patch edge 384, and thereafter onward toward top edge 352 of bag 351. Skirt 366 also contains first grip assisters 384 and second grip assisters 386, each of which pass through both first lay-flat side 356 (as illustrated) and second lay-flat side 358 (not illustrated) of skirt 366. First grip assisters 384 have respective hanging chads 388 therein, and second grip assisters 386 have respective hanging chads 390 therein. Skirt 366 also contains supplemental heat seal 392 outward of tear initiators 376 and 378 and parallel to first bottom edge 354. Supplemental heat seal 392 is a heat seal of the first lay-flat side of skirt 366 to the second lay-flat side of skirt 366. Supplemental heat seal 392 reduces curling and shrinking of skirt 366 in the region of tear initiators 376 and 378 as well as in the region of grip assisters 384 and 386, thereby enhancing end user detection and utilization of the tear initiators and grip assisters for the easy manual tearing open of bag 351 and patch 380. Although FIGS. 6A and 6B illustrate a backseamed patch bag with a fin-type backseam heat seal, alternatively the backseam heat seal could be a lap-type backseam heat seal in which the inside layer of the bag film is heat sealed to the outside layer of the bag film.

[0109] FIG. 7 illustrates a schematic of alternative heat-shrinkable end-seal patch bag 150, in lay-flat position. Alternative patch bag 150 largely corresponds with end-seal heat-shrinkable patch bag 10 of FIG. 1. Patch bag 150 has bag 151 having first lay-flat side 152, second lay-flat side 154, top edge 156, bottom edge 158, first sile edge 160, second side edge 162, end seal 164 (a heat seal), skirt 166, first tear initiator 168 in first lay-flat side 152, second tear initiator 170 in second lay-flat side 154, first grip assisters 172 having hanging chads 174, second grip assisters 176 having hanging chads 178, and four supplemental spot seals 180. Patch 182 is adhered to bag 151, with patch 182 having bottom edge 184 with patch tear initiators 186, 188, and 190 adjacent one another. Middle patch tear initiator 188 is Y-shaped and is positioned along an MD tear line from first tear initiator 168. However, in the event that a tear propagating from first tear initiator 168 deviates slightly from the machine direction, it will likely propagate into either Y-shaped patch tear initiator 186 or V-shaped patch tear initiator 190. The multiplicity of patch tear initiators in patch bag 150 reduces the need for precision in aligning a single patch tear initiator with the bag tear initiator. In fact, the entire lower edge of the patch can be provided with tear initiators so that the tear propagated from the bag tear initiator will undoubtedly propagate into a patch tear initiator in the edge of the patch closest to the bag tear initiator. The patch tear initiators can have a Y-shape, V-shape, U-shape, etc. Each of Y-shape of patch tear initiators 186 and 188 provides an enhanced point of stress concentration in providing a cut which is along the desired line of tear propagation to the opposite edge 192 of patch 182. However, the V-shape of patch tear initiator 190 has also been found to provide sufficient stress concentration to initiate a tear to initiate and propagate from patch tear initiator 190 to opposite edge 192 of patch 182. Of course, the embodiments of FIG. 1, FIG. 3 and FIG. 5 could also have a V-shaped patch tear initiator instead of the Y-shaped patch tear initiators illustrated in FIG. 1, FIG. 3 and FIG. 5. Other patch tear initiator shapes are also operable, such as a straight slit, a curved slit, a semicircular notch, a square-shaped notch, a rectangle-shaped notch, a half pentagon shaped notch, a half hexagon shaped notch, a half oval shaped notch, etc.

[0110] The four spot welds 180 in FIG. 7 are an alternative to the supplemental seal 46 of the embodiment of FIG. 1, the supplemental seal 92 of the embodiment of FIG. 3, and the supplemental seal 140 of the embodiment of FIG. 5. As with supplemental seals 46, 92, and 140, spot welds 180 are heat seals of the first lay-flat side of skirt 166 to the second lay-flat side of skirt 166. As with supplemental seals 46, 92, and 140, spot welds 180 enhance end user detection and utilization of tear initiators 168 and 170, as well as grip assisters 172 and 176, by annealing/heat-setting a portion of skirt 166 to reduce shrinkage and curling upon shrinking the film against the meat product inside the bag.

[0111] FIG. 8 is a perspective view of the front of packaged product 300 containing a bone-in meat product 302 having a protruding bone end 304, with meat product 302 being completely surrounded by packaging article 306, which has been shrunk tightly around meat product 302. Packaging article 306 was prepared from a heat-shrinkable end-seal patch bag comprising a heat-shrinkable bag (made from heat shrinkable film 308) into which meat product 302 was placed, with meat product 302 positioned within the bag so that the heat-shrinkable patch 310 on the bag covered protruding bone end 304. Atmosphere within the heat-shrinkable bag was then evacuated and the open end of the bag sealed closed at top heat seal 324. The heat-shrinkable bag film and heat-shrinkable patch film were then shrunk tightly around meat product 302 by passing the packaged product through a hot air shrink tunnel, resulting in packaged product 300 as illustrated in FIG. 8. [0112] Packaged product 300 has bottom skirt 312 bounded by bottom edge 314, side edges 315 and 317, and heat seal 316. Front and back sides of skirt 312 have tear initiators 316 & 317, respectively, as well as first pair of grip assisters 318 & 319, respectively, and 320 & 321, respectively. Moreover, the front and back sides of skirt 312 are heat sealed together at four spot seals 322. Skirt 326 above top heat seal 324 has shrunk and curled as a result of the shrinkage of the heat-shrinkable bag film 308. Patch 310 has patch tear initiator 328 aligned with tear initiator 317 in skirt 312, so that a controlled direction MD tear from tear initiator 317 will propagate into patch tear initiator 328, with bag film 330 and patch 310 thereafter tearing together in the machine direction up the length of the packaging article 306 to the opposite edge 330 of patch 310, and then on to the opposite edge 332 of bag film 308.

[0113] FIG. 9 illustrates a schematic of a preferred process for producing the multilayer heat-shrinkable film from which the bag can be made. In the process illustrated in FIG. 9, solid polymer beads (not illustrated) are fed to a plurality of extruders 200 (for simplicity, only one extruder is illustrated). Inside extruders 200 the polymer beads are forwarded, melted, and degassed, following which the resulting bubble-free melt is forwarded into die head 202, and extruded through an annular die, resulting in tubing 204 which is 10 to 30 mils thick, more preferably 15 to 25 mils thick.

[0114] After cooling or quenching by water spray from cooling ring 206, tubing 204 is collapsed by pinch rolls 208, and is thereafter fed through irradiation vault 210 surrounded by shielding 209, where tubing 204 is irradiated with high energy electrons (i.e., ionizing radiation) from iron core transformer accelerator 214. Tubing 204 is guided through irradiation vault 210 on rolls 212. Preferably, tubing 204 is irradiated to a level of about 4.5 MR.

[0115] After irradiation, irradiated tubing 216 is directed through nip rolls 218, following which irradiated tubing 216 is slightly inflated, resulting in trapped bubble 220. However, at trapped bubble 220, the tubing is not significantly drawn
longitudinally, as the surface speed of nip rolls 224 are about the same speed as nip rolls 218. Furthermore, irradiated tubing 216 is inflated only enough to provide a substantially circular tubing without significant transverse orientation, i.e., without stretching.

[0116] Slightly inflated, irradiated tubing 216 is passed through vacuum chamber 222, and thereafter forwarded through coating die 225. Second tubular film 226 is melt extruded from coating die 225 and coated onto slightly inflated, irradiated tube 220, to form two-ply tubular film 228. Second tubular film 226 preferably comprises an O₂-bARRIER layer, which does not pass through the ionizing radiation. Further details of the above-described coating step are generally as set forth in U.S. Pat. No. 4,278,738, to BRAX et al., which is hereby incorporated by reference thereto, in its entirety.

[0117] After irradiation and coating, two-ply tubing film 228 is wound up onto windup roll 230. Thereafter, windup roll 230 is removed and installed as unwind roll 232 on a second stage in the process of making the tubing film as ultimately desired. Two-ply tubular film 228, from unwind roll 232, is unwound and passed over guide roll 234, after which two-ply tubular film 228 passes into hot water bath tank 236 containing hot water 238. The now collapsed, irradiated, coated tubular film 228 is submerged in hot water 238 (having a temperature of about 210°F.) for a retention time of at least about 5 seconds, i.e., for a time period in order to bring the film up to the desired temperature for biaxial orientation. Thereafter, irradiated tubular film 228 is directed through nip rolls 240, and bubble 242 is blown, thereby transversely stretching tubular film 228. Furthermore, while being blown, i.e., transversely stretched, nip rolls 244 draw tubular film 228 in the longitudinal direction, as nip rolls 244 have a surface speed higher than the surface speed of nip rolls 240. As a result of the transverse stretching and longitudinal drawing, irradiated, coated biaxially-oriented blowing film 246 is produced, this blown tubing preferably having been both stretched in the solid state in a ratio of from about 1:1.5-1:6, and drawn in a ratio of from about 1:1.5-1:6. More preferably, the stretching and drawing are each performed a ratio of from about 1.2-1.4. The result is a biaxial orientation of from about 1.2-2.5×1.36, more preferably, 1.4-1.6. While bubble 242 is maintained between pinch rolls 240 and 244, tubing film 246 is collapsed by rolls 248, and thereafter conveyed through nip rolls 244 and across guide roll 250, and then rolled onto wind-up roll 252. Idler roll 254 assures a good wind-up.

[0118] FIG. 10 illustrates a schematic of a preferred process for producing a multilayer film from which the heat-shrinkable patch is made. In the process illustrated in FIG. 10, solid polymer beads (not illustrated) are fed to a plurality of extruders 300 (for simplicity, only one extruder is illustrated). Inside extruders 300, the polymer beads are forward, melted, and degassed, following which the resulting bubble-free melt is forwarded into die head 302, and extruded through annular die, resulting in tubing 304 which is 5-40 mils thick, more preferably 20-30 mils thick, still more preferably, about 25 mls thick.

[0119] After cooling or quenching by water spray from cooling ring 306, tubing 304 is collapsed by pinch rolls 308, and is thereafter fed through irradiation vault 310 surrounded by shielding 312, where tubing 304 is irradiated with high energy electrons (i.e., ionizing radiation) from iron core transformer accelerator 314. Tubing 304 is guided through irradiation vault 310 on rolls 316. Preferably, the irradiation of tubing 304 is at a level of about 7 MR.

[0120] After irradiation, irradiated tubing 318 is directed over guide roll 320, after which irradiated tubing 318 passes into hot water bath tank 322 containing water 324. The now collapsed irradiated tubing 318 is immersed in the hot water for retention time of at least about 5 seconds, i.e., for a time period in order to bring the film up to the desired temperature, following which supplemental heating means (not illustrated) including a plurality of steam rolls around which irradiated tubing is partially wound, and optional hot air blowers, elevate the temperature of irradiated tubing 318 to a desired orientation temperature of from about 240° F. to 250° F. Thereafter, irradiated film tubing 318 is directed through nip rolls 326, and bubble 328 is blown, thereby transversely stretching irradiated tubing 318. Furthermore, while being blown, i.e., transversely stretched, nip rolls 330 draw irradiated film 318 in the longitudinal direction, as nip rolls 330 have a higher surface speed than the surface speed of nip rolls 326. As a result of the transverse stretching and longitudinal drawing, irradiated, biaxially-oriented blowing film 332 is produced, this blown tubing preferably having been both stretched in a ratio of from about 1.1:1.5-1.6, and drawn in a ratio of from about 1.1:1.5-1.6. More preferably, the stretching and drawing are each performed a ratio of from about 1.2-1.4.

[0121] Preferably, the stock film from which the bag is formed has a total thickness of from about 1.2 to 5 mls, or 1.5 to 4 mls, or 1.6 to 3 mls, or 1.7 to 2.5 mls, or 1.8 to 2.2 mls, or about 2 mls. Preferably the stock film from which the bag is formed is a multilayer film having from 3 to 12 layers, or 4 to 10 layers, or 5 to 9 layers, or 6 to 8 layers.

[0122] Grip assist holes can be sized to allow a user’s finger(s) to be inserted therethrough to assist in gripping the film. Grip assist holes work in conjunction with the tear initiators, by providing a secure manual grip of the bag in a location designed to assist in generating tear initiation force along a tear line emanating from the tear initiators.

[0123] The grip assist hole in a first lay-flat side of the bag can overlap or coincide with the grip assist hole in a second lay-flat side of the bag. While grip assist holes can have any desired shape (e.g., round, rectangular, square, triangular, pentagonal, hexagonal, etc.), preferably the holes are round, or any “corners” on the holes are rounded, to reduce the presence of stress concentration points that could cause a tear to initiate from the grip assist hole, as an objective is to have the tear initiated from the tear initiator, with the tear running to an opposite side edge of the bag.

[0124] In one embodiment, the grip-assist holes can be made by cutting through both lay-flat sides of the bag to remove a piece of film to form the holes. However, this process produces small, loose pieces of film corresponding with the size of the cut hole. In order to avoid the possibility of having these small, loose pieces of film get inside the bag, they must be controlled and collected, which lowers the efficiency of the production process while at the same time increasing the complexity of the production process. It is simpler and more efficient to provide the grip assist hole in a shape that corresponds with a “partial hole cut”, i.e., a cut...
through the film to make a portion of the hole, the cut not being complete so that a hole is formed, as illustrated in FIGS. 1, 3, 4, 5, 6A, and 7. Such partial cuts leave a "hanging chad" so that no separated small pieces of film are produced.

Resins Utilized in the Examples

Unless otherwise indicated, the following listing of resins identifies the various resins utilized in the Example below.

<table>
<thead>
<tr>
<th>Resin code</th>
<th>Trade name</th>
<th>Generic Resin Name [additional information]</th>
<th>Density (g/cc)</th>
<th>Melt Index (dg/min)</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSPE 1</td>
<td>Affinity® PL 1281GI</td>
<td>Homogeneous ethylene/acetate copolymer</td>
<td>0.900</td>
<td>6.0</td>
<td>Dow</td>
</tr>
<tr>
<td>SSPE 2</td>
<td>Affinity® PL 1856G</td>
<td>Homogeneous ethylene/acetate copolymer</td>
<td>0.902</td>
<td>3.0</td>
<td>Dow</td>
</tr>
<tr>
<td>VLDPE</td>
<td>XLS 61520.15L</td>
<td>Very low density polyethylene</td>
<td>0.903</td>
<td>0.5</td>
<td>Dow</td>
</tr>
<tr>
<td>LLDPE 1</td>
<td>Dowlex® 2645.03</td>
<td>Linear Low Density Polyethylene</td>
<td>0.920</td>
<td>1.0</td>
<td>Dow</td>
</tr>
<tr>
<td>LLDPE 2</td>
<td>LL 3003.32</td>
<td>Heterogeneous Ethylene/hexene copolymer</td>
<td>0.9175</td>
<td>3.2</td>
<td>Exxon Mobil</td>
</tr>
<tr>
<td>EVA 1</td>
<td>Escorone® LD 713.93</td>
<td>Ethylene-vinyl acetate copolymer (14.4% VA)</td>
<td>0.933</td>
<td>3.5</td>
<td>Exxon Mobil</td>
</tr>
<tr>
<td>EVA 2</td>
<td>Escorone® LD 761.36</td>
<td>Ethylene-vinyl acetate copolymer (25.7% VA)</td>
<td>0.950</td>
<td>5.75</td>
<td>Exxon Mobil</td>
</tr>
<tr>
<td>EAA</td>
<td>Primaacor1410 adhesive polymer</td>
<td>Ethylene-acrylic acid copolymer (9.5% acrylic acid)</td>
<td>0.938</td>
<td>1.5</td>
<td>Dow</td>
</tr>
<tr>
<td>PVDC</td>
<td>Sxara® 806</td>
<td>Vinylidene chloride/methyl acrylate copolymer</td>
<td>1.69</td>
<td>—</td>
<td>Dow</td>
</tr>
<tr>
<td>Bright</td>
<td>L-7106-AB</td>
<td>Optical brightener in LDPE</td>
<td>0.945</td>
<td>4.5</td>
<td>Bayshore Industrial Inc.</td>
</tr>
</tbody>
</table>

Example 1

Working

An end-seal bag was made from a coextruded, multilayer, heat-shrinkable film produced utilizing the process set forth in FIG. 10, described above, for use as a patch to be adhered to the end-seal bag made from the film of Table 2, described above. The multilayer, heat-shrinkable, self-welded film tubing for use as a patch was extruded from an annular die as a three layer extrudate, with Layer 1 being the outside of the tubing and Layer 3 being the inside (self-welding) layer of the tubing. The composition and thickness of the three layers is as set forth in Table 3.

<table>
<thead>
<tr>
<th>Layer No.</th>
<th>Layer 1</th>
<th>Layer 2</th>
<th>Layer 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer</td>
<td>90% VLDPE</td>
<td>100% VLDPE</td>
<td>80% EAA</td>
</tr>
<tr>
<td>Composition</td>
<td>10% Bright</td>
<td>16% Bright</td>
<td>34% Bright</td>
</tr>
<tr>
<td>Layer thickness</td>
<td>0.43 mil</td>
<td>1.58 mil</td>
<td>0.24 mil</td>
</tr>
<tr>
<td>Before self-welding</td>
<td>Total layer thickness</td>
<td>0.86 mil</td>
<td>3.16 mil</td>
</tr>
</tbody>
</table>

TABLE 1

TABLE 2

Example 1: Multilayer Heat-Shrinkable Bag Film

<table>
<thead>
<tr>
<th>Layer 1</th>
<th>Layer 2</th>
<th>Layer 6</th>
<th>Layer 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>80%</td>
<td>70%</td>
<td>70%</td>
<td>80%</td>
</tr>
<tr>
<td>SSPE 1</td>
<td>VLDPE</td>
<td>Layer 3</td>
<td>Layer 5</td>
</tr>
<tr>
<td>20%</td>
<td>30%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>LLDPE 2</td>
<td>EVA 1</td>
<td>EVA 1</td>
<td>PVDC</td>
</tr>
<tr>
<td>EVA 1</td>
<td>EVA 1</td>
<td>EVA 2</td>
<td>EVA 1</td>
</tr>
<tr>
<td>LLDPE 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.43 mil</td>
<td>0.78 mil</td>
<td>0.09 mil</td>
<td>0.18 mil</td>
</tr>
<tr>
<td>0.09 mil</td>
<td>0.26 mil</td>
<td>0.17 mil</td>
<td></td>
</tr>
</tbody>
</table>

TABLE 3

Multilayer Heat-Shrinkable Patch Film

<table>
<thead>
<tr>
<th>Layer</th>
<th>Layer 1</th>
<th>Layer 2</th>
<th>Layer 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>90%</td>
<td>VLDPE</td>
<td>100% VLDPE</td>
<td>80% EAA</td>
</tr>
<tr>
<td>10%</td>
<td>Bright</td>
<td>16% Bright</td>
<td>34% Bright</td>
</tr>
<tr>
<td>0.43 mil</td>
<td>1.58 mil</td>
<td>0.24 mil</td>
<td></td>
</tr>
<tr>
<td>0.86 mil</td>
<td>3.16 mil</td>
<td>0.48 mil</td>
<td></td>
</tr>
<tr>
<td>Before self-welding</td>
<td>Total layer thickness</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Upon self-welding, the three-layer 1/2/3 extrudate of Table 3 formed a six-layer coextruded heat-shrinkable film of the structure 1/2/3/3/2/1, with Layer 1 forming the outer layers of the self-welded heat-shrinkable patch film and Layer 3 forming the self-welding layer, with the final thickness of the self-welded heat-shrinkable film being 4.5 mils.

The film of Table 2 was seamless tubing having a lay-flat width of 9 to 10 inches. The tubing was cut and sealed to form an end-seal bag having a length of about 17 to 18 inches before shrinking. A patch according to Table 2 was cut and adhered to the outside surface of the bag, resulting in a patch bag in accordance with FIG. 1 and FIG. 2, i.e., with a curved heat seal and with the patch not extending to the heat seal. The bag was provided with the tear initiators, grip assisters, and supplemental heat seal as illustrated in FIG. 1. The patch was provided with a patch tear initiator as illustrated in FIG. 2, with a machine direction line extending from a bag tear initiator into the patch tear initiator. The distance between the bag tear initiator and the patch tear initiator was about 3 inches.

A whole turkey product was placed inside the bag and the atmosphere evacuated from the bag, and the bag sealed closed with a heat seal of the inside layer of the bag to itself in a region between the product and the top edge of the bag. The excess bag length was trimmed off and the resulting package was then shrink tightly against the product by passing the packaged product through a shrink tunnel. The packaged product was then placed in a refrigerator and cooled to about 2°C. The cooled packaged product was then removed from the refrigerant and torn open using two hands, each with a finger through a grip assister. Tears were manually initiated and manually propagated from each of the two tear initiators in the bag skirt by pulling the grip assisters away from one another, causing the bag tear initiators to spread open followed by initiating two machine direction tears, one from each of the two bag tear initiators. The two tears propagated down the length of the shrunken package. One of the MD tears propagated into the patch tear initiator, and thereafter the patch and bag tore together to the opposite edge of the patch, and as tearing continued, to the opposite edge of the bag.

Example 2

Comparative

A heat-shrinkable end-seal bag was made as in Example 1, and a patch was adhered to the bag as in Example 1, except that the patch was not provided with a tear initiator. Upon insertion of bone-in meat product into the resulting patch bag, evacuation of atmosphere from the bag, sealing the bag closed, cutting excess bag tail off, shrinking the bag against the meat product by passing the packaged product through a shrink tunnel, refrigerating the packaged product, removal and tearing the bag open using the grip assisters, the result was that the bag exhibited a controlled direction MD tear until the bag tear propagated to the edge of the patch. Once the bag tear propagated to the edge of the patch, the application of further tearing force resulted in an initial stretching of the patch as the bag continued tearing toward and to the opposite edge of the bag. As the bag tore, the patch delaminated fully from the bag along one side of the bag MD tear line, and delaminated partially from the bag on the other side of the bag MD tear line. At no point did the bag and patch tear together. Significantly more force was required to stretch and delaminate the patch from the bag than to tear the bag and patch together as in Example 1.

What is claimed is:

1. A patch bag comprising a heat-shrinkable patch adhered to a heat-shrinkable bag having an open top and a top edge, a closed bottom and a bottom edge, a first side edge, a second side edge, a first lay-flat side, a second lay-flat side, a heat seal of a region of the first lay-flat side to a region of the second lay-flat side, a first tear initiator in the first lay-flat side in a bag skirt outward of the heat seal or in a bag header between the patch and the top edge of the bag, a second tear initiator in the second lay-flat side in the bag skirt outward of the heat seal or in the bag header between the patch and the top edge of the bag, with at least a portion of the heat-shrinkable patch being adhered to an outside surface of the first lay-flat side of the bag, with the patch having a patch tear initiator located on an edge of the patch in a location separated from the first tear initiator, the patch tear initiator being aligned with an MD or TD tear line extending from the first bag tear initiator, with the heat shrinkable bag comprising a multilayer film having at least one layer comprising an incompatible polymer blend.

2. The patch bag according to claim 1, wherein the incompatible polymer blend comprises at least one member selected from the group consisting of:

- (A) a blend of from 80 to 60 wt % ethylene homopolymer and/or ethylene/α-olefin copolymer with from 20 to 40 wt ethylene/unsaturated ester copolymer having an unsaturated ester content of at least 10 wt %;
- (B) a blend of ionomer resin with ethylene/unsaturated ester copolymer, and/or polybutene, and/or propylene homopolymer and/or propylene copolymer;
- (C) a blend of homogeneous ethylene/α-olefin copolymer with recycled polymer blend comprising ethylene homopolymer, propylene homopolymer, ethylene copolymer, propylene copolymer, polyamide, ethylene/vinyl alcohol copolymer, ionomer resin, anhydride-modified ethylene/α-olefin copolymer, and/or anti-block;
- (D) a blend of from 10 to 75 wt % ethylene/unsaturated ester copolymer with from 90 to 15 wt % polypropylene and/or propylene/ethylene copolymer, and/or polybutene, and/or modified ethylene/α-olefin copolymer, and/or styrene homopolymer, and/or styrene/butadiene copolymer;
- (E) a blend of ethylene/norbornene copolymer with ethylene/unsaturated ester copolymer and/or polypropylene and/or polybutene;
- (F) a blend of from 90 to 15 wt % ethylene/α-olefin copolymer with from 10 to 75 wt % polypropylene and polybutene and/or ethylene/norbornene;
- (G) a blend of from 90 to 25 wt % homogeneous propylene homopolymer and/or homogeneous propylene copolymer with from 10 to 75 wt % homogeneous ethylene/α-olefin copolymer and/or ethylene/unsaturated ester copolymer;
- (H) a blend of propylene homopolymer and/or propylene/ethylene copolymer and/or polybutene with ethylene/methyl acrylate copolymer and/or ethylene/acyrylic acid copolymer and/or ethylene/butyl acrylate copolymer;
- (I) a blend of polyamide with polystyrene and/or ethylene/α-olefin copolymer and/or ethylene/vinyl acetate copolymer and/or styrene/butadiene copolymer;
- (J) a blend of polyamide 6 and polyamide 6I6T,
(K) a blend of a thermoplastic polymer and a filler, wherein the filler is present in an amount of at least 5 wt %, based on layer weight.

3. The heat-shrinkable patch bag according to claim 1, wherein the bag is an end-seal bag comprising a seamless tubing with the first and second bag side edges being folded edges, with the heat seal being an end seal across a bottom of the bag, with the skirt being outward of the end seal, with the patch tear initiator being aligned with the MD tear line extending from the first tear initiator.

4. The heat-shrinkable patch bag according to claim 1, wherein the bag is a side-seal bag having an open top, a folded bottom edge, first side seal along the first side edge, second side seal along the second side edge, with respective first and second bag skirts outward of respective first and second side seals, with the first and second tear initiators being in the first bag skirt and outward of the first side seal, with the patch tear initiator being aligned with the MD tear line extending from the first tear initiator.

5. The heat-shrinkable patch bag according to claim 1, wherein the bag is a pouch having a bottom seal which is a heat seal of the first lay-flat side to the second lay-flat side along the bottom edge, with a bottom skirt between the bottom edge and the bottom seal, and a first side seal which is a heat seal of the first lay-flat side to the second lay-flat side along the first side edge with a first skirt between the first side seal and the first side edge, a second side seal which is a heat seal of the first lay-flat side to the second lay-flat side along the second side edge with a second side skirt between the second side seal and the second side edge, with the first and second tear initiators being in the same skirt.

6. The heat-shrinkable patch bag according to claim 1, wherein the bag is a backseamed bag having a bottom seal which is a heat seal of the first lay-flat side to the second lay-flat side along the bottom edge, with a bottom skirt between the bottom edge and the bottom seal, with the backseamed bag having a backseamed seal which is a heat seal of the multilayer film to itself, with the backseamed seal being on the second lay-flat side of the bag and the backseam running from the bottom edge of the bag to the top edge of the bag.

7. The heat-shrinkable patch bag according to claim 1, wherein the patch comprises a plurality of tear initiators, with one of the tear initiators being aligned with an MD or TD tear line extending from the first bag tear initiator.

8. The heat-shrinkable patch bag according to claim 1, wherein the patch tear initiator is V-shaped or Y-shaped.

9. The heat-shrinkable patch bag according to claim 1, wherein the bag film is a multilayer film comprising an outer seal and a inner contact layer which is an inside layer of the bag, with a outer barrier layer which is an outside layer of the bag and with a inner layer which comprises ethylene/α-olefin copolymer, an outer barrier layer which is an outside layer of the bag and which comprises ethylene/α-olefin copolymer, an internal O₂-barrier layer, a first tie layer between the seal layer and the O₂-barrier layer, a second tie layer between the seal layer and the first tie layer and the second tie layer, wherein the first and second incompatible polymer blend layers comprise a blend of from 60 to 80 wt % ethylene/α-olefin copolymer and 40 to 20 wt % ethylene/unsaturated ester copolymer having an unsaturated ester content of at least 10 wt %, based on polymer weight, with the amount of incompatible polymer blend in the film being from 30 to 70 wt %, based on total film weight, and the patch comprises self-welded multilayer film having an outer layer comprising ethylene/α-olefin copolymer, self-weld layer comprising an ethylene unsaturated ester or ethylene/unsaturated acid copolymer, and an intermediate layer between the self weld layer and the outer layer comprising ethylene/α-olefin copolymer.

10. The heat-shrinkable patch bag according to claim 1, wherein the patch is positioned inward of the heat seal and does not extend to the heat seal.

11. The heat-shrinkable patch bag according to claim 1, wherein the first tear initiator is placed in a central region of the bag, and the second tear initiator is placed in the central region of the bag, with the central region extending up to 70% of a bag dimension transverse to a centerline.

12. The heat-shrinkable patch bag according to claim 1, wherein the skirt further comprises a grip assist and, at least a portion of the skirt or header is heatset in order to reduce the shrinkage of the skirt or header upon shrinking the film around the product.

13. The heat-shrinkable patch bag according to claim 12, wherein the skirt portion is in the skirt and the skirt portion comprises at least one supplemental heat seal of at least a portion of the first lay-flat side of the skirt to a portion of the second lay-flat side of the skirt.

14. The heat-shrinkable patch bag according to claim 1, wherein the patch covers at least a portion of the heat seal and a portion of the patch covers a portion of the skirt, with the portion of the patch covering the skirt having an edge inside an outer edge of the skirt.

15. The heat-shrinkable patch bag according to claim 1, wherein the multilayer film has Peak Load Impact Strength, determined using ASTM D 3763-95A, of at least 50 Newtons per mil, and the multilayer film has thickness of from 1.5 to 5 mils.

16. The heat-shrinkable patch bag according to claim 1, wherein the patch does not have a line of weakness aligned with the patch tear initiator.

17. The patch bag according to claim 1, wherein the first tear initiator and the second tear initiator are coincident or substantially coincident.

18. The heat-shrinkable patch bag according to claim 1, wherein the patch comprises a heat shrinkable film that does not comprise an incompatible polymer blend.

19. The heat-shrinkable patch bag according to claim 1, wherein the patch comprises a heat shrinkable film containing an incompatible polymer blend.

20. The heat-shrinkable patch bag according to claim 1, wherein the patch is a first patch adhered to a first lay-flat side of the bag, with the patch tear initiator being a first tear initiator in the first patch, with the first patch tear initiator being aligned with the first bag tear initiator, with the patch bag further comprising and a second patch adhered to a second lay-flat side of the bag, the second patch having a second patch tear initiator which is aligned with the second bag tear initiator.

* * * * *