

PEELABLE SEALANT FILM AND PACKAGING

TECHNICAL FIELD

[001] This disclosure is related to a peelable sealant film, packaging films and packaged products made therefrom. The films described herein may be recyclable in a polyolefin-based stream.

BACKGROUND

[002] Peelable films are widely used in various industries, including food packaging, medical packaging, and industrial packaging. Peelable lidding films can be sealed to packaging components, such as formed containers (e.g., cups, trays, or arrays), to form a package. The package can be opened by peelably removing the lidding film from the packaging component in the sealed area. Packages of this type (e.g., formed containers sealed with peelable lidding film) may contain products such as yogurt, pudding, sauce, syrup, jelly, or fruit juice, for example.

[003] These peelable films are designed to provide a secure seal to protect the contents of the package while also being easy to open by the end-user. The peelable films further should: i) include a low seal initiation temperature (SIT) to facilitate the secure seal at high manufacturing speeds, ii) have clean removal or clean peel (i.e., good peel quality) from a packaging component that includes minimal or no stretchiness, stringiness, fragmentation of the sealant film, or tearing of the peelable film layers, and iii) product resistance (i.e., resistance to products, for example, oily, acidic, or alcoholic products that affect a secure seal).

[004] Conventional approaches for producing peelable films involve using a combination of polymers to achieve the desired properties. However, these approaches often result in films that are either too difficult to peel from a package or too weak to provide adequate protection to the contents of the package, leading to user frustration or product spoilage. Heat seal coatings are often used to provide an appropriate peel strength to peel open the package. However, global demand for plastic waste reduction and sustainable packaging solutions is on the rise such that many packaging applications are moving to

polyolefin-based structures. Existing heat seal coatings are unable to adequately seal to polyolefins at low SIT and provide good product resistance.

SUMMARY

[005] This disclosure provides a peelable sealant film that combines a peel layer with a seal layer. The peel layer includes a blend of a primary polymer and a secondary polymer. The seal layer includes a blend of a primary polymer and a secondary polymer, where the primary polymers and secondary polymers for each of the peel layer and seal layer, are carefully selected to provide both excellent sealing strength and easy peeling properties. The peel layer secondary polymer includes a polymer that can remain dispersed in the primary polymer that further enhances the peeling properties without compromising the seal strength. The peelable sealant film provides a secure seal, easy opening, clean peel or good peel quality, good product resistance, and manufacturing efficiencies (e.g., low SIT at high manufacturing speeds), making it ideal for a wide range of packaging applications. The peelable sealant film may be recyclable.

[006] In a first aspect, a peelable sealant film includes a peel layer including a blend including a peel layer primary polymer in a range of from 30% to 95%, by weight of the peel layer, and a peel layer secondary polymer in a range of from 5% to 30%, by weight of the peel layer. The peelable sealant film includes a seal layer including a blend including a seal layer primary polymer in a range of from 50% to 90%, by weight of the seal layer, and a seal layer secondary polymer in a range of from 10% to 40%, by weight of the seal layer. The peel layer primary polymer includes polyethylene and the peel layer secondary polymer includes polybutene, polypropylene, or combinations thereof. The seal layer primary polymer includes metallocene linear low density polyethylene (mLLDPE), ethylene vinyl acetate (EVA), alpha-olefin copolymer, elastomer, or combinations thereof, and the seal layer secondary polymer includes cycloolefinic copolymer (COC). The peel layer and the seal layer are directly adjacent to each other.

[007] In a second aspect, a packaging film includes an exterior film and a peelable sealant film. The peelable sealant film includes a peel layer and a seal

layer. The peel layer includes a blend including a peel layer primary polymer in a range of from 30% to 95%, by weight of the peel layer, and a peel layer secondary polymer in a range of from 5% to 30%, by weight of the peel layer. The seal layer includes a blend including a seal layer primary polymer in a range of from 50% to 90%, by weight of the seal layer, and a seal layer secondary polymer in a range of from 10% to 40%, by weight of the seal layer. The peel layer primary polymer includes polyethylene and the peel layer secondary polymer includes polybutene, polypropylene, or combinations thereof. The seal layer primary polymer includes metallocene linear low density polyethylene (mLLDPE), ethylene vinyl acetate (EVA), alpha-olefin copolymer, elastomer, or combinations thereof, and the seal layer secondary polymer includes cycloolefinic copolymer (COC). The peel layer and the seal layer are directly adjacent to each other. The peel layer is positioned between the exterior film and the seal layer.

[008] In a third aspect, a package includes a formed packaging component having an interior surface, a packaging film including an exterior film, a peelable sealant film, and a heat seal. The peelable sealant film including a peel layer and a seal layer. The peel layer includes a blend including a peel layer primary polymer in a range of from 30% to 95%, by weight of the peel layer, and a peel layer secondary polymer in a range of from 5% to 30%, by weight of the peel layer. The seal layer includes a blend including a seal layer primary polymer in a range of from 50% to 90%, by weight of the seal layer, and a seal layer secondary polymer in a range of from 10% to 40%, by weight of the seal layer. The peel layer primary polymer includes polyethylene and the peel layer secondary polymer includes polybutene, polypropylene, or combinations thereof. The seal layer primary polymer includes metallocene linear low density polyethylene (mLLDPE), ethylene vinyl acetate (EVA), alpha-olefin copolymer, elastomer, or combinations thereof, and the seal layer secondary polymer includes cycloolefinic copolymer (COC). The peel layer and the seal layer are directly adjacent to each other. The peel layer is positioned between the exterior film and the seal layer. The heat seal is formed between the seal layer and the interior surface of the formed packaging component.

[009] Other aspects that may be used individually or in combination with respect to any aspect are as follows.

- [010] In some aspects, the peel layer secondary polymer may be incompatible with the peel layer primary polymer.
- [011] In some aspects, the peel layer may be a rupturable layer.
- [012] In some aspects, the seal layer primary polymer may include a peak melting point temperature of 107° Celsius (225° Fahrenheit) or less.
- [013] In some aspects, the seal layer may include a thickness in a range of from greater than 0.0 micron to 5.1 micron (0.0 mil to 0.2 mil).
- [014] Other aspects that may be used individually or in combination with respect to the second and third aspects are as follows.
- [015] In some aspects, the exterior film may include polyamide, polyester, polypropylene, polyethylene, or combinations thereof.
- [016] In some aspects, the exterior film may include an oriented film.
- [017] In some aspects, the exterior film may include a metallized layer.
- [018] In some aspects, the exterior film may include an inorganic oxide layer.
- [019] In some aspects, the packaging film may further include an ink layer.
- [020] In some aspects, the packaging film may further include a total composition of at least 90% polyolefin-based polymers, by weight of the film.
- [021] In some aspects, the packaging film may include a lidding film.
- [022] In some aspects, the packaging film may include a formed packaging component.
- [023] Other aspects that may be used individually or in combination with respect to the third aspect is as follows.
- [024] In some aspects, the formed packaging component may include a polyolefin (PO), a polystyrene (PS), or a polyester (PET).
- [025] In some aspects, the formed packaging component may include an array.
- [026] In some aspects, the heat seal may include a hermetic seal.
- [027] In some aspects, the heat seal may be manually peelable at the peel layer.
- [028] In some aspects, the package may further include a product contained in the package.

BRIEF DESCRIPTION OF THE DRAWINGS

- [029] The disclosure may be more completely understood in consideration of the following detailed description of various embodiments of the disclosure in connection with the accompanying drawings, in which:
- [030] Figure 1 illustrates a schematic cross-sectional view of an embodiment of a peelable sealant film;
- [031] Figure 2 illustrates a schematic cross-sectional view of an embodiment of a peelable sealant film;
- [032] Figure 3 illustrates a schematic cross-sectional view of an embodiment of an exterior film;
- [033] Figure 4 illustrates a schematic cross-sectional view of an embodiment of an exterior film;
- [034] Figure 5 illustrates a schematic cross-sectional view of an embodiment of a packaging film;
- [035] Figure 6 illustrates a schematic cross-sectional view of an embodiment of a packaging film;
- [036] Figure 7 illustrates a perspective view of an embodiment of a package including a peelable sealant film and a formed packaging component;
- [037] Figure 8 illustrates a schematic partial view of a sealed portion of the package shown in Figure 7;
- [038] Figure 9 illustrates a plan view of a sealed single serve package;
- [039] Figure 10 illustrates a plan view of an array of sealed single serve packages; and
- [040] Figure 11 illustrates a schematic cross-sectional view a formed packaging component.
- [041] The drawings show some but not all embodiments. The elements depicted in the drawings are illustrative and not necessarily to scale, and the same (or similar) reference numbers denote the same (or similar) features throughout the drawings.

DETAILED DESCRIPTION

[042] Described herein are peelable sealant films that may be used for a variety of packaging applications. The peelable sealant films include a peel layer and a seal layer. The seal layer includes a blend of cycloolefinic copolymer (COC) with a polymer that can provide a low seal initiation temperature (SIT). The peelable sealant film may be combined with an exterior film to form a film that can be constructed to be a packaging component of a package. The packaging component may be a lidding film, for example, that includes an exterior film and a peelable sealant film, and the lidding film may be sealed to another packaging component (e.g., a formed packaging component). The combination of COC with low SIT polymers in the seal layer and combined with the peel layer, advantageously provides improved peel quality (e.g., clean peel) without compromising SIT when used in lidding applications, for example. In another example, the packaging component may be a formed packaging component that includes an exterior film and a peelable the sealant film. The packages may contain food or non-food products. In other examples, the packaging film may be sealed to itself or another film to form a pouch or sachet, for example (e.g., horizontal form fill and seal (HFFS) applications, etc.).

[043] The peelable sealant film, packaging films, and packages described herein may be suitable for recycling. As used in this application, the term “suitable for recycling” is meant to indicate that the peelable sealant film, packaging films, or packages can be converted into a new, useful item by means of reprocessing in a recycle stream. Reprocessing may entail washing, separating, melting, and forming, among many other steps. Typically, when polymeric items are recycled by reprocessing, the material is mechanically chopped into small pieces (e.g., granulated, flaked, etc.), melted, mixed, and reformed into the new product. If multiple incompatible materials are present in the items to be recycled, interactions occur during reprocessing that can cause gels, brittle material, poor appearance, and generally unusable or poor quality products. Using the term “recyclable” indicates that these drawbacks generally are not present.

Peelable Sealant Film

- [044] A peelable sealant film is a multilayer film that includes a peel layer and a seal layer. The peel layer and the seal layer are positioned directly adjacent to each other. The seal layer is a surface layer of the peelable sealant film. The peelable sealant film may include other layers that may provide adhesion or bulk, for example, that are adjacent to the peel layer. The peel layer and the seal layer may be comprised within a multilayer film containing a total of 3, 4, or more layers.
- [045] The term “layer”, as used herein, refers to a building block of a film that is a structure of a single material type, a homogeneous blend of materials, or a dispersion blend of materials. A layer may be a single polymer, a blend of materials such as a blend of various polymers, may contain metallic materials, and may have additives. Layers may be continuous with the film (i.e., coextensive with the film) or may be discontinuous or patterned. A layer has an insignificant thickness (z direction) as compared to the length and width (x-y direction), and therefore is defined to have two major surfaces, the area of which are defined by the length and width of the layer.
- [046] As used herein, the terms “surface layer”, or “surface film”, are used to describe a film or layer that does not have another layer on at least one of its major surfaces and is located on one of the major surfaces of the film in which it is comprised. For example, a surface layer is on an exterior of the multilayer structure.
- [047] Similarly, the term “film” refers to a web built of layers and/or films, all of which are directly adjacent to and connected to each other. A film can be described as having a thickness that is insignificant as compared to the length and width of the film. Films are generally regarded as having two major surfaces, opposite each other, expanding in the length and width directions.
- [048] The term “multilayer”, as used herein, refers to a single substrate structure (e.g., film, ply, etc.), which may have a plurality of layers, generally in the form of a sheet or web that can be made from a polymeric material or a non-polymeric material bonded together by any conventional means known in the art, (i.e., coextrusion, lamination, coating, or a combination thereof).
- [049] Multilayer structures include as many layers as desired and, preferably, at least three layers. In multilayer structures that include at least three layers,

the structure includes an interior layer. As used throughout this application, the terms "interior layer" or "inner layer" refer to a layer that is positioned between two other layers, is connected to another layer at both major surfaces, and is not located on the surface of the film in which it is comprised. An interior film or layer is adjacent to another film or layer on both surfaces. In other words, an interior layer is between two other layers. A layer may have sub-layers.

[050] As used herein, the term "adjacent" means that the items, such as layers of a film, are near each other, with or without intervening material, such as adhesive. As used herein, the term "directly adjacent" or "in direct contact with" means that the items are in contact with each other, without intervening material.

[051] Embodiments of peelable sealant films are shown in **Figures 1-2**. A peelable sealant film **10** includes a peel layer **12** and a seal layer **14**. The peel layer **12** includes a peel layer first surface **13** and a peel layer second surface **15**. The peel layer first surface **13** may include a first outer surface of the peelable sealant film **10**. The peel layer second surface **15** is in direct contact with an adjacent surface of the seal **14** as shown in peelable sealant film **10**. The seal layer **14** includes a seal layer first surface **17** and a seal layer second surface **19**. The seal layer second surface **19** includes an outer surface of the peelable sealant film **10** that opposes the peel layer first surface **13**. The seal layer second surface can form a seal between the peelable sealant film and another film.

[052] Another embodiment of a peelable sealant film **20** is shown in **Figure 2**. The peelable sealant film **20** includes a peel layer **22**, a seal layer **24**, a first additional layer **30**, a second additional layer **32**, a third additional layer **34**, a fourth additional layer **36**, and a fifth additional layer **38**. The fifth additional layer **38** includes a fifth additional layer first surface **33** and a fifth additional layer second surface **35**. The fifth additional layer first surface **33** includes an outer surface of the peelable sealant film **20**. The fifth additional layer second surface **35** is in direct contact with an adjacent surface of the fourth additional layer **36**. The peel layer **22** includes a peel layer first surface **23** and a peel layer second surface **25**. The seal layer **24** includes a seal layer first surface **27** and a seal layer second surface **29**. The seal layer second surface **29** includes an outer surface of the peelable sealant film **20** that opposes the fifth additional layer

first surface **33**. The seal layer first surface **27** is in direct contact with an adjacent surface of the peel layer **22** that is the peel layer second surface **25**. The first additional layer **30** includes a first additional layer first surface **37** and a first additional layer second surface **39**. The peel layer first surface **23** is in direct contact with the first additional layer second surface **39**. Any additional layers may be provided, for example, for bulk or adhesion. The peelable sealant film may include as many layers as necessary for the desired properties. The peelable sealant film is not limited to a 2-layer, 3-layer, 5-layer, or 7-layer film, for example.

[053] The peelable sealant film may be produced by coextrusion with all the layers simultaneously combined, for example by blown or cast film processes. Alternatively, the layers of the peelable sealant film may be combined by other known processes including, but not limited to, extrusion coating, extrusion lamination, and adhesive lamination. Any of the additional layers (e.g., first additional layer, second additional layer, etc.) may include an adhesive layer or tie layer. The terms, "adhesive layer" or "tie layer", refer to a layer or material placed on one or more layers to promote the adhesion of that layer to another surface. For example, tie layers may be positioned between two layers of a multilayer film to maintain the two layers in position relative to each other and prevent undesirable delamination. In another example, adhesive layers may be positioned between two films of a laminate to maintain the two layers in position relative to each other and prevent undesirable delamination.

[054] The peelable sealant film may have a thickness in a range of from 22.9 micron (0.9 mil) to 762.0 micron (30.0 mil) or greater. In some applications, such as a lidding film, the thickness of the peelable sealing film may be in a range from 22.9 micron (0.9 mil) to 50.8 micron (2.0 mil). In other applications, such as a formed packaging component, the thickness of the peelable sealing film may be greater than 50.8 micron (2.0 mil) and greater than 762.0 micron (30.0 mil).

[055] The peel layer includes a blend of a peel layer primary polymer and a peel layer secondary polymer. The peel layer primary polymer includes polyethylene. As used throughout this application, the term "polyethylene" or "PE" refers to, unless indicated otherwise, ethylene homopolymers or copolymers. Such copolymers of ethylene include copolymers of ethylene with

other units or groups such as vinyl acetate, acid groups, acrylate groups, or otherwise. The term “polyethylene” or “PE” is used without regard to the presence or absence of substituent branch groups. Polyethylene includes, for example, medium density polyethylene (MDPE), high density polyethylene (HDPE), low density polyethylene (LDPE), linear low-density polyethylene (LLDPE), ultra-low density polyethylene (ULDPE), ethylene alpha-olefin copolymer, ethylene vinyl acetate (EVA), ethylene acid copolymers, ethylene acrylate copolymers, cyclic olefin copolymers, or blends of such. Various polyethylene polymers may be recycled as reclaimed polyethylene or reclaimed polyolefin.

[056] The peel layer primary polymer may be present in an amount that ranges from 30% to 95%, by weight of the peel layer. For example, from 30% to 40%, 40% to 50%, 50% to 60%, 60% to 70%, 70% to 80%, 80% to 90%, 90% to 95%, or any range or combination of ranges therein, by weight of the peel layer.

[057] The peel layer secondary polymer includes polymers that are dispersedly incompatible with the peel layer primary polymer. As used throughout this application, the term “incompatible” refers to two materials that do not disperse well when melt blended. With respect to the peel layer primary and secondary polymers, the secondary polymer exists in defined islands within a matrix of the primary polymer. The peel layer serves to impart peelability to a film structure by adhesive splitting at the peel layer and seal layer interface or by allowing cohesive splitting within the thickness of the peel layer due to the incompatibility of the peel layer primary and secondary polymers.

[058] The peel layer secondary polymer may include polybutene, polypropylene, or combinations thereof. As used throughout this application, the term “polybutylene” or “PB”, refers to a polymer having polymeric units derived from butene-1 as the major (i.e., at least 75% polymeric units) components, and desirably, at least 80% of its polymeric units derived from butene-1. A non-limiting polybutylene example may be a random copolymer of butene-1 with ethylene. As used throughout this application, the term “polypropylene” or “PP”, refers to, unless indicated otherwise, a homopolymer or copolymer having at least one propylene monomer linkage within the repeating backbone of the polymer. The propylene linkage can be represented by the general formula: $-\text{CH}_2-\text{CH}(\text{CH}_3)-$.

- [059] The peel layer secondary polymer may be present in an amount that ranges from 5% to 30%, by weight of the peel layer. For example, from 5% to 10%, 10% to 20%, 20% to 30%, or any range or combination of ranges therein, by weight of the peel layer.
- [060] The peel layer primary and secondary polymers may be accompanied by other minor components such as slip, antiblock, processing aid, nucleation additives, or hydrocarbon additives in amount that ranges from 0% to 10%, by weight of the peel layer.
- [061] The peel layer may have a thickness in a range of from greater than 0.0 micron (0.0 mil) to 76.2 micron (3.0 mil).
- [062] The seal layer includes a blend of a seal layer primary polymer and a seal layer secondary polymer. The seal layer primary polymer includes polymers that are known by one having skill in the art to provide low seal initiation temperatures (SIT) and have low melting point temperatures. The seal layer primary polymer may include a peak melting point temperature (T_{pm}) of less than or equal to 107° C (225° F), less than or equal to 100 °C (212 °F), or less than or equal to 90 °C (194 °F), according to ASTM D3418-08 with a heating rate of 20 °C (68 °F) / minute and without holding between cycles. The seal layer primary polymer includes metallocene linear low density polyethylene (mLLDPE), ethylene vinyl acetate (EVA), alpha-olefin copolymer, elastomer, or combinations thereof. As used throughout this application, the terms "metallocene linear low density polyethylene" or "mLLDPE", refer to a LLDPE produced with a metallocene or constrained geometry catalyst. As used throughout this application, the term "elastomer", refers to ethylene alpha-olefin copolymers of densities below about 0.90 grams per cubic centimeter (g/cc) with elastomeric properties. Some elastomers are also referred to as "ethylene alpha olefin-plastomers".
- [063] It may be advantageous if the seal layer softens and seals at a relatively low SIT to enable faster packaging line speeds and reduced risk of product damage. For example, some embodiments may include a seal layer that exhibits an SIT of less than or equal to 110 °Celsius (°C), (230 °Fahrenheit (°F)), less than or equal to 100 °C (212 °F), or less than or equal to 90 °C (194 °F) when measured according to the test method described herein.

[064] The seal layer primary polymer may be present in an amount that ranges from 50% to 90%, by weight of the seal layer. For example, from 50% to 60%, 60% to 70%, 70% to 80%, 80% to 90%, or any range or combination of ranges therein, by weight of the seal layer.

[065] The seal layer secondary polymer includes cycloolefinic copolymer (COC). As used throughout this application, the terms “cycloolefinic copolymer” or “COC”, refer to cyclic monomers that are copolymerized by various methods. COC may be produced by chain copolymerization of cyclic monomers such as norbornene or tetracyclododecene with ethene, or by ring-opening metathesis polymerization of various cyclic monomers followed by hydrogenation, for example.

[066] The seal layer secondary polymer may be present in an amount that ranges from 10% to 40%, by weight of the seal layer. For example, from 10% to 20%, 20% to 30%, 30% to 40%, or any range or combination of ranges therein, by weight of the seal layer.

[067] The seal layer primary and secondary polymers may be accompanied by other minor components such as slip, antiblock, processing aid, nucleation additives, or hydrocarbon additives in amount that ranges from 0% to 10%, by weight of the seal layer.

[068] The seal layer may have a thickness in a range of from greater than 0.0 micron (0.0 mil) to 5.1 micron (0.2 mil). The seal layer having low thickness is advantageous because the seal will peel more cleanly than if the seal layer were thicker than the disclosed range.

Packaging Film

[069] A packaging film includes an exterior film and a peelable sealant film. The peelable sealant film is as previously described. The exterior film may be a monolayer or multilayer film. The exterior film is connected to the peelable sealant film such that the peel layer is positioned in between the exterior film and the seal layer. The exterior film is one that is connected to another layer at only one of the major layer surfaces. In other words, one major surface of an exterior film is exposed.

[070] The exterior film may include polymers and materials that include heat resistant properties or abuse protection, among other things. Suitable polymers

for the exterior film may include one or more of any of the following: polyolefins (e.g., polyethylenes, polypropylenes), polyamides, polyesters, and polystyrenes. Examples of suitable polyesters include amorphous (co)polyesters, poly(ethylene/terephthalic acid), and poly(ethylene/naphthalate).

[071] The exterior film may be oriented. As used herein, the term “oriented” indicates that the film has been heated to a temperature lower than the melting point of the material and stretched at least 2X. This is typically accomplished by a double- or triple-bubble process, by a tenter-frame process, or an MDO (machine direction orientation) process using heated rolls. A typical blown film or cast film process does impart some stretching of the film, but not enough to be considered oriented as described herein. The film may be biaxially oriented or mono-axially oriented in either direction. The exterior film may be heat set (i.e., annealed) after orientation, such that it is dimensionally stable under elevated temperature conditions that might be experienced during conversion of the film (i.e., printing or laminating) or during the use. The exterior film may be produced using specific polymers and may be oriented using specific conditions which optimize the heat resistance or other properties of the film.

[072] The exterior film may include a barrier layer that includes a barrier material. The term “barrier material”, as used herein, refers to a material that significantly reduces the transmission of one or more molecular species through the layer. A barrier material may limit or reduce the permeation of migratory species such as moisture, oxygen, and/or other gasses. Barrier materials typically include metals or polymers and may be a film layer or a coating. Barrier polymeric materials are not limited to polymers including ethylene vinyl alcohol copolymer (EVOH), polyvinylidene chloride (PVDC), high density polyethylene (HDPE), cyclic olefin copolymers (COC), polyamides, polyacrylates, (e.g., PET, PEN), polyacrylonitrile (“PAN”), and polypropylenes. Useful barrier metallic materials may include aluminum or metallic foil (e.g., a web of metal having a thickness of at least 1.0 micron, typically more than 5.0 micron) or polymeric films coated with an inorganic deposition, such as oxides of silicon (SiOx) or aluminum (AlOx), and films comprising polychlorotrifluoroethylene (PCTFE) that may be liquid coated, vacuum coated, or otherwise deposited for forming the barrier layer. The barrier layer of the packaging film is generally coextensive

with the packaging film. The barrier layer may be multilayer and contain different layers of barrier materials. The barrier layer may be a blend of multiple barrier materials. The barrier layer provides the specific barrier required to preserve the product within a package throughout an extended shelf-life which may be several months or even more than one year. The barrier layer may be accompanied by other minor components such as slip, antiblock, processing aid, nucleation additives, or hydrocarbon additives.

[073] The barrier layer may be located on a surface of the exterior film. In some embodiments, the barrier layer is located on an interior surface of the exterior film facing the peelable sealant film.

[074] The exterior film may further include an ink layer. The ink layer may be continuous or discontinuous (e.g., patterned) and may include graphics and pertinent usage, regulatory or marketing information, for example. The ink layer may be positioned on a surface of the exterior film that is closest to, or exposed to, an external environment (e.g., exterior film exterior surface or exposed surface). The ink layer can also be positioned on an interior or non-exposed surface that is closer to the inside of a package (e.g., exterior film interior surface or non-exposed surface), that opposes the exterior surface. For example, when the ink layer is printed onto an interior surface of the exterior film, the ink layer is positioned between and protected by the exterior film and the peelable sealant film after lamination.

[075] In some embodiments, the sealant film may include an ink layer. The ink layer may be continuous or discontinuous and may include graphics or other information. The ink layer may be positioned on a surface of the sealant film such that the ink layer is positioned between and protected by the exterior film and the seal layer after lamination. The packaging film may include multiple ink layers.

[076] The exterior film may include an over lacquer layer adjacent to the ink layer when the ink layer is present on the exposed surface of the exterior film. The over lacquer layer may be in direct contact with the ink layer. The over lacquer layer may be in direct contact with portions of exterior film surface that do not include ink (e.g., a discontinuous ink layer). The over lacquer layer may include lacquers also referred to as varnishes, overprints, overprint varnish, etc. The over lacquer layer may further protect the ink layer from flaking off or

scuffing when exposed to the rigors of packaging lines, shipping stresses, or consumer misuse. The over lacquer layer may be printed or extruded by means known in the art.

[077] With reference to **Figure 3**, an exterior film **40** is shown. The exterior film **40** includes a first surface **43** that includes an exterior surface of the exterior film **40** and a second surface **45** that include an interior surface of the exterior film **40**. The exterior film **40** includes an ink layer **42** positioned on the first surface **43**. The exterior film **40** includes an over lacquer layer **44** positioned directly adjacent to the ink layer **42**. The exterior film **40** includes a barrier layer **46** positioned directly adjacent to the second surface **45**.

[078] Another exterior film **50** is shown **Figure 4**. The exterior film **50** includes a first surface **53** that includes an exterior surface of the exterior film **50** and a second surface **55** that include an interior surface of the exterior film **50**. The exterior film **50** includes an ink layer **52** positioned on the second surface **55**.

[079] The exterior film is not limited to the exterior films **40**, **50** shown in **Figures 3-4**. The exterior film may include an unlimited number of layers (e.g., ink layer, barrier layer, over lacquer layer) and the layers may be in various configurations to provide the necessary properties for a given application.

[080] The exterior film may be connected (e.g., laminated) to the peelable sealant film by an adhesive lamination process. Alternatively, the exterior film and the peelable sealant film may be connected to one another by other means such as extrusion lamination, using an extruded polymer for bonding, coextrusion, or thermal lamination, for example.

[081] With reference to **Figure 5**, a packaging film **60** is shown. The packaging film **60** illustrates an adhesive lamination of a peelable sealant film **61** and an exterior film **65**. The peelable sealant film **61** includes a peel layer **62** and a seal layer **64**. An adhesive layer **66** is positioned between the peel layer **62** and the exterior film **65** that connects the exterior film **65** to the peelable sealant film **61**.

[082] With reference to **Figure 6**, a packaging film **70** is shown. The packaging film **70** illustrates a thermal lamination of a peelable sealant film **71** and an exterior film **75**. The peelable sealant film **71** includes a peel layer **72** and a seal layer **74**. The peel layer **72** is directly connected to an interior surface of the exterior film **75** without an intervening laminating agent known by one of skill in the art.

Packages and Packaged Products

- [083] The packaging film may be used as a packaging component to package products. Non-limiting food product examples include yogurt, pudding, jam, jelly, fruit, fruit juice, sauce, and protein, such as meat. Non-limiting, non-food product examples include industrial items (e.g., tools, hardware, etc.) or medical devices. The product may be any type of food, beverage, pharmaceutical or other medical aid, nutraceutical, consumer good or industrial good. The packaging film is especially suited to contain products that include corrosive contents, for example, those having acidic (e.g., tomatoes, citrus juice, etc.), oily, or alcoholic content by providing good resistance to these corrosive contents. The product may be sensitive to oxygen and/or moisture such that the package prevents the ingress of oxygen and the egress moisture.
- [084] One embodiment of the packaging film may be a lidding film that generally includes the structure of the packaging film shown in **Figure 5**. As used throughout this application, a “lidding film” refers to a film that could be used in a flat state to cover the opening in a packaging component such as a formed (e.g., formed, preformed, etc.) packaging component that may be a cup, a tray, a plate, or a bowl and that has one or more cavities for holding a product. In some instances, the formed packaging component may be formed from the packaging film of the present disclosure. In other instances, the formed packaging component may be formed from another film that is not the packaging film of the present disclosure. In this instance, the formed packaging component may include a polyolefin (PO), a polystyrene (PS), a high impact polystyrene (HIPS), or a polyester (PET), and may include a sealant film other than the peelable sealant film disclosed herein. The package may also include other components including, but not limited to, labels, absorbers and dividers. The exterior film for lidding film applications may include oriented films, including, but not limited to, biaxially oriented nylon (BON) or metallized biaxially oriented nylon (m-BON). The lidding film may have a thickness from about 63.5 micron (2.5 mil) to about 254.0 micron (10.0 mil), or from about 76.2 micron (3.0 mil) to about 152.4 micron (6.0 mil). The exterior film may have a thickness from about 7.1 micron (0.3 mil) to about 25.4 micron (1.0 mil). The

peelable sealant film may have a thickness from about 19.0 micron (0.75 mil) to about 50.8 micron (2.0 mil).

[085] The formed packaging component (e.g., cup, tray) may be filled with a product, sealed (e.g., heat sealed) with the lidding film at the seal layer, forming a packaged product, and remain hermetically sealed throughout the shelf-life of the packaged product. The seal layer includes a composition that allows the formation of a heat seal, thus forming a hermetic package. As used herein, the terms “heat seal”, “heat sealed”, or “heat sealing”, refer to the connecting of two or more surfaces by application of both heat and pressure for a short period of time, or by way of an ultrasonic energy sealing process.

[086] An object of the disclosure is to provide a peelable seal between the lidding film and the formed packaging component such that the package is manually openable. As used herein, the term “peelable seal” refers to a seal that can be opened manually (i.e., pulling by hand strength without the use of tools such as knives or scissors). A manually openable package is one in which the peel strength of the lidding film to the packaging component can be controlled over a wide temperature range. As used herein, the term “peel strength”, refers to the measure of the average force to part two bonded materials like tape, labels, textile, or plastic films. Peelable seals are generally defined within the packaging industry as seals that can be separated by a peel strength (e.g., force) of less than 2,500 g/24.5 mm when measured according to ASTM F88/F88M - 09. It is important that the seal between the lidding film and the packaging component have sufficient seal strength to remain secure, unbroken, and airtight (i.e., hermetic) during package fabrication, distribution, and storage that is generally defined by a peel strength of at least about 150 g/24.5 mm. The range of the peel strengths listed in the present disclosure shall be wide enough to cover both peak and average peel strengths, however the present disclosure is not to be limited by the peel strengths in any manner other than the seal remaining hermetic until a user peelably removes the lidding film from the packaging component. The heat seal between the lidding film and the packaging component can readily be peeled apart by hand without uncontrolled or random tearing or rupturing of the lidding film.

[087] The lidding films disclosed herein include that the peel layer is “buried” in the packaging film structure. That is, the peel layer is positioned intermediate

of the exterior film and the seal formed between the seal layer and the packaging component. The peel layer is rupturable (e.g., rupturable layer) such that the heat seal between the packaging component and the seal layer has a seal strength that is greater than the cohesive strength of the peel layer. In other words, the peel layer has a peel strength that is less than a peel strength of the heat seal joining the seal layer to an outer surface of the packaging component and the manual opening of the package (e.g., peeling mechanism) occurs within, or at, the peel layer.

[088] With reference to **Figures 7-8** a package **100** is shown as a sealed cup. The package **100** includes a lidding film **110** sealed to a formed packaging component **120** that is in the form of a cup. A heat seal **130** connects the seal layer of the lidding film **110** to a flange **125** at an interior surface **105** of the formed packaging component **120**. Product (not shown) can be hermetically sealed between the lidding film **110** and the formed packaging component **120**. **Figure 8** includes a partial view of an area that includes the lidding film **110**, the seal **130**, and the flange **125** shown in **Figure 7** at circle **8**. The lidding film **110** includes a peelable sealant film **111** that includes a peel layer **112** and a seal layer **114**. An exterior film **115** is adhesively connected to the peelable sealant film **111** with an adhesive layer **116** positioned between the exterior film **115** and the peel layer **112**. The seal layer **114** is connected to the flange **125** via the heat seal **130**. The package **100** may be manually opened by peeling the lidding film **110** from the flange **125** with hand force that ruptures peel layer **112**.

[089] The formed packaging component is formed from a sheet that may be thermoformed into articles such as trays, cups, etc. Use of single serve polymeric containers is well known, and at times, these single serve containers are manufactured and sold in an array that includes multiple, single serve containers that are connected and individually separable from the array. The containers are generally connected to one another along their flanges and may be broken apart by breaking the connection at the flanges. The inventors have surprisingly discovered that the lidding film including the packaging film of the present disclosure, cuts cleanly and allows for clean separation of the single serve containers from the array, while forming good seals at high manufacturing speeds, providing easy opening, clean peel (i.e., good peel quality), and having good product resistance.

[090] With reference to **Figures 9-10**, top views of an individual and an array of single serve packages is shown. The single serve package **100** shown in **Figure 9** resembles the package **100** shown in **Figure 7**. **Figure 9** shows the lidding film **110** and the seal **130** that connects the lidding film **110** to the formed packaging component **120**. The package **100** is an individual single serve container that can be separated from an array **140** shown in **Figure 10**.

[091] In another embodiment, the packaging film may be a thermoformable sheet that generally includes the structure of the packaging film shown in **Figure 6**. The thermoformable sheet may be formed into a formed packaging component. In this embodiment, the formed packaging component is formed from the packaging film (i.e., exterior film and peelable sealant film) of the present disclosure.

[092] With reference to **Figures 6 and 11**, a thermoformable sheet **70** has been formed into a formed packaging component **220**, that is shown as a cup. The formed packaging component **220** includes the exterior film **75** and the peelable sealant film **71**. The exterior film **75** includes an exterior surface of the counterpart formed packaging component **226**. The seal layer **74** of the peelable sealant film **71** includes an interior surface **228** of the formed packaging component **220**. The peel layer **72** of the peelable sealant film **71** is positioned between the seal layer **71** and the exterior film **75**. The formed packaging component **220** may be filled with a product and sealed (e.g., heat sealed) with a peelable or non-peelable lidding film.

[093] The peelable sealant film may be sealed to another film (e.g., exterior film) whether peelability is needed (e.g., lidding film) or not (e.g., formed packaging component).

[094] The packaging film in a thermoformable sheet application may include a total thickness ranging from 279.4 micron (11.0 mil) to 2032.0 micron (80.0 mil), or greater. In some thermoformable sheet applications, the packaging film includes a thickness from 1270.0 micron (50.0 mil) to 1524.0 micron (60.0 mil). The peelable sealant film may include a thickness ranging from 25.4 micron (1.0 mil) to 127.0 micron (5.0 mil). The exterior film may include a total thickness ranging from 152.4 micron (6.0 mil) to 2006.6 micron (79.0 mil). The exterior film for thermoformable sheet applications may include PO, PE, PP, PET, or high impact polystyrene (HIPS), for example.

Recyclability

[095] The peelable sealant film, packaging film, and packages made with the packaging film may be suitable to be recycled in a polyolefin-based recycling process when there is a high polyolefin content. As used herein, a “polyolefin-based polymer” refers to a homopolymer or copolymer having at least one alkene monomer linkage within the repeating backbone of the polymer. Primary examples of polyolefin-based polymers are polyethylene homopolymers and copolymers and polypropylene homopolymers and copolymers. Other examples of polyolefin-based polymers are ethylene vinyl alcohol copolymer and cyclic olefin copolymer.

[096] The peelable sealant film, packaging film, or package may include a polyolefin-based polymer content in a range of from 90% to 100%, by weight of the packaging film or package, respectively. The polyolefin-based polymer content includes the amount of polyolefin included in the exterior film and the peelable sealant film, with respect to the peelable sealant film, packaging film, or in the package, when considered in terms of the entire package. In other words, the “total composition” of the peelable sealant film, packaging film, or the package, refers to all materials encompassed therein, respectively of the packaging film or the package. Specifically, the peelable sealant film, packaging films, or packages may have low levels of, or may be free from materials such as polyester, polyamide, chlorine containing polymers, and aluminum foil. The peelable sealant film, packaging films, or packages may contain non-polyolefin-based polymers such as those used in adhesive layers or ink layers, but these can be minimized and are generally less than 10% of the overall composition, by weight. The packaging films or packages may contain non-polymeric materials such as barrier materials, but these are minimized and generally less than 10% of the overall composition, by weight.

[097] The total composition of the peelable sealant film, packaging film, or packages formed therefrom, may include greater than or equal to 90%, greater than or equal to 95%, or greater than or equal to 99%, by weight of polyolefin-based polymer. The total composition of the peelable sealant film, packaging film, or package may include less than or equal to 100%, less than or equal to

95%, or no less than or equal to 90% of polyolefin-based polymer, by weight of the peelable sealant film, packaging film, or package, respectively.

[098] In some embodiments, the polyolefin-based polymer may include polyethylene. That is, the packaging film or the package may include a polyethylene-based polymer content in a range of from 90% to 100%, by weight of the packaging film or package, respectively. The polyethylene-based polymer content includes the amount of polyethylene included in the exterior film and the peelable sealant film in the packaging film or the package. The total composition of the packaging film or the package may include greater than or equal to 90%, greater than or equal to 95%, or greater than or equal to 99%, by weight of polyethylene-based polymer. The total composition of the packaging film or the package may include less than or equal to 100%, less than or equal to 95%, or no less than or equal to 90% of polyethylene-based polymer, by weight of the packaging film or package, respectively.

[099] In other embodiments, the polyolefin-based polymer may include polypropylene. That is, the packaging film or package may include a polypropylene-based polymer content in a range of from 90% to 100%, by weight of the packaging film or the package, respectively. The polypropylene-based polymer content includes the amount of polypropylene included in the exterior film and the peelable sealant film in the packaging film or the package. The total composition of the packaging film or the package may include greater than or equal to 90%, greater than or equal to 95%, or greater than or equal to 99%, by weight of polypropylene-based polymer. The total composition of the packaging film or the package may include less than or equal to 100%, less than or equal to 95%, or no less than or equal to 90% of polypropylene-based polymer, by weight of the packaging film or the package, respectively.

[100] In other embodiments, the polyolefin-based polymer may include mixed polyolefins (e.g., polyethylene and polypropylene). That is, the packaging film or package may include a mixed polyolefin content in a range of from 90% to 100%, by weight of the packaging film or the package, respectively. The mixed polyolefin content includes the amount of polyolefin included in the exterior film and the peelable sealant film in the packaging film or the package. The total composition of the packaging film or the package may include greater than or equal to 90%, greater than or equal to 95%, or greater than or equal to 99%,

by weight of polyolefin-based polymer. The total composition of the packaging film or the package may include less than or equal to 100%, less than or equal to 95%, or no less than or equal to 90% of polyolefin-based polymer, by weight of the packaging film or the package, respectively.

Examples

- [101] The following illustrative examples are merely meant to exemplify the present disclosure and not intended to limit or otherwise define the scope of the present disclosure.
- [102] Product Resistance
- [103] Packaging films were constructed as lidding films and sealed to formed packaging components to form sealed cup packages. The packages were evaluated for product resistance. The lidding film structure variables were:
- [104] Example 1: over lacquer layer / ink layer / 15.2 micron m-BON / adhesive layer / 31.7 micron peelable sealant film, where the peelable sealant film included a peel layer that included 12% PB blended with 88% LDPE, and a seal layer that included 70% mLLDPE, 20% COC, 9% LDPE, and about 1% processing additives.
- [105] Example 2: over lacquer layer / ink layer / 15.2 micron m-BON / adhesive layer / 31.7 micron peelable sealant film, where the peelable sealant film included a peel layer that included 12% PB blended with 88% LDPE, and a seal layer that included 70% elastomer, 20% COC, 9% LDPE, and about 1% processing additives.
- [106] Comparative Example 1: over lacquer layer / ink layer / 7.1 micron (28.0 ga) aluminum foil / adhesive layer / 12.2 micron (48 ga) polyester film / EVA-based heat seal coating @ 2-4 lbs/ream.
- [107] The formed packaging component was formed from a thermoformable sheet into an array having the following structure: 406.4 micron PP film thermally laminated to 50.8 micron sealant layer that included layers of PP, EVOH, and LLDPE or mLLDPE, with LLDPE or mLLDPE being the seal layer of the sheet.
- [108] The cavities of the formed packaging component array were filled with honey mustard, buffalo sauce, and barbeque sauce product.

[109] Each of the Example and Comparative example lidding film variables were sealed to the formed packaging component array at sealing conditions of 274° C (525° F), 0.3 second dwell time at a pressure of 30 psi, forming sealed cup packages.

[110] Twenty (20) sealed cup packages of each variable were allowed to age for 6 weeks at 38° Celsius (100° F) and 20% RH. The sealed cup packages were inverted such that the lidding material exterior surface was resting on, or closest to, the surface upon which the package was set onto.

[111] The sealed cup packages were visually checked at weekly intervals for leakage of product or seal failure. The results are reported in TABLE 1.

[112] TABLE 1

Variable	Week 6
Example 1	Sealed
Example 2	Sealed
Comparative Example 1	Failed

[113] The results indicate that Examples 1 and 2 have good product resistance when compared to Comparative Example 1 at the end of the 6 week test period.

[114] Total Composition

[115] A total composition of the structures tested for product resistance are included in TABLE 2.

[116] TABLE 2

Variable	Structure	Layer Wt (g/m ²)	PO Wt (g/m ²)	PE Wt (g/m ²)	PP Wt (g/m ²)
Example 1	over lacquer	0.3	-	-	-
	ink	0.1	-	-	-
	15.2 micron m- BON	17.6	-	-	-
	adhesive	2.2	-	-	-

	multilayer peelable sealant film with COC	30.2	30.0	29.3	-
	Total Composition:		59% PO	58% PE	0% PP
Example 2	over lacquer	0.3	-	-	-
	ink	0.1	-	-	-
	15.2 micron m- BON	17.6	-	-	-
	adhesive	2.2	-	-	-
	multilayer peelable sealant film with COC	30.2	30.0	29.3	-
	Total Composition:		59% PO	58% PE	0% PP
Comparative Example 1	over lacquer	0.3	-	-	-
	ink	0.1	-	-	-
	7.1 micron Al foil	15.8	-	-	-
	adhesive	2.2	-	-	-
	12.2 micron PET film	19.3			
	EVA-based heat seal coating*	5	-	-	-
	Total Composition:		0% PO	0% PE	0% PP
Formed packaging	406.4 micron PP film	376.7	376.6	-	376.6

component sheet					
	multilayer sealant film	49.5	42.5	7.4	35.1
	Total Composition:		98% PO	2% PE	96% PP

[117] * EVA-based heat seal coating includes negligible amounts of PO or PE.

[118] A total composition of a film structure according to the present disclosure that may be used for a formed packaging component sheet is included in TABLE 3.

[119] TABLE 3

Variable	Structure	Layer Wt (g/m ²)	PO Wt (g/m ²)	PE Wt (g/m ²)
Formed packaging component sheet according to disclosure	406.4 micron PP film	376.9	376.6	0
	50.8 multilayer peelable sealant film	50.0	39.1	17.0
	Total Composition:		97.4% PO	4.0% PE

[120] In a package format, the formed packaging component accounts for approximately 90% of the package, by weight, and the lidding films account for approximately 10% of the package, by weight.

[121] Seal Initiation Temperature

[122] Packaging films were constructed as lidding films and heat sealed to formed packaging components to form sealed cup packages. The lidding film structure variables were:

- [123] Example 1: over lacquer layer / ink layer / 15.2 micron m-BON / adhesive layer / 31.7 micron peelable sealant film, where the peelable sealant film included a peel layer that included 12% PB blended with 88% LDPE, and a seal layer that included 70% mLLDPE, 20% COC, 9% LDPE, and about 1% processing additives.
- [124] Comparative Example 1: over lacquer layer / ink layer / 15.2 micron m-BON / adhesive layer / 31.7 micron peelable sealant film, where the peelable sealant film included a peel layer that included 12% PB blended with 88% LDPE, and a seal layer that included 70% mLLDPE, 9% LDPE, and about 1% processing additives.
- [125] Comparative Example 2: over lacquer layer / ink layer / 7.1 micron (28.0 ga) aluminum foil / adhesive layer / 12.2 micron (48.0 ga) polyester film / EVA-based heat seal coating @ 2-4 lbs/ream.
- [126] Comparative Example 3: over lacquer layer / ink layer / 7.1 micron (28.0 ga) aluminum foil / adhesive layer / 12.2 micron (48.0 ga) polyester film / EVA-based heat seal coating @ 2-4 lbs/ream.
- [127] Comparative Example 4: 12.2 micron (48.0 ga) OPET / primer / ink / adhesive layer / 76.2 micron (3 mil) EVOH - EVA (5%) - PB that is commercially available from Amcor, Neenah, WI, USA.
- [128] Comparative Example 5: 12.2 micron (48.0 ga) OPET / primer / ink / adhesive layer / 76.2 micron (3 mil) EVOH – LLDPE that is commercially available from Amcor, Neenah, WI, USA.
- [129] Comparative Example 6: 10.1 micron (40.0 ga) OPP / ink / white LDPE extrudate / foil / EAA-LDPE blend extrudate that is commercially available from Amcor, Neenah, WI, USA.
- [130] The formed packaging component used for Example 1 and Comparative Examples 1-2 and 4-6 were formed from a thermoformable sheet into an array having the following structure: 406.4 micron PP film thermally laminated to 50.8 micron sealant layer that included layers of PP, EVOH, and LLDPE or mLLDPE, with LLDPE or mLLDPE being the seal layer of the sheet.
- [131] The formed packaging component used for Comparative Example 3 was formed from a 380.0 micron (15 mil) HIPS sheet coated with a PVdC seal layer @ 2-4 lbs/ream.

[132] The cavities of the formed packaging component array were not filled with product.

[133] Each of the Example and Comparative Example film variables were sealed to the formed packaging component array at sealing conditions of 0.3 second dwell time at a pressure of 30 psi. The heat seals were made with 2.54 cm (1.0 inch) strips on a seal bar. Three (3) replicates of each variable were evaluated for seal formation. An initial seal test temperature was about 93.3 °C (200 °F). The temperature was increased in increments of about 5 °C to 11 °C (corresponding to 15 °F increments), while keeping the pressure and the dwell time constant. The seal was visually inspected after each increment in temperature for each of the Example and Comparative Example variables. Three stages of visual inspection, along with the corresponding rating for each stage, are shown in TABLE 4.

[134] TABLE 4

Visual Inspection Stage	Rating
Perfectly sealed	#
Partially sealed, some lidding material creep away from cup edge	@
No seal initiation	0

[135] The visual inspection results for Example 1 and Comparative Film Examples 1-6 are shown in TABLE 5.

[136] TABLE 5

Variable	°C	93.3	101.7	110.0	121.1	126.7	135.0	143.3	148.9
	°F	200.0	215.0	230.0	245.0	260.0	275.0	290.0	300.0
Example 1		0	@	#	#	#	#	#	#
Comparative Example 1		0	@	#	#	#	#	#	#

Comparative Example 2	0	0	0	@	@	#	#	#
Comparative Example 3	0	0	#	#	#	#	#	#
Comparative Example 4	0	0	0	0	0	@	@	#
Comparative Example 5	0	0	0	0	0	@	@	#
Comparative Example 6	0	0	0	0	#	#	#	#

[137] The results indicate that Example 1 and Comparative Example 1 form comparable seals at the same temperatures. Example 1 demonstrates lower seal initiation temperatures than Comparative Examples 2 and 4-6. Example 1 and Comparative Example 3 form relatively comparable seals at the same temperatures. Further, Example 1 may provide recyclability potential over Comparative Example 2-3 that include a heat seal coating.

[138] Peel Quality

[139] Examples 1 and Comparative Example 1 and 4 film variables and the formed packaging component that were described for seal initiation temperature testing were sealed to each other to form sealed cup packages. The sealed cup packages were evaluated for peel quality. Example 1 and Comparative Examples 1 and 4 were heat sealed to the formed packaging component at two different temperatures, 126.7° C (260° F) and 148.9° C (300° F), with a dwell time of 0.3 second and a pressure of 30 psi. The heat seals were made with 2.54 cm (1.0 inch) strips on a seal bar. Two (2) replicates of each variable were evaluated peel quality. The sealed cup packages were allowed to cool to room temperature 20.0 – 23.3 °C (68.0 – 74.0 °F) and 30% - 60% RH. The packages were manually opened by peeling the lidding material from the formed packaging component. The peel quality was rated on a scale from 1 to 10, according to the characteristics shown in TABLE 6.

[140]

TABLE 6

Visual Inspection Characteristics	Rating
Clean peel; no observable stringing	10
Some observable stringing; string width <1 mm	8
Observable stringing; most string widths between 1 - 2 mm	6
Observable stringing; most string widths between 1 - 2 mm with outliers up to 5 mm	4
Observable stringing; most string widths between 1 - 2 mm with outliers up to 10 mm	2
Observable stringing; most string widths between 1 - 2 mm with outliers up to 15 mm	1

[141] The visual inspection results for Example 1 and Comparative Film Examples 1 and 4 at 126.7° C (260° F) are shown in TABLE 7.

[142]

TABLE 7

Variable	Peel Quality Rating
Example 1	10
Comparative Example 1	1
Comparative Example 4	- **

[143] ** The samples did not have seal initiation; a seal was not formed.

[144] The visual inspection results for Example 1 and Comparative Film Examples 1 and 4 at 148.9° C (300° F) are shown in TABLE 8.

[145]

TABLE 8

Variable	Peel Quality Rating
Example 1	10
Comparative Example 1	8
Comparative Example 4	10

[146] The results indicate that the Example 1 provides clean peel or a high quality peel.

[147] CLAUSES

[148] Clause A. A peelable sealant film comprising: a peel layer comprising a blend comprising a peel layer primary polymer in a range of from 30% to 95%, by weight of the peel layer, and a peel layer secondary polymer in a range of from 5% to 30%, by weight of the peel layer; and a seal layer comprising a blend comprising a seal layer primary polymer in a range of from 50% to 90%, by weight of the seal layer, and a seal layer secondary polymer in a range of from 10% to 40%, by weight of the seal layer; wherein the peel layer primary polymer comprises polyethylene, wherein the peel layer secondary polymer comprises polybutene, polypropylene, or combinations thereof, wherein the seal layer primary polymer comprises metallocene linear low density polyethylene (mLLDPE), ethylene vinyl acetate (EVA), alpha-olefin copolymer, elastomer, or combinations thereof, wherein the seal layer secondary polymer comprises cycloolefinic copolymer (COC), and wherein the peel layer and the seal layer are directly adjacent to each other.

[149] Clause B. A packaging film comprising: an exterior film; and a peelable sealant film comprising a peel layer and a seal layer, the peel layer comprising a blend comprising a peel layer primary polymer in a range of from 30% to 95%, by weight of the peel layer, and a peel layer secondary polymer in a range of from 5% to 30%, by weight of the peel layer, and the seal layer comprising a blend comprising a seal layer primary polymer in a range of from 50% to 90%, by weight of the seal layer, and a seal layer secondary polymer in a range of from 10% to 40%, by weight of the seal layer; wherein the peel layer primary polymer comprises polyethylene, wherein the peel layer secondary polymer comprises polybutene, polypropylene, or combinations thereof, wherein the seal layer primary polymer comprises metallocene linear low density polyethylene (mLLDPE), ethylene vinyl acetate (EVA), alpha-olefin copolymer, elastomer, or combinations thereof, wherein the seal layer secondary polymer comprises cycloolefinic copolymer (COC), wherein the peel layer and the seal layer are directly adjacent to each other, and wherein the peel layer is positioned between the exterior film and the seal layer.

- [150] Clause C. A package comprising: a formed packaging component having an interior surface; a packaging film comprising an exterior film, a peelable sealant film comprising a peel layer and a seal layer, the peel layer comprising a blend comprising a peel layer primary polymer in a range of from 30% to 95%, by weight of the peel layer, and a peel layer secondary polymer in a range of from 5% to 30%, by weight of the peel layer, and the seal layer comprising a blend comprising a seal layer primary polymer in a range of from 50% to 90%, by weight of the seal layer, and a seal layer secondary polymer in a range of from 10% to 40%, by weight of the seal layer; and a heat seal; wherein the peel layer primary polymer comprises polyethylene, wherein the peel layer secondary polymer comprises polybutene, polypropylene, or combinations thereof, wherein the seal layer primary polymer comprises metallocene linear low density polyethylene (mLLDPE), ethylene vinyl acetate (EVA), alpha-olefin copolymer, elastomer, or combinations thereof, wherein the seal layer secondary polymer comprises cycloolefinic copolymer (COC), and wherein the peel layer and the seal layer are directly adjacent to each other, wherein the peel layer is positioned between the exterior film and the seal layer, wherein the heat seal is formed between the seal layer and the interior surface of the formed packaging component.
- [151] Clause D. The peelable sealant film of any previous clause, wherein the peel layer secondary polymer is incompatible with the peel layer primary polymer.
- [152] Clause E. The peelable sealant film of any previous clause, wherein the peel layer is a rupturable layer.
- [153] Clause F. The peelable sealant film of any previous clause, wherein the seal layer primary polymer comprises a peak melting point temperature of 107° Celsius (225° Fahrenheit) or less.
- [154] Clause G. The peelable sealant film of any previous clauses, wherein the seal layer comprises a thickness in a range of from greater than 0.0 micron to 5.1 micron (0.0 mil to 0.2 mil).
- [155] Clause H. The packaging film according to any one of clauses B-G, wherein the exterior film comprises polyamide, polyester, polypropylene, polyethylene, or combinations thereof.

- [156] Clause I. The packaging film according to any one of clauses B-H, wherein the exterior film comprises an oriented film.
- [157] Clause J. The packaging film according to any one of clauses B-I, wherein the exterior film comprises a metallized layer.
- [158] Clause K. The packaging film according to any one of clauses B-J, wherein the exterior film comprises an inorganic oxide layer.
- [159] Clause L. The packaging film or peelable sealant film according to any one of clauses A-K, further comprising an ink layer.
- [160] Clause M. The packaging film or peelable sealant film according to any one of clauses A-L, further comprising a total composition of at least 90% polyolefin-based polymers, by weight of the packaging film.
- [161] Clause N. The packaging film according to any one of clauses B-M, wherein the packaging film comprises a lidding film.
- [162] Clause O. The packaging film according to any one of clauses B-N, wherein the packaging film comprises a formed packaging component.
- [163] Clause P. The package according to any one of clauses C-O, wherein the formed packaging component comprises polyolefin (PO), polystyrene (PS), or polyester (PET).
- [164] Clause Q. The package according to any one of clauses C-P, wherein the formed packaging component comprises an array.
- [165] Clause R. The package according to any one of clauses C-Q, wherein the heat seal comprises a hermetic seal.
- [166] Clause S. The package according to any one of clauses C-R, wherein the heat seal is manually peelable at the peel layer.
- [167] Clause T. The package according to any one of clauses C-S, further comprising a product contained in the package.
- [168] The above description and examples illustrate certain embodiments of the present disclosure and are not to be interpreted as limiting. Selection of particular embodiments, combinations thereof, modifications, and adaptations of the various embodiments, conditions and parameters normally encountered in the art will be apparent to those skilled in the art and are deemed to be within the spirit and scope of the present disclosure.

What is claimed is:

1. A peelable sealant film comprising:

a peel layer comprising a blend comprising a peel layer primary polymer in a range of from 30% to 95%, by weight of the peel layer, and a peel layer secondary polymer in a range of from 5% to 30%, by weight of the peel layer; and

a seal layer comprising a blend comprising a seal layer primary polymer in a range of from 50% to 90%, by weight of the seal layer, and a seal layer secondary polymer in a range of from 10% to 40%, by weight of the seal layer;

wherein the peel layer primary polymer comprises polyethylene, wherein the peel layer secondary polymer comprises polybutene, polypropylene, or combinations thereof, wherein the seal layer primary polymer comprises metallocene linear low density polyethylene (mLLDPE), ethylene vinyl acetate (EVA), alpha-olefin copolymer, elastomer, or combinations thereof, wherein the seal layer secondary polymer comprises cycloolefinic copolymer (COC), and wherein the peel layer and the seal layer are directly adjacent to each other.

2. The peelable sealant film of claim 1, wherein the peel layer secondary polymer is incompatible with the peel layer primary polymer.

3. The peelable sealant film of any one of claims 1-2, wherein the peel layer is a rupturable layer.

4. The peelable sealant film of any one of claims 1-3, wherein the seal layer primary polymer comprises a peak melting point temperature of 107° Celsius (225° Fahrenheit) or less.

5. The peelable sealant film of any one of claims 1-4, wherein the seal layer comprises a thickness in a range of from greater than 0.0 micron to 5.1 micron (0.0 mil to 0.2 mil).

6. A packaging film comprising:

an exterior film; and

a peelable sealant film comprising a peel layer and a seal layer, the peel layer comprising a blend comprising a peel layer primary polymer in a range of from 30% to 95%, by weight of the peel layer, and a peel layer secondary polymer in a range of from 5% to 30%, by weight of the peel layer, and the seal layer comprising a blend comprising a seal layer primary polymer in a range of from 50% to 90%, by weight of the seal layer, and a seal layer secondary polymer in a range of from 10% to 40%, by weight of the seal layer;

wherein the peel layer primary polymer comprises polyethylene, wherein the peel layer secondary polymer comprises polybutene, polypropylene, or combinations thereof, wherein the seal layer primary polymer comprises metallocene linear low density polyethylene (mLLDPE), ethylene vinyl acetate (EVA), alpha-olefin copolymer, elastomer, or combinations thereof, wherein the seal layer secondary polymer comprises cycloolefinic copolymer (COC), wherein the peel layer and the seal layer are directly adjacent to each other, and wherein the peel layer is positioned between the exterior film and the seal layer.

7. The packaging film of claim 6, wherein the exterior film comprises polyamide, polyester, polypropylene, polyethylene, or combinations thereof.
8. The packaging film of any one of claims 6-7, wherein the exterior film comprises an oriented film.
9. The packaging film of any one of claims 6-8, wherein the exterior film comprises a metallized layer.
10. The packaging film of any one of claims 6-9, wherein the exterior film comprises an inorganic oxide layer.
11. The packaging film of any one of claims 6-10, further comprising an ink layer.

12. The packaging film of any one of claims 6-11, further comprising a total composition of at least 90% polyolefin-based polymers, by weight of the packaging film.
13. The packaging film of any one of claims 6-12, wherein the packaging film comprises a lidding film.
14. The packaging film of any one of claims 6-13, wherein the packaging film comprises a formed packaging component.
15. A package comprising:
- a formed packaging component having an interior surface;
 - a packaging film comprising an exterior film, a peelable sealant film comprising a peel layer and a seal layer, the peel layer comprising a blend comprising a peel layer primary polymer in a range of from 30% to 95%, by weight of the peel layer, and a peel layer secondary polymer in a range of from 5% to 30%, by weight of the peel layer, and the seal layer comprising a blend comprising a seal layer primary polymer in a range of from 50% to 90%, by weight of the seal layer, and a seal layer secondary polymer in a range of from 10% to 40%, by weight of the seal layer; and
 - a heat seal;
- wherein the peel layer primary polymer comprises polyethylene, wherein the peel layer secondary polymer comprises polybutene, polypropylene, or combinations thereof, wherein the seal layer primary polymer comprises metallocene linear low density polyethylene (mLLDPE), ethylene vinyl acetate (EVA), alpha-olefin copolymer, elastomer, or combinations thereof, wherein the seal layer secondary polymer comprises cycloolefinic copolymer (COC), and wherein the peel layer and the seal layer are directly adjacent to each other, wherein the peel layer is positioned between the exterior film and the seal layer, wherein the heat seal is formed between the seal layer and the interior surface of the formed packaging component.
16. The package of claim 15, wherein the formed packaging component comprises polyolefin (PO), polystyrene (PS), or polyester (PET).

17. The package of any one of claims 15-16, wherein the formed packaging component comprises an array.
18. The package of any one of claims 15-17, wherein the heat seal comprises a hermetic seal.
19. The package of any one of claims 15-18, wherein the heat seal is manually peelable at the peel layer.
20. The package of any one of claims 15-19, further comprising a product contained in the package.