CONTAINER HAVING A METAL END TO WHICH A MEMBRANE IS SEALED

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ABSTRACT

A container having an ethylene vinyl acetate-based or ethylene methyl-acrylate-based sealant as the sealant layer for a flexible membrane lid that is heat-sealed to a ring-shaped metal end on the container. In some embodiments, the sealant comprises ethylene vinyl acetate blended with a polyolefin. The polyolefin can comprise a polyethylene such as low-density polyethylene. The metal end can have a spot-coated surface or an uncoated (i.e., bare metal) surface. A coating of a polypropylene-based composition is provided on the metal end. The sealant layer of the lid is heat-sealed to the polypropylene-based coating on the metal end to form a peelable seal. The resulting seal allows the lid to be peeled off the metal end by detachment of the sealant layer from the polypropylene-based coating.

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BACKGROUND OF THE INVENTION

[0001] This invention relates to containers for foods or other consumer products, wherein a metal ring is affixed about the opening of the container and the container is sealed by a flexible membrane lid removably attached to the ring.

[0002] In such containers, the metal ring, also referred to as a metal end, is attached to the top of the container, typically by double-seaming the metal end to a flange at the top of the container, and the flexible membrane lid is sealed to the metal end so as to cover an opening defined therein. The lid generally includes one or more layers providing strength and/or barrier properties, and a sealant layer defining the lower surface of the lid. The sealant layer’s function is to seal to the metal end, typically by heat sealing.

[0003] It is desirable for the lid to be sealed to the metal end with sufficient strength to prevent inadvertent detachment of the lid during shipping and handling prior to the consumer opening the container. On the other hand, it is also desirable for the consumer to be able to peel the lid off the metal end with relatively little force, so that people of diverse ages and abilities can open the container, and so that the lid comes off cleanly in one piece rather than tearing. These objectives of high seal strength and low peel force tend to be at odds with each other, but various container closures that strike a balance between these dual objectives have been developed. Some such closures have employed an ionomer resin such as SURYL® as the sealant layer of the membrane lid. This sealant material is readily heat-sealable to the spot-coated and non-spot-coated electro-tin-plated (ETP) steel ends that are commonly employed. However, this material is one of the most expensive sealants on the market, and also suffers from the “age-up” phenomenon whereby the strength of the seal to the metal end tends to increase with age, which is undesirable. SURYL® also has a relatively narrow heat-sealing temperature window; if the temperature is too high, the seal strength is too great for easy peelability of the lid, and if the temperature is too low, the seal strength can be too low to keep the lid from inadvertently detaching from the metal end. It can be difficult to control the processing conditions so as to stay within the desired temperature window. Further complicating this situation is the fact that SURYL® seals more readily to non-spot-coated ETP steel than to spot-coated ETP steel. Thus, a lower sealing temperature must be used for non-spot-coated metal ends than is used for spot-coated metal ends. In a container processing plant that employs both types of metal ends, it is thus necessary to have two different processes.

[0004] Additionally, even for a given type of metal end, there can be substantial variability in the surface characteristics of the metal, which can affect the strength of the seal. Such variability is not readily predicted or accounted for, and hence the strength of the seals with the membrane lids tends to have substantial variability.

[0005] Accordingly, an alternative sealant and closure system has been sought. It is desired to provide a sealant and closure system affording a wider temperature window for the heat-sealing operation. It is also desirable for the closure system to be able to use the same heat-sealing process conditions for both spot-coated and non-spot-coated metal ends, and to produce more-consistent seal strengths even under variable surface characteristics of the metal ends.

BRIEF SUMMARY OF THE INVENTION

[0006] The present invention addresses the above needs and achieves other advantages, by providing container closure systems having an ethylene vinyl acetate-based or ethylene methyl-acrylate-based sealant as the sealant layer for a flexible membrane lid. In some embodiments, the sealant comprises ethylene vinyl acetate blended with a polyolefin. The polyolefin can comprise a polyethylene such as low-density polyethylene. The metal end can have a spot-coated surface or an uncoated (i.e., bare metal) surface. A coating of a polypropylene-based composition is provided on the metal end. The polypropylene-based composition can comprise, as one example, epoxy having polypropylene dispersed therein. The sealant layer of the lid is heat-sealed to the polypropylene-based coating on the metal end to form a peelable seal. The resulting seal allows the lid to be peeled off the metal end by detachment of the sealant layer from the polypropylene-based coating. This closure system is less-sensitive to the heat-sealing temperature than the prior SURYL®-based closure and the seal strength is substantially unaffected by the metal surface characteristics, since the seal’s failure mechanism is adhesive delamination between the lid and the coating on the metal end.

[0007] In an alternative embodiment of the invention, the coating on the metal end comprises an epoxy without any polypropylene dispersed therein.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

[0008] Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

[0009] FIG. 1 is a perspective view of a container in accordance with an embodiment of the invention;

[0010] FIG. 2 is a cross-sectional view along line 2-2 in FIG. 1, showing the closure system; and

[0011] FIG. 3 is a magnified, exploded cross-sectional view of the membrane and metal end in accordance with one embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0012] The present inventions now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of the inventions are shown. Indeed, these inventions may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like numbers refer to like elements throughout.

[0013] A container 10 in accordance with an embodiment of the invention is depicted in FIGS. 1-3. The container 10 includes a receptacle 12 having a side wall 14 that encircles the interior of the receptacle. The wall 14 can have various
configurations and cross-sectional shapes. A circular cross-section is shown, but alternatively the receptacle can have other shapes such as oval, square or rectangular, oblong, etc. The receptacle can be made of various materials and by various processes. For instance, the receptacle can be formed of plastic by thermoforming, blow-molding, or injection-molding, or can be formed of composite materials (e.g., paperboard with a liner of impervious material such as polymer film and/or foil) by spiral-winding or convolute-wrapping processes. The particular details of the receptacle are not important to the present invention.

[0014] The container 10 also includes a closure system comprising a metal end 16 and a flexible membrane lid 18. The metal end 16 is ring-shaped so as to define a central opening 20 there-through. The opening 20 is encircled by a radially inner edge 22 of the metal end; the inner edge 22 advantageously is curled or rolled as shown. The metal end is affixed to the upper edge of the receptacle wall 14. The affixing of the metal end can be accomplished, for example, by seaming together a curled radially outer edge of the metal end and the upper edge of the receptacle wall as shown. A sealing composition (not shown) can be disposed between the metal end and receptacle wall in the seam region to make the seam hermetic. The membrane lid 18 is sealed to the upper surface of the metal end 16 to seal the container closed at its top end. The lid advantageously includes a pull tab 24 that is not sealed to the metal end so that it can be readily grasped and pulled to remove the lid from the metal end.

[0015] The membrane lid 18 comprises a substrate 26 and a sealant layer 28. The sealant layer 28 forms the lower surface of the lid. The substrate 26 can comprise various numbers of layers of various materials such as metal foil, polymer film, metallized polymer film (i.e., film having a very thin coating of substantially pure metal deposited thereon), paper, etc. When the container contents must be sealed against moisture and/or oxygen infiltration from the outside environment, at least one layer of the substrate comprises a barrier layer. Various materials can be used as barriers, including metal foil, metallized polyester, non-metallized polymer film (e.g., EVOH), and others. A combination of two or more such barrier layers can be used. The particular structure of the substrate 26 is not important to the present invention.

[0016] The sealant layer 28 comprises a heat-scalable material. The heat-scalable material can comprise an ethylene vinyl acetate-based (EVA-based) resin or an ethylene methyl-acrylate-based (EMA-based) resin. Examples of suitable EVA-based and EMA-based resins include various resins available from DuPont under the trademark APPEL®.

[0017] In one embodiment, the sealant layer 28 comprises a blend of an EVA-based or EMA-based resin with a polyolefin. The polyolefin can comprise a polyethylene such as low-density polyethylene (LDPE). As an example, the sealant layer can comprise a blend of a EVA and LDPE, or a blend of EVA, ethylene acrylic acid (EAA), and LDPE. A suitable composition, for instance, can comprise about 80% by weight of EVA having vinyl acetate content of about 28%, and about 20% by weight LDPE.

[0018] In accordance with the invention, the metal end 16 is coated on its upper surface with a coating 30 of a material that forms a peelable heat seal with the sealant layer 28 of the lid. In one embodiment of the invention, the coating 30 can comprise an epoxy. An example of a suitable epoxy is available from Valspar as product number 88X003C.

[0019] In another embodiment, the coating 30 can comprise an epoxy in which polypropylene is dispersed. When this composition is coated onto the metal end and cured, the surface of the resulting coating 30 is characterized by a multiplicity of microscopic spaced “islands” of polypropylene that are dispersed within the matrix of the epoxy. These polypropylene islands comprise bonding sites to which the membrane lid 18 can be sealed. The peel strength of the bond between the lid and the metal end can be controlled by varying the fraction of the total surface area of the coating 30 that is made up of the polypropylene bonding sites or islands. This fraction is a function primarily of the relative proportions of the epoxy and polypropylene making up the coating 30.

[0020] The closure system of the invention can be employed with various types of metal ends, including bare (i.e., uncoated) metal as well as coated metal. As examples, the invention is applicable to spot-coated electro-tin-plated (ETP) steel as well as uncoated ETP steel. The invention is advantageous in that the blow-off strength and peel-force characteristics of the seal between the lid and the metal end are not affected to a substantial extent by the surface characteristics of the metal end (i.e., whether it is uncoated or coated, etc.), because the failure mechanism of the seal is adhesive failure between the lid sealant layer and the epoxy-based coating on the metal end. Furthermore, the EVA-based or EMA-based sealant 28 has a relatively wide heat-sealing temperature window. Consequently, the strengths of the seals to the membrane lids tend to be more consistent than in prior closure systems.

[0021] Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the inventions are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

What is claimed is:

1. A container, comprising:
   a receptacle comprising a wall, the wall having an upper edge extending about an opening of the receptacle;
   a metal end affixed to the upper edge of the wall, the metal end defining a central opening providing access to an interior of the receptacle, the metal end defining an upper surface facing away from the interior of the receptacle, the upper surface being coated with a polypropylene-based composition; and
   a flexible membrane lid comprising a substrate and a sealant layer, the sealant layer defining a lower surface of the lid, the sealant layer and the polypropylene-based composition on the upper surface of the metal end being heat-sealed together so as to seal the lid to the metal end, the sealant layer comprising a blend of ethylene vinyl acetate and a polyolefin.
2. The container of claim 1, wherein the metal end comprises tin-plated steel.
3. The container of claim 1, wherein the metal end comprises spot-coated tin-plated steel.
4. The container of claim 1, wherein the polypropylene-based composition comprises epoxy in which polypropylene is dispersed.
5. The container of claim 1, wherein the polyolefin in the sealant layer comprises polyethylene.
6. The container of claim 5, wherein the polyethylene comprises low-density polyethylene.
7. A container, comprising:
   a receptacle comprising a wall, the wall having an upper edge extending about an opening of the receptacle;
   a metal end affixed to the upper edge of the wall, the metal end defining a central opening providing access to an interior of the receptacle, the metal end defining an upper surface facing away from the interior of the receptacle, the upper surface being coated with an epoxy-based composition; and
   a flexible membrane lid comprising a substrate and a sealant layer, the sealant layer defining a lower surface of the lid, the sealant layer sealingly affixing the lid to the polypropylene-based composition on the upper surface of the metal end so as to close the central opening of the metal end, the sealant layer comprising an ethylene vinyl acetate-based resin.
8. The container of claim 7, wherein the epoxy-based composition consists essentially of epoxy.
9. The container of claim 7, wherein the epoxy-based composition comprises epoxy in which polypropylene is dispersed.
10. The container of claim 7, wherein the sealant layer comprises ethylene vinyl acetate blended with polyolefin.
11. The container of claim 10, wherein the polyolefin comprises polyethylene.
12. The container of claim 7, wherein the metal end comprises electro-tin-plated steel to which the coating of epoxy-based composition is applied.
13. The container of claim 7, wherein the metal end comprises spot-coated electro-tin-plated steel to which the coating of epoxy-based composition is applied.
14. A container, comprising:
   a receptacle comprising a wall, the wall having an upper edge extending about an opening of the receptacle;
   a metal end affixed to the upper edge of the wall, the metal end defining a central opening providing access to an interior of the receptacle, the metal end defining an upper surface facing away from the interior of the receptacle, the upper surface being coated with an epoxy-based composition; and
   a flexible membrane lid comprising a substrate and a sealant layer, the sealant layer defining a lower surface of the lid, the sealant layer sealingly affixing the lid to the polypropylene-based composition on the upper surface of the metal end so as to close the central opening of the metal end, the sealant layer comprising an ethylene methyl-acrylate-based resin.
15. The container of claim 14, wherein the epoxy-based composition consists essentially of epoxy.
16. The container of claim 14, wherein the epoxy-based composition comprises epoxy in which polypropylene is dispersed.
17. The container of claim 14, wherein the sealant layer comprises ethylene vinyl acetate blended with polyolefin.
18. The container of claim 17, wherein the polyolefin comprises polyethylene.
19. The container of claim 14, wherein the metal end comprises electro-tin-plated steel to which the coating of epoxy-based composition is applied.
20. The container of claim 14, wherein the metal end comprises spot-coated electro-tin-plated steel to which the coating of epoxy-based composition is applied.