CONTAINER FOR SEPARATELY CONTAINING REACTIVE MATERIALS AND METHOD OF FORMING SAME

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ABSTRACT
An enclosed container for separately containing at least two reactive materials is provided. The container includes (a) a film arranged to form a first elongated compartment and a second elongated compartment, wherein the film comprises polypropylene and/or polyethylene; (b) a first reactive material contained in the first elongated compartment; and (c) a second reactive material contained in the second elongated compartment. The first reactive material is not in contact with the second reactive material. The first and second reactive materials are reactants in a chemical reaction.
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BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to containers for separately containing at least two reactive materials and methods of forming same.

[0003] 2. Description of the Related Art

[0004] To ensure that a chemical reaction is conducted efficiently and/or properly, it is typically important to use amounts of reactants in particular proportions. For example, the ratios of the various reactants of a chemical reaction can have significant effects on the amount and/or type of products formed from the reaction. In addition, the use of excess amounts of reactants can result in higher raw material costs.

[0005] Ensuring that correct proportions of the reactants of a particular reaction are used can be difficult and/or time consuming, and can detract from productivity. For example, reactants are typically sold in bulk containers from which amounts of the reactant can be taken and measured. Employing the reactants in this manner can be time consuming and wasteful, and can also result in improperly measured quantities of reactants due to human error.

[0006] A sheet of film can be used to form a container which contains a particular amount of a reactant. Such containers can provide an efficient and cost-effective means for storing and dispensing a reactant. See, for example, U.S. Pat. Nos. 4,103,473 and 4,274,244, the entire contents of which are incorporated herein by reference.

[0007] It is generally beneficial to provide a film-formed container having durable film seals in order to reduce or prevent the rupturing of the film seals. For example, the rupturing of the film seals can render the container unusable. However, the film used to form the container often requires the use of high-temperature heaters for fusing the film together. The operation of such heaters can result in significant energy costs.

[0008] In addition, the film used to form the container often does not provide sufficient barrier properties, for example, allowing the contained material and/or vapors emanating therefrom to permeate through the film. Such permeation through the film can lead to discoloration of the film and/or undesirable chemical reactions.

[0009] In view of the foregoing, there is a need for a convenient means of dispensing proportioned amounts of reactive materials. There is also a need for a container with sufficient barrier properties with respect to the materials contained therein. There is a further need for a cost-efficient means for forming containers from a sheet of film which can be used to contain reactive materials.

[0010] To overcome the disadvantages of the related art, it is an object of the present invention to provide a container for separately containing at least two reactive components and a method of forming same. In particular, it is an object of the present invention to provide a container which enables the convenient dispensing of proportioned amounts of reactive materials, and which provides sufficient barrier properties with respect to the material contained therein. It is another object of the invention to provide a cost-efficient method for forming a container from a sheet of film.

[0011] Other objects and aspects of the present invention will become apparent to one of ordinary skill in the art upon review of the specification, drawings and claims appended hereto.

SUMMARY OF THE INVENTION

[0012] The foregoing objectives are met by the inventive containers and methods of forming same. According to a first aspect of the present invention, a container for separately containing at least two reactive materials is provided. The container comprises:

[0013] (a) a film arranged to form a first elongated compartment and a second elongated compartment, wherein the film comprises polypropylene and polyethylene;

[0014] (b) a first reactive material contained in the first elongated compartment; and

[0015] (c) a second reactive material contained in the second elongated compartment,

[0016] wherein the first reactive material is not in contact with the second reactive material, and wherein the first and second reactive materials are reactants in a chemical reaction.

[0017] According to another aspect of the present invention, a method of forming a container for separately containing at least two reactive materials is provided. The method comprises:

[0018] (a) providing a film comprising polypropylene and polyethylene;

[0019] (b) arranging the film to form a first elongated compartment and a second elongated compartment;

[0020] (c) heating a first portion of the film which overlaps a second portion of the film at a temperature effective to fuse the first and second portions and to maintain the arrangement of the first and second elongated compartments; and

[0021] (d) at least partially filling the first compartment with a first reactive material and the second compartment with a second reactive material,

[0022] wherein the first reactive material is not in contact with the second reactive material, and wherein the first and second reactive materials are reactants in a chemical reaction.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The objects and advantages of the invention will become apparent from the following detailed description of the preferred embodiments thereof taken in connection with the accompanying drawings in which:

[0024] FIG. 1 is a side view of an exemplary container according to one aspect of the present invention;

[0025] FIG. 2 is a cross-sectional view of an exemplary container according to one aspect of the present invention; and
FIG. 3 is a cross-sectional view of a film used to form a container, according to one aspect of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Referring to FIGS. 1 and 2, an enclosed container 10 for separately containing at least two reactive materials is provided. The container 10 includes a first elongated compartment 30 containing a first reactive material and a second elongated compartment 40 containing a second reactive material. The first and second reactive materials react upon contact and sufficient mixing with each other, and the first and second compartments 30 and 40 enable the first and second reactive materials to be separately contained prior to the use of such materials. For example, the first and second elongated compartments 30 and 40 can be effective for preventing contact between the first and second reactive materials.

Advantageously, the first and second reactive materials can be conveniently and simultaneously dispensed from the container 10, wherein the amounts dispensed are in a predetermined ratio. The reactive materials can be useful in various applications including as an adhesive, for example, of composite materials, and in chemical anchoring applications. Specific exemplary uses include the production and repair of vehicles such as boats and automobiles, the production and repair of bath tubs and shower stalls, and the repair of concrete materials. Preferably, the reactive materials are reactants of a polymerization reaction.

The container 10 can be longitudinally oriented, preferably in the shape of a cylinder having a substantially circular cross-sectional profile. However, the cross-sectional profile of the container 10 is not limited to a circular shape and can be of any shape including, for example, a substantially elliptical or rectangular shape.

The length and diameter of the container 10 typically depend on the particular application of the reactive materials contained in the container 10. For example, containers intended for a single use or a limited amount of uses can be relatively small, whereas containers intended for a high quantity of uses can be relatively large. The container 10 can have a diameter of from about 0.5 to about 3 inches, more preferably from about 0.9 to about 2 inches. The length of the container 10 can be from about 6 to 30 inches, more preferably from about 10 to about 20 inches.

The film 20 and the reactive materials which form the container 10 can be relatively flexible and/or malleable. The dimensions of the container 10 (such as the cross-sectional profile, length and diameter thereof) can vary due to such flexibility/malleability. One of ordinary skill in the art would understand that the terms “about” and “substantial” as used herein to describe the dimensions of the container 10 take into account the possible flexibility and/or malleability of the film 20 and reactive materials.

The container 10 comprises first and second longitudinal ends 50 and 60. At each end 50 and 60, the container 10 is preferably sealed to reduce or prevent the reactive materials from inadvertently flowing from the container 10. For example, the film 20 can be gathered together at each longitudinal end 50 and 60 and retained in a gathered position using fasteners such as, for example, portions of wire 52 and 62. Alternatively, the longitudinal ends 50 and 60 of the container 10 can be sealed using an adhesive material or by heat-sealing.

The first and second elongated compartments 30 and 40 can be longitudinally oriented within the container 10, and preferably are substantially parallel to the longitudinal axis of the container 10. In an exemplary embodiment, and as shown in FIG. 2, the second elongated compartment 40 is formed substantially within the first elongated compartment 30. The first and second elongated compartments 30 and 40 can be arranged adjacent to each other. For example, a single ply of the film 20 can separate the first and second elongated compartments 30 and 40.

Each of the first and second elongated compartments 30 and 40 preferably has a substantially constant cross-sectional profile. In an exemplary embodiment, the cross-sectional profile of the elongated compartments measured along substantially the entire length of the container 10, is not the same as the cross-sectional profile measured at and/or proximal to the longitudinal ends 50 and 60 of the container 10.

The first and second elongated compartments 30 and 40 traverse substantially the entire length of the container 10. For example, the lengths of the first and second elongated compartments 30 and 40 can be shorter than the length of the container 10 due to the gathered film 20 at the longitudinal ends 50 and 60 of the container 10 and/or the optional fasteners at each end.

Preferably, the container 10 is formed from a single sheet of film 20 arranged to define the first and second elongated compartments 30 and 40. Methods and apparatuses for arranging a film to form a container are described in U.S. Pat. Nos. 4,103,473 and 4,274,244, the contents of which are incorporated herein by reference. Advantageously, the film 20 can be arranged in such a manner that the first elongated compartment 30 has a first predetermined volume and the second elongated compartment 40 has a second predetermined volume. The values of the predetermined volumes of the elongated compartments 30 and 40 typically depend on, for example, the types of reactive materials that are present in the container 10. By setting the volumes of the elongated compartments at predetermined values, the amounts of reactive materials dispensed from the container 10 can be in a proper ratio.

Preferably, the film 20 is formed of a material that is inert to or resists chemical reaction with the reactive materials contained in the container 10. Advantageously, the film 20 comprises polypropylene and/or polyethylene, preferably biaxially-oriented polypropylene. For example, biaxially-oriented polypropylene that can be used in the film 20 is available from Intermedex, Inc. located in Yardley, Pa., and Cydsa Colo. located in Monterrey, Mexico.

Referring to FIG. 3, according to a preferred embodiment of the present invention, the film 20 can be formed from a first layer 100 comprising polypropylene and/or polyethylene, a second layer 200 comprising polyester, and a third layer 300 comprising polypropylene and/or polyethylene. In a preferred embodiment, the first layer 100 and third layer 300 comprise biaxially-oriented polypropylene.
As shown in FIG. 3, the first layer 100 can be disposed above the second layer 200, and the second layer 200 can be disposed above the third layer 300. In a preferred embodiment, the first layer 100 is disposed on the second layer 200, and the second layer 200 is disposed on the third layer 300. The layers 100, 200 and 300 can be fastened together by any suitable means including, for example, by employing an adhesive between the first and second layers 100 and 200, and the second and third layers 200 and 300.

The first layer 100, second layer 200 and third layer 300 can be of any suitable width. Preferably, the width of the first and third layers are from about 0.75 to about 1.5 mils. The width of the second layer can be from about 0.5 to about 1 mil. The width of the film 20 can be any suitable width, preferably from about 2 to about 4 mils.

The first and second elongated compartments 30 and 40 contain first and second reactive materials, respectively. Preferably, the first and second elongated compartments 30 and 40 are effective for separately containing the first and second reactive materials, thereby reducing or eliminating the contact between the reactive materials. As a result, undesirable reactions between the reactive materials can be reduced or eliminated.

The reactive materials can be selected depending on the particular application of the container 10. For example, the reactive materials can comprise liquid and/or solid materials. In a preferred embodiment, the first and second reactive materials comprise a reactive resin component and a hardener component, respectively. When contacted and sufficiently mixed, such reactive materials typically become polymerized, wherein the hardener component acts as a cross-linking agent with respect to the resin component. The resin component and the hardener component can comprise, for example, a reactive unsaturated polyester resin and a benzoyl peroxide or methyl ethyl ketone peroxide hardener, respectively. Such reactive materials can be useful, for example, as an adhesive and in chemical anchoring applications.

Preferably, the reactive resin component is present in the container 10 in a greater proportion than the hardener component. For example, the ratio of reactive resin component to hardener component is preferably from about 9:1 to about 1.5:1, by weight. However, the amounts of reactive resin component and hardener component are not limited to this ratio, as the ratio depends, for example, on the particular application. The elongated compartment which contains a higher proportion of reactive material is typically larger than the elongated compartment which contains a lower proportion of reactive material.

The resin component can include additional materials, for example, to improve the properties thereof. Exemplary materials which can be added to the resin component include an inhibitor for stabilizing the resin component, in order to extend shelf life and/or pot life. A glycol can be added as a liquid diluent, an internal lubricant and/or an antifreezing agent. Fumed silica can be added as a thixotropic. Additional materials can be added such as glass spheres for weight reduction, titanium dioxide as a whitener, fiber material for reinforcement, and a colorant.

The hardener component can also include additional materials, for example, to improve the properties thereof. Exemplary materials which can be added to the hardener component include a glycol as a liquid diluent and/or an antifreezing agent. Mineral oil can be added as an internal lubricant and/or a suspension agent, and water can be added as a liquid diluent. A colorant can also be added.

The resin and/or hardener components can also contain a filler. Exemplary fillers include limestone, dolomite and sandstone.

Advantageously, the inventive container 10 enables the convenient and precise application to a point of use of amounts of the first and second reactive materials in a desired ratio. As discussed above, one drawback associated with employing multicomponent reactions such as polymerization reactions is that care should be taken to measure the amounts of the various reactants to ensure a proper ratio of the reactants.

The inventive container 10 conspicuously ameliorates or eliminates this problem by providing the reactive materials in elongated compartments with predetermined volumes, and optionally with substantially constant cross-sectional profiles. The container 10 can be used, for example, by forming an opening at an end thereof and applying pressure to dispense the at least two reactive materials simultaneously. In this manner, the reactive materials dispensed from the container 10 can be consistently dispensed in a predetermined ratio.

For example, the container 10 can be opened by making an incision in the film 20 proximal to a longitudinal end of the container 10. Optionally, the container 10 can comprise means to facilitate the opening of the container 10 such as, for example, a plurality of perforations in the film 20 and/or a marking on the film 20 indicating a suitable area to make an incision. Once an opening is formed in the film 20, the first and second reactive materials can be simultaneously dispensed from the container 10 by applying external pressure thereto, for example, by manually squeezing the container 10. In this manner, the first and second reactive materials can be dispensed to a point of use in a predetermined ratio without the need to individually measure amounts of the first and second reactive materials.

Optionally, the container 10 can be used in conjunction with a device for dispensing the reactive materials, such as a pneumatic dispenser, to facilitate applying the reactive materials to a point of use. The container 10 can also be used with a mixing device such as, for example, a static mixer arranged proximally to the opening in the container 10. Use of such a mixing device can conspicuously ameliorate or eliminate the need for manually mixing the dispensed amount of first and second reactive materials.

According to another aspect of the present invention, a method is provided of forming a container 10 which separately contains at least two reactive materials. The method of forming the container 10 can be conducted on a continuous or batch basis, preferably on a continuous basis. The method includes providing the film 20 described above, and arranging the film 20 to form a first elongated compartment 30 and a second elongated compartment 40. For example, the film 20 can be arranged using the methods and apparatuses disclosed in U.S. Pat. Nos. 4,103,473 and 4,274, 244, the entire contents of which are incorporated herein by reference.
The film 20 is preferably arranged such that the first and second elongated compartments 30 and 40 are longitudinally oriented, and preferably extend in a direction substantially parallel to the longitudinal axis of the container 10. In an exemplary embodiment, the film 20 is arranged such that each of the first and second elongated compartments 30 and 40 has a cross-sectional profile which is substantially constant.

In order to maintain the first and second elongated compartments 30 and 40 in place, the film 20 can be heat-sealed along overlapping portions of the film 20. The heating step is effective to fuse the overlapping portions of the film 20 together. Advantageously, the use of the film 20 described above enables a reduction of the temperature necessary to form a durable heat seal with the film 20 in comparison with various other conventionally used films such as, for example, a polyester film. For example, the film 20 can be heat-sealed at a temperature of from about 185°F to about 225°F, whereas conventional polyester films are typically heat-sealed at about 350°F. Such reduction in temperature enables the reduction of energy costs associated with the use of the heater, as well as the formation of durable seals which can reduce the amount of scrap produced by defective containers.

Employing the film 20 can also reduce the operating air pressure level of the heater, thereby further saving energy costs. For example, while a heater for scaling polyester films typically operates at an air pressure level of about 60 psi, a heater for scaling the inventive film 20 can operate at air pressure levels of, for example, from about 30 to about 40 psi. In addition, the use of the film 20 can also obviate the need for using alcohol in the manufacturing process, which is typically used as a film softener in processes which employ conventional films such as polyester films.

The first and second elongated compartments 30 and 40 are at least partially filled with the first and second reactive materials, respectively, and preferably entirely filled. The filling step typically occurs after the heat-scaling step, but may be conducted at any time after formation of the elongated compartments. The first and second reactive materials can be introduced into the first and second elongated compartments 30 and 40 using any suitable apparatus such as, for example, feed mandrels as disclosed in U.S. Pat. No. 4,274,244.

While the invention has been described in detail with reference to specific embodiments thereof, it will be apparent to one skilled in the art that various changes and modifications can be made, and equivalents employed without departing from the scope of the claims.

What is claimed is:

1. A container for separately containing at least two reactive materials, comprising:

   (a) a film arranged to form a first elongated compartment and a second elongated compartment, wherein the film comprises polypropylene and/or polyethylene;

   (b) a first reactive material contained in the first elongated compartment; and

   (c) a second reactive material contained in the second elongated compartment,

   wherein the first reactive material is not in contact with the second reactive material, and wherein the first and second reactive materials are reactants in a chemical reaction.

2. The container of claim 1, wherein each of the first and second elongated compartments traverses substantially the length of the container.

3. The container of claim 1, wherein the film comprises biaxially-oriented polypropylene.

4. The container of claim 1, wherein the film is formed from a first layer comprising polypropylene or polyethylene, a second layer comprising polyester, and a third layer comprising polypropylene or polyethylene.

5. The container of claim 4, wherein the first and third layers comprise biaxially-oriented polypropylene.

6. The container of claim 4, wherein the first layer is disposed above the second layer, and the second layer is disposed above the third layer.

7. The container of claim 6, wherein the first layer is disposed on the second layer, and the second layer is disposed on the third layer.

8. The container of claim 1, wherein the first and second reactive materials comprise a resin component and a hardener component, respectively.

9. The container of claim 8, wherein the resin component comprises a reactive unsaturated polyester resin and the hardener component comprises benzoyl peroxide and/or methyl ethyl ketone peroxide.

10. The container of claim 1, wherein the first and/or second reactive material comprises a filler selected from the group consisting of limestone, dolomite and sandstone.

11. The container of claim 1, wherein the first and second elongated compartments are substantially parallel to the longitudinal axis of the container.

12. The container of claim 1, wherein the first and second elongated compartments have a substantially constant cross-sectional profile along the length of the container.

13. The container of claim 1, wherein the volume of the first elongated compartment is greater than the volume of the second elongated compartment.

14. The container of claim 1, wherein the second elongated compartment is formed within the first elongated compartment.

15. Method of forming a container for separately containing at least two reactive materials, comprising:

   (a) providing a film comprising polypropylene and/or polyethylene;

   (b) arranging the film to form a first elongated compartment and a second elongated compartment;

   (c) heating a first portion of the film which overlaps a second portion of the film at a temperature effective to fuse the first and second portions and to maintain the arrangement of the first and second elongated compartments; and

   (d) at least partially filling the first compartment with a first reactive material and the second compartment with a second reactive material,

   wherein the first reactive material is not in contact with the second reactive material, and wherein the first and second reactive materials are reactants in a chemical reaction.
16. The method of claim 15, wherein each of the first and second elongated compartments traverses substantially the length of the container.

17. The method of claim 15, wherein the film comprises biaxially-oriented polypropylene.

18. The method of claim 15, wherein the film is formed from a first layer comprising polypropylene or polyethylene, a second layer comprising polyester, and a third layer comprising polypropylene or polyethylene.

19. The method of claim 18, wherein the first and third layers comprise biaxially-oriented polypropylene.

20. The method of claim 18, wherein the first layer is disposed above the second layer, and the second layer is disposed above the third layer.

21. The method of claim 20, wherein the first layer is disposed on the second layer, and the second layer is disposed on the third layer.

22. The method of claim 15, wherein the first and second reactive materials comprise a resin component and a hardener component, respectively.

23. The method of claim 22, wherein the resin component comprises a reactive unsaturated polyester resin and the hardener component comprises benzoyl peroxide and/or methyl ethyl ketone peroxide.

24. The method of claim 15, wherein the first and/or second reactive material comprises a filler selected from the group consisting of limestone, dolomite and sandstone.

25. The method of claim 15, wherein the first and second elongated compartments are substantially parallel to the longitudinal axis of the container.

26. The method of claim 15, wherein the first and second elongated compartments have a substantially constant cross-sectional profile along the length of the container.

27. The method of claim 15, wherein the volume of the first elongated compartment is greater than the volume of the second elongated compartment.

28. The method of claim 15, wherein the second elongated compartment is formed within the first elongated compartment.