The present invention provides a battery package excellent in strength, impact resistance and transparency, wherein main components thereof are all made of a biodegradable resin by vacuum forming. The battery package includes a base and a container composed of a drawn sheet of biodegradable aliphatic polyester. The drawn sheet is made of a composition containing a polylactic polymer and at least one of polybutylene succinate and polycaprolactone.
FIG. 3

(1-1) Container molding step
A drawn sheet of biodegradable resin is molded into a container by vacuum forming

(1-2) Base bonding step
A laminate layer of biodegradable resin is bonded to a biodegradable resin base

Container Bonded product

(1-3) Integration step
The container and the laminate layer are heat-sealed to integrate the container and the base

Battery package

FIG. 4

(2-1) Container molding step
A drawn sheet of biodegradable resin is molded into a container by vacuum forming

(2-2) Fold formation step
Peripheral edges of the container are bent to form folds

(2-3) Integration step
A biodegradable resin base is slid into the folds to integrate the container and the base

Battery package
FIG. 5

(1-1) Container molding step

a. Print is given on a drawn sheet of biodegradable resin

b. The drawn sheet is molded into a container by vacuum forming

(1-2) Base bonding step

a. Print is given on a biodegradable resin base

b. A laminate layer of biodegradable resin is bonded to the base

Container Bonded product

(1-3) Integration step (Blister process)

a. A battery pack is accommodated in the container

b. The container and the laminate layer are heat-sealed to integrate the container and the base

Battery package
BATTERY PACKAGE AND METHOD FOR PRODUCING THE SAME

FIELD OF THE INVENTION

[0001] The present invention relates to a battery package and a method for producing the same.

BACKGROUND OF THE INVENTION

[0002] Thermoplastic resins such as polyethylene, polyvinyl chloride, polystyrene and polyethylene terephthalate (PET) have been used as materials for product packages. These resins, however, are chemically stable, and therefore do not decompose under natural environment. Instead, they remain physically and chemically unaffected.

[0003] Accordingly, the use of such materials is accompanied by the problem that it may lead to pollution of the environment and more landfill sites. Currently, battery packages, in particular, are mostly made of PET, and they are disposed of with other wastes while the batteries are collected.

[0004] In order to solve the above problems, as environmentally friendly resins, biodegradable resins capable of decomposing and disappearing with time under natural environment have been developed, and some plastic bags and containers are made therefrom. Examples of the biodegradable resins include aliphatic polyester, modified polyvinyl alcohol (PVA), cellulose ester compounds and modified starch. Among them, the aliphatic polyester is environmentally preferred because alcohol and carboxylic acid generated therefrom during the decomposition are extremely less toxic.

[0005] The biodegradable resins have been used in relatively large molded products such as a film as disclosed by Japanese Laid-Open Patent Publication No. Hei 10-100353, a document folder as disclosed by Japanese Laid-Open Patent Publication No. 2001-130183, and food trays. However, due to their brittleness, it has been difficult to mold or form the resin into an extremely compact shape such as a battery package. Moreover, because battery packages, which accommodate batteries that are relatively heavy, are required to have sufficient strength, impact resistance and transparency, it has been difficult to obtain a molded product that satisfies all these requirements.

[0006] Under the circumstances, in Japanese Laid-Open Patent Publication No. 2004-348976 (Japanese Patent Application No. 2003-135903), the present inventors have proposed to form a drawn sheet of biodegradable resin into a container by means of vacuum/pressure forming. However, because strong force is applied during the vacuum/pressure forming, the resulting container might have a slightly thin portion, resulting in a lower strength, and the productivity tends to be low.

[0007] In view of the above, an object of the present invention is to provide a battery package excellent in strength, impact resistance and transparency produced by vacuum/pressure forming method using a biodegradable resin. Another object of the present invention is to provide an environmentally friendly battery package whose main components are all made of a biodegradable resin.

BRIEF SUMMARY OF THE INVENTION

[0008] The present invention relates to a battery package comprising a base and a container including a drawn sheet of biodegradable aliphatic polyester, wherein the drawn sheet comprises a composition containing a polylactic polymer and either of polybutylene succinate and polycaprolactone.

[0009] It is effective that the base be made of a biodegradable aliphatic polyester. It is preferred that the biodegradable aliphatic polyester be a polylactic polyester.

[0010] Further, a laminate layer made of a biodegradable aliphatic polyester is preferably arranged between the base and the container.

[0011] The base preferably has a first printing layer, an anti-offset layer and a second printing layer laminated in this order on the surface of the base opposite to the container-side surface.

[0012] The present invention further provides a method for producing a battery package comprising the steps of: forming a drawn sheet of biodegradable aliphatic polyester into a container having a holder portion by vacuum forming; and integrating the container with a base made of a drawn sheet of biodegradable aliphatic polyester to obtain a battery package.

[0013] In this case, it is preferred to bond a laminate layer made of a drawn sheet of biodegradable aliphatic polyester to the base to obtain a bonded product, and to heat seal (melt) the laminate layer and the container to integrate the base and the container.

[0014] Alternatively, it is also preferred to bond the peripheral edges of the container on the opposite side of the holder portion to form folds, and to insert the base in the folds to integrate the container and the base.

[0015] According to the present invention, a battery package whose main components are all made of a biodegradable resin that exhibits excellent strength, excellent impact resistance and excellent transparency can be produced by a conventional vacuum molding (forming).

[0016] While the novel features of the invention are set forth particularly in the appended claims, the invention, both as to organization and content, will be better understood and appreciated, along with other objects and features thereof, from the following detailed description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0017] FIG. 1 is an exploded perspective view schematically illustrating an embodiment of a battery package according to the present invention.

[0018] FIG. 2 is an exploded perspective view schematically illustrating another embodiment of a battery package according to the present invention.

[0019] FIG. 3 is a flowchart illustrating the major steps of a first embodiment of a method for producing a battery package according to the present invention.

[0020] FIG. 4 is a flowchart illustrating the major steps of a second embodiment of a method for producing a battery package according to the present invention.

[0021] FIG. 5 is a flowchart illustrating the steps of a method for producing a battery package according to EXAMPLE of the present invention.
DETAILED DESCRIPTION OF THE INVENTION

[0022] (1) Battery Package

[0023] The present invention relates to a battery package including a base and a container, the container being made of a drawn sheet of biodegradable aliphatic polyester, characterized in that the drawn sheet is made of a resin composition containing a polyactic polymer and either of polybutylene succinate and polycaprolactone.

[0024] In view of the problems encountered in conventional techniques, the present inventors vigorously conducted experiments and analyzed the results regarding the molding/forming of biodegradable resins and the obtained products. As a result, they found that the addition of a softening agent, polybutylene succinate or polycaprolactone, to a polyactic polymer achieves the production of a battery package by a conventional vacuum molding method in which a biodegradable resin is not used. Based on this finding, the present invention has been accomplished.

[0025] FIG. 1 is an exploded perspective view schematically illustrating an embodiment of a battery package according to the present invention.

[0026] A battery package 1 shown in FIG. 1 is composed of a base 2 and a transparent container 3. A battery pack 4 is accommodated in a holder portion 3a of the container 3. On the surface of the base 2 facing the container 3 is given a certain print, and then a laminate layer (not shown in the drawing) is further formed.

[0027] A brim 5b of the container 3 and the laminate layer is then bonded by, for example, heat sealing to integrate the base 2 and the container 3. The base 2 may have a hanging aperture 2a so that the battery package 1 can be hanged on a sales shelf for display. In a conventional battery package, backing paper is used instead of the base 2.

[0028] FIG. 2 is an exploded perspective view schematically illustrating another embodiment of a battery package according to the present invention.

[0029] A battery package 11 shown in FIG. 2 is composed of a base 12 and a transparent container 13. A battery pack 14 is accommodated in a holder portion 13a of the container 13. In a second embodiment, a certain print is given on the surface of the base 12 facing the container 13, but the laminate layer may be omitted.

[0030] Instead of not forming a laminate layer, a portion of the container 13 corresponding to the brim 5b in FIG. 1 is folded to the opposite side to the holder portion 13a to form folds 13b, 13c and 13d. In other words, the periphery of the container 13 is folded by 180 degrees on the base 12 side to form the folds. Along the alternate long and short dash lines shown in FIG. 2, the base 12 is slid into the folds 13b and 13d from the edges thereof in the direction of an arrow X. When the base 12 reaches the fold 13c, the base 12 and the container 13 are integrated.

[0031] Since the base 12 is merely inserted in the folds 13b, 13c and 13d of the container 13, the base 12 is preferably fixed with the folds 13b, 13c and 13d. There is no specific limitation on the means for fixing them, and any means can be used. For example, they may be fixed by means of heat sealing, an adhesive or a staple.

[0032] Similar to the first embodiment, the base 12 may have a hanging aperture 12a so that the battery package 11 can be hanged on a sales shelf for display.

[0033] In the battery packages 1 and 11 shown in FIGS. 1 and 2, it is at least required that the container 3, 13 is transparent so that the design printed on the outer jacket of the batteries in the battery pack 4, 14 can be observed by a user or a customer. The base 2, 12 facing the container 3, 13, may also be transparent, though a certain print is given to the surfaces of the base 2, 12.

[0034] In the battery packages shown in FIGS. 1 and 2, printing layers are usually formed on the surface of the base 2, 12 facing the container 3, 13 (first surface) and the surface opposite to the first surface (second surface), respectively.

[0035] In the present invention, only the second surface may have a first printing layer, an anti-offset layer and a second printing layer formed thereon in this order.

[0036] Examples of the biodegradable resin usable in the present invention include aliphatic polyester, modified polyvinyl alcohol (PVA), cellulose ester compounds and modified starch. Among them, the aliphatic polyester is environmentally preferred because alcohol and carboxylic acid generated therefrom during decomposition are extremely less toxic.

[0037] Examples of the aliphatic polyester include polymers produced by microorganism-mediated processes such as a hydroxybutyric acid-valeric acid polymer, synthetic polymers such as polycaprolactone and an aliphatic dicarboxylic acid-aliphatic diol condensate and semisynthetic polymers such as polyactic polymers.

[0038] From the viewpoint of excellent transparency, stiffness, heat resistance and processability, the polyactic polymers are preferably used. The polyactic polymer may be a homopolymer of L-lactic acid and/or D-lactic acid. Alternatively, it may be a copolymer or a mixture (or a polymer alloy) with other hydroxycarboxylic acids as long as its biodegradability is not impaired.

[0039] Examples of other hydroxycarboxylic acids include glycolic acid, 3-hydroxybutyric acid, 4-hydroxybutyric acid, 3-hydroxyvaleric acid, 4-hydroxyvaleric acid and 6-hydroxycapeic acid.

[0040] The polyactic polymer, a preferred biodegradable resin, preferably has a weight-average molecular weight of 50,000 to 100,000. If the weight-average molecular weight is less than 50,000, practical physical properties will hardly be exhibited. Conversely, if the weight-average molecular weight is higher than 100,000, melt viscosity will be too high, resulting in poor moldability.

[0041] The polyactic polymer has a high glass transition point and high crystallinity, and it has characteristics similar to those of polyethylene terephthalate (PET). Further, a film made of polyactic acid can be uniaxially or biaxially drawn (stretched). The resulting drawn sheet, in which molecules are oriented, is low in brittleness, hard to crack and extremely favorable in strength. Moreover, the polyactic polymer film can be formed by extrusion casting, which ensures transparency of the film. In the present invention, a drawn sheet is preferably used as a material to produce a container particularly by vacuum forming, which will be described later.
A raw material for the polylactic polymer may be corn. Starch is separated from corn and then converted into sugar. Lactic acid is then obtained by lactic acid fermentation, which is converted into lactide, and then polymerized into polylactic acid. As just described, the polylactic polymer can be made without using petroleum materials. Therefore, according to the present invention, the final resulting battery package as well as the preparation process of the raw material are environmentally friendly.

In the present invention, the drawn sheet is produced from a resin composition obtained by mixing the polylactic acid with a softening agent. When the drawn sheet is molded from only the polylactic polymer, the molding has to be performed at a relatively low temperature so as to prevent the sheet from being brittle. For this reason, not vacuum forming, but vacuum-pressure forming is considered as a preferred method for producing the drawn sheet. Vacuum pressure forming, however, blasts strong force onto the drawn sheet, reducing the strength of the thin portion of the sheet, which could decrease the productivity.

In view of the above, the present invention uses a resin composition obtained by adding a softening agent such as polybutylene succinate or polycaprolactone to the polylactic polymer so that the container can be formed from the drawn sheet by vacuum forming even when polylactic polymer is used.

In this case, the mixing ratio between the polylactic polymer and the softening agent is not specifically limited as long as the drawn sheet can be molded into the container by vacuum forming. Because the softening agent is milky white, the ratio should be in the range where the transparency of the container is not impaired.

Specifically, the mixing ratio can be appropriately adjusted according to the molding conditions such as the strength of the container (low brittleness, resistance to cracking), tolerance to thinness of the side surfaces of the container, temperature, degree of vacuum, and processing speed.

The resin composition may further contain other polymer materials as long as the effect of the present invention is not impaired. Additionally, for the purpose of adjusting the physical properties and processability, it may further contain a plasticizer, a lubricant, an inorganic filler, an ultraviolet absorber, a heat stabilizer, a light stabilizer, a light absorber, a coloring agent, a pigment or/and a modifier.

The reason why the drawn sheet is used will be explained below.

Because battery packages are required to have a relatively finely shaped holder portion with corners designed to fit the battery, moldability as well as transparency is required. Biodegradable resins are brittle, and thus when a biodegradable resin sheet is molded under conventional conditions, cracks may occur.

In order to solve the problem, the present invention uses a drawn biodegradable resin sheet for the production of the container. The drawing (stretching) process improves the brittleness and strength of the resulting sheet, and thus a container resistant to cracking can be obtained. A biaxially drawn sheet is more preferred than a uniaxially drawn sheet because a biaxially drawn sheet has higher strength.

Although the drawn sheet has higher strength than an undrawn sheet, it is slightly poor in processability. Accordingly, it is difficult to mold the drawn biodegradable resin sheet into the container by vacuum forming or the like under the same conditions as used when molding a package from a commonly used thermoplastic resin. In view of this, in the present invention, the softening agent described above is used, and the drawn sheet is molded into the container by vacuum forming.

The drawn sheet preferably has a tensile strength (breaking strength) of 40 to 90 MPa. When the tensile strength is less than 40 MPa, sufficient strength to carry the battery cannot be obtained. Conversely, when the tensile strength is greater than 90 MPa, the sheet will have too high a strength, decreasing moldability and transparency of the sheet. Particularly preferred is 60 to 80 MPa. The tensile strength in the present invention is measured according to JIS K 7127, in which a Type 2 test specimen is used and measurement is made at a test rate of 200 mm/min.

Further, the drawn sheet preferably has a tensile elasticity of 1 to 7 GPa. When the drawn sheet has a tensile elasticity of less than 1 GPa, the sheet will be too stiff, decreasing moldability of the sheet. When the drawn sheet has a tensile elasticity exceeding 7 GPa, the sheet will be too soft, which may cause difficulty in carrying the battery. Particularly preferred is 2 to 6 GPa. The tensile elasticity can be measured according to JIS K 7127.

As an index of the sheet transparency, the drawn sheet preferably has a haze of less than 10%. When the haze is not less than 10%, the sheet will have decreased transparency, losing the inherent function of the package. Particularly preferred is 2 to 8%. The haze is measured according to JIS K 7105.

Further, if a laminate layer made of biodegradable aliphatic polyester is formed between the base and the container, the base and the container can be integrated by heat sealing, which will be described later.

Instead of forming the laminate layer, if folds are formed by folding the peripheral edges of the container, the base can be inserted in the folds whereby the container and the base can be integrated.

The holder portion of the container accommodates a battery pack including a plurality of batteries wrapped in a shrink pack. It is preferred that the shrink pack is also made of a biodegradable aliphatic polyester. The biodegradable aliphatic polyester is preferably a polylactic polymer. The shrink pack is preferably made of a drawn sheet of the biodegradable aliphatic polyester.

The base preferably has a thickness of 50 to 200 μm. When the base has a thickness of less than 50 μm, the resulting sheet will be too thin, which may cause difficulty in carrying the battery. When the base has a thickness exceeding 200 μm, thermal conductivity will be decreased, causing variations in adhesion strength when the base and the container are heat-scaled, resulting in a final package of lower quality. Besides, it is difficult to control heat during the heat sealing process.

The laminate layer preferably has a thickness of 20 to 80 μm. When the laminate layer has a thickness less than 20 μm, the cushioning property of the laminate layer itself
will be decreased, causing variations in adhesion pressure and adhesion strength during heat sealing. Further, when the thickness is less than 20 \( \mu \text{m} \) the laminate layer may stretch too much and be susceptible to rupture. Conversely, when the laminate layer has a thickness greater than 80 \( \mu \text{m} \), a longer time will be needed for the heat sealing process, and the base may be adversely affected (e.g. deformed) by excessive application of heat. Particularly preferred is a thickness of 40 to 60 \( \mu \text{m} \).

[0060] As mentioned above, when the printing layers are formed only on the second surface of the base, the laminate layer can be omitted.

[0061] The drawn sheet preferably has a thickness of 200 to 600 \( \mu \text{m} \). When the sheet for the container has a thickness less than 200 \( \mu \text{m} \), the tolerance range for heat during molding will be small, and the sheet will be deformed (e.g. stretched too much or the like) due to its small thickness. Moreover, heat control during molding will be difficult even when the sheet has a thickness greater than 600 \( \mu \text{m} \), no further improvement can be expected.

[0062] The printing on the base can be done by a conventional method. The bonding of the laminate layer to the base can also be done using a conventional adhesive. Examples of the adhesive include a vinyl adhesive, an acryl adhesive, a polyamide adhesive, a polyester adhesive, a rubber adhesive and a urethane adhesive.

[0063] In the present invention, however, it is preferred to use a biodegradable adhesive made of a polysaccharide such as starch, amylose or amylopectin; a protein and a polypeptide such as gelatin, casein, zein or collagen; unvulcanized rubber or aliphatic polyester.

[0064] (2) Method for Producing Battery Package

[0065] Hereinafter, a description will be given of a method for producing a battery package according to the present invention.

[0066] The battery package according to the present invention can be produced by the steps of: forming a drawn sheet of biodegradable aliphatic polyester into a container having a holder portion by vacuum forming; and integrating the container with a base made of a drawn sheet of biodegradable aliphatic polyester to obtain a battery package.

[0067] The method for producing the battery package according to the present invention will now be discussed briefly.

[0068] FIG. 3 is a flowchart illustrating the major steps of a first embodiment of a method for producing a battery package according to the present invention. FIG. 4 is a flowchart illustrating the major steps of a second embodiment of a method for producing a battery package according to the present invention.

[0069] In the first embodiment, as shown in FIG. 3, a drawn biodegradable resin sheet is formed into a container having a holder portion by vacuum forming in the container molding step (1-1). Subsequently, in the base bonding step (1-2), a laminate layer composed of a drawn biodegradable aliphatic polyester material is bonded to a base composed of a drawn sheet of biodegradable aliphatic polyester to give a bonded product. The container molding step (1-1) and the base bonding step (1-2) may be performed simultaneously, or separately (e.g. either step may be performed prior to the other).

[0070] In the integration step (1-3), the laminate layer in the bonded product and the container are heat-sealed. Thereby, the base and the container are integrated to obtain a battery package according to the present invention (blister pack). In FIG. 1, the step of accommodating a battery pack in the container is omitted.

[0071] In the second embodiment, as shown in FIG. 4, a drawn sheet of biodegradable aliphatic polyester is molded into a container having a holder portion by vacuum/pressure forming in the container molding step (2-1) in the same manner as the container molding step (1-1) of the first embodiment. Subsequently, in the fold formation step (2-2), the peripheral edges of the container are bent on the opposite side of the holder portion to form folds.

[0072] The shape and size of the folds will be described in detail in Examples given later. The folds may have any shape and size as long as the base and the container can be integrated in the integration step (2-3) and they allow the battery pack to be retained in the holder portion. For example, the peripheral edges of the container may be bent on the opposite side of the holder portion.

[0073] Finally, in the integration step (2-3), the base made of the drawn sheet of biodegradable aliphatic polyester is inserted into the folds. Then, by blister process for integrating the container and the base, a battery package according to the present invention is obtained. In FIG. 2, the step of accommodating the battery pack is also omitted.

[0074] FIGS. 3 and 4 show only the major steps of a method for producing a battery package of the present invention. The detailed conditions for each step and the additional steps such as the step of accommodating the battery pack before the integration step will be described in EXAMPLES below.

[0075] Hereinafter, the present invention will be described in further detail with reference to EXAMPLES, but it is to be understood that the invention is not limited thereto.

EXAMPLE 1

[0076] In this example, a battery package 1 according to the present invention having the structure shown in FIG. 1 was produced in accordance with the steps of the first embodiment shown in FIG. 5.

[0077] (1) Container Molding Step

[0078] Using a resin composition containing polyactic acid (hereinafter referred to as “PLA”) and polybutylene succinate (softening agent A) in a weight ratio of 100:6 and another resin composition containing PLA and polycaprolactone (softening agent B) in a weight ratio of 100:6, transparent drawn sheets having a thickness of 250 \( \mu \text{m} \) were prepared. The drawn sheets had a tensile strength (breaking strength) of 60 MPa in length direction and 65 MPa in width...
direction, a tensile elasticity of 3.2 GPa in length direction and 3.1 GPa in width direction, and a haze of 10%. The heat shrinkage of the drawn sheets was measured according to JIS Z 1712 in which a test specimen was heated at 120°C for 5 minutes. As a result, the drawn sheets had a heat shrinkage of 3.7% in length direction and 1.7% in width direction.

[0079] In a battery package 1, a certain mark was printed on the surface of a holder portion 3a of a container 3 opposite to the base 2 by rotary printing using a UV ink. The mark states that the battery package 1 according to the present invention is made of a biodegradable resin and thus an environmentally friendly product.

[0080] Then, using a vacuum forming machine, each of the drawn sheets was formed into a container 3 having the shape shown in FIG. 1 by vacuum forming at a forming temperature of 110°C.

[0081] (2) Base Bonding Step

[0082] Separately from the container bonding step just described above, a translucent drawn sheet of PLA having a thickness of 100 μm was prepared as a base 2. The base 2 had a tensile strength (breaking strength) of 110 MPa both in length and width directions, and a tensile elasticity of 4.0 GPa in length direction and 4.4 GPa in width direction. The heat shrinkage of the base was measured according to JIS Z 1712 in which a test specimen was heated at 120°C for 5 minutes. As a result, the base had a heat shrinkage of 1.7% in length direction and 0.5% in width direction. A certain print was given on the surface of the base 2 facing the container 3 (first surface) by rotary printing using a UV ink.

[0083] Subsequently, as a laminate layer, a transparent drawn sheet of PLA having a thickness of 50 μm was prepared. The laminate layer had a tensile strength (breaking strength) of 110 MPa both in length and width directions, a tensile elasticity of 3.8 GPa in length direction and 4.3 GPa in width direction, and a haze of 2%. The heat shrinkage of the laminate layer was measured according to JIS Z 1712 in which a test specimen was heated at 120°C for 5 minutes. As a result, the laminate layer had a heat shrinkage of 2.7% in length direction and 0.3% in width direction.

[0084] The laminate layer was bonded to the printing surface of the base 2 (first surface) using a polyamide adhesive to give a bonded product.

[0085] (3) Integration Step

[0086] A battery pack containing four cylindrical AA batteries (shrink-packed) 4 was prepared, which was then accommodated in the holder portion 3a of the container 3.

[0087] Finally, a brim 3b of the container 3 and the laminate layer (not shown in the drawing) on the base 2 were bonded by heat sealing at 100°C. Thereby, a battery package 1 of the present invention was obtained.

EXAMPLE 2

[0088] A battery package 2 according to the present invention was produced in the same manner as in EXAMPLE 1 except for the following points. Instead of using the laminate layer, on the other surface of the base 2 (second surface) were successively formed a 5 μm thick first printing layer made of a UV ink by relief printing, a 12 μm thick anti-offset layer made of a UV ink by flexographic printing and a 5 μm thick second printing layer by relief printing. The base 2 and the container 3 were directly bonded by heat sealing at a heating temperature of 100°C.

COMPARATIVE EXAMPLE 1

[0089] A battery package 3 for comparison having the structure shown in FIG. 1 was produced in the same manner as in EXAMPLE 1 except that the softening agent was not added to PLA used for production of the drawn sheet of the container 3 and that the container 3 was obtained by vacuum/pressure forming at a forming temperature of 100°C.

[0090] [Evaluation]

[0091] The battery packages 1 and 2 and the battery package 3 for comparison produced above were subjected to the following evaluation tests.

[0092] (1) Drop Test

[0093] The battery packages 1 and 2 and the battery package 3 for comparison, ten of each, were packed in a unit packing box by a conventional method. Each of the boxes was dropped onto a concrete surface from the height of 50 cm, which was repeated 5 times.

[0094] The number of damaged battery packages after the box was dropped 5 times is shown in Table 1.

[0095] (2) Vibration Test

[0096] The battery packages 1 and 2 and the battery package 3 for comparison, ten of each, were packed in a unit packing box by a conventional method. Subsequently, a packing box containing five unit packing boxes was formed for the battery packages 1 and 2 and the battery package 3 for comparison, which was then subjected to vibration test at a vibration frequency of 5 to 50 Hz for about 10 to 30 minutes.

[0097] As a result, no scratch, crack and deformation were found in any of the battery packages.

[0098] (3) Storage Test

[0099] The battery packages 1 and 2 and the battery package 3 for comparison, five of each, were prepared and stored at a controlled temperature of 40°C and a high humidity of 90% RH for 168 hours, after which they were visually checked.

[0100] The number of cracked or deformed battery packages is shown in Table 1.

[0101] (4) Weather Resistance Test

[0102] The battery packages 1 and 2 and the battery package for comparison, five of each, were prepared and subjected to a solar radiation test using a sunshine weather-meter at a temperature of 63°C for 340 hours.
The number of yellowed battery packages is shown in Table 1.

**TABLE 1**

<table>
<thead>
<tr>
<th>Base</th>
<th>Laminate layer</th>
<th>Container</th>
<th>Vacuum forming into container</th>
<th>Forming method of container</th>
<th>Drop test</th>
<th>Storage test</th>
<th>Weather resistance test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex. 1</td>
<td>PLA</td>
<td>PLA</td>
<td>PLA + softening agent A</td>
<td>possible Vacuum</td>
<td>6/50</td>
<td>0/5</td>
<td>0/5</td>
</tr>
<tr>
<td></td>
<td>PLA</td>
<td>PLA</td>
<td>PLA + softening agent B</td>
<td>possible Vacuum</td>
<td>8/50</td>
<td>0/5</td>
<td>0/5</td>
</tr>
<tr>
<td>Ex. 2</td>
<td>PLA</td>
<td>—</td>
<td>PLA + softening agent A</td>
<td>possible Vacuum</td>
<td>4/50</td>
<td>0/5</td>
<td>0/5</td>
</tr>
<tr>
<td></td>
<td>PLA</td>
<td>—</td>
<td>PLA + softening agent B</td>
<td>possible Vacuum</td>
<td>6/50</td>
<td>0/5</td>
<td>0/5</td>
</tr>
<tr>
<td>Comp.</td>
<td>PLA</td>
<td>PLA</td>
<td>PLA</td>
<td>not possible Vacuum/pressure</td>
<td>10/50</td>
<td>0/5</td>
<td>0/5</td>
</tr>
</tbody>
</table>

The results shown in Table 1 clearly indicates that the battery packages of EXAMPLES 1 and 2 are similar to the battery package of COMPARATIVE EXAMPLE 1 in terms of drop strength, storage characteristics and weather resistance characteristics. This means that the battery package according to the present invention is excellent in strength and productivity.

The battery package according to the present invention can accommodate any articles and it is suitable for display at stores/shops.

Although the present invention has been described in terms of the presently preferred embodiments, it is to be understood that such disclosure is not to be interpreted as limiting. Various alterations and modifications will no doubt become apparent to those skilled in the art to which the present invention pertains, after having read the above disclosure. Accordingly, it is intended that the appended claims be interpreted as covering all alterations and modifications as fall within the true spirit and scope of the invention.

1. A battery package comprising a base and a container including a drawn sheet of biodegradable aliphatic polyester, wherein said drawn sheet comprises a composition containing a polylactic polymer and either of polybutylene succinate and polycapro lactone.

2. The battery package in accordance with claim 1, wherein said base comprises a biodegradable aliphatic polyester.

3. The battery package in accordance with claim 1, further comprising a laminate layer comprising a biodegradable aliphatic polyester arranged between said base and said container.

4. The battery package in accordance with claim 2, wherein said biodegradable aliphatic polyester constituting said base is a polylactic polymer.

5. The battery package in accordance with claim 1, wherein said base has a first printing layer, an anti-offset layer and a second printing layer laminated in this order on the surface thereof opposite to the container-side surface.

6. A method for producing a battery package comprising the steps of:

   a. forming a drawn sheet of biodegradable aliphatic polyester into a container having a holder portion by vacuum forming; and

   b. integrating said container with a base comprising a drawn sheet of biodegradable aliphatic polyester to obtain a battery package.

7. The method for producing a battery package in accordance with claim 6, wherein said drawn sheet comprises a composition containing a polylactic polymer and either of polybutylene succinate and polycapro lactone.

8. The method for producing a battery package in accordance with claim 6, further comprising the steps of:

   a. bonding a laminate layer comprising a drawn sheet of biodegradable aliphatic polyester to said base to obtain a bonded product; and

   b. heat sealing said laminate layer and said container to integrate said base and said container.

9. The method for producing a battery package in accordance with claim 6, further comprising the steps of:

   a. bonding the peripheral edges of said container on the opposite side of said holder portion to form folds; and

   b. inserting said base in said folds to integrate said container and said base.

10. The method for producing a battery package in accordance with claim 1, wherein said base comprises a biodegradable aliphatic polyester.

11. The method for producing a battery package in accordance with claim 10, wherein said biodegradable aliphatic polyester constituting said base is a polylactic polymer.