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(71) Applicant: **Zeon Corporation**
Tokyo 100-8246 (JP)

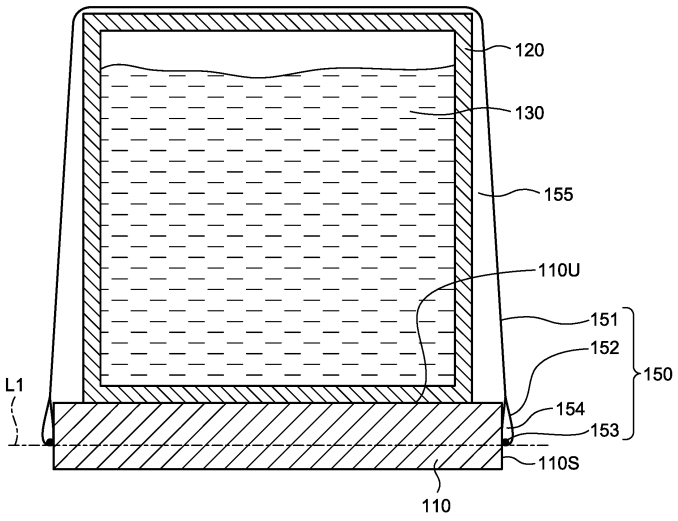
(72) Inventors:
- **YOSHIDA, Naoki**
  Tokyo 100-8246 (JP)
- **ARAI, Kenji**
  Tokyo 100-8246 (JP)

(74) Representative: **Hansen, Norbert**
Maiwald Patentanwalts- und Rechtsanwaltsgesellschaft mbH
Elisenhof
Elisenstraße 3
80335 München (DE)

(54) PACKAGING COVER, PACKAGED ARTICLE, AND PACKAGING METHOD

(57) A wrapping cover for packaging a liquid battery material, including a bag-shaped sheet constituted by a sheet including a resin layer and having a shape of a bag with an opening, wherein the bag-shaped sheet includes a contracting portion provided around the opening so as to be capable of adjusting a size of the opening, and the wrapping cover further comprises a fastening member provided along the opening so as to be capable of adjusting the size of the opening; as well as a package and a packaging method using the same. Preferably, the fastening member has an elastic property, and a surface resistance value of the sheet is 10^{11} ohm/sq. or less.

FIG.2



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Description

Field

[0001] The present invention relates to a wrapping cover for packaging a liquid battery material, a package of a liquid battery material, and a method for packaging a liquid battery material.

Background

[0002] It has been known that a variety of wrapping covers are used for packaging contents to be stored and transported (see Patent Literatures 1 to 3, for example).

[0003] For transportation of liquid industrial materials, containers capable of containing such materials may be used. Particularly, a container called an intermediate bulk container (IBC) may be conveniently used for conveying a liquid material.

Citation List

Patent Literature

[0004]

Patent Literature 1: Japanese Patent Application Laid-Open No. 2008-68913 A
Patent Literature 2: Japanese Registered Utility Model No. 3147324
Patent Literature 3: Japanese Registered Utility Model No. 3120439

Summary

Technical Problem

[0005] Some of materials used for producing batteries such as secondary batteries are stored and transported in a liquid state.

[0006] When a liquid battery material needs to be stored and transported, it is conceivable that such storage and transportation are performed with the liquid battery material being contained in the aforementioned container. However, when the liquid battery material, after having been stored and transported with such a container, is drained out of the container to be used for producing a battery, the performance of the resultant battery may become insufficient.

[0007] Thus, an object of the present invention is to provide a device that can prevent deterioration in the performance of a liquid battery material in the storage and transportation of the liquid battery material, and a package and a packaging method that enable storage and transportation of a liquid battery material while preventing deterioration in the performance of the liquid battery material.

Solution to Problem

[0008] The present inventor has made studies to solve the aforementioned problem. Consequently, the present inventor has conceived of adopting a wrapping cover that is used for packaging contents for a container that is in operation of storage and transportation of a liquid battery material. The present inventor has also found that using a wrapping cover having a specific feature as the aforementioned wrapping cover can solve the aforementioned problem. The present invention has been made in view of such finding.

[0009] That is, the present invention is as follows.

<1> A wrapping cover for packaging a liquid battery material, comprising
a bag-shaped sheet constituted by a sheet including a resin layer and having a shape of a bag with an opening, wherein the bag-shaped sheet includes a contracting portion provided around the opening so as to be capable of adjusting a size of the opening, and
the wrapping cover further comprises a fastening member provided along the opening so as to be capable of adjusting the size of the opening.
<2> The wrapping cover according to <1>, wherein the fastening member has an elastic property.
<3> The wrapping cover according to <1> or <2>, wherein a surface resistance value of the sheet is $10^{11}\ \Omega$/sq. or less.
<4> The wrapping cover according to any one of <1> to <3>, wherein the resin layer is a layer of a resin containing

polyethylene.
<5> The wrapping cover according to any one of <1> to <4>, wherein the sheet includes, in addition to the resin layer, a thin metal film layer.
<6> A package of a liquid battery material comprising:

a liquid battery material;
a container that contains the liquid battery material; and
the wrapping cover according to any one of <1> to <5> enclosing an outer surface of the container, wherein the enclosing is in a manner of covering an outer surface at at least an upper portion of the container with the opening of the wrapping cover facing downward, and
the opening is closed at the contracting portion.

<7> The package according to <6>, wherein a ratio ((B/A) × 100%) of an enclosed content volume (B) with respect to a wrapping cover volume (A) in an area enclosed by the wrapping cover is 60 to 99%.
<8> A method for packaging a liquid battery material comprising:

containing the liquid battery material in a container;
enclosing the container with the wrapping cover according to any one of <1> to <5>; and
adjusting a size of the opening of the wrapping cover by the fastening member to close the opening, wherein the enclosing is in a manner of covering an outer surface at at least an upper portion of the container with the opening of the wrapping cover facing downward.

Advantageous Effects of Invention

[0010] The present invention provides a device that can prevent deterioration in the performance of a liquid battery material in the storage and transportation of the liquid battery material, and a package and a packaging method that enable storage and transportation of a liquid battery material while preventing deterioration in the performance of the liquid battery material.

Brief Description of Drawings

[0011]

FIG. 1 is a perspective view schematically showing a wrapping cover of the present invention and a package of the present invention that uses the wrapping cover and is packaged by a packaging method of the present invention.
FIG. 2 is a vertical cross-sectional view of the package shown in FIG. 1.

Description of Embodiments

[0012] Hereinafter, the present invention will be described in detail with reference to embodiments and examples. However, the present invention is not limited to the following embodiments and examples, and may be freely modified for implementation without departing from the scope of claims of the present invention and the scope of their equivalents.

[1. Summary of Wrapping Cover and Package]

[0013] The wrapping cover of the present invention is a wrapping cover for packaging a liquid battery material. Examples of the liquid battery material may include a variety of materials used in batteries such as a binder and a slurry used for producing an electrode and a porous separator, and an electrolytic solution, and liquid raw materials used for preparing these materials. In a particularly preferable example, the liquid battery material is a binder used for producing an electrode and a porous separator. It is particularly preferable to apply the present invention to a binder since the contamination of a small amount of impurities and a slight property change in the binder greatly influence the performance of the resultant battery.
[0014] The wrapping cover of the present invention includes a specific bag-shaped sheet and a fastening member. The package of the present invention includes a liquid battery material, a container that contains the liquid battery material, and the wrapping cover of the present invention for enclosing the outer surface of the container.
[0015] FIG. 1 is a perspective view schematically showing the wrapping cover of the present invention and the package of the present invention that uses the wrapping cover and is packaged by a packaging method of the present invention. FIG. 2 is a vertical cross-sectional view of the package shown in FIG. 1.

[0016] In FIG. 1, a package 100 includes: a container 120; a liquid battery material 130 contained in the container 120; a pallet 110, which is an optional component for supporting the container 120; and a wrapping cover 150 for enclosing the outer surfaces of the container 120 and the pallet 110.

[0017] In this example, the container 120 is a hollow container and is capable of storing and transporting the liquid battery material 130 while keeping the material in a hermetically sealed manner. The pallet 110 supports the container 120 on an upper surface 110U thereof.

[2. Wrapping Cover]

[0018] The wrapping cover of the present invention includes a bag-shaped sheet. The bag-shaped sheet is formed by a specific sheet.

[0019] The sheet includes a resin layer. As the resin that constitutes the resin layer, resins suitable for the use of wrapping materials may be appropriately selected. Specifically, it may be a resin containing a polymer such as polyethylene, polypropylene, polyethylene terephthalate, vinyl chloride, polyamide, or polyetherimide. Among such polymers, polyethylene is preferable from the viewpoint of flexibility and durability against breakage. Among polyethylene, high density polyethylene is particularly preferable from the viewpoint of flexibility and durability against breakage.

[0020] The resin layer in the sheet may be a film-shaped layer, or may be a layer of any other shape. Examples of non-film-shaped layers may include woven fabric shape and non-woven fabric shapes. Woven and non-woven fabric resin layers are preferable because they provide high strength in addition to flexibility. In particular, high density polyethylene woven fabric is preferable because high durability can be obtained.

[0021] When the resin layer is a film-shaped layer, examples of the molding method therefor may include a melt extrusion molding method, a solution casting molding method, and a calendar molding method. The resin layer of the woven fabric may be obtained by weaving a narrow tape-shaped polyethylene films so that the films cross lengthwise and crosswise or diagonally.

[0022] The resin constituting the resin layer may contain an optional component in addition to the polymer. For example, the resin may include a conductive material in addition to the polymer. By including a conductive material, the surface resistance of the sheet can be reduced. Examples of conductive materials may include a carbon material such as carbon black, an ionic conductive agent comprising an inorganic ionic substance such as lithium perchlorate, sodium perchlorate, calcium perchlorate or lithium chloride, and an organic ionic substance represented by modified aliphatic dimethylethyl ammonium acetate, lauryl ammonium acetate, octadecyltrimethylammonium perchlorate, etc., and quaternary ammonium salts such as tetrabutylammonium chloride (bromide), hexadecyltrimethylammonium chloride (bromide), etc., and an ionic antistatic agent such as a cationic surfactant, an anionic surfactant, an amphoteric ionic surfactant such as a variety of betaines, etc. These surfactants may be solely used or in combination of two or more. The content ratio of the conductive material may be, for example, 0.05 to 30 parts by weight relative to 100 parts by weight of the resin.

[0023] The sheet may include any other optional layer in addition to the resin layer. For example, the sheet may include a thin metal film layer. In particular, it is preferable to include a thin metal film layer having an ability to reflect light such as infrared light, visible light, and ultraviolet light and having a high ability to reflect heat radiation. By including such a thin metal film layer, it is possible to reduce the irradiation of light to the liquid battery material and the temperature rise of the liquid battery material during storage and transportation. As a result, it is possible to suppress the deterioration in performance due to the property change of the liquid battery material at the time of storage and transportation of the liquid battery material. A specific example of such a thin metal film layer may be a thin aluminum film layer.

[0024] The sheet may include only a single thin metal film layer. Alternatively, the sheet may include two or more thin metal film layers. When the sheet includes two or more thin metal film layers, the thin metal film layers may be provided only on one side of the resin layer or on both sides of the resin layer. Provision of the plurality of thin metal film layers can reduce the surface resistance value of the sheet, and provision of the thin metal film layers on both sides of the resin layer can especially reduce the surface resistance value of the sheet.

[0025] Alternatively, provision of the thin metal film layer inside the resin layer can prevent the generation of metallic powders from the sheet since no metallic layers are present on the surfaces of the sheet.

[0026] Examples of the method for forming a thin metal film layer on a surface of a resin layer may include a method in which a resin layer is bonded to a metal sheet that has been separately produced, a method in which a metal is vapor-deposited on a surface of a resin layer, and a combination of these methods.

[0027] The film thickness of the sheet is preferably 50 μm or more, more preferably 80 μm or more, and still more preferably 100 μm or more, and the upper limit value thereof is preferably 900 μm or less, more preferably 500 μm or less, and still more preferably 200 μm or less.

[0028] It is preferable that the sheet has a small surface resistance value. Specifically, the surface resistance value of the sheet is preferably 10^{11} Ω/sq. or less, more preferably 10^{10} Ω/sq. or less, still more preferably 10^{9} Ω/sq. or less, and most preferably 10^{2} Ω/sq. or less. With such a smaller surface resistance value, electrostatic charging of the wrapping cover can be suppressed. By such suppression of the electrostatic charging, attachment of minute foreign matters from

the surrounding environment to the wrapping cover can be reduced when the wrapping cover is used. This can prevent the contamination of the liquid battery material in a particularly effective manner when the wrapping cover is removed and the liquid battery material is drained. Thus, deterioration in the performance of the liquid battery material in the storage and transportation of the liquid battery material can be prevented in a particularly effective manner. The lower limit of the surface resistance value of the sheet is not particularly limited, and may be 0.01 Ω/sq. or more, for example.

[0029] The bag-shaped sheet has a shape of a bag with an opening. The bag-shaped sheet further includes a contracting portion provided around the opening. The wrapping cover of the present invention includes a fastening member provided along the opening so as to be capable of adjusting the size of the opening of the bag-shaped sheet. In the example of FIG. 2, the wrapping cover 150 includes a bag portion 151 having a bag shape, and a contracting portion 152 provided around the opening of the bag portion 151. The contracting portion 152 has a strip-shape inner cavity 154. The wrapping cover 150 further includes a fastening member 153 passed through the inner cavity 154.

[0030] The fastening member of the wrapping cover of the present invention is provided so as to be capable of adjusting the size of the opening. In the example of FIG. 2, the fastening member 153 is provided in the inner cavity 154. Thus, the size of the opening can be adjusted by changing the size of the fastening member in the inner cavity 154.

[0031] In a preferred example, the fastening member has an elastic property. Specifically, the fastening member may have a property with which the application of a load in the length direction can cause 10% or more reversible length extension from a state without any load. By employing a fastening member having an elastic property as the fastening member, the opening can be easily expanded and the opening can be easily closed through the use of its force of contraction in the operations of packaging. In addition, the generation of a gap during the storage and the transportation can be reduced in a particularly effective manner. Thus, use of the wrapping cover can be facilitated, and the effect of preventing deterioration in the performance of the liquid battery material can be increased.

[0032] From the viewpoint of possessing such an elastic property, the material that constitutes the fastening member is preferably rubber, or a composite material composed of rubber and any other material. However, the material that constitutes the fastening member is not limited thereto, and resins with no elastic property, and any other materials generally used as materials for strings may be used.

[0033] The shape of the fastening member may be an elongated shape extendable around the opening. The shape of a cross-section cut along a plane perpendicular to the lengthwise direction of the fastening member is not limited to any particular shape. The fastening member may be a band having a flat cross-section, or a string having a cross-sectional shape such as a circle, an oval, or a rectangle. When the fastening member is a band, such a fastening member is particularly preferable since the opening can be tightly closed at the contracting portion. In a particularly preferable mode, the fastening member may be a rubber band.

[3. Package and Packaging Method]

[0034] The container in the package of the present invention is not particularly limited to any shape and any material as long as the container can contain and seal the liquid battery material therein. The container may preferably include: a main body integrally molded of a resin; a liquid injection opening (not shown) disposed at the top and capable of being tightly closed by a cap; and a discharge valve (not shown) at the bottom of the container. For types of containers, a 10-liter container, a 20-liter container, a 200-liter drum, a 1000-liter container, or the like may be used.

[0035] In addition to the aforementioned liquid battery material, container, and wrapping cover, the package of the present invention may further include an optional element. Examples of such an optional element may include accessories of the container such as a pallet and a cage. When the package includes a cage that surrounds the container, the wrapping cover may be positioned either inside or outside the cage. From the viewpoint of facilitating the removal of the cover, the wrapping cover is preferably positioned outside the cage. From the viewpoint of increasing a container occupancy rate and from the viewpoint of preventing breakage in an upper portion of the wrapping cover, on the other hand, the wrapping cover may preferably be positioned inside the cage.

[0036] In the package of the present invention, the wrapping cover encloses the outer surface of the container. Such enclosure refers to enclosure covering at least an upper portion of the container, preferably the outer surface of the entire container, with the opening of the wrapping cover facing downward.

[0037] Explaining with reference to the example of FIGS. 1 and 2, the wrapping cover 150 covers the outer surface of the entire container 120 and an upper portion of the pallet 110 with the opening thereof facing downward. The opening of the contracting portion 152 of the wrapping cover 150 is closed by the fastening member 153, and the contracting portion 152 is in close contact with side surfaces 110S of the pallet 110.

[0038] Furthermore, in the package of the present invention, the opening is closed at the contracting portion of the wrapping cover. An operation of closing the opening may be performed by adjusting the size of the opening of the wrapping cover by the fastening member. When a member having an elastic property such as a rubber band is employed as a fastening member, for example, such adjustment may be performed by utilizing the contraction force of the fastening member. When a member having no elastic property such as a resin string is employed as a fastening member, for

example, the fastening member may be provided with the both ends thereof extending to the outside of the inner cavity of the contracting portion. By drawing and tying the ends of the string, the opening may be closed.

[0039] In the package of the present invention, it is preferable that a ratio ((B/A) × 100%) of an enclosed content volume (B) with respect to a wrapping cover volume (A) in an area enclosed by the wrapping cover falls within a particular range. Such a ratio ((B/A) × 100%) may be referred to as a "container occupancy rate" in the present application.

[0040] The container occupancy rate is preferably 60% or more, more preferably 65% or more, and still more preferably 70% or more, and is preferably 95% or less, more preferably 93% or less, and still more preferably 90% or less. The wrapping cover volume (A) refers to the volume of a wrapping cover in a package. In the example of FIG. 2, the wrapping cover volume (A) refers to the volume of the wrapping cover in an area above the lower end of the opening of the wrapping cover, which is indicated by a line L1. The enclosed content volume (B) refers to the volume of an enclosed container and other contents in an area wrapped by the wrapping cover. In the example of FIG. 2, the enclosed content volume (B) refers to the volume of a portion occupied by the outer surfaces of the container 120 and the pallet 110 in the area above the lower end of the opening of the wrapping cover, which is indicated by the line L1. In the example of FIG. 2, a difference between the volume (A) and the volume (B) corresponds to the volume of a void 155.

[0041] When the container occupancy rate is equal to or more than the aforementioned lower limit, the amount of minute foreign matters that stay in the void inside the wrapping cover can be reduced. Thus, deterioration in the performance of the liquid battery material in the storage and transportation of the liquid battery material can be prevented in a particularly effective manner. When the container occupancy rate is equal to or less than the aforementioned upper limit, breakage of the wrapping cover can be prevented.

[0042] According to the packaging method of the present invention and the package of the present invention, the liquid battery material can be stored and transported with suppressed deterioration in the performance of the liquid battery material. Specifically, since the container is enclosed by the wrapping cover, minute foreign matters that are floating in a space can be prevented from attaching to the outer surface of the container during the storage and the transportation. Such foreign matters tend to accumulate mostly on the upper surface of the container. Thus, the attachment of the foreign matters can be effectively prevented by providing enclosure covering at least the upper portion of the container with the opening of the wrapping cover facing downward. When the sheet includes a thin metal film layer, in particular, a property change in the liquid battery material during the storage and the transportation can also be prevented. Thus, this is especially advantageous in the prevention of deterioration in the performance of the liquid battery material.

[0043] After the end of the storage and the transportation, the foreign matters attached to the wrapping cover can be easily removed by removing the wrapping cover from the package. An operation of draining the liquid battery material out of the container for use is usually performed in a clean room. Contents to be carried into the clean room are usually subjected to a dust removal treatment at a pre-chamber of a clean room. Thus, the removal of the wrapping cover from the package may be performed as a part of the dust removal treatment at the pre-chamber of the clean room. In such a dust removal treatment, any treatment such as dust removal by air blow may be additionally performed. After the container has been carried into the clean room, the liquid battery material is drained from the interior to the exterior of the container by an operation such as opening the valve of the container, and the liquid battery material can be used for producing batteries. Use of the liquid battery material in this manner can effectively prevent foreign matters from mixing into the liquid battery material as impurities.

[Example]

[0044] Hereinafter, the present invention will be specifically described by illustrating Examples. However, the present invention is not limited to the Examples described below. The present invention may be optionally modified for implementation without departing from the scope of claims of the present invention and its equivalents.

[0045] In the following description, "%" and "part" representing quantity are on the basis of weight, unless otherwise specified. The operations described below were performed under the conditions of normal temperature and normal pressure, unless otherwise specified.

[Evaluation Method]

(Surface Resistance Value)

[0046] Each sample (a multilayer sheet) was cut out to have an area of 100 mm square or more, and the surface resistivity (Ω/sq.) of a surface resin layer was measured with a surface resistance meter (for a surface resistance value of 10^5 Ω/sq. or more, main body: Model-152 and probe: 152P-CR manufactured by Treck Japan KK; for a surface resistance value of less than 10^5 Ω/sq., Loresta-GP MCD-T610 manufactured by Mitsubishi Chemical Corporation). The measurement environment was at a temperature of 23±5°C and at a humidity of 55±10%.

(Filtration Property)

[0047] 1000 kg of the test binder obtained in each of Examples and Comparative Examples was filtered. Upon the filtration, a cartridge filter with a filtration accuracy of 5 μm was used, and a pressure applied to the filtrate upon filtration was 0.05 MPa. A rate of filtration (S50, in the unit of kg/min) at the time of filtering the first 50 kg and a rate of filtration (S800, in the unit of kg/min) at the time of filtering 800 kg were measured, a filtration rate ratio (S800/S50) was obtained, and an evaluation was made on the basis of the following criteria.

A: The filtration rate ratio is more than 0.99.
B: The filtration rate ratio is more than 0.97 and equal to or less than 0.99.
C: The filtration rate ratio is more than 0.94 and equal to or less than 0.97.
D: The filtration rate ratio is equal to or less than 0.94.

(High-Temperature Cycle Property)

[0048] Using the test binders obtained in Examples and Comparative Examples, laminated cell lithium ion secondary batteries were produced and evaluated. Specific procedure thereof is as follows.

[Production of Negative-Electrode Slurry Composition]

[0049] In a planetary mixer, 90 parts of natural graphite as a negative-electrode active material formed by carbon, 10 parts of SiOx as a negative-electrode active material containing silicon, 1 part in terms of a solid content of the test binder, and 1 part in terms of a solid content of a 1% aqueous solution (the viscosity measured with a B-type viscometer at 25°C was 7800 mPa·s) of high-molecular-weight carboxymethyl cellulose ("MAC800LC" produced by Nippon Paper Chemicals Co., Ltd.) as a water-soluble polymer were placed, and thereto ion-exchange water into the planetary mixer was further added so as to adjust the total solid content concentration to 52%. The materials were mixed to thereby prepare a negative-electrode slurry composition.

[Production of Negative Electrode]

[0050] The aforementioned negative-electrode slurry composition was applied onto a copper foil with a thickness of 20 μm, which is a current collector, by a comma coater. The application amount of the negative-electrode slurry composition at this time was set so that the solid content of the negative-electrode slurry composition per a unit area of a surface of the copper foil was 11 mg/cm^2 to 12 mg/cm^2. After that, the applied negative-electrode slurry composition was dried to form a negative-electrode active material layer on the surface of the copper foil. The drying was performed by conveying the copper foil at a speed of 0.5 m/min in an oven at 60°C over 2 minutes. After that, the copper foil was subjected to a heating treatment at 120°C for 2 minutes to obtain a negative electrode primary product. This primary product was subjected to pressing by a roll press machine so that the density of the negative-electrode active material layer in the negative electrode became 1.50 g/cm^3 to 1.60 g/cm^3. In this manner, the negative electrode was produced.

[Production of Positive Electrode]

[0051] In a planetary mixer, 100 parts by weight of $LiCoO_2$ as a positive-electrode active material, 2 parts of acetylene black ("HS-100" produced by Denki Kagaku Kogyo K.K.) as an electroconductive material, and 2 parts of polyvinylidene fluoride (PVDF; "KF-1100" produced by Kureha Corporation) as a binder were placed, and thereto 2-methylpyrrolidone was further added so as to adjust the total solid content concentration to 67%. The materials were mixed to thereby prepare a positive-electrode slurry composition.

[0052] The positive-electrode slurry composition was applied onto an aluminum foil with a thickness of 20 μm, which is a current collector, by a comma coater. The application amount of the positive-electrode slurry composition at this time was set so that the solid content of the positive-electrode slurry composition per a unit area of a surface of the aluminum foil was 30 mg/cm^2. After that, the applied positive-electrode slurry composition was dried to form a positive-electrode active material layer on the surface of the aluminum foil. The drying was performed by conveying the aluminum foil at a speed of 0.5 m/min in the oven at 60°C for over 2 minutes. After that, the aluminum foil was subjected to a heating treatment at 120°C for 2 minutes to obtain a positive electrode primary product. This primary product was dried, and then subjected to pressing by a roll press machine so that the density of the positive-electrode active material layer in the positive electrode became 3.45 g/cm^3 to 3.54 g/cm^3 after being pressed. In this manner, the positive electrode was obtained.

[Production of Lithium Ion Secondary Battery]

[0053] A single-layer polypropylene separator (a width of 65 mm, a length of 500 mm, and a thickness of 25 μm; produced by a dry method; a porosity of 55%) was prepared. This separator was cut out into a square of 5 × 5 cm^2.

[0054] Subsequently, an outer covering of an aluminum wrapping material was prepared as an outer covering of a battery. The aforementioned positive electrode was cut out into a square of 4 × 4 cm^2, and the cut-out positive electrode was disposed in such a manner that a surface thereof on the current collector side was in contact with the outer covering of the aluminum wrapping material. The square separator produced as described above was disposed on a surface of the positive-electrode active material layer of the positive electrode. Furthermore, the aforementioned negative electrode was cut out into a square of 4.2 × 4.2 cm^2, and the cut-out negative electrode was disposed on the separator in such a manner that a surface thereof on the negative-electrode active material layer side faces the separator. This was filled with a $LiPF_6$ solution having a concentration of 1.0 M (the solvent was a mixed solvent of ethylene carbonate/ethyl methyl carbonate = 3/7 (volume ratio), additive; 2% by volume of vinylene carbonate (solvent ratio)) as an electrolytic solution. Furthermore, heat sealing at 150°C was performed to seal an opening of the aluminum wrapping material. In this manner, the opening of the aluminum outer covering was closed, to thereby produce a lithium ion secondary battery.

[Evaluation]

[0055] After the lithium ion secondary battery had been left to stand for 24 hours at 25°C, operations of charging and discharging were performed at 4.2 V and at a charging/discharging rate of 0.1 C in an environment at 25°C, to thereby measure an initial capacity C0. Furthermore, charging and discharging were repeated at 4.2 V and at a charging/discharging rate of 0.1 C in an environment at 60°C, to thereby measure a capacity C2 after 100 cycles. The measurement of capacities C0 and C2 were performed for 36 battery units, and the average values thereof were used in the following calculation.

[0056] A charging/discharging capacity retention rate ΔCC (%) was obtained by Expression ΔCC = C2/C0 × 100, and therewith a high-temperature cycle property was evaluated. A higher value of the charging/discharging capacity retention rate ΔCC is indicative of a better high-temperature cycle property.

A: The charging/discharging capacity retention rate is equal to or more than 85%.
B: The charging/discharging capacity retention rate is equal to or more than 80% and less than 85%.
C: The charging/discharging capacity retention rate is equal to or more than 75% and less than 80%.
D: The charging/discharging capacity retention rate is equal to or more than 70% and less than 75%.
E: The charging/discharging capacity retention rate is less than 70%.

[Example 1]

(1-1. Multilayer Sheet)

[0057] A multilayer sheet was prepared. The multilayer sheet had resin layers as both surface layers thereof, and had a thin aluminum film layer as an inner layer. The resin layer was a layer containing carbon black and polyethylene, and was made by kneading 7 parts by weight of carbon black relative to 100 parts by weight of a resin. The surface resistance value of this multilayer sheet was 10^5 Ω/sq. The thickness of this multilayer sheet was 600 μm.

(1-2. Wrapping Cover)

[0058] An 8-cord rubber band (manufactured by Kabushiki Kaisha Kitani) made of natural rubber was prepared as a fastening member.

[0059] The multilayer sheet prepared in (1-1) was formed into a bag shape to obtain a bag-shaped sheet having the shape schematically shown in FIGS. 1 and 2. The bag-shaped sheet had a bag portion (indicated by the reference numeral 151 in FIG. 2) and a contracting portion (indicated by the reference numeral 152 in FIG. 2) provided around an opening and having a strip-shape inner cavity. Furthermore, the fastening member was provided by being passed through the inner cavity of the contracting portion. In this manner, a wrapping cover was obtained.

(1-3. Battery Binder)

[0060] As a battery binder, BM-400B (ZEON Corporation) was prepared.

(1-4. Package)

[0061] A 1 m^3 container (trade name: "San bulk", intermediate bulk container, manufactured by Sanko Co., Ltd.) was filled with 1000 kg of the battery binder prepared in (1-3). The container having the battery binder therein was placed on a pallet dedicated for this container and having a width and a length each of which is larger than that of the container by 6%. The entire container and a part of the pallet were enclosed by the wrapping cover obtained in (1-2), and the opening was closed through the use of the force of contraction of the fastening member. When the opening was closed, the wrapping cover was brought into close contact with the container, to thereby reduce its container occupancy rate. In this manner, a package in a state schematically shown in FIGS. 1 and 2 was obtained. The container occupancy rate in the obtained package was 89%.

(1-5. Storage of Package)

[0062] The package obtained in (1-4) was placed in a room for storing packages. The room was filled with copper powder, of which 65% by weight of total particles had particle diameters falling within a range of 45 to 150 μm, and an air current was generated. Under the conditions of a copper powder concentration of 5,000 mg/m^3, a temperature of 60°C, and a wind speed of 5 m/sec, the package was stored for 8 hours.

(1-6. Evaluations)

[0063] After the end of the storage period, the package was transferred to a pre-chamber of a clean room, and the wrapping cover was removed from the package. After that, the container was transferred into a clean room. The valve at the bottom of the container was opened to drain the total volume of the battery binder, and the drained battery binder was dropped, under its own weight, into a container having an opening in an upper part thereof. The battery binder in this container was used as a test binder to evaluate the filtration property and the high-temperature cycle property.

[Example 2]

(2-1. Multilayer Sheet)

[0064] A multilayer sheet was prepared. The multilayer sheet had resin layers as both surface layers thereof, and had a thin aluminum film layer as an inner layer. The resin layer was a layer containing polyethylene. The surface resistance value of this sheet was 10^9 Ω/sq. The thickness of this multilayer sheet was 500 μm.

(2-2. Wrapping Cover, Package, and Evaluations)

[0065] A wrapping cover and a package were obtained and evaluated by the same manner as those of (1-2) to (1-6) of Example 1 except that the multilayer sheet obtained in (2-1) was used instead of the multilayer sheet obtained in (1-1) .

[Example 3]

[0066] A wrapping cover and a package were obtained and evaluated by the same manner as those of Example 1 except for the following changes.

- A multilayer sheet formed of the same material as that used in (2-1) of Example 2 and having a width and a length each of which is larger than that of the container by 22% was used instead of the multilayer sheet obtained in (1-1) .
- When the opening was closed, the wrapping cover was not brought into close contact with the container at the time of producing the package in (1-4).

[Example 4]

[0067] A wrapping cover and a package were obtained and evaluated by the same manner as those of Example 1 except for the following changes.

- The multilayer sheet obtained in (2-1) of Example 2 was used instead of the multilayer sheet obtained in (1-1).
- A resin string without any elastic property was used instead of the rubber band as a fastening member at the time of producing the wrapping cover in (1-2). The string was provided in such a manner that both the ends extended

outside of the inner cavity of the contracting portion.

- Both the ends of the string were pulled and tied together to close the opening at the time of producing the package in (1-4).

[Example 5]

(5-1. Resin Sheet)

[0068] A resin sheet was prepared. The resin sheet was a sheet formed of polyethylene terephthalate. The surface resistance value of this resin sheet was 10^9 Ω/sq. The thickness of this resin sheet was 500 μm.

(5-2. Wrapping Cover, Package, and Evaluations)

[0069] A wrapping cover and a package were obtained and evaluated by the same manner as those of (1-2) to (1-6) of Example 1 except that the resin sheet obtained in (5-1) was used instead of the multilayer sheet obtained in (1-1).

[Example 6]

(6-1. Resin Sheet)

[0070] A resin sheet was prepared, which is composed of five layers of an aluminum foil of 7 μm/ a polyethylene film layer of 30 μm/ a high-density polyethylene sheet woven fabric of 60 μm/ a polyethylene film layer of 30 μm/ an aluminum-deposited film of 12 μm. The surface resistance value of this resin sheet was 10^2 Ω/sq. The thickness of this resin sheet was 140 μm.

(6-2. Wrapping Cover, Package, and Evaluations)

[0071] A wrapping cover and a package were obtained and evaluated by the same manner as those of (1-2) to (1-6) of Example 1 except that, instead of the multilayer sheet obtained in (1-1), the resin sheet obtained in (6-1) was used with the aluminum foil side thereof facing outward.

[Comparative Example 1]

(C1-1. Storage of Unpackaged Container)

[0072] A container on a pallet was stored for 8 hours by the same manner as those of (1-3) to (1-5) of Example 1 except that the container having the battery binder therein and the pallet were placed in the room for storing packages as they were without using the wrapping cover and without packaging the container and the pallet.

(C1-2. Evaluations)

[0073] After the end of the storage period, the pallet and the container were transferred to the pre-chamber of the clean room. Copper powders accumulated on the container were removed by air blow. After that, the container was transferred into the clean room. The valve at the bottom of the container was opened to drop the total volume of the battery binder in the container, under its own weight, into a container having an opening in an upper part thereof. The battery binder in this container was used as a test binder to evaluate the filtration property and the high-temperature cycle property.

[Comparative Example 2]

(C2-1. Resin Sheet)

[0074] A resin sheet was prepared. The resin sheet was a sheet formed of polyethylene. The surface resistance value of this resin sheet was 10^9 Ω/sq. The thickness of this resin sheet was 500 μm.

(C2-2. Wrapping Cover)

[0075] The resin sheet prepared in (C2-1) was formed into a bag shape to obtain a bag-shaped sheet. The shape and

size of the bag-shaped sheet were the same as those obtained in Example 1. The resulting bag-shaped sheet was used as the wrapping cover without any fastening member provided thereto.

(C2-3. Package and Evaluations)

[0076] A package was obtained and evaluated by the same manner as those of (1-3) to (1-6) of Example 1 except for the following changes.

- The wrapping cover obtained in (C2-2) was used instead of the wrapping cover obtained in (1-2).
- The operation for closing the opening was not performed at the time of producing the package in (1-4).

[0077] The results of Examples and Comparative Examples are shown in Table 1.

Table 1

	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Comp. Ex. 1	Comp. Ex. 2
Occupancy rate (%)	89	89	67	89	89	89	-	89
Fastening member material	Rubber	Rubber	Rubber	Resin	Rubber	Rubber	-	None
Surface resistance (ohm/sq.)	10^5	10^9	10^9	10^9	10^9	10^2	-	10^9
Resin layer material	PE(C)	PE	PE	PE	PET	PE	-	PE
Aluminum layer	Yes	Yes	Yes	Yes	No	Yes	-	No
Filtration property	A	A	B	B	B	A	D	C
High-temperature cycle property	B	C	C	C	C	A	E	D
PE(C): Polyethylene resin containing carbon PE: Polyethylene resin PET: Polyethylene terephthalate resin								

[0078] As apparent from the results of Examples and Comparative Examples, it is found that, when the battery binder is stored by the package of the present invention obtained by the method of the present invention using the wrapping cover of the present invention, good results are obtained in both the filtration property of the battery binder and the high-temperature cycle property of the battery.

Reference Sign List

[0079]

100: package
110: pallet
110S: pallet side surface
110U: pallet upper surface
120: container
130: liquid battery material
150: wrapping cover
151: bag portion
152: contracting portion
153: fastening member
154: inner cavity
155: void

Claims

1. A wrapping cover for packaging a liquid battery material, comprising
a bag-shaped sheet constituted by a sheet including a resin layer and having a shape of a bag with an opening, wherein the bag-shaped sheet includes a contracting portion provided around the opening so as to be capable of adjusting a size of the opening, and
the wrapping cover further comprises a fastening member provided along the opening so as to be capable of adjusting the size of the opening.

2. The wrapping cover according to claim 1, wherein the fastening member has an elastic property.

3. The wrapping cover according to claim 1 or 2, wherein a surface resistance value of the sheet is 10^{11} Ω/sq. or less.

4. The wrapping cover according to any one of claims 1 to 3, wherein the resin layer is a layer of a resin containing polyethylene.

5. The wrapping cover according to any one of claims 1 to 4, wherein the sheet includes, in addition to the resin layer, a thin metal film layer.

6. A package of a liquid battery material comprising:

a liquid battery material;
a container that contains the liquid battery material; and
the wrapping cover according to any one of claims 1 to 5 enclosing an outer surface of the container, wherein the enclosing is in a manner of covering an outer surface at at least an upper portion of the container with the opening of the wrapping cover facing downward, and
the opening is closed at the contracting portion.

7. The package according to claim 6, wherein a ratio ((B/A) × 100%) of an enclosed content volume (B) with respect to a wrapping cover volume (A) in an area enclosed by the wrapping cover is 60 to 99%.

8. A method for packaging a liquid battery material comprising:

containing the liquid battery material in a container;
enclosing the container with the wrapping cover according to any one of claims 1 to 5; and
adjusting a size of the opening of the wrapping cover by the fastening member to close the opening, wherein the enclosing is in a manner of covering an outer surface at at least an upper portion of the container with the opening of the wrapping cover facing downward.

FIG.1

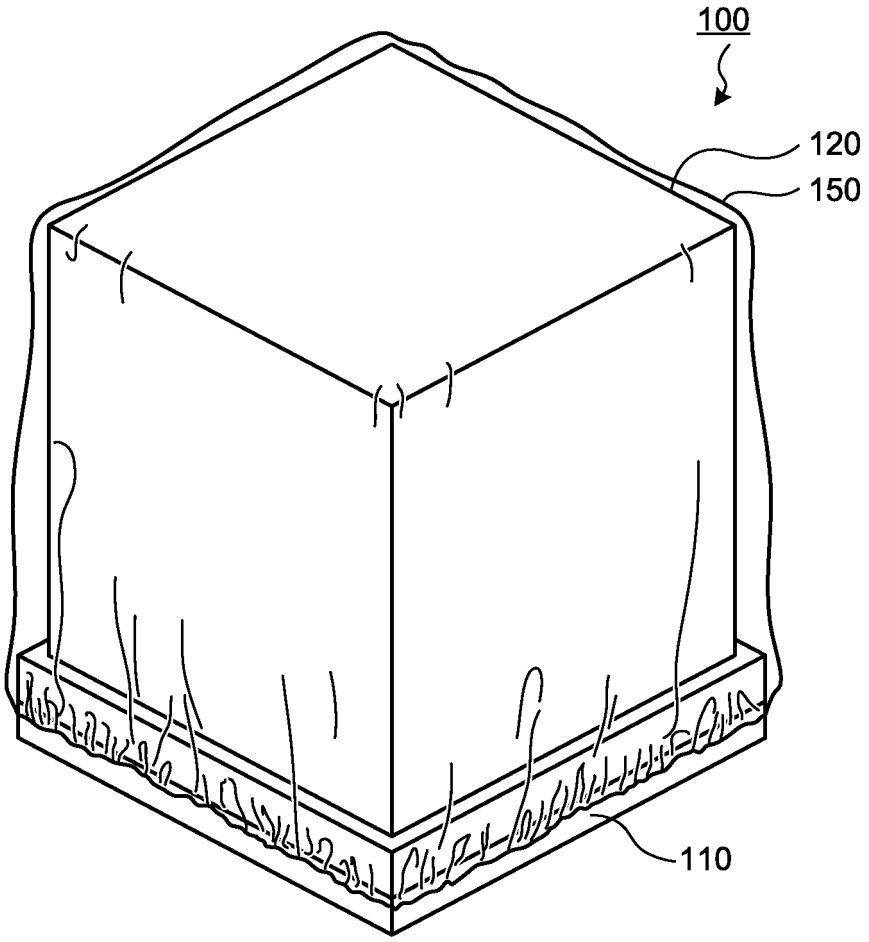
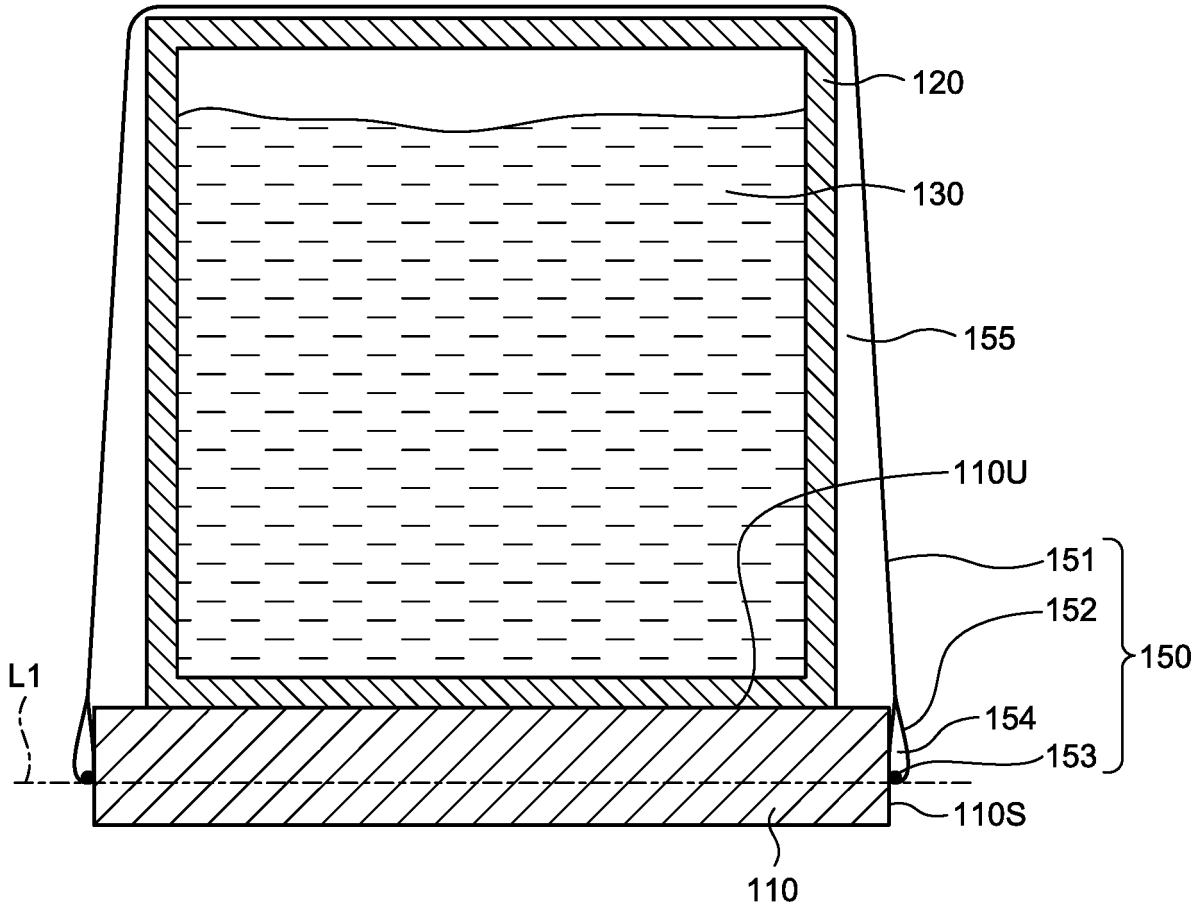


FIG.2



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/009664

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. B65D65/04(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl. B65D65/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2002-362615 A (SEKISUI PLASTICS) 18 December 2002, claims, paragraphs [0001]-[0031], fig. 1-4 (Family: none)	1-8
Y	JP 2016-62741 A (TAKADA, Fujio) 25 April 2016, paragraph [0004] (Family: none)	1-8
Y	JP 3154380 U (PRIME POLYMER CO., LTD.) 15 October 2009, paragraph [0031] (Family: none)	2-8

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search 17.05.2018	Date of mailing of the international search report 29.05.2018
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/009664

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 10-44288 A (IGUCHI PORIECHIREN KK) 17 February 1998, claim 2, paragraph [0002], fig. 3 (Family: none)	3-8
A	JP 3022338 U (AICELLO CHEMICAL CO., LTD.) 22 March 1996 (Family: none)	1-8

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REFERENCES CITED IN THE DESCRIPTION

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- JP 2008068913 A **[0004]**
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- JP 3120439 B **[0004]**