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(54) Heat insulation cold closet for medical supplies

(57) The invention relates to a heat insulation cold closet for medical supplies, comprising a closet body with an opening, and a cover body sealed and meshed with the opening; the closet body, from inside to outside, successively consists of a rigid polyurethane layer, a vacuum heat insulation panel layer, a foamed polyurethane panel layer and a housing. As regards the heat insulation cold closet according to the present invention, due to the fact that a vacuum heat insulation panel layer and a rigid polyurethane layer are arranged in a polyurethane foamed plastic layer to form a composite heat insulation structure, the thickness of the heat insulation cold closet is reduced.

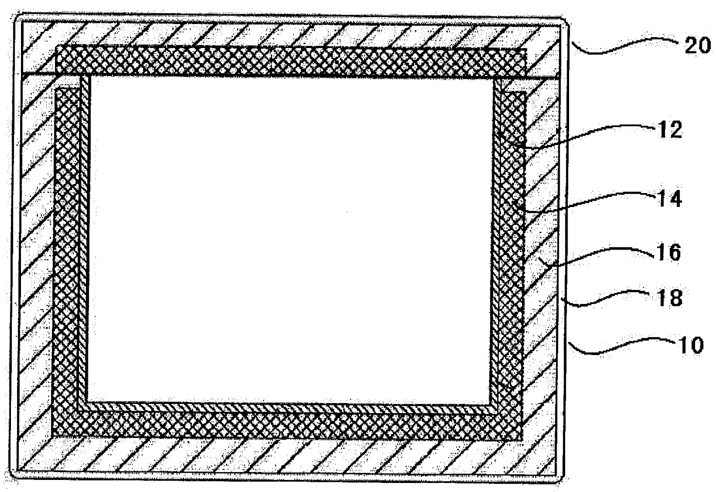

FIGURE 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to the technical field of the preservation of medical supplies, and more specifically to a heat insulation cold closet for medical supplies.

BACKGROUND ART

[0002] With the rapid development of bioengineering technology, biological drugs against serious diseases and diseases difficult to treat have been continuously emerging. When the ambient temperatures are too high, these drugs will speed up chemical reactions, which encourage the breeding of microbes and thereby destroy the structures of the drugs, make the drugs deteriorate and fail to achieve good efficacy. If some deteriorated drugs cannot be found in time, they will impose serious side effects on human bodies and even cause death. Therefore, the development, storage, transportation and many other operations of biological drugs must be carried out in a low temperature environment.

[0003] The cold storage of drugs falls into two major categories: cold storage with the use of power and cold storage without the use of powder. For cold storage with the use of power, power needs to be applied during the cold storage and accordingly the cold storage conditions are restrained more or less, and the cost is increased due to the cost of an uninterrupted power supply. Cold storage without the use of powder relies on coolant and a heat insulation material. Generally, coolant-filled bags are put around a drug to be refrigerated, and then the drug to be refrigerated and the coolant-filled bags are put into a container made of a heat insulation material to achieve the effect of preventing heat exchange and heat conduction. The cold-storage cold closet in the prior art mainly consists of a cold closet and a coolant, and most of the current cold-storage cold closets are made of the heat-insulation and heat-preservation material - polyurethane foamed plastic. Although polyurethane foam has good heat-preservation properties, in order to achieve the desired preservation effect, the thickness of polyurethane foam in the closet body of a cold closet is generally about 50 mm, thereby making the cold-storage closet heavy. The closet body needs to have a large dimension in order to maintain the effective volume of the interior of the closet body, thus such cold closet is not practical.

CONTENTS OF THE INVENTION

[0004] To solve the above-mentioned technical problem, it is an object of the invention to provide a heat insulation cold closet for medical supplies. The heat insulation cold closet for medical supplies according to the present invention not only has good cold-storage and heat-insulation effects, but also can significantly increase the effective volume of the closet body.

[0005] The heat insulation cold closet for medical supplies according to the present invention comprises a closet body with an opening, and a cover body sealed and meshed with the opening, characterized in that the closet body, from inside to outside, successively consists of a rigid polyurethane layer, a vacuum heat insulation panel layer, a foamed polyurethane panel layer and a housing.

[0006] Wherein, the cover body, from inside to outside, successively consists of a vacuum heat insulation panel layer, a foamed polyurethane panel layer and a housing.

[0007] Wherein, the rigid polyurethane layer has a thickness of 2 to 5 mm, the vacuum heat insulation panel layer has a thickness of 8 to 15 mm, and the foamed polyurethane panel layer has a thickness of 5 to 20 mm.

[0008] Wherein, the material of the housing is polypropylene or polyethylene.

[0009] Compared with the prior art, the heat insulation cold closet for medical supplies according to the present invention has the following beneficial effects:

[0010] As regards the heat insulation cold closet according to the present invention, due to the fact that a vacuum heat insulation panel layer and a rigid polyurethane layer are arranged in a polyurethane foamed plastic layer to form a composite heat insulation structure, the thickness of the heat insulation cold closet is reduced so that the effective volume of an incubator having the same shape can be greatly increased; furthermore, the coefficient of heat insulation of the heat insulation cold closet is smaller than or equal to 0.004 W/mK, heat radiation, heat conduction and heat convection between the interior of the closet body and the external environment can be effectively prevented, and the heat insulation closet can guarantee that the interior temperature is controlled at 2-8°C for more than 120 hours. The heat insulation cold closet according to the present invention is mainly used for cold storage and freezing of drugs, such as vaccines, insulin, blood products, biological products and reagents, during transportation and storage.

BRIEF DESCRIPTION OF THE DRAWING

[0011] Figure 1 is a structure diagram of the heat insulation cold closet for medical supplies according to the present invention.

DESCRIPTION OF EMBODIMENTS

[0012] Hereinafter, the technical solution of the present invention will be further described in detail with reference to the examples and the accompanying drawing.

[0013] As shown in Figure 1, the heat insulation cold closet for medical supplies according to the present invention comprises a closet body 10 with an opening, and a cover body 20 sealed and meshed with the opening; the closet body, from inside to outside, successively consists of a rigid polyurethane layer 12, a vacuum heat insulation panel layer 14, a foamed polyurethane panel layer 16 and a housing 18; the cover body, from inside to outside, successively consists of a vacuum heat insulation panel layer, a foamed polyurethane panel layer and a housing. Due to the fact that a vacuum heat insulation panel layer and a rigid polyurethane layer are arranged in a polyurethane foamed plastic layer to form a composite heat insulation structure, the thickness of the heat insulation cold closet is reduced so that the effective volume of an incubator having the same shape can be greatly increased. During transportation, refrigerated items, such as vaccines, insulin, blood products, biological products, reagents and other drugs as well as a coolant, are first stacked in a certain ratio and a certain manner in the closet body 10, the cover body 20 is closed to isolate the environment inside the closet body 10 from the environment outside the closet body 10, and the cold energy emitted by the coolant ensures that the refrigerated items in the incubator are in certain cryogenic states. The composite heat insulation structure formed from the polyurethane foamed plastic layer and the vacuum heat insulation panel layer, as described in the present invention, allows the heat insulation cold closet according to the present invention to have a coefficient of heat insulation of ≤ 0.004 W/mK, so that heat radiation, heat conduction and heat convection between the interior of the closet body and the external environment can be effectively prevented. Furthermore, since the foamed polyurethane panel layer and the vacuum heat insulation panel layer are liable to deformation and breakage in case of collision due to an external force, a rigid polyurethane layer is further provided. The rigid polyurethane material not only does not contaminate drugs or other products, but also has high hardness and strength and can provide the composite heat insulation structure with adequate protection. The foamed polyurethane panel layer according to the present invention can be obtained by *in-situ* foaming, or a foamed polyurethane panel can be prepared, then an acrylic adhesive is applied, and the foamed polyurethane panel and a vacuum heat insulation panel layer are laminated to form a composite heat insulation structure.

Rigid Polyurethane Layer

Example 1

[0014] The rigid polyurethane layer was obtained by casting or coating a polyurethane prepolymer prepared from 23.5 to 25.0 wt% of MDI, 18.0 to 20.0 wt% of PEG1000, 5.0 to 5.5 wt% of PTMG1000, 2.0 to 2.2 wt% of 1,4-butanediol, 1.2 to 1.5 wt% of ethoxylated bisphenol F diacrylate, 1.5 to 1.8 wt% of vinyltriethoxysilane, 0.20 to 0.25 wt% of dibutyltin dilaurate, 5.0 to 5.5 wt% of ethyl methyl carbonate, and ethyl acetate being the balance. Specifically, all the raw materials, other than dibutyltin dilaurate, in the above ratio were mixed homogeneously under stirring, the temperature of the resulting reaction liquid was adjusted to 83~85C in a nitrogen atmosphere, then the above-mentioned proportion of dibutyltin dilaurate was added to carry out the reaction for 100 to 120 minutes, and a polyurethane prepolymer was obtained after cooling; and then, a rigid polyurethane layer was obtained by a widely known casting or coating method. The rigid polyurethane layer has excellent mechanical properties. When the thickness of the rigid polyurethane layer is 0.1 mm, it has a tensile strength of greater than 12MPa and an elongation rate of 180 to 250%, and thus can provide the composite heat insulation structure with adequate protection. (The test was carried out by the following method: The polyurethane prepolymer was coated on the surface of release paper using a coater, and then heat treatment was performed at 50°C for 15 minutes to obtain a rigid polyurethane layer having a thickness of 0.1 mm. Then, a 6cm × 1cm sample was obtained by cutting, the sample was elongated at a speed of 300 mm/min, and the tensile strength and the elongation rate thereof were determined.)

Comparative Example 1

[0015] A polyurethane layer was obtained by casting or coating a polyurethane prepolymer prepared from 25.0 wt% of MDI, 18.0 wt% of PEG1000, 5.5 wt% of PTMG1000, 2.2 wt% of 1,4-butanediol, 1.5 wt% of ethoxylated bisphenol F diacrylate, 0.20 wt% of dibutyltin dilaurate, 5.5 wt% of ethyl methyl carbonate, and ethyl acetate being the balance. The preparation method is the same as that described in Example 1. When the thickness of the polyurethane layer is 0.1 mm, it has a tensile strength of greater than 5 to 6MPa and an elongation rate of between 250 and 280%.

Comparative Example 2

[0016] A polyurethane layer was obtained by casting or coating a polyurethane prepolymer prepared from 25.0 wt% of MDI, 18.0 wt% of PEG1000, 5.5 wt% of PTMG1000, 2.2 wt% of 1,4-butanediol, 1.8 wt% of vinyltriethoxysilane, 0.20 wt% of dibutyltin dilaurate, 5.5 wt% of ethyl methyl carbonate, and ethyl acetate being the balance. The preparation method is the same as that described in Example 1. When the thickness of the polyurethane layer is 0.1 mm, it has a tensile strength of greater than 7 to 8MPa and an elongation rate of between 120 and 150%.

Comparative Example 3

[0017] A polyurethane layer was obtained by casting or coating a polyurethane prepolymer prepared from 25.0 wt% of MDI, 18.0 wt% of PEG1000, 5.5 wt% of PTMG1000, 2.2 wt% of 1,4-butanediol, 0.20 wt% of dibutyltin dilaurate, 5.5 wt% of ethyl methyl carbonate, and ethyl acetate being the balance. The preparation method is the same as that described in Example 1. When the thickness of the polyurethane layer is 0.1 mm, it has a tensile strength of greater than 5 to 6MPa and an elongation rate of between 200 and 250%.

Vacuum Heat Insulation Panel Layer

Example 2

[0018] The vacuum heat insulation panel comprises a core material and a sealing layer, the core material being a panel which is formed from glass fibers and a getter composition and the interior of which is kept in vacuum; the core material is sealed with the sealing layer, which is formed from a first aluminum foil layer and a second aluminum foil layer laminated on the upper and lower surfaces of a PET film; the PET film has a thickness of 100 to 120 μm, and both the first and second aluminum foil layers have a thickness of 20 to 25 μm; and the first and second aluminum foil layers are anodized such that an anodized aluminum film is formed on each of them. The anodized aluminum film was prepared by the following method: First, an aluminum foil layer was washed (with the acidic cleaning agent AcidClean®UC, a product from Atotech Germany Ltd.), and then impregnated in an aqueous solution of 5 wt% sodium hydroxide at a liquid temperature of 30°C for 2 minutes so that it was treated with sodium hydroxide; after washing with water, the aluminum foil layer was impregnated in a 5wt% nitric acid bath at a liquid temperature of 10°C for 1 minute (for the purpose of neutralization), and then anodized in an aqueous solution of citric acid. The aqueous solution of citric acid contained 18 to 20 g/L of citric acid, 1.8 to 2.0 g/L of dihydroxyethylglycine, 0.8 to 1.0 g/L of hydrogen peroxide, and 2.5 to 3.0 g/L of triammonium citrate, wherein the liquid temperature was 10 to 12°C, the current density was 0.1 to 0.2 A/dm^2, and electrolysis was carried out for 8 to 10 min. The above-mentioned anodization made it possible to supply sufficient aluminum ions, to essentially eliminate a depolarization effect, and to obtain a compact anodized aluminum film. After the above treatment, the thickness of the anodized aluminum film was 1 to 2 μm.

Comparative Example 4

[0019] The vacuum heat insulation panel of this example only differs from the vacuum heat insulation panel of Example 2 in that the method for the preparation of an anodized aluminum film is different. To be specific, in this example, the anodized aluminum film was generated by electrolysis in an oxalic acid solution. First, an aluminum foil layer was washed (with the acidic cleaning agent AcidClean®UC, a product from Atotech Germany Ltd.), and then impregnated in an aqueous solution of 5wt% sodium hydroxide at a liquid temperature of 30°C for 2 minutes so that it was treated with sodium hydroxide; after washing with water, the aluminum foil layer was impregnated in a 5wt% nitric acid bath at a liquid temperature of 10°C for 1 minute (for the purpose of neutralization), and then anodized in an aqueous solution of oxalic acid. The aqueous solution of oxalic acid contained 20 g/L of oxalic acid, 1.8 g/L of EDTA, and 3.0 g/L of ammonium oxalate, wherein the liquid temperature was 10~12 °C, the current density was 0.2 A/dm^2, and electrolysis was carried out for 8 min. The thickness of the anodized aluminum film was about 2 μm.

Comparative Example 5

[0020] The vacuum heat insulation panel of this example only differs from the vacuum heat insulation panel of Example 2 in that the method for the preparation of an anodized aluminum film is different. To be specific, in this example, the anodized aluminum film was generated by electrolysis in a sulfuric acid solution. First, an aluminum foil layer was washed (with the acidic cleaning agent AcidClean®UC, a product from Atotech Germany Ltd.), and then impregnated in an aqueous solution of 5wt% sodium hydroxide at a liquid temperature of 30°C for 2 minutes so that it was treated with sodium hydroxide; after washing with water, the aluminum foil layer was impregnated in a 5wt% nitric acid bath at a liquid temperature of 10°C for 1 minute (for the purpose of neutralization), and then anodized in an aqueous solution of sulfuric acid. The aqueous solution of sulfuric acid contained 20 g/L of sulfuric acid, 1.8 g/L of EDTA, and 3.0 g/L of ammonium sulfate, wherein the liquid temperature was 10~12°C, the current density was 0.2 A/dm^2, and electrolysis was carried out for 8 min. The thickness of the anodized aluminum film was about 2 μm.

Comparative Example 6

[0021] The vacuum heat insulation panel of this example only differs from the vacuum heat insulation panel of Example 2 in that an anodized aluminum film is not formed.

[0022] At room temperature, the vacuum heat insulation panel of Example 2 and the vacuum heat insulation panels of Comparative Examples 4 to 6 have substantially the same coefficient of heat insulation. Then, the vacuum heat insulation panel of Example 2 and the vacuum heat insulation panels of Comparative Examples 4 to 6 were kept in an accelerated penetration environment at 80°C and 95RH for 48h; their respective coefficients of heat insulation were measured at room temperature, wherein the coefficients of heat insulation in Comparative Examples 4 to 5 reached 0.031 W/mK and 0.035 W/mK respectively, the coefficient of heat insulation in Comparative Example 6 reached 0.05 W/mK or more, but the coefficient of heat insulation of the vacuum heat insulation panel of Example 2 was surprisingly maintained at 0.01 W/mK or less. It can be determined from the above comparison that the vacuum heat insulation panel of Example 2 is capable of stably maintaining the vacuum degree of the interior.

[0023] The heat insulation cold closet according to the present invention is mainly used for cold storage and freezing of drugs, such as vaccines, insulin, blood products, biological products and reagents, during transportation and storage; and, of course, it can also be applied to the preservation of items that need be refrigerated, such as food or electronic products.

[0024] For those of ordinary skills in the art, the specific examples together with the accompanying drawing merely illustrate the present invention, and it is obvious that how to specifically carry out the present invention is not limited to the above modes. All kinds of non-substantive improvements made by the method, idea and technical solution of the present invention, or any direct applications of the idea and technical solution of the present invention to other occasions without improvement are within the scope of protection of the present invention.

Claims

1. A heat insulation cold closet for medical supplies, comprising a closet body with an opening, and a cover body sealed and meshed with the opening, **characterized in that** the closet body, from inside to outside, successively consists of a rigid polyurethane layer, a vacuum heat insulation panel layer, a foamed polyurethane panel layer and a housing.

2. The heat insulation cold closet for medical supplies according to claim 1, **characterized in that** the cover body, from inside to outside, successively consists of a vacuum heat insulation panel layer, a foamed polyurethane panel layer and a housing.

3. The heat insulation cold closet for medical supplies according to claim 1 or 2, **characterized in that** the rigid polyurethane layer has a thickness of 2 to 5 mm, the vacuum heat insulation panel layer has a thickness of 8 to 15 mm, and the foamed polyurethane panel layer has a thickness of 5 to 20 mm.

4. The heat insulation cold closet for medical supplies according to claim 3, **characterized in that** the material of the housing is polypropylene or polyethylene.

5. The heat insulation cold closet for medical supplies according to claim 1, **characterized in that** the rigid polyurethane layer is obtained by casting or coating a polyurethane prepolymer prepared from 23.5 to 25.0 wt% of MDI, 18.0 to 20.0 wt% of PEG1000, 5.0 to 5.5 wt% of PTMG1000, 2.0 to 2.2 wt% of 1,4-butanediol, 1.2 to 1.5wt% of ethoxylated bisphenol F diacrylate, 1.5 to 1.8 wt% of vinyltriethoxysilane, 0.20 to 0.25 wt% of dibutyltin dilaurate, 5.0 to 5.5 wt% of ethyl methyl carbonate, and ethyl acetate being the balance.

6. The heat insulation cold closet for medical supplies according to claim 5, **characterized in that** the rigid polyurethane layer has a tensile strength of greater than 12MPa and an elongation rate of 180 to 250%.

7. The heat insulation cold closet for medical supplies according to claim 5, **characterized in that** the rigid polyurethane layer has a thickness of 0.1 mm.

8. The heat insulation cold closet for medical supplies according to claim 1, **characterized in that** the vacuum heat insulation panel comprises a core material and a sealing layer, the core material being a panel which is formed from glass fibers and a getter composition and the interior of which is kept in vacuum; the core material is sealed with the sealing layer, which is formed from a first aluminum foil layer and a second aluminum foil layer laminated on the upper and lower surfaces of a PET film; the PET film has a thickness of 100 to 120 μm, and both the first and second aluminum foil layers have a thickness of 20 to 25 μm; and the first and second aluminum foil layers are anodized such that an anodized aluminum film is formed on each of them.

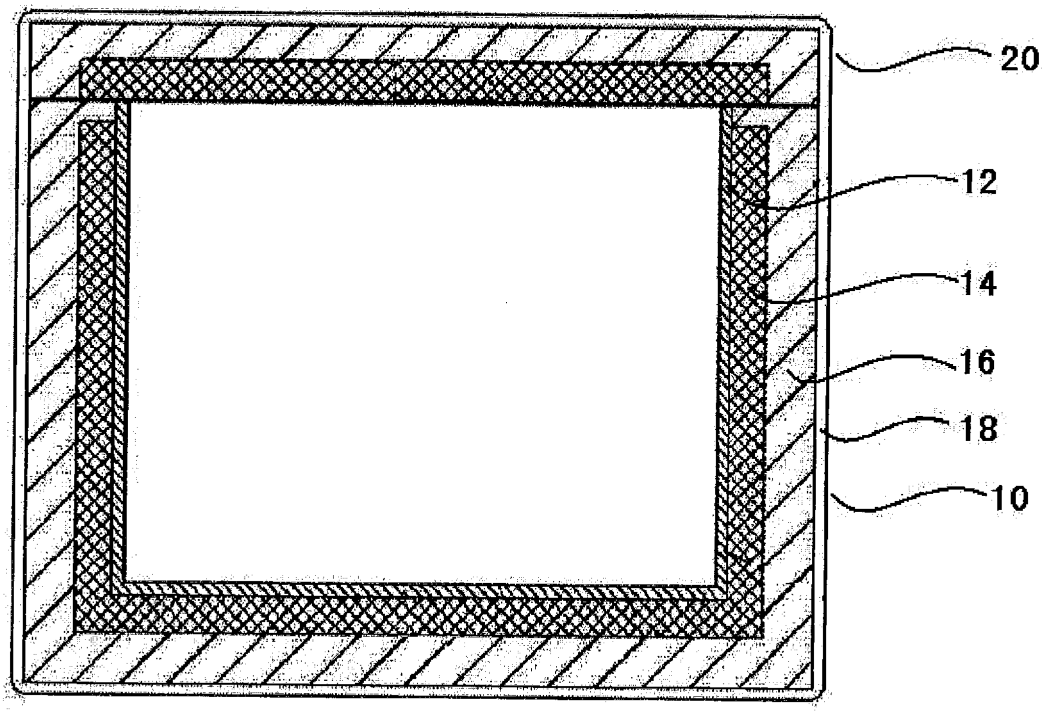

FIGURE 1

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EUROPEAN SEARCH REPORT

Application Number
EP 15 15 0295

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 2 022 728 A1 (HOFFMANN LA ROCHE [CH]) 11 February 2009 (2009-02-11) * paragraph [0017] * * paragraph [0023] * * paragraph [0025] * * figure 1 * -----	1	INV. B65D81/38
A	FR 2 830 077 A1 (SOFRIGAM [FR]) 28 March 2003 (2003-03-28) * claim 1 * -----	1	
A	WO 2005/026605 A1 (BASF AG [DE]; FECHNER FRANK [DE]; FRITZ RALF [DE]; BIEDERMANN ANJA [DE) 24 March 2005 (2005-03-24) * page 2, line 9 - line 11 * * page 2, line 39 - page 8 * -----	1	

TECHNICAL FIELDS SEARCHED (IPC)

B65D
F25D

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
The Hague	4 May 2015	Bridault, Alain

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 15 15 0295

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04-05-2015

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