

ASSEMBLY FOR FORMING A PACKAGE FOR
STORAGE OF MEDICAL CONTAINER

This invention relates to an assembly for forming a package for storing a plastics medical container. More particularly, this invention relates to an assembly for forming a package for the storage of a plastics medical container such as a blood bag or a transfusion solution bag which contains therein a medicinal fluid.

Plastics medical containers such as blood bag and transfusion bags contain therein anticoagulants such as ACD solution and CPD solution which serve to prevent
10 the blood from being coagulated during collection or transfusion of blood. The medical containers containing such chemical solutions are stowed in tightly closed packages of synthetic resin designed exclusively for the purpose of storage. Since the medical containers are made of plastics
15 materials and therefore are pervious to gases, there is a possibility that oxygen gas, for example, will penetrate through these containers and pass into the solutions contained therein to cause oxidative degradation of the chemical solutions. The wetting components, particularly
20 the moisture, present in the chemical solutions penetrate through the walls of the containers and add to the humidity within the packages. If aerobic microorganisms survive by some reason or other within the chemical solutions, there is the possibility that the microorganisms,

which collect on the surface of the containers between the time these containers are manufactured and the time they are put to use, will proliferate because of the heightened humidity.

5 It has been recently proposed to put deoxidizer in the packages to effect quick reduction of concentration of oxygen within the tightly closed packages and prevent the contents of the containers from oxidising. As a tightly closed package suited to the
10 prevention of its contents from oxidising, there has been proposed a bag-shaped package which is obtained by vacuum depositing aluminum on the opposed surfaces of two superposed polyester type resin sheets and heat sealing the corresponding peripheries of the two sheets by way
15 of a hot melt type adhesive agent (Japanese Published Unexamined Patent No. SHO 53(1978)-113693). Since the bag-shaped package is deficient in shape-retaining property, the inner volume of the package decreases and its walls collapse as the oxygen therein is gradually
20 absorbed by the deoxidizer. When the contents of the package and the walls of the package adhere fast to the surfaces of the deoxidizer, the absorption of oxygen by the deoxidizer fails to proceed at the expected rate and the concentration of oxygen in the package fails
25 to fall to the prescribed level (less than 0.1%/50 hrs.), frequently with the result that microorganisms which by chance have found their way into the containers in the course of fabrication will enjoy growth in the presence of

oxygen. Since the bag-shaped package has an inferior shape-retaining property, it tends to be inconvenient for storage. When such bag-shaped packages are piled up during storage or in transit, they can collapse with adverse effects upon their contents. If the prior package is molded three-dimensionally, the conditions involved in the molding deform and crack the conventional gas and steam barrier layers formed of aluminum and the package thus is non effective as a gas barrier.

10 The present invention provides an assembly for forming a package for the storage of a plastics medical container holding a medicinal fluid therein, which has (a) a tray provided round the opening thereof with a flange portion, and formed by a laminate

15 comprising an outer polyolefin layer, an intermediate plastics layer to act as a barrier to passage of gases and steam, and an inner polyolefin layer, (b) a lid member comprising a laminate of an inner polyamide layer, an intermediate plastics layer to act as a barrier to

20 passage of gases and steam, and an outer resin layer of sufficient thermal resistance to withstand the conditions of heat sealing; a hot melt adhesive layer formed of materials of dissimilar melting points including at least one material substantially the same

25 as a polyolefin of a tray layer being provided so that

a peelable heat seal is formable between the said inner layers of the tray and the lid member.

The invention also provides a package containing a container of medicinal fluid, the package comprising
5 (a) a tray having a flange around its opening and formed of a laminate comprising polyolefin layers with a gas and steam barrier plastics layer therebetween, (b) a lid formed of a laminate of polyamide and a resin layer of sufficient thermal resistance to withstand the conditions
10 of heat sealing with a gas and steam barrier plastics layer therebetween, and (c) a hot melt adhesive forming a peelable heat seal between the tray flange and polyamide lid layer.

As used herein the term "thermal resistance"
15 signifies that under particular thermal conditions (i.e. heat sealing conditions) there is resistance to adverse effects on stability and resistance to degradation.

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Thus the invention provides both a package assembly and a package when assembled and sealed, i.e. when containing the container of medical fluid and with lid member and tray flange peelably heat sealed via the hot melt adhesive layer.

The polyolefin layers of the tray may be of polypropylene and the hot melt adhesive layer of a blend of polyethylene with polypropylene; the weight ratio of polyethylene to polypropylene in this hot melt adhesive layer is suitably from 20 : 80 to 50 : 50. The intermediate layer of the lid member is suitably of polyvinylidene chloride or ethylene-vinyl alcohol copolymer. The intermediate layer of the tray is suitably of ethylene-vinyl alcohol copolymer. The thermally resistant outer layer of the lid member is suitably of polyester, polyamide or polypropylene. The tray part may be transparent.

The invention is illustrated, by way of example only, in the accompanying drawings, in which :-

FIG.1 is a perspective view of an assembled and sealed package according to the present invention, and

FIG.2 is a cross section taken along the line II-II of FIG.1.

The illustrated package is produced by preparing a tray part 5 provided round the opening thereof with a flange portion 4 by molding a laminated sheet comprising a polyolefin layer (outer layer) 1, a plastics layer 2

capable of resisting passage of gases and steam (intermediate layer), and a polyolefin layer (inner layer) 3; separately preparing a lid member 9 by laminating a polyamide layer (inner layer) 6, a plastics layer 7 capable of resisting passage of gases and steam (intermediate layer), and a layer 8 of sufficient thermal resistance to withstand the conditions of heat sealing (outer layer); preparing a hot melt adhesive layer 10 comprising a plurality of materials having dissimilar melting points and including material identical with polyolefin in layer 3 of tray part 5; and tightly heat sealing the flange portion 4 of the tray part 5 and the corresponding portion of the lid member 9 via the layer 10 to form a peelable seal therebetween.

15 Examples of the polyolefin which forms the outer layer 1 and the inner layer 3 of the tray part 5 are polyethylene and polypropylene. Polypropylene is preferred because of its excellent shape-retaining property and thermal resistance compared to polyethylene. For use
20 herein the polyethylene advantageously has a molecular weight of 3,000 to 200,000, preferably 50,000 to 100,000, and the polypropylene a molecular weight of 5,000 to 1,000,000, preferably 100,000 to 500,000. The thickness of each of the polyolefin layers is e.g. 500 to
25 600 μ m. The intermediate layer 2 of the tray part 5 which is capable of resisting passage of gases and steam is desirably formed of ethylene-vinyl alcohol copolymer; The thickness of this layer is e.g. about 50 μ m. The vinyl

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alcohol content of the copolymer is desirably 20 to 80 mol%, preferably 40 to 70 mol%. The molecular weight of the copolymer is desirably 5,000 to 100,000, preferably 10,000 to 50,000.

5 The layer 10 which at least in use can be the innermost layer of the lid member 9 is desirably formed of a blend of polyethylene with polypropylene. The weight ratio of the polyethylene to the polypropylene in the blend, when the inner layer 3 of the tray part 5 is of
10 polypropylene, is desirably in the range of 20 : 80 to 50 : 50 to give a good heat sealing which yet is peelable open. The thickness of layer 10 is e.g. 30 to 60 μ m, preferably 40 to 50 μ m. The layer of blend is superposed by a layer of polyamide, such as nylon 6 or nylon-6,6;
15 this permits the lid member to retain its strength. The intermediate layer 7 is desirably formed of polyvinylidene chloride or ethylene-vinyl alcohol copolymer. Generally, polyvinylidene chloride is used superposed on a polyolefin film, particularly a biaxially drawn
20 polypropylene film. Generally, the molecular weight of the polypropylene is 5,000 to 1,000,000, e.g. 100,000 to 500,000. The thickness of the polyolefin film is e.g. 20 to 40 μ m. The molecular weight of the polyvinylidene chloride is e.g. 8,000 to 20,000, preferably 10,000 to
25 15,000, and its thickness may for example be 5 to 10 μ m. This film exhibits an outstanding ability to resist passage of gases and steam. A still better barrier property is obtained by using a plurality of such layers

superposed. To ensure safe storage of a plastics medical container holding a medicinal fluid therein, the intermediate layer 7 desirably has not more than $1 \text{ g/m}^2 \cdot 24 \text{ hr}$ (40°C , 90% RH), preferably $0.1\text{--}0.2 \text{ g/m}^2 \cdot 24 \text{ hr}$ (40°C , 90% RH), perviousness to humidity. To ensure prevention of growth of aerobic microorganisms, the gas barrier property of the intermediate layer 7 is desirably not more than 0.1% /72 hr, preferably not more than 0.1% /50 hr of oxygen concentration in the package. Examples of the resin of the outer layer 8 of thermal resistance enough to withstand the conditions of heat sealing include polyesters such as polyethylene terephthalate and polybutylene terephthalate, polyamides such as nylon 6 and nylon-6,6, and polypropylene. Among other polymers mentioned above, polyethylene terephthalate proves to be particularly desirable. The thickness of the layer 8 is e.g. 10 to 30 μm , preferably 12 to 25 μm .

The weight ratio of the polyethylene to the polypropylene in the hot melt adhesive layer is from 20 : 80 to 50 : 50 where the inner layer 3 of tray part 5 is formed of polypropylene and from 80 : 20 to 50 : 50 where the inner layer 3 is formed of polyethylene. This is because the seal is peeled open with great difficulty when the proportion in the blend of the material identical with the polyolefin forming the inner layer of the tray part 5 is too high and the adhesiveness of the flange portion and the lid member is insufficient when the

proportion is too low.

Examples of medical container for which this invention is advantageously usable include blood bags, transfusion bags, etc. containing therein anticoagulants, fluids or transfusion, and other medicinal fluids such as ACD-A solution (containing 2.20 g of sodium citrate, 0.80 g of citric acid and 2.20 g of grape sugar in 100 ml of aqueous solution, for example) and CPD solution (containing 0.327 g of citric acid, 2.63 g of sodium citrate, 0.251 g of disodium citrate and 2.32 g of dextrose in 100 ml of aqueous solution, for example); these bags may have their accessories such as tubes, connectors and syringes integrally molded therewith or connected thereto.

A package provided by this invention may contain a deoxidizer 13, in any of numerous forms; at least one compound selected from iron carbide, iron carbonyl, ferrous oxide, ferrous hydroxide and iron silicate and halogenated metal (containing water when necessary) (Japanese Published Unexamined Patent No. SHO 54(1979)-37088), and deoxidizer which is obtained by coating powdered metal with halogenated metal (Japanese Published Unexamined Patent No. SHO 54(1979)-35189) are examples.

Storage of a medical container 12 in a package is accomplished by first stowing the medical container 12 of medicinal fluid 11 in position in the tray part 5 which already contains the deoxidizer 13 if

required, then applying the lid member 9 to the flange portion 4 of the tray part 5 with the hot melt adhesive layer 10 therebetween, and tightly heat sealing the lid 9 and the flange portion 4 by high frequency or some other heating means. In this case, at least one segment of the corner 14 of the flange portion 4 may be left partially intact by the heat sealing so that this segment will facilitate the peeling of the seal of the package when the medical container is to be put to use.

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10 The aforementioned hot melt adhesive layer 10 is generally supplied bonded (under application of heat and pressured) to the flange 4 of the tray part 5 or to the periphery of the inner layer 6 of the lid member 9. Optionally, the adhesive layer 10 may be superposed on

15 the lid member and extend outwardly and down and around the flange portion to seal the lid when wrapped fully around flange portion. The adhesive layer may be superposed over the entire surface of the lid member. Of course, any deoxidizer may be placed in the tray 5

20 before, simultaneously with or after the medical container 12.

The present invention is illustrated more specifically below in working Examples 1 to 10:

As illustrated in FIGS. 1 and 2, in a tray

25 part 5 formed of a laminated sheet comprising an outer layer 1 of polypropylene (having a molecular weight of 100,000 to 500,000) 500 μ m in thickness, an intermediate layer 2 of ethylene-vinyl alcohol copolymer (having a

molecular weight of 10,000 to 50,000) 5 μ m in thickness,
and an inner layer 3 of polypropylene (having a molecular
weight of 100,000 to 500,000) 500 μ m in thickness, was
set a pack of deoxidizer in a bag-like container having
5 as one wall a gas pervious sheet of paper. Further a
blood bag 12 made polyvinyl chloride and containing
therein an anticoagulant was set in position in the
tray part 5. Then a lid member 9, obtained by laminating
a layer 6 composed of nylon layer 10 μ m in thickness and
10 a high barrier layer 10 μ m in thickness, an intermediate
layer 7 composed of two layers each of a film of
biaxially drawn polypropylene (having a molecular weight
of 100,000 to 500,000) 20 μ m in thickness superposed by
a layer of polyvinylidene chloride (having a molecular
15 weight of 10,000 to 15,000) 10 μ m in thickness, and an
outer layer 8 of polyethylene terephthalate (having a
molecular weight of 100,000 to 500,000), was heat sealed
by high frequency to the flange portion 4 of the tray
part 5 by way of a hot melt adhesive layer 10 of a blend
20 of polyethylene (having a molecular weight of 50,000 to
100,000) and polypropylene (having a molecular weight
of 100,000 to 500,000) in a weight ratio of 30 : 70 and
superposed in advance on the flange portion 4 of the
tray part 5. The packages thus produced were tested for
25 concentration of oxygen contained therein by the use of
a zirconia type analyzer (made by Toray Ltd). The
results were as shown in Table 1. When the procedure
described above was repeated by using ethylene-vinyl

alcohol copolymer as the material for the layer of the lid member capable of resisting passage of gases and steam, there were obtained similar results.

Table 1

5		Oxygen concentration (% by volume)				
	Example No.	After 24 hrs	After 33 hrs	After 48 hrs	After 53 hrs	After 57 hrs
	1	110	6.5	0.153	0.075	0.0038
	2	-	6.8	0.264	0.042	-
	3	-	7.3	0.065	0.038	-
10	4	-	-	0.072	0.032	-
	5	-	-	0.283	0.041	-
	6	-	-	0.156	0.011	-
	7	-	-	0.090	0.024	-
	8	-	-	0.017	0.012	-
15	9	-	-	0.013	0.023	-
	10	-	-	0.061	0.017	-

As described above, a package of this invention for the storage of a medical container is obtained by preparing a tray part provided round the opening thereof with
 20 a flange portion by molding a laminated sheet comprising a polyolefin layer, a plastics layer capable of resisting passage of gases and steam, and a polyolefin layer, separately preparing a lid member formed by laminating a polyamide layer, a plastics layer capable of resisting passage
 25 of gases and steam and a layer of sufficient thermal resistance to withstand the conditions of heat

sealing, also preparing a hotmelt adhesive layer, and tightly heat sealing the flange portion 4 of the tray part and the corresponding portion of the lid member via the adhesive layer to form a peelable seal. Because
5 of the inner and outer polyolefin layers, the tray part can enjoy high shape-retaining property and transparency.

With use of ethylene-vinyl alcohol copolymer as the layer capable of resisting passage of gases and steam, the tray part combines transparency and a high ability to
10 resist passage of gases (including oxygen) and steam.

The lid member has a high ability to resist passage of gases and steam when polyvinylidene chloride or ethylene-vinyl alcohol copolymer is used as or in the intermediate layer. When polyester,
15 polyamide or polypropylene is selected as the resin for the outer layer required to withstand the conditions of heat sealing, the lid member has ample shape-retaining property in spite of the conditions of heat sealing. When all these layers are transparent, the
20 condition of the medical container inside the package can be readily inspected without opening the package. When polypropylene is selected for the polyolefin layers in the tray part and a blend of polyethylene with polypropylene is selected for the hotmelt adhesive layer, with the weight
25 ratio of polyethylene to polypropylene falling in the range of 20 : 80 to 50 : 50, the package has ample adhesive strength and excels in peel openability.

Even when a package of this invention contains a medical container such as a blood bag or transfusion bag made of a material such as polyvinyl chloride which is highly pervious to steam and containing an anticoagulant, a fluid for transfusion or other similar medicinal fluid, it can prevent passage of gases and, therefore, prevent oxygen in the ambient air from penetrating into the therapeutic container. Particularly when deoxidizer is contained simultaneously with the medical container in the package, the interior of the package can be retained in a substantially oxygen-free condition with the medicinal fluid in the medical container free from oxidative deterioration. If aerobic microorganisms by chance find their way into the medical container, they are not allowed to attain growth in the absence of oxygen. The package, accordingly, can keep its interior in a substantially sterilized condition. Further the package can resist leakage of steam in both directions; steam which diffuses out of the medical container is only allowed to saturate the interior of the package and is not allowed to escape from the package. Thus, the medicinal fluid in the medical container is not lost while the container is stored in the package. By having at least the tray part of the package formed of transparent layers, the medical container stored inside the package can be inspected without opening the package.



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C L A I M S :

1. An assembly for forming a package for the storage of a plastics medical container holding a medicinal fluid therein, which has (a) a tray provided round the opening thereof with a flange portion,
5 and formed by a laminate comprising an outer polyolefin layer, an intermediate plastics layer to act as a barrier to passage of gases and steam, and an inner polyolefin layer and (b) a lid member comprising a laminate of an inner polyamide layer, an intermediate
10 plastics layer to act as a barrier to passage of gases and steam, and an outer resin layer of sufficient thermal resistance to withstand the conditions of heat sealing; a hot melt adhesive layer formed of materials of dissimilar melting points
15 including at least one material substantially the same as a polyolefin of a tray layer being provided so that a peelable heat seal is formable between the said inner layers of the tray and the lid member.
2. An assembly according to claim 1 wherein the
20 polyolefin layer of the tray comprises polypropylene and the hot melt adhesive layer comprises a blend of polyethylene with polypropylene.
3. An assembly according to claim 2 wherein the
25 weight ratio of polyethylene to polypropylene in the



hot melt adhesive layer is in the range of 20 : 80 to
50 : 50.

5 4. An assembly according to any preceding claim
 wherein the intermediate plastics layer of the lid
 member comprises a polyvinylidene chloride or ethylene-
 vinyl alcohol copolymer.

10 5. An assembly according to any of claims 1 to 3
 wherein the intermediate plastics layer of the lid
 member comprises superposed layers of polyvinylidene
 chloride and polyolefin.

15 6. An assembly according to any preceding claim
 wherein the intermediate plastics layer of the tray
 comprises ethylene-vinyl alcohol copolymer or poly-
 vinylidene chloride.

20 7. An assembly according to any preceding claim
 wherein the thermally resistant layer is selected from
 polyesters, polyamides and polypropylene.

 8. An assembly according to any preceding claim
 wherein at least the tray is transparent.

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 9. An assembly according to any preceding claim
 formed into a package containing a container of



medicinal fluid and having the lid member and tray flange peelably sealed via the hot melt adhesive layer.

5 10. An assembly for forming a package for a container of medicinal fluid, the assembly being substantially as hereinbefore described with reference to the accompanying drawings.

10 11. An assembly for forming a package for a container of medicinal fluid, the assembly being substantially as described in any Example herein.

15 12. A package containing a container of medicinal fluid, the package comprising (a) a tray having a flange around its opening and formed of a laminate comprising polyolefin layers with a gas and steam barrier plastics layer therebetween, (b) a lid formed of a laminate of polyamide and a resin layer of sufficient thermal resistance to withstand the conditions of heat sealing with a gas and steam barrier plastics layer therebetween, and (c) a hot melt adhesive forming a peelable heat seal between the tray flange and polyamide lid layer.

20 25 13. A package containing a container of medicinal fluid, the package being substantially as hereinbefore described with reference to the accompanying drawings.



14. A package containing a container of medicinal fluid, the package being substantially as described in any Example herein.

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