In the medical field, in particular, contamination of the glass outer wall when filling glass bottles with radioactive substances must be prevented as the glass bottles are handled by hospital staff.

~~The~~Embodiments of the present invention seek to solve~~s~~ the problem of contamination by providing a new container according to the independent claim 1 ~~and a method of filling the new container according to the invention according to independent claim 12. The invention further relates to the use of the container according to the invention for holding and storing radioactive compounds, particularly radioactive substances for therapeutic and/or diagnostic purposes according to independent claim 10~~.

Preferred embodiments of the invention can be found in the dependent claims.

Thus in ~~a first~~an aspect the present invention relates to a container for a liquid, ~~containing at least~~comprising

- a cavity for holding the liquid, the cavity being bounded by walls at the sides and at the bottom,
- an opening for filling the cavity with the liquid,
- a closure for closing off the cavity, the closure having a piercing region for inserting a cannula into the cavity,
- a bottom casing which surrounds the walls of the cavity ~~in the standing area~~ at its base,
- a top casing which surrounds the pierceable closure with the exception of the piercing region, and
- a film which extends from the top casing to the bottom casing, joining the bottom casing and the top casing together, and surrounds those areas of the walls of the cavity which are not already surrounded by the top casing or bottom casing, wherein the film is adhesively bonded to the top casing, the bottom casing, and the walls; wherein the walls of the cavity and the closure form an inner shell constituting a primary vessel, and wherein the bottom casing, top casing, and film together enclose any surface contamination on the primary vessel.

The container according to the invention has an inner and outer shell. The inner shell surrounds a cavity which serves to hold a liquid. The inner shell thus constitutes a primary vessel into which a liquid can be placed and in which the liquid is stored.

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The outer shell surrounds the inner shell. The outer shell is only applied after the cavity has been filled. The outer shell is intended to enclose any residues of liquids

that have accidentally reached the outside of the inner shell during filling, so that these residues cannot form a handling or health hazard or enter the environment.

According to embodiments of the invention the inner shell is formed by walls and a closure. The walls delimit the cavity for holding the liquid at the sides and at the bottom. At the top the cavity is not delimited, i.e. an opening is located here for filling the cavity with a liquid.

Any directional information in the present description relates to the direction of gravity. The term "downwards" means in the direction of gravity. The term "upwards" means in the opposite direction to gravity. Terms such as "lateral" or "to the sides" indicate a direction perpendicular to the direction of gravity.

The walls consist of a material that is impervious to the liquid used and which is not attacked by the liquid used. The man skilled in materials science will be aware of the materials that are suitable for particular liquids.

Preferred materials are glasses or plastics as these are inert to a large number of different liquids, i.e. are not attacked. However it is also possible for the walls to consist of metal, for example. For aqueous solutions, glasses and plastics are particularly suitable, for example polymers such as polyolefins (e.g. polyethylene, polypropylene) or polyesters (e.g. polyethylene terephthalate, polycarbonate). Composite materials are also possible.

In a preferred embodiment a silicate glass is used of the kind conventionally used for storing aqueous chemicals. Such glasses are sold by companies such as Schott AG, for example.

As the container according to the invention is preferably intended to hold single doses of drugs or diagnostic agents, the cavity preferably has a volume of from 1 ml to 200 ml. Particularly preferably, the cavity has a volume of from 2 ml to 100 ml, most preferably from 5 ml to 30 ml.

The walls that bound the cavity for holding a liquid form a primary vessel which may be in the shape of a hollow cylinder in the lower region (particularly externally),

~~The~~Embodiments of the present invention further relates to the use of the container according to the invention for storing radioactive substances, particularly radiotherapeutic and/or diagnostic agents, most preferably substances that emit alpha particles. Preferably the container according to the invention holds a single dose for the treatment of a human being or animal or for diagnostic use in a human or animal.

The container of the invention (and all other aspects) is particularly suited to use with liquids containing alpha-emitting radionuclides. This is because such alpha-emitting radionuclides are hazardous and/or toxic and subject to strict controls but alpha radiation is readily stopped by materials such as plastics which are suitable for the formation of the top and bottom casings and films referred to herein. Thus hazards for alpha-emitting radionuclides are effectively avoided or limited by encapsulation of any surface contamination by the methods described herein.

The preferred embodiments mentioned above for the containers according to the invention also apply analogously to the use according to the invention.

Before the use of the novel container a liquid is first placed in the primary vessel. It is possible for the primary vessel to be sterilised before being filled. The skilled man in the field of medicine and sterilisation technology will be familiar with suitable methods, of which so-called autoclaving is mentioned here by way of example. After filling, which is preferably carried out automatically using corresponding pipetting robots, the primary vessel is sealed in fluidtight manner - again preferably automatically - with a pierceable closure.

It is possible to carry out sterilisation, e.g. by autoclaving, after the sealing process.

It is conceivable that during the filling or sealing of the primary vessel or during any sterilisation process contamination may occur to the outer wall of the primary vessel. It is possible, for example, that a drop of the liquid will land on the edge of the primary vessel opening during filling and tiny amounts of the liquid will not be sealed in the primary vessel during sealing but will remain between the primary vessel and the closure, so that there is a risk of these amounts entering the environment. In the case of radioactive substances (such as alpha-emitting

radionuclides), in particular, it is absolutely essential to prevent contamination of the environment.

Therefore after filling and sealing and sterilisation, if applicable, the container according to the invention is enveloped: the primary vessel is provided with a bottom casing, the closure is provided with a top casing, the remainder of the primary vessel is provided with a film which is also covered by parts of the top and bottom casings and optionally a sealing film is placed over the piercing region.

~~The~~Embodiments of the present invention thus also includes a method of filling the container with a liquid. The method according to the invention comprises at least the following steps:

- filling a primary vessel with a liquid (e.g. a liquid containing at least one toxic and/or hazardous substance such as an a radionuclide),
- closing the filled primary vessel,
- providing the primary vessel with a bottom casing at the base,
- providing the closure with a top casing,
- enveloping those parts of the primary vessel that are not already enclosed by the bottom casing or top casing with a film, the film extending from the bottom casing to the top casing and joining these together (save that any opening in the top casing may be left un-encapsulated or may be encapsulated by a further sealing film).

The preferred embodiments mentioned above for the container according to the invention also apply analogously to the method according to the invention.

In a preferred embodiment of the method according to the invention the film that has an adhesive layer on one side is wrapped around the primary vessel to attach it to the primary vessel. The process is preferably automated. The film is preferably a transparent or substantially transparent film. This allows that the contents of the container may remain visible.

In a further embodiment, the invention provides for a method for reducing a hazard from radiation emanating from surface contamination of a primary vessel containing at least one radioisotope comprising:

Claims

1. Container for a liquid, comprising

- a cavity for holding the liquid, the cavity being bounded by walls at the sides and at the bottom,
- an opening for filling the cavity with the liquid,
- a closure for closing off the cavity, the closure having a piercing region for inserting a cannula into the cavity,
- a bottom casing which surrounds the walls of the cavity in the standing area,
- a top casing which surrounds the pierceable closure with the exception of the piercing region, and
- a film which extends from the top casing to the bottom casing and surrounds those areas of the walls of the cavity which are not already surrounded by the top casing or bottom casing.

2. Container according to claim 1, characterised in that the walls that bound the cavity are made of glass.

3. Container according to claim 1 or 2, characterised in that the top casing is frictionally connected to the closure.

4. Container according to any of claims 1 to 3, characterised in that the bottom casing is frictionally connected to the walls at the base.

5. Container according to any of claims 1 to 4, characterised in that the top and/or bottom casing consist(s) of an elastic polymer.

6. Container according to any of claims 1 to 5, characterised in that the film is adhesively bonded to the top casing, the bottom casing and the walls.

7. Container according to one of claims 1 to 6, characterised in that the film is partially adhesively bonded to itself.

8. Container according to any of claims 1 to 7, characterised in that the walls that enclose the cavity form a primary vessel that is in the shape of a hollow cylinder in its base and belly region, that tapers upwardly towards the opening so as to form a shoulder and a neck, and in that a flange is provided around the opening.

9. Container according to claim 8, characterised in that the closure has an apron that is secured to the flange of the primary vessel.

10. Container according to any of claims 1 to 9, characterised in that the top casing has an upper region that is of tapered cross-section and a lower region of widened cross-section in the manner of a telescopic cylinder, the upper region being provided for connection to the closure and the lower region fitting flush with the walls that enclose the cavity.

11 Container according to any of claims 1 to 10 containing at least one radionuclide.

12. Use of a container according to any of claims 1 to 11, for holding and storing radioactive substances, particularly radioactive substances that are used for therapeutic and/or diagnostic purposes.

13 Use according to claim 12 wherein said radioactive substance comprises at least one alpa-emitting radionuclide.

14. Use according to claim 12 or claim 13 , characterised in that the container contains a single dose of the medicament.

15. Method of filling a container with a liquid, comprising at least the following steps:

- filling a primary vessel with a liquid,
- closing the filled primary vessel,
- providing the primary vessel with a bottom casing in the standing area,
- providing the closure with a top casing,

- enveloping those parts of the primary vessel that are not already surrounded by the bottom casing or top casing with a film, the film extending from the bottom casing to the top casing and connecting them to each other.

16. Method according to claim 15, characterised in that the liquid is a single dose of a medicament, particularly a radiotherapeutic agent.

17. Method according to one of claims 15 or 16, characterised in that the film has an adhesive layer on one side and the film for attachment to the bottom casing, top casing and primary vessel is wrapped around the specified components.

18. A method for reducing a hazard from radiation emanating from surface contamination of a primary vessel containing at least one radioisotope comprising:

- closing the filled primary vessel,
- providing the primary vessel with a bottom casing in the standing area,
- providing the closure with a top casing,
- enveloping those parts of the primary vessel that are not already surrounded by the bottom casing or top casing with a film, the film extending from the bottom casing to the top casing and connecting them to each other.

19. The method of claim 18 wherein the hazard is a handling hazard, a contamination hazard, and/or and environmental hazard.

20. Use of a top casing, a bottom casing and a film extending from the bottom casing to the top casing to reducing a hazard from radiation emanating from surface contamination of a filled primary vessel containing at least one radioisotope.

Claims

1. A container for a liquid, comprising

a cavity for holding the liquid, the cavity being bounded by walls at the sides and at the bottom,

an opening for filling the cavity with the liquid,

a closure for closing off the cavity, the closure having a piercing region for inserting a cannula into the cavity,

a bottom casing which surrounds the walls of the cavity at its base,

a top casing which surrounds the pierceable closure with the exception of the piercing region, and

a film which extends from the top casing to the bottom casing, joining the bottom casing and top casing together, and surrounds those areas of the walls of the cavity which are not already surrounded by the top casing or bottom casing; wherein the film is adhesively bonded to the top casing, the bottom casing, and the walls;

wherein the walls of the cavity and the closure form an inner shell constituting a primary vessel, and wherein the bottom casing, top casing, and film together enclose any surface contamination on the primary vessel.

2. The container according to claim 1, wherein the walls that bound the cavity are made of glass.

3. The container according to claim 1, wherein the top casing is frictionally connected to the closure.

4. The container according to claim 1, wherein the bottom casing is frictionally connected to the walls at the base.

5. The container according to claim 1, wherein the top and/or bottom casing consist(s) of an elastic polymer.

6. The container according to claim 1, wherein the film is partially adhesively bonded to itself.

7. The container according to claim 1, wherein said primary vessel is in the shape of a hollow cylinder in its base and belly region, that tapers upwardly towards the opening so as to form a shoulder and a neck, and in that a flange is provided around the opening.

8. The container according to claim 7, wherein the closure has an apron that is secured to the flange of the primary vessel.

9. The container according to claim 1, wherein the top casing has an upper region that is of tapered cross-section and a lower region of widened cross-section in the manner of a telescopic cylinder, the upper region being provided for connection to the closure and the lower region fitting flush with the walls that enclose the cavity.

10. The container according to claim 1 containing at least one radionuclide.

11. A use of a container according to claim 1, for holding and storing radioactive substances, particularly radioactive substances that are used for therapeutic and/or diagnostic purposes.

12. The use according to claim 11 wherein said radioactive substance comprises at least one alpha-emitting radionuclide.

13. The use according to claim 11, wherein the container contains a single dose of the medicament.